PostGIS 3.4.0dev 사용자
지침서

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Abstract

PostGIS는 객체 관계형 데이터베이스 시스템인 PostgreSQL 의 확장 프로그램으데이터베이스에 GIS(지리정보 시스객체를 저장할 수 있게 해줍니다.
PostGIS는 GiST 기반 R-Tree 공간 인덱스를 지원&#
GIS 객체의 분석 및 공간 처리를 위한
기능을 포함하고 있습니다.

이 문서는 3.4.0dev 버전의 사용자 지침&#x

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Chapter 1

소개

PostGIS is a spatial extension for the PostgreSQL relational database that was created by Refractions Research Inc, as a spatial database technology research project. Refractions is a GIS and database consulting company in Victoria, British Columbia, Canada, specializing in data integration and custom software development.

PostGIS is now a project of the OSGeo Foundation and is developed and funded by many FOSS4G developers and organizations all over the world that gain great benefit from its functionality and versatility.

The PostGIS project development group plans on supporting and enhancing PostGIS to better support a range of important GIS functionality in the areas of OGC and SQL/MM spatial standards, advanced topological constructs (coverages, surfaces, networks), data source for desktop user interface tools for viewing and editing GIS data, and web-based access tools.

1.1 프로젝트 운영 위원&#xd68

PostGIS 프로젝트 운영 위원회(Project Steering Committee; PSC)는 PostGIS 프로젝트의 대략적인 방&#x
발표 주기, 문서화 및 원조 활동을
조정합니다. PSC는 또한 일반 사용&#xc79
지원을 제공하고, PostGIS 커뮤니티 전&#xb
개발하는 소프트웨어 패치를 받&#x
승인하며, 개발자 커밋 접근, PSC 신&#xc78
결정 또는 중요한 API 변경 등 PostGIS에
관한 여러 가지 사안에 대해 투표&#
실시합니다.

Raúl Marín Rodríguez MVT support, Bug fixing, Performance and stability improvements, GitHub curation, alignment of PostGIS with PostgreSQL releases

레지나 오베(Regina Obe) Buildbot Maintenance, Windows production and experimental builds, documentation, alignment of PostGIS with PostgreSQL releases, X3D support, TIGER geocoder support, management functions.

Darafei Praliaskouski Index improvements, bug fixing and geometry/geography function improvements, SFCGAL, raster, GitHub curation, and bot maintenance.

폴 램지(Paul Ramsey) (의장) Co-founder of PostGIS project. General bug fixing, geography support, geography and geometry index support (2D, 3D, nD index and anything spatial index), underlying geometry internal structures, GEOS functionality integration and alignment with GEOS releases, alignment of PostGIS with PostgreSQL releases, loader/dumper, and Shapefile GUI loader.

산드로 산틸리(Sandro Santilli) Bug fixes and maintenance, buildbot maintenance, git mirror management, management functions, integration of new GEOS functionality and alignment with GEOS releases, topology support, and raster framework and low level API functions.

1.2 핵심 공헌자 - 현재

니클라스 아벤(Nicklas Avén) 거리 함수 개&#x
거리와 관계 함수 포함) 및 추가
작업, TWKB(Tiny WKB) 출력 포맷(개발중), 개&#xa
사용자 지원을 담당

댄 배스턴(Dan Baston) Geometry clustering function additions, other geometry algorithm enhancements, GEOS enhancements and general user support

Martin Davis GEOS enhancements and documentation

Björn Harrtell MapBox Vector Tile and GeoBuf functions. Gogs testing and GitLab experimentation.

Aliaksandr Kalenik Geometry Processing, PostgreSQL gist, general bug fixing

1.3 핵심 공헌자 - 과거

박 뽀리(Bborie Park) Prior PSC Member. Raster development, integration with GDAL, raster loader, user support, general bug fixing, testing on various OS (Slackware, Mac, Windows, and more)

마크 케이브-에일런드(Mark Cave-Ayland) Prior PSC Member. Coordinated bug fixing and maintenance effort, spatial index selectivity and binding, loader/dumper, and Shapefile GUI Loader, integration of new and new function enhancements.

호르헤 아레발로(Jorge Arévalo) 래스터 개&#
GDAL 드라이버 지원, 로더를 담당

올리비에 쿠르텡(Olivier Courtin) XML(KML, GML)/GeoJSON 입&
기능, 3D 지원 및 버그 수정을 담당

크리스 호지슨(Chris Hodgson) 전 PSC 회원. 개&#xad
개발, 사이트 및 빌드봇 유지보&#xc21
OSGeo 육성 프로젝트 관리를 담당

마테우스 로스코트(Mateusz Loskot) PostGIS 용 CMake
지원, 파이썬 래스터 로더 원본
개발, 저레벨 래스터 API 함수 개발&#
담당

케빈 뉴펠드(Kevin Neufeld) 전 PSC 회원. 문서&#xd65
및 문서화 지원 도구, 빌드봇 유&#xc9
PostGIS 뉴스그룹에서 고급 사용자 지&
PostGIS 유지보수 기능 개선을 담당

데이브 블래스비(Dave Blasby) PostGIS의 원 개&#xbc
공동 창립자. 서버측 객체, 인덱&#xc2
바인딩 및 서버측의 여러 분석
기능들을 작업

제프 라운스버리(Jeff Lounsbury) shapefile 로더/덤&
원본을 개발. 현재 PostGIS 프로젝트
소유자 대표

마크 레슬리(Mark Leslie) 진행중인 유지&#xbc
및 핵심 기능 개발. 곡선 지원 개&#xc1
shapefile GUI 로더를 담당

피에르 라신(Pierre Racine) Architect of PostGIS raster implementation. Raster overall architecture, prototyping, programming support

다피트 츠바르크(David Zwarg) 래스터 개&#x 맵 대수학 분석 기능들)을 담당

1.4 기타 공헌자

개인 공헌자

Alex Bodnaru
Alex Mayrhofer
Andrea Peri
Andreas Forø Tollefsen
Andreas Neumann
Andrew Gierth
Anne Ghisla
Antoine Bajolet
Arthur Lesuisse
Artur Zakirov
Barbara Phillipot
Ben Jubb
Bernhard Reiter
Björn Esser
Brian Hamlin
Bruce Rindahl
Bruno Wolff III
Bryce L. Nordgren
Carl Anderson
Charlie Savage
Christian Schroeder
Christoph Berg
Christoph Moench-Tegeder
Dane Springmeyer
Daryl Herzmann
Dave Fuhry
다피트 츠바르크(David Zw
다피트 츠바르크(David Zw
다피트 츠바르크(David Zw
Dmitry Vasilyev
Eduin Carrillo
Eugene Antimirov
Even Rouault
Florian Weimer
Frank Warmerdam
George Silva
Gerald Fenoy

후원 기업 PostGIS 프로젝트에 직접적&# 금전을 후원하거나, 개발자 시&#xac0 및 호스팅에 기여를 한 기업들&#xc78

- Aiven
- Arrival 3D
- Associazione Italiana per l'Informazione Geografica Libera (GFOSS.it)
- AusVet

- Avencia
- Azavea
- Boundless
- Cadcorp
- Camptocamp
- Carto
- Crunchy Data
- City of Boston (DND)
- City of Helsinki
- Clever Elephant Solutions
- Cooperativa Alveo
- Deimos Space
- Faunalia
- Geographic Data BC
- Hunter Systems Group
- ISciences, LLC
- Kontur
- Lidwala Consulting Engineers
- LISAsoft
- Logical Tracking & Tracing International AG
- Maponics
- Michigan Tech Research Institute
- Natural Resources Canada
- Norwegian Forest and Landscape Institue
- Norwegian Institute of Bioeconomy Research (NIBIO)
- OSGeo
- Oslandia
- Palantir Technologies
- Paragon Corporation
- R3 GIS
- Refractions Research
- Regione Toscana - SITA
- Safe Software
- Sirius Corporation plc
- Stadt Uster
- UC Davis Center for Vectorborne Diseases
- Université Laval
- U.S. Department of State (HIU)
- Zonar Systems

크라우드 펀딩 캠페인 크라우&#xb4d
펀딩 캠페인이란 수많은 사람&#xb4e
서비스할 수 있는, 우리가 간절&#xd7
원하는 기능들을 후원받기 위&#xd5
진행하는 캠페인입니다. 각 캠&#xd3

특정 기능 또는 일련의 기능에 특화되어 있습니다. 각 후원자&#xb2 필요한 펀딩의 작은 일부분을 담당하며, 충분한 공헌자 또는 조직이 모일 경우 많은 사용자&#xb97 도울 수 있는 작업을 위한 비용&#xc7 충당할 수 있습니다. 여러분이 생각하기에 다른 사람들이 기&#xaeb 공동 펀딩에 참여할 만한 아이&#xb5 있다면, PostGIS 뉴스그룹 에 여러분&#xc758 생각을 포스팅해서 우리 모두&#xac0 함께 실현할 수 있습니다.

PostGIS 2.0.0은 이런 전략 아래 탄생한 &#xc-cab; 번째 출시작입니다. 우리는 Pledg-Bank 를 이용했으며 이를 통해 캠페& 두 번 성공적으로 진행했습니&#xb2e

postgistopology - 10명 이상의 후원자들이 2.0.0 버& toTopGeometry 함수 빌드와 지형 지원 강화& 위해 250달러씩 후원했습니다.

postgis64windows - 후원자 20여 명이 윈도우 용 64비트 PostGIS의 문제점을 해결하기 위한 작업에 100달러씩 지원했고, 성공했습니다. 이제 PostgreSQL 스택 빌&#x PostGIS 2.0.1 64비트 버전을 다운로드할 수 있습니다.

주요 지원 라이브러리 The GEOS geometry operations library

The GDAL Geospatial Data Abstraction Library used to power much of the raster functionality introduced in PostGIS 2. In kind, improvements needed in GDAL to support PostGIS are contributed back to the GDAL project.

The PROJ cartographic projection library

마지막으로 그러나 역시 중요&#xd55 PostGIS의 기반이 된 PostgreSQL DBMS - PostGIS의 유동&#xc131 속도의 대부분은 PostgreSQL가 제공하&#xb 확장성, 강력한 쿼리 플래너, GiST 인& 그리고 다양한 SQL 기능들 없이는 불가능했습니다.

Chapter 2

PostGIS 설치

이 장에서는 PostGIS 설치에 요구되는 모든 과정을 설명합니다.

2.1 짧은 설명

사용자의 검색 경로에 모든 의존&#x
설정되어 있을 때 컴파일하려면:

```
tar -xvfz postgis-3.4.0dev.tar.gz
cd postgis-3.4.0dev
./configure
make
make install
```

PostGIS가 설치되면, PostGIS를 사용하고자
하는 모든 데이터베이스 각각에&#x
활성화하거나 (Section 3.3)업그레이드(Section 3.4
합니다.

2.2 소스를 컴파일하고 &#xc124

Note

현재 많은 OS 시스템들이 PostgreSQL/-PostGIS용 사전 구축된 패키지를 포함하고 있습니다. 많은 경우, 최신 버전이 필요하거나 패키지 관리자인 경우가 아니라면 컴파일할 필요가 없습니다.

This section includes general compilation instructions, if you are compiling for Windows etc or another OS, you may find additional more detailed help at PostGIS User contributed compile guides and PostGIS Dev Wiki.

Pre-Built Packages for various OS are listed in PostGIS Pre-built Packages

만약 윈도우 사용자라면 Stack-builder 또는 PostGIS Windows download site 를 통해 안정적인 버전을 받을 수 있습니다. 또 1~2주에 한 번 혹은 뭔가 특이한 일이 일어날 경우 빌드를 하는 very bleeding-edge windows experimental builds 가 있습니다. 사용자는 이를 통해 진행중인 PostGIS 배포본을 실행해볼 수 있습니다.

The PostGIS module is an extension to the PostgreSQL backend server. As such, PostGIS 3.4.0dev *requires* full PostgreSQL server headers access in order to compile. It can be built against PostgreSQL versions 12 - 16. Earlier versions of PostgreSQL are *not* supported.

Refer to the PostgreSQL installation guides if you haven't already installed PostgreSQL. https://www.postgresql.org .

Note

GEOS 기능성을 위해 PostgreSQL설치 시 표준 C++ 라이브러리를 명확하게 링크해야 할 수도 있습니다.

```
LDFLAGS=-lstdc++ ./configure [YOUR OPTIONS HERE]
```

이것은 구 버전 개발 도구 이용시 거짓 C++ 예외 상호작용을 피하기 위한 방법입니다. 만약 사용자가 이상한 문제(백엔드가 갑자기 끊어진다거나 또는 비슷한 증상)를 겪는다면 PostgreSQL을 다시 컴파일해야 할 수도 있습니다.

다음은 PostGIS 소스를 설정하고 취합&#xd
단계를 설명합니다. 리눅스 사용&#
위한 설명이므로 윈도우 또는 맥
사용자에겐 해당되지 않습니다.

2.2.1 소스 획득

PostGIS 소스 압축파일을 다운로드 웹&#xc
http://postgis.net/stuff/postgis-3.4.0dev.tar.gz 에서 다운로드하십&#xc2d

```
wget http://postgis.net/stuff/postgis-3.4.0dev.tar.gz
tar -xvzf postgis-3.4.0dev.tar.gz
cd postgis-3.4.0dev
```

이 명령어를 실행하면 현재 작업 디렉토리에 `postgis-3.4.0dev` (이)라는 명칭&#xc75 디렉터리가 생길 것입니다.

다른 방법으로는, svn 저장소 http://svn.osgeo.org/-postgis/trunk/ 에서 소스를 체크아웃(checkout)할 &#xc218 있습니다.

```
git clone https://git.osgeo.org/gitea/postgis/postgis.git postgis
cd postgis
sh autogen.sh
```

설치를 계속하려면 새로 만든 `postgis-3` 디렉터리로 이동합니다.

```
./configure
```

2.2.2 설치 요구사항

PostGIS를 빌드하고 사용하기 위해서&#xb 다음과 같은 요구사항들을 만족&#x 합니다.

필수 사항

- PostgreSQL 12 - 16. A complete installation of PostgreSQL (including server headers) is required. PostgreSQL is available from http://www.postgresql.org .

  For a full PostgreSQL / PostGIS support matrix and PostGIS/GEOS support matrix refer to https://trac.osgeo.org/postgis/-wiki/UsersWikiPostgreSQLPostGIS

- GNU C 컴파일러(`gcc`). PostGIS를 컴파일하기 위해 그 밖에 다른 ANSI C 컴파일러들&#x 사용할 수 있으나 `gcc` 로 컴파일했&#xc7 경우 오류가 훨씬 적게 발생합니&

- GNU Make(`gmake` 또는 `make`). 많은 시스템들에서 GNU `make` 는 make의 기본 버전입니다. `make -v`를 통해 버전을 확인하십시오. 다른 버전의 make는 PostGIS `Makefile`을 제대로 처리&#x 못 할 수도 있습니다.

- Proj reprojection library. Proj 6.1 or above is required. The Proj library is used to provide coordinate reprojection support within PostGIS. Proj is available for download from https://proj.org/ .

- GEOS geometry library, version 3.6 or greater, but GEOS 3.11+ is required to take full advantage of all the new functions and features. GEOS is available for download from https://libgeos.org .

- LibXML2, version 2.5.x or higher. LibXML2 is currently used in some imports functions (ST_GeomFromGML and ST_GeomFromK LibXML2 is available for download from https://gitlab.gnome.org/GNOME/libxml2/-/releases.

- JSON-C 0.9 또는 이후 버전. JSON-C는 현재 ST_GeomFromGe 함수를 통해 GeoJSON을 임포트하는 데 사용되고 있습니다. JSON-C는 https://github.com/json-c/json-c/releases/ 에서 다운로드할 수 있습니&#x

- GDAL, version 2+ is required 3+ is preferred. This is required for raster support. https://gdal.org/download.html.
- 이 파라미터는 현재 작동되지 않패키지가 PostgreSQL 설치 경로에만 설치것이기 때문입니다. 해당 버그를 추적하려면 http://trac.osgeo.org/postgis/ticket/635 를 참조하&#

선택 사항

- 또 Section 2.1 에 설명된 대로 사용자가 사용하길 원하는 드라이버를 활작업도 잊지 마십시오.
- shapefile 로더 shp2pgsql-gui 를 컴파일하기 위한 GTK(GTK+2.0, 2.8+ 필요). http://www.gtk.org/.
- SFCGAL, version 1.3.1 (or higher), 1.4.1 or higher is recommended and required to be able to use all functionality. SFCGAL can be used to provide additional 2D and 3D advanced analysis functions to PostGIS cf Section 7.21. And also allow to use SFCGAL rather than GEOS for some 2D functions provided by both backends (like ST_Intersection or ST_Area, for instance). A PostgreSQL configuration variable `postgis.backend` allow end user to control which backend he want to use if SFCGAL is installed (GEOS by default). Nota: SFCGAL 1.2 require at least CGAL 4.3 and Boost 1.54 (cf: https://oslandia.gitlab.io/SFCGAL/dev.html) https://gitlab.com/Oslandia/SFCGAL/.
- In order to build the Section 11.1 you will also need PCRE http://www.pcre.org (which generally is already installed on nix systems). Section 11.1 will automatically be built if it detects a PCRE library, or you pass in a valid `--with-pcre-dir=/path/to/p` during configure.
- To enable ST_AsMVT protobuf-c library 1.1.0 or higher (for usage) and the protoc-c compiler (for building) are required. Also, pkg-config is required to verify the correct minimum version of protobuf-c. See protobuf-c. By default, Postgis will use Wagyu to validate MVT polygons faster which requires a c++11 compiler. It will use CXXFLAGS and the same compiler as the PostgreSQL installation. To disable this and use GEOS instead use the `--without-wagyu` during the configure step.
- CUnit(`CUnit`). 회기 검증을 하는 데 필요합&#x http://cunit.sourceforge.net/
- DocBook(`xsltproc`)은 문서를 발행할 때 필요&#xd5 DocBook은 http://www.docbook.org/ 에서 다운로드할 수 있습니다.
- DBLatex(`dblatex`)는 PDF 형식의 문서를 발행할 때 필요합니다. DBLatex는 http://dblatex.sourceforge.net/ 에서 다운로드할 수 있습니다.
- ImageMagick(`convert`)은 문서에 사용되는 이미&#xc 생성하는 데 필요합니다. ImageMagick은 http://www.imagemagick.org/ 에서 다운로드할 수 있습&

2.2.3 설정

대부분의 리눅스 설치에서 첫 번단계는 소스 코드를 빌드하는 데 사용할 Makefile을 생성하는 것입니다. 셸 스크립트를 실행해서 Makefile을 작&#x

./configure

추가 파라미터 없이 사용하면, 이 명령은 자동적으로 PostGIS 소스코드를 사용자 시스템에 빌드하는 데 필수 구성 요소들과 라이브러리&#x

위치를 확인하려 합니다. **./configure** 명령
가장 흔한 사용법이긴 하지만, 이
스크립트는 비표준적인 위치에
있는 필수 라이브러리와 프로그&#x
대한 몇몇 파라미터를 받습니다.

다음은 가장 많이 사용되는 파라&#x
나열한 목록입니다. 전체 목록은
--help 또는 **--help=short** 파라미터를 사용하십&#x

--with-library-minor-version Starting with PostGIS 3.0, the library files generated by default will no longer have the minor version as part of the file name. This means all PostGIS 3 libs will end in `postgis-3`. This was done to make pg_upgrade easier, with downside that you can only install one version PostGIS 3 series in your server. To get the old behavior of file including the minor version: e.g. `postgis-3.0` add this switch to your configure statement.

--prefix=PREFIX PostGIS 라이브러리와 SQL 스크립트&
설치될 경로입니다. 기본적으&#xb85
PostgreSQL가 설치된 경로와 같은 곳에
설치됩니다.

Caution

이 파라미터는 현재 작동되지
않습니다. 패키지가 PostgreSQL 설치
경로에만 설치될 것이기
때문입니다. 해당 버그를
추적하려면 http://trac.osgeo.org/postgis/ticket/635 를
참조하십시오.

--with-pgconfig=FILE PostgreSQL은 PostGIS 같은 확장 프로그&#xb7a
PostgreSQL 설치 디렉토리의 위치를 확&#x
해주는 **pg_config** 라는 유틸리티를 제&#xacf
PostGIS 빌드 시 대상이 될 특정 PostgreSQL 설&#x
디렉터리를 사용자가 직접 설&#xc81
이 파라미터(**--with-pgconfig=/path/to/pg_config**)를 사용&#xd558

--with-gdalconfig=FILE GDAL은 래스터 지원을 위한 &#xae30
제공하는 필수 라이브러리로,
GDAL 설치 디렉터리의 위치를 확인
소프트웨어 설치를 활성화하&#xae3
위한 **gdal-config**를 지원합니다. PostGIS 빌드
시 대상이 될 특정 GDAL 설치 디렉&#xd13
사용자가 직접 설정하려면 이
파라미터(**--with-gdalconfig=/path/to/gdal-config**)를 사용하&#xc2

--with-geosconfig=FILE GEOS는 필수 도형 라이브러리
GEOS 설치 디렉터리의 위치를 확인
소프트웨어 설치를 활성화하&#xae3
위한 **geos-config**라는 유틸리티를 제공&#xd5
PostGIS 빌드 시 대상이 될 특정 GEOS 설치
디렉터리를 사용자가 직접 설&#xc81
이 파라미터(**--with-geosconfig=/path/to/geos-config**)를 사용&#xd5

--with-xml2config=FILE LibXML은 GeomFromKML/GML 프로세스를 진&#x
위해 필요한 라이브러리입니&#xb2e
일반적으로 libxml을 설치하면 찾을
수 있지만, 설치하지 않았거나
특정 버전을 사용하기 바랄 경&#xc6

LibXML 설치 디렉터리의 위치를 확&#xc77
소프트웨어 설치를 활성화하&#xae3
위해 `xml2-config`라는 설정 파일에 PostGIS의
위치를 지정해야 합니다. PostGIS 빌&#xb4d
시 대상이 될 특정 LibXML 설치 디렉&#xd1
사용자가 직접 설정하려면 이
파라미터(**--with-xml2config=/path/to/xml2-config**)를 사용하&#xc

--with-projdir=DIR Proj4는 PostGIS 필수 재투영 라이브&#xb7
PostGIS 빌드 시 대상이 될 특정 Proj4 설치
디렉터리를 사용자가 직접 설&#xc81
이 파라미터(**--with-projdir=/path/to/projdir**)를 사용하&#

--with-libiconv=DIR iconv 설치 경로

--with-jsondir=DIR JSON-C 는 MIT-라이선스의 JSON 라이브&
PostGIS의 ST_GeomFromJSON 지원에 필요합니다.
PostGIS 빌드 시 대상이 될 특정 JSON-C 설&#xce58
디렉터리를 사용자가 직접 설&#xc81
이 파라미터(**--with-jsondir=/path/to/jsondir**)를 사용하&#

--with-pcredir=DIR PCRE 는 BSD-라이선스의 펄 호환
가능 정규 표현식 라이브러리&#xb85
address_standardizer 확장 프로그램이 필요합&#xb2
PostGIS 빌드 시 대상이 될 특정 PCRE 설치
디렉터리를 사용자가 직접 설&#xc81
이 파라미터(**--with-pcredir=/path/to/pcredir**)를 사용하&#

--with-gui 데이터 임포트 GUI 컴파일(GTK+2.0 필&#xc6
shp2pgsql-gui의 shp2pgsql에 대한 그래픽 인테페&
생성합니다.

--without-raster 래스터 지원 설치

--without-topology Disable topology support. There is no corresponding library as all logic needed for topology is in postgis-3.4.0dev library.

--with-gettext=no 기본적으로 PostGIS는 gettext 지원을 &#xac10
함께 컴파일하지만, 로더의 파&#xc19
야기하는 비호환성 문제가 발&#xc0d
경우 이 명령어로 gettext 지원을 완전
비활성화시킬 수 있습니다. 이&#xb7
방법으로 설정을 변경해서 문&#xc81
해결하는 예는 버그 티켓 http://trac.osgeo.org/postgis/ticket/748 을 참조하십시오. 주의: gettext 지&
끈다고 해서 별다른 문제는 없&#xc2
gettext 지원은 아직 문서화되지도 않
검증중에 있는 GUI 로더 용 국제 도&
지원에 사용됩니다.

--with-sfcgal=PATH 기본적으로 PostGIS는 이 스위치
없이는 sfcgal 지원과 함께 설치되지
않습니다. `PATH` 는 sfcgal-config를 가리키는
대체 경로를 지정하도록 해주&#xb29
선택적인 인자입니다.

--without-phony-revision Disable updating postgis_revision.h to match current HEAD of the git repository.

Note

PostGIS를 SVN 저장소 에서 얻었다면, 먼저 다음 스크립트를 실행하십시오.

./autogen.sh

이 스크립트는 **configure** 스크립트를 생성하는데, 이 스크립트는 PostGIS의 사용자 지정 설치를 위해 이용됩니다.

만약 tar 파일 형태로 PostGIS를 얻었다면 이미 **configure** 가 생성되었&#xae30 때문에 **./autogen.sh** 를 실행할 필요는 없습니다.

2.2.4 빌드

일단 Makefile이 생성되면 PostGIS 빌드 작업&#xc 실행만큼이나 쉽습니다.

make

산출물의 마지막 줄에 "`PostGIS was built successfull Ready to install.`"이란 문장이 보여야 합니&#xb2e

As of PostGIS v1.4.0, all the functions have comments generated from the documentation. If you wish to install these comments into your spatial databases later, run the command which requires docbook. The postgis_comments.sql and other package comments files raster_comments.sql, topology_comments.sql are also packaged in the tar.gz distribution in the doc folder so no need to make comments if installing from the tar ball. Comments are also included as part of the CREATE EXTENSION install.

make comments

PostGIS 2.0 버전부터 소개되었습니다. 빠& 참조 또는 학습용 유인물에 적합&#x 참조 자료(cheat sheet) html 파일을 생성합니&#xb2 파일 생성에 xsltproc가 필요하며, doc 폴더 안에 다음`topology_cheatsheet.html`, `tiger_geocoder_cheatsheet.html`, `raster_ cheatsheet.html`, `postgis_cheatsheet.html` 4개의 파일을 생성&#x 것입니다.

html 및 pdf 형식으로 미리 만들어진 파&#xc PostGIS / PostgreSQL Study Guides 에서 다운로드받을 수 있습니다.

make cheatsheets

2.2.5 PostGIS Extensions 빌드 및 배포

PostgreSQL 9.1 이상을 사용 중이라면 PostGIS extentions&#xc740 자동적으로 빌드 및 설치됩니다.

소스 저장소로부터 생성할 경우&#x 먼저 function descriptions 부터 빌드해౼ 합니다. docbook을 설치하셨다면 빌드할 수 있&#x 다음 명령을 통해 수동으로 생성&# 수도 있습니다:

make comments

만약 사용자가 tar 파일 배포본을 이& 빌드한다면 미리 빌드된 것이 tar 파&

함께 배포됨으로 comments를 따로 빌드&#
필요가 없습니다.

만약 PostgreSQL 9.1을 기반으로 빌드 중이&#xb77
extensions은 설치 과정의 일환으로 자동
빌드될 것입니다. 만약 필요하다&#
extensions 폴더로부터의 빌드하거나 또&#
다른 서버에서 필요한 파일을 복&#
수 있습니다.

```
cd extensions
cd postgis
make clean
make
export PGUSER=postgres #overwrite psql variables
make check #to test before install
make install
# to test extensions
make check RUNTESTFLAGS=--extension
```

Note

`make check` uses psql to run tests and as such can use psql environment variables. Common ones useful to override are `PGUSER`,`PGPORT`, and `PGHOST`. Refer to psql environment variables

---

extension 파일은 OS에 상관없이 PostGIS버전만
같으면 적용에 문제가 없습니다.
그러므로 PostGIS binaries가 설치된 서버에
확장 파일만 복사해도 문제가 없&#x

만약 extension을 수동으로 또는 다른 서&#
설치하고 싶으면 다음 파일들을
사용자의 PostgreSQL 설치경로의 `PostgreSQL / share / extension` 폴더에 있는 extensions 폴더에서 복&#xc0
PostGIS가 설치되지 않은 서버에 필요&#xc
바이너리 파일들을 넣어 주십시&#x

- 이것들이 지정되지 않은 경우 설&
  수 있는 extension 의 버전 등의 정보를
  나타내는 제어 파일입니다. `postgis.control, postgis_topology.control`.
- 각 extension의 /sql 폴더에 모든 파일들이
  있습니다. 다음 파일들은 postgreSQL의
  share/extension 폴더의 루트에 복사 되어야
  함에 주의하십시오. `extensions/postgis/sql/*.sql, extensions/postgis_topology/sql/*.sql`

이렇게 한 다음, 사용자는 사용 가&#
extensions으로 `postgis, postgis_topology` 을 PgAdmin -> extensions에서 볼
수 있을 것입니다.

만약 psql을 이용 중이라면 다음의
쿼리를 실행함으로써 확인할 수
있습니다.

```
SELECT name, default_version,installed_version
FROM pg_available_extensions WHERE name LIKE 'postgis%' or name LIKE 'address%';
```

```
             name              | default_version | installed_version
-------------------------------+-----------------+-------------------
 address_standardizer          | 3.4.0dev        | 3.4.0dev
 address_standardizer_data_us  | 3.4.0dev        | 3.4.0dev
 postgis                       | 3.4.0dev        | 3.4.0dev
 postgis_sfcgal                | 3.4.0dev        |
 postgis_tiger_geocoder        | 3.4.0dev        | 3.4.0dev
 postgis_topology              | 3.4.0dev        |
(6 rows)
```

만약 사용자가 쿼리하는 데이터&#xb
extension이 설치되어 있다면, 사용자는
`installed_version` 컬럼에서 이름을 볼 수 있&#xc2b5
만약 아무 레코드도 없다면 서버&#x
postgis extension이 전혀 설치되어 있지 않음&#xc7
뜻합니다. PgAdmin III 1.14이상 버전에서는
데이터베이스 탐색 트리의 `extensions`&#xc5d0
마우스 오른쪽 버튼 클릭을 통해
업그레이드 또는 삭제를 허용합&#x

extension이 이용 가능한 상태라면 pgAdmin exten-
sion 인터페이스 또는 다음의 sql 명령&#xc
실행함으로써 선택한 데이터베&#x
안에 postgis extension을 설치할 수 있습니다:

```
CREATE EXTENSION postgis;
CREATE EXTENSION postgis_sfcgal;
CREATE EXTENSION fuzzystrmatch; --needed for postgis_tiger_geocoder
--optional used by postgis_tiger_geocoder, or can be used standalone
CREATE EXTENSION address_standardizer;
CREATE EXTENSION address_standardizer_data_us;
CREATE EXTENSION postgis_tiger_geocoder;
CREATE EXTENSION postgis_topology;
```

PSQL에서 다음 명령어를 사용하면
어떤 버전을 설치했는지, 어떤 스&#
설치했는지 알 수 있습니다.

```
\connect mygisdb
\x
\dx postgis*
```

```
List of installed extensions
-[ RECORD 1 ]-------------------------------------------------
-
Name        | postgis
Version     | 3.4.0dev
Schema      | public
Description | PostGIS geometry, geography, and raster spat..
-[ RECORD 2 ]-------------------------------------------------
-
Name        | postgis_tiger_geocoder
Version     | 3.4.0dev
Schema      | tiger
Description | PostGIS tiger geocoder and reverse geocoder
-[ RECORD 3 ]-------------------------------------------------
-
Name        | postgis_topology
Version     | 3.4.0dev
Schema      | topology
```

```
Description | PostGIS topology spatial types and functions
```

Warning

spatial_ref_sys, layer, topology 확장 테이블은 백업되지 않습니다. 이것들은 postgis 또는 postgis_topology extension이 백업이 될 경우에만 백업이 가능합니다. 이는 전체 데이터베이스가 백업될 때에만 발생한다고 볼 수 있습니다. PosgGIS 2.0.1에서는 데이터베이스 백업시 srid 레코드만이 백업됩니다. 이와 관한 문제를 발견하면 trac 티켓을 발행해주십시오. extension 테이블의 구조들은 CREATE EXTENSION과 함께 생성되기 때문에 백업되지 않습니다. 이러한 방식은 PostgreSQL extension 모델에 적용되기 때문에 조치를 취할 수 있는 방법이 없습니다.

우리의 멋진 확장 프로그램 시스&#x
없이 3.4.0dev 을 설치했다면, 먼저 다음
업그레이드 스크립트를 실행해&#x
확장 프로그램 기반 최신 버전으&#x
변경할 수 있습니다: postgis_upgrade_22_minor.sql,raster_
upgrade_22_minor.sql,topology_upgrade_22_minor.sql.

```
CREATE EXTENSION postgis FROM unpackaged;
CREATE EXTENSION postgis_topology FROM unpackaged;
CREATE EXTENSION postgis_tiger_geocoder FROM unpackaged;
```

2.2.6 테스트

만약 PostGIS 빌드를 테스트하고 싶다&#xb
실행하십시오.

make check

위 명령어는 활성 PostgreSQL 데이터베이
바탕으로 생성된 라이브러리를
이용하여 다양한 확인과 회귀 테&#x
실행할 것입니다.

Note

PostgreSQL, GEOS, 또는 Proj4를 표준이 아닌 경로에 설치한 경우, LD_LIBRARY_PATH 환경 변수에 해당 라이브러리 경로를 설정해주어야 합니다.

Caution

현재, **make check** 검사들을 실시할 때에는 PATH와 PGPORT 환경 변수를 따릅니다. PostgreSQL의 설정 매개변수&#xc7 **--with-pgconfig**에 명시되어 있어도 이것을 적용하지 *않습니다*. 따라서, PostgreSQL 설치시의 환경설정&#xacf 일치하도록 PATH를 수정해주십시&#xc6

If successful, make check will produce the output of almost 500 tests. The results will look similar to the following (numerous lines omitted below):

```
CUnit - A unit testing framework for C - Version 2.1-3
     http://cunit.sourceforge.net/

        .
        .
        .

Run Summary:    Type  Total    Ran Passed Failed Inactive
              suites     44     44    n/a      0        0
               tests    300    300    300      0        0
             asserts   4215   4215   4215      0      n/a
Elapsed time =    0.229 seconds

        .
        .
        .

Running tests

        .
        .
        .

Run tests: 134
Failed: 0


-- if you build with SFCGAL

        .
        .
        .

Running tests

        .
        .
        .

Run tests: 13
Failed: 0

-- if you built with raster support

        .
        .
        .
```

```
Run Summary:    Type  Total    Ran Passed Failed Inactive
              suites     12     12    n/a      0        0
               tests     65     65     65      0        0
             asserts  45896  45896  45896      0      n/a


        .
        .
        .

Running tests

        .
        .
        .

Run tests: 101
Failed: 0

-- topology regress

.
.
.

Running tests

        .
        .
        .

Run tests: 51
Failed: 0

-- if you built --with-gui, you should see this too

     CUnit - A unit testing framework for C - Version 2.1-2
     http://cunit.sourceforge.net/

        .
        .
        .

Run Summary:    Type  Total    Ran Passed Failed Inactive
              suites      2      2    n/a      0        0
               tests      4      4      4      0        0
             asserts      4      4      4      0      n/a
```

postgis_tiger_geocoder 와 address_standardizer 확장 프로그램
현재 표준 PostgreSQL 설치검사(installcheck)만을
지원합니다. 이 확장 프로그램들&#
테스트하려면 다음을 실행하십&#x
주의:. 이미 PostGIS 코드 폴더의 루트에&#x
make install을 실행했다면 다시 실행할 필&
없습니다.

address_standardizer의 경우:

```
cd extensions/address_standardizer
make install
make installcheck
```

다음과 같은 결과가 나와야 합니&#x

```
============== dropping database "contrib_regression" ==============
DROP DATABASE
============== creating database "contrib_regression" ==============
CREATE DATABASE
ALTER DATABASE
============== running regression test queries        ==============
test test-init-extensions     ... ok
test test-parseaddress        ... ok
test test-standardize_address_1 ... ok
test test-standardize_address_2 ... ok

====================
 All 4 tests passed.
====================
```

TIGER 지오코딩 도구의 경우, 사용자&#xc7
PostgreSQL 인스턴스 안에서 PostGIS 및 fuzzystrmatch 확&#xc7a
프로그램을 이용할 수 있는지 확&#
address_standardizer 지원이 되도록 PostGIS를 빌드했&#x
address_standardizer 테스트도 함께 실행될 것입&

```
cd extensions/postgis_tiger_geocoder
make install
make installcheck
```

다음과 같은 결과가 나와야 합니&#x

```
============== dropping database "contrib_regression" ==============
DROP DATABASE
============== creating database "contrib_regression" ==============
CREATE DATABASE
ALTER DATABASE
============== installing fuzzystrmatch               ==============
CREATE EXTENSION
============== installing postgis                     ==============
CREATE EXTENSION
============== installing postgis_tiger_geocoder      ==============
CREATE EXTENSION
============== installing address_standardizer        ==============
CREATE EXTENSION
============== running regression test queries        ==============
test test-normalize_address   ... ok
test test-pagc_normalize_address ... ok

====================
All 2 tests passed.
====================
```

2.2.7 설치

PostGIS 설치를 위해서 다음을 입력하&#x

make install

이것은 **--prefix** 설정 파라미터에 정의&#xb
하위 경로에 PostGIS 설치 파일을 복사&#x
것입니다.

- 로더(loader)와 덤퍼 바이너리 들은 `[prefix]/bin`에 설치됩니다.
- `postgis.sql`와 같은 SQL 파일들은 `[prefix]/share/contrib`에 설치됩니다.
- PostGIS 라이브러리들은 `[prefix]/lib`에 설치&#xb

만약 기존에 `postgis_comments.sql`, `raster_comments.sql` 파일&#x 생성하기 위해 **make comments** 명령어를 실&#xd 적이 있으시다면, 다음을 실행해 sql 파일을 설치하십시오.

make comments-install

> **Note**
> **xsltproc**의 적용 이후 일반적인 설치로부터 `postgis_comments.sql`, `raster_comments.sql`, `topology_comments.sql`는 분리되었습니다.

2.3 주소 표준화 도구 설&#xce5 및 활용

`address_standardizer` 확장 프로그램은 별도로 다운로드해야 하는 별도의 패키&# PostGIS 2.2 버전부터는 내장되어 있습니& 이 확장 프로그램이 무슨 일을 하&# 사용자의 필요에 따라 어떻게 설&# 대한 자세한 정보는 Section 11.1 를 참조하

이 표준화 도구는 Normalize_Address 대신 PostGIS 용&# 패키징된 TIGER 지오코딩 도구(geocoder)와 함께 쓰일 수 있습니다. 이렇게 대& 사용하는 방법은 Section 2.4.2 을 참조하십 주소 표준화 도구를 사용자의 다&# 지오코딩 도구를 위한 구성 요소(bui block)로 사용하거나, 주소를 더 쉽게 비교하기 위해 사용자 주소를 표&# 데 사용할 수도 있습니다.

주소 표준화 도구는 PCRE에 의존성&#xc7 갖습니다. PCRE는 많은 유닉스 파생 시스템에 일반적으로 이미 설치&#x 있지만, http://www.pcre.org 에서 최신 버전을 다&# 수 있습니다. Section 2.2.3 과정에서 PCRE를 찾&# 주소 표준화 도구 확장 프로그램&# 자동적으로 빌드할 것입니다. 사&# 사용하고자 하는 PCRE를 따로 설치&#xd5 경우, 설정 파라미터 `--with-pcredir=/path/to/pcre` 의 `/path/to/pcre` 부분에 사용자의 PCRE include 및 lib 디&#xb8 루트 폴더를 입력하십시오.

윈도우 사용자의 경우 PostGIS 2.1 이상 버& 번들은 이미address_standardizer와 함께 패키징&# 있으므로 컴파일할 필요없이 바&#x `CREATE EXTENSION` 단계로 건너뛸 수 있습니다

설치를 완료했다면 사용자 데이&#x
연결해서 SQL을 실행할 수 있습니&#xb2e4

```
CREATE EXTENSION address_standardizer;
```

다음 테스트에는 어떤 rules, gaz, 또는 lex
테이블도 필요없습니다.

```
SELECT num, street, city, state, zip
 FROM parse_address('1 Devonshire Place PH301, Boston, MA 02109');
```

다음과 같은 결과가 나와야 합니&#x

```
num |         street         |  city  | state |  zip
----+------------------------+--------+-------+-------
 1  | Devonshire Place PH301 | Boston | MA    | 02109
```

2.4 Installing, Upgrading Tiger Geocoder, and loading data

Extras like Tiger geocoder may not be packaged in your PostGIS distribution. If you are missing the tiger geocoder extension or want a newer version than what your install comes with, then use the `share/extension/postgis_tiger_geocoder.*` files from the packages in Windows Unreleased Versions section for your version of PostgreSQL. Although these packages are for windows, the postgis_tiger_geocoder extension files will work on any OS since the extension is an SQL/plpgsql only extension.

2.4.1 Tiger Geocoder Enabling your PostGIS database

1. These directions assume your PostgreSQL installation already has the postgis_tiger_geocoder extension installed.

2. PSQL, pgAdmin 또는 다른 도구를 통해 사&#xc6a9
   데이터베이스에 연결해서 다&#xc74
   SQL 명령어를 실행하십시오. 이미
   PostGIS가 설치된 데이터베이스에 &#xc124
   경우, 첫 번째 단계를 수행할 필&#xc6
   없다는 사실을 주의하십시오.
   이미 `fuzzystrmatch` 확장 프로그램이 설&#xce5
   있다면 이 두 번째 단계도 수행&#xd5
   필요가 없습니다.

   ```
   CREATE EXTENSION postgis;
   CREATE EXTENSION fuzzystrmatch;
   CREATE EXTENSION postgis_tiger_geocoder;
   --this one is optional if you want to use the rules based standardizer ( ↩
       pagc_normalize_address)
   CREATE EXTENSION address_standardizer;
   ```

   이미 postgis_tiger_geocoder 확장 프로그램을 설&#x
   최신 버전으로 업데이트만 하&#xace
   할 경우:

   ```
   ALTER EXTENSION postgis UPDATE;
   ALTER EXTENSION postgis_tiger_geocoder UPDATE;
   ```

   `tiger.loader_platform` 과 `tiger.loader_variables` 에 사용자 지&#x
   항목을 만들었거나 변경한 경&#xc6b
   이 테이블들도 업데이트해야
   할 수도 있습니다.

3. 제대로 설치되었는지 확인하&#xb82 사용자 데이터베이스에 다음 SQL을 실행하십시오:

```
SELECT na.address, na.streetname,na.streettypeabbrev, na.zip
        FROM normalize_address('1 Devonshire Place, Boston, MA 02109') AS na;
```

다음과 같은 결과가 나와야 합&#xb2c8

```
address | streetname | streettypeabbrev |  zip
---------+------------+------------------+-------
           1 | Devonshire | Pl               | 02109
```

4. `tiger.loader_platform` 테이블에 사용자의 실&#xd5 파일과 서버의 경로를 새 레코&#xb4d 생성하십시오.

   예를 들어 `sh` 규약(convention)을 따르는 debbie라는 프로파일을 생성하려면 다음과 같이 해야 합니다.

```
INSERT INTO tiger.loader_platform(os, declare_sect, pgbin, wget, unzip_command, psql,  ↩
    path_sep,
                    loader, environ_set_command, county_process_command)
SELECT 'debbie', declare_sect, pgbin, wget, unzip_command, psql, path_sep,
           loader, environ_set_command, county_process_command
  FROM tiger.loader_platform
  WHERE os = 'sh';
```

   그 다음 debbie의 pg, unzip,shp2pgsql, PSQL 등의 경로 위&# 맞도록 *declare_sect* 열의 경로를 편집하&#x

   이 `loader_platform` 테이블을 편집하지 않&#x 경우, 각 항목의 흔히 있는(common case) 위치만을 담게 되며 스크립트&#xac0 생생된 후 생성된 스크립트를 직접 편집해야 할 것입니다.

5. As of PostGIS 2.4.1 the Zip code-5 digit tabulation area `zcta5` load step was revised to load current zcta5 data and is part of the Loader_Generate_Nation_Script when enabled. It is turned off by default because it takes quite a bit of time to load (20 to 60 minutes), takes up quite a bit of disk space, and is not used that often.

   To enable it, do the following:

```
UPDATE tiger.loader_lookuptables SET load = true WHERE table_name = 'zcta520';
```

   If present the Geocode function can use it if a boundary filter is added to limit to just zips in that boundary. The Reverse_Geocode function uses it if the returned address is missing a zip, which often happens with highway reverse geocoding.

6. 서버의 루트, 또는 서버에 충분&#xd 빠른 네트워크로 연결된 경우 사용자 PC의 루트에 `gisdata` 라는 폴더&# 생성하십시오. 이 폴더로 TIGER 파&#xc77c 다운로드해서 처리할 것입니&#xb2e 서버의 루트에 폴더를 만드는 게 마음에 안 들거나, 또는 단순&#xd 다른 폴더로 변경하고 싶다면, `tiger.loader_variables` 테이블의 `staging_fold` 항목을 편집하십시오.

7. gisdata 폴더 또는 사용자가 staging_fold 에 지정한 폴더 안에 temp라는 폴더를 생성하십시오. 다운로드한 TIGER &#xb370 로더가 이 temp 폴더에 압축해제할 것입니다.

8. Then run the Loader_Generate_Nation_Script SQL function make sure to use the name of your custom profile and copy the script to a .sh or .bat file. So for example to build the nation load:

```
psql -c "SELECT Loader_Generate_Nation_Script('debbie')" -d geocoder -tA > /gisdata/ ↩
    nation_script_load.sh
```

9. Run the generated nation load commandline scripts.

```
cd /gisdata
sh nation_script_load.sh
```

10. After you are done running the nation script, you should have three tables in your tiger_data schema and they should be filled with data. Confirm you do by doing the following queries from psql or pgAdmin

```
SELECT count(*) FROM tiger_data.county_all;
```

```
count
-------
  3235
(1 row)
```

```
SELECT count(*) FROM tiger_data.state_all;
```

```
count
-------
    56
(1 row)
```

11. By default the tables corresponding to bg, tract, tabblock20 are not loaded. These tables are not used by the geocoder but are used by folks for population statistics. If you wish to load them as part of your state loads, run the following statement to enable them.

```
UPDATE tiger.loader_lookuptables SET load = true WHERE load = false AND lookup_name IN ↩
    ('tract', 'bg', 'tabblock20');
```

Alternatively you can load just these tables after loading state data using the Loader_Generate_Census_Script

12. For each state you want to load data for, generate a state script Loader_Generate_Script.

Warning
DO NOT Generate the state script until you have already loaded the nation data, because the state script utilizes county list loaded by nation script.

13.
```
psql -c "SELECT Loader_Generate_Script(ARRAY['MA'], 'debbie')" -d geocoder -tA > / ↩
    gisdata/ma_load.sh
```

14. 생성된 명령어 스크립트를 실&#xd5

```
cd /gisdata
sh ma_load.sh
```

15. 모든 데이터를 로딩한 다음 또&#xb2
어떤 정지 지점에서 모든 TIGER 테&#xc774
분석해서 (상속된 통계를 포함&#xd5
통계(stat)를 업데이트하는 것이 좋&

```
SELECT install_missing_indexes();
vacuum (analyze, verbose) tiger.addr;
vacuum (analyze, verbose) tiger.edges;
vacuum (analyze, verbose) tiger.faces;
vacuum (analyze, verbose) tiger.featnames;
vacuum (analyze, verbose) tiger.place;
vacuum (analyze, verbose) tiger.cousub;
vacuum (analyze, verbose) tiger.county;
vacuum (analyze, verbose) tiger.state;
vacuum (analyze, verbose) tiger.zip_lookup_base;
vacuum (analyze, verbose) tiger.zip_state;
vacuum (analyze, verbose) tiger.zip_state_loc;
```

2.4.2 주소 표준화 도구를 TIGER 지&#xc62 도구와 함께 사용

사용자들의 많은 불평 가운데 하&#
주소 정규화 도구 Normalize_Address 함수가 지&#
작업 전 준비 과정에서 주소를 정&#
것입니다. 정규화 도구는 완벽하&#
않아 그 불완전함을 수정하려면
막대한 노력이 필요합니다. 그래&#
우리는 훨씬 나은 주소 표준화 도&#
엔진을 가진 또다른 프로젝트와
통합시켰습니다. 이 새로운 address_standardizer&
이용하려면, Section 2.3 에 설명된 대로 확
프로그램을 컴파일해서 사용자
데이터베이스에 확장 프로그램&#x
설치하십시오.

`postgis_tiger_geocoder` 를 설치했던 데이터베이
이 확장 프로그램을 설치했다면,
Normalize_Address 대신 Pagc_Normalize_Address 를 이용할 수 있&#
이 확장 프로그램은 TIGER 유무와 상&#xa
동작하므로, 국제 주소와 같은 다&#
데이터 소스와 함께 사용할 수 있&#
실제로 TIGER 지오코딩 도구 확장 프&#xb
규칙 테이블 (`tiger.pagc_rules`), 지명 색인 테&#xc
(`tiger.pagc_gaz`), 그리고 어휘 목록 테이블 (`tiger.
자체 수정 버전과 함께 패키징되&#
있습니다. 사용자 자신의 필요에
따라 이들을 추가하고 업데이트&#
표준화 작업 과정을 향상시킬 수
있습니다.

2.4.3 Required tools for tiger data loading

인구조사 웹사이트에서 필요한
주의 데이터를 다운로드 받습니&#
압축을 풀면 주 단위로 별개의 세&#
이뤄져 있습니다. 각 주 테이블은

tiger스키마 정의에 따라 접속 및 쿼&#xb9
할 수 있고, Drop_State_Tables_Generate_Script를 다시 불러&#xc
삭제하는 등의 작업을 실시할 수
있습니다.

데이터를 로딩하기 위해서는 다&#
같은 도구들이 필요합니다:

- 인구조사 웹사이트에서 받은 압&#
  파일을 풀기 위한 툴

  Unix 계열 시스템에서는 대부분 unzip&#xc73c
  해제할 수 있습니다.

  윈도우의 경우, 무료 압축/압축해
  툴인 7-zip이 http://www.7-zip.org/에서 다운로드 가&#x
- PostGIS 기본 설치시 설치되는 shp2pgsql 명&#xb839
- 웹 다운로드 툴인 wget은 대부분의Unix
  시스템에 설치되어 있습니다.

  윈도우를 사용 중이면 http://gnuwin32.sourceforge.net/-packages/wget.htm에서 다운로드 가능합니다.

If you are upgrading from tiger_2010, you'll need to first generate and run Drop_Nation_Tables_Generate_Script. Before you load any state data, you need to load the nation wide data which you do with Loader_Generate_Nation_Script. Which will generate a loader script for you. Loader_Generate_Nation_Script is a one-time step that should be done for upgrading (from a prior year tiger census data) and for new installs.

사용자의 플랫폼에서 사용자가
지정한 행정구역 데이터를 로드&#
스크립트를 생성하려면 Loader_Generate_Script &#xb97
참조하십시오. 이 데이터들을 개&#
로드할 수 있다는 점을 기억하십&#
사용자가 지정한 모든 행정구역&#
한번에 로드하지 않아도 됩니다.
필요할 때마다 로드할 수 있습니&#

원하는 데이터가 로딩이 된 후 Install_Missing_Indexes에서 설명된 대로 다음을 실&

```
SELECT install_missing_indexes();
```

실행이 잘되는지 확인하려면 Geocode&#x
이용하여 해당 주의 주소를 변환&#x
보십시오.

2.4.4 Upgrading your Tiger Geocoder Install and Data

First upgrade your postgis_tiger_geocoder extension as follows:

```
ALTER EXTENSION postgis_tiger_geocoder UPDATE;
```

다음으로 모든 nation 테이블을 drop 하고
새로 불러옵니다. 이 SQL 문장으로
drop 스크립트를 만듭니다. 자세한
내용은 다음을 참고하십시오. Drop_Nation_

```
SELECT drop_nation_tables_generate_script();
```

생성된 drop SQL 문장을 실행하십시오.

이 SELECT 구문으로 nation load 스크립트를 생&#
자세한 내용을 다음을 참고하십&#x
Loader_Generate_Nation_Script

윈도우용

```
SELECT loader_generate_nation_script('windows');
```

unix/linux 용

```
SELECT loader_generate_nation_script('sh');
```

Refer to Section 2.4.1 for instructions on how to run the generate script. This only needs to be done once.

Note
You can have a mix of different year state tables and can upgrade each state separately. Before you upgrade a state you first need to drop the prior year state tables for that state using Drop_State_Tables_Generate_Script.

2.5 설치 과정에서 흔히 &#xbc1 문제들

인스톨이나 업그레이드 시 잘 되&#
않을 경우 확인해야 할 몇 가지 사&#
아래와 같습니다.

1. PostgreSQL 12 또는 그 보다 최신 버전을 설&
   체크하십시오. 현재 작동하고
   계시는 PostgreSQL의 버전과 동일한 PostgreSQL
   소스 버전을 바탕으로 컴파일&#xd55
   확인해주십시오. (Linux) 배포본이 이
   PostgreSQL이 설치된 경우 중복 설치가
   될 수 있고, 또는 이전에 설치한
   사실을 잊어버렸을 수도 있습&#xb2c
   PostGIS는 PostgreSQL 12 또는 그 이상 버전에서
   작동되므로 구 버전을 이용 시
   예상하지 못한 에러들이 발생&#xd56
   수 있습니다. 어떤 PostgreSQL 버전이 작&#
   있는지 확인하기 위해서는 psql을
   통하여 데이터베이스에 접속&#xd57
   다음의 쿼리를 실행하십시오:

   ```
   SELECT version();
   ```

   RPM 방식이라면 다음과 같은 **rpm** 커&#xb9e
   이전 설치 패키지의 존재를 확&#xc7
   수 있습니다: **rpm -qa | grep postgresql**

2. 만약 업그레이드가 실패하면
   기존 PostGIS설치 버전으로 복원하&#xc154
   합니다.

   ```
   SELECT postgis_full_version();
   ```

또한 PostreSQL, Proj4 라이브러리 및 GEOS 라이&#xbe0c
대한 버전과 경로에 대한 설정이
올바른지 확인하십시오.

1. 설정은 `postgis_config.hh` 파일을 생성하기
   위해 사용됩니다. `POSTGIS_PGSQL_VERSION`, `POSTGIS_PROJ_VERS`
   and `POSTGIS_GEOS_VERSION` 변수가 정확한지 확인&#

Chapter 3

PostGIS Administration

3.1 Performance Tuning

Tuning for PostGIS performance is much like tuning for any PostgreSQL workload. The only additional consideration is that geometries and rasters are usually large, so memory-related optimizations generally have more of an impact on PostGIS than other types of PostgreSQL queries.

For general details about optimizing PostgreSQL, refer to Tuning your PostgreSQL Server.

For PostgreSQL 9.4+ configuration can be set at the server level without touching `postgresql.conf` or `postgresql.auto.conf` by using the `ALTER SYSTEM` command.

```
ALTER SYSTEM SET work_mem = '256MB';
-- this forces non-startup configs to take effect for new connections
SELECT pg_reload_conf();
-- show current setting value
-- use SHOW ALL to see all settings
SHOW work_mem;
```

In addition to the Postgres settings, PostGIS has some custom settings which are listed in Section 7.24.

3.1.1 Startup

These settings are configured in `postgresql.conf`:

constraint_exclusion

- Default: partition
- This is generally used for table partitioning. The default for this is set to "partition" which is ideal for PostgreSQL 8.4 and above since it will force the planner to only analyze tables for constraint consideration if they are in an inherited hierarchy and not pay the planner penalty otherwise.

shared_buffers

- Default: ~128MB in PostgreSQL 9.6
- Set to about 25% to 40% of available RAM. On windows you may not be able to set as high.

max_worker_processes This setting is only available for PostgreSQL 9.4+. For PostgreSQL 9.6+ this setting has additional importance in that it controls the max number of processes you can have for parallel queries.

- Default: 8
- Sets the maximum number of background processes that the system can support. This parameter can only be set at server start.

3.1.2 Runtime

work_mem - sets the size of memory used for sort operations and complex queries

- Default: 1-4MB
- Adjust up for large dbs, complex queries, lots of RAM
- Adjust down for many concurrent users or low RAM.
- If you have lots of RAM and few developers:

```
SET work_mem TO '256MB';
```

maintenance_work_mem - the memory size used for VACUUM, CREATE INDEX, etc.

- Default: 16-64MB
- Generally too low - ties up I/O, locks objects while swapping memory
- Recommend 32MB to 1GB on production servers w/lots of RAM, but depends on the # of concurrent users. If you have lots of RAM and few developers:

```
SET maintenance_work_mem TO '1GB';
```

max_parallel_workers_per_gather

This setting is only available for PostgreSQL 9.6+ and will only affect PostGIS 2.3+, since only PostGIS 2.3+ supports parallel queries. If set to higher than 0, then some queries such as those involving relation functions like `ST_Intersects` can use multiple processes and can run more than twice as fast when doing so. If you have a lot of processors to spare, you should change the value of this to as many processors as you have. Also make sure to bump up `max_worker_processes` to at least as high as this number.

- Default: 0
- Sets the maximum number of workers that can be started by a single `Gather` node. Parallel workers are taken from the pool of processes established by `max_worker_processes`. Note that the requested number of workers may not actually be available at run time. If this occurs, the plan will run with fewer workers than expected, which may be inefficient. Setting this value to 0, which is the default, disables parallel query execution.

3.2 Configuring raster support

If you enabled raster support you may want to read below how to properly configure it.

As of PostGIS 2.1.3, out-of-db rasters and all raster drivers are disabled by default. In order to re-enable these, you need to set the following environment variables `POSTGIS_GDAL_ENABLED_DRIVERS` and `POSTGIS_ENABLE_OUTDB_RASTERS` in the server environment. For PostGIS 2.2, you can use the more cross-platform approach of setting the corresponding Section 7.24.

If you want to enable offline raster:

```
POSTGIS_ENABLE_OUTDB_RASTERS=1
```

Any other setting or no setting at all will disable out of db rasters.

In order to enable all GDAL drivers available in your GDAL install, set this environment variable as follows

```
POSTGIS_GDAL_ENABLED_DRIVERS=ENABLE_ALL
```

If you want to only enable specific drivers, set your environment variable as follows:

```
POSTGIS_GDAL_ENABLED_DRIVERS="GTiff PNG JPEG GIF XYZ"
```

Note
If you are on windows, do not quote the driver list

Setting environment variables varies depending on OS. For PostgreSQL installed on Ubuntu or Debian via apt-postgresql, the preferred way is to edit `/etc/postgresql/10/main/environment` where 10 refers to version of PostgreSQL and main refers to the cluster.

On windows, if you are running as a service, you can set via System variables which for Windows 7 you can get to by right-clicking on Computer->Properties Advanced System Settings or in explorer navigating to `Control Panel\All Control Panel Items\System`. Then clicking *Advanced System Settings ->Advanced->Environment Variables* and adding new system variables.

After you set the environment variables, you'll need to restart your PostgreSQL service for the changes to take effect.

3.3 공간 데이터베이스 &#xc0dd

3.3.1 Spatially enable database using EXTENSION

If you are using PostgreSQL 9.1+ and have compiled and installed the extensions/postgis modules, you can turn a database into a spatial one using the EXTENSION mechanism.

Core postgis extension includes geometry, geography, spatial_ref_sys and all the functions and comments. Raster and topology are packaged as a separate extension.

Run the following SQL snippet in the database you want to enable spatially:

```
CREATE EXTENSION IF NOT EXISTS plpgsql;
      CREATE EXTENSION postgis;
      CREATE EXTENSION postgis_raster; -- OPTIONAL
      CREATE EXTENSION postgis_topology; -- OPTIONAL
```

3.3.2 Spatially enable database without using EXTENSION (discouraged)

Note
This is generally only needed if you cannot or don't want to get PostGIS installed in the PostgreSQL extension directory (for example during testing, development or in a restricted environment).

Adding PostGIS objects and function definitions into your database is done by loading the various sql files located in `[prefix]/share/contrib` as specified during the build phase.

The core PostGIS objects (geometry and geography types, and their support functions) are in the `postgis.sql` script. Raster objects are in the `rtpostgis.sql` script. Topology objects are in the `topology.sql` script.

For a complete set of EPSG coordinate system definition identifiers, you can also load the `spatial_ref_sys.sql` definitions file and populate the `spatial_ref_sys` table. This will permit you to perform ST_Transform() operations on geometries.

If you wish to add comments to the PostGIS functions, you can find them in the `postgis_comments.sql` script. Comments can be viewed by simply typing **\dd [function_name]** from a **psql** terminal window.

Run the following Shell commands in your terminal:

```
DB=[yourdatabase]
    SCRIPTSDIR=`pg_config --sharedir`/contrib/postgis-3.3/

    # Core objects
    psql -d ${DB} -f ${SCRIPTSDIR}/postgis.sql
    psql -d ${DB} -f ${SCRIPTSDIR}/spatial_ref_sys.sql
    psql -d ${DB} -f ${SCRIPTSDIR}/postgis_comments.sql # OPTIONAL

    # Raster support (OPTIONAL)
    psql -d ${DB} -f ${SCRIPTSDIR}/rtpostgis.sql
    psql -d ${DB} -f ${SCRIPTSDIR}/raster_comments.sql # OPTIONAL

    # Topology support (OPTIONAL)
    psql -d ${DB} -f ${SCRIPTSDIR}/topology.sql
    psql -d ${DB} -f ${SCRIPTSDIR}/topology_comments.sql # OPTIONAL
```

3.4 Upgrading spatial databases

Upgrading existing spatial databases can be tricky as it requires replacement or introduction of new PostGIS object definitions.

Unfortunately not all definitions can be easily replaced in a live database, so sometimes your best bet is a dump/reload process.

PostGIS provides a SOFT UPGRADE procedure for minor or bugfix releases, and a HARD UPGRADE procedure for major releases.

Before attempting to upgrade PostGIS, it is always worth to backup your data. If you use the -Fc flag to pg_dump you will always be able to restore the dump with a HARD UPGRADE.

3.4.1 Soft upgrade

If you installed your database using extensions, you'll need to upgrade using the extension model as well. If you installed using the old sql script way, you are advised to switch your install to extensions because the script way is no longer supported.

3.4.1.1 Soft Upgrade 9.1+ using extensions

If you originally installed PostGIS with extensions, then you need to upgrade using extensions as well. Doing a minor upgrade with extensions, is fairly painless.

If you are running PostGIS 3 or above, then you should use the PostGIS_Extensions_Upgrade function to upgrade to the latest version you have installed.

```
SELECT postgis_extensions_upgrade();
```

If you are running PostGIS 2.5 or lower, then do the following:

```
ALTER EXTENSION postgis UPDATE;
SELECT postgis_extensions_upgrade();
-- This second call is needed to rebundle postgis_raster extension
SELECT postgis_extensions_upgrade();
```

If you have multiple versions of PostGIS installed, and you don't want to upgrade to the latest, you can explicitly specify the version as follows:

```
ALTER EXTENSION postgis UPDATE TO "3.4.0dev";
ALTER EXTENSION postgis_topology UPDATE TO "3.4.0dev";
```

If you get an error notice something like:

```
No migration path defined for ... to 3.4.0dev
```

Then you'll need to backup your database, create a fresh one as described in Section 3.3.1 and then restore your backup on top of this new database.

If you get a notice message like:

```
Version "3.4.0dev" of extension "postgis" is already installed
```

Then everything is already up to date and you can safely ignore it. **UNLESS** you're attempting to upgrade from an development version to the next (which doesn't get a new version number); in that case you can append "next" to the version string, and next time you'll need to drop the "next" suffix again:

```
ALTER EXTENSION postgis UPDATE TO "3.4.0devnext";
ALTER EXTENSION postgis_topology UPDATE TO "3.4.0devnext";
```

Note
If you installed PostGIS originally without a version specified, you can often skip the reinstallation of postgis extension before restoring since the backup just has `CREATE EXTENSION postgis` and thus picks up the newest latest version during restore.

Note
If you are upgrading PostGIS extension from a version prior to 3.0.0, you will have a new extension *postgis_raster* which you can safely drop, if you don't need raster support. You can drop as follows:

```
DROP EXTENSION postgis_raster;
```

3.4.1.2 Soft Upgrade Pre 9.1+ or without extensions

This section applies only to those who installed PostGIS not using extensions. If you have extensions and try to upgrade with this approach you'll get messages like:

```
can't drop ... because postgis extension depends on it
```

NOTE: if you are moving from PostGIS 1.* to PostGIS 2.* or from PostGIS 2.* prior to r7409, you cannot use this procedure but would rather need to do a HARD UPGRADE.

After compiling and installing (make install) you should find a set of `*_upgrade.sql` files in the installation folders. You can list them all with:

```
ls `pg_config --sharedir`/contrib/postgis-3.4.0dev/*_upgrade.sql
```

Load them all in turn, starting from `postgis_upgrade.sql`.

```
psql -f postgis_upgrade.sql -d your_spatial_database
```

The same procedure applies to raster, topology and sfcgal extensions, with upgrade files named `rtpostgis_upgrade.sql`, `topology_upgrade.sql` and `sfcgal_upgrade.sql` respectively. If you need them:

```
psql -f rtpostgis_upgrade.sql -d your_spatial_database
```

```
psql -f topology_upgrade.sql -d your_spatial_database
```

```
psql -f sfcgal_upgrade.sql -d your_spatial_database
```

You are advised to switch to an extension based install by running

```
psql -c "SELECT postgis_extensions_upgrade();"
```

Note
If you can't find the `postgis_upgrade.sql` specific for upgrading your version you are using a version too early for a soft upgrade and need to do a HARD UPGRADE.

The PostGIS_Full_Version function should inform you about the need to run this kind of upgrade using a "procs need upgrade" message.

3.4.2 Hard upgrade

By HARD UPGRADE we mean full dump/reload of postgis-enabled databases. You need a HARD UPGRADE when PostGIS objects' internal storage changes or when SOFT UPGRADE is not possible. The Release Notes appendix reports for each version whether you need a dump/reload (HARD UPGRADE) to upgrade.

The dump/reload process is assisted by the postgis_restore.pl script which takes care of skipping from the dump all definitions which belong to PostGIS (including old ones), allowing you to restore your schemas and data into a database with PostGIS installed without getting duplicate symbol errors or bringing forward deprecated objects.

Supplementary instructions for windows users are available at Windows Hard upgrade.

The Procedure is as follows:

1. Create a "custom-format" dump of the database you want to upgrade (let's call it `olddb`) include binary blobs (-b) and verbose (-v) output. The user can be the owner of the db, need not be postgres super account.

   ```
   pg_dump -h localhost -p 5432 -U postgres -Fc -b -v -f "/somepath/olddb.backup" olddb
   ```

2. Do a fresh install of PostGIS in a new database -- we'll refer to this database as `newdb`. Please refer to Section 3.3.2 and Section 3.3.1 for instructions on how to do this.

   The spatial_ref_sys entries found in your dump will be restored, but they will not override existing ones in spatial_ref_sys. This is to ensure that fixes in the official set will be properly propagated to restored databases. If for any reason you really want your own overrides of standard entries just don't load the spatial_ref_sys.sql file when creating the new db.

   If your database is really old or you know you've been using long deprecated functions in your views and functions, you might need to load `legacy.sql` for all your functions and views etc. to properly come back. Only do this if _really_ needed. Consider upgrading your views and functions before dumping instead, if possible. The deprecated functions can be later removed by loading `uninstall_legacy.sql`.

3. Restore your backup into your fresh `newdb` database using postgis_restore.pl. Unexpected errors, if any, will be printed to the standard error stream by psql. Keep a log of those.

   ```
   perl utils/postgis_restore.pl "/somepath/olddb.backup" | psql -h localhost -p 5432 -U ↩
       postgres newdb 2> errors.txt
   ```

Errors may arise in the following cases:

1. Some of your views or functions make use of deprecated PostGIS objects. In order to fix this you may try loading `legacy.sql` script prior to restore or you'll have to restore to a version of PostGIS which still contains those objects and try a migration again after porting your code. If the `legacy.sql` way works for you, don't forget to fix your code to stop using deprecated functions and drop them loading `uninstall_legacy.sql`.

2. Some custom records of spatial_ref_sys in dump file have an invalid SRID value. Valid SRID values are bigger than 0 and smaller than 999000. Values in the 999000.999999 range are reserved for internal use while values > 999999 can't be used at all. All your custom records with invalid SRIDs will be retained, with those > 999999 moved into the reserved range, but the spatial_ref_sys table would lose a check constraint guarding for that invariant to hold and possibly also its primary key (when multiple invalid SRIDS get converted to the same reserved SRID value).

   In order to fix this you should copy your custom SRS to a SRID with a valid value (maybe in the 910000..910999 range), convert all your tables to the new srid (see UpdateGeometrySRID), delete the invalid entry from spatial_ref_sys and re-construct the check(s) with:

```
ALTER TABLE spatial_ref_sys ADD CONSTRAINT spatial_ref_sys_srid_check check (srid > 0 ↩
    AND srid < 999000 );
```

```
ALTER TABLE spatial_ref_sys ADD PRIMARY KEY(srid));
```

   If you are upgrading an old database containing french IGN cartography, you will have probably SRIDs out of range and you will see, when importing your database, issues like this :

```
 WARNING: SRID 310642222 converted to 999175 (in reserved zone)
```

   In this case, you can try following steps : first throw out completely the IGN from the sql which is resulting from postgis_restore.pl. So, after having run :

```
perl utils/postgis_restore.pl "/somepath/olddb.backup" > olddb.sql
```

   run this command :

```
grep -v IGNF olddb.sql > olddb-without-IGN.sql
```

   Create then your newdb, activate the required Postgis extensions, and insert properly the french system IGN with : this script After these operations, import your data :

```
psql -h localhost -p 5432 -U postgres -d newdb -f olddb-without-IGN.sql  2> errors.txt
```

Chapter 4

Data Management

4.1 GIS (벡터) 데이터 로드

4.1.1 OGC Geometry

The Open Geospatial Consortium (OGC) developed the *Simple Features Access* standard (SFA) to provide a model for geospatial data. It defines the fundamental spatial type of **Geometry**, along with operations which manipulate and transform geometry values to perform spatial analysis tasks. PostGIS implements the OGC Geometry model as the PostgreSQL data types geometry and geography.

Geometry is an *abstract* type. Geometry values belong to one of its *concrete* subtypes which represent various kinds and dimensions of geometric shapes. These include the **atomic** types Point, LineString, LinearRing and Polygon, and the **collection** types MultiPoint, MultiLineString, MultiPolygon and GeometryCollection. The *Simple Features Access - Part 1: Common architecture v1.2.1* adds subtypes for the structures PolyhedralSurface, Triangle and TIN.

Geometry models shapes in the 2-dimensional Cartesian plane. The PolyhedralSurface, Triangle, and TIN types can also represent shapes in 3-dimensional space. The size and location of shapes are specified by their **coordinates**. Each coordinate has a X and Y **ordinate** value determining its location in the plane. Shapes are constructed from points or line segments, with points specified by a single coordinate, and line segments by two coordinates.

Coordinates may contain optional Z and M ordinate values. The Z ordinate is often used to represent elevation. The M ordinate contains a measure value, which may represent time or distance. If Z or M values are present in a geometry value, they must be defined for each point in the geometry. If a geometry has Z or M ordinates the **coordinate dimension** is 3D; if it has both Z and M the coordinate dimension is 4D.

Geometry values are associated with a **spatial reference system** indicating the coordinate system in which it is embedded. The spatial reference system is identified by the geometry SRID number. The units of the X and Y axes are determined by the spatial reference system. In **planar** reference systems the X and Y coordinates typically represent easting and northing, while in **geodetic** systems they represent longitude and latitude. SRID 0 represents an infinite Cartesian plane with no units assigned to its axes. See Section 4.5.

The geometry **dimension** is a property of geometry types. Point types have dimension 0, linear types have dimension 1, and polygonal types have dimension 2. Collections have the dimension of the maximum element dimension.

A geometry value may be **empty**. Empty values contain no vertices (for atomic geometry types) or no elements (for collections).

An important property of geometry values is their spatial **extent** or **bounding box**, which the OGC model calls **envelope**. This is the 2 or 3-dimensional box which encloses the coordinates of a geometry. It is an efficient way to represent a geometry's extent in coordinate space and to check whether two geometries interact.

The geometry model allows evaluating topological spatial relationships as described in Section 5.1.1. To support this the concepts of **interior**, **boundary** and **exterior** are defined for each geometry type. Geometries are topologically closed, so they always contain their boundary. The boundary is a geometry of dimension one less than that of the geometry itself.

The OGC geometry model defines validity rules for each geometry type. These rules ensure that geometry values represents realistic situations (e.g. it is possible to specify a polygon with a hole lying outside the shell, but this makes no sense geometrically and is thus invalid). PostGIS also allows storing and manipulating invalid geometry values. This allows detecting and fixing them if needed. See Section 4.4

4.1.1.1 Point

A Point is a 0-dimensional geometry that represents a single location in coordinate space.

```
POINT (1 2)
POINT Z (1 2 3)
POINT ZM (1 2 3 4)
```

4.1.1.2 LineString

A LineString is a 1-dimensional line formed by a contiguous sequence of line segments. Each line segment is defined by two points, with the end point of one segment forming the start point of the next segment. An OGC-valid LineString has either zero or two or more points, but PostGIS also allows single-point LineStrings. LineStrings may cross themselves (self-intersect). A LineString is **closed** if the start and end points are the same. A LineString is **simple** if it does not self-intersect.

```
LINESTRING(0 0,1 1,1 2)
```

4.1.1.3 LinearRing

A LinearRing is a LineString which is both closed and simple. The first and last points must be equal, and the line must not self-intersect.

```
CIRCULARSTRING(0 0, 4 0, 4 4, 0 4, 0 0)
```

4.1.1.4 Polygon

A Polygon is a 2-dimensional planar region, delimited by an exterior boundary (the shell) and zero or more interior boundaries (holes). Each boundary is a LinearRing.

```
POLYGON((0 0 0,4 0 0,4 4 0,0 4 0,0 0 0),(1 1 0,2 1 0,2 2 0,1 2 0,1 1 0))
```

4.1.1.5 MultiPoint

A MultiPoint is a collection of Points.

```
MULTIPOINT((0 0),(1 2))
```

4.1.1.6 MultiLineString

A MultiLineString is a collection of LineStrings. A MultiLineString is closed if each of its elements is closed.

```
MULTILINESTRING((0 0,1 1,1 2),(2 3,3 2,5 4))
```

4.1.1.7 MultiPolygon

A MultiPolygon is a collection of non-overlapping, non-adjacent Polygons. Polygons in the collection may touch only at a finite number of points.

```
MULTIPOLYGON(((0 0,4 0,4 4,0 4,0 0),(1 1,2 1,2 2,1 2,1 1)), ((-1 -1,-1 -2,-2 -2,-2 -1,-1 ↩
    -1)))
```

4.1.1.8 GeometryCollection

A GeometryCollection is a heterogeneous (mixed) collection of geometries.

```
GEOMETRYCOLLECTION(POINT(2 3),LINESTRING(2 3,3 4))
```

4.1.1.9 PolyhedralSurface

A PolyhedralSurface is a contiguous collection of patches or facets which share some edges. Each patch is a planar Polygon. If the Polygon coordinates have Z ordinates then the surface is 3-dimensional.

```
POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)), ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 ↩
     0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)), ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)), ((0 ↩
    1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )
```

4.1.1.10 Triangle

A Triangle is a polygon defined by three distinct non-collinear vertices. Because a Triangle is a polygon it is specified by four coordinates, with the first and fourth being equal.

```
TRIANGLE ((0 0, 0 9, 9 0, 0 0))
```

4.1.1.11 TIN

A TIN is a collection of non-overlapping Triangles representing a Triangulated Irregular Network.

```
TIN( ((0 0 0, 0 0 1, 0 1 0, 0 0 0)), ((0 0 0, 0 1 0, 1 1 0, 0 0 0)) )
```

4.1.2 SQL-MM Part 3

The *ISO/IEC 13249-3 SQL Multimedia - Spatial* standard (SQL/MM) extends the OGC SFA to define Geometry subtypes containing curves with circular arcs. The SQL/MM types support 3DM, 3DZ and 4D coordinates.

Note

SQL-MM 실행 과정에서 지정된 허용 오차를 기준으로 부동소수점을 비교합니다. 현재 허용 오차는 1E-8입니다.

4.1.2.1 CircularString

CIRCULARSTRING은 기본 곡선 유형으로, 선형&
LINESTRING과 비슷합니다. 단일 분절에&#xb29
시작점과 종단점(첫 번째 및 세 번&#
그리고 곡선 위의 다른 한 점 이렇&#
포인트 세 개가 필요합니다. 예외&#
닫힌 원으로, 이 경우 시작점과 종&#
동일합니다. 이 경우 두 번째 포인&#
원호의 중심, 즉 원의 반대편이 되&
합니다. 원호를 함께 묶으려면, LINESTRI
마찬가지로 한 원호의 마지막 포&#
다음 원호의 첫 번째 포인트가 되&#
합니다. 즉 유효한 원형 스트링은
1을 초과하는 홀수 개수의 포인트&#
가져야만 한다는 뜻입니다.

```
CIRCULARSTRING(0 0, 4 0, 4 4, 0 4, 0 0)
```

4.1.2.2 CompoundCurve

복심곡선(compound curve)이란 곡선(원호) 분&#x
선형 분절이 함께 있는 연속적인
단일 곡선을 말합니다. 즉 구성 요&
잘 형성되어야 함은 물론, (마지막&
제외한) 모든 구성 요소의 종단점&#
다음 구성 요소의 시작점과 일치&#x
한다는 뜻입니다.

```
COMPOUNDCURVE(CIRCULARSTRING(0 0, 1 1, 1 0),(1 0, 0 1))
```

4.1.2.3 CurvePolygon

CURVEPOLYGON은 일반 폴리곤입니다. 외곽&#x
함께 0개 이상의 내곽선을 가지고
있을 뿐입니다. 차이라면 내외곽&#x
원형 스트링, 선형 스트링, 또는 복&
스트링 형태를 할 수 있다는 점입&#

PostGIS는 1.4버전부터 만곡 폴리곤에 대&#
복심곡선을 지원합니다.

```
CURVEPOLYGON(CIRCULARSTRING(0 0, 4 0, 4 4, 0 4, 0 0),(1 1, 3 3, 3 1, 1 1))
```

Example: A CurvePolygon with the shell defined by a CompoundCurve containing a CircularString and a LineString, and a hole defined by a CircularString

```
&#xb9cc;&#xace1; &#xd3f4;&#xb9ac;&#xace4; &#xb0b4;&#xbd80;&#xc758;  ↩
    &#xbcf5;&#xc2ec;&#xace1;&#xc120;&#xc758; &#xc608;: CURVEPOLYGON(COMPOUNDCURVE( ↩
    CIRCULARSTRING(0 0,2 0, 2 1, 2 3, 4 3),(4 3, 4 5, 1 4, 0 0)), CIRCULARSTRING(1.7 1, 1.4  ↩
    0.4, 1.6 0.4, 1.6 0.5, 1.7 1) )
```

4.1.2.4 MultiCurve

MULTICURVE는 원형 스트링, 선형 스트링, 복합 스트링을 포함할 수 있는 곡집합입니다.

```
MULTICURVE( (0 0, 5 5), CIRCULARSTRING(4 0, 4 4, 8 4) )
```

4.1.2.5 MultiSurface

MULTISURFACE는 면 집합으로, (선형) 폴리곤수도 만곡 폴리곤일 수도 있습니&#x

```
MULTISURFACE(CURVEPOLYGON(CIRCULARSTRING(0 0, 4 0, 4 4, 0 4, 0 0),(1 1, 3 3, 3 1, 1 1)) ↩
    ,((10 10, 14 12, 11 10, 10 10),(11 11, 11.5 11, 11 11.5, 11 11)))
```

4.1.3 OpenGIS WKB 및 WKT

OpenGIS사양서에는 공간 오브젝트들&#xc나타내는 두 가지 표준 방법이 정&#xc있습니다: Well-Known Text (WKT) 형태와 Well-Known Binary (WKB) 형태. WKT와 WKB 모두 오브젝트 타입과 오브젝트를 구성하는 좌표들에 대한 정보를 포함하고 있습니다.

공간 참조 시스템의 WKT(Well-Known Text) 표현식다음은 WKT SRS 표현식의 예입니다:

- POINT(0 0)
- POINT(0 0)
- POINT(0 0)
- POINT EMPTY
- LINESTRING(0 0,1 1,1 2)
- LINESTRING
- POLYGON((0 0,4 0,4 4,0 4,0 0),(1 1, 2 1, 2 2, 1 2,1 1))
- MULTIPOINT((0 0),(1 2))
- MULTIPOINT((0 0),(1 2))
- MULTIPOINT
- MULTILINESTRING((0 0,1 1,1 2),(2 3,3 2,5 4))
- MULTIPOLYGON(((0 0,4 0,4 4,0 4,0 0),(1 1,2 1,2 2,1 2,1 1)), ((-1 -1,-1 -2,-2 -2,-2 -1,-1 -1)))
- GEOMETRYCOLLECTION(POINT(2 3),LINESTRING(2 3,3 4))
- GEOMETRYCOLLECTION

Input and output of WKT is provided by the functions ST_AsText and ST_GeomFromText:

```
bytea WKB = ST_AsBinary(geometry);
text WKT = ST_AsText(geometry);
geometry = ST_GeomFromWKB(bytea WKB, SRID);
geometry = ST_GeometryFromText(text WKT, SRID);
```

예를 들어 OGC 공간 객체를 생성하&#xace0
삽입하기 위한 유효한 삽입 구문&#
다음과 같을 것입니다:

```
INSERT INTO geotable ( the_geom, the_name )
VALUES ( ST_GeomFromText('POINT(-126.4 45.32)', 312), 'A Place');
```

Well-Known Binary (WKB) provides a portable, full-precision representation of spatial data as binary data (arrays of bytes). Examples of the WKB representations of spatial objects are:

- POINT(0 0)

  WKB: 01010000000000000000F03F000000000000F03

- LINESTRING(0 0,1 1,1 2)

  WKB: 010200000002000000000000000000000000000000000000000000000000000000F03F000000000000F03F000000000000F03F0000000000000040

Input and output of WKB is provided by the functions ST_AsBinary and ST_GeomFromWKB:

```
bytea WKB = ST_AsBinary(geometry);
text WKT = ST_AsText(geometry);
geometry = ST_GeomFromWKB(bytea WKB, SRID);
geometry = ST_GeometryFromText(text WKT, SRID);
```

예를 들어 OGC 공간 객체를 생성하&#xace0
삽입하기 위한 유효한 삽입 구문&#
다음과 같을 것입니다:

```
INSERT INTO geotable ( the_geom, the_name )
VALUES ( ST_GeomFromText('POINT(-126.4 45.32)', 312), 'A Place');
```

4.2 Geometry Data Type

PostGIS implements the OGC Simple Features model by defining a PostgreSQL data type called `geometry`. It represents all of the geometry subtypes by using an internal type code (see 도형 유형 and ST_GeometryType). This allows modelling spatial features as rows of tables defined with a column of type `geometry`.

The `geometry` data type is *opaque*, which means that all access is done via invoking functions on geometry values. Functions allow creating geometry objects, accessing or updating all internal fields, and compute new geometry values. PostGIS supports all the functions specified in the OGC *Simple feature access - Part 2: SQL option* (SFS) specification, as well many others. See Chapter 7 for the full list of functions.

Note

PostGIS follows the SFA standard by prefixing spatial functions with "ST_". This was intended to stand for "Spatial and Temporal", but the temporal part of the standard was never developed. Instead it can be interpreted as "Spatial Type".

OpenGIS 사양서는 공간 객체의 내부 저&#x
형식이 공간 참조 시스템 식별자(SR
포함하도록 요구합니다. 데이터&#
삽입될 공간 객체 생성시 SRID가 필&#xc69

To make querying geometry efficient PostGIS defines various kinds of spatial indexes, and spatial operators to use them. See Section 4.9 and Section 5.2 for details.

4.2.1 OpenGIS WKB 및 WKT

OGC SFA specifications initially supported only 2D geometries, and the geometry SRID is not included in the input/output representations. The OGC SFA specification 1.2.1 (which aligns with the ISO 19125 standard) adds support for 3D (ZYZ) and measured (XYM and XYZM) coordinates, but still does not include the SRID value.

Because of these limitations PostGIS defined extended EWKB and EWKT formats. They provide 3D (XYZ and XYM) and 4D (XYZM) coordinate support and include SRID information. Including all geometry information allows PostGIS to use EWKB as the format of record (e.g. in DUMP files).

EWKB and EWKT are used for the "canonical forms" of PostGIS data objects. For input, the canonical form for binary data is EWKB, and for text data either EWKB or EWKT is accepted. This allows geometry values to be created by casting a text value in either HEXEWKB or EWKT to a geometry value using `::geometry`. For output, the canonical form for binary is EWKB, and for text it is HEXEWKB (hex-encoded EWKB).

For example this statement creates a geometry by casting from an EWKT text value, and outputs it using the canonical form of HEXEWKB:

```
=# SELECT 'SRID=4;POINT(0 0)'::geometry;

geometry
----------------------------------------------------
0101000020040000000000000000000000000000000000000000
(1 row)
```

PostGIS EWKT output has a few differences to OGC WKT:

- For 3DZ geometries the Z qualifier is omitted:
  POINT(0 0)
  POINT(0 0)
- For 3DM geometries the M qualifier is included:
  POINT(0 0)
  POINT(0 0)
- For 4D geometries the ZM qualifier is omitted:
  POINT(0 0)
  POINT(0 0)

EWKT avoids over-specifying dimensionality and the inconsistencies that can occur with the OGC/ISO format, such as:

- POINT(0 0)
- POINT(0 0)
- POINT(0 0)

Caution

PostGIS는 현재 OGC 형식의 상위 집합인 형식을 확장합니다(유효 모든 WKB/WKT는 유효한 EWKB/EWKT가 됩니다). 하지만 향후 달라질 수도 있습니다. 특히 OGC가 PostGIS 확장 프로그램과 상충하는 새 형식을 들고 나온다면 말입니다. 그러므로 이 피처에 의존해서는 안 됩니다!

피쳐들의 공간 오브젝트들의 텍&#x
문자열표현들(WKT) 의 예들로는 다&#xc7
같은 것들이 있습니다:

- POINT(0 0 0) -- XYZ
- SRID=32632;POINT(0 0) -- SRID 추가 XY
- POINTM(0 0 0) -- XYM
- POINT(0 0 0 0) -- XYZM
- SRID=4326;MULTIPOINTM(0 0 0,1 2 1) -- SRID 추가 XYM
- MULTILINESTRING((0 0 0,1 1 0,1 2 1),(2 3 1,3 2 1,5 4 1))
- POLYGON((0 0 0,4 0 0,4 4 0,0 4 0,0 0 0),(1 1 0,2 1 0,2 2 0,1 2 0,1 1 0))
- MULTIPOLYGON(((0 0 0,4 0 0,4 4 0,0 4 0,0 0 0),(1 1 0,2 1 0,2 2 0,1 2 0,1 1 0)),((-1 -1 0,-1 -2 0,-2 -2 0,-2 -1 0,-1 -1 0)))
- GEOMETRYCOLLECTIONM(POINTM(2 3 9), LINESTRINGM(2 3 4, 3 4 5))
- MULTICURVE((0 0, 5 5), CIRCULARSTRING(4 0, 4 4, 8 4))
- POLYHEDRALSURFACE(((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)), ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)), ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)), ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)))
- TRIANGLE ((0 0, 0 9, 9 0, 0 0))
- TIN(((0 0 0, 0 0 1, 0 1 0, 0 0 0)), ((0 0 0, 0 1 0, 1 1 0, 0 0 0)))

다음과 같은 인터페이스를 이용&#x
이 형식을 입력/출력할 수 있습니&

```
bytea EWKB = ST_AsEWKB(geometry);
text EWKT = ST_AsEWKT(geometry);
geometry = ST_GeomFromEWKB(bytea EWKB);
geometry = ST_GeomFromEWKT(text EWKT);
```

예를 들어 PostGIS 공간 객체를 생성하&#xa
삽입하기 위한 유효한 삽입 구문&#
다음과 같을 것입니다:

```
INSERT INTO geotable ( the_geom, the_name )
  VALUES ( ST_GeomFromEWKT('SRID=312;POINTM(-126.4 45.32 15)'), 'A Place' )
```

4.3 PostGIS 지리형 유형

지리형 유형은 (종종 "측지" 좌표,
또는 "위도/경도"나 "경도/위도"라&#xace0
불리는) "지리" 좌표로 표현되는 공&
피처를 자체적으로 지원합니다.
지리 좌표는 각도 단위(도)를 사용&#
구면(球面) 좌표입니다.

PostGIS 도형 유형은 평면을 기반으로
합니다. 평면상에서 두 포인트 사&#
가장 짧은 경로는 직선입니다. 즉
데카르트 수학과 직선 벡터를 이&#

도형에 대해 계산(면적, 거리, 길이, 교차점 등)한다는 뜻입니다.

PostGIS 지리형 유형은 구면을 기반으&#xb 합니다. 구면상에서 두 포인트 사&# 가장 짧은 경로는 대권(大圈; great circle arc)입니다. 즉 지리형에 대한 계산(&#xba7 거리, 길이, 교차점 등)은 더 복잡한 수학을 이용해서 구면상에서 이&#x 한다는 뜻입니다. 더 정확하게 측& 지구의 실제 회전타원체(spheroidal shape)를 고려해서 계산해야 하는데, 수학&# 아주 복잡해질 수밖에 없습니다.

기저 수학이 훨씬 더 복잡하기 때&# 지리형 유형을 위해 정의된 함수&# 도형 유형의 함수보다 더 적습니&# 시간이 지날수록 새 알고리즘이 추가되어 지리형 유형의 역량은 확장될 것입니다.

Like the geometry data type, geography data is associated with a spatial reference system via a spatial reference system identifier (SRID). Any geodetic (long/lat based) spatial reference system defined in the `spatial_ref_sys` table can be used. (Prior to PostGIS 2.2, the geography type supported only WGS 84 geodetic (SRID:4326)). You can add your own custom geodetic spatial reference system as described in Section 4.5.2.

For all spatial reference systems the units returned by measurement functions (e.g. ST_Distance, ST_Length, ST_Perimeter, ST_Area) and for the distance argument of ST_DWithin are in meters.

4.3.1 공간 테이블 생성

You can create a table to store geography data using the CREATE TABLE SQL statement with a column of type `geography`. The following example creates a table with a geography column storing 2D LineStrings in the WGS84 geodetic coordinate system (SRID 4326):

```
CREATE TABLE global_points (
    id SERIAL PRIMARY KEY,
    name VARCHAR(64),
    location GEOGRAPHY(POINT,4326)
  );
```

The geography type supports two optional type modifiers:

- 유형 변경자가 허용하는 값은 다& 같습니다. POINT, LINESTRING, POLYGON, MULTIPOINT, MULTILINESTRING, MULTIPOLYGON. 또 이 변경자는 Z, M 및 ZM이라는 접미사를 통해 차원수 제약도 지& 따라서, 예를 들자면 'LINESTRINGM'의 변경& 3차원 이하의 라인 스트링만을 허 것이며, 세 번째 차원을 기준으로 취급할 것입니다. 마찬가지로 'POINTZM 네 가지 차원의 데이터를 입력해& 할 것입니다.
- the SRID modifier restricts the spatial reference system SRID to a particular number. If omitted, the SRID defaults to 4326 (WGS84 geodetic), and all calculations are performed using WGS84.

Examples of creating tables with geography columns:

- POINT: 2D 포인트 도형을 담은 테이블 생성:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- POINT: 2D 포인트 도형을 담은 테이블 생성:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- Create a table with 3D (XYZ) POINTs and an explicit SRID of 4326:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINTZ,4326) );
```

- Create a table with 2D LINESTRING geography with the default SRID 4326:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- POINT: 2D 포인트 도형을 담은 테이블 생성:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

Geography fields are registered in the `geography_columns` system view. You can query the `geography_columns` view and see that the table is listed:

```
-- &#xba54;&#xd0c0;&#xb370;&#xc774;&#xd130; &#xbdf0;&#xc758; &#xb0b4;&#xc6a9;&#xc744;  ↩
    &#xc0b4;&#xd3b4;&#xbd05;&#xc2dc;&#xb2e4;
SELECT * FROM geography_columns;
```

도형과 동일한 방법으로 인덱스&#x
생성합니다. PostGIS가 열 유형이 지리&#x
것을 감지하고 일반적인 도형 용
평면 인덱스 대신 적절한 구면 기&#
인덱스를 생성할 것입니다.

```
-- &#xd14c;&#xc2a4;&#xd2b8; &#xd14c;&#xc774;&#xbe14;&#xc5d0; &#xad6c;&#xba74;  ↩
    &#xc778;&#xb371;&#xc2a4; &#xc0dd;&#xc131;
  CREATE INDEX global_points_gix ON global_points USING GIST ( location );
```

4.3.2 PostGIS 지리형 유형

You can insert data into geography tables in the same way as geometry. Geometry data will autocast to the geography type if it has SRID 4326. The EWKT and EWKB formats can also be used to specify geography values.

```
-- &#xd14c;&#xc2a4;&#xd2b8;&#xc6a9; &#xd14c;&#xc774;&#xbe14;&#xc5d0;  ↩
    &#xb370;&#xc774;&#xd130;&#xb97c; &#xcd94;&#xac00;&#xd574;&#xbd05;&#xc2dc;&#xb2e4;
INSERT INTO global_points (name, location) VALUES ('Town', ST_GeographyFromText('SRID=4326; ↩
    POINT(-110 30)') );
INSERT INTO global_points (name, location) VALUES ('Forest', ST_GeographyFromText('SRID ↩
    =4326;POINT(-109 29)') );
INSERT INTO global_points (name, location) VALUES ('London', ST_GeographyFromText('SRID ↩
    =4326;POINT(0 49)') );
```

Any geodetic (long/lat) spatial reference system listed in `spatial_ref_sys` table may be specified as a geography SRID. Non-geodetic coordinate systems raise an error if used.

```
=# SELECT 'SRID=4;POINT(0 0)'::geometry;

geometry
----------------------------------------------------
0101000020040000000000000000000000000000000000000
(1 row)
```

```
=# SELECT 'SRID=4;POINT(0 0)'::geometry;

geometry
----------------------------------------------------
0101000020040000000000000000000000000000000000000
(1 row)
```

```
-- NAD83 UTM zone meters - gives an error since it is a meter-based planar projection
SELECT 'SRID=26910;POINT(-123 34)'::geography;

ERROR:  Only lon/lat coordinate systems are supported in geography.
```

쿼리 및 측정 함수는 미터 단위를 사용합니다. 따라서 거리 파라미&#x 미터로 표현되어야 하고, 반환값&# 미터(또는 면적의 경우 평방미터) 단위가 될 것입니다.

```
-- &#xb2e4;&#xc74c;&#xc740; &#xac70;&#xb9ac; &#xcffc;&#xb9ac;&#xc785;&#xb2c8;&#xb2e4;.  ↩
    &#xc8fc;&#xc758;: &#xb7f0;&#xb358;&#xc774; &#xd5c8;&#xc6a9; &#xbc94;&#xc704; 1000km  ↩
    &#xbc16;&#xc5d0; &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;
  SELECT name FROM global_points WHERE ST_DWithin(location, ST_GeographyFromText('SRID ↩
     =4326;POINT(-110 29)'), 1000000);
```

시애틀에서 런던으로 가는 비행&#x 122.33 47.606, 0.0 51.5)) 레이캬비크에(POINT(-21.96 64.15)) 얼마&#xb0 접근하는지 계산해보면, 실제 계&#x 지리형이 얼마나 강력한지 알 수 있습니다.

지리형 유형이 시애틀과 런던을 잇는 대권항로와 레이캬비크 사&#x 구면 상 가장 짧은 거리를 실제로 계산할 수 있습니다.

```
-- &#xc9c0;&#xb9ac;&#xd615;&#xc744; &#xc774;&#xc6a9;&#xd55c; &#xac70;&#xb9ac;  ↩
    &#xacc4;&#xc0b0;(122.2km)
  SELECT ST_Distance('LINESTRING(-122.33 47.606, 0.0 51.5)'::geography, 'POINT(-21.96  ↩
     64.15)':: geography);
```

대권 매퍼(Great Circle mapper) 도형 유형은 평면 세계지도 상에서 시애틀과 런던&#xc 직선으로 잇는 경로와 레이캬비&#x 사이의 아무 의미도 없는 데카르&# 거리를 계산합니다. 결과값의 명&#x 단위를 "도(degree)"라고 할 수도 있겠지&# 결과값은 세 포인트 사이의 어떤 실제 각도 차이도 반영하지 않기 때문에 "도"라고 하는 것조차 부정& 일이 됩니다.

```
-- &#xb3c4;&#xd615;&#xc744; &#xc774;&#xc6a9;&#xd55c; &#xac70;&#xb9ac;  ↩
    &#xacc4;&#xc0b0;(13.3"&#xb3c4;")
  SELECT ST_Distance('LINESTRING(-122.33 47.606, 0.0 51.5)'::geometry, 'POINT(-21.96 64.15) ↩
      ':: geometry);
```

4.3.3 도형 데이터 유형과 지리&#xc 데이터 유형을 중첩해서 이용하는 경우

새로운 지리형 유형은 데이터를 경도/위도 좌표로 저장할 수 있도&# 해주지만, 단점도 있습니다. 도형&# 대상으로 정의된 함수보다 지리&#x 대상 함수가 더 적고, 그 정의된 함& 실행하는 데 CPU 시간을 더 많이 잡&#xc5

사용자가 선택한 유형은 사용자&#x 빌드하는 응용 프로그램 영역에&#x 기대한대로 동작하도록 적합한 조건을 갖춰야 합니다. 사용자 데&# 전세계 또는 광대한 대륙 지역을 포괄할 예정입니까 아니면 시, 도, 군 또는 그 이하의 지자체에 국한&# 예정입니까?

- 사용자 데이터가 좁은 지역에 국& 사용 가능한 실행성 및 기능성 관& 적합한 투영을 선택하고 도형을 이용하는 것이 최선의 해결책이 될 수도 있습니다.
- 사용자 데이터가 전세계 또는 대& 걸쳐 있을 경우, 지리형을 이용하& 일일이 어떤 투영법을 이용할지 고민하지 않고 시스템을 빌드할 수도 있습니다. 사용자 데이터를 경도/위도로 저장하고, 지리형을 대상으로 정의된 함수를 이용하&
- 투영에 대한 이해가 부족하고, 따 공부하고 싶지도 않으며, 지리형 사용시 기능성이 제한된다는 사&# 받아들일 준비가 되어 있다면, 도 지리형을 사용하는 편이 더 쉬울 수 있습니다. 그냥 사용자 데이터& 경도/위도로 로드한 다음 작업을 시작하십시오.

지리형과 도형을 각각 지원하는 함수를 비교해보려면 Section 12.11 를 참조 지리형 함수의 목록 및 설명을 간&# 살펴보려면 Section 12.4 를 참조하십시오.

4.3.4 지리형 고급 FAQ

1. *계산 작업시 구체 상에서 계산&#xd55*
   됩니까 회전타원체 상에서 하&#xac8
   됩니까?

   기본적으로, 모든 거리 및 면적
   계산은 회전타원체 상에서 이&#xb8e
   좁은 지역을 대상으로 한 계산&#xc75
   결과와 해당 지역에 적절한 투&#xc60
   적용한 평면 상 계산 결과는 일&#xce5
   것입니다. 더 넓은 지역이라면
   투영법을 적용한 평면 상 계산&#xbcf
   회전타원체 상 계산이 언제나
   더 정확할 것입니다. 최종 불 파&#xb
   'FALSE'를 설정하면 모든 지리형 함&#xc21
   구체 상 계산을 할 수 있습니다.
   이렇게 하면 계산 속도가 조금
   빨라질 것입니다. 특히 도형들&#xc7
   매우 단순한 경우에 말입니다.

2. *날짜변경선과 남극/북극은 어&#xb5b*

   모든 계산은 날짜변경선이나
   양극을 고려하지 않고 이루어&#xc9d
   좌표가 회전타원체(경도/위도)&#xc7
   때문에 날짜변경선을 지나는
   형상이라도, 계산이라는 관점&#xc5c
   보면, 다른 어떤 형상과도 다를
   바가 없습니다.

3. *공간 처리할 수 있는 가장 긴 원&#xd0*
   무엇인가요?

   두 포인트 사이의 "보간 라인"으&#xb
   대권호(great circle arc)를 이용합니다. 즉 대
   따라 어느 방향으로 이동하느&#xb0
   따라 두 포인트가 실제로는 두
   가지 방식으로 만난다는 뜻입&#xb2c
   모든 코드는 포인트들이 대권&#xc74
   따라 가는 두 경로 가운데 '짧은'
   경로로 만난다고 가정합니다.
   결과적으로, 180도 이상의 원호를
   가진다면 정확히 모델링된 형&#xc0
   아니게 됩니다.

4. *유럽이나 러시아의 면적을 계&#xc0b*
   또는 광대한 지역을 삽입하는
   작업이 이렇게 느린 이유가 뭐&#xc9

   폴리곤이 너무나 크기 때문이&#xc9c
   광대한 지역은 두 가지 이유로
   좋지 않습니다. 먼저 경계가 워&#xb0
   길기 때문에 어떤 쿼리를 실행&#xd55
   인덱스가 피처 전체를 읽어오&#xb29
   경향이 있습니다. 그리고 꼭짓&#xc81
   개수도 너무 많아서 거리, 밀폐
   여부 등의 테스트를 할 때 적어&#xb3
   한 번, 때로는 n번 이상(이때 n은 다&
   후보 피처의 꼭짓점 개수) 꼭짓&#xc81
   목록 전체를 훑어야 하기 때문&#xc7

도형의 경우, 대용량 폴리곤을
대상으로 좁은 지역에 대한 쿼&#xb9a
할 때 사용자 도형 데이터를 더
작은 덩어리들로 "비정규화"해&#xc
인덱스가 효율적으로 객체의
일부분을 하위 쿼리(subquery)할 수 있&#xb3
만들어 쿼리 시 매번 전체 객체&#xb97
읽어올 필요가 없도록 하는 편&#xc7
좋습니다. 유럽 전체를 폴리곤
한 개로 저장할 수 있다고 해서
꼭 그렇게 해야 한다는 뜻은 아&#xb2

4.4 Geometry Validation

PostGIS is compliant with the Open Geospatial Consortium's (OGC) Simple Features specification. That standard defines the concepts of geometry being *simple* and *valid*. These definitions allow the Simple Features geometry model to represent spatial objects in a consistent and unambiguous way that supports efficient computation. (Note: the OGC SF and SQL/MM have the same definitions for simple and valid.)

4.4.1 Simple Geometry

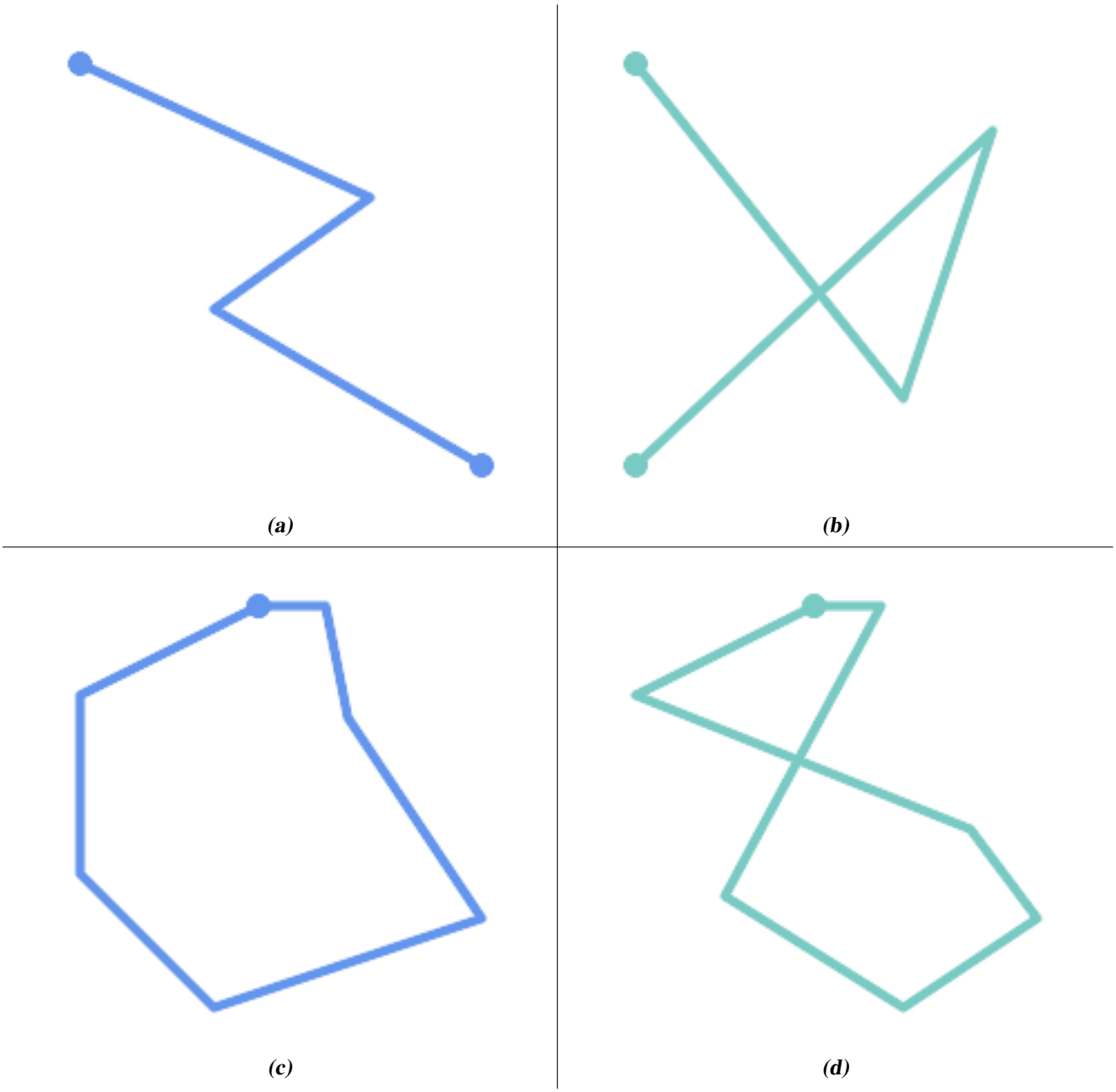
A *simple* geometry is one that has no anomalous geometric points, such as self intersection or self tangency.

`POINT` 란 0차원 도형 객체로서 상속적&#x
단순형 입니다.

`MULTIPOINT` 는 어떤 두 좌표(`POINT`)도 동일하&#xc9c0
않은 (동일한 좌표를 공유하지 않&#
단순형 입니다.

A `LINESTRING` is *simple* if it does not pass through the same point twice, except for the endpoints. If the endpoints of a simple LineString are identical it is called *closed* and referred to as a Linear Ring.

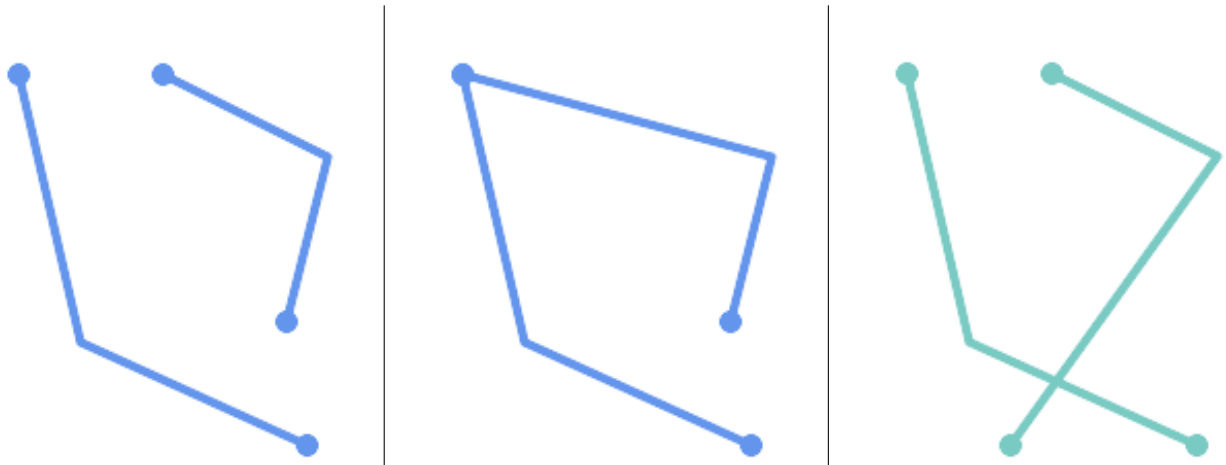
***(a)** and **(c)** are simple `LINESTRING`s. **(b)** and **(d)** are not simple. **(c)** is a closed Linear Ring.*



(a) ***(b)*** ***(c)*** ***(d)***

A `MULTILINESTRING` is *simple* only if all of its elements are simple and the only intersection between any two elements occurs at points that are on the boundaries of both elements.

(e) *and* ***(f)*** *are simple* `MULTILINESTRING`*s.* ***(g)*** *is not simple.*



(e) ***(f)*** ***(g)***

POLYGONs are formed from linear rings, so valid polygonal geometry is always *simple*.

To test if a geometry is simple use the ST_IsSimple function:

```
SELECT
   ST_IsSimple('LINESTRING(0 0, 100 100)') AS straight,
   ST_IsSimple('LINESTRING(0 0, 100 100, 100 0, 0 100)') AS crossing;

 straight | crossing
----------+----------
 t        | f
```

Generally, PostGIS functions do not require geometric arguments to be simple. Simplicity is primarily used as a basis for defining geometric validity. It is also a requirement for some kinds of spatial data models (for example, linear networks often disallow lines that cross). Multipoint and linear geometry can be made simple using ST_UnaryUnion.

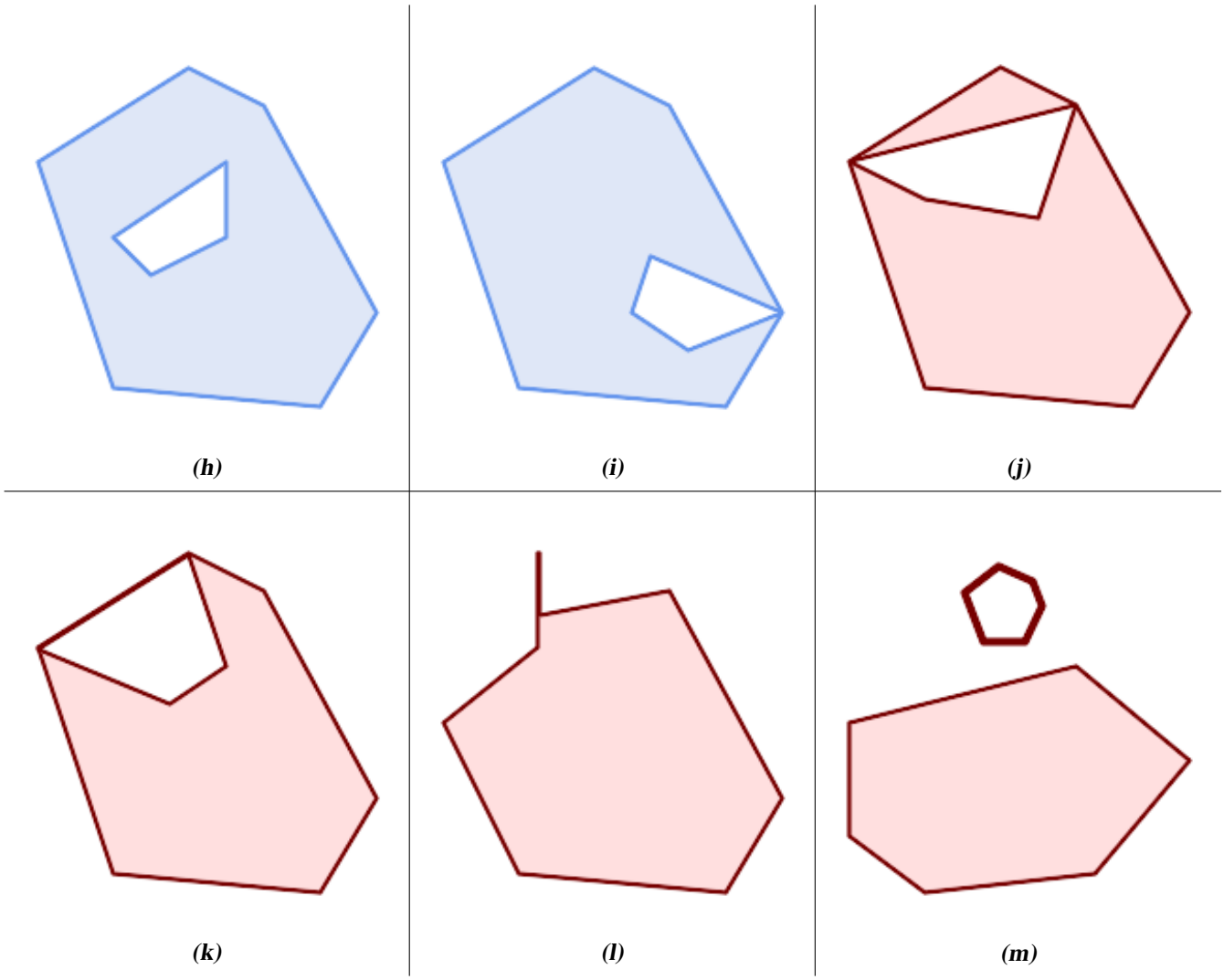
4.4.2 Valid Geometry

Geometry validity primarily applies to 2-dimensional geometries (POLYGONs and MULTIPOLYGONs) . Validity is defined by rules that allow polygonal geometry to model planar areas unambiguously.

A POLYGON is *valid* if:

1. the polygon boundary rings (the exterior shell ring and interior hole rings) are *simple* (do not cross or self-touch). Because of this a polygon cannnot have cut lines, spikes or loops. This implies that polygon holes must be represented as interior rings, rather than by the exterior ring self-touching (a so-called "inverted hole").
2. boundary rings do not cross
3. boundary rings may touch at points but only as a tangent (i.e. not in a line)
4. interior rings are contained in the exterior ring
5. the polygon interior is simply connected (i.e. the rings must not touch in a way that splits the polygon into more than one part)

(h) *and* ***(i)*** *are valid POLYGONs.* ***(j-m)*** *are invalid.* ***(j)*** *can be represented as a valid MULTIPOLYGON.*



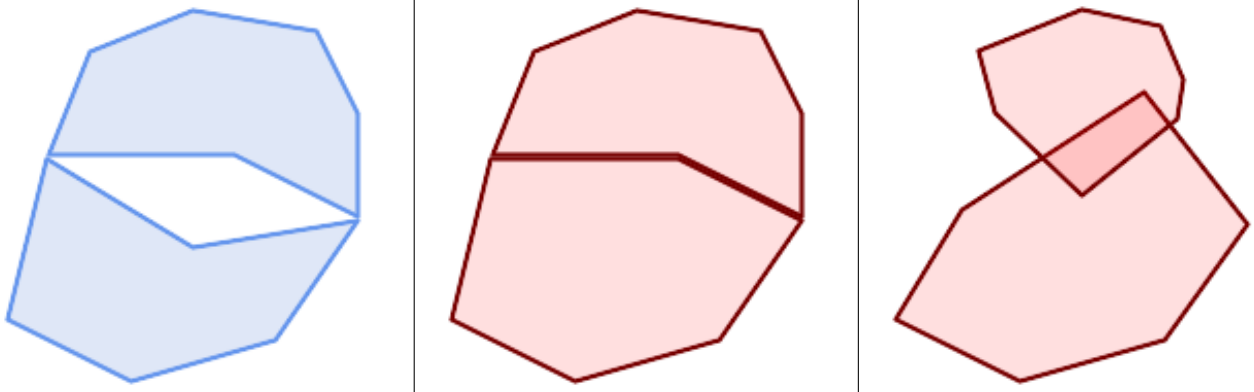
(h) ***(i)*** ***(j)***

(k) ***(l)*** ***(m)***

A `MULTIPOLYGON` is *valid* if:

1. its element `POLYGON`s are valid
2. elements do not overlap (i.e. their interiors must not intersect)
3. elements touch only at points (i.e. not along a line)

(n) *is a valid* `MULTIPOLYGON`. ***(o)*** *and* ***(p)*** *are invalid.*



(n) *(o)* *(p)*

These rules mean that valid polygonal geometry is also *simple*.

For linear geometry the only validity rule is that `LINESTRING`s must have at least two points and have non-zero length (or equivalently, have at least two distinct points.) Note that non-simple (self-intersecting) lines are valid.

```
SELECT
   ST_IsValid('LINESTRING(0 0, 1 1)') AS len_nonzero,
   ST_IsValid('LINESTRING(0 0, 0 0, 0 0)') AS len_zero,
   ST_IsValid('LINESTRING(10 10, 150 150, 180 50, 20 130)') AS self_int;

 len_nonzero | len_zero | self_int
-------------+----------+----------
 t           | f        | t
```

`POINT` and `MULTIPOINT` geometries have no validity rules.

4.4.3 Managing Validity

PostGIS allows creating and storing both valid and invalid Geometry. This allows invalid geometry to be detected and flagged or fixed. There are also situations where the OGC validity rules are stricter than desired (examples of this are zero-length linestrings and polygons with inverted holes.)

Many of the functions provided by PostGIS rely on the assumption that geometry arguments are valid. For example, it does not make sense to calculate the area of a polygon that has a hole defined outside of the polygon, or to construct a polygon from a non-simple boundary line. Assuming valid geometric inputs allows functions to operate more efficiently, since they do not need to check for topological correctness. (Notable exceptions are that zero-length lines and polygons with inversions are generally handled correctly.) Also, most PostGIS functions produce valid geometry output if the inputs are valid. This allows PostGIS functions to be chained together safely.

If you encounter unexpected error messages when calling PostGIS functions (such as "GEOS Intersection() threw an error!"), you should first confirm that the function arguments are valid. If they are not, then consider using one of the techniques below to ensure the data you are processing is valid.

Note
If a function reports an error with valid inputs, then you may have found an error in either PostGIS or one of the libraries it uses, and you should report this to the PostGIS project. The same is true if a PostGIS function returns an invalid geometry for valid input.

To test if a geometry is valid use the ST_IsValid function:

```
SELECT ST_IsValid('POLYGON ((20 180, 180 180, 180 20, 20 20, 20 180))');
-----------------
 t
```

Information about the nature and location of an geometry invalidity are provided by the ST_IsValidDetail function:

```
SELECT valid, reason, ST_AsText(location) AS location
    FROM ST_IsValidDetail('POLYGON ((20 20, 120 190, 50 190, 170 50, 20 20))') AS t;

 valid |      reason       |                  location
-------+-------------------+--------------------------------------------
 f     | Self-intersection | POINT(91.51162790697674 141.56976744186045)
```

In some situations it is desirable to correct invalid geometry automatically. Use the ST_MakeValid function to do this. (`ST_MakeValid` is a case of a spatial function that *does* allow invalid input!)

By default, PostGIS does not check for validity when loading geometry, because validity testing can take a lot of CPU time for complex geometries. If you do not trust your data sources, you can enforce a validity check on your tables by adding a check constraint:

```
ALTER TABLE mytable
  ADD CONSTRAINT geometry_valid_check
        CHECK (ST_IsValid(the_geom));
```

4.5 SPATIAL_REF_SYS 테이블과 공간 &#xcc3 시스템

A Spatial Reference System (SRS) (also called a Coordinate Reference System (CRS)) defines how geometry is referenced to locations on the Earth's surface. There are three types of SRS:

- A **geodetic** SRS uses angular coordinates (longitude and latitude) which map directly to the surface of the earth.
- A **projected** SRS uses a mathematical projection transformation to "flatten" the surface of the spheroidal earth onto a plane. It assigns location coordinates in a way that allows direct measurement of quantities such as distance, area, and angle. The coordinate system is Cartesian, which means it has a defined origin point and two perpendicular axes (usually oriented North and East). Each projected SRS uses a stated length unit (usually metres or feet). A projected SRS may be limited in its area of applicability to avoid distortion and fit within the defined coordinate bounds.
- A **local** SRS is a Cartesian coordinate system which is not referenced to the earth's surface. In PostGIS this is specified by a SRID value of 0.

There are many different spatial reference systems in use. Common SRSes are standardized in the European Petroleum Survey Group EPSG database. For convenience PostGIS (and many other spatial systems) refers to SRS definitions using an integer identifier called a SRID.

A geometry is associated with a Spatial Reference System by its SRID value, which is accessed by ST_SRID. The SRID for a geometry can be assigned using ST_SetSRID. Some geometry constructor functions allow supplying a SRID (such as ST_Point and ST_MakeEnvelope). The EWKT format supports SRIDs with the `SRID=n;` prefix.

Spatial functions processing pairs of geometries (such as overlay and relationship functions) require that the input geometries are in the same spatial reference system (have the same SRID). Geometry data can be transformed into a different spatial reference system using ST_Transform and ST_TransformPipeline. Geometry returned from functions has the same SRS as the input geometries.

4.5.1 SPATIAL_REF_SYS Table

The SPATIAL_REF_SYS table used by PostGIS is an OGC-compliant database table that defines the available spatial reference systems. It holds the numeric SRIDs and textual descriptions of the coordinate systems.

SPATIAL_REF_SYS 테이블 정의는 다음과 같습&

```
CREATE TABLE spatial_ref_sys (
  srid       INTEGER NOT NULL PRIMARY KEY,
  auth_name  VARCHAR(256),
  auth_srid  INTEGER,
  srtext     VARCHAR(2048),
  proj4text  VARCHAR(2048)
)
```

다음과 같은 명령행 옵션이 있습&#

srid 데이터베이스 내부에서 공간 &#xcc38
시스템(SRS)을 고유하게 식별하는
정수값입니다.

auth_name 해당 참조 시스템을 위해 인용
표준 또는 표준들 본체의 명칭&#xc7
예를 들어 "EPSG"는 유효한 AUTH_NAME 이라&#x
할 수 있습니다.

auth_srid The ID of the Spatial Reference System as defined by the Authority cited in the auth_name. In the case of EPSG, this is the EPSG code.

srtext 공간 참조 시스템의 WKT(Well-Known Text) 표현&
다음은 WKT SRS 표현식의 예입니다:

```
PROJCS["NAD83 / UTM Zone 10N",
  GEOGCS["NAD83",
        DATUM["North_American_Datum_1983",
          SPHEROID["GRS 1980",6378137,298.257222101]
        ],
        PRIMEM["Greenwich",0],
        UNIT["degree",0.0174532925199433]
  ],
  PROJECTION["Transverse_Mercator"],
  PARAMETER["latitude_of_origin",0],
  PARAMETER["central_meridian",-123],
  PARAMETER["scale_factor",0.9996],
  PARAMETER["false_easting",500000],
  PARAMETER["false_northing",0],
  UNIT["metre",1]
]
```

For a discussion of SRS WKT, see the OGC standard Well-known text representation of coordinate reference systems.

proj4text PostGIS는 좌표 변환 기능을 제공하&#x
위해 proj4 라이브러리를 이용합니&#
PROJ4TEXT 열이 특정 SRID에 대응하는 proj4 좌&
정의 스트링을 담고 있습니다.
다음은 그 예입니다:

```
+proj=utm +zone=10 +ellps=clrk66 +datum=NAD27 +units=m
```

이에 대한 자세한 정보는 http://trac.osgeo.org/-
proj/ 주소의 proj4 웹사이트를 참조하&#xc2e
spatial_ref_sys.sql 파일이 모든 EPSG 투영에 대&
SRTEXT 및 PROJ4TEXT 정의를 담고 있습니다.

When retrieving spatial reference system definitions for use in transformations, PostGIS uses fhe following strategy:

- If `auth_name` and `auth_srid` are present (non-NULL) use the PROJ SRS based on those entries (if one exists).
- If `srtext` is present create a SRS using it, if possible.
- If `proj4text` is present create a SRS using it, if possible.

4.5.2 SPATIAL_REF_SYS 테이블과 공간 참조 시스템

PostGIS의 `SPATIAL_REF_SYS` 테이블이 proj 라이브러리처리할 수 있는, 좀 더 널리 사용되공간 참조 시스템 3000여 개를 담고 있긴 하지만 현재까지 알려진 모공간 참조 시스템을 다 담고 있지않으며, 사용자가 proj4의 구조를 잘알고 있다면 자기만의 사용자 지투영을 정의할 수도 있습니다. 공참조 시스템 대부분은 특정 지역특화되어 있으며, 특화된 지역 범바깥에서 사용할 경우 어떤 의미없다는 점을 명심하십시오.

핵심 `SPATIAL_REF_SYS` 테이블에 정의되지 않공간 참조 시스템은 http://spatialreference.org/ 에 훌정리되어 있습니다.

좀 더 널리 사용되는 공간 참조 시스템을 4326 - WGS 84 Long Lat, 4269 - NAD 83 Long Lat, 3395 - WGS 84 World Mercator, 2163 - US National Atlas Equal Area, 그리고 NAD 83 및 WGS 84 UTM 대(帶; zone)의 공간 참조 시스템이 있습니다. 각 UTM 대측정에 가장 이상적인 공간 참조 시스템이지만, 6도 범위의 지역특화되어 있습니다.

미국 여러 주의 평면 공간 참조 시또는 피트 기반)은 각 주마다 보통 한 개 또는 두 개가 존재합니다. 미기반 공간 참조 시스템 대부분은 `SPATIAL_REF_SYS` 테이블에 들어 있지만, 피트 기반 또는 ESRI가 생성한 공간 참조 시스템 중 상당수는 사용자가 spatialreference.org 에서 찾아와야 합니다.

You can even define non-Earth-based coordinate systems, such as Mars 2000 This Mars coordinate system is non-planar (it's in degrees spheroidal), but you can use it with the `geography` type to obtain length and proximity measurements in meters instead of degrees.

Here is an example of loading a custom coordinate system using an unassigned SRID and the PROJ definition for a US-centric Lambert Conformal projection:

```
INSERT INTO spatial_ref_sys (srid, proj4text)
VALUES ( 990000,
  '+proj=lcc  +lon_0=-95 +lat_0=25 +lat_1=25 +lat_2=25 +x_0=0 +y_0=0 +datum=WGS84 +units=m  ↩
     +no_defs'
);
```

4.6 공간 테이블 생성

4.6.1 공간 테이블 생성

You can create a table to store geometry data using the CREATE TABLE SQL statement with a column of type `geometry`. The following example creates a table with a geometry column storing 2D (XY) LineStrings in the BC-Albers coordinate system (SRID 3005):

```
CREATE TABLE global_points (
    id SERIAL PRIMARY KEY,
    name VARCHAR(64),
    location GEOGRAPHY(POINT,4326)
  );
```

The `geometry` type supports two optional **type modifiers**:

- 유형 변경자가 허용하는 값은 다&
  같습니다. POINT, LINESTRING, POLYGON, MULTIPOINT, MULTILINESTRING, MULTIPOLYGON. 또 이 변경자는 Z, M 및 ZM이라는
  접미사를 통해 차원수 제약도 지&
  따라서, 예를 들자면 'LINESTRINGM'의 변경&
  3차원 이하의 라인 스트링만을 허
  것이며, 세 번째 차원을 기준으로
  취급할 것입니다. 마찬가지로 'POINTZM
  네 가지 차원의 데이터를 입력해&
  할 것입니다.
- the **SRID modifier** restricts the spatial reference system SRID to a particular number. If omitted, the SRID defaults to 0.

Examples of creating tables with geometry columns:

- Create a table holding any kind of geometry with the default SRID:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- Create a table with 2D POINT geometry with the default SRID:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- Create a table with 3D (XYZ) POINTs and an explicit SRID of 3005:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- Create a table with 4D (XYZM) LINESTRING geometry with the default SRID:

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINT,4326) );
```

- Create a table with 2D POLYGON geometry with the SRID 4267 (NAD 1927 long lat):

```
CREATE TABLE testgeog(gid serial PRIMARY KEY, the_geog geography(POINTZ,4326) );
```

It is possible to have more than one geometry column in a table. This can be specified when the table is created, or a column can be added using the ALTER TABLE SQL statement. This example adds a column that can hold 3D LineStrings:

```
ALTER TABLE roads ADD COLUMN geom2 geometry(LINESTRINGZ,4326);
```

4.6.2 The GEOMETRY_COLUMNS VIEW

OpenGIS의 "SQL 용 단순 피처 사양서(Simple Features Specification for SQL)"는 표준 GIS 객체 유형, 그 유형&#x 다루기 위해 필요한 함수, 그리고 메타데이터 테이블의 집합을 정&# 메타데이터의 일관성을 유지하&#x 위해 공간 열 생성 및 삭제와 같은 작업은 OpenGIS가 정의한 특별한 과정&#x 거쳐 이루어집니다.

```
\d geometry_columns
```

```
View "public.geometry_columns"
      Column       |          Type          | Modifiers
-------------------+------------------------+-----------
 f_table_catalog   | character varying(256) |
 f_table_schema    | character varying(256) |
 f_table_name      | character varying(256) |
 f_geometry_column | character varying(256) |
 coord_dimension   | integer                |
 srid              | integer                |
 type              | character varying(30)  |
```

다음과 같은 명령행 옵션이 있습&#x

f_table_catalog, f_table_schema, f_table_name 도형 열을 담고 있는 피처 테이블의 조건을 완전히 만족하는 명칭입니다. "카탈로&#xac "스키마"가 오라클 용어라는 점&#xc 주목하십시오. "카탈로그"를 대&#xcc PostgreSQL 용어가 없기 때문에 해당 열&#xc 공백으로 남게 됩니다. "스키마"&#xc 경우 PostgreSQL 스키마 명칭이 사용됩&#xb `public` 입니다).

\d geometry_columns 피처 테이블이 담고 있는 &#xb3c4 열의 명칭입니다.

coord_dimension 열의 공간 차원(2, 3, 또는 4차원)&#xc78

srid 해당 테이블이 담고 있는 도형&#xc75 좌표가 사용하는 공간 좌표 시&#xc2a ID로, `SPATIAL_REF_SYS` 를 참조하는 외래 키(foreign key)입니다.

type 공간 객체의 유형입니다. 공간 열을 단일 유형으로 제약하려&#xba7 다음 유형 가운데 하나를 이용&#xd5 POINT, LINESTRING, POLYGON, MULTIPOINT, MULTILINESTRING, MULTIPOLYGON, GEOMETRYCOLLECTION 또는 이에 상응하는 XYM 버전의 POINTM, LINESTRINGM, POLYGONM, MULTIPOINTM, MULTILINESTRINGM, MULTIPOLYGONM, GEOMETRYCOLLECTIONM. 혼합 유형 집합을 이용하&#x 유형으로 "GEOMETRY"를 이용할 수 있습&

4.6.3 geometry_columns에 도형 열을 직접 등&#x

AddGeometryColumn() 함수를 쓸 수 없을 때 이런 일이 발생할 수 있는 두 가지 경우&#

있는데, SQL 뷰 그리고 대규모 삽입(bulk insert)의 경우입니다. 이런 경우, 해당 열에 제약 조건을 걸어서 geometry_columns 테&#x 등록을 바로잡을 수 있습니다. PostGIS 2.0 이상 버전에서는, 사용자 열이 typmod 기반이라면 생성 과정 중에 정&#xd 등록할 것이기 때문에 아무것도 할 필요가 없다는 점을 기억하십&#

```
-- &#xc774;&#xb807;&#xac8c; &#xc0dd;&#xc131;&#xb41c; &#xbdf0;&#xac00;  ↩
    &#xc788;&#xb2e4;&#xace0; &#xd569;&#xc2dc;&#xb2e4;.
CREATE VIEW  public.vwmytablemercator AS
        SELECT gid, ST_Transform(geom,3395) As geom, f_name
        FROM public.mytable;

-- PostGIS 2.0 &#xc774;&#xc0c1; &#xbc84;&#xc804;&#xc5d0; &#xc815;&#xd655;&#xd558;&#xac8c;  ↩
    &#xb4f1;&#xb85d;&#xd558;&#xb824;&#xba74;
-- &#xb3c4;&#xd615;&#xc744; &#xd615;&#xbcc0;&#xd658;&#xd574;&#xc57c;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.
--
DROP VIEW public.vwmytablemercator;
CREATE VIEW  public.vwmytablemercator AS
        SELECT gid, ST_Transform(geom,3395)::geometry(Geometry, 3395) As geom, f_name
        FROM public.mytable;

-- &#xb3c4;&#xd615; &#xc720;&#xd615;&#xc774; 2D &#xd3f4;&#xb9ac;&#xace4;&#xc774;&#xb780;  ↩
    &#xc0ac;&#xc2e4;&#xc744; &#xd655;&#xc2e4;&#xd788; &#xc54c;&#xace0; &#xc788;&#xc744;  ↩
    &#xacbd;&#xc6b0; &#xb2e4;&#xc74c;&#xacfc; &#xac19;&#xc774; &#xd560; &#xc218;  ↩
    &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
DROP VIEW public.vwmytablemercator;
CREATE VIEW  public.vwmytablemercator AS
        SELECT gid, ST_Transform(geom,3395)::geometry(Polygon, 3395) As geom, f_name
        FROM public.mytable;
```

```
-- &#xb300;&#xaddc;&#xbaa8; &#xc0bd;&#xc785; &#xc791;&#xc5c5;&#xc744; &#xd1b5;&#xd574;  ↩
    &#xd30c;&#xc0dd; &#xd14c;&#xc774;&#xbe14;&#xc744;  ↩
    &#xc0dd;&#xc131;&#xd588;&#xb2e4;&#xace0; &#xd569;&#xc2dc;&#xb2e4;.
SELECT poi.gid, poi.geom, citybounds.city_name
INTO myschema.my_special_pois
FROM poi INNER JOIN citybounds ON ST_Intersects(citybounds.geom, poi.geom);

-- &#xc0c8; &#xd14c;&#xc774;&#xbe14;&#xc5d0; 2D &#xc778;&#xb371;&#xc2a4;&#xb97c;  ↩
    &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
CREATE INDEX idx_myschema_myspecialpois_geom_gist
  ON myschema.my_special_pois USING gist(geom);

-- &#xc0ac;&#xc6a9;&#xc790; &#xd3ec;&#xc778;&#xd2b8;&#xac00; 3D &#xb610;&#xb294; 3M  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xc77c; &#xacbd;&#xc6b0;,
-- 2D &#xc778;&#xb371;&#xc2a4;&#xac00; &#xc544;&#xb2c8;&#xb77c; nD  ↩
    &#xc778;&#xb371;&#xc2a4;&#xb97c; &#xc0dd;&#xc131;&#xd558;&#xb294; &#xd3b8;&#xc774;  ↩
    &#xc88b;&#xc744; &#xc218;&#xb3c4; &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
-- &#xb2e4;&#xc74c;&#xcc98;&#xb7fc; &#xb9d0;&#xc774;&#xc8e0;.
CREATE INDEX my_special_pois_geom_gist_nd
        ON my_special_pois USING gist(geom gist_geometry_ops_nd);

-- &#xc774; &#xc0c8; &#xd14c;&#xc774;&#xbe14;&#xc758; &#xb3c4;&#xd615; &#xc5f4;&#xc744;  ↩
    geometry_columns &#xd14c;&#xc774;&#xbe14;&#xc5d0; &#xc9c1;&#xc811;  ↩
    &#xb4f1;&#xb85d;&#xd558;&#xb294;
-- &#xb2e4;&#xc74c; &#xbc29;&#xbc95;&#xc740; PostGIS 2.0 &#xc774;&#xd6c4; &#xbc84;&#xc804;  ↩
    &#xbc0f; 1.4 &#xc774;&#xd6c4; &#xbc84;&#xc804; &#xbaa8;&#xb450;&#xc5d0;&#xc11c;  ↩
    &#xb3d9;&#xc791;&#xd569;&#xb2c8;&#xb2e4;.
```

```
-- PostGIS 2.0 &#xbc84;&#xc804;&#xc758; &#xacbd;&#xc6b0; &#xc5f4;&#xc744; typmod  ↩
    &#xae30;&#xbc18;&#xc73c;&#xb85c; &#xb9cc;&#xb4e4;&#xae30; &#xc704;&#xd574;
-- &#xd14c;&#xc774;&#xbe14;&#xc758; &#xae30;&#xc800; &#xad6c;&#xc870;&#xb97c;  ↩
    &#xbcc0;&#xacbd;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
-- PostGIS 2.0 &#xc774;&#xc804; &#xbc84;&#xc804;&#xc758; &#xacbd;&#xc6b0;,  ↩
    &#xb3d9;&#xc77c;&#xd55c; &#xbc29;&#xbc95;&#xc73c;&#xb85c; &#xbdf0;&#xb97c;  ↩
    &#xb4f1;&#xb85d;&#xd560; &#xc218;&#xb3c4; &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT populate_geometry_columns('myschema.my_special_pois'::regclass);

-- PostGIS 2.0 &#xbc84;&#xc804;&#xc744; &#xc0ac;&#xc6a9;&#xc911;&#xc774;&#xace0;  ↩
    &#xc5b4;&#xb5a4; &#xc774;&#xc720;&#xc5d0;&#xc11c;&#xb4e0;
-- &#xad6c;&#xc2dd; &#xc81c;&#xc57d;&#xc870;&#xac74; &#xae30;&#xbc18; &#xc815;&#xc758;  ↩
    &#xb3d9;&#xc791;&#xc774; &#xd544;&#xc694;&#xd55c; &#xacbd;&#xc6b0;
-- (&#xbaa8;&#xb4e0; &#xc790;&#xc2dd; &#xac1d;&#xccb4;&#xac00; &#xb3d9;&#xc77c;&#xd55c;  ↩
    &#xc720;&#xd615;&#xacfc; SRID&#xac00; &#xc544;&#xb2cc; &#xc0c1;&#xc18d;  ↩
    &#xd14c;&#xc774;&#xbe14;&#xc758; &#xacbd;&#xc6b0; &#xb4f1;)
-- &#xc120;&#xd0dd;&#xc801;&#xc778; &#xc0c8; use_typmod argument  ↩
    &#xd30c;&#xb77c;&#xbbf8;&#xd130;&#xb97c; &#xac70;&#xc9d3;&#xc73c;&#xb85c;  ↩
    &#xc124;&#xc815;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
SELECT populate_geometry_columns('myschema.my_special_pois'::regclass, false);
```

구식 제약조건 기반 방법을 여전&#x
지원하긴 하지만, 뷰에서 직접적&#x
사용되는 제약조건 기반 도형 열&#x
typmod 기반 열과는 달리 geometry_columns 테이블&#xc5c
정확하게 등록되지 않을 겁니다.
다음은 typmod를 이용하는 열과 제약&#xc8
이용하는 또다른 열을 정의하는
예시입니다.

```
CREATE TABLE pois_ny(gid SERIAL PRIMARY KEY
   , poi_name text, cat varchar(20)
   , geom geometry(POINT,4326) );
SELECT AddGeometryColumn('pois_ny', 'geom_2160', 2160, 'POINT', 2, false);
```

PSQL에서 실행할 경우

```
\d pois_ny;
```

두 열이 서로 다르게 정의되었다&#x
사실을 알 수 있습니다. 하나는 typ-
mod, 다른 하나는 제약조건으로 정&#xc75

```
Table "public.pois_ny"
  Column   |         Type          |                       Modifiers

-----------+-----------------------+-------------------------------------------------------
 gid       | integer               | not null default nextval('pois_ny_gid_seq'::regclass)
 poi_name  | text                  |
 cat       | character varying(20) |
 geom      | geometry(Point,4326)  |
 geom_2160 | geometry              |
Indexes:
    "pois_ny_pkey" PRIMARY KEY, btree (gid)
Check constraints:
    "enforce_dims_geom_2160" CHECK (st_ndims(geom_2160) = 2)
    "enforce_geotype_geom_2160" CHECK (geometrytype(geom_2160) = 'POINT'::text
        OR geom_2160 IS NULL)
    "enforce_srid_geom_2160" CHECK (st_srid(geom_2160) = 2160)
```

둘 다 geometry_columns 테이블에 정확하게 등&#x

```
SELECT f_table_name, f_geometry_column, srid, type
        FROM geometry_columns
        WHERE f_table_name = 'pois_ny';
```

```
f_table_name | f_geometry_column | srid | type
-------------+-------------------+------+-------
pois_ny      | geom              | 4326 | POINT
pois_ny      | geom_2160         | 2160 | POINT
```

하지만 -- 다음과 같은 뷰를 생성하&#
한다면

```
CREATE VIEW vw_pois_ny_parks AS
SELECT *
  FROM pois_ny
  WHERE cat='park';

SELECT f_table_name, f_geometry_column, srid, type
        FROM geometry_columns
        WHERE f_table_name = 'vw_pois_ny_parks';
```

typmod 기반 도형 열은 정확하게 등록&#xb
제약조건 기반 도형 열은 정확하&#
등록되지 않습니다.

```
f_table_name   | f_geometry_column | srid |   type
-----------------+-------------------+------+----------
 vw_pois_ny_parks | geom              | 4326 | POINT
 vw_pois_ny_parks | geom_2160         |    0 | GEOMETRY
```

PostGIS 향후 버전에서는 변경될 수도
있지만, 현재 버전에서 제약조건
기반 뷰 열을 정확하게 등록하려&#
다음과 같이 해야 합니다:

```
DROP VIEW vw_pois_ny_parks;
CREATE VIEW vw_pois_ny_parks AS
SELECT gid, poi_name, cat
  , geom
  , geom_2160::geometry(POINT,2160) As geom_2160
  FROM pois_ny
  WHERE cat='park';
SELECT f_table_name, f_geometry_column, srid, type
        FROM geometry_columns
        WHERE f_table_name = 'vw_pois_ny_parks';
```

```
f_table_name   | f_geometry_column | srid | type
-----------------+-------------------+------+-------
 vw_pois_ny_parks | geom              | 4326 | POINT
 vw_pois_ny_parks | geom_2160         | 2160 | POINT
```

4.7 GIS (벡터) 데이터 로드

공간 테이블 생성을 끝냈다면, 사&#
데이터베이스에 GIS 데이터를 업&#xb85c
준비가 된 것입니다. 현재, 형식화&

SQL 구문을 사용하거나 shapefile 로더/덤&#xd37c
사용하는 두 가지 방법으로 PostGIS/Post-
greSQL 데이터베이스에 데이터를 입&#xb
수 있습니다.

4.7.1 SQL을 이용해 데이터 가져오

사용자 데이터를 텍스트 표현식&#
변환할 수 있다면, PostGIS에 사용자 데&#
입력하는 가장 쉬운 방법은 형식&#
SQL을 이용하는 것입니다. Oracle이나 다&
SQL 데이터베이스와 마찬가지로, SQL
터미널 모니터에 SQL "INSERT" 선언문으&#xb85
가득 찬 대용량 텍스트 파일을 송&#
방법으로 데이터를 일괄 로드시&#
수 있습니다.

데이터 업로드 파일(예를 들어 `roads.sql`)은 다음처럼 보일 것입니다:

```
BEGIN;
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (1,ST_GeomFromText('LINESTRING(191232 243118,191108 243242)',-1),'Jeff Rd');
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (2,ST_GeomFromText('LINESTRING(189141 244158,189265 244817)',-1),'Geordie Rd');
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (3,ST_GeomFromText('LINESTRING(192783 228138,192612 229814)',-1),'Paul St');
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (4,ST_GeomFromText('LINESTRING(189412 252431,189631 259122)',-1),'Graeme Ave');
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (5,ST_GeomFromText('LINESTRING(190131 224148,190871 228134)',-1),'Phil Tce');
INSERT INTO roads (road_id, roads_geom, road_name)
  VALUES (6,ST_GeomFromText('LINESTRING(198231 263418,198213 268322)',-1),'Dave Cres');
COMMIT;
```

"psql" SQL 터미널 모니터를 이용해서 Post-
greSQL로 데이터 파일을 매우 쉽게 송&#x
수 있습니다.

```
psql -d [database] -f roads.sql
```

4.7.2 shp2pgsql: ESRI shapefile 로더 이용하기

`shp2pgsql` 데이터 로더는 ESRI shapefile을, 도형 형&#
지리형 형식이든, PostGIS/PostgreSQL 데이터베&
삽입하기에 적합한 SQL로 변환합&#xb2c8
이 로더에는 명령행(command line) 플래그&#xb85
구별되는 몇 가지 실행 모드가 존&#

shp2pgsql 명령행 로더 외에, 사용자가 Post-
GIS를 처음 접하는 경우 스크립트&#xb97c
사용하지 않고 단 한 번 로드하는
데 더 쉽게 사용할 수 있을 뿐만 아&
명령행 로더가 가진 대부분의 옵&#
가지고 있는 `shp2pgsql-gui` 그래픽 인터페&#
있습니다. `shp2pgsql-gui`를 pgAdmin III의 플러그인&
설정할 수도 있습니다.

c|a|d|p -- 이들은 상호배타적인 옵션&#xb

-c 새 테이블을 생성한 다음 shapefile의 데이터로 해당 테이블을 채웁&*이것이 기본 모드입니다*.

-a 기존 데이터베이스 테이블에 shapefile의 데이터를 추가합니다. 이 옵션을 이용해서 복수의 파일&# 로드하려면, 파일들이 동일한 속성 및 동일한 데이터 유형을 담고 있어야 한다는 점을 주의&#

-d 기존 데이터베이스 테이블을 삭제(drop)한 다음 shapefile의 데이터를 가진 새 테이블을 생성합니다.

-p 테이블을 생성하는 SQL 코드만 &#xc0dd 어떤 실제 데이터도 추가하지 않습니다. 테이블 생성과 데이&# 로드 단계를 완전히 분리해야 할 경우 사용할 수 있습니다.

-? 도움말 화면을 표출합니다.

-D 산출물 데이터의 형식으로 PostgreSQL "덤프(dump)" 형식을 사용합니다. 이 옵션은 -a, -c 및 -d와 함께 사용할 수 있습니다. 이 덤프 형식은 기본 "삽입" SQL 형식보다 훨씬 빨리 로드 수 있습니다. 대용량 데이터셋&#xc7 경우 이 옵션을 사용하십시오.

-s [<FROM_SRID%gt;:]<SRID> 도형 테이블을 생성하&#xace 지정된 SRID로 채웁니다. 입력 shapefile이 주어진 FROM_SRID를 쓰도록 설정하는 옵션도 있습니다. 이런 경우 도&#xd6 목표 SRID로 재투영될 것입니다. FROM_SR -D 옵션과 함께 사용될 수 없습니&#x

-k 식별자의 대소문자(열, 스키마 &#xbc0f 속성)를 유지합니다. shapefile 안의 속&#xc1 모두 대문자라는 점을 주의하&#xc2e

-i DBF 헤더 서명이 64비트 bigint 형식을 보&#xc7 모든 정수를 표준 32비트 정수로 강제 변환하고 64비트 bigint 형식을 생성하지 않습니다.

-I 도형 열에 GiST 인덱스를 생성합니&#x

-m "-m 파일명" 형식으로 (긴) 열 명칭&#xac 10문자 DBF 열 명칭을 매핑하는 목&#xb85d 담은 파일을 지정합니다. 이 파&#xc7 내용은 공백으로 구분된 두 명&#xce6 이루어진 하나 이상의 행으로, 행 맨 앞과 맨 뒤에는 공백이 없&#xc5 합니다. 다음은 그 예시입니다:

```
COLUMNNAME DBFFIELD1
AVERYLONGCOLUMNNAME DBFFIELD2
```

-S 다중(multi) 도형 대신 단순 도형을 생&
이 옵션은 모든 도형이 실제로
단일형(예: 단일 외곽선을 가진
다중 폴리곤 또는 단일 꼭짓점&#xc74
가진 다중 포인트)일 경우에만
작동합니다.

-t <dimensionality> 산출 도형이 지정된 차원수&
가지도록 강제합니다. 차원수&#xb9
지시하는 데 다음 스트링을 사&#xc6
2D, 3DZ, 3DM, 4D

입력물이 지정된 차원수보다
낮은 차원일 경우, 출력물의 해&#xb2
차원은 0으로 채워질 것입니다.
입력물이 지정된 차원수보다
높은 차원일 경우, 필요 없는 차&#xc
제거될 것입니다.

-w WKB 대신 WKT 형식으로 출력합니다.
정확도가 부족하기 때문에 좌&#xd4
이동될 가능성이 있다는 점을
주의하십시오.

-e 각 선언문을 상호처리를 이용하&
않고 자체적으로 실행합니다.
오류를 생성하는 몇몇 망가진
도형이 있을 경우 이 옵션을 사&#xc6
괜󌰮은 데이터 대다수를 로드&#xd5
수 있습니다. "덤프" 형식은 항상
상호처리를 이용하기 때문에
-D 플래그와 함께 사용할 수 없다&#x
점을 주의하십시오.

-W <encoding> 입력 데이터(DBF 파일)의 인코&#xb529
지정합니다. 이 옵션을 사용하&#xba
DBF의 모든 속성을 지정된 인코딩&#
UTF8로 변환합니다. 그 결과로 생성&
SQL 출력물은 `SET CLIENT_ENCODING to UTF8` 명령어를
담게 되어, 백엔드에서 UTF8을 데이&
내부에서 이용하도록 설정된
어떤 인코딩으로든 재변환할
수 있습니다.

-N <policy> NULL 도형 처리 방침 -- insert*(상관없이
삽입), skip(건너뛰기), abort(중단)

-n DBF 파일만 임포트합니다. 사용자
데이터에 대응하는 shapefile이 없다&#xba7
자동적으로 이 모드로 전환하&#xc5c
DBF만 로드할 것입니다. 따라서 전&
shapefile 집합을 가지고 있지만 도형&#xc744
빼고 속성 데이터만 필요한 경&#xc6b
이 플래그를 설정해야 합니다.

-G (경도/위도가 필요한) 도형 대신
WGS84 경위도(SRID=4326)를 쓰는 지리형을
이용합니다.

-T <tablespace> 새 테이블을 위한 테이블스&#xd 지정합니다. -X 파라미터가 함께 쓰인 경우가 아니라면 여전히 인덱스가 기본 테이블스페이&#xc2a4 이용할 것입니다. PostgreSQL 문서는 사&#x 지정 테이블스페이스가 필요&#xd55 경우를 잘 설명하고 있습니다.

-X <tablespace> 새 테이블의 인덱스를 위한 테이블스페이스를 지정합니&#xb2e 이 옵션은 기본 키(primary key) 인덱스에 적용되며, -I 플래그를 함께 사용&#xd 경우 GiST 공간 인덱스에도 적용됩&#

-c When used, this flag will prevent the generation of `ANALYZE` statements. Without the -Z flag (default behavior), the `ANALYZE` statements will be generated.

다음은 로더를 이용해서 입력 파&# 생성하고 업로드하는 세션의 예&#x

```
# shp2pgsql -c -D -s 4269 -i -I shaperoads.shp myschema.roadstable > roads.sql
# psql -d roadsdb -f roads.sql
```

UNIX 파이프(pipe)를 이용하면 모든 변환 및 업로드 작업을 한 번에 끝낼 수 있습니다:

```
# shp2pgsql shaperoads.shp myschema.roadstable | psql -d roadsdb
```

4.8 공간 테이블 생성

SQL이나 shapefile 로더/덤퍼를 이용해서 데이터베이스로부터 데이터를 추출할 수 있습니다. SQL 단원에서 공간 테이블에 대한 비교 및 쿼리&#x 할 수 있는 몇몇 연산자에 대해 논& 것입니다.

4.8.1 SQL을 이용해 데이터 가져오

데이터베이스로부터 데이터를 추출하는 가장 간단한 방법은 SQL 선별(select) 쿼리로 반환될 레코드 및 열의 개수를 줄인 다음 해당 결과 열을 파싱 가능한 텍스트 파일로 덤프받는 것입니다:

```
db=# SELECT road_id, ST_AsText(road_geom) AS geom, road_name FROM roads;

road_id | geom                                      | road_name
--------+-------------------------------------------+-----------
          1 | LINESTRING(191232 243118,191108 243242) | Jeff Rd
          2 | LINESTRING(189141 244158,189265 244817) | Geordie Rd
          3 | LINESTRING(192783 228138,192612 229814) | Paul St
          4 | LINESTRING(189412 252431,189631 259122) | Graeme Ave
          5 | LINESTRING(190131 224148,190871 228134) | Phil Tce
```

```
          6 | LINESTRING(198231 263418,198213 268322) | Dave Cres
          7 | LINESTRING(218421 284121,224123 241231) | Chris Way
(6 rows)
```

하지만, 반환되는 필드의 개수를 줄이기 위해 어떤 종류의 제약이 필요할 때가 있을 것입니다. 속성 기반 제약의 경우, 일반적인 비공&#x 테이블의 경우와 동일한 SQL 문법&#xc74 쓰면 됩니다. 공간 제약의 경우, 다&# 유용한 연산자들을 쓸 수 있습니&#x

ST_Intersects This function tells whether two geometries share any space.

= 이 연산자는 두 도형이 기하학적
동일한지를 테스트합니다.예&#xb97
들어, 'POLYGON((0 0,1 1,1 0,0 0))'과 'POLYGON((0 0,1 1,1 0,0 0))'이 동일&#xd5
말입니다(동일합니다).

다음으로, 이 연산자들을 쿼리에 쓸 수 있습니다. SQL 명령행에 도형&#xacf 경계 상자를 지정할 때, "ST_GeomFromText()" 함&#xc218 이용해서 스트링 표현식을 도형&#x 정확하게 변환시켜야 합니다. 해&# 데이터와 일치하는 가공의 공간 참조 시스템은 312입니다. 다음은 그 예시입니다:

```
SELECT road_id, road_name
  FROM roads
  WHERE ST_OrderingEquals(roads_geom , ST_GeomFromText('LINESTRING(191232 243118,191108  ↩
      243242)',312) ) ;
```

이 쿼리는 해당 값과 동일한 도형&#x 담고 있는 "ROADS_GEOM" 테이블로부터 단&#x 레코드를 반환할 것입니다.

To check whether some of the roads passes in the area defined by a polygon:

```
SELECT road_id, road_name
FROM roads
WHERE roads_geom && ST_GeomFromText('POLYGON((...))',312);
```

가장 흔한 공간 쿼리는 아마도 데&#x 브라우저 또는 웹 매퍼 같은 클라&# 소프트웨어가 화면 표출을 위해 "맵 프레임(map frame)" 용량에 해당하는 데이터를 가져오기 위해 사용하&#x "프레임 기반(frame-based)" 쿼리일 것입니&#xb2e4

"&&" 연산자 사용시, 비교 피처로 BOX3D 또는 도형을 지정할 수 있습니다. 하지만 도형을 지정했을 경우, 비&# 작업에 해당 경계 상자가 사용될 것입니다.

Using a "BOX3D" object for the frame, such a query looks like this:

```
SELECT ST_AsText(roads_geom) AS geom
FROM roads
WHERE
  roads_geom && ST_MakeEnvelope(191232, 243117,191232, 243119,312);
```

화면에 해당하는 데이터의 투영&#
지정하는 데 SRID 312를 썼다는 사실에
주의하십시오.

4.8.2 덤퍼 이용하기

`pgsql2shp` 테이블 덤퍼는 데이터베이스
직접 연결되어 (아마도 쿼리가 정&#x
테이블을 shapefile로 변환합니다. 기본
문법은 다음과 같습니다:

```
pgsql2shp [<options>] <database> [<schema>.]<table>
```

```
pgsql2shp [<options>] <database> <query>
```

다음과 같은 명령행 옵션이 있습&#x

-f <filename> 특정 파일명으로 출력물을 &#xc79

-h <host> 연결할 데이터베이스 호스트&#
설정합니다.

-p <port> 데이터베이스 호스트 연결시
사용할 포트를 설정합니다.

-P <password> 데이터베이스 연결에 사용&#xd56
비밀번호를 설정합니다.

-u <user> 데이터베이스 연결에 사용할
사용자명을 설정합니다.

-g <geometry column> 복수의 도형 열을 가진 테&#xc774
경우, shapefile 작성에 이용될 도형 열&#xc74
설정합니다.

-b 바이너리 커서를 사용하도록 설&
이 옵션을 쓰면 실행 속도가 빨&#xb7
테이블 안에 있는 비(非) 도형 속&#x
가운데 하나라도 텍스트로 작&#xc1
캐스트(cast)가 부족할 경우 실행되&
않을 것입니다.

-r 로(raw) 모드입니다. `gid` 필드를 삭제&#xd558
열 명칭을 제외하지 않습니다.

-m `filename` 식별자를 10문자 명칭으로 다&#x
매핑(remap)합니다. 해당 파일의 내&#xc6a9
공백으로 구분된 두 심볼로 이&#xb8e
복수의 행으로, 행 맨 앞과 맨 뒤&#xc5
공백이 없어야 합니다. VERYLONGSYMBOL SHORT-
ONE ANOTHERVERYLONGSYMBOL SHORTER 등과 같은 예가 있&#xc

4.9 인덱스 빌드 작업

인덱스 덕분에 공간 데이터베이&#x
대용량 데이터셋을 사용할 수 있&#
인덱스 작업을 하지 않으면, 어떤

피처를 검색하든 데이터베이스
안의 모든 레코드를 "순차 스캔"해&
할 것입니다. 인덱스 작업은 데이&
특정 레코드를 찾기 위해 빠르게
훑어갈 수 있는 검색 트리로 조직&#
검색 속도를 향상시킵니다. PostgreSQL는
기본적으로 B-Tree, R-Tree, GiST 세 종류의 인덱&
지원합니다.

The B-tree index method commonly used for attribute data is not very useful for spatial data, since it only supports storing and querying data in a single dimension. Data such as geometry (which has 2 or more dimensions) requires an index method that supports range query across all the data dimensions. One of the key advantages of PostgreSQL for spatial data handling is that it offers several kinds of index methods which work well for multi-dimensional data: GiST, BRIN and SP-GiST indexes.

- GiST(Generalized Search Tree) 인덱스는 데이터를 "한
  쪽에 있는 것", "겹치는 것", "내부에
  있는 것"으로 분해하며 GIS 데이터&#xb
  포함한 광범위한 데이터 유형에
  쓰일 수 있습니다. PostGIS는 GiST를 써서
  GIS 데이터에 인덱스 작업을 한 다&#xc7
  해당 데이터에 다시 작업된 R-Tree 인&#x
  이용합니다.
- **BRIN (Block Range Index)** indexes operate by summarizing the spatial extent of ranges of table records. Search is done via a scan of the ranges. BRIN is only appropriate for use for some kinds of data (spatially sorted, with infrequent or no update). But it provides much faster index create time, and much smaller index size.
- **SP-GiST (Space-Partitioned Generalized Search Tree)** is a generic index method that supports partitioned search trees such as quad-trees, k-d trees, and radix trees (tries).

Spatial indexes store only the bounding box of geometries. Spatial queries use the index as a **primary filter** to quickly determine a set of geometries potentially matching the query condition. Most spatial queries require a **secondary filter** that uses a spatial predicate function to test a more specific spatial condition. For more information on queying with spatial predicates see Section 5.2.

See also the PostGIS Workshop section on spatial indexes, and the PostgreSQL manual.

4.9.1 GiST 인덱스

GiST는 "일반화된 검색 트리"의 줄임&#xb
인덱스 작업의 포괄적인 형태입&#
GIS 인덱스 작업 외에도, 일반 B-Tree 인덱&
작업으로는 쓸 수 없는 온갖 종류&#
비정규 데이터 구조(정수 배열, 분&
데이터 등등)에 대한 검색 속도를
향상시키는 데 GiST를 이용합니다.

GIS 데이터 테이블이 수천 행을 넘&#xac8
되면, 데이터 공간 검색의 속도를
향상시키기 위해 인덱스를 빌드&#x
싶게 될 것입니다(사용자의 모든
검색이 속성에 기반하는 경우가
아니라면 말입니다. 그런 경우, 속&#
필드에 대해 일반 인덱스를 빌드&#
됩니다).

"도형" 열에 대해 GiST 인덱스를 빌드&#xd
데 필요한 문법은 다음과 같습니&#

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

이 문법은 항상 2D 인덱스를 빌드&#xd560
것입니다. 해당 도형 유형에 PostGIS 2.0
이상 버전이 지원하는 n차원 인덱&
얻으려면, 다음 문법으로 생성할
수 있습니다:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ([geometryfield] gist_geometry_ops_nd);
```

Building a spatial index is a computationally intensive exercise. It also blocks write access to your table for the time it creates, so on a production system you may want to do in in a slower CONCURRENTLY-aware way:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

After building an index, it is sometimes helpful to force PostgreSQL to collect table statistics, which are used to optimize query plans:

```
VACUUM ANALYZE [table_name] [(column_name)];
```

4.9.2 GiST 인덱스

BRIN stands for "Block Range Index". It is a general-purpose index method introduced in PostgreSQL 9.5. BRIN is a *lossy* index method, meaning that a secondary check is required to confirm that a record matches a given search condition (which is the case for all provided spatial indexes). It provides much faster index creation and much smaller index size, with reasonable read performance. Its primary purpose is to support indexing very large tables on columns which have a correlation with their physical location within the table. In addition to spatial indexing, BRIN can speed up searches on various kinds of attribute data structures (integer, arrays etc). For more information see the PostgreSQL manual.

GIS 데이터 테이블이 수󌲜 행을 넘&#xac8
되면, 데이터 공간 검색의 속도를
향상시키기 위해 인덱스를 빌드&#x
싶게 될 것입니다(사용자의 모든
검색이 속성에 기반하는 경우가
아니라면 말입니다. 그런 경우, 속&#
필드에 대해 일반 인덱스를 빌드&#
됩니다).

A BRIN index stores the bounding box enclosing all the geometries contained in the rows in a contiguous set of table blocks, called a *block range*. When executing a query using the index the block ranges are scanned to find the ones that intersect the query extent. This is efficient only if the data is physically ordered so that the bounding boxes for block ranges have minimal overlap (and ideally are mutually exclusive). The resulting index is very small in size, but is typically less performant for read than a GiST index over the same data.

Building a BRIN index is much less CPU-intensive than building a GiST index. It's common to find that a BRIN index is ten times faster to build than a GiST index over the same data. And because a BRIN index stores only one bounding box for each range of table blocks, it's common to use up to a thousand times less disk space than a GiST index.

You can choose the number of blocks to summarize in a range. If you decrease this number, the index will be bigger but will probably provide better performance.

For BRIN to be effective, the table data should be stored in a physical order which minimizes the amount of block extent overlap. It may be that the data is already sorted appropriately (for instance, if it is loaded from another dataset that is already sorted in spatial order). Otherwise, this can be accomplished by sorting the data by a one-dimensional spatial key. One way to do this is to create a new table sorted by the geometry values (which in recent PostGIS versions uses an efficient Hilbert curve ordering):

```
CREATE TABLE table_sorted AS
   SELECT * FROM table  ORDER BY geom;
```

Alternatively, data can be sorted in-place by using a GeoHash as a (temporary) index, and clustering on that index:

```
CREATE INDEX idx_temp_geohash ON table
    USING btree (ST_GeoHash( ST_Transform( geom, 4326 ), 20));
CLUSTER table USING idx_temp_geohash;
```

"도형" 열에 대해 GiST 인덱스를 빌드&#xd
데 필요한 문법은 다음과 같습니&#x

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

이 문법은 항상 2D 인덱스를 빌드&#xd560
것입니다. 해당 도형 유형에 PostGIS 2.0
이상 버전이 지원하는 n차원 인덱&
얻으려면, 다음 문법으로 생성할
수 있습니다:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ([geometryfield] gist_geometry_ops_nd);
```

You can also get a 4D-dimensional index using the 4D operator class:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ([geometryfield] gist_geometry_ops_nd);
```

The above commands use the default number of blocks in a range, which is 128. To specify the number of blocks to summarise in a range, use this syntax

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

Keep in mind that a BRIN index only stores one index entry for a large number of rows. If your table stores geometries with a mixed number of dimensions, it's likely that the resulting index will have poor performance. You can avoid this performance penalty by choosing the operator class with the least number of dimensions of the stored geometries

"도형" 열에 대해 GiST 인덱스를 빌드&#xd
데 필요한 문법은 다음과 같습니&#x

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

이 문법은 항상 2D 인덱스를 빌드&#xd560
것입니다. 해당 도형 유형에 PostGIS 2.0
이상 버전이 지원하는 n차원 인덱&
얻으려면, 다음 문법으로 생성할
수 있습니다:

Currently, only "inclusion support" is provided, meaning that just the `&&`, `~` and `@` operators can be used for the 2D cases (for both `geometry` and `geography`), and just the `&&&` operator for 3D geometries. There is currently no support for kNN searches.

An important difference between BRIN and other index types is that the database does not maintain the index dynamically. Changes to spatial data in the table are simply appended to the end of the index. This will cause index search performance to degrade over time. The index can be updated by performing a `VACUUM`, or by using a special function `brin_summarize_new_values`. For this reason BRIN may be most appropriate for use with data that is read-only, or only rarely changing. For more information refer to the manual.

To summarize using BRIN for spatial data:

- Index build time is very fast, and index size is very small.
- Index query time is slower than GiST, but can still be very acceptable.
- Requires table data to be sorted in a spatial ordering.
- Requires manual index maintenance.
- Most appropriate for very large tables, with low or no overlap (e.g. points), which are static or change infrequently.
- More effective for queries which return relatively large numbers of data records.

4.9.3 GiST 인덱스

SP-GiST stands for "Space-Partitioned Generalized Search Tree" and is a generic form of indexing for multi-dimensional data types that supports partitioned search trees, such as quad-trees, k-d trees, and radix trees (tries). The common feature of these data structures is that they repeatedly divide the search space into partitions that need not be of equal size. In addition to spatial indexing, SP-GiST is used to speed up searches on many kinds of data, such as phone routing, ip routing, substring search, etc. For more information see the PostgreSQL manual.

As it is the case for GiST indexes, SP-GiST indexes are lossy, in the sense that they store the bounding box enclosing spatial objects. SP-GiST indexes can be considered as an alternative to GiST indexes.

GIS 데이터 테이블이 수천 행을 넘&#xac8
되면, 데이터 공간 검색의 속도를
향상시키기 위해 인덱스를 빌드&#x
싶게 될 것입니다(사용자의 모든
검색이 속성에 기반하는 경우가
아니라면 말입니다. 그런 경우, 속&#
필드에 대해 일반 인덱스를 빌드&#
됩니다).

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

이 문법은 항상 2D 인덱스를 빌드&#xd560
것입니다. 해당 도형 유형에 PostGIS 2.0
이상 버전이 지원하는 n차원 인덱&
얻으려면, 다음 문법으로 생성할
수 있습니다:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ([geometryfield] gist_geometry_ops_nd);
```

Building a spatial index is a computationally intensive operation. It also blocks write access to your table for the time it creates, so on a production system you may want to do in in a slower CONCURRENTLY-aware way:

```
CREATE INDEX [indexname] ON [tablename] USING GIST ( [geometryfield] );
```

After building an index, it is sometimes helpful to force PostgreSQL to collect table statistics, which are used to optimize query plans:

```
VACUUM ANALYZE [table_name] [(column_name)];
```

An SP-GiST index can accelerate queries involving the following operators:

- <<, &<, &>, >>, <<|, &<|, |&>, |>>, &&, @>, <@, and ~=, for 2-dimensional indexes,
- &/&, ~==, @>>, and <<@, for 3-dimensional indexes.

There is no support for kNN searches at the moment.

4.9.4 인덱스 빌드 작업

일반적인 경우라면 인덱스는 눈&#x
보이지 않게 데이터 접속 속도를
향상시킵니다. 인덱스가 빌드된
후, 쿼리 설계자는 쿼리 설계의 속&#x
향상기키는 데 언제 인덱스 정보&#x
사용할 것인지 투명하게 결정합&#x
안타깝게도 PostGIS 쿼리 설계자가 GiST
인덱스의 사용을 제대로 최적화&#x

못 하기 때문에, 종종 공간 인덱스&#
활용해야 할 검색이 대신 기본값&#x
전체 데이터의 순차 스캔을 이용&#x
때가 있습니다.

사용자의 공간 인덱스가 (또는 사&#
속성 인덱스가) 활용되지 않고 있&#
사실을 알게 되었다면, 몇 가지 해&#
방법이 있습니다:

- Examine the query plan and check your query actually computes the thing you need. An erroneous JOIN, either forgotten or to the wrong table, can unexpectedly retrieve table records multiple times. To get the query plan, execute with `EXPLAIN` in front of the query.
- Make sure statistics are gathered about the number and distributions of values in a table, to provide the query planner with better information to make decisions around index usage. **VACUUM ANALYZE** will compute both.

  You should regularly vacuum your databases anyways. Many PostgreSQL DBAs run **VACUUM** as an off-peak cron job on a regular basis.
- 두 번째, 빈공간 분석으로 해결이
  안 될 경우 **SET ENABLE_SEQSCAN=OFF** 명령어를 통&#xc
  강제로 쿼리 설계자가 인덱스 정&#
  이용하도록 할 수 있습니다. 이
  명령어는 공간 인덱스 쿼리일 경&#
  한해 드물게 이용해야 합니다. 일
  쿼리 설계자는 언제 일반 B-Tree 인덱&#xc
  활용해야 하는지 사용자보다 더
  잘 알고 있습니다. 사용자 쿼리 실&
  후, 다른 쿼리가 평소처럼 쿼리 설&#
  활용하도록 `ENABLE_SEQSCAN` 을 다시 켤지 고
  합니다.
- 쿼리 설계자가 순차 및 인덱스 스&#
  경중(cost)을 잘못 판단하고 있다면,
  postgresql.conf 파일의 random_page_cost의 값을 줄여보&#xac7
  "SET random_page_cost=#"로 써보십시오. 해당 파라&#
  기본값은 4이지만, 1또는 2로 설정&#xd5
  값을 감소시킬수록 점점 더 쿼리
  설계자가 인덱스 스캔을 활용하&
  될 것입니다.
- If **SET ENABLE_SEQSCAN TO OFF;** does not help your query, the query may be using a SQL construct that the Postgres planner is not yet able to optimize. It may be possible to rewrite the query in a way that the planner is able to handle. For example, a subquery with an inline SELECT may not produce an efficient plan, but could possibly be rewritten using a LATERAL JOIN.

For more information see the Postgres manual section on Query Planning.

Chapter 5

Spatial Queries

The *raison d'etre* of spatial databases is to perform queries inside the database which would ordinarily require desktop GIS functionality. Using PostGIS effectively requires knowing what spatial functions are available, how to use them in queries, and ensuring that appropriate indexes are in place to provide good performance.

5.1 Determining Spatial Relationships

Spatial relationships indicate how two geometries interact with one another. They are a fundamental capability for querying geometry.

5.1.1 Dimensionally Extended 9-Intersection Model

According to the OpenGIS Simple Features Implementation Specification for SQL, "the basic approach to comparing two geometries is to make pair-wise tests of the intersections between the Interiors, Boundaries and Exteriors of the two geometries and to classify the relationship between the two geometries based on the entries in the resulting 'intersection' matrix."

In the theory of point-set topology, the points in a geometry embedded in 2-dimensional space are categorized into three sets:

Boundary

The boundary of a geometry is the set of geometries of the next lower dimension. For `POINT`s, which have a dimension of 0, the boundary is the empty set. The boundary of a `LINESTRING` is the two endpoints. For `POLYGON`s, the boundary is the linework of the exterior and interior rings.

Interior

The interior of a geometry are those points of a geometry that are not in the boundary. For `POINT`s, the interior is the point itself. The interior of a `LINESTRING` is the set of points between the endpoints. For `POLYGON`s, the interior is the areal surface inside the polygon.

Exterior

The exterior of a geometry is the rest of the space in which the geometry is embedded; in other words, all points not in the interior or on the boundary of the geometry. It is a 2-dimensional non-closed surface.

The Dimensionally Extended 9-Intersection Model (DE-9IM) describes the spatial relationship between two geometries by specifying the dimensions of the 9 intersections between the above sets for each geometry. The intersection dimensions can be formally represented in a 3x3 **intersection matrix**.

For a geometry *g* the *Interior*, *Boundary*, and *Exterior* are denoted using the notation *I(g)*, *B(g)*, and *E(g)*. Also, *dim(s)* denotes the dimension of a set *s* with the domain of `{0,1,2,F}`:

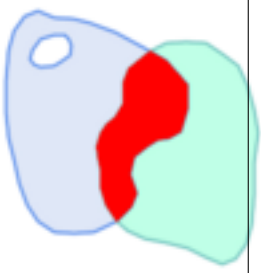
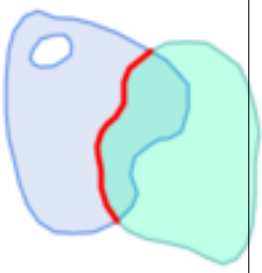
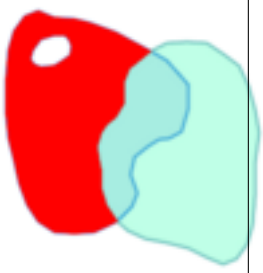
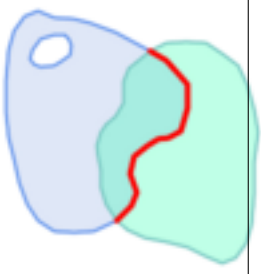
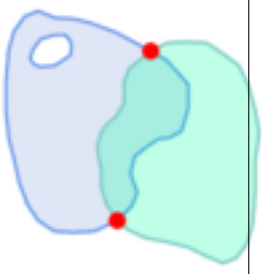
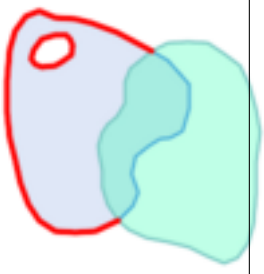
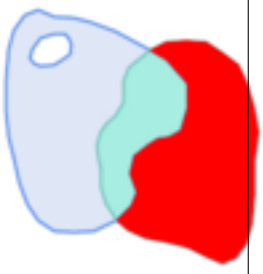
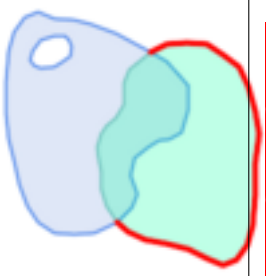
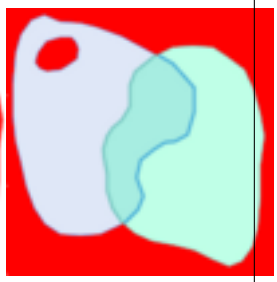
- `0` => point

- `1` => line
- `2` => area
- `F` => empty set

Using this notation, the intersection matrix for two geometries *a* and *b* is:

	Interior	**Boundary**	**Exterior**
Interior	*dim(I(a) ∩ I(b))*	*dim(I(a) ∩ B(b))*	*dim(I(a) ∩ E(b))*
Boundary	*dim(B(a) ∩ I(b))*	*dim(B(a) ∩ B(b))*	*dim(B(a) ∩ E(b))*
Exterior	*dim(E(a) ∩ I(b))*	*dim(E(a) ∩ B(b))*	*dim(E(a) ∩ E(b))*

Visually, for two overlapping polygonal geometries, this looks like:

	Interior	**Boundary**	**Exterior**
Interior	 *dim(I(a) ∩ I(b))* = **2**	 *dim(I(a) ∩ B(b)* = **1**	 *dim(I(a) ∩ E(b))* = **2**
Boundary	 *dim(B(a) ∩ I(b))* = **1**	 *dim(B(a) ∩ B(b))* = **0**	 *dim(B(a) ∩ E(b))* = **1**
Exterior	 *dim(E(a) ∩ I(b))* = **2**	 *dim(E(a) ∩ B(b))* = **1**	 *dim(E(a) ∩ E(b)* = **2**

Reading from left to right and top to bottom, the intersection matrix is represented as the text string '**212101212**'.

For more information, refer to:

- OpenGIS Simple Features Implementation Specification for SQL (version 1.1, section 2.1.13.2)
- Wikipedia: Dimensionally Extended Nine-Intersection Model (DE-9IM)
- GeoTools: Point Set Theory and the DE-9IM Matrix

5.1.2 Named Spatial Relationships

To make it easy to determine common spatial relationships, the OGC SFS defines a set of *named spatial relationship predicates*. PostGIS provides these as the functions ST_Contains, ST_Crosses, ST_Disjoint, ST_Equals, ST_Intersects, ST_Overlaps, ST_Touches, ST_Within. It also defines the non-standard relationship predicates ST_Covers, ST_CoveredBy, and ST_ContainsProperly.

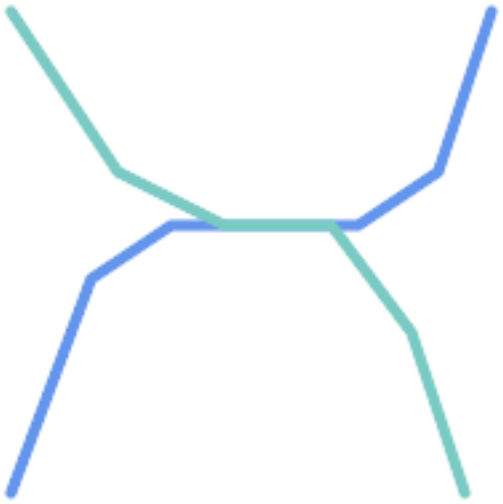
Spatial predicates are usually used as conditions in SQL `WHERE` or `JOIN` clauses. The named spatial predicates automatically use a spatial index if one is available, so there is no need to use the bounding box operator `&&` as well. For example:

```
SELECT city.name, state.name, city.geom
FROM city JOIN state ON ST_Intersects(city.geom, state.geom);
```

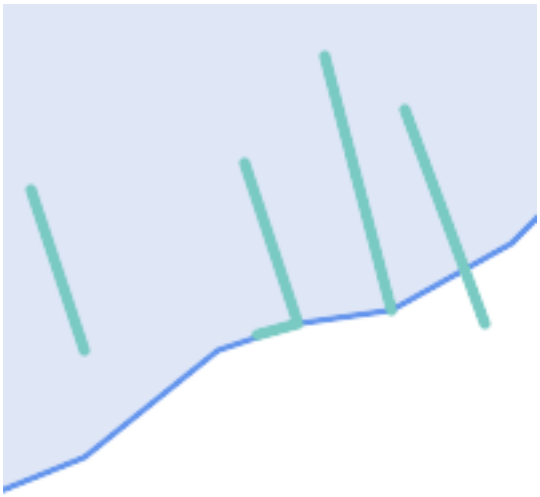
For more details and illustrations, see the PostGIS Workshop.

5.1.3 General Spatial Relationships

In some cases the named spatial relationships are insufficient to provide a desired spatial filter condition.



For example, consider a linear dataset representing a road network. It may be required to identify all road segments that cross each other, not at a point, but in a line (perhaps to validate some business rule). In this case ST_Crosses does not provide the necessary spatial filter, since for linear features it returns `true` only where they cross at a point.
A two-step solution would be to first compute the actual intersection (ST_Intersection) of pairs of road lines that spatially intersect (ST_Intersects), and then check if the intersection's ST_GeometryType is '`LINESTRING`' (properly dealing with cases that return `GEOMETRYCOLLECTION`s of `[MULTI]POINT`s, `[MULTI]LINESTRING`s, etc.).
Clearly, a simpler and faster solution is desirable.



A second example is locating wharves that intersect a lake's boundary on a line and where one end of the wharf is up on shore. In other words, where a wharf is within but not completely contained by a lake, intersects the boundary of a lake on a line, and where exactly one of the wharf's endpoints is within or on the boundary of the lake. It is possible to use a combination of spatial predicates to find the required features:

- ST_Contains(lake, wharf) = TRUE
- ST_ContainsProperly(lake, wharf) = FALSE
- ST_GeometryType(ST_Intersection(wharf, lake)) = 'LINESTRING'
- ST_NumGeometries(ST_Multi(ST_Intersection(ST_Boundary(wharf), ST_Boundary(lake)))) = 1

  ... but needless to say, this is quite complicated.

These requirements can be met by computing the full DE-9IM intersection matrix. PostGIS provides the ST_Relate function to do this:

```
SELECT ST_Relate( 'LINESTRING (1 1, 5 5)',
                  'POLYGON ((3 3, 3 7, 7 7, 7 3, 3 3))' );
st_relate
-----------
1010F0212
```

To test a particular spatial relationship, an **intersection matrix pattern** is used. This is the matrix representation augmented with the additional symbols `{T,*}`:

- `T` => intersection dimension is non-empty; i.e. is in `{0,1,2}`
- `*` => don't care

Using intersection matrix patterns, specific spatial relationships can be evaluated in a more succinct way. The ST_Relate and the ST_RelateMatch functions can be used to test intersection matrix patterns. For the first example above, the intersection matrix pattern specifying two lines intersecting in a line is '**1*1***1****':

```
-- Find road segments that intersect in a line
SELECT a.id
FROM roads a, roads b
WHERE a.id != b.id
      AND a.geom && b.geom
      AND ST_Relate(a.geom, b.geom, '1*1***1**');
```

For the second example, the intersection matrix pattern specifying a line partly inside and partly outside a polygon is '**102101FF2**':

```
-- Find wharves partly on a lake's shoreline
SELECT a.lake_id, b.wharf_id
FROM lakes a, wharfs b
WHERE a.geom && b.geom
      AND ST_Relate(a.geom, b.geom, '102101FF2');
```

5.2 Using Spatial Indexes

When constructing queries using spatial conditions, for best performance it is important to ensure that a spatial index is used, if one exists (see Section 4.9). To do this, a spatial operator or index-aware function must be used in a `WHERE` or `ON` clause of the query.

Spatial operators include the bounding box operators (of which the most commonly used is &&; see Section 7.10.1 for the full list) and the distance operators used in nearest-neighbor queries (the most common being <->; see Section 7.10.2 for the full list.)

Index-aware functions automatically add a bounding box operator to the spatial condition. Index-aware functions include the named spatial relationship predicates ST_Contains, ST_ContainsProperly, ST_CoveredBy, ST_Covers, ST_Crosses, ST_Intersects, ST_Overlaps, ST_Touches, ST_Within, ST_Within, and ST_3DIntersects, and the distance predicates ST_DWithin, ST_DFullyWithin, ST_3DDFullyWithin, and ST_3DDWithin .)

Functions such as ST_Distance do *not* use indexes to optimize their operation. For example, the following query would be quite slow on a large table:

```
SELECT geom
FROM geom_table
WHERE ST_Distance( geom, 'SRID=312;POINT(100000 200000)' ) < 100
```

This query selects all the geometries in `geom_table` which are within 100 units of the point (100000, 200000). It will be slow because it is calculating the distance between each point in the table and the specified point, ie. one `ST_Distance()` calculation is computed for **every** row in the table.

The number of rows processed can be reduced substantially by using the index-aware function ST_DWithin:

```
SELECT geom
FROM geom_table
WHERE ST_DWithin( geom, 'SRID=312;POINT(100000 200000)', 100 )
```

This query selects the same geometries, but it does it in a more efficient way. This is enabled by `ST_DWithin()` using the `&&` operator internally on an expanded bounding box of the query geometry. If there is a spatial index on `geom`, the query planner will recognize that it can use the index to reduce the number of rows scanned before calculating the distance. The spatial index allows retrieving only records with geometries whose bounding boxes overlap the expanded extent and hence which *might* be within the required distance. The actual distance is then computed to confirm whether to include the record in the result set.

For more information and examples see the PostGIS Workshop.

5.3 Examples of Spatial SQL

The examples in this section make use of a table of linear roads, and a table of polygonal municipality boundaries. The definition of the `bc_roads` table is:

```
Column     | Type              | Description
-----------+-------------------+-------------------
gid        | integer           | Unique ID
name       | character varying | Road Name
geom       | geometry          | Location Geometry (Linestring)
```

The definition of the `bc_municipality` table is:

```
Column   | Type              | Description
---------+-------------------+-------------------
gid      | integer           | Unique ID
code     | integer           | Unique ID
name     | character varying | City / Town Name
geom     | geometry          | Location Geometry (Polygon)
```

1. *What is the total length of all roads, expressed in kilometers?*

   You can answer this question with a very simple piece of SQL:

   ```
   SELECT sum(ST_Length(geom))/1000 AS km_roads FROM bc_roads;

   km_roads
   ------------------
   70842.1243039643
   ```

2. *How large is the city of Prince George, in hectares?*

   This query combines an attribute condition (on the municipality name) with a spatial calculation (of the polygon area):

   ```
   SELECT
     ST_Area(geom)/10000 AS hectares
   FROM bc_municipality
   WHERE name = 'PRINCE GEORGE';

   hectares
   ------------------
   32657.9103824927
   ```

3. *What is the largest municipality in the province, by area?*

   This query uses a spatial measurement as an ordering value. There are several ways of approaching this problem, but the most efficient is below:

   ```
   SELECT
     name,
     ST_Area(geom)/10000 AS hectares
   FROM bc_municipality
   ORDER BY hectares DESC
   LIMIT 1;

   name           | hectares
   ---------------+-----------------
   TUMBLER RIDGE  | 155020.02556131
   ```

   Note that in order to answer this query we have to calculate the area of every polygon. If we were doing this a lot it would make sense to add an area column to the table that could be indexed for performance. By ordering the results in a descending direction, and them using the PostgreSQL "LIMIT" command we can easily select just the largest value without using an aggregate function like MAX().

4. *What is the length of roads fully contained within each municipality?*

   This is an example of a "spatial join", which brings together data from two tables (with a join) using a spatial interaction ("contained") as the join condition (rather than the usual relational approach of joining on a common key):

   ```
   SELECT
     m.name,
     sum(ST_Length(r.geom))/1000 as roads_km
   FROM bc_roads AS r
   JOIN bc_municipality AS m
   ```

```
  ON ST_Contains(m.geom, r.geom)
GROUP BY m.name
ORDER BY roads_km;

name                         | roads_km
-----------------------------+------------------
SURREY                       | 1539.47553551242
VANCOUVER                    | 1450.33093486576
LANGLEY DISTRICT             | 833.793392535662
BURNABY                      | 773.769091404338
PRINCE GEORGE                | 694.37554369147
...
```

This query takes a while, because every road in the table is summarized into the final result (about 250K roads for the example table). For smaller datsets (several thousand records on several hundred) the response can be very fast.

5. *Create a new table with all the roads within the city of Prince George.*

   This is an example of an "overlay", which takes in two tables and outputs a new table that consists of spatially clipped or cut resultants. Unlike the "spatial join" demonstrated above, this query creates new geometries. An overlay is like a turbo-charged spatial join, and is useful for more exact analysis work:

```
CREATE TABLE pg_roads as
SELECT
  ST_Intersection(r.geom, m.geom) AS intersection_geom,
  ST_Length(r.geom) AS rd_orig_length,
  r.*
FROM bc_roads AS r
JOIN bc_municipality AS m
  ON ST_Intersects(r.geom, m.geom)
WHERE
  m.name = 'PRINCE GEORGE';
```

6. *What is the length in kilometers of "Douglas St" in Victoria?*

```
SELECT
  sum(ST_Length(r.geom))/1000 AS kilometers
FROM bc_roads r
JOIN bc_municipality m
  ON ST_Intersects(m.geom, r.geom
WHERE
  r.name = 'Douglas St'
  AND m.name = 'VICTORIA';

kilometers
------------------
4.89151904172838
```

7. *What is the largest municipality polygon that has a hole?*

```
SELECT gid, name, ST_Area(geom) AS area
FROM bc_municipality
WHERE ST_NRings(geom) > 1
ORDER BY area DESC LIMIT 1;

gid  | name         | area
-----+--------------+------------------
12   | SPALLUMCHEEN | 257374619.430216
```

Chapter 6

성능 향상 비&#x

6.1 대용량 도형을 담은 &#xc80 테이블

6.1.1 문제점 설명

현재 PostgreSQL (8.0 포함) 버전들의 쿼리 최&#xc8 TOAST 테이블과 관련된 약점이 있습&#xb TOAST 테이블은 일반 데이터 페이지&#xc 적합하지 않은 (긴 텍스트, 큰 이미또는 수많은 꼭짓점을 가진 복잡 도형 같은) 대용량(데이터 크기 관값을 저장하는 데 쓰이는 일종의 "확장 공간(extension room)"입니다. 자세한 정&#x the PostgreSQL Documentation for TOAST 를 참고하십시오.

상당히 대용량의 도형을 가진 테&#x (전체 유럽 국가들의 고해상도 국&#x 담고 있는 테이블처럼) 도형 행이 그렇게 많지 않을 경우 문제가 드&#x 이때 테이블 자체는 저용량이지&#x 많은 TOAST 공간을 차지합니다. 이번 예제의 경우, 테이블 자체는 약 80행 담고 있고 데이터 페이지 3장만 사&# TOAST 테이블은 8,225페이지를 차지합니

이 테이블의 행 가운데 몇 행과만 일치하는 경계 상자를 검색하기 위한 도형 연산자 &&&를 이용하는 쿼리를 전송해봅시다. 이때 쿼리 최적화기는 해당 테이블이 데이&#x 페이지 3장과 80행만 가지고 있다고 판단합니다. 이런 저용량 테이블&# 인덱스보다 순차 스캔이 훨씬 빠&# 거라고 추정할 것입니다. 따라서 GiST 인덱스를 무시하기로 합니다. 일반적인 경우라면 이 추정이 맞&# 그러나 이번 예제의 경우, && 연산&#xc790 경계 상자를 비교하기 위해 디스&# 모든 도형을 불러와야 하기 때문&# 결국 모든 TOAST 페이지도 읽어야 합&#xb

사용자 시스템에 이 버그가 있는&#x
확인하려면, "EXPLAIN ANALYZE" PostgreSQL 명령어를
실행하십시오. 자세한 정보 및 기&#
세부 사항을 알고 싶다면, PostgreSQL 성능
메일링 리스트에 있는 다음 스레&#
읽어볼 수 있습니다: http://archives.postgresql.org/pgsql-performance/200
02/msg00030.php

and newer thread on PostGIS https://lists.osgeo.org/pipermail/postgis-devel/2017-June/026209.html

6.1.2 해결 방법

PostgreSQL 개발자들은 쿼리 추정이 TOAST를
인식하도록 만들어 이 문제를 해&#
하고 있습니다. 현 시점에서는, 다&
두 가지 해결 방법이 있습니다:

첫 번째 해결책은 쿼리 설계자가
인덱스를 사용하도록 강제하는
방법입니다. 쿼리를 전송하기 전&#x
서버로 "SET enable_seqscan TO off;"를 전송하십시오.
이렇게 하면 기본적으로 쿼리 설&#xa
순차 스캔을 사용할 수 있는 경우&#
사용하지 않도록 강제합니다. 따&#
평상시처럼 GiST 인덱스를 이용할
것입니다. 그러나 이 플래그를 매&#
연결할 때마다 설정해야 하고 다&#
상황에서 쿼리 설계자가 잘못 추&#x
하기 때문에, 쿼리가 끝난 후에 "SET
enable_seqscan TO on;"을 전송해야 합니다.

두 번째 해결책은 쿼리 설계자가
추정하는 만큼 순차 스캔 속도를
높이는 방법입니다. 경계 상자를
"캐시"하는 추가 열을 생성한 다음,
이 추가 열을 대상으로 일치 여부&#
쿼리하면 됩니다. 이번 예제의 경&#
해당 명령어는 다음과 같습니다:

```
SELECT AddGeometryColumn('myschema','mytable','bbox','4326','GEOMETRY','2');
UPDATE mytable SET bbox = ST_Envelope(ST_Force2D(the_geom));
```

이제 geom_column 대신 bbox 에 대해 && 연산자&#xb97
이용하도록 다음과 같이 사용자
쿼리를 변경하십시오:

```
SELECT geom_column
FROM mytable
WHERE bbox && ST_SetSRID('BOX3D(0 0,1 1)'::box3d,4326);
```

물론, mytable의 열을 변경하거나 추가&#x
경우, bbox의 "일관성"을 유지해야 합&#xb
일관성을 유지시키는 가장 명료&#x
방법은 트리거(trigger)일 것입니다. 물&#xb
사용자 응용 프로그램을 수정해&#x
bbox 열의 정보를 항상 최신 상태로
유지하도록 하거나, 모든 수정 작&#
후 매번 앞에서 나온 UPDATE 쿼리를 실&#x
수도 있습니다.

6.2 도형 인덱스에 대한 &#xd07 작업

레코드 대부분이 읽기 전용이고, 쿼리의 대다수가 단일 인덱스를 이용하는 테이블의 경우, PostgreSQL은 CLUSTER 명령어를 제공합니다. 이 명령&#xc5b 모든 데이터 행을 인덱스 기준과 동일한 순서로 물리적으로 재정&#x 이렇게 하면 성능 향상 관련 두 가& 장점이 나타납니다. 첫째, 인덱스 범위 스캔을 하는 경우 데이터 테&# 대한 요청 횟수가 극단적으로 줄&#x 둘째, 사용자가 작업중인 집합이 인덱스 상의 조금 작은 간격에 집&# 있을 경우 데이터 행이 더 적은 데& 페이지를 따라 퍼져 있기 때문에 더 효율적인 캐시 작업이 가능합&# (이 시점에서 PostgreSQL 지침서에 있는 CLUSTER 명령어 문서를 읽어보는 편이 좋습니다.)

하지만, 현재 PostgreSQL은 PostGIS GiST 인덱스에 대한 클러스터 작업을 허용하지 않습니다. 왜냐하면 GiST 인덱스가 NULL 값을 단순히 무시하기 때문에, 다음과 같은 오류 메시지를 보게 될 것입니다:

```
lwgeom=# CLUSTER my_geom_index ON my_table;
ERROR: cannot cluster when index access method does not handle null values
HINT: You may be able to work around this by marking column "the_geom" NOT NULL.
```

HINT 메시지의 내용대로, 테이블에 "not null" 제약조건을 추가하면 이 결점&#x 피해 갈 수 있습니다:

```
lwgeom=# ALTER TABLE my_table ALTER COLUMN the_geom SET not null;
ALTER TABLE
```

물론, 사용자 도형 열 안에 실제로 NULL 값이 필요한 경우 이 방법을 쓸 수는 없습니다. 또한 제약조건을 추가하려면 앞의 메소드를 이용&#x 합니다. "ALTER TABLE blubb ADD CHECK (geometry is not null);"처럼 CHECK 제약조건을 사용하는 방법은 먹&#x 않을 겁니다.

6.3 차원 변환 피하기

때때로 사용자 테이블에 3D 또는 4D 데이터가 있지만, 항상 2D 도형만&#xc744 출력하는 OpenGIS 준수 ST_AsText() 또는 ST_AsBinary() 함&# 통해서만 접근하는 경우가 있을 수 있습니다. 이런 경우 내부적으&#

ST_Force2D() 함수를 호출하는데, 대용량 도형의 경우 이 함수는 시스템의 자원을 상당히 잡아먹습니다. 이&# 자원 낭비를 피하려면, 미리 그 추&# 차원을 완전히 삭제하는 편이 효&# 수 있습니다.

```
UPDATE mytable SET the_geom = ST_Force2D(the_geom);
VACUUM FULL ANALYZE mytable;
```

AddGeometryColumn() 함수를 통해 사용자 도형 열을 추가했을 경우 도형 차원에 제약조건이 걸려 있다는 사실을 주의하십시오. 이를 우회하려면 제약조건을 삭제해야 합니다. geometry_columns 테이블 내부 항목을 업데이&#xd 다음 제약조건을 다시 생성하는 걸 잊지 마십시오.

대용량 테이블의 경우, 사용자의 기본 키 또는 또다른 사용 가능한 기준과 함께 WHERE 절을 이용해서 테&#x 일부분만 업데이트하도록 제한&# 다음 업데이트마다 간단히 "VACUUM;"을 실행하는 방식으로 이 업데이트&# 작은 부분으로 나누는 편이 좋을 수 있습니다. 이렇게 하면 필요한 임시 디스크 공간이 급격히 줄어&#x 또한 몇 종류의 차원이 섞인 도형&# 가지고 있을 경우, "WHERE dimension(the_geom)>2"로 업&#xb3 제한하면 이미 2D인 도형을 다시 작성하는 일을 건너뛸 수 있습니&#

Chapter 7

PostGIS Reference

아래의 함수들은 PostGIS 사용자가 필&#xc
하는 함수들이며, 일반 사용자가
쓰지 않는 PostGIS 객체에 필요한 다른
지원 함수들도 있습니다.

Note

PostGIS는 기존 명명 규칙에서 SQL-MM-중심 명명 규칙으로 전환하기 시작했습니다. 그 결과로, 여러분이 알고 있고 좋아하는 대부분의 함수 이름이 표준 Spatial Type (ST) 접두어를 사용한 이름으로 변경되었습니다. 갱신된 함수들이 이전 함수들과 같은 기능을 제공하며, 비록 이 문서에는 나열되어 있지는 않지만 이전 함수도 사용할 수 있습니다. 다음 버전 출시에는 이 문서에 없는 비 ST_ 함수들이 더 이상 사용되지 않을 것이며 제외될 예정이므로 이들 함수의 사용을 중단해 주십시오.

7.1 PostgreSQL PostGIS Geometry/Geography/Box 유형

7.1.1 box2d

box2d — The type representing a 2-dimensional bounding box.

설명

box3d 지오메트리 또는 지오메트리 셋의 범위를 표현하는데 사용되&#x
postgis 공간 데이터 타입입니다. ST_3DExtent는
box3d 객체를 반환합니다.

The representation contains the values `xmin, ymin, xmax, ymax`. These are the minimum and maximum values of the X and Y extents.

`box2d` objects have a text representation which looks like `BOX(1 2,5 6)`.

캐스팅 동작

이 섹션에는 자동 형변환 뿐만 아&#
이 데이터 유형에 허용되는 명시&#
캐스팅이 나열됩니다.

변환 대상	동작
box3d	자동적
geometry	자동적

관련 정보

Section 12.7

7.1.2 box3d

box3d — The type representing a 3-dimensional bounding box.

설명

box3d 지오메트리 또는 지오메트리
셋의 범위를 표현하는데 사용되&#
postgis 공간 데이터 타입입니다. ST_3DExtent는
box3d 객체를 반환합니다.

The representation contains the values `xmin, ymin, zmin, xmax, ymax, zmax`. These are the minimum and maxium values of the X, Y and Z extents.

`box3d` objects have a text representation which looks like `BOX3D(1 2 3,5 6 5)`.

캐스팅 동작

이 섹션에는 자동 형변환 뿐만 아&#
이 데이터 유형에 허용되는 명시&#
캐스팅이 나열됩니다.

변환 대상	동작
box	자동적
box2d	자동적
geometry	자동적

관련 정보

Section 12.7

7.1.3 geometry

geometry — geography는 지구곡면 좌표계에서 피&
표현하는데 사용되는 공간 데이&#x
타입입니다.

설명

geography는 지구곡면 좌표계에서 피처&#x
표현하는데 사용되는 공간 데이&#x
타입입니다.

All spatial operations on geometry use the units of the Spatial Reference System the geometry is in.

캐스팅 동작

이 섹션에는 자동 형변환 뿐만 아&
이 데이터 유형에 허용되는 명시&
캐스팅이 나열됩니다.

변환 대상	동작
box	자동적
box2d	자동적
box3d	자동적
bytea	자동적
geography	자동적
text	자동적

관련 정보

Section 4.1, Section 4.3

7.1.4 geometry_dump

geometry_dump — A composite type used to describe the parts of complex geometry.

설명

`geometry_dump` is a composite data type containing the fields:

- `geom` - a geometry representing a component of the dumped geometry. The geometry type depends on the originating function.
- `path[]` - an integer array that defines the navigation path within the dumped geometry to the `geom` component. The path array is 1-based (i.e. `path[1]` is the first element.)

It is used by the `ST_Dump*` family of functions as an output type to explode a complex geometry into its constituent parts.

관련 정보

Section 12.6

7.1.5 geography

geography — The type representing spatial features with geodetic (ellipsoidal) coordinate systems.

설명

geography는 지구곡면 좌표계에서 피처&#x
표현하는데 사용되는 공간 데이&#x
타입입니다.

Spatial operations on the geography type provide more accurate results by taking the ellipsoidal model into account.

캐스팅 동작

이 섹션에는 자동 형변환 뿐만 아&#
이 데이터 유형에 허용되는 명시&#
캐스팅이 나열됩니다.

변환 대상	동작
geometry	명시적

관련 정보

Section 4.3, Section 4.3

7.2 관리 함수

7.2.1 AddGeometryColumn

AddGeometryColumn — 공간 테이블에서 지오메&#xd2b8
컬럼을 제거합니다.

Synopsis

text **AddGeometryColumn**(varchar table_name, varchar column_name, integer srid, varchar type, integer dimension, boolean use_typmod=true);
text **AddGeometryColumn**(varchar schema_name, varchar table_name, varchar column_name, integer srid, varchar type, integer dimension, boolean use_typmod=true);
text **AddGeometryColumn**(varchar catalog_name, varchar schema_name, varchar table_name, varchar column_name, integer srid, varchar type, integer dimension, boolean use_typmod=true);

설명

기존 테이블의 속성으로 지오메&#x
컬럼을 추가합니다. `schema_name`은 테이&#xbe
스키마의 이름입니다. `srid`은 정수&#xac
이어야 하며 SPATIAL_REF_SYS 테이블의 요소&
참조합니다. `type`은 지오메트리 타&#xc7
일티하는 문자열, 예를 들어 'POLYGON'
이나 'MULTILINESTRING' 이어야 합니다. 스키&#xb9c
이름이 없거나 (혹은 현재 search_path에
안버이거나) 지정된 SRID, 지오메트&#xb9
타입, 차원 등이 잘못된 경우 오류&#
발생됩니다.

Note

변경사항: 2.0.0 이 함수는 geometry_columns이 시스템 카테고리에서 읽히는 뷰인 동안 더 이상 geometry_columns을 업데이트 하지 않습니다. 이것은 기본적으로 컨스트레인트를 만들지 않지만, 대신에 PostgreSQL의 내장된 타입 변경 동작이 대신합니다. 그래서 예를 들어 WGS84 POINT 컬럼을 이 함수로 만든다면 이 함수는 다음과 동등합니다: `ALTER TABLE some_table ADD COLUMN geom geometry(Point,4326);` 변경 사항: 2.0.0 버전. 제약조건의 구식 습성이 필요할 경우, 기본값인 `use_typmod` 를 이용하되, 거짓으로 설정하십시오.

Note

변경 사항: 2.0.0 버전. 더 이상 뷰를 직접 geometry_columns에 등록시킬 수는 없지만, 도형 typmod 테이블 도형을 기반으로 빌드된 , 그리고 래퍼 함수 없이 사용되는 뷰는 자신의 페어런트 테이블 열의 typmod 습성을 상속하기 때문에 스스로를 정확히 등록시킵니다. 이런 뷰 도형 열을 geometry_columns에 정확히 등록시키려면, 다른 도형을 출력하는 도형 함수를 이용하는 뷰를 typmod 도형으로 형변환시켜야 할 것입니다. Section 4.6.3 을 참조하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

개선 사항: 2.0.0 버전. use_typmod 인자가 추가&#x
제약조건 기반 도형 열 대신 기본&#x
typmod 도형 열을 생성합니다.

예제

```
-- &#xb370;&#xc774;&#xd130;&#xb97c; &#xb2f4;&#xae30; &#xc704;&#xd55c;  ↩
    &#xc2a4;&#xd0a4;&#xb9c8;&#xb97c; &#xc0dd;&#xc131;
CREATE SCHEMA my_schema;
-- &#xc0c8;&#xb85c;&#xc6b4; &#xb2e8;&#xc21c; PostgreSQL &#xd14c;&#xc774;&#xbe14;  ↩
    &#xc0dd;&#xc131;
CREATE TABLE my_schema.my_spatial_table (id serial);
```

```
-- &#xb2e8;&#xc77c; "id" &#xc5f4;&#xc744; &#xac00;&#xc9c4; &#xb2e8;&#xc21c;  ↩
    &#xd14c;&#xc774;&#xbe14;&#xc744; &#xbcf4;&#xc5ec;&#xc8fc;&#xb294;  ↩
    &#xd14c;&#xc774;&#xbe14;&#xc744; &#xc124;&#xba85;&#xd558;&#xae30;
postgis=# \d my_schema.my_spatial_table
                                                    Table "my_schema.my_spatial_table"
 Column |  Type   |                                  Modifiers
--------+---------+------------------------------------------------------------------------- ↩

 id     | integer | not null default nextval('my_schema.my_spatial_table_id_seq'::regclass)

-- &#xd14c;&#xc774;&#xbe14;&#xc5d0; &#xacf5;&#xac04; &#xc5f4;&#xc744; &#xcd94;&#xac00;
SELECT AddGeometryColumn ('my_schema','my_spatial_table','geom',4326,'POINT',2);

-- &#xc608;&#xc804; &#xc81c;&#xc57d;&#xc870;&#xac74; &#xae30;&#xbc18;  ↩
    &#xc2b5;&#xc131;&#xc744; &#xc774;&#xc6a9;&#xd574;&#xc11c;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xcd94;&#xac00;
SELECT AddGeometryColumn ('my_schema','my_spatial_table','geom_c',4326,'POINT',2, false);

-- &#xc608;&#xc804; &#xc81c;&#xc57d;&#xc870;&#xac74; &#xc2b5;&#xc131;&#xc744;  ↩
    &#xc774;&#xc6a9;&#xd574;&#xc11c; &#xb9cc;&#xace1; &#xd3f4;&#xb9ac;&#xace4;&#xc744;  ↩
    &#xcd94;&#xac00;
SELECT AddGeometryColumn ('my_schema','my_spatial_table','geomcp_c',4326,'CURVEPOLYGON',2,  ↩
    false);

-- &#xc0c8; &#xb3c4;&#xd615;&#xc744; &#xcd94;&#xac00;&#xd588;&#xc74c;&#xc744;  ↩
    &#xbcf4;&#xc5ec;&#xc8fc;&#xb3c4;&#xb85d; &#xd14c;&#xc774;&#xbe14;&#xc744;  ↩
    &#xb2e4;&#xc2dc; &#xc124;&#xba85;&#xd558;&#xae30;
\d my_schema.my_spatial_table
                           addgeometrycolumn
-------------------------------------------------------------------
 my_schema.my_spatial_table.geomcp_c SRID:4326 TYPE:CURVEPOLYGON DIMS:2
(1 row)

                                    Table "my_schema.my_spatial_table"
  Column  |         Type         |                                 Modifiers
----------+----------------------+-------------------------------------------------------------------------

 id       | integer              | not null default nextval('my_schema. ↩
     my_spatial_table_id_seq'::regclass)
 geom     | geometry(Point,4326) |
 geom_c   | geometry             |
 geomcp_c | geometry             |
Check constraints:
    "enforce_dims_geom_c" CHECK (st_ndims(geom_c) = 2)
    "enforce_dims_geomcp_c" CHECK (st_ndims(geomcp_c) = 2)
    "enforce_geotype_geom_c" CHECK (geometrytype(geom_c) = 'POINT'::text OR geom_c IS NULL)
    "enforce_geotype_geomcp_c" CHECK (geometrytype(geomcp_c) = 'CURVEPOLYGON'::text OR  ↩
        geomcp_c IS NULL)
    "enforce_srid_geom_c" CHECK (st_srid(geom_c) = 4326)
    "enforce_srid_geomcp_c" CHECK (st_srid(geomcp_c) = 4326)

-- geometry_columns &#xbdf0;&#xb3c4; &#xc0c8; &#xc5f4;&#xb4e4;&#xc744;  ↩
    &#xb4f1;&#xb85d;&#xd569;&#xb2c8;&#xb2e4;. --
SELECT f_geometry_column As col_name, type, srid, coord_dimension As ndims
    FROM geometry_columns
    WHERE f_table_name = 'my_spatial_table' AND f_table_schema = 'my_schema';

 col_name |     type     | srid | ndims
----------+--------------+------+-------
 geom     | Point        | 4326 |     2
 geom_c   | Point        | 4326 |     2
```

```
 geomcp_c | CurvePolygon | 4326 |     2
```

관련 정보

DropGeometryColumn, DropGeometryTable, Section 4.6.2, Section 4.6.3

7.2.2 DropGeometryColumn

DropGeometryColumn — 공간 테이블에서 지오메&#xd2b8
컬럼을 제거합니다.

Synopsis

text **DropGeometryColumn**(varchar table_name, varchar column_name);
text **DropGeometryColumn**(varchar schema_name, varchar table_name, varchar column_name);
text **DropGeometryColumn**(varchar catalog_name, varchar schema_name, varchar table_name, varchar column_name);

설명

공간 테이블에서 도형 열을 제거&#x
schema_name이 geometry_columns 테이블에 있는 테이블
행의 f_table_schema 항목과 일치해야 한다&#xb29
점에 주의하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Note

변경 사항: 2.0.0 버전. 하위 호환성을 위해 이 함수를 제공합니다. 이제는 geometry_columns이 시스템 카탈로그를 기반으로 하는 뷰이기 때문에, 다른 어떤 테이블 열과도 마찬가지로 도형 열도 ALTER TABLE 을 이용해서 삭제할 수 있습니다.

예제

```
SELECT DropGeometryColumn ('my_schema','my_spatial_table','geom');
                        -- &#xacb0;&#xacfc; &#xcd9c;&#xb825;&#xbb3c; --
                                    dropgeometrycolumn
----------------------------------------------------
 my_schema.my_spatial_table.geom effectively removed.

-- PostGIS 2.0 &#xc774;&#xc0c1; &#xbc84;&#xc804;&#xc5d0;&#xc11c; &#xc704;  ↩
    &#xcffc;&#xb9ac;&#xb294; &#xd45c;&#xc900; &#xb300;&#xccb4;  ↩
    &#xd14c;&#xc774;&#xbe14;&#xacfc;&#xb3c4; &#xb3d9;&#xb4f1;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xc591;&#xcabd; &#xbaa8;&#xb450; geometry_columns&#xb85c;&#xbd80;&#xd130;  ↩
    &#xb4f1;&#xb85d; &#xd574;&#xc81c;&#xb420; &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
ALTER TABLE my_schema.my_spatial_table DROP column geom;
```

관련 정보

AddGeometryColumn, DropGeometryTable, Section 4.6.2

7.2.3 DropGeometryTable

DropGeometryTable — 테이블 및 geometry_columns의 모든 참조&
삭제합니다.

Synopsis

boolean **DropGeometryTable**(varchar table_name);
boolean **DropGeometryTable**(varchar schema_name, varchar table_name);
boolean **DropGeometryTable**(varchar catalog_name, varchar schema_name, varchar table_name);

설명

테이블 및 geometry_columns에 있는 테이블의
모든 참조를 삭제합니다. 주의: 스&#
제공하지 않는다면 스키마를 인&#x
aware) pgSQL 설치 상에서 current_schema()를 사용해보&#

> **Note**
> 변경 사항: 2.0.0 버전. 하위
> 호환성을 위해 이 함수를
> 제공합니다. 이제는 geometry_columns이
> 시스템 카탈로그를 기반으로
> 하는 뷰이기 때문에, 다른 어떤
> 테이블과도 마찬가지로 도형
> 열을 가진 테이블도 `DROP TABLE` 을
> 이용해서 삭제할 수 있습니다.

예제

```
SELECT DropGeometryTable ('my_schema','my_spatial_table');
-- &#xacb0;&#xacfc; &#xcd9c;&#xb825;&#xbb3c; --
my_schema.my_spatial_table dropped.

-- &#xc774;&#xc81c; &#xc704; &#xcffc;&#xb9ac;&#xb294; &#xb2e4;&#xc74c;&#xacfc;  ↩
    &#xb3d9;&#xb4f1;&#xd569;&#xb2c8;&#xb2e4;. --
DROP TABLE my_schema.my_spatial_table;
```

관련 정보

AddGeometryColumn, DropGeometryColumn, Section 4.6.2

7.2.4 Find_SRID

Find_SRID — Returns the SRID defined for a geometry column.

Synopsis

integer **Find_SRID**(varchar a_schema_name, varchar a_table_name, varchar a_geomfield_name);

설명

Returns the integer SRID of the specified geometry column by searching through the GEOMETRY_COLUMNS table. If the geometry column has not been properly added (e.g. with the AddGeometryColumn function), this function will not work.

예제

```
SELECT Find_SRID('public', 'tiger_us_state_2007', 'geom_4269');
find_srid
----------
4269
```

관련 정보

ST_SRID

7.2.5 Populate_Geometry_Columns

Populate_Geometry_Columns — Ensures geometry columns are defined with type modifiers or have appropriate spatial constraints.

Synopsis

text **Populate_Geometry_Columns**(boolean use_typmod=true);
int **Populate_Geometry_Columns**(oid relation_oid, boolean use_typmod=true);

설명

지오메트리 컬럼이 타입 변경자&#x
정의되거나 적절한 공간 제약을
가지고 있는지 확인합니다. 이 함&#
공간 관련 테이블들이 `geometry_columns` 뷰에
올바르게 등록되도록 합니다. 기&#
유형 변경자를 가지지 않는 모든
지오메트리 컬럼들을 유형 변경&#x
가진 지오메트리 컬럼들로 변환&#x
엣날식 동작을 원하면 `use_typmod=false`으로
설정

하위 호환성 및 각 차일드 테이블&#
서로 다른 도형 유형을 가질 수도
있는 테이블 상속 같은 공간 필요&#
위해, 구 버전 확인 제약조건 습성&
계속 지원합니다. 구 버전 습성이
필요하다면, `use_typmod=false` 처럼 새 선택&#xc801
인자를 거짓으로 패스해야 합니&#
이렇게 하면 유형 변경자는 없지&#
제약조건 3개가 정의된 도형 열을
생성할 것입니다. 다시 말해, 모든
도형 열이 적어도 3개의 제약조건&#
가진 테이블에 종속된다는 뜻입&#

- `enforce_dims_the_geom` - ensures every geometry has the same dimension (see ST_NDims)
- `enforce_geotype_the_geom` - ensures every geometry is of the same type (see 도형 유형)
- `enforce_srid_the_geom` - ensures every geometry is in the same projection (see ST_SRID)

`oid` 테이블이 제공될 경우, 이 함수&#xb29
테이블에 있는 모든 도형 열의 SRID,
차원, 그리고 도형 유형을 결정하&#
하며, 필요한 경우 제약조건을 추&#
합니다. 함수가 제대로 작동했다&#
올바른 행이 geometry_columns 테이블에 삽입&#
아닐 경우, 예외가 잡혀 문제점을
설명하는 오류 메시지가 뜹니다.

`oid` 테이블과 함께 `oid` 뷰가 제공될 경&#x
이 함수는 `geometry_columns` 테이블에 올바&#xb978
항목을 삽입하며 뷰에 있는 모든
도형의 SRID, 차원, 유형을 결정하려
하지만, 제약조건을 강제하지는
않습니다.

이 함수의 파라미터가 없는 변종&#
공간 제약조건을 테이블의 적절&#x
곳에 추가하며 먼저 데이터베이&#x
내부의 모든 공간 테이블 및 뷰에
대해 geometry_columns 테이블의 용량을 줄이&#x
다시 채우는 파라미터가 있는 변&#
위한 단순 래퍼입니다. 파라미터&#
없는 변종은 데이터베이스 내부&#
감지된 도형 열의 개수 및 `geometry_columns`
테이블로 삽입된 개수를 요약해&#
반환합니다. 파라미터가 있는 버&#
단순히 `geometry_columns` 테이블로 삽입된 &#xd589
개수를 반환합니다.

유효버전: 1.4.0

변경 사항: 2.0.0 버전. 이제 도형 유형&#xc
제한하기 위해 확인 제약조건 대&#
유형 변경자를 이용합니다. 새 `use_typmo`
를 거짓으로 설정하면, 확인 제약&#
습성을 계속 쓸 수 있습니다.

개선 사항: 2.0.0 버전. 열 생성시 유형
변경자와 함께, 또는 확인 제약조&#
함께 생성할지 통제할 수 있는 `use_typmo`
의 선택적 인자가 추가됐습니다.

예제:

```
CREATE TABLE public.myspatial_table(gid serial, geom geometry);
INSERT INTO myspatial_table(geom) VALUES(ST_GeomFromText('LINESTRING(1 2, 3 4)',4326) );
-- &#xc774;&#xc81c; &#xc720;&#xd615; &#xc218;&#xc815;&#xc790;(typ modifier)&#xb97c;  ↩
    &#xc774;&#xc6a9;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;. &#xc774;  ↩
    &#xcffc;&#xb9ac;&#xac00; &#xc791;&#xb3d9;&#xd558;&#xb824;&#xba74;,  ↩
    &#xb370;&#xc774;&#xd130;&#xac00; &#xc874;&#xc7ac;&#xd574;&#xc57c;&#xb9cc;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.
SELECT Populate_Geometry_Columns('public.myspatial_table'::regclass);
```

```
populate_geometry_columns
--------------------------
                        1


\d myspatial_table

                                  Table "public.myspatial_table"
 Column |           Type            |                           Modifiers
--------+---------------------------+-----------------------------------------------------------------

 gid    | integer                   | not null default nextval('myspatial_table_gid_seq':: ↩
    regclass)
 geom   | geometry(LineString,4326) |
```

```
-- &#xb3c4;&#xd615; &#xc5f4;&#xc774; typmod&#xac00; &#xc544;&#xb2c8;&#xac70;&#xb098;  ↩
    &#xc774;&#xbbf8; &#xc81c;&#xc57d;&#xc870;&#xac74;&#xc744; &#xac00;&#xc9c0;&#xace0;  ↩
    &#xc788;&#xc9c0; &#xc54a;&#xc744; &#xacbd;&#xc6b0;,  ↩
    &#xc81c;&#xc57d;&#xc870;&#xac74;&#xc744; &#xc774;&#xc6a9;&#xd558;&#xb3c4;&#xb85d;  ↩
    &#xb3c4;&#xd615; &#xc5f4;&#xc744; &#xbcc0;&#xacbd;&#xd560;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
-- &#xc774; &#xcffc;&#xb9ac;&#xac00; &#xc791;&#xb3d9;&#xd558;&#xb824;&#xba74;,  ↩
    &#xb370;&#xc774;&#xd130;&#xac00; &#xc874;&#xc7ac;&#xd574;&#xc57c;&#xb9cc;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.
CREATE TABLE public.myspatial_table_cs(gid serial, geom geometry);
INSERT INTO myspatial_table_cs(geom) VALUES(ST_GeomFromText('LINESTRING(1 2, 3 4)',4326) );
SELECT Populate_Geometry_Columns('public.myspatial_table_cs'::regclass, false);
populate_geometry_columns
--------------------------
                        1
\d myspatial_table_cs

                          Table "public.myspatial_table_cs"
 Column |   Type   |                            Modifiers
--------+----------+-------------------------------------------------------------------
 gid    | integer  | not null default nextval('myspatial_table_cs_gid_seq'::regclass)
 geom   | geometry |
Check constraints:
    "enforce_dims_geom" CHECK (st_ndims(geom) = 2)
    "enforce_geotype_geom" CHECK (geometrytype(geom) = 'LINESTRING'::text OR geom IS NULL)
    "enforce_srid_geom" CHECK (st_srid(geom) = 4326)
```

7.2.6 UpdateGeometrySRID

UpdateGeometrySRID — Updates the SRID of all features in a geometry column, and the table metadata.

Synopsis

text **UpdateGeometrySRID**(varchar table_name, varchar column_name, integer srid);
text **UpdateGeometrySRID**(varchar schema_name, varchar table_name, varchar column_name, integer srid);
text **UpdateGeometrySRID**(varchar catalog_name, varchar schema_name, varchar table_name, varchar column_name, integer srid);

설명

지오메트리 컬럼, geometry_columns 메타데이&#x
및 srid를 대상으로 모든 피처들의

SRID를 갱신합니다. 주의: 만약 스키&#xb9
지원되지 않으면 schema-aware pgsql installations 설치본&
current_schema() 사용

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예제

Insert geometries into roads table with a SRID set already using EWKT format:

```
COPY roads (geom) FROM STDIN;
SRID=4326;LINESTRING(0 0, 10 10)
SRID=4326;LINESTRING(10 10, 15 0)
\.
```

다음은 도로 테이블의 이전 SRID와
상관없이 SRID를 4326으로 변경할 것입&#

```
SELECT UpdateGeometrySRID('roads','geom',4326);
```

앞의 예시는 다음 DDL 선언문과 동&#xc77

```
ALTER TABLE roads
  ALTER COLUMN geom TYPE geometry(MULTILINESTRING, 4326)
    USING ST_SetSRID(geom,4326);
```

로드 작업 중 투영체를 잘못 (또는
'unknown'으로) 적용했는데 모든 데이터&
한번에 웹 메르카토르로 변환하&#x
싶다면, DDL을 통해 가능합니다. 하&#xc9
PostGIS 관리 함수 가운데 한번에 이런
작업을 할 수 있는 동일한 함수는
없습니다.

```
ALTER TABLE roads
 ALTER COLUMN geom TYPE geometry(MULTILINESTRING, 3857) USING ST_Transform(ST_SetSRID(geom ↩
     ,4326),3857) ;
```

관련 정보

UpdateRasterSRID, ST_SetSRID, ST_Transform

7.3 도형 작성자(constructor)

7.3.1 ST_GeomCollFromText

ST_GeomCollFromText — Creates a GeometryCollection or Multi* geometry from a set of geometries.

Synopsis

geometry **ST_MakeLine**(geometry set geoms);
geometry **ST_MakeLine**(geometry geom1, geometry geom2);
geometry **ST_MakeLine**(geometry[] geoms_array);

설명

Collects geometries into a geometry collection. The result is either a Multi* or a GeometryCollection, depending on whether the input geometries have the same or different types (homogeneous or heterogeneous). The input geometries are left unchanged within the collection.

Variant 1: accepts two input geometries

Variant 2: accepts an array of geometries

Variant 3: aggregate function accepting a rowset of geometries.

Note
If any of the input geometries are collections (Multi* or GeometryCollection) ST_Collect returns a GeometryCollection (since that is the only type which can contain nested collections). To prevent this, use ST_Dump in a subquery to expand the input collections to their atomic elements (see example below).

Note
ST_Collect and ST_Union appear similar, but in fact operate quite differently. ST_Collect aggregates geometries into a collection without changing them in any way. ST_Union geometrically merges geometries where they overlap, and splits linestrings at intersections. It may return single geometries when it dissolves boundaries.

1.4.0 버전부터 사용할 수 있습니다. 이 버전부터 ST_MakeLine가 도형 배열을 입력받을 수 있습니다. 더 많은 포인트를 빨리 처리하기 위해 ST_MakeLine 합산함수를 개선했습니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시: XLink 사용

Collect 2D points.

```
SELECT ST_AsText( ST_Collect( ST_GeomFromText('POINT(1 2)'),
        ST_GeomFromText('POINT(-2 3)') ));

st_astext
----------
MULTIPOINT((1 2),(-2 3))
```

Collect 3D points.

```
SELECT ST_AsEWKT( ST_Collect( ST_GeomFromEWKT('POINT(1 2 3)'),
                ST_GeomFromEWKT('POINT(1 2 4)') ) );

                st_asewkt
-------------------------
 MULTIPOINT(1 2 3,1 2 4)
```

Collect curves.

```
SELECT ST_AsText( ST_Collect( 'CIRCULARSTRING(220268 150415,220227 150505,220227 150406)',
                'CIRCULARSTRING(220227 150406,2220227 150407,220227 150406)'));

                st_astext
-----------------------------------------------------------------------------------
MULTICURVE(CIRCULARSTRING(220268 150415,220227 150505,220227 150406),
 CIRCULARSTRING(220227 150406,2220227 150407,220227 150406))
```

예시: 배열 버전 사용하기

Using an array constructor for a subquery.

```
SELECT ST_Collect( ARRAY( SELECT geom FROM sometable ) );
```

Using an array constructor for values.

```
SELECT ST_AsText(  ST_Collect(
                ARRAY[ ST_GeomFromText('LINESTRING(1 2, 3 4)'),
                        ST_GeomFromText('LINESTRING(3 4, 4 5)') ] )) As wktcollect;

--wkt collect --
MULTILINESTRING((1 2,3 4),(3 4,4 5))
```

예시: 공간 합산 버전

Creating multiple collections by grouping geometries in a table.

```
SELECT stusps, ST_Collect(f.geom) as geom
         FROM (SELECT stusps, (ST_Dump(geom)).geom As geom
                              FROM
                              somestatetable ) As f
        GROUP BY stusps
```

참고

ST_Dump, ST_AsBinary

7.3.2 ST_LineFromMultiPoint

ST_LineFromMultiPoint — 멀티포인트 도형으로부&#xd1
라인스트링을 생성합니다.

Synopsis

geometry **ST_LineFromMultiPoint**(geometry aMultiPoint);

설명

멀티포인트 도형으로부터 라인&#x
생성합니다.

Use ST_MakeLine to create lines from Point or LineString inputs.

This function supports 3d and will not drop the z-index.

예시

멀티포인트 도형으로부터 라인&#x
생성합니다.

```
-- 3D &#xba40;&#xd2f0;&#xd3ec;&#xc778;&#xd2b8;&#xb85c;&#xbd80;&#xd130; 3D  ↩
    &#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1; &#xc0dd;&#xc131;&#xd558;&#xae30;
SELECT ST_AsEWKT(ST_LineFromMultiPoint(ST_GeomFromEWKT('MULTIPOINT(1 2 3, 4 5 6, 7 8 9)'))) ↩
    ;
-- &#xacb0;&#xacfc; --
LINESTRING(1 2 3,4 5 6,7 8 9)
```

참고

ST_AsEWKT, ST_AsKML

7.3.3 ST_MakeEnvelope

ST_MakeEnvelope — 주어진 최소값과 최대값으&#x
형성된 직사각형 폴리곤을 생성&#x
입력값이 SRID로 지정된 SRS를 가지고
있어야 합니다.

Synopsis

geometry **ST_MakeEnvelope**(double precision xmin, double precision ymin, double precision xmax, double precision ymax, integer srid=unknown);

설명

최소값과 최대값으로 형성된 직&#x
폴리곤을 생성합니다. 입력값이
SRID로 지정된 SRS를 가지고 있어야 합&#
지정된 SRID가 없을 경우 알려지지
않은 공간 참조 시스템을 쓴다고
가정합니다.

1.5 버전부터 사용할 수 있습니다.

개선 사항: 2.0 버전부터 SRID를 지정하&#
않고도 직사각형(envelope)을 설정할 수
있는 기능이 추가됐습니다.

예시: 경계 상자 폴리곤을 빌드하&#

```
SELECT ST_AsText(ST_MakeEnvelope(10, 10, 11, 11, 4326));

st_asewkt
-----------
POLYGON((10 10, 10 11, 11 11, 11 10, 10 10))
```

참고

ST_MakePoint, ST_MakePoint, ST_Point, ST_SRID

7.3.4 ST_MakeLine

ST_MakeLine — 포인트, 멀티포인트 또는 라&#xc
도형으로부터 라인스트링을 생&#x

Synopsis

geometry **ST_MakeLine**(geometry set geoms);
geometry **ST_MakeLine**(geometry geom1, geometry geom2);
geometry **ST_MakeLine**(geometry[] geoms_array);

설명

Creates a LineString containing the points of Point, MultiPoint, or LineString geometries. Other geometry types cause an error.

Variant 1: accepts two input geometries

Variant 2: accepts an array of geometries

Variant 3: aggregate function accepting a rowset of geometries. To ensure the order of the input geometries use `ORDER BY` in the function call, or a subquery with an `ORDER BY` clause.

Repeated nodes at the beginning of input LineStrings are collapsed to a single point. Repeated points in Point and MultiPoint inputs are not collapsed. ST_RemoveRepeatedPoints can be used to collapse repeated points from the output LineString.

This function supports 3d and will not drop the z-index.

2.0.0 버전부터 라인스트링 구성 요&#xc18
입력을 지원하기 시작했습니다.

2.0.0 버전부터 라인스트링 구성 요&#xc18
입력을 지원하기 시작했습니다.

1.4.0 버전부터 사용할 수 있습니다.
이 버전부터 ST_MakeLine가 도형 배열을
입력받을 수 있습니다. 더 많은 포&
더 빨리 처리하기 위해 ST_MakeLine 합산
함수를 개선했습니다.

예시: 배열 버전 사용하기

Create a line composed of two points.

```
SELECT ST_MakeLine(ARRAY(SELECT ST_Centroid(the_geom) FROM visit_locations ORDER BY  ↩
    visit_time));

-- 3D &#xd3ec;&#xc778;&#xd2b8; 3&#xac1c;&#xb85c; 3D &#xb77c;&#xc778; &#xb9cc;&#xb4e4;&#xae30;
SELECT ST_AsEWKT(ST_MakeLine(ARRAY[ST_MakePoint(1,2,3),
                                   ST_MakePoint(3,4,5), ST_MakePoint(6,6,6)]));
                 st_asewkt
--------------------------
LINESTRING(1 2 3,3 4 5,6 6 6)
```

주어진 3D 포인트 도형 2개로 정의&#xb418
BOX3D를 생성합니다.

```
SELECT ST_AsEWKT( ST_MakeLine(ST_MakePoint(1,2,3), ST_MakePoint(3,4,5) ));

                st_asewkt
--------------------------
 LINESTRING(1 2 3,3 4 5)
```

포인트, 멀티포인트 또는 라인 도&#
라인스트링을 생성합니다.

```
select ST_AsText( ST_MakeLine( 'LINESTRING(0 0, 1 1)', 'LINESTRING(2 2, 3 3)' ) );

          st_astext
-----------------------------
 LINESTRING(0 0,1 1,2 2,3 3)
```

예시: 배열 버전 사용하기

Create a line from an array formed by a subquery with ordering.

```
SELECT ST_MakeLine( ARRAY( SELECT ST_Centroid(geom) FROM visit_locations ORDER BY  ↩
    visit_time) );
```

Create a 3D line from an array of 3D points

```
SELECT ST_MakeLine(ARRAY(SELECT ST_Centroid(the_geom) FROM visit_locations ORDER BY  ↩
    visit_time));

-- 3D &#xd3ec;&#xc778;&#xd2b8; 3&#xac1c;&#xb85c; 3D &#xb77c;&#xc778; &#xb9cc;&#xb4e4;&#xae30;
SELECT ST_AsEWKT(ST_MakeLine(ARRAY[ST_MakePoint(1,2,3),
                                   ST_MakePoint(3,4,5), ST_MakePoint(6,6,6)]));
                st_asewkt
--------------------------
LINESTRING(1 2 3,3 4 5,6 6 6)
```

예시: 공간 합산 버전

이 예시는 GPS 포인트 배열을 입력&#xbc1
도형 항목이 이동 순서대로의 GPS
포인트들로 이루어진 라인스트&#x
GPS 이동 하나당 한 개의 레코드를
생성합니다.

Using aggregate `ORDER BY` provides a correctly-ordered LineString.

```
SELECT gps.track_id, ST_MakeLine(gps.geom ORDER BY gps_time) As geom
        FROM gps_points As gps
        GROUP BY track_id;
```

Prior to PostgreSQL 9, ordering in a subquery can be used. However, sometimes the query plan may not respect the order of the subquery.

```
SELECT gps.track_id, ST_MakeLine(gps.geom) As geom
        FROM ( SELECT track_id, gps_time, geom
                        FROM gps_points ORDER BY track_id, gps_time ) As gps
        GROUP BY track_id;
```

참고

ST_RemoveRepeatedPoints, ST_AsText, ST_GeomFromText, ST_MakePoint

7.3.5 ST_MakePoint

ST_MakePoint — Creates a 2D, 3DZ or 4D Point.

Synopsis

geometry **ST_Point**(float x_lon, float y_lat);

geometry **ST_MakePointM**(float x, float y, float m);

geometry **ST_MakePoint**(double precision x, double precision y, double precision z, double precision m);

설명

주어진 포인트 도형들로 정의되&#x
BOX2D를 생성합니다.

Use ST_MakePointM to make points with XYM coordinates.

While not OGC-compliant, `ST_MakePoint` is faster and more precise than ST_GeomFromText and ST_PointFromText. It is also easier to use for numeric coordinate values.

Note
For geodetic coordinates, `X` is longitude and `Y` is latitude

---

This function supports 3d and will not drop the z-index.

예시

```
-- &#xc54c;&#xb824;&#xc9c0;&#xc9c0; &#xc54a;&#xc740; SRID&#xb97c; &#xac00;&#xc9c4;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xbc18;&#xd658;
SELECT ST_MakePoint(-71.1043443253471, 42.3150676015829);

-- WGS84 &#xacbd;&#xc704;&#xb3c4;&#xb85c; &#xd45c;&#xc2dc;&#xb41c;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xbc18;&#xd658;
SELECT ST_SetSRID(ST_MakePoint(-71.1043443253471, 42.3150676015829),4326);

-- 3D (&#xc608;&#xb97c; &#xb4e4;&#xc790;&#xba74; &#xace0;&#xb3c4;&#xb97c; &#xac00;&#xc9c4;) ↩
     &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xbc18;&#xd658;
SELECT ST_MakePoint(1, 2,1.5);

-- &#xd3ec;&#xc778;&#xd2b8;&#xc758; z&#xb97c; &#xc5bb;&#xc5b4;&#xc624;&#xae30;
SELECT ST_Z(ST_MakePoint(1, 2,1.5));
result
-------
1.5
```

참고

ST_GeomFromText, ST_PointFromText, ST_SetSRID, ST_MakePointM

7.3.6 ST_MakePointM

ST_MakePointM — x, y 좌표 및 단위를 가진 포인&#xd2b8
생성합니다.

Synopsis

geometry **ST_MakePointM**(float x, float y, float m);

설명

x, y 좌표 및 단위를 가진 포인트를 생성합니다.

Use ST_MakePoint to make points with XY, XYZ, or XYZM coordinates.

Note
For geodetic coordinates, `X` is longitude and `Y` is latitude

예시

Note
ST_AsEWKT is used for text output because ST_AsText does not support M values.

Create point with unknown SRID.

```
SELECT ST_AsEWKT(  ST_MakePointM(-71.1043443253471, 42.3150676015829, 10)  );

                                  st_asewkt
-----------------------------------------------
 POINTM(-71.1043443253471 42.3150676015829 10)
```

x, y 좌표 및 단위를 가진 포인트를 생성합니다.

```
SELECT ST_AsEWKT( ST_SetSRID(  ST_MakePointM(-71.104, 42.315, 10),  4326));

                                             st_asewkt
-----------------------------------------------------
SRID=4326;POINTM(-71.104 42.315 10)
```

Get measure of created point.

```
SELECT ST_M(  ST_MakePointM(-71.104, 42.315, 10)  );

result
-------
10
```

참고

ST_AsEWKT, ST_MakePoint, ST_SetSRID

7.3.7 ST_MakePolygon

ST_MakePolygon — Creates a Polygon from a shell and optional list of holes.

Synopsis

geometry **ST_MakePolygon**(geometry linestring);

geometry **ST_MakePolygon**(geometry outerlinestring, geometry[] interiorlinestrings);

설명

주어진 외부 구조(shell)로 형성된 폴&#xb9a
생성합니다. 입력 도형이 닫힌 라&
합니다.

Variant 1: Accepts one shell LineString.

Variant 2: Accepts a shell LineString and an array of inner (hole) LineStrings. A geometry array can be constructed using the PostgreSQL array_agg(), ARRAY[] or ARRAY() constructs.

Note

이 함수에 멀티라인스트링을 입력할 수는 없습니다. 라인스트링을 생성하려면 ST_LineMerge 또는 ST_Dump 를 이용하십시오.

This function supports 3d and will not drop the z-index.

예시: 배열 버전 사용하기

인코딩된 폴리라인 스트링으로&#xb
라인스트링을 생성합니다.

```
SELECT ST_MLineFromText('MULTILINESTRING((1 2, 3 4), (4 5, 6 7))');
```

Create a Polygon from an open LineString, using ST_StartPoint and ST_AddPoint to close it.

```
SELECT ST_MakePolygon( ST_AddPoint(foo.open_line, ST_StartPoint(foo.open_line)) )
FROM (
  SELECT ST_GeomFromText('LINESTRING(75 29,77 29,77 29, 75 29)') As open_line) As foo;
```

인코딩된 폴리라인 스트링으로&#xb
라인스트링을 생성합니다.

```
SELECT ST_AsEWKT( ST_MakePolygon( 'LINESTRING(75.15 29.53 1,77 29 1,77.6 29.5 1, 75.15  ↩
    29.53 1)'));

st_asewkt
-----------
POLYGON((75.15 29.53 1,77 29 1,77.6 29.5 1,75.15 29.53 1))
```

Create a Polygon from a LineString with measures

```
SELECT ST_AsEWKT( ST_MakePolygon( 'LINESTRINGM(75.15 29.53 1,77 29 1,77.6 29.5 2, 75.15  ↩
    29.53 2)' ));

st_asewkt
----------
POLYGONM((75.15 29.53 1,77 29 1,77.6 29.5 2,75.15 29.53 2))
```

예시: 내곽 구조를 가진 외곽 구조

개미 구멍을 가진 도넛을 빌드해&#x

```
SELECT ST_MakePolygon(
                ST_ExteriorRing(ST_Buffer(foo.line,10)),
        ARRAY[ST_Translate(foo.line,1,1),
                ST_ExteriorRing(ST_Buffer(ST_MakePoint(20,20),1)) ]
        )
FROM
        (SELECT ST_ExteriorRing(ST_Buffer(ST_MakePoint(10,10),10,10))
                As line )
                As foo;
```

Create a set of province boundaries with holes representing lakes. The input is a table of province Polygons/MultiPolygons and a table of water linestrings. Lines forming lakes are determined by using ST_IsClosed. The province linework is extracted by using ST_Boundary. As required by `ST_MakePolygon`, the boundary is forced to be a single LineString by using ST_LineMerge. (However, note that if a province has more than one region or has islands this will produce an invalid polygon.) Using a LEFT JOIN ensures all provinces are included even if they have no lakes.

Note

NULL 배열을 ST_MakePolygon에 입력하면 NULL을 반환하기 때문에 CASE 구조를 활용합니다.

```
SELECT p.gid, p.province_name,
        CASE WHEN array_agg(w.geom) IS NULL
        THEN p.geom
        ELSE  ST_MakePolygon( ST_LineMerge(ST_Boundary(p.geom)),
                        array_agg(w.geom)) END
FROM
        provinces p LEFT JOIN waterlines w
                ON (ST_Within(w.geom, p.geom) AND ST_IsClosed(w.geom))
GROUP BY p.gid, p.province_name, p.geom;
```

Another technique is to utilize a correlated subquery and the ARRAY() constructor that converts a row set to an array.

```
SELECT p.gid, p.province_name,
                CASE WHEN
                        ST_Accum(w.the_geom) IS NULL THEN p.the_geom
                ELSE  ST_MakePolygon(ST_LineMerge(ST_Boundary(p.the_geom)), ST_Accum(w. ↩
                    the_geom)) END
        FROM
                provinces p LEFT JOIN waterlines w
                        ON (ST_Within(w.the_geom, p.the_geom) AND ST_IsClosed(w.the_geom))
        GROUP BY p.gid, p.province_name, p.the_geom;

-- &#xc55e;&#xacfc; &#xb3d9;&#xc77c;&#xd55c; &#xc608;&#xc2dc;&#xc774;&#xc9c0;&#xb9cc;,  ↩
    &#xc0c1;&#xad00; &#xd558;&#xc704; &#xcffc;&#xb9ac;&#xc640;
-- &#xd589;&#xc758; &#xc9d1;&#xd569;&#xc744; &#xbc30;&#xc5f4;&#xb85c;  ↩
    &#xbcc0;&#xd658;&#xd558;&#xb294; PostgreSQL &#xb0b4;&#xc7a5; ARRAY()  ↩
    &#xd568;&#xc218;&#xb97c; &#xd65c;&#xc6a9;&#xd569;&#xb2c8;&#xb2e4;.

        SELECT p.gid,  p.province_name, CASE WHEN
                EXISTS(SELECT w.the_geom
                        FROM waterlines w
                        WHERE ST_Within(w.the_geom, p.the_geom)
                        AND ST_IsClosed(w.the_geom))
                THEN
```

```
                ST_MakePolygon(ST_LineMerge(ST_Boundary(p.the_geom)),
                        ARRAY(SELECT w.the_geom
                                FROM waterlines w
                                WHERE ST_Within(w.the_geom, p.the_geom)
                                AND ST_IsClosed(w.the_geom)))
                ELSE p.the_geom END As the_geom
        FROM
                provinces p;
```

참고

ST_BuildArea ST_Polygon

7.3.8 ST_Point

ST_Point — Creates a Point with X, Y and SRID values.

Synopsis

geometry **ST_Point**(float x_lon, float y_lat);

geometry **ST_MakePointM**(float x, float y, float m);

설명

Returns a Point with the given X and Y coordinate values. This is the SQL-MM equivalent for ST_MakePoint that takes just X and Y.

Note
For geodetic coordinates, `X` is longitude and `Y` is latitude

---

Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry.

This method implements the SQL/MM specification. SQL-MM 3: 6.1.2

예시: 도형

```
SELECT ST_Point( -71.104, 42.315);
```

```
SELECT ST_SetSRID(ST_Point( -71.104, 42.315),4326);
```

New in 3.2.0: With SRID specified

```
SELECT ST_Point( -71.104, 42.315, 4326);
```

예시: 지리형

Pre-PostGIS 3.2 syntax

```
SELECT CAST( ST_SetSRID(ST_Point( -71.104, 42.315), 4326) AS geography);
```

3.2 and on you can include the srid

```
SELECT CAST( ST_Point( -71.104, 42.315, 4326) AS geography);
```

PostgreSQL also provides the `::` short-hand for casting

```
SELECT ST_Point( -71.104, 42.315, 4326)::geography;
```

If the point coordinates are not in a geodetic coordinate system (such as WGS84), then they must be reprojected before casting to a geography. In this example a point in Pennsylvania State Plane feet (SRID 2273) is projected to WGS84 (SRID 4326).

```
SELECT CAST(ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326) As geography);
```

참고

Section 4.3, ST_MakePoint, ST_SetSRID, ST_Transform, ST_Point, ST_Point, ST_Point

7.3.9 ST_Point

ST_Point — Creates a Point with X, Y, Z and SRID values.

Synopsis

geometry **ST_MakePoint**(double precision x, double precision y, double precision z, double precision m);

설명

주어진 좌표값을 가진 ST_Point를 반환&#x
ST_MakePoint와 동일한 OGC 함수입니다.

Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry.

예시

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

참고

ST_MakePoint, ST_PointFromText, ST_SetSRID, ST_MakePointM

7.3.10 ST_Point

ST_Point — Creates a Point with X, Y, M and SRID values.

Synopsis

geometry **ST_PointM**(float x, float y, float m, integer srid=unknown);

설명

주어진 좌표값을 가진 ST_Point를 반환&#x
ST_MakePoint와 동일한 OGC 함수입니다.

Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry.

예시

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

참고

ST_MakePoint, ST_PointFromText, ST_SetSRID, ST_MakePointM

7.3.11 ST_Point

ST_Point — Creates a Point with X, Y, Z, M and SRID values.

Synopsis

geometry **ST_MakeEnvelope**(double precision xmin, double precision ymin, double precision xmax, double precision ymax, integer srid=unknown);

설명

주어진 좌표값을 가진 ST_Point를 반환&#x
ST_MakePoint와 동일한 OGC 함수입니다.

Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry.

예시

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

```
SELECT ST_SetSRID(ST_Point(-71.1043443253471, 42.3150676015829),4326)
```

참고

ST_MakePoint, ST_Point, ST_Point, ST_Point, ST_SetSRID

7.3.12 ST_Polygon

ST_Polygon — Creates a Polygon from a LineString with a specified SRID.

Synopsis

geometry **ST_Polygon**(geometry aLineString, integer srid);

설명

Returns a polygon built from the given LineString and sets the spatial reference system from the `srid`.

ST_Polygon is similar to ST_MakePolygon Variant 1 with the addition of setting the SRID.

, ST_MakePoint, ST_SetSRID

> **Note**
> 이 함수에 멀티라인스트링을 입력할 수는 없습니다. 라인스트링을 생성하려면 ST_LineMerge 또는 ST_Dump 를 이용하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 8.3.2

This function supports 3d and will not drop the z-index.

예시

Create a 2D polygon.

```
SELECT ST_AsText( ST_Polygon('LINESTRING(75 29, 77 29, 77 29, 75 29)'::geometry, 4326) );

-- result --
POLYGON((75 29, 77 29, 77 29, 75 29))
```

Create a 3D polygon.

```
SELECT ST_AsEWKT( ST_Polygon( ST_GeomFromEWKT('LINESTRING(75 29 1, 77 29 2, 77 29 3, 75 29  ↩
    1)'), 4326) );

-- result --
SRID=4326;POLYGON((75 29 1, 77 29 2, 77 29 3, 75 29 1))
```

참고

ST_AsEWKT, ST_AsText, ST_GeomFromEWKT, ST_GeomFromText, ST_LineMerge, ST_MakePolygon

7.3.13 ST_MakeEnvelope

ST_MakeEnvelope — Creates a rectangular Polygon in Web Mercator (SRID:3857) using the XYZ tile system.

Synopsis

geometry **ST_MakePoint**(double precision x, double precision y, double precision z, double precision m);

설명

Creates a rectangular Polygon giving the extent of a tile in the XYZ tile system. The tile is specifed by the zoom level Z and the XY index of the tile in the grid at that level. Can be used to define the tile bounds required by ST_AsMVTGeom to convert geometry into the MVT tile coordinate space.

By default, the tile envelope is in the Web Mercator coordinate system (SRID:3857) using the standard range of the Web Mercator system (-20037508.342789, 20037508.342789). This is the most common coordinate system used for MVT tiles. The optional `bounds` parameter can be used to generate tiles in any coordinate system. It is a geometry that has the SRID and extent of the "Zoom Level zero" square within which the XYZ tile system is inscribed.

The optional `margin` parameter can be used to expand a tile by the given percentage. E.g. `margin=0.125` expands the tile by 12.5%, which is equivalent to buffer=512 when the tile extent size is 4096, as used in ST_AsMVTGeom. This is useful to create a tile buffer to include data lying outside of the tile's visible area, but whose existence affects the tile rendering. For example, a city name (a point) could be near an edge of a tile, so its label should be rendered on two tiles, even though the point is located in the visible area of just one tile. Using expanded tiles in a query will include the city point in both tiles. Use a negative value to shrink the tile instead. Values less than -0.5 are prohibited because that would eliminate the tile completely. Do not specify a margin when using with `ST_AsMVTGeom`. See the example for ST_AsMVT.

개선 사항: 2.0.0 버전에서 선택적인 기본 SRID 파라미터가 추가됐습니&#xb2e4

2.1.0 버전부터 사용할 수 있습니다.

예시: 경계 상자 폴리곤을 빌드하&#

```
SELECT ST_AsText( ST_TileEnvelope(2, 1, 1) );

 st_astext
------------------------------
 POLYGON((-10018754.1713945 0,-10018754.1713945 10018754.1713945,0 10018754.1713945,0  ↩
     0,-10018754.1713945 0))

SELECT ST_AsText( ST_TileEnvelope(3, 1, 1, ST_MakeEnvelope(-180, -90, 180, 90, 4326) ) );

                      st_astext
------------------------------------------------------
 POLYGON((-135 45,-135 67.5,-90 67.5,-90 45,-135 45))
```

참고

ST_MakeEnvelope

7.3.14 ST_HexagonGrid

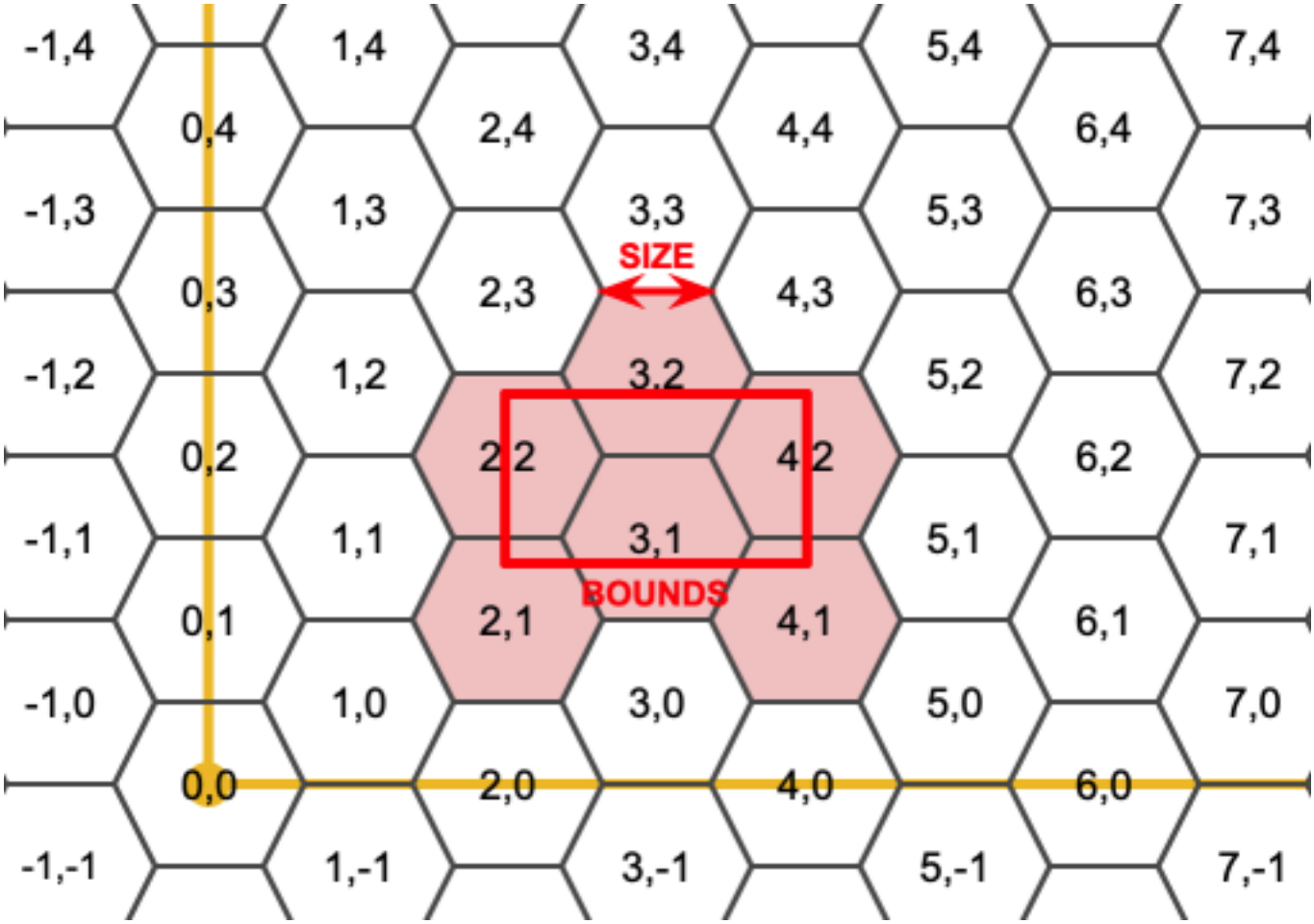
ST_HexagonGrid — Returns a set of hexagons and cell indices that completely cover the bounds of the geometry argument.

Synopsis

geometry **ST_Point**(float x_lon, float y_lat);

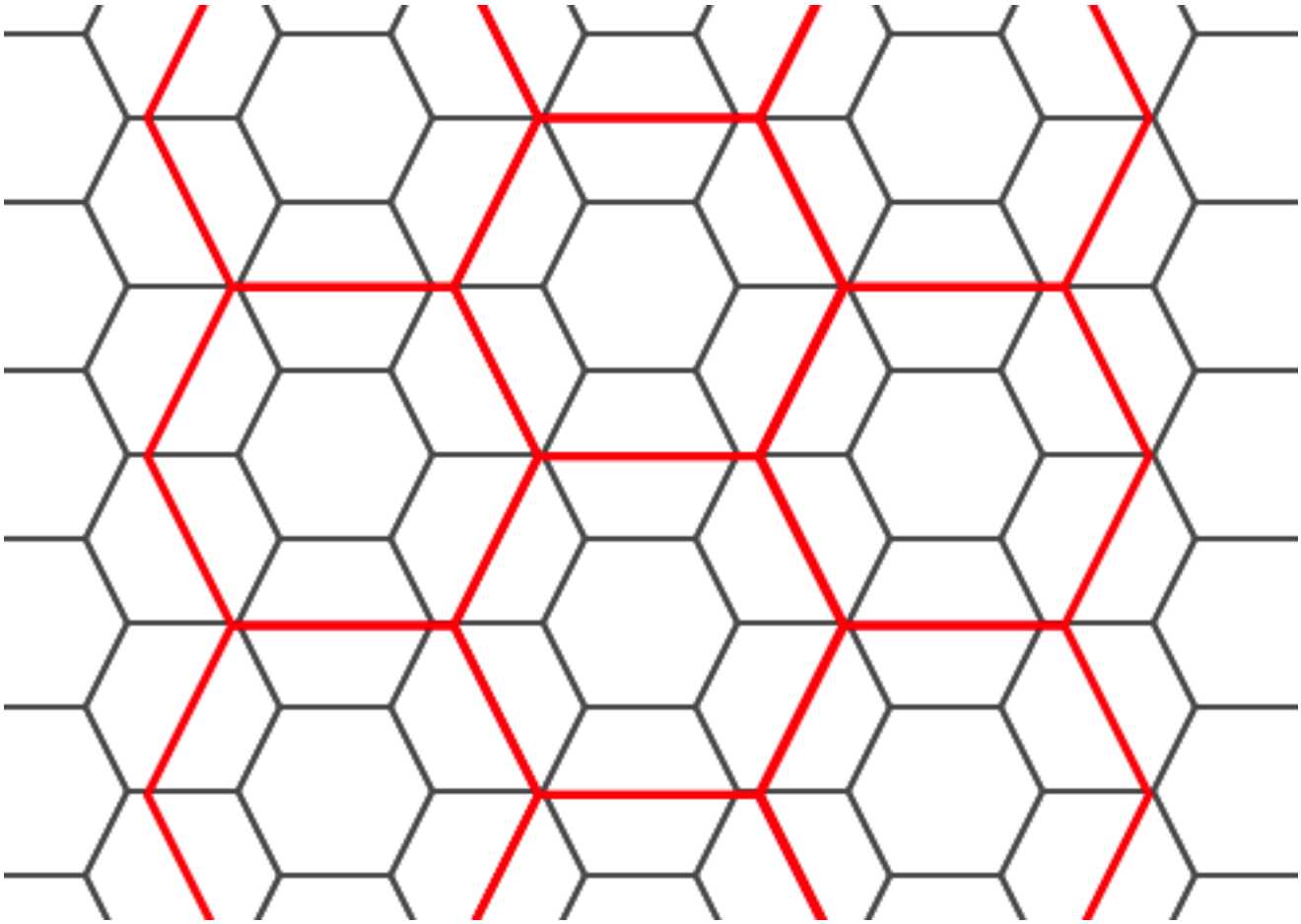
설명

Starts with the concept of a hexagon tiling of the plane. (Not a hexagon tiling of the globe, this is not the H3 tiling scheme.) For a given planar SRS, and a given edge size, starting at the origin of the SRS, there is one unique hexagonal tiling of the plane, Tiling(SRS, Size). This function answers the question: what hexagons in a given Tiling(SRS, Size) overlap with a given bounds.



The SRS for the output hexagons is the SRS provided by the bounds geometry.

Doubling or tripling the edge size of the hexagon generates a new parent tiling that fits with the origin tiling. Unfortunately, it is not possible to generate parent hexagon tilings that the child tiles perfectly fit inside.



2.1.0 버전부터 사용할 수 있습니다.

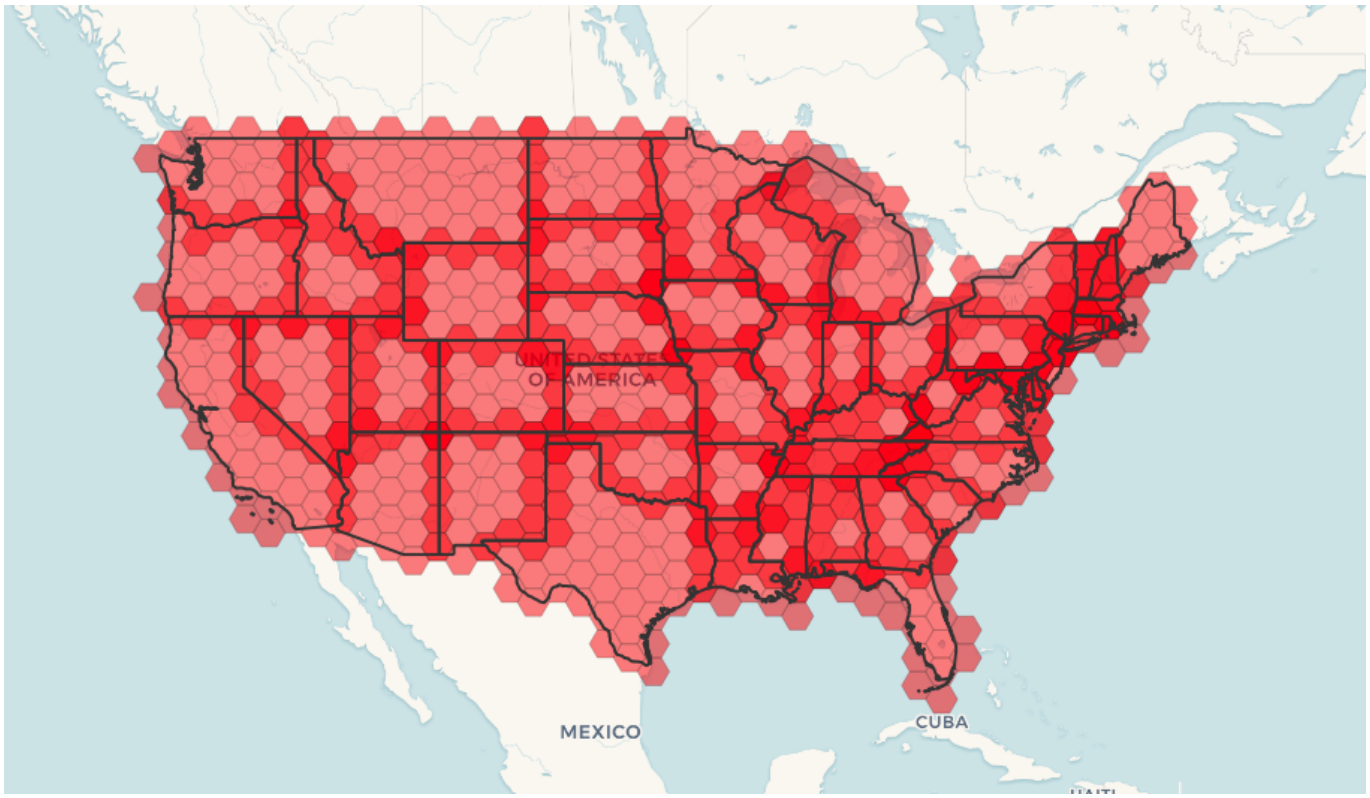
예시: 배열 버전 사용하기

To do a point summary against a hexagonal tiling, generate a hexagon grid using the extent of the points as the bounds, then spatially join to that grid.

```
SELECT COUNT(*), hexes.geom
FROM
    ST_HexagonGrid(
        10000,
        ST_SetSRID(ST_EstimatedExtent('pointtable', 'geom'), 3857)
    ) AS hexes
    INNER JOIN
    pointtable AS pts
    ON ST_Intersects(pts.geom, hexes.geom)
GROUP BY hexes.geom;
```

예시: 경계 상자 폴리곤을 빌드하&#

If we generate a set of hexagons for each polygon boundary and filter out those that do not intersect their hexagons, we end up with a tiling for each polygon.



Tiling states results in a hexagon coverage of each state, and multiple hexagons overlapping at the borders between states.

Note
The LATERAL keyword is implied for set-returning functions when referring to a prior table in the FROM list. So CROSS JOIN LATERAL, CROSS JOIN, or just plain , are equivalent constructs for this example.

```
SELECT admin1.gid, hex.geom
FROM
    admin1
    CROSS JOIN
    ST_HexagonGrid(100000, admin1.geom) AS hex
WHERE
    adm0_a3 = 'USA'
    AND
    ST_Intersects(admin1.geom, hex.geom)
```

참고

ST_EstimatedExtent, ST_MakePoint, ST_Point, ST_SRID

7.3.15 ST_Hexagon

ST_Hexagon — Returns a single hexagon, using the provided edge size and cell coordinate within the hexagon grid space.

Synopsis

geometry **ST_MakePoint**(double precision x, double precision y, double precision z, double precision m);

설명

Uses the same hexagon tiling concept as ST_HexagonGrid, but generates just one hexagon at the desired cell coordinate. Optionally, can adjust origin coordinate of the tiling, the default origin is at 0,0.

Hexagons are generated with no SRID set, so use ST_SetSRID to set the SRID to the one you expect.

2.1.0 버전부터 사용할 수 있습니다.

Example: Creating a hexagon at the origin

```
SELECT ST_AsText(ST_SetSRID(ST_Hexagon(1.0, 0, 0), 3857));

POLYGON((-1 0,-0.5
         -0.866025403784439,0.5
         -0.866025403784439,1
         0,0.5
         0.866025403784439,-0.5
         0.866025403784439,-1 0))
```

참고

ST_MakeEnvelope, ST_MakePoint, ST_SetSRID

7.3.16 ST_SquareGrid

ST_SquareGrid — Returns a set of grid squares and cell indices that completely cover the bounds of the geometry argument.

Synopsis

geometry **ST_Point**(float x_lon, float y_lat);

설명

Starts with the concept of a square tiling of the plane. For a given planar SRS, and a given edge size, starting at the origin of the SRS, there is one unique square tiling of the plane, Tiling(SRS, Size). This function answers the question: what grids in a given Tiling(SRS, Size) overlap with a given bounds.

The SRS for the output squares is the SRS provided by the bounds geometry.

Doubling or edge size of the square generates a new parent tiling that perfectly fits with the original tiling. Standard web map tilings in mercator are just powers-of-two square grids in the mercator plane.

2.1.0 버전부터 사용할 수 있습니다.

예시: 경계 상자 폴리곤을 빌드하&#

The grid will fill the whole bounds of the country, so if you want just squares that touch the country you will have to filter afterwards with ST_Intersects.

```
WITH grid AS (
SELECT (ST_SquareGrid(1, ST_Transform(geom,4326))).*
FROM admin0 WHERE name = 'Canada'
)
  SELEcT ST_AsText(geom)
  FROM grid
```

예시: 배열 버전 사용하기

To do a point summary against a square tiling, generate a square grid using the extent of the points as the bounds, then spatially join to that grid. Note the estimated extent might be off from actual extent, so be cautious and at very least make sure you've analyzed your table.

```
SELECT COUNT(*), squares.geom
    FROM
    pointtable AS pts
    INNER JOIN
    ST_SquareGrid(
        1000,
        ST_SetSRID(ST_EstimatedExtent('pointtable', 'geom'), 3857)
    ) AS squares
    ON ST_Intersects(pts.geom, squares.geom)
    GROUP BY squares.geom
```

예시: 배열 버전 사용하기

This yields the same result as the first example but will be slower for a large number of points

```
SELECT COUNT(*), squares.geom
    FROM
    pointtable AS pts
    INNER JOIN
    ST_SquareGrid(
        1000,
       pts.geom
    ) AS squares
    ON ST_Intersects(pts.geom, squares.geom)
    GROUP BY squares.geom
```

참고

ST_MakeEnvelope, ST_Point, ST_SetSRID, ST_SRID

7.3.17 ST_Square

ST_Square — Returns a single square, using the provided edge size and cell coordinate within the square grid space.

Synopsis

geometry **ST_MakePoint**(double precision x, double precision y, double precision z, double precision m);

설명

Uses the same square tiling concept as ST_SquareGrid, but generates just one square at the desired cell coordinate. Optionally, can adjust origin coordinate of the tiling, the default origin is at 0,0.

Squares are generated with no SRID set, so use ST_SetSRID to set the SRID to the one you expect.

2.1.0 버전부터 사용할 수 있습니다.

Example: Creating a square at the origin

```
SELECT ST_AsText(ST_MakeEnvelope(10, 10, 11, 11, 4326));

st_asewkt
-----------
POLYGON((10 10, 10 11, 11 11, 11 10, 10 10))
```

참고

ST_MakeEnvelope, ST_MakeLine, ST_MakePolygon

7.3.18 ST_Letters

ST_Letters — Returns the input letters rendered as geometry with a default start position at the origin and default text height of 100.

Synopsis

geometry **ST_Letters**(text letters, json font);

설명

Uses a built-in font to render out a string as a multipolygon geometry. The default text height is 100.0, the distance from the bottom of a descender to the top of a capital. The default start position places the start of the baseline at the origin. Over-riding the font involves passing in a json map, with a character as the key, and base64 encoded TWKB for the font shape, with the fonts having a height of 1000 units from the bottom of the descenders to the tops of the capitals.

The text is generated at the origin by default, so to reposition and resize the text, first apply the `ST_Scale` function and then apply the `ST_Translate` function.

2.1.0 버전부터 사용할 수 있습니다.

예시: 경계 상자 폴리곤을 빌드하&#

```
SELECT ST_AsText(ST_Letters('Yo'), 1);
```

Letters generated by ST_Letters

Example: Scaling and moving words

```
SELECT ST_Translate(ST_Scale(ST_Letters('Yo'), 10, 10), 100,100);
```

참고

ST_AsTWKB, ST_Scale, ST_Translate

7.4 도형 접근자(accessor)

7.4.1 도형 유형

도형 유형 — ST_Geometry 값의 도형 유형을 반환합니다.

Synopsis

text **GeometryType**(geometry geomA);

설명

도형의 유형을 스트링으로 반환&#
예: 'LINESTRING', 'POLYGON', 'MULTIPOINT' 등등.

OGC 사양 s2.1.1.1 - 해당 도형 인스턴스가 속해 있는, 인스턴스화할 수 있는 도형 하위 유형의 명칭을 스트링&#
반환합니다.

Note

이 함수는 'POINTM' 형식의 스트링을 반환해서 도형에 단위가 적용되었는지 여부도 보여줍니&#

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT GeometryType(ST_GeomFromText('LINESTRING(77.29 29.07,77.42 29.26,77.27 29.31,77.29  ↩
    29.07)'));
 geometrytype
--------------
 LINESTRING
```

```
SELECT ST_GeometryType(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0  ↩
    0 0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1) ↩
                    ) )'));
                        -- &#xacb0;&#xacfc;
                        POLYHEDRALSURFACE
```

```
SELECT GeometryType(geom) as result
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
 result
--------
 TIN
```

참고

ST_GeometryType

7.4.2 ST_Boundary

ST_Boundary — 해당 도형의 결합된 범위의 닫힘 여부를 반환합니다.

Synopsis

geometry **ST_Boundary**(geometry geomA);

설명

해당 도형의 결합된 범위의 닫힘(cl
여부를 반환합니다. 결합 범위(combinatori

boundary)는 OGC 사양서의 3.12.3.2 단원이 설명&#xd558
정의됩니다. 이 함수의 결과가 닫&#
때문에, 즉 위상적(位相的)으로 폐&
때문에, OGC 사양서 3.12.2 단원에서 설명&
표현적인 도형 원형(primitive)을 이용해&#
결과 범위를 표현할 수 있습니다.

GEOS 모듈로 실행

Note

2.0.0 미만 버전에서 이 함수를 GEOMETRYCOLLECTION과 함께 사용하면 예외가 발생했습니다. 2.0.0 이후 버전은 대신 (입력을 지원하지 않는다는 의미의) NULL을 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. OGC SPEC s2.1.1.1

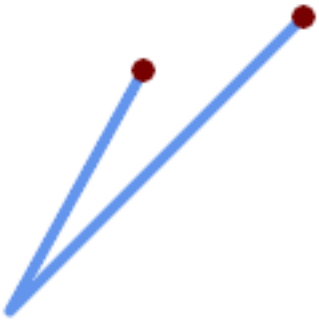
This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.17

This function supports 3d and will not drop the z-index.

개선 사항: 2.1.0 버전부터 삼각형을 지원하기 시작했습니다.

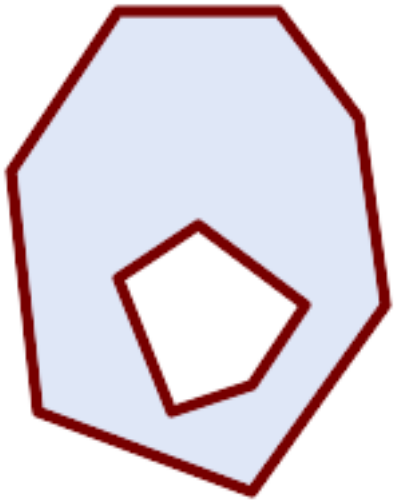
Changed: 3.2.0 support for TIN, does not use geos, does not linearize curves

예시



*범위
포인트들이
겹치는
라인스트링*

```
SELECT ST_Boundary(geom)
FROM (SELECT 'LINESTRING(100 150,50 60,  ↩
     70 80, 160 170)'::geometry As geom) As f;

ST_AsText output

MULTIPOINT((100 150),(160 170))
```



*범위
멀티라인스트링
가진 폴리곤
구멍*

```
SELECT ST_Boundary(geom)
FROM (SELECT
'POLYGON (( 10 130, 50 190, 110 190, 140  ↩
     150, 150 80, 100 10, 20 40, 10 130 ),
        ( 70 40, 100 50, 120 80, 80 110,  ↩
     50 90, 70 40 ))'::geometry As geom) As f;

ST_AsText output

MULTILINESTRING((10 130,50 190,110  ↩
     190,140 150,150 80,100 10,20 40,10 130),
        (70 40,100 50,120 80,80 110,50  ↩
     90,70 40))
```

```
SELECT ST_AsText(ST_Boundary(ST_GeomFromText('LINESTRING(1 1,0 0, -1 1)')));
st_astext
-----------
MULTIPOINT((1 1),(-1 1))

SELECT ST_AsText(ST_Boundary(ST_GeomFromText('POLYGON((1 1,0 0, -1 1, 1 1))')));
st_astext
----------
LINESTRING(1 1,0 0,-1 1,1 1)

--Using a 3d polygon
SELECT ST_AsEWKT(ST_Boundary(ST_GeomFromEWKT('POLYGON((1 1 1,0 0 1, -1 1 1, 1 1 1))')));

st_asewkt
-----------------------------------
LINESTRING(1 1 1,0 0 1,-1 1 1,1 1 1)

--Using a 3d multilinestring
SELECT ST_AsEWKT(ST_Boundary(ST_GeomFromEWKT('MULTILINESTRING((1 1 1,0 0 0.5, -1 1 1),(1 1  ↩
    0.5,0 0 0.5, -1 1 0.5, 1 1 0.5) )')));
```

```
st_asewkt
----------
MULTIPOINT((-1 1 1),(1 1 0.75))
```

참고

ST_AsText, ST_ExteriorRing, ST_MakePolygon

7.4.3 ST_BoundingDiagonal

ST_BoundingDiagonal — 주어진 도형의 경계 상자&#xc75
대각선을 반환합니다.

Synopsis

geometry **ST_BoundingDiagonal**(geometry geom, boolean fits=false);

설명

주어진 도형의 경계 상자의 대각&#x
라인스트링으로 반환합니다. 빈
도형을 입력받은 경우 빈 대각선&#
반환하게 됩니다. 빈 도형이 아니&
포인트 2개 중 시작점이 각 차원의
최소값들을, 종단점이 각 차원의
최대값들을 가진 라인스트링을
반환합니다.

`fits` 파라미터는 딱 맞는(best fit) 경계 상&#xc790
필요한지 여부를 설정합니다. 거&#
설정한다면 조금 넉넉한 경계 상&#
용납할 수 있습니다(수많은 꼭짓&#
가진 도형의 경우 더 빨리 처리할
수 있습니다). 어떤 경우든 반환된
대각선의 경계 상자는 항상 입력
도형을 둘러쌉니다.

반환된 라인스트링 도형은 언제&#
입력 도형의 SRID 및 차원수를 유지&#xd5

Note

차원이 낮은 (입력 도형이
단일 꼭짓점) 경우 반환되는
라인스트링이 위상적으로
유효하지 않을 (내부가 없을)
것입니다. 그렇다고 해서
반환된 도형이 의미론적으로
유효하지 않다는 뜻은
아닙니다.

2.2.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

예시

```
-- &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xb458;&#xb7ec;&#xc2fc;  ↩
    &#xbc84;&#xd37c;&#xc5d0;&#xc11c; X&#xc758; &#xcd5c;&#xc18c;&#xac12;&#xc744;  ↩
    &#xc5bb;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT ST_X(ST_StartPoint(ST_BoundingDiagonal(
  ST_Buffer(ST_MakePoint(0,0),10)
)));
 st_x
------
  -10
```

참고

ST_StartPoint, ST_EndPoint, ST_X, ST_Y, ST_Z, ST_M, &&&

7.4.4 ST_CoordDim

ST_CoordDim — ST_Geometry 값의 좌표 차원을 반환합&

Synopsis

integer **ST_CoordDim**(geometry geomA);

설명

ST_Geometry 값의 좌표 차원을 반환합니&#xb2e4

이 함수는 MM을 준수하는, ST_NDims 와 동&#xc
함수합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.3

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_CoordDim('CIRCULARSTRING(1 2 3, 1 3 4, 5 6 7, 8 9 10, 11 12 13)');
-- &#xacb0;&#xacfc; --
3

SELECT ST_CoordDim(ST_Point(1,2));
-- &#xacb0;&#xacfc; --
2
```

참고

ST_NDims

7.4.5 ST_Dimension

ST_Dimension — ST_Geometry 값의 좌표 차원을 반환합

Synopsis

integer **ST_Dimension**(geometry g);

설명

좌표 차원과 동등하거나 낮아야 하는, 해당 도형 객체의 내재된 차원반환합니다. OGC 사양서 s2.1.1.1 단원을 보면 `POINT` 는 0, `LINESTRING` 은 1, `POLYGON` 은 2, 그리고 `GEOMETRYCOLLECTION` 의 경우 구성 요소 가운데 가장 높은 차원입니다. 알려지지 않은 (텅 빈) 도형인 경우 null을 반환&#xd5

This method implements the SQL/MM specification. SQL-MM 3: 5.1.2

개선 사항: 2.0.0 버전부터 다면체 표&#xba7 surface) 및 TIN을 지원합니다. 빈 도형이 주어져도 더 이상 예외가 발생하&#x 않습니다.

> **Note**
> 2.0.0 미만 버전에서는 빈 도형에 대해 예외를 발생시켰습니다.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_Dimension('GEOMETRYCOLLECTION(LINESTRING(1 1,0 0),POINT(0 0))');
ST_Dimension
------------
1
```

참고

ST_NDims

7.4.6 ST_Dump

ST_Dump — Returns a set of `geometry_dump` rows for the components of a geometry.

Synopsis

geometry **ST_Envelope**(geometry g1);

설명

A set-returning function (SRF) that extracts the components of a geometry. It returns a set of geometry_dump rows, each containing a geometry (*geom* field) and an array of integers (*path* field).

For an atomic geometry type (POINT,LINESTRING,POLYGON) a single record is returned with an empty *path* array and the input geometry as *geom*. For a collection or multi-geometry a record is returned for each of the collection components, and the *path* denotes the position of the component inside the collection.

ST_Dump is useful for expanding geometries. It is the inverse of a ST_GeomCollFromText / GROUP BY, in that it creates new rows. For example it can be use to expand MULTIPOLYGONS into POLYGONS.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

Availability: PostGIS 1.0.0RC1. Requires PostgreSQL 7.3 or higher.

Note

1.3.4 미만 버전에서 이 함수에 만곡 도형(curve)을 담고 있는 도형을 입력하면 충돌이 일어났습니다. 1.3.4 버전부터 이 버그가 해결됐습니다.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

표준 예시

```
SELECT sometable.field1, sometable.field1,
      (ST_Dump(sometable.geom)).geom AS geom
FROM sometable;

-- Break a compound curve into its constituent linestrings and circularstrings
SELECT ST_AsEWKT(a.geom), ST_HasArc(a.geom)
  FROM ( SELECT (ST_Dump(p_geom)).geom AS geom
         FROM (SELECT ST_GeomFromEWKT('COMPOUNDCURVE(CIRCULARSTRING(0 0, 1 1, 1 0),(1 0, 0  ↩
             1))') AS p_geom) AS b
        ) AS a;
          st_asewkt          | st_hasarc
-----------------------------+----------
 CIRCULARSTRING(0 0,1 1,1 0) | t
 LINESTRING(1 0,0 1)         | f
(2 rows)
```

다면체 표면, TIN 및 삼각형 예시

```
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74; &#xc608;&#xc2dc;
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74;&#xc744; &#xac01; &#xba74;&#xc73c;&#xb85c; ↩
    &#xbd84;&#xd574;&#xd558;&#xae30;
SELECT ST_AsEWKT(ST_GeometryN(p_geom,3)) As geom_ewkt
  FROM (SELECT ST_GeomFromEWKT('POLYHEDRALSURFACE(
((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)),
((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)),
((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1))
)')  AS p_geom )  AS a;

                geom_ewkt
-----------------------------------------
 POLYGON((0 0 0,1 0 0,1 0 1,0 0 1,0 0 0))
```

```
-- TIN --
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                 wkt
-------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

참고

geometry_dump, ST_GeomFromEWKT, ST_Dump, ST_GeometryN, ST_NumGeometries

7.4.7 ST_NumPoints

ST_NumPoints — 도형의 내용을 요약한 텍스&#x
반환합니다.

Synopsis

geometry **ST_Points**(geometry geom);

설명

A set-returning function (SRF) that extracts the coordinates (vertices) of a geometry. It returns a set of geometry_dump rows, each containing a geometry (*geom* field) and an array of integers (*path* field).

- the *geom* field POINTs represent the coordinates of the supplied geometry.
- the *path* field (an integer[]) is an index enumerating the coordinate positions in the elements of the supplied geometry. The indices are 1-based. For example, for a LINESTRING the paths are {i} where i is the nth coordinate in the LINESTRING. For a POLYGON the paths are {i, j} where i is the ring number (1 is outer; inner rings follow) and j is the coordinate position in the ring.

To obtain a single geometry containing the coordinates use ST_Points.

Enhanced: 2.1.0 Faster speed. Reimplemented as native-C.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

1.2.2 버전부터 사용할 수 있습니다.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

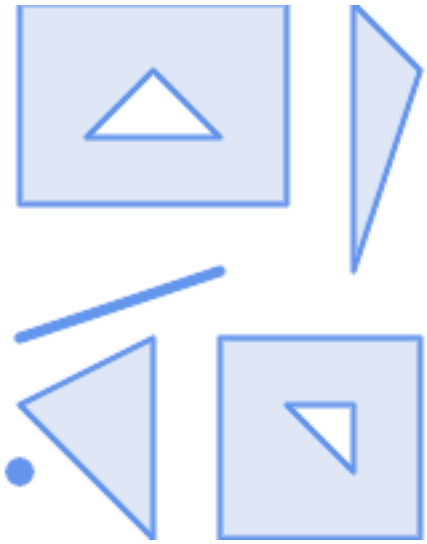
This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

Classic Explode a Table of LineStrings into nodes

```
SELECT edge_id, (dp).path[1] As index, ST_AsText((dp).geom) As wktnode
FROM (SELECT 1 As edge_id
        , ST_DumpPoints(ST_GeomFromText('LINESTRING(1 2, 3 4, 10 10)')) AS dp
     UNION ALL
     SELECT 2 As edge_id
        , ST_DumpPoints(ST_GeomFromText('LINESTRING(3 5, 5 6, 9 10)')) AS dp
   ) As foo;
 edge_id | index |    wktnode
---------+-------+--------------
       1 |     1 | POINT(1 2)
       1 |     2 | POINT(3 4)
       1 |     3 | POINT(10 10)
       2 |     1 | POINT(3 5)
       2 |     2 | POINT(5 6)
       2 |     3 | POINT(9 10)
```

표준 예시



```
SELECT path, ST_AsText(geom)
FROM (
  SELECT (ST_DumpPoints(g.geom)).*
  FROM
    (SELECT
       'GEOMETRYCOLLECTION(
          POINT ( 0 1 ),
          LINESTRING ( 0 3, 3 4 ),
          POLYGON (( 2 0, 2 3, 0 2, 2 0 )),
          POLYGON (( 3 0, 3 3, 6 3, 6 0, 3 0 ),
                   ( 5 1, 4 2, 5 2, 5 1 )),
          MULTIPOLYGON (
                  (( 0 5, 0 8, 4 8, 4 5, 0 5 ),
                   ( 1 6, 3 6, 2 7, 1 6 )),
                  (( 5 4, 5 8, 6 7, 5 4 ))
          )
        )'::geometry AS geom
    ) AS g
  ) j;

   path    | st_astext
-----------+------------
 {1,1}     | POINT(0 1)
 {2,1}     | POINT(0 3)
 {2,2}     | POINT(3 4)
 {3,1,1}   | POINT(2 0)
 {3,1,2}   | POINT(2 3)
 {3,1,3}   | POINT(0 2)
 {3,1,4}   | POINT(2 0)
 {4,1,1}   | POINT(3 0)
 {4,1,2}   | POINT(3 3)
 {4,1,3}   | POINT(6 3)
 {4,1,4}   | POINT(6 0)
 {4,1,5}   | POINT(3 0)
 {4,2,1}   | POINT(5 1)
 {4,2,2}   | POINT(4 2)
 {4,2,3}   | POINT(5 2)
 {4,2,4}   | POINT(5 1)
 {5,1,1,1} | POINT(0 5)
 {5,1,1,2} | POINT(0 8)
 {5,1,1,3} | POINT(4 8)
```

```
 {5,1,1,4} | POINT(4 5)
 {5,1,1,5} | POINT(0 5)
 {5,1,2,1} | POINT(1 6)
 {5,1,2,2} | POINT(3 6)
 {5,1,2,3} | POINT(2 7)
 {5,1,2,4} | POINT(1 6)
 {5,2,1,1} | POINT(5 4)
 {5,2,1,2} | POINT(5 8)
 {5,2,1,3} | POINT(6 7)
 {5,2,1,4} | POINT(5 4)
(29 rows)
```

다면체 표면, TIN 및 삼각형 예시

```
-- Polyhedral surface cube --
SELECT (g.gdump).path, ST_AsEWKT((g.gdump).geom) as wkt
  FROM
    (SELECT
       ST_DumpPoints(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0  ↩
          0)),
((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )') ) AS gdump
    ) AS g;
-- result --
  path   |     wkt
---------+--------------
 {1,1,1} | POINT(0 0 0)
 {1,1,2} | POINT(0 0 1)
 {1,1,3} | POINT(0 1 1)
 {1,1,4} | POINT(0 1 0)
 {1,1,5} | POINT(0 0 0)
 {2,1,1} | POINT(0 0 0)
 {2,1,2} | POINT(0 1 0)
 {2,1,3} | POINT(1 1 0)
 {2,1,4} | POINT(1 0 0)
 {2,1,5} | POINT(0 0 0)
 {3,1,1} | POINT(0 0 0)
 {3,1,2} | POINT(1 0 0)
 {3,1,3} | POINT(1 0 1)
 {3,1,4} | POINT(0 0 1)
 {3,1,5} | POINT(0 0 0)
 {4,1,1} | POINT(1 1 0)
 {4,1,2} | POINT(1 1 1)
 {4,1,3} | POINT(1 0 1)
 {4,1,4} | POINT(1 0 0)
 {4,1,5} | POINT(1 1 0)
 {5,1,1} | POINT(0 1 0)
 {5,1,2} | POINT(0 1 1)
 {5,1,3} | POINT(1 1 1)
 {5,1,4} | POINT(1 1 0)
 {5,1,5} | POINT(0 1 0)
 {6,1,1} | POINT(0 0 1)
 {6,1,2} | POINT(1 0 1)
 {6,1,3} | POINT(1 1 1)
 {6,1,4} | POINT(0 1 1)
 {6,1,5} | POINT(0 0 1)
(30 rows)
```

```
-- TIN --
```

```
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                 wkt
------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

```
-- TIN --
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                 wkt
------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

참고

geometry_dump, ST_GeomFromEWKT, ST_Dump, ST_GeometryN, ST_NumGeometries

7.4.8 ST_NumPoints

ST_NumPoints — 도형의 내용을 요약한 텍스&#x
반환합니다.

Synopsis

geometry **ST_Points**(geometry geom);

설명

A set-returning function (SRF) that extracts the segments of a geometry. It returns a set of geometry_dump rows, each containing a geometry (*geom* field) and an array of integers (*path* field).

- `LINESTRING` 이 닫혀 있는 단순 도형인 경&#xc
  `TRUE` 를 반환합니다.
- the *path* field (an `integer[]`) is an index enumerating the segment start point positions in the elements of the supplied geometry. The indices are 1-based. For example, for a `LINESTRING` the paths are `{i}` where `i` is the `nth` segment start point in the `LINESTRING`. For a `POLYGON` the paths are `{i, j}` where `i` is the ring number (1 is outer; inner rings follow) and `j` is the segment start point position in the ring.

2.2.0 버전부터 사용할 수 있습니다.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

표준 예시

```
SELECT path, ST_AsText(geom)
FROM (
    SELECT (ST_DumpSegments(g.geom)).*
    FROM (SELECT 'GEOMETRYCOLLECTION(
    LINESTRING(1 1, 3 3, 4 4),
    POLYGON((5 5, 6 6, 7 7, 5 5))
)'::geometry AS geom
        ) AS g
) j;

  path   &#x2502;      st_astext
---------------------------------
 {1,1}   &#x2502; LINESTRING(1 1,3 3)
 {1,2}   &#x2502; LINESTRING(3 3,4 4)
 {2,1,1} &#x2502; LINESTRING(5 5,6 6)
 {2,1,2} &#x2502; LINESTRING(6 6,7 7)
 {2,1,3} &#x2502; LINESTRING(7 7,5 5)
(5 rows)
```

다면체 표면, TIN 및 삼각형 예시

```
-- TIN --
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
```

```
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                 wkt
-------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

```
-- TIN --
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                 wkt
-------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

참고

geometry_dump, ST_GeomCollFromText, ST_Dump, ST_NumInteriorRing,

7.4.9 ST_NRings

ST_NRings — Returns a set of `geometry_dump` rows for the exterior and interior rings of a Polygon.

Synopsis

geometry **ST_ExteriorRing**(geometry a_polygon);

설명

A set-returning function (SRF) that extracts the rings of a polygon. It returns a set of geometry_dump rows, each containing a geometry (*`geom`* field) and an array of integers (*`path`* field).

The *`geom`* field contains each ring as a POLYGON. The *`path`* field is an integer array of length 1 containing the polygon ring index. The exterior ring (shell) has index 0. The interior rings (holes) have indices of 1 and higher.

Note

이 함수는 멀티폴리곤을 입력받지 못 합니다. 멀티폴리곤경우 ST_Dump 함수와 결합해서 이용하십시오.

Availability: PostGIS 1.1.3. Requires PostgreSQL 7.3 or higher.

This function supports 3d and will not drop the z-index.

예시

General form of query.

```
SELECT polyTable.field1, polyTable.field1,
          (ST_DumpRings(polyTable.geom)).geom As geom
FROM polyTable;
```

A polygon with a single hole.

```
SELECT path, ST_AsEWKT(geom) As geom
        FROM ST_DumpRings(
                ST_GeomFromEWKT('POLYGON((-8149064 5133092 1,-8149064 5132986 1,-8148996  ↩
                    5132839 1,-8148972 5132767 1,-8148958 5132508 1,-8148941 5132466  ↩
                    1,-8148924 5132394 1,
                -8148903 5132210 1,-8148930 5131967 1,-8148992 5131978 1,-8149237 5132093  ↩
                    1,-8149404 5132211 1,-8149647 5132310 1,-8149757 5132394 1,
                -8150305 5132788 1,-8149064 5133092 1),
                (-8149362 5132394 1,-8149446 5132501 1,-8149548 5132597 1,-8149695 5132675  ↩
                    1,-8149362 5132394 1))')
                )  as foo;
 path |                                              geom
------------------------------------------------------------------------------------------------------------

  {0} | POLYGON((-8149064 5133092 1,-8149064 5132986 1,-8148996 5132839 1,-8148972 5132767  ↩
      1,-8148958 5132508 1,
          |           -8148941 5132466 1,-8148924 5132394 1,
          |           -8148903 5132210 1,-8148930 5131967 1,
          |           -8148992 5131978 1,-8149237 5132093 1,
          |           -8149404 5132211 1,-8149647 5132310 1,-8149757 5132394 1,-8150305  ↩
              5132788 1,-8149064 5133092 1))
  {1} | POLYGON((-8149362 5132394 1,-8149446 5132501 1,
          |           -8149548 5132597 1,-8149695 5132675 1,-8149362 5132394 1))
```

참고

geometry_dump, ST_GeomFromEWKT, ST_Dump, ST_GeometryN, ST_NumGeometries

7.4.10 ST_EndPoint

ST_EndPoint — ST_LineString 또는 ST_CircularString 값에 있는 포인&#
개수를 반환합니다.

Synopsis

geometry **ST_Points**(geometry geom);

설명

LINESTRING 또는 CIRCULARLINESTRING 도형의 첫 번째 포&
POINT로 반환합니다. 입력 파라미터&#x

`LINESTRING` 또는 `CIRCULARLINESTRING` 이 아닐 경우 `NULL` 을 반환합니다.

This method implements the SQL/MM specification. SQL-MM 3: 7.1.4

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Note

변경 사항: 2.0.0 버전부터 단일 도형 멀티라인스트링을 지원하지 않습니다. PostGIS 예전 버전이라면 단일 라인 멀티라인스트링을 입력받는 경우 시작점을 반환했을 겁니다. 2.0.0 버전은 다른 모든 멀티라인스트링처럼 NULL을 반환할 뿐입니다. 구식 습성은 문서화되지 않은 기능이지만, 사용자 데이터를 라인스트링으로 저장했다고 가정한 사용자의 경우 현재 2.0 버전에서 NULL이 반환될 수도 있습니다.

예시

End point of a LineString

```
postgis=# SELECT ST_AsText(ST_EndPoint('LINESTRING(1 1, 2 2, 3 3)'::geometry));
 st_astext
------------
 POINT(3 3)
```

End point of a non-LineString is NULL

```
SELECT ST_EndPoint('POINT(1 1)'::geometry) IS NULL AS is_null;
  is_null
----------
 t
```

End point of a 3D LineString

```
--3d endpoint
SELECT ST_AsEWKT(ST_EndPoint('LINESTRING(1 1 2, 1 2 3, 0 0 5)'));
  st_asewkt
--------------
 POINT(0 0 5)
```

ST_LineString 또는 ST_CircularString 값에 있는 포인트의 개수를 반환합니다.

```
SELECT ST_AsText(ST_EndPoint('CIRCULARSTRING(5 2,-3 1.999999, -2 1, -4 2, 6 3)'::geometry)) ↩
    ;
 st_astext
------------
 POINT(6 3)
```

참고

ST_PointN, ST_StartPoint

7.4.11 ST_Envelope

ST_Envelope — 주어진 도형의 이중 정밀도(double precision; float8) 경계 상자를 표현하는 도형&#xc7 반환합니다.

Synopsis

geometry **ST_Envelope**(geometry g1);

설명

주어진 도형에 대해 float8 형 최소치 경계 상자를 도형으로 반환합니&#x 해당 폴리곤은 경계 상자의 꼭짓&#xc 포인트들로 정의됩니다((MINX, MINY), (MINX, MAXY), (MAXX, MAXY), (MAXX, MINY), (MINX, MINY)). (PostGIS는 ZMIN/ZMAX 좌표도 추가&# 것입니다.)

차원이 낮은 (수직 라인, 포인트) 경& POLYGON 보다 낮은 차원의, 예를 들어 POINT 또는 LINESTRING 도형을 반환할 것입니&#xb2e

1.5.0 버전부터 사용할 수 있으며, float4 형 대신 이중 정밀도 형으로 출력하&# 변경되었습니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.19

예시

```
SELECT ST_AsText(ST_Envelope('POINT(1 3)'::geometry));
 st_astext
------------
 POINT(1 3)
(1 row)


SELECT ST_AsText(ST_Envelope('LINESTRING(0 0, 1 3)'::geometry));
                  st_astext
---------------------------------
 POLYGON((0 0,0 3,1 3,1 0,0 0))
(1 row)


SELECT ST_AsText(ST_Envelope('POLYGON((0 0, 0 1, 1.0000001 1, 1.0000001 0, 0 0))'::geometry ↩
    ));
                                                    st_astext
--------------------------------------------------------------
 POLYGON((0 0,0 1,1.00000011920929 1,1.00000011920929 0,0 0))
```

```
(1 row)
SELECT ST_AsText(ST_Envelope('POLYGON((0 0, 0 1, 1.0000000001 1, 1.0000000001 0, 0 0))':: ↩
    geometry));
                                                    st_astext
------------------------------------------------------------
 POLYGON((0 0,0 1,1.00000011920929 1,1.00000011920929 0,0 0))
(1 row)

SELECT Box3D(geom), Box2D(geom), ST_AsText(ST_Envelope(geom)) As envelopewkt
        FROM (SELECT 'POLYGON((0 0, 0 1000012333334.34545678, 1.0000001 1, 1.0000001 0, 0  ↩
            0))'::geometry As geom) As foo;
```

Envelope of a point and linestring.

```
SELECT ST_AsText(ST_Envelope(
                ST_Collect(
                        ST_GeomFromText('LINESTRING(55 75,125 150)'),
                                ST_Point(20, 80))
                                )) As wktenv;
wktenv
-----------
POLYGON((20 75,20 150,125 150,125 75,20 75))
```

참고

Box2D, Box3D, ST_OrientedEnvelope

7.4.12 ST_ExteriorRing

ST_ExteriorRing — 폴리곤 도형의 내곽 고리의 개수를 반환합니다.

Synopsis

geometry **ST_ExteriorRing**(geometry a_polygon);

설명

POLYGON 도형의 외곽 고리(exterior ring)를 표현&#xd558
라인스트링을 반환합니다. 도형&#
폴리곤이 아닌 경우 NULL을 반환합&#xb2

Note

이 함수는 멀티폴리곤을
입력받지 못 합니다. 멀티폴리곤
경우 ST_Dump 함수와 결합해서
이용하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 2.1.5.1

This method implements the SQL/MM specification. SQL-MM 3: 8.2.3, 8.3.3

This function supports 3d and will not drop the z-index.

예시

```
-- &#xd3f4;&#xb9ac;&#xace4; &#xd14c;&#xc774;&#xbe14;&#xc774; &#xc788;&#xc744; &#xacbd;&#xc6b0;
SELECT gid, ST_ExteriorRing(the_geom) AS ering
FROM sometable;

-- &#xba40;&#xd2f0;&#xd3f4;&#xb9ac;&#xace4; &#xd14c;&#xc774;&#xbe14;&#xc774;&#xba70;  ↩
    &#xac01; &#xd3f4;&#xb9ac;&#xace4;&#xc758;
-- &#xc678;&#xacfd; &#xace0;&#xb9ac;&#xb4e4;&#xb85c; &#xc774;&#xb8e8;&#xc5b4;&#xc9c4;  ↩
    &#xba40;&#xd2f0;&#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1;&#xc744;  ↩
    &#xbc18;&#xd658;&#xd558;&#xace0;&#xc790; &#xd560; &#xacbd;&#xc6b0;
SELECT gid, ST_Collect(ST_ExteriorRing(the_geom)) AS erings
        FROM (SELECT gid, (ST_Dump(the_geom)).geom As the_geom
                        FROM sometable) As foo
GROUP BY gid;

--3d Example
SELECT ST_AsEWKT(
        ST_ExteriorRing(
        ST_GeomFromEWKT('POLYGON((0 0 1, 1 1 1, 1 2 1, 1 1 1, 0 0 1))')
        )
);

st_asewkt
---------
LINESTRING(0 0 1,1 1 1,1 2 1,1 1 1,0 0 1)
```

참고

ST_InteriorRingN, ST_Boundary, ST_NumInteriorRings

7.4.13 ST_GeometryN

ST_GeometryN — ST_Geometry 값의 도형 유형을 반환&#xd569

Synopsis

geometry **ST_GeometryN**(geometry geomA, integer n);

설명

입력 도형이 도형 집합, (멀티)포인&
(멀티)라인스트링, 멀티커브(multicurve) 또
(멀티)폴리곤이나 다면체 표면일
경우 1-기반 N번째 도형을 반환하&#xba70
그 외의 경우 NULL을 반환합니다.

Note
0.8.0 버전부터 인덱스는 OGC 사양을 따라 1-기반입니다. 예전 버전은 대신 0-기반 인덱스를 시행했습니다.

Note
모든 도형들을 추출하고자 한다면 ST_Dump 함수가 더 효율적이&#xba7
단일 도형에 대해서도 작동할
것입니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

변경 사항: 2.0.0 미만 버전은 단일 도&#xd6
대해 NULL을 반환했을 겁니다. 2.0.0 버전
ST_GeometryN(..,1) 경우에 대한 도형을 반환하&
변경됐습니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 9.1.5

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

표준 예시

```
--Extracting a subset of points from a 3d multipoint
SELECT n, ST_AsEWKT(ST_GeometryN(geom, n)) As geomewkt
FROM (
VALUES (ST_GeomFromEWKT('MULTIPOINT((1 2 7), (3 4 7), (5 6 7), (8 9 10))') ),
( ST_GeomFromEWKT('MULTICURVE(CIRCULARSTRING(2.5 2.5,4.5 2.5, 3.5 3.5), (10 11, 12 11))') )
        )As foo(geom)
        CROSS JOIN generate_series(1,100) n
```

```
WHERE n <= ST_NumGeometries(geom);

 n |               geomewkt
---+----------------------------------------
 1 | POINT(1 2 7)
 2 | POINT(3 4 7)
 3 | POINT(5 6 7)
 4 | POINT(8 9 10)
 1 | CIRCULARSTRING(2.5 2.5,4.5 2.5,3.5 3.5)
 2 | LINESTRING(10 11,12 11)


--Extracting all geometries (useful when you want to assign an id)
SELECT gid, n, ST_GeometryN(geom, n)
FROM sometable CROSS JOIN generate_series(1,100) n
WHERE n <= ST_NumGeometries(geom);
```

다면체 표면, TIN 및 삼각형 예시

```
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74; &#xc608;&#xc2dc;
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74;&#xc744; &#xac01; &#xba74;&#xc73c;&#xb85c;  ↩
    &#xbd84;&#xd574;&#xd558;&#xae30;
SELECT ST_AsEWKT(ST_GeometryN(p_geom,3)) As geom_ewkt
  FROM (SELECT ST_GeomFromEWKT('POLYHEDRALSURFACE(
((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)),
((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)),
((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1))
)')  AS p_geom )  AS a;

               geom_ewkt
----------------------------------------
 POLYGON((0 0 0,1 0 0,1 0 1,0 0 1,0 0 0))
```

```
-- TIN --
SELECT ST_AsEWKT(ST_GeometryN(geom,2)) as wkt
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
-- &#xacb0;&#xacfc; --
                wkt
-------------------------------------
 TRIANGLE((0 0 0,0 1 0,1 1 0,0 0 0))
```

참고

ST_Dump, ST_NumGeometries

7.4.14 ST_GeometryType

ST_GeometryType — ST_Geometry 값의 도형 유형을 반환&#xd5

Synopsis

text **ST_GeometryType**(geometry g1);

설명

도형의 유형을 'ST_LineString', 'ST_Polygon', 'ST_MultiPolygon' 등과 같은 스트링으로 반환합니다. 이 함수는 도형의 단위가 설정돼 있&# 알려주지 않는 것은 물론, 반환된 결과물이 스트링이며 접두사 ST가 달린다는 점에서도 GeometryType(geometry) 함수&#xc64 다릅니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba surface)을 지원합니다.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.4

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_GeometryType(ST_GeomFromText('LINESTRING(77.29 29.07,77.42 29.26,77.27  ↩
    29.31,77.29 29.07)'));
-- &#xacb0;&#xacfc;
ST_LineString
```

```
SELECT ST_GeometryType(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0  ↩
    0 0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1) ↩
                    ) )'));
                        -- &#xacb0;&#xacfc;
                        ST_PolyhedralSurface
```

```
SELECT ST_GeometryType(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0  ↩
    0 0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1) ↩
                    ) )'));
                        -- &#xacb0;&#xacfc;
                        ST_PolyhedralSurface
```

```
SELECT ST_GeometryType(geom) as result
  FROM
    (SELECT
       ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')  AS geom
    ) AS g;
 result
--------
 ST_Tin
```

참고

도형 유형

7.4.15 ST_HasArc

ST_HasArc — Tests if a geometry contains a circular arc

Synopsis

boolean **ST_IsEmpty**(geometry geomA);

설명

해당 도형이 텅 빈 도형 집합, 폴리&
포인트 등인 경우 TRUE 를 반환합니&#xb2

1.2.2 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_HasArc(ST_Collect('LINESTRING(1 2, 3 4, 5 6)', 'CIRCULARSTRING(1 1, 2 3, 4 5, 6  ↩
    7, 5 6)'));
               st_hasarc
               --------
               t
```

참고

ST_CurveToLine, ST_PointN

7.4.16 ST_InteriorRingN

ST_InteriorRingN — 폴리곤 도형의 내곽 고리의 개수를 반환합니다.

Synopsis

geometry **ST_InteriorRingN**(geometry a_polygon, integer n);

설명

폴리곤 도형의 N번째 내곽 라인스&#
고리를 반환합니다. 도형이 폴리&#
아니거나 주어진 N이 범위(range)를 벗&#x
경우 NULL을 반환합니다.

Note

이 함수는 멀티폴리곤을
입력받지 못 합니다. 멀티폴리곤&
경우 ST_Dump 함수와 결합해서
이용하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 8.2.6, 8.3.5

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsText(ST_InteriorRingN(the_geom, 1)) As the_geom
FROM (SELECT ST_BuildArea(
                ST_Collect(ST_Buffer(ST_Point(1,2), 20,3),
                        ST_Buffer(ST_Point(1, 2), 10,3))) As the_geom
                )  as foo
```

참고

ST_ExteriorRing, ST_M, ST_X, ST_Y, ST_ZMax, ST_ZMin

7.4.17 ST_IsClosed

ST_IsClosed — LINESTRING 의 시작점과 종단점이 일&#
경우 TRUE 를 반환합니다. 다면체 표&#xb
닫혀 (부피를 가지고) 있는 경우 TRUE
를 반환합니다.

Synopsis

boolean **ST_IsClosed**(geometry g);

설명

`LINESTRING` 의 시작점과 종단점이 일치&#xd558
경우 `TRUE` 를 반환합니다. 다면체 표&#xb
경우, 다면체 표면이 면적(열림)을
가지고 있는지 부피(닫힘)를 가지&#
있는지 알려줍니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 7.1.5, 9.3.3

> **Note**
> SQL-MM은 `ST_IsClosed(NULL)` 의 결과를 0으로 정의하지만, PostGIS는 `NULL` 을 반환합니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

This function supports Polyhedral surfaces.

라인스트링 및 포인트 예시

```
postgis=# SELECT ST_IsClosed('LINESTRING(0 0, 1 1)'::geometry);
 st_isclosed
-------------
 f
(1 row)

postgis=# SELECT ST_IsClosed('LINESTRING(0 0, 0 1, 1 1, 0 0)'::geometry);
 st_isclosed
-------------
 t
(1 row)

postgis=# SELECT ST_IsClosed('MULTILINESTRING((0 0, 0 1, 1 1, 0 0),(0 0, 1 1))'::geometry);
 st_isclosed
-------------
 f
(1 row)

postgis=# SELECT ST_IsClosed('POINT(0 0)'::geometry);
 st_isclosed
-------------
 t
(1 row)

postgis=# SELECT ST_IsClosed('MULTIPOINT((0 0), (1 1))'::geometry);
 st_isclosed
-------------
 t
(1 row)
```

다면체 표면 예시

```
-- &#xc785;&#xbc29;&#xccb4; --
                SELECT ST_IsClosed(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1  ↩
                    1, 0 1 0, 0 0 0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1) ↩
                    ) )'));

 st_isclosed
-------------
 t


 -- &#xc785;&#xbc29;&#xccb4;&#xc774;&#xc9c0;&#xb9cc; &#xd55c; &#xba74;&#xc774;  ↩
     &#xc5c6;&#xb294; &#xacbd;&#xc6b0; --
 SELECT ST_IsClosed(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0  ↩
     0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)) )'));

 st_isclosed
-------------
 f
```

참고

ST_IsRing

7.4.18 ST_IsCollection

ST_IsCollection — 해당 도형이 텅 빈 도형 집합, 폴리곤, 포인트 등인 경우 TRUE 를 반&#xd6

Synopsis

boolean **ST_IsCollection**(geometry g);

설명

인수의 도형 유형이 다음 가운데 하나일 경우 TRUE 를 반환합니다:

- GEOMETRYCOLLECTION
- MULTI{POINT,POLYGON,LINESTRING,CURVE,SURFACE}
- COMPOUNDCURVE

Note

이 함수는 도형의 유형을 분석합니다. 즉 비어 있거나 단일 요소를 담고 있는 집합일 경우에도 TRUE 를 반환할 것이라는 뜻입니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
postgis=# SELECT ST_IsCollection('LINESTRING(0 0, 1 1)'::geometry);
 st_iscollection
-----------------
 f
(1 row)

postgis=# SELECT ST_IsCollection('MULTIPOINT EMPTY'::geometry);
 st_iscollection
-----------------
 t
(1 row)

postgis=# SELECT ST_IsCollection('MULTIPOINT((0 0))'::geometry);
 st_iscollection
-----------------
 t
(1 row)

postgis=# SELECT ST_IsCollection('MULTIPOINT((0 0), (42 42))'::geometry);
 st_iscollection
-----------------
 t
(1 row)

postgis=# SELECT ST_IsCollection('GEOMETRYCOLLECTION(POINT(0 0))'::geometry);
 st_iscollection
-----------------
 t
(1 row)
```

참고

ST_NumGeometries

7.4.19 ST_IsEmpty

ST_IsEmpty — Tests if a geometry is empty.

Synopsis

boolean **ST_IsEmpty**(geometry geomA);

설명

해당 도형이 텅 빈 도형인 경우 `TRUE` 를 반환합니다. `TRUE` 인 경우, 해당 도&#x
텅 빈 도형 집합, 폴리곤, 포인트 등&
표현한다는 뜻입니다.

Note

SQL-MM은 `ST_IsEmpty(NULL)` 의 결과를 0으로 정의하지만, PostGIS는 `NULL` 을 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.7

This method supports Circular Strings and Curves.

Warning

변경 사항: PostGIS 2.0.0 미만 버전에서는 ST_GeomFromText('GEOMETRYCOLLECTION(EMPTY)') 를 사용할 수 있었습니다. PostGIS 2.0.0 버전부터, SQL/MM 표준을 더 잘 준수하기 위해 이런 사용법은 금지됐습니다.

예시

```
SELECT ST_IsEmpty(ST_GeomFromText('GEOMETRYCOLLECTION EMPTY'));
 st_isempty
------------
 t
(1 row)

 SELECT ST_IsEmpty(ST_GeomFromText('POLYGON EMPTY'));
 st_isempty
------------
 t
(1 row)

SELECT ST_IsEmpty(ST_GeomFromText('POLYGON((1 2, 3 4, 5 6, 1 2))'));

 st_isempty
------------
 f
(1 row)

 SELECT ST_IsEmpty(ST_GeomFromText('POLYGON((1 2, 3 4, 5 6, 1 2))')) = false;
 ?column?
----------
 t
(1 row)

 SELECT ST_IsEmpty(ST_GeomFromText('CIRCULARSTRING EMPTY'));
  st_isempty
------------
```

```
 t
(1 row)
```

7.4.20 ST_IsPolygonCCW

ST_IsPolygonCCW — Tests if Polygons have exterior rings oriented counter-clockwise and interior rings oriented clockwise.

Synopsis

boolean **ST_IsPolygonCCW** (geometry geom);

설명

Returns true if all polygonal components of the input geometry use a counter-clockwise orientation for their exterior ring, and a clockwise direction for all interior rings.

Returns true if the geometry has no polygonal components.

Note
Closed linestrings are not considered polygonal components, so you would still get a true return by passing a single closed linestring no matter its orientation.

Note
If a polygonal geometry does not use reversed orientation for interior rings (i.e., if one or more interior rings are oriented in the same direction as an exterior ring) then both ST_IsPolygonCW and ST_IsPolygonCCW will return false.

2.2.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

참고

ST_ForcePolygonCW , ST_ForcePolygonCCW , ST_IsPolygonCW

7.4.21 ST_IsPolygonCW

ST_IsPolygonCW — Tests if Polygons have exterior rings oriented clockwise and interior rings oriented counter-clockwise.

Synopsis

boolean **ST_IsPolygonCW** (geometry geom);

설명

Returns true if all polygonal components of the input geometry use a clockwise orientation for their exterior ring, and a counter-clockwise direction for all interior rings.

Returns true if the geometry has no polygonal components.

Note
Closed linestrings are not considered polygonal components, so you would still get a true return by passing a single closed linestring no matter its orientation.

Note
If a polygonal geometry does not use reversed orientation for interior rings (i.e., if one or more interior rings are oriented in the same direction as an exterior ring) then both ST_IsPolygonCW and ST_IsPolygonCCW will return false.

2.2.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

참고

ST_ForcePolygonCW , ST_ForcePolygonCCW , ST_IsPolygonCW

7.4.22 ST_IsRing

ST_IsRing — Tests if a LineString is closed and simple.

Synopsis

boolean **ST_IsRing**(geometry g);

설명

해당 `LINESTRING` 이 ST_IsClosed (`ST_StartPoint` ((*g*)) ~= `ST_Endpoint` ((*g*))) 인 동&
ST_IsSimple 인 (자체 교차하지 않는) 경우
`TRUE` 를 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 2.1.5.1

This method implements the SQL/MM specification. SQL-MM 3: 7.1.6

Note
SQL-MM은 `ST_IsRing(NULL)` 의 결과를 0으로 정의하지만, PostGIS는 `NULL` 을 반환합니다.

예시

```
SELECT ST_IsRing(the_geom), ST_IsClosed(the_geom), ST_IsSimple(the_geom)
FROM (SELECT 'LINESTRING(0 0, 0 1, 1 1, 1 0, 0 0)'::geometry AS the_geom) AS foo;
 st_isring | st_isclosed | st_issimple
-----------+-------------+-------------
 t         | t           | t
(1 row)

SELECT ST_IsRing(the_geom), ST_IsClosed(the_geom), ST_IsSimple(the_geom)
FROM (SELECT 'LINESTRING(0 0, 0 1, 1 0, 1 1, 0 0)'::geometry AS the_geom) AS foo;
 st_isring | st_isclosed | st_issimple
-----------+-------------+-------------
 f         | t           | f
(1 row)
```

참고

ST_IsClosed, ST_IsSimple, ST_StartPoint, ST_EndPoint

7.4.23 ST_IsSimple

ST_IsSimple — 해당 도형이 자체 교차하거&#xb09
자체 접촉하는 이례적인 도형 포&#
가지고 있지 않을 경우 TRUE 를 반환&#xd5

Synopsis

boolean **ST_IsSimple**(geometry geomA);

설명

해당 도형이 자체 교차하거나 자&#
접촉하는 이례적인 도형 포인트&#
가지고 있지 않을 경우 TRUE 를 반환&#xd5
도형 단순성 및 유효성에 대한 OGC&#xc75
정의를 더 자세히 알고 싶다면, "OpenGIS&
도형 준수성 확인(Ensuring OpenGIS compliancy of geometries)" 을
참조하십시오.

Note
SQL-MM은 ST_IsSimple(NULL) 의 결과를 0으로 정의하지만, PostGIS는 NULL 을 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.8

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_IsSimple(ST_GeomFromText('POLYGON((1 2, 3 4, 5 6, 1 2))'));
 st_issimple
-------------
 t
(1 row)

 SELECT ST_IsSimple(ST_GeomFromText('LINESTRING(1 1,2 2,2 3.5,1 3,1 2,2 1)'));
 st_issimple
-------------
 f
(1 row)
```

참고

ST_IsValid

7.4.24 ST_M

ST_M — Returns the M coordinate of a Point.

Synopsis

float **ST_M**(geometry a_point);

설명

포인트의 M 좌표를 반환합니다. M 좌표가 없는 경우 NULL을 반환합니&#xb2
포인트만 입력받을 수 있습니다.

Note

이 함수는 (아직) OGC 사양에 들어가지 않지만, 포인트 좌표 추출자(extractor) 함수 목록을 완성하기 위해 이 문서에 작성됐습니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_M(ST_GeomFromEWKT('POINT(1 2 3 4)'));
 st_m
------
        4
(1 row)
```

참고

ST_GeomFromEWKT, ST_X, ST_Y, ST_Z

7.4.25 ST_MemSize

ST_MemSize — ST_Geometry 값의 도형 유형을 반환합&

Synopsis

integer **ST_NRings**(geometry geomA);

설명

ST_Geometry 값의 도형 유형을 반환합니&#xb2e4

This complements the PostgreSQL built-in database object functions pg_column_size, pg_size_pretty, pg_relation_size, pg_total_relatio

Note

pg_relation_size which gives the byte size of a table may return byte size lower than ST_MemSize. This is because pg_relation_size does not add toasted table contribution and large geometries are stored in TOAST tables.
pg_total_relation_size - includes, the table, the toasted tables, and the indexes.
pg_column_size returns how much space a geometry would take in a column considering compression, so may be lower than ST_MemSize

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Changed: 2.2.0 name changed to ST_MemSize to follow naming convention.

예시

```
--Return how much byte space Boston takes up  in our Mass data set
SELECT pg_size_pretty(SUM(ST_MemSize(geom))) as totgeomsum,
pg_size_pretty(SUM(CASE WHEN town = 'BOSTON' THEN ST_MemSize(geom) ELSE 0 END)) As bossum,
CAST(SUM(CASE WHEN town = 'BOSTON' THEN ST_MemSize(geom) ELSE 0 END)*1.00 /
                SUM(ST_MemSize(geom))*100 As numeric(10,2)) As perbos
FROM towns;

totgeomsum        bossum        perbos
----------        ------        ------
1522 kB                30 kB        1.99


SELECT ST_MemSize(ST_GeomFromText('CIRCULARSTRING(220268 150415,220227 150505,220227  ↩
    150406)'));

---
73
```

```
--What percentage of our table is taken up by just the geometry
SELECT pg_total_relation_size('public.neighborhoods') As fulltable_size, sum(ST_MemSize( ↩
    geom)) As geomsize,
sum(ST_MemSize(geom))*1.00/pg_total_relation_size('public.neighborhoods')*100 As pergeom
FROM neighborhoods;
fulltable_size geomsize  pergeom
-----------------------------------------------
262144         96238         36.71188354492187500000
```

7.4.26 ST_NDims

ST_NDims — ST_Geometry 값의 좌표 차원을 반환합&#x

Synopsis

integer **ST_NDims**(geometry g1);

설명

도형의 좌표 차원을 반환합니다. PostGIS는 2 - 2차원 (x,y), 3 - 3차원 (x,y,z), 3 - 단위를 가진 2차원 (x,y,m), 그리고 4 - 단위를 가진 3차원 공간 (x,y,z,m)을 지원합니다.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_NDims(ST_GeomFromText('POINT(1 1)')) As d2point,
        ST_NDims(ST_GeomFromEWKT('POINT(1 1 2)')) As d3point,
        ST_NDims(ST_GeomFromEWKT('POINTM(1 1 0.5)')) As d2pointm;

         d2point | d3point | d2pointm
---------+---------+----------
           2 |       3 |        3
```

참고

ST_CoordDim, ST_Dimension, ST_GeomFromEWKT

7.4.27 ST_NPoints

ST_NPoints — 도형이 가지고 있는 포인트(&#xaf2 개수를 반환합니다.

Synopsis

integer **ST_NPoints**(geometry g1);

설명

도형이 가지고 있는 포인트의 개&#x
반환합니다. 모든 도형을 입력받&#
수 있습니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

Note

1.3.4 미만 버전에서 이 함수에 만곡 도형(curve)을 담고 있는 도형을 입력하면 충돌이 일어났습니다. 1.3.4 버전부터 이 버그가 해결됐습니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_NPoints(ST_GeomFromText('LINESTRING(77.29 29.07,77.42 29.26,77.27 29.31,77.29  ↩
    29.07)'));
-- &#xacb0;&#xacfc;
4

-- 3&#xcc28;&#xc6d0; &#xacf5;&#xac04;&#xc5d0; &#xc788;&#xb294; &#xd3f4;&#xb9ac;&#xace4;
SELECT ST_NPoints(ST_GeomFromEWKT('LINESTRING(77.29 29.07 1,77.42 29.26 0,77.27 29.31  ↩
    -1,77.29 29.07 3)'))
-- &#xacb0;&#xacfc;
4
```

참고

ST_NumPoints

7.4.28 ST_NRings

ST_NRings — 폴리곤 도형의 내곽 고리의 개수를 반환합니다.

Synopsis

integer **ST_NRings**(geometry geomA);

설명

도형이 폴리곤 또는 멀티폴리곤&#x
경우 고리의 개수를 반환합니다.
NumInteriorRings 함수와는 달리, 외곽 고리도
개수에 포함시킵니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_NRings(the_geom) As Nrings, ST_NumInteriorRings(the_geom) As ninterrings
                                        FROM (SELECT ST_GeomFromText('POLYGON((1 2, 3 4, 5  ↩
                                            6, 1 2))') As the_geom) As foo;
         nrings | ninterrings
--------+-------------
          1 |           0
(1 row)
```

참고

ST_NumInteriorRings

7.4.29 ST_NumGeometries

ST_NumGeometries — 도형이 가지고 있는 포인트
개수를 반환합니다. 모든 도형을
입력받을 수 있습니다.

Synopsis

integer **ST_NumGeometries**(geometry geom);

설명

도형의 개수를 반환합니다. 도형
집합 또는 멀티 도형인 경우 도형&#
개수를, 단일 도형인 경우 1을 반환&
도형 집합도 멀티 도형도 단일 도&#
아닌 경우 NULL을 반환합니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

변경 사항: 2.0.0 미만 버전에서 도형&#xc77
집합이나 멀티 유형이 아닐 경우
NULL을 반환했습니다. 2.0.0 버전부터 폴
라인스트링, 포인트 같은 단일 도&#
대해 1을 반환합니다.

This method implements the SQL/MM specification. SQL-MM 3: 9.1.4

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
--Prior versions would have returned NULL for this -- in 2.0.0 this returns 1
SELECT ST_NumGeometries(ST_GeomFromText('LINESTRING(77.29 29.07,77.42 29.26,77.27  ↩
    29.31,77.29 29.07)'));
--result
1

--Geometry Collection Example - multis count as one geom in a collection
SELECT ST_NumGeometries(ST_GeomFromEWKT('GEOMETRYCOLLECTION(MULTIPOINT((-2 3),(-2 2)),
LINESTRING(5 5 ,10 10),
POLYGON((-7 4.2,-7.1 5,-7.1 4.3,-7 4.2)))'));
--result
3
```

참고

ST_GeometryN, ST_Multi

7.4.30 ST_NumInteriorRings

ST_NumInteriorRings — 폴리곤 도형의 내곽 고리&#xc758
개수를 반환합니다.

Synopsis

integer **ST_NumInteriorRings**(geometry a_polygon);

설명

폴리곤 도형의 내곽 고리의 개수&#x
반환합니다. 도형이 폴리곤이 아&#
경우 NULL을 반환합니다.

This method implements the SQL/MM specification. SQL-MM 3: 8.2.5

변경 사항: 2.0.0 미만 버전에서는 멀&#xd2f
입력하면 첫 번째 폴리곤의 내곽
고리의 개수를 반환받을 수 있었&#x

예시

```
-- &#xc815;&#xaddc; &#xd3f4;&#xb9ac;&#xace4;&#xc778; &#xacbd;&#xc6b0;
SELECT gid, field1, field2, ST_NumInteriorRings(the_geom) AS numholes
FROM sometable;

-- &#xba40;&#xd2f0;&#xd3f4;&#xb9ac;&#xace4;&#xc778; &#xacbd;&#xc6b0;
```

```
-- &#xadf8;&#xb9ac;&#xace0; &#xba40;&#xd2f0;&#xd3f4;&#xb9ac;&#xace4;  ↩
    &#xb0b4;&#xbd80;&#xc5d0; &#xc788;&#xb294; &#xbaa8;&#xb4e0; &#xb0b4;&#xacfd;  ↩
    &#xace0;&#xb9ac;&#xc758; &#xac1c;&#xc218;&#xb97c; &#xc54c;&#xace0;&#xc790;  ↩
    &#xd558;&#xb294; &#xacbd;&#xc6b0;
SELECT gid, field1, field2, SUM(ST_NumInteriorRings(the_geom)) AS numholes
FROM (SELECT gid, field1, field2, (ST_Dump(the_geom)).geom As the_geom
        FROM sometable) As foo
GROUP BY gid, field1,field2;
```

참고

ST_NumInteriorRing, ST_PointN

7.4.31 ST_NumInteriorRing

ST_NumInteriorRing — 도형 안에 있는 폴리곤의 내곽 고리의 개수를 반환합니다. ST_NumInteriorRings 함수와 동일합니다.

Synopsis

integer **ST_NumInteriorRing**(geometry a_polygon);

참고

ST_NumInteriorRings, ST_PointN

7.4.32 ST_NumPatches

ST_NumPatches — 다면체 표면 상에 있는 면의 개수를 반환합니다. 다면체 도형&#x
아닌 경우 NULL을 반환할 것입니다.

Synopsis

integer **ST_NumPatches**(geometry g1);

설명

다면체 표면 상에 있는 면의 개수&#x
반환합니다. 다면체 도형이 아닌
경우 NULL을 반환할 것입니다. 이 함&#x
ST_NumGeometries와 동일하지만 MM 명명법을
지원합니다. MM 규약을 신경 쓰지
않는다면 ST_NumGeometries가 더 빠릅니다.

2.0.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.5

This function supports Polyhedral surfaces.

예시

```
SELECT ST_NumPatches(ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0  ↩
    0)),
                ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0) ↩
                    ),
                ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
                ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1) ↩
                    ) )'));
                -- &#xacb0;&#xacfc;
                6
```

참고

ST_GeomFromEWKT, ST_NumGeometries

7.4.33 ST_NumPoints

ST_NumPoints — ST_LineString 또는 ST_CircularString 값에 있는 포인&
개수를 반환합니다.

Synopsis

integer **ST_NumPoints**(geometry g1);

설명

ST_LineString 또는 ST_CircularString 값에 있는 포인트&#xc758
개수를 반환합니다. 1.4 미만 버전&#xc5d0
사양서대로 라인스트링만 입력&#x
1.4 버전부터 이 함수는 단순히 라&#xc778
아닌, 도형의 꼭짓점의 개수를 반&#
ST_NPoints 함수와 비슷해졌습니다. 쿼리
목적이 다양하고 많은 도형 유형&#
사용할 수 있는 ST_NPoints 함수를 대신
사용하는 편이 좋습니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 7.2.4

예시

```
SELECT ST_NumPoints(ST_GeomFromText('LINESTRING(77.29 29.07,77.42 29.26,77.27 29.31,77.29  ↩
    29.07)'));
                -- &#xacb0;&#xacfc;
                4
```

참고

ST_NPoints

7.4.34 ST_PatchN

ST_PatchN — ST_Geometry 값의 도형 유형을 반환합&#x

Synopsis

geometry **ST_PatchN**(geometry geomA, integer n);

설명

도형이 POLYHEDRALSURFACE, POLYHEDRALSURFACEM 인 경우 1-기&#xbc1
N번째 도형 (면)을 반환합니다. 그
외의 경우 NULL을 반환합니다. 이 함&#x
다면체 표면에 대해 ST_GeometryN과 동일&#xd55
답을 반환합니다. ST_GeometryN을 이용하&#xb2
편이 더 빠릅니다.

Note
인덱스는 1-기반입니다.

Note
모든 도형들을 추출하고자
한다면 ST_Dump 함수가 더 효율적입&#xb2c8

2.0.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.5

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

```
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74;&#xc758; &#xb450; &#xbc88;&#xc9f8;  ↩
    &#xba74;&#xc744; &#xcd94;&#xcd9c;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_PatchN(geom, 2)) As geomewkt
FROM (
VALUES (ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
        ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
        ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
        ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )')) ) ↩
             As foo(geom);

              geomewkt
---+-----------------------------------------
 POLYGON((0 0 0,0 1 0,1 1 0,1 0 0,0 0 0))
```

참고

ST_AsEWKT, ST_GeomFromEWKT, ST_Dump, ST_GeometryN, ST_NumGeometries

7.4.35 ST_PointN

ST_PointN — ST_LineString 또는 ST_CircularString 값에 있는 포인&#x
개수를 반환합니다.

Synopsis

geometry **ST_PointN**(geometry a_linestring, integer n);

설명

도형 안에 있는 단일 라인스트링
또는 원형 라인스트링의 N번째 포&
반환합니다. 음수 값은 라인스트&#
종단점으로부터 반대로 집계되&#x
-1이 마지막 포인트입니다. 도형 안
라인스트링이 없는 경우 NULL을 반&#xd6

Note

0.8.0 버전부터 인덱스는 OGC 사양을
따라 1-기반입니다. OGC는 반대
방향 인덱스(음수 인덱스)를
지원하지 않습니다. 예전
버전은 대신 0-기반 인덱스를
도입했습니다.

Note

멀티라인스트링 안에 있는
각 라인스트링의 N번째
포인트를 얻고자 할 경우, 이
함수를 ST_Dump 함수와 연결해서
이용하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 7.2.5, 7.3.5

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Note

변경 사항: 2.0.0 버전부터 단일 도형 멀티라인스트링을 지원하지 않습니다. PostGIS 예전 버전이라면 단일 라인멀티라인스트링을 입력받는 경우 시작점을 반환했을 겁니다. 2.0.0 버전은 다른 모든 멀티라인스트링처럼 NULL을 반환할 뿐입니다.
변경 사항: 2.3.0 버전부터 음수인덱스(-1이 마지막 포인트)를 이용할 수 있습니다.

예시

```
-- &#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1;&#xc73c;&#xb85c;&#xbd80;&#xd130;  ↩
    &#xbaa8;&#xb4e0; &#xd3ec;&#xc778;&#xd2b8;&#xb97c;  ↩
    &#xcd94;&#xcd9c;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(
   ST_PointN(
          column1,
          generate_series(1, ST_NPoints(column1))
   ))
FROM ( VALUES ('LINESTRING(0 0, 1 1, 2 2)'::geometry) ) AS foo;

 st_astext
------------
 POINT(0 0)
 POINT(1 1)
 POINT(2 2)
(3 rows)

-- &#xc6d0;&#xd615; &#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1; &#xc608;&#xc2dc;
SELECT ST_AsText(ST_PointN(ST_GeomFromText('CIRCULARSTRING(1 2, 3 2, 1 2)'),2));

st_astext
----------
POINT(3 2)

SELECT st_astext(f)
FROM ST_GeometryFromtext('LINESTRING(0 0 0, 1 1 1, 2 2 2)') as g
        ,ST_PointN(g, -2) AS f -- 1 based index

st_astext
----------
"POINT Z (1 1 1)"
```

참고

ST_NPoints

7.4.36 ST_Points

ST_Points — 도형의 모든 좌표들을 담고 있는 멀티포인트를 반환합니다.

Synopsis

geometry **ST_Points**(geometry geom);

설명

Returns a MultiPoint containing all the coordinates of a geometry. Duplicate points are preserved, including the start and end points of ring geometries. (If desired, duplicate points can be removed by calling ST_RemoveRepeatedPoints on the result).

To obtain information about the position of each coordinate in the parent geometry use ST_NumPoints.

M and Z coordinates are preserved if present.

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

2.3.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_Points('POLYGON Z ((30 10 4,10 30 5,40 40 6, 30 10))'));

--result
MULTIPOINT Z ((30 10 4),(10 30 5),(40 40 6),(30 10 4))
```

참고

ST_RemoveRepeatedPoints, ST_PointN

7.4.37 ST_StartPoint

ST_StartPoint — Returns the first point of a LineString.

Synopsis

geometry **ST_StartPoint**(geometry geomA);

설명

LINESTRING 또는 CIRCULARLINESTRING 도형의 첫 번째 포&
POINT로 반환합니다. 입력 파라미터&#xa
LINESTRING 또는 CIRCULARLINESTRING 이 아닐 경우 NULL 을
반환합니다.

This method implements the SQL/MM specification. SQL-MM 3: 7.1.3

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Note

Enhanced: 3.2.0 returns a point for all geometries. Prior behavior returns NULLs if input was not a LineString. 변경 사항: 2.0.0 버전부터 단일 도형 멀티라인스트링을 지원하지 않습니다. PostGIS 예전 버전이라면 단일 라인 멀티라인스트링을 입력받는 경우 시작점을 반환했을 겁니다. 2.0.0 버전은 다른 모든 멀티라인스트링처럼 NULL을 반환할 뿐입니다. 구식 습성은 문서화되지 않은 기능이지만, 사용자 데이터를 라인스트링으로 저장했다고 가정한 사용자의 경우 현재 2.0 버전에서 NULL이 반환될 수도 있습니다.

예시

Start point of a LineString

```
SELECT ST_AsText(ST_StartPoint('LINESTRING(0 1, 0 2)'::geometry));
 st_astext
------------
 POINT(0 1)
```

Start point of a non-LineString is NULL

```
SELECT ST_StartPoint('POINT(0 1)'::geometry) IS NULL AS is_null;
  is_null
----------
 t
```

Start point of a 3D LineString

```
SELECT ST_AsEWKT(ST_StartPoint('LINESTRING(0 1 1, 0 2 2)'::geometry));
 st_asewkt
------------
 POINT(0 1 1)
```

ST_LineString 또는 ST_CircularString 값에 있는 포인트의
개수를 반환합니다.

```
SELECT ST_AsText(ST_StartPoint('CIRCULARSTRING(5 2,-3 1.999999, -2 1, -4 2, 6 3)'::geometry ↩
    ));
 st_astext
------------
 POINT(5 2)
```

참고

ST_EndPoint, ST_PointN

7.4.38 ST_Summary

ST_Summary — 도형의 내용을 요약한 텍스&#xd2
반환합니다.

Synopsis

text **ST_Summary**(geometry g);
text **ST_Summary**(geography g);

설명

도형의 내용을 요약한 텍스트를
반환합니다.

도형 유형 뒤에 대괄호로 표기된
플래그는 다음과 같은 뜻입니다:

- M: M 좌표가 존재합니다.
- Z: Z 좌표가 존재합니다.
- B: 캐쉬된 경계 상자를 가지고 있&#xc2b5
- G: 측지형(지리형)입니다.
- S: 공간 참조 시스템을 가지고 있습

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

1.2.2 버전부터 사용할 수 있습니다.

개선 사항: 2.0.0 버전부터 지리형을
지원하기 시작했습니다.

개선 사항: 2.1.0 버전. 알려진 공간 참&#xc8
시스템을 가진 경우를 나타내는
S 플래그가 추가됐습니다.

개선 사항: 2.2.0 버전부터 TIN 및 만곡 도&#
지원하기 시작했습니다.

예시

```
=# SELECT ST_Summary(ST_GeomFromText('LINESTRING(0 0, 1 1)')) as geom,
        ST_Summary(ST_GeogFromText('POLYGON((0 0, 1 1, 1 2, 1 1, 0 0))')) geog;
            geom             |          geog
-----------------------------+-------------------------
 LineString[B] with 2 points | Polygon[BGS] with 1 rings
                             | ring 0 has 5 points
                             :
(1 row)


=# SELECT ST_Summary(ST_GeogFromText('LINESTRING(0 0 1, 1 1 1)')) As geog_line,
```

```
        ST_Summary(ST_GeomFromText('SRID=4326;POLYGON((0 0 1, 1 1 2, 1 2 3, 1 1 1, 0 0 1)) ↩
            ')) As geom_poly;
;
           geog_line              |        geom_poly
--------------------------------- +--------------------------
 LineString[ZBGS] with 2 points | Polygon[ZBS] with 1 rings
                                :    ring 0 has 5 points
                                :
(1 row)
```

참고

PostGIS_DropBBox, PostGIS_AddBBox, ST_Force3DM, ST_Force3DZ, ST_Force2D, geography

ST_IsValid, ST_IsValid, ST_IsValidReason, ST_IsValidDetail

7.4.39 ST_X

ST_X — Returns the X coordinate of a Point.

Synopsis

float **ST_X**(geometry a_point);

설명

포인트의 X 좌표를 반환합니다. X 좌표가 없는 경우 NULL을 반환합니&#xb2 포인트만 입력받을 수 있습니다.

Note
To get the minimum and maximum X value of geometry coordinates use the functions ST_XMin and ST_XMax.

This method implements the SQL/MM specification. SQL-MM 3: 6.1.3

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_X(ST_GeomFromEWKT('POINT(1 2 3 4)'));
 st_x
------
        1
(1 row)

SELECT ST_Y(ST_Centroid(ST_GeomFromEWKT('LINESTRING(1 2 3 4, 1 1 1 1)')));
 st_y
------
  1.5
(1 row)
```

참고

ST_Centroid, ST_GeomFromEWKT, ST_M, ST_XMax, ST_XMin, ST_Y, ST_Z

7.4.40 ST_Y

ST_Y — Returns the Y coordinate of a Point.

Synopsis

float **ST_Y**(geometry a_point);

설명

포인트의 Y 좌표를 반환합니다. Y 좌표가 없는 경우 NULL을 반환합니&#xb2 포인트만 입력받을 수 있습니다.

Note
To get the minimum and maximum Y value of geometry coordinates use the functions ST_YMin and ST_YMax.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 6.1.4

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_Y(ST_GeomFromEWKT('POINT(1 2 3 4)'));
 st_y
------
        2
(1 row)

SELECT ST_Y(ST_Centroid(ST_GeomFromEWKT('LINESTRING(1 2 3 4, 1 1 1 1)')));
 st_y
------
  1.5
(1 row)
```

참고

ST_Centroid, ST_GeomFromEWKT, ST_M, ST_X, ST_YMax, ST_YMin, ST_Z

7.4.41 ST_Z

ST_Z — Returns the Z coordinate of a Point.

Synopsis

float **ST_Z**(geometry a_point);

설명

포인트의 Z 좌표를 반환합니다. Z 좌표가 없는 경우 NULL을 반환합니&#xb2
포인트만 입력받을 수 있습니다.

Note
To get the minimum and maximum Z value of geometry coordinates use the functions ST_ZMin and ST_ZMax.

This method implements the SQL/MM specification.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_Z(ST_GeomFromEWKT('POINT(1 2 3 4)'));
 st_z
------
        3
(1 row)
```

참고

ST_GeomFromEWKT, ST_M, ST_X, ST_Y, ST_ZMax, ST_ZMin

7.4.42 ST_Zmflag

ST_Zmflag — ST_Geometry 값의 좌표 차원을 반환합&#x

Synopsis

smallint **ST_Zmflag**(geometry geomA);

설명

ST_Geometry 값의 좌표 차원을 반환합니&#xb2e4

Values are: 0 = 2D, 1 = 3D-M, 2 = 3D-Z, 3 = 4D.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_Zmflag(ST_GeomFromEWKT('LINESTRING(1 2, 3 4)'));
 st_zmflag
-----------
                0

SELECT ST_Zmflag(ST_GeomFromEWKT('LINESTRINGM(1 2 3, 3 4 3)'));
 st_zmflag
-----------
                1

SELECT ST_Zmflag(ST_GeomFromEWKT('CIRCULARSTRING(1 2 3, 3 4 3, 5 6 3)'));
 st_zmflag
-----------
                2
SELECT ST_Zmflag(ST_GeomFromEWKT('POINT(1 2 3 4)'));
 st_zmflag
-----------
                3
```

참고

ST_CoordDim, ST_NDims, ST_Dimension

7.5 도형 편집자(editor)

7.5.1 ST_AddPoint

ST_AddPoint — 라인스트링에 포인트를 추&#xac0

Synopsis

geometry **ST_AddPoint**(geometry linestring, geometry point);

geometry **ST_AddPoint**(geometry linestring, geometry point, integer position = -1);

설명

Adds a point to a LineString before the index *position* (using a 0-based index). If the *position* parameter is omitted or is -1 the point is appended to the end of the LineString.

1.1.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

Add a point to the end of a 3D line

```
SELECT ST_AsEWKT(ST_AddPoint('LINESTRING(0 0 1, 1 1 1)', ST_MakePoint(1, 2, 3)));

    st_asewkt
    ----------
    LINESTRING(0 0 1,1 1 1,1 2 3)
```

Guarantee all lines in a table are closed by adding the start point of each line to the end of the line only for those that are not closed.

```
UPDATE sometable
SET geom = ST_AddPoint(geom, ST_StartPoint(geom))
FROM sometable
WHERE ST_IsClosed(geom) = false;
```

참고

ST_RemovePoint, ST_SetPoint

7.5.2 ST_CollectionExtract

ST_CollectionExtract — Given a geometry collection, returns a multi-geometry containing only elements of a specified type.

Synopsis

geometry **ST_CollectionExtract**(geometry collection);

geometry **ST_CollectionExtract**(geometry collection, integer type);

설명

Given a geometry collection, returns a homogeneous multi-geometry.

If the `type` is not specified, returns a multi-geometry containing only geometries of the highest dimension. So polygons are preferred over lines, which are preferred over points.

If the `type` is specified, returns a multi-geometry containing only that type. If there are no sub-geometries of the right type, an EMPTY geometry is returned. Only points, lines and polygons are supported. The type numbers are:

- 1 == POINT
- 2 == LINESTRING
- 3 == POLYGON

For atomic geometry inputs, the geometry is retured unchanged if the input type matches the requested type. Otherwise, the result is an EMPTY geometry of the specified type. If required, these can be converted to multi-geometries using ST_Multi.

Warning
MultiPolygon results are not checked for validity. If the polygon components are adjacent or overlapping the result will be invalid. (For example, this can occur when applying this function to an ST_Split result.) This situation can be checked with ST_IsValid and repaired with ST_MakeValid.

1.5.0 버전부터 사용할 수 있습니다.

Note
Prior to 1.5.3 this function returned atomic inputs unchanged, no matter type. In 1.5.3 non-matching single geometries returned a NULL result. In 2.0.0 non-matching single geometries return an EMPTY result of the requested type.

예시

Extract highest-dimension type:

```
SELECT ST_AsText(ST_CollectionExtract(
        'GEOMETRYCOLLECTION( POINT(0 0), LINESTRING(1 1, 2 2) )'));
    st_astext
    ---------------
    MULTILINESTRING((1 1, 2 2))
```

Extract points (type 1 == POINT):

```
SELECT ST_AsText(ST_CollectionExtract(
        'GEOMETRYCOLLECTION(GEOMETRYCOLLECTION(POINT(0 0)))',
        1 ));
    st_astext
    ---------------
    MULTIPOINT((0 0))
```

Extract lines (type 2 == LINESTRING):

```
SELECT ST_AsText(ST_CollectionExtract(
        'GEOMETRYCOLLECTION(GEOMETRYCOLLECTION(LINESTRING(0 0, 1 1)),LINESTRING(2 2, 3 3)) ↩
            ',
        2 ));
    st_astext
    ---------------
    MULTILINESTRING((0 0, 1 1), (2 2, 3 3))
```

참고

ST_CollectionHomogenize, ST_Multi, ST_IsValid, ST_MakeValid

7.5.3 ST_CollectionHomogenize

ST_CollectionHomogenize — Returns the simplest representation of a geometry collection.

Synopsis

geometry **ST_CollectionHomogenize**(geometry collection);

설명

도형 집합을 입력받아 해당 내용&#x
"가장 단순한" 표현식을 반환합니&

- Homogeneous (uniform) collections are returned as the appropriate multi-geometry.
- Heterogeneous (mixed) collections are flattened into a single GeometryCollection.
- Collections containing a single atomic element are returned as that element.
- Atomic geometries are returned unchanged. If required, these can be converted to a multi-geometry using ST_Multi.

Warning
This function does not ensure that the result is valid. In particular, a collection containing adjacent or overlapping Polygons will create an invalid MultiPolygon. This situation can be checked with ST_IsValid and repaired with ST_MakeValid.

2.0.0 버전부터 사용할 수 있습니다.

예시

Single-element collection converted to an atomic geometry

```
SELECT ST_AsText(ST_CollectionHomogenize('GEOMETRYCOLLECTION(POINT(0 0))'));

        st_astext
        ------------
        POINT(0 0)
```

Nested single-element collection converted to an atomic geometry:

```
SELECT ST_AsText(ST_CollectionHomogenize('GEOMETRYCOLLECTION(MULTIPOINT((0 0)))'));

        st_astext
        ------------
        POINT(0 0)
```

Collection converted to a multi-geometry:

```
SELECT ST_AsText(ST_CollectionHomogenize('GEOMETRYCOLLECTION(POINT(0 0),POINT(1 1))'));

        st_astext
        ---------------------
        MULTIPOINT((0 0),(1 1))
```

Nested heterogeneous collection flattened to a GeometryCollection:

```
SELECT ST_AsText(ST_CollectionHomogenize('GEOMETRYCOLLECTION(POINT(0 0), GEOMETRYCOLLECTION ↩
    ( LINESTRING(1 1, 2 2)))'));

        st_astext
        ---------------------
        GEOMETRYCOLLECTION(POINT(0 0),LINESTRING(1 1,2 2))
```

Collection of Polygons converted to an (invalid) MultiPolygon:

```
SELECT ST_AsText(ST_CollectionHomogenize('GEOMETRYCOLLECTION (POLYGON ((10 50, 50 50, 50  ↩
    10, 10 10, 10 50)), POLYGON ((90 50, 90 10, 50 10, 50 50, 90 50)))'));

        st_astext
        ---------------------
        MULTIPOLYGON(((10 50,50 50,50 10,10 10,10 50)),((90 50,90 10,50 10,50 50,90 50)))
```

참고

ST_CollectionExtract, ST_Multi, ST_IsValid, ST_MakeValid

7.5.4 ST_CurveToLine

ST_CurveToLine — Converts a geometry containing curves to a linear geometry.

Synopsis

geometry **ST_CurveToLine**(geometry curveGeom, float tolerance, integer tolerance_type, integer flags);

설명

Converts a CIRCULAR STRING to regular LINESTRING or CURVEPOLYGON to POLYGON or MULTISURFACE to MULTIPOLYGON. Useful for outputting to devices that can't support CIRCULARSTRING geometry types

Converts a given geometry to a linear geometry. Each curved geometry or segment is converted into a linear approximation using the given `tolerance` and options (32 segments per quadrant and no options by default).

The 'tolerance_type' argument determines interpretation of the `tolerance` argument. It can take the following values:

- 0 (default): Tolerance is max segments per quadrant.
- 1: Tolerance is max-deviation of line from curve, in source units.
- 2: Tolerance is max-angle, in radians, between generating radii.

The 'flags' argument is a bitfield. 0 by default. Supported bits are:

- 1: Symmetric (orientation idependent) output.
- 2: Retain angle, avoids reducing angles (segment lengths) when producing symmetric output. Has no effect when Symmetric flag is off.

Availability: 1.3.0

Enhanced: 2.4.0 added support for max-deviation and max-angle tolerance, and for symmetric output.

Enhanced: 3.0.0 implemented a minimum number of segments per linearized arc to prevent topological collapse.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 7.1.7

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_AsText(ST_CurveToLine(ST_GeomFromText('CIRCULARSTRING(220268 150415,220227  ↩
    150505,220227 150406)')));

--Result --
 LINESTRING(220268 150415,220269.95064912 150416.539364228,220271.823415575  ↩
     150418.17258804,220273.613787707 150419.895736857,
 220275.317452352 150421.704659462,220276.930305234 150423.594998003,220278.448460847  ↩
     150425.562198489,
 220279.868261823 150427.60152176,220281.186287736 150429.708054909,220282.399363347  ↩
     150431.876723113,
```

```
220283.50456625 150434.10230186,220284.499233914 150436.379429536,220285.380970099  ↩
    150438.702620341,220286.147650624 150441.066277505,
220286.797428488 150443.464706771,220287.328738321 150445.892130112,220287.740300149  ↩
    150448.342699654,
220288.031122486 150450.810511759,220288.200504713 150453.289621251,220288.248038775  ↩
    150455.77405574,
220288.173610157 150458.257830005,220287.977398166 150460.734960415,220287.659875492  ↩
    150463.199479347,
220287.221807076 150465.64544956,220286.664248262 150468.066978495,220285.988542259  ↩
    150470.458232479,220285.196316903 150472.81345077,
220284.289480732 150475.126959442,220283.270218395 150477.39318505,220282.140985384  ↩
    150479.606668057,
220280.90450212 150481.762075989,220279.5637474 150483.85421628,220278.12195122  ↩
    150485.87804878,
220276.582586992 150487.828697901,220274.949363179 150489.701464356,220273.226214362  ↩
    150491.491836488,
220271.417291757 150493.195501133,220269.526953216 150494.808354014,220267.559752731  ↩
    150496.326509628,
220265.520429459 150497.746310603,220263.41389631 150499.064336517,220261.245228106  ↩
    150500.277412127,
220259.019649359 150501.38261503,220256.742521683 150502.377282695,220254.419330878  ↩
    150503.259018879,
220252.055673714 150504.025699404,220249.657244448 150504.675477269,220247.229821107  ↩
    150505.206787101,
220244.779251566 150505.61834893,220242.311439461 150505.909171266,220239.832329968  ↩
    150506.078553494,
220237.347895479 150506.126087555,220234.864121215 150506.051658938,220232.386990804  ↩
    150505.855446946,
220229.922471872 150505.537924272,220227.47650166 150505.099855856,220225.054972724  ↩
    150504.542297043,
220222.663718741 150503.86659104,220220.308500449 150503.074365683,
220217.994991777 150502.167529512,220215.72876617 150501.148267175,
220213.515283163 150500.019034164,220211.35987523 150498.7825509,
220209.267734939 150497.441796181,220207.243902439 150496,
220205.293253319 150494.460635772,220203.420486864 150492.82741196,220201.630114732  ↩
    150491.104263143,
220199.926450087 150489.295340538,220198.313597205 150487.405001997,220196.795441592  ↩
    150485.437801511,
220195.375640616 150483.39847824,220194.057614703 150481.291945091,220192.844539092  ↩
    150479.123276887,220191.739336189 150476.89769814,
220190.744668525 150474.620570464,220189.86293234 150472.297379659,220189.096251815  ↩
    150469.933722495,
220188.446473951 150467.535293229,220187.915164118 150465.107869888,220187.50360229  ↩
    150462.657300346,
220187.212779953 150460.189488241,220187.043397726 150457.710378749,220186.995863664  ↩
    150455.22594426,
220187.070292282 150452.742169995,220187.266504273 150450.265039585,220187.584026947  ↩
    150447.800520653,
220188.022095363 150445.35455044,220188.579654177 150442.933021505,220189.25536018  ↩
    150440.541767521,
220190.047585536 150438.18654923,220190.954421707 150435.873040558,220191.973684044  ↩
    150433.60681495,
220193.102917055 150431.393331943,220194.339400319 150429.237924011,220195.680155039  ↩
    150427.14578372,220197.12195122 150425.12195122,
220198.661315447 150423.171302099,220200.29453926 150421.298535644,220202.017688077  ↩
    150419.508163512,220203.826610682 150417.804498867,
220205.716949223 150416.191645986,220207.684149708 150414.673490372,220209.72347298  ↩
    150413.253689397,220211.830006129 150411.935663483,
220213.998674333 150410.722587873,220216.22425308 150409.61738497,220218.501380756  ↩
    150408.622717305,220220.824571561 150407.740981121,
220223.188228725 150406.974300596,220225.586657991 150406.324522731,220227 150406)
```

```
--3d example
SELECT ST_AsEWKT(ST_CurveToLine(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227  ↩
    150505 2,220227 150406 3)')));
Output
------
 LINESTRING(220268 150415 1,220269.95064912 150416.539364228 1.0181172856673,
 220271.823415575 150418.17258804 1.03623457133459,220273.613787707 150419.895736857  ↩
     1.05435185700189,....AD INFINITUM ....
    220225.586657991 150406.324522731 1.32611114201132,220227 150406 3)

--use only 2 segments to approximate quarter circle
SELECT ST_AsText(ST_CurveToLine(ST_GeomFromText('CIRCULARSTRING(220268 150415,220227  ↩
    150505,220227 150406)'),2));
st_astext
------------------------------
 LINESTRING(220268 150415,220287.740300149 150448.342699654,220278.12195122  ↩
     150485.87804878,
 220244.779251566 150505.61834893,220207.243902439 150496,220187.50360229 150462.657300346,
 220197.12195122 150425.12195122,220227 150406)

-- Ensure approximated line is no further than 20 units away from
-- original curve, and make the result direction-neutral
SELECT ST_AsText(ST_CurveToLine(
 'CIRCULARSTRING(0 0,100 -100,200 0)'::geometry,
    20, -- Tolerance
    1, -- Above is max distance between curve and line
    1  -- Symmetric flag
));
st_astext
-------------------------------------------------------------------------------------------
 LINESTRING(0 0,50 -86.6025403784438,150 -86.6025403784439,200 -1.1331077795296e-13,200 0)
```

참고

ST_LineToCurve

7.5.5 ST_Scroll

ST_Scroll — Change start point of a closed LineString.

Synopsis

geometry **ST_Scroll**(geometry linestring, geometry point);

설명

Changes the start/end point of a closed LineString to the given vertex *point*.

Availability: 3.2.0

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

예시

Make e closed line start at its 3rd vertex

```
SELECT ST_AsEWKT(ST_Scroll('SRID=4326;LINESTRING(0 0 0 1, 10 0 2 0, 5 5 4 2,0 0 0 1)', ' ↩
    POINT(5 5 4 2)'));

st_asewkt
----------
SRID=4326;LINESTRING(5 5 4 2,0 0 0 1,10 0 2 0,5 5 4 2)
```

참고

ST_Normalize

7.5.6 ST_FlipCoordinates

ST_FlipCoordinates — Returns a version of a geometry with X and Y axis flipped.

Synopsis

geometry **ST_FlipCoordinates**(geometry geom);

설명

Returns a version of the given geometry with X and Y axis flipped. Useful for fixing geometries which contain coordinates expressed as latitude/longitude (Y,X).

2.0.0 버전부터 사용할 수 있습니다.

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_AsEWKT(ST_FlipCoordinates(GeomFromEWKT('POINT(1 2)')));
 st_asewkt
------------
POINT(2 1)
```

참고

ST_SwapOrdinates

7.5.7 ST_Force2D

ST_Force2D — 도형을 "2차원 모드"로 강제합&#x

Synopsis

geometry **ST_Force2D**(geometry geomA);

설명

도형을 "2차원 모드"로 강제해서 출&
표현식이 X 및 Y 좌표만을 가지도록
합니다. 이 함수는 (OGC가 사양에 2차&#x
도형만 있기 때문에) OGC 준수 출력&#xbb
강제하는 데 유용합니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Force_2D였습니다.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsEWKT(ST_Force2D(ST_GeomFromEWKT('CIRCULARSTRING(1 1 2, 2 3 2, 4 5 2, 6 7 2, 5 6 ↩
    2)')));
                st_asewkt
--------------------------------------
CIRCULARSTRING(1 1,2 3,4 5,6 7,5 6)

SELECT  ST_AsEWKT(ST_Force2D('POLYGON((0 0 2,0 5 2,5 0 2,0 0 2),(1 1 2,3 1 2,1 3 2,1 1 2)) ↩
    '));

                                  st_asewkt
-----------------------------------------------
 POLYGON((0 0,0 5,5 0,0 0),(1 1,3 1,1 3,1 1))
```

참고

ST_Force3D

7.5.8 ST_Force3D

ST_Force3D — 도형을 XYZ 모드로 강제합니다.
ST_Force3DZ라고도 합니다.

Synopsis

geometry **ST_Force3D**(geometry geomA, float Zvalue = 0.0);

설명

Forces the geometries into XYZ mode. This is an alias for ST_Force3DZ. If a geometry has no Z component, then a `Zvalue` Z coordinate is tacked on.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Force_3D였습니다.

Changed: 3.1.0. Added support for supplying a non-zero Z value.

This function supports Polyhedral surfaces.

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

예시

```
-- &#xae30;&#xc874; 3D &#xb3c4;&#xd615;&#xc740; &#xbcc0;&#xacbd;&#xb418;&#xc9c0;  ↩
    &#xc54a;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_Force3D(ST_GeomFromEWKT('CIRCULARSTRING(1 1 2, 2 3 2, 4 5 2, 6 7 2, 5 6 ↩
    2)')));
st_asewkt
------------------------------------------------
 CIRCULARSTRING(1 1 2,2 3 2,4 5 2,6 7 2,5 6 2)


SELECT  ST_AsEWKT(ST_Force3D('POLYGON((0 0,0 5,5 0,0 0),(1 1,3 1,1 3,1 1))'));

st_asewkt
------------------------------------------------------------
 POLYGON((0 0 0,0 5 0,5 0 0,0 0 0),(1 1 0,3 1 0,1 3 0,1 1 0))
```

참고

ST_AsEWKT, ST_Force2D, ST_Force3DM, ST_Force3DZ

7.5.9 ST_Force3DZ

ST_Force3DZ — 도형을 XYZ 모드로 강제합니다.

Synopsis

geometry **ST_Force3DZ**(geometry geomA, float Zvalue = 0.0);

설명

Forces the geometries into XYZ mode. If a geometry has no Z component, then a *Zvalue* Z coordinate is tacked on.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Force_3DZ였습니다.

Changed: 3.1.0. Added support for supplying a non-zero Z value.

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
-- &#xae30;&#xc874; 3D &#xb3c4;&#xd615;&#xc740; &#xbcc0;&#xacbd;&#xb418;&#xc9c0;  ↩
    &#xc54a;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_Force3DZ(ST_GeomFromEWKT('CIRCULARSTRING(1 1 2, 2 3 2, 4 5 2, 6 7 2, 5  ↩
    6 2)')));
st_asewkt
---------------------------------------------
 CIRCULARSTRING(1 1 2,2 3 2,4 5 2,6 7 2,5 6 2)


SELECT  ST_AsEWKT(ST_Force3DZ('POLYGON((0 0,0 5,5 0,0 0),(1 1,3 1,1 3,1 1))'));

st_asewkt
-------------------------------------------------------------
 POLYGON((0 0 0,0 5 0,5 0 0,0 0 0),(1 1 0,3 1 0,1 3 0,1 1 0))
```

참고

ST_AsEWKT, ST_Force2D, ST_Force3DM, ST_Force3D

7.5.10 ST_Force3DM

ST_Force3DM — 도형을 XYM 모드로 강제합니&#xb2e4

Synopsis

geometry **ST_Force3DM**(geometry geomA, float Mvalue = 0.0);

설명

Forces the geometries into XYM mode. If a geometry has no M component, then a *Mvalue* M coordinate is tacked on. If it has a Z component, then Z is removed

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Force_3DM이었니&#xb2e

Changed: 3.1.0. Added support for supplying a non-zero M value.

This method supports Circular Strings and Curves.

예시

```
-- &#xae30;&#xc874; 3D &#xb3c4;&#xd615;&#xc740; &#xbcc0;&#xacbd;&#xb418;&#xc9c0;  ↩
    &#xc54a;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_Force3DM(ST_GeomFromEWKT('CIRCULARSTRING(1 1 2, 2 3 2, 4 5 2, 6 7 2, 5  ↩
    6 2)')));
st_asewkt
-----------------------------------------------
 CIRCULARSTRINGM(1 1 0,2 3 0,4 5 0,6 7 0,5 6 0)


SELECT  ST_AsEWKT(ST_Force3DM('POLYGON((0 0 1,0 5 1,5 0 1,0 0 1),(1 1 1,3 1 1,1 3 1,1 1 1)) ↩
    '));

st_asewkt
-----------------------------------------------------------------
 POLYGONM((0 0 0,0 5 0,5 0 0,0 0 0),(1 1 0,3 1 0,1 3 0,1 1 0))
```

참고

ST_AsEWKT, ST_Force2D, ST_Force3DM, ST_Force3D, ST_GeomFromEWKT

7.5.11 ST_Force4D

ST_Force4D — 도형을 XYZM 모드로 강제합니다

Synopsis

geometry **ST_Force4D**(geometry geomA, float Zvalue = 0.0, float Mvalue = 0.0);

설명

Forces the geometries into XYZM mode. *Zvalue* and *Mvalue* is tacked on for missing Z and M dimensions, respectively.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Force_4D였습니다.

Changed: 3.1.0. Added support for supplying non-zero Z and M values.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
-- &#xae30;&#xc874; 3D &#xb3c4;&#xd615;&#xc740; &#xbcc0;&#xacbd;&#xb418;&#xc9c0;  ↩
    &#xc54a;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_Force4D(ST_GeomFromEWKT('CIRCULARSTRING(1 1 2, 2 3 2, 4 5 2, 6 7 2, 5 6 ↩
    2)')));
st_asewkt
-----------------------------------------------------------
 CIRCULARSTRING(1 1 2 0,2 3 2 0,4 5 2 0,6 7 2 0,5 6 2 0)
```

```
SELECT  ST_AsEWKT(ST_Force4D('MULTILINESTRINGM((0 0 1,0 5 2,5 0 3,0 0 4),(1 1 1,3 1 1,1 3  ↩
    1,1 1 1))'));

st_asewkt
-----------------------------------------------------------------------------------
 MULTILINESTRING((0 0 0 1,0 5 0 2,5 0 0 3,0 0 0 4),(1 1 0 1,3 1 0 1,1 3 0 1,1 1 0 1))
```

참고

ST_AsEWKT, ST_Force2D, ST_Force3DM, ST_Force3D

7.5.12 ST_ForcePolygonCCW

ST_ForcePolygonCCW — Orients all exterior rings counter-clockwise and all interior rings clockwise.

Synopsis

geometry **ST_ForcePolygonCCW** (geometry geom);

설명

Forces (Multi)Polygons to use a counter-clockwise orientation for their exterior ring, and a clockwise orientation for their interior rings. Non-polygonal geometries are returned unchanged.

Availability: 2.4.0

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

참고

ST_ForcePolygonCW , ST_IsPolygonCCW , ST_IsPolygonCW

7.5.13 ST_ForceCollection

ST_ForceCollection — 도형을 도형 집합으로 변환

Synopsis

geometry **ST_ForceCollection**(geometry geomA);

설명

도형을 도형 집합으로 변환합니&#
이 함수는 WKB 표현식을 단순화하&#xb2
데 유용합니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

1.2.2 버전부터 사용할 수 있습니다. 1.3.4 미만 버전에서 이 함수에 만곡 도형(curve)을 담고 있는 도형을 입력&#xd 충돌이 일어났습니다. 1.3.4 버전부&#xd13 이 버그가 해결됐습니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까& 이 함수의 명칭은 ST_Force_Collection이었습니&#

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT  ST_AsEWKT(ST_ForceCollection('POLYGON((0 0 1,0 5 1,5 0 1,0 0 1),(1 1 1,3 1 1,1 3  ↩
    1,1 1 1))'));

st_asewkt
-----------------------------------------------------------------------------------
 GEOMETRYCOLLECTION(POLYGON((0 0 1,0 5 1,5 0 1,0 0 1),(1 1 1,3 1 1,1 3 1,1 1 1)))


  SELECT ST_AsText(ST_ForceCollection('CIRCULARSTRING(220227 150406,2220227 150407,220227  ↩
      150406)'));
st_astext
-----------------------------------------------------------------------------------
 GEOMETRYCOLLECTION(CIRCULARSTRING(220227 150406,2220227 150407,220227 150406))
(1 row)
```

```
-- &#xb2e4;&#xba74;&#xccb4; &#xc608;&#xc2dc; --
SELECT ST_AsEWKT(ST_ForceCollection('POLYHEDRALSURFACE(((0 0 0,0 0 1,0 1 1,0 1 0,0 0 0)),
 ((0 0 0,0 1 0,1 1 0,1 0 0,0 0 0)),
 ((0 0 0,1 0 0,1 0 1,0 0 1,0 0 0)),
 ((1 1 0,1 1 1,1 0 1,1 0 0,1 1 0)),
 ((0 1 0,0 1 1,1 1 1,1 1 0,0 1 0)),
 ((0 0 1,1 0 1,1 1 1,0 1 1,0 0 1)))'))

st_asewkt
-----------------------------------------------------------------------------------
GEOMETRYCOLLECTION(
  POLYGON((0 0 0,0 0 1,0 1 1,0 1 0,0 0 0)),
  POLYGON((0 0 0,0 1 0,1 1 0,1 0 0,0 0 0)),
  POLYGON((0 0 0,1 0 0,1 0 1,0 0 1,0 0 0)),
  POLYGON((1 1 0,1 1 1,1 0 1,1 0 0,1 1 0)),
  POLYGON((0 1 0,0 1 1,1 1 1,1 1 0,0 1 0)),
  POLYGON((0 0 1,1 0 1,1 1 1,0 1 1,0 0 1))
)
```

참고

ST_AsEWKT, ST_Force2D, ST_Force3DM, ST_Force3D, ST_GeomFromEWKT

7.5.14 ST_ForcePolygonCW

ST_ForcePolygonCW — Orients all exterior rings clockwise and all interior rings counter-clockwise.

Synopsis

geometry **ST_ForcePolygonCW** (geometry geom);

설명

Forces (Multi)Polygons to use a clockwise orientation for their exterior ring, and a counter-clockwise orientation for their interior rings. Non-polygonal geometries are returned unchanged.

Availability: 2.4.0

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

참고

ST_ForcePolygonCCW , ST_IsPolygonCCW , ST_IsPolygonCW

7.5.15 ST_ForceSFS

ST_ForceSFS — 도형이 SFS 1.1 도형 유형만을 쓰&#xb3c
강제합니다.

Synopsis

geometry **ST_ForceSFS**(geometry geomA);
geometry **ST_ForceSFS**(geometry geomA, text version);

설명

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

7.5.16 ST_ForceRHR

ST_ForceRHR — 폴리곤 안에 있는 꼭짓점들&#xc7
방향(orientation)이 오른손 법칙(Right-Hand Rule)을 따&
강제합니다.

Synopsis

geometry **ST_ForceRHR**(geometry g);

설명

Forces the orientation of the vertices in a polygon to follow a Right-Hand-Rule, in which the area that is bounded by the polygon is to the right of the boundary. In particular, the exterior ring is orientated in a clockwise direction and the interior rings in a counter-clockwise direction. This function is a synonym for ST_ForcePolygonCW

Note
The above definition of the Right-Hand-Rule conflicts with definitions used in other contexts. To avoid confusion, it is recommended to use ST_ForcePolygonCW.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_AsEWKT(
  ST_ForceRHR(
        'POLYGON((0 0 2, 5 0 2, 0 5 2, 0 0 2),(1 1 2, 1 3 2, 3 1 2, 1 1 2))'
  )
);
st_asewkt
------------------------------------------------------------
 POLYGON((0 0 2,0 5 2,5 0 2,0 0 2),(1 1 2,3 1 2,1 3 2,1 1 2))
(1 row)
```

참고

ST_ForcePolygonCCW , ST_ForcePolygonCW , ST_IsPolygonCCW , ST_IsPolygonCW , ST_BuildArea, ST_Polygonize, ST_Reverse

7.5.17 ST_ForceCurve

ST_ForceCurve — 적용이 가능한 경우, 도형을 해당 도형의 만곡 유형으로 상위 형변환(upcast)합니다.

Synopsis

geometry **ST_ForceCurve**(geometry g);

설명

적용이 가능한 경우, 도형을 해당
도형의 만곡 표현식으로 바꿉니&#x
라인을 복합 곡선(compoundcurve)으로, 멀티&#xb
멀티커브로, 폴리곤을 커브폴리&#xa
멀티폴리곤을 멀티서페이스(multisurface)&

변환합니다. 입력 폴리곤이 이미 만곡된 표현식인 경우 입력 표현그대로 반환합니다.

2.2.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_AsText(
  ST_ForceCurve(
        'POLYGON((0 0 2, 5 0 2, 0 5 2, 0 0 2),(1 1 2, 1 3 2, 3 1 2, 1 1 2))'::geometry
  )
);
st_astext
------------------------------------------------------------------------
 CURVEPOLYGON Z ((0 0 2,5 0 2,0 5 2,0 0 2),(1 1 2,1 3 2,3 1 2,1 1 2))
(1 row)
```

참고

ST_LineToCurve

7.5.18 ST_LineToCurve

ST_LineToCurve — Converts a linear geometry to a curved geometry.

Synopsis

geometry **ST_LineToCurve**(geometry geomANoncircular);

설명

Converts plain LINESTRING/POLYGON to CIRCULAR STRINGs and Curved Polygons. Note much fewer points are needed to describe the curved equivalent.

Note
If the input LINESTRING/POLYGON is not curved enough to clearly represent a curve, the function will return the same input geometry.

Availability: 1.3.0

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
-- 2D Example
SELECT ST_AsText(ST_LineToCurve(foo.geom)) As curvedastext,ST_AsText(foo.geom) As  ↩
    non_curvedastext
    FROM (SELECT ST_Buffer('POINT(1 3)'::geometry, 3) As geom) As foo;

curvedatext                                                                  non_curvedastext
-----------------------------------------------------------------------------|------------------------------

CURVEPOLYGON(CIRCULARSTRING(4 3,3.12132034355964 0.878679656440359, | POLYGON((4  ↩
    3,3.94235584120969 2.41472903395162,3.77163859753386 1.85194970290473,
1 0,-1.12132034355965 5.12132034355963,4 3))                          |  3.49440883690764  ↩
    1.33328930094119,3.12132034355964 0.878679656440359,
                                                                      |  2.66671069905881  ↩
                                                                          0.505591163092366,2.14805029
                                                                           0.228361402466141,
                                                                      |  1.58527096604839  ↩
                                                                          0.0576441587903094,1 ↩
                                                                           0,
                                                                      |  0.414729033951621  ↩
                                                                          0.0576441587903077,-0.148050
                                                                           0.228361402466137,
                                                                      |  -0.666710699058802  ↩
                                                                          0.505591163092361,-1.1213203
                                                                           0.878679656440353,
                                                                      |  -1.49440883690763  ↩
                                                                          1.33328930094119,-1.77163859
                                                                           1.85194970290472
                                                                      |  --ETC--  ↩
                                                                          ,3.94235584120969  ↩
                                                                          3.58527096604839,4  ↩
                                                                          3))

--3D example
SELECT ST_AsText(ST_LineToCurve(geom)) As curved, ST_AsText(geom) AS not_curved
FROM (SELECT ST_Translate(ST_Force3D(ST_Boundary(ST_Buffer(ST_Point(1,3), 2,2))),0,0,3) AS  ↩
    geom) AS foo;

                        curved                         |               not_curved
-------------------------------------------------------+-------------------------------------------

 CIRCULARSTRING Z (3 3 3,-1 2.99999999999999 3,3 3 3) | LINESTRING Z (3 3 3,2.4142135623731 ↩
     1.58578643762691 3,1 1 3,
                                                      | -0.414213562373092 1.5857864376269  ↩
                                                          3,-1 2.99999999999999 3,
                                                      | -0.414213562373101 4.41421356237309 ↩
                                                           3,
                                                      | 0.999999999999991 5  ↩
                                                          3,2.41421356237309 4.4142135623731 ↩
                                                           3,3 3 3)
(1 row)
```

참고

ST_CurveToLine

7.5.19 ST_Multi

ST_Multi — 도형을 멀티 유형 도형으로 반환합니다.

Synopsis

geometry **ST_Multi**(geometry geom);

설명

Returns the geometry as a MULTI* geometry collection. If the geometry is already a collection, it is returned unchanged.

예시

```
SELECT ST_AsText(ST_Multi('POLYGON ((10 30, 30 30, 30 10, 10 10, 10 30))'));
                    st_astext
    ------------------------------------------------
    MULTIPOLYGON(((10 30,30 30,30 10,10 10,10 30)))
```

참고

ST_AsText

7.5.20 ST_LineExtend

ST_LineExtend — Returns a line with the last and first segments extended the specified distance(s).

Synopsis

geometry **ST_LineExtend**(geometry line, float distance_forward, float distance_backward=0.0);

설명

Returns a line with the last and first segments extended the specified distance(s). Distance of zero carries out no extension. Only non-negative distances are allowed. The first (and last) two distinct points in a line are used to determine the direction of projection, duplicate points are ignored.

Availability: 3.4.0

Example: Projected point at 100,000 meters and bearing 45 degrees

```
SELECT ST_AsText(ST_Project('POINT(0 0)'::geography, 100000, radians(45.0)));
-----------------------------------------
 POINT(0.635231029125537 0.639472334729198)
```

참고

ST_LocateAlong, ST_Project

7.5.21 ST_Normalize

ST_Normalize — 도형을 해당 도형의 기본형&#xc
반환합니다.

Synopsis

geometry **ST_Normalize**(geometry geom);

설명

도형을 해당 도형의 정규화된/기&#
형태로 반환합니다. 폴리곤 고리,
폴리곤 내부 고리에 있는 꼭짓점,
멀티 유형 도형 집합체의 요소를
재정렬할 수도 있습니다.

대부분의 경우, 테스트 작업 목적&#
쓸모가 있습니다(기대한 결과물&#xa
반환된 결과물의 비교 등).

2.3.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_Normalize(ST_GeomFromText(
  'GEOMETRYCOLLECTION(
    POINT(2 3),
    MULTILINESTRING((0 0, 1 1),(2 2, 3 3)),
    POLYGON(
      (0 10,0 0,10 0,10 10,0 10),
      (4 2,2 2,2 4,4 4,4 2),
      (6 8,8 8,8 6,6 6,6 8)
    )
  )'
)));
                                                                                st_astext
-----------------------------------------------------------------------------------------------------------------------------------

 GEOMETRYCOLLECTION(POLYGON((0 0,0 10,10 10,10 0,0 0),(6 6,8 6,8 8,6 8,6 6),(2 2,4 2,4 4,2  ↩
    4,2 2)),MULTILINESTRING((2 2,3 3),(0 0,1 1)),POINT(2 3))
(1 row)
```

참고

ST_Equals,

7.5.22 ST_Project

ST_Project — Returns a point projected from a start point by a distance and bearing (azimuth).

Synopsis

geometry **ST_Project**(geometry g1, float distance, float azimuth);
geometry **ST_Project**(geometry g1, geometry g2, float distance);
geography **ST_Project**(geography g1, float distance, float azimuth);
geography **ST_Project**(geography g1, geography g2, float distance);

설명

Returns a point projected from a point along a geodesic using a given distance and azimuth (bearing). This is known as the direct geodesic problem.

The two-point version uses the path from the first to the second point to implicitly define the azimuth and uses the distance as before.

The distance is given in meters. Negative values are supported.

The azimuth (also known as heading or bearing) is given in radians. It is measured clockwise from true north.

- North is azimuth zero (0 degrees)
- East is azimuth $\pi/2$ (90 degrees)
- South is azimuth π (180 degrees)
- West is azimuth $3\pi/2$ (270 degrees)

Negative azimuth values and values greater than 2π (360 degrees) are supported.

2.0.0 버전부터 사용할 수 있습니다.

Enhanced: 2.4.0 Allow negative distance and non-normalized azimuth.

Enhanced: 3.4.0 Allow geometry arguments and two-point form omitting azimuth.

Example: Projected point at 100,000 meters and bearing 45 degrees

```
SELECT ST_AsText(ST_Project('POINT(0 0)'::geography, 100000, radians(45.0)));
-----------------------------------------
 POINT(0.635231029125537 0.639472334729198)
```

참고

ST_Azimuth, ST_Distance, PostgreSQL function radians()

7.5.23 ST_QuantizeCoordinates

ST_QuantizeCoordinates — Sets least significant bits of coordinates to zero

Synopsis

geometry **ST_QuantizeCoordinates** (geometry g , int prec_x , int prec_y , int prec_z , int prec_m);

설명

`ST_QuantizeCoordinates` determines the number of bits (`N`) required to represent a coordinate value with a specified number of digits after the decimal point, and then sets all but the `N` most significant bits to zero. The resulting coordinate value will still round to the original value, but will have improved compressiblity. This can result in a significant disk usage reduction provided that the geometry column is using a compressible storage type. The function allows specification of a different number of digits after the decimal point in each dimension; unspecified dimensions are assumed to have the precision of the `x` dimension. Negative digits are interpreted to refer digits to the left of the decimal point, (i.e., `prec_x=-2` will preserve coordinate values to the nearest 100.

The coordinates produced by `ST_QuantizeCoordinates` are independent of the geometry that contains those coordinates and the relative position of those coordinates within the geometry. As a result, existing topological relationships between geometries are unaffected by use of this function. The function may produce invalid geometry when it is called with a number of digits lower than the intrinsic precision of the geometry.

Availability: 2.5.0

Technical Background

PostGIS stores all coordinate values as double-precision floating point integers, which can reliably represent 15 significant digits. However, PostGIS may be used to manage data that intrinsically has fewer than 15 significant digits. An example is TIGER data, which is provided as geographic coordinates with six digits of precision after the decimal point (thus requiring only nine significant digits of longitude and eight significant digits of latitude.)

When 15 significant digits are available, there are many possible representations of a number with 9 significant digits. A double precision floating point number uses 52 explicit bits to represent the significand (mantissa) of the coordinate. Only 30 bits are needed to represent a mantissa with 9 significant digits, leaving 22 insignificant bits; we can set their value to anything we like and still end up with a number that rounds to our input value. For example, the value 100.123456 can be represented by the floating point numbers closest to 100.123456000000, 100.123456000001, and 100.123456432199. All are equally valid, in that `ST_AsText(geom, 6)` will return the same result with any of these inputs. As we can set these bits to any value, `ST_QuantizeCoordinates` sets the 22 insignificant bits to zero. For a long coordinate sequence this creates a pattern of blocks of consecutive zeros that is compressed by PostgreSQL more effeciently.

Note

Only the on-disk size of the geometry is potentially affected by `ST_QuantizeCoordinates`. ST_MemSize, which reports the in-memory usage of the geometry, will return the the same value regardless of the disk space used by a geometry.

예시

```
SELECT ST_AsText(ST_QuantizeCoordinates('POINT (100.123456 0)'::geometry, 4));
st_astext
-------------------------
POINT(100.123455047607 0)
```

```
WITH test AS (SELECT 'POINT (123.456789123456 123.456789123456)'::geometry AS geom)
SELECT
  digits,
  encode(ST_QuantizeCoordinates(geom, digits), 'hex'),
  ST_AsText(ST_QuantizeCoordinates(geom, digits))
FROM test, generate_series(15, -15, -1) AS digits;

digits  |                   encode                   |                st_astext
--------+--------------------------------------------+------------------------------------------ ↩

15      | 01010000005f9a72083cdd5e405f9a72083cdd5e40 | POINT(123.456789123456  ↩
    123.456789123456)
14      | 01010000005f9a72083cdd5e405f9a72083cdd5e40 | POINT(123.456789123456  ↩
    123.456789123456)
13      | 01010000005f9a72083cdd5e405f9a72083cdd5e40 | POINT(123.456789123456  ↩
    123.456789123456)
12      | 01010000005c9a72083cdd5e405c9a72083cdd5e40 | POINT(123.456789123456  ↩
    123.456789123456)
11      | 0101000000409a72083cdd5e40409a72083cdd5e40 | POINT(123.456789123456  ↩
    123.456789123456)
10      | 0101000000009a72083cdd5e40009a72083cdd5e40 | POINT(123.456789123455  ↩
    123.456789123455)
9       | 0101000000009072083cdd5e40009072083cdd5e40 | POINT(123.456789123418  ↩
    123.456789123418)
8       | 0101000000008072083cdd5e40008072083cdd5e40 | POINT(123.45678912336  ↩
    123.45678912336)
7       | 0101000000000070083cdd5e40000070083cdd5e40 | POINT(123.456789121032  ↩
    123.456789121032)
6       | 0101000000000040083cdd5e40000040083cdd5e40 | POINT(123.456789076328  ↩
    123.456789076328)
```

```
5       | 0101000000000000083cdd5e40000000083cdd5e40 | POINT(123.456789016724  ↩
    123.456789016724)
4       | 0101000000000000003cdd5e40000000003cdd5e40 | POINT(123.456787109375  ↩
    123.456787109375)
3       | 0101000000000000003cdd5e40000000003cdd5e40 | POINT(123.456787109375  ↩
    123.456787109375)
2       | 0101000000000000038dd5e400000000038dd5e40 | POINT(123.45654296875  ↩
    123.45654296875)
1       | 0101000000000000000dd5e400000000000dd5e40 | POINT(123.453125 123.453125)
0       | 0101000000000000000dc5e400000000000dc5e40 | POINT(123.4375 123.4375)
-1      | 0101000000000000000c05e400000000000c05e40 | POINT(123 123)
-2      | 01010000000000000000005e400000000000005e40 | POINT(120 120)
-3      | 010100000000000000000058400000000000005840 | POINT(96 96)
-4      | 010100000000000000000058400000000000005840 | POINT(96 96)
-5      | 010100000000000000000058400000000000005840 | POINT(96 96)
-6      | 010100000000000000000058400000000000005840 | POINT(96 96)
-7      | 010100000000000000000058400000000000005840 | POINT(96 96)
-8      | 010100000000000000000058400000000000005840 | POINT(96 96)
-9      | 010100000000000000000058400000000000005840 | POINT(96 96)
-10     | 010100000000000000000058400000000000005840 | POINT(96 96)
-11     | 010100000000000000000058400000000000005840 | POINT(96 96)
-12     | 010100000000000000000058400000000000005840 | POINT(96 96)
-13     | 010100000000000000000058400000000000005840 | POINT(96 96)
-14     | 010100000000000000000058400000000000005840 | POINT(96 96)
-15     | 010100000000000000000058400000000000005840 | POINT(96 96)
```

참고

ST_SnapToGrid

7.5.24 ST_RemovePoint

ST_RemovePoint — Remove a point from a linestring.

Synopsis

geometry **ST_RemovePoint**(geometry linestring, integer offset);

설명

Removes a point from a LineString, given its index (0-based). Useful for turning a closed line (ring) into an open linestring.

Enhanced: 3.2.0

1.1.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

Guarantees no lines are closed by removing the end point of closed lines (rings). Assumes geom is of type LINESTRING

```
UPDATE sometable
        SET geom = ST_RemovePoint(geom, ST_NPoints(geom) - 1)
        FROM sometable
        WHERE ST_IsClosed(geom);
```

참고

ST_AddPoint, ST_NPoints, ST_NumPoints

7.5.25 ST_RemoveRepeatedPoints

ST_RemoveRepeatedPoints — Returns a version of a geometry with duplicate points removed.

Synopsis

geometry **ST_RemoveRepeatedPoints**(geometry geom, float8 tolerance);

설명

Returns a version of the given geometry with duplicate consecutive points removed. The function processes only (Multi)LineStrings, (Multi)Polygons and MultiPoints but it can be called with any kind of geometry. Elements of GeometryCollections are processed individually. The endpoints of LineStrings are preserved.

If the *tolerance* parameter is provided, vertices within the tolerance distance of one another are considered to be duplicates.

Enhanced: 3.2.0

2.2.0 버전부터 사용할 수 있습니다.

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsText( ST_RemoveRepeatedPoints( 'MULTIPOINT ((1 1), (2 2), (3 3), (2 2))'));
-------------------------
 MULTIPOINT(1 1,2 2,3 3)
```

```
SELECT ST_AsText( ST_RemoveRepeatedPoints( 'LINESTRING (0 0, 0 0, 1 1, 0 0, 1 1, 2 2)'));
---------------------------------
 LINESTRING(0 0,1 1,0 0,1 1,2 2)
```

Example: Collection elements are processed individually.

```
SELECT ST_AsText( ST_RemoveRepeatedPoints( 'GEOMETRYCOLLECTION (LINESTRING (1 1, 2 2, 2 2,  ↩
    3 3), POINT (4 4), POINT (4 4), POINT (5 5))'));
-----------------------------------------------------------------------------
 GEOMETRYCOLLECTION(LINESTRING(1 1,2 2,3 3),POINT(4 4),POINT(4 4),POINT(5 5))
```

Example: Repeated point removal with a distance tolerance.

```
SELECT ST_AsText( ST_RemoveRepeatedPoints( 'LINESTRING (0 0, 0 0, 1 1, 5 5, 1 1, 2 2)', 2)) ↩
    ;
-------------------------
 LINESTRING(0 0,5 5,2 2)
```

참고

ST_Simplify

7.5.26 ST_Reverse

ST_Reverse — 꼭짓점들의 순서가 반대인 도형을 반환합니다.

Synopsis

geometry **ST_Reverse**(geometry g1);

설명

어떤 도형도 입력받을 수 있으며, 꼭짓점들의 순서를 반전시킵니&#x

Enhanced: 2.4.0 support for curves was introduced.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_AsText(geom) as line, ST_AsText(ST_Reverse(geom)) As reverseline
FROM
(SELECT ST_MakeLine(ST_Point(1,2),
                ST_Point(1,10)) As geom) as foo;
--result
                line         |     reverseline
---------------------+----------------------
LINESTRING(1 2,1 10) | LINESTRING(1 10,1 2)
```

7.5.27 ST_Segmentize

ST_Segmentize — Returns a modified geometry/geography having no segment longer than a given distance.

Synopsis

geometry **ST_Segmentize**(geometry geom, float max_segment_length);
geography **ST_Segmentize**(geography geog, float max_segment_length);

설명

Returns a modified geometry/geography having no segment longer than `max_segment_length`. Length is computed in 2D. Segments are always split into equal-length subsegments.

- For geometry, the maximum length is in the units of the spatial reference system.
- For geography, the maximum length is in meters. Distances are computed on the sphere. Added vertices are created along the spherical great-circle arcs defined by segment endpoints.

Note
This only shortens long segments. It does not lengthen segments shorter than the maximum length.

Warning
For inputs containing long segments, specifying a relatively short `max_segment_length` can cause a very large number of vertices to be added. This can happen unintentionally if the argument is specified accidentally as a number of segments, rather than a maximum length.

1.2.2 버전부터 사용할 수 있습니다.

Enhanced: 3.0.0 Segmentize geometry now produces equal-length subsegments

Enhanced: 2.3.0 Segmentize geography now produces equal-length subsegments

개선 사항: 2.1.0 버전부터 지리형을 지원하기 시작했습니다.

Changed: 2.1.0 As a result of the introduction of geography support, the usage `ST_Segmentize('LINESTRING(1 2, 3 4)', 0.5)` causes an ambiguous function error. The input needs to be properly typed as a geometry or geography. Use ST_GeomFromText, ST_GeogFromText or a cast to the required type (e.g. `ST_Segmentize('LINESTRING(1 2, 3 4)'::geometry, 0.5)`)

예시

Segmentizing a line. Long segments are split evenly, and short segments are not split.

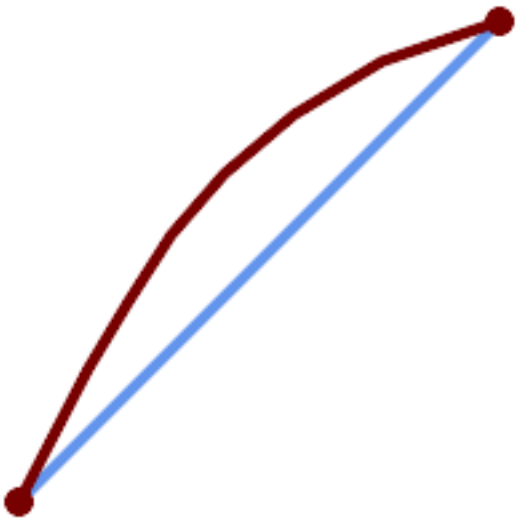
```
SELECT ST_AsText(ST_Segmentize(
    'MULTILINESTRING((0 0, 0 1, 0 9),(1 10, 1 18))'::geometry,
        5 ) );
--------------------------------------------------
MULTILINESTRING((0 0,0 1,0 5,0 9),(1 10,1 14,1 18))
```

Segmentizing a polygon:

```
SELECT ST_AsText(
        ST_Segmentize(('POLYGON((0 0, 0 8, 30 0, 0 0))'::geometry), 10));
------------------------------------------------------
POLYGON((0 0,0 8,7.5 6,15 4,22.5 2,30 0,20 0,10 0,0 0))
```

Segmentizing a geographic line, using a maximum segment length of 2000 kilometers. Vertices are added along the great-circle arc connecting the endpoints.

```
SELECT ST_AsText(
        ST_Segmentize(('LINESTRING (0 0, 60 60)'::geography), 2000000));
------------------------------------------------------------
LINESTRING(0 0,4.2526322946211 8.43596525986862,8.69579947419404  ↩
    16.824093489701564,13.550465473227048 25.107950473646188,19.1066053508691  ↩
    33.21091076089908,25.779290201459894 41.01711439406505,34.188839517966954  ↩
    48.337222885886,45.238153936612264 54.84733442373889,60 60)
```



A geographic line segmentized along a great circle arc

참고

ST_LineSubstring

7.5.28 ST_SetPoint

ST_SetPoint — 라인스트링의 포인트를 주&#xc5b4
포인트로 대체합니다.

Synopsis

geometry **ST_SetPoint**(geometry linestring, integer zerobasedposition, geometry point);

설명

라인스트링의 N번째 포인트를 주&#
포인트로 대체합니다. 인덱스는
0-기반입니다. 음수 인덱스는 반대&
세기 때문에, -1이 마지막 포인트가
됩니다. 꼭짓점 하나가 움직였을
때 연결 관계를 유지하려는 경우
이 함수가 트리거 역할로 특히 유&#

1.1.0 버전부터 사용할 수 있습니다.

업데이트 사항: 2.3.0 버전에서 음수
인덱스를 지원하기 시작했습니&#x

This function supports 3d and will not drop the z-index.

예시

```
--Change first point in line string from -1 3 to -1 1
SELECT ST_AsText(ST_SetPoint('LINESTRING(-1 2,-1 3)', 0, 'POINT(-1 1)'));
           st_astext
-----------------------
 LINESTRING(-1 1,-1 3)

---Change last point in a line string (lets play with 3d linestring this time)
SELECT ST_AsEWKT(ST_SetPoint(foo.geom, ST_NumPoints(foo.geom) - 1, ST_GeomFromEWKT('POINT ↩
    (-1 1 3)')))
FROM (SELECT ST_GeomFromEWKT('LINESTRING(-1 2 3,-1 3 4, 5 6 7)') As geom) As foo;
           st_asewkt
-----------------------
LINESTRING(-1 2 3,-1 3 4,-1 1 3)

SELECT ST_AsText(ST_SetPoint(g, -3, p))
FROM ST_GEomFromText('LINESTRING(0 0, 1 1, 2 2, 3 3, 4 4)') AS g
        , ST_PointN(g,1) as p;
           st_astext
-----------------------
LINESTRING(0 0,1 1,0 0,3 3,4 4)
```

참고

ST_AddPoint, ST_NPoints, ST_NumPoints, ST_PointN, ST_RemovePoint

7.5.29 ST_ShiftLongitude

ST_ShiftLongitude — Shifts the longitude coordinates of a geometry between -180..180 and 0..360.

Synopsis

geometry **ST_ShiftLongitude**(geometry geom);

설명

Reads every point/vertex in a geometry, and shifts its longitude coordinate from -180..0 to 180..360 and vice versa if between these ranges. This function is symmetrical so the result is a 0..360 representation of a -180..180 data and a -180..180 representation of a 0..360 data.

Note
This is only useful for data with coordinates in longitude/latitude; e.g. SRID 4326 (WGS 84 geographic)

Warning
1.3.4 미만 버전에서는 버그 때문에 멀티포인트를 입력받지 못 했습니다. 1.3.4 버전부터 멀티포인트도 입력할 수 있습니다.

This function supports 3d and will not drop the z-index.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface) 및 TIN을 지원합니다.

주의: 2.2.0 미만 버전에서, 이 함수의
명칭은 "ST_Shift_Longitude"였습니다.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
--single point forward transformation
SELECT ST_AsText(ST_ShiftLongitude('SRID=4326;POINT(270 0)'::geometry))

st_astext
----------
POINT(-90 0)


--single point reverse transformation
SELECT ST_AsText(ST_ShiftLongitude('SRID=4326;POINT(-90 0)'::geometry))

st_astext
----------
POINT(270 0)


--for linestrings the functions affects only to the sufficient coordinates
SELECT ST_AsText(ST_ShiftLongitude('SRID=4326;LINESTRING(174 12, 182 13)'::geometry))

st_astext
----------
LINESTRING(174 12,-178 13)
```

참고

ST_WrapX

7.5.30 ST_WrapX

ST_WrapX — X값 근처에서 도형을 래핑합&#xb2

Synopsis

geometry **ST_WrapX**(geometry geom, float8 wrap, float8 move);

설명

This function splits the input geometries and then moves every resulting component falling on the right (for negative 'move') or on the left (for positive 'move') of given 'wrap' line in the direction specified by the 'move' parameter, finally re-unioning the pieces together.

Note

이 함수는 경위도 입력물이 한 편에서 다른 편으로 걸쳐 있지 않은 관심 피처를 갖도록 하는 데 유용합니다.

Availability: 2.3.0 requires GEOS

This function supports 3d and will not drop the z-index.

예시

```
-- Move all components of the given geometries whose bounding box
-- falls completely on the left of x=0 to +360
select ST_WrapX(geom, 0, 360);

-- Move all components of the given geometries whose bounding box
-- falls completely on the left of x=-30 to +360
select ST_WrapX(geom, -30, 360);
```

참고

ST_ShiftLongitude

7.5.31 ST_SnapToGrid

ST_SnapToGrid — 입력 도형의 모든 포인트를 정규 그리드로 스냅(snap)시킵니다.

Synopsis

geometry **ST_SnapToGrid**(geometry geomA, float originX, float originY, float sizeX, float sizeY);
geometry **ST_SnapToGrid**(geometry geomA, float sizeX, float sizeY);
geometry **ST_SnapToGrid**(geometry geomA, float size);
geometry **ST_SnapToGrid**(geometry geomA, geometry pointOrigin, float sizeX, float sizeY, float sizeZ, float sizeM);

설명

변종 1, 2, 3: 입력 도형의 모든 포인트&#xb
원점과 셀(cell) 크기로 정의된 그리&#xb4dc
스냅(snap)시킵니다. 동일한 셀에 떨&#xc5
연속된 포인트들을 제거하며, 출&#x
포인트들이 주어진 유형의 도형&#x
정의하기에 부족할 경우 결국 NULL&#xc7
반환합니다. 도형 집합 안에서 이&
붕괴된 도형은 집합에서 제외됩&#
정확도를 낮추는 데 유용합니다.

변종 4: 1.1.0 버전에서 추가되었습니&#xb2
입력 도형의 모든 포인트를 원점(&
번째 인수, 포인트여야 합니다) 및
셀 크기로 정의된 그리드로 스냅&#x

사용자가 그리드로 스냅시키고 싶지 않은 차원의 경우, 셀 크기를 0으로 설정하십시오.

Note

반환되는 도형이 단순성을 잃을 수도 있습니다(ST_IsSimple 참조).

Note

1.1.0 버전 배포 전에는 이함수가 항상 2차원 도형을 반환했습니다. 1.1.0 버전부터 반환되는 도형이, 더 높은 차원값은 건드리지 않은 채, 입력 도형과 동일한 차원수를 가지게 됐습니다. 모든 그리드 차원을 정의하려면 두 번째 도형 인자를 입력받는 버전을 이용하십시오.

1.0.0RC1 버전부터 사용할 수 있습니다.

1.1.0 버전부터 Z 및 M을 지원합니다.

This function supports 3d and will not drop the z-index.

예시

```
--Snap your geometries to a precision grid of 10^-3
UPDATE mytable
   SET geom = ST_SnapToGrid(geom, 0.001);

SELECT ST_AsText(ST_SnapToGrid(
                        ST_GeomFromText('LINESTRING(1.1115678 2.123, 4.111111 3.2374897,  ↩
                            4.11112 3.23748667)'),
                        0.001)
                );
                          st_astext
-------------------------------------
 LINESTRING(1.112 2.123,4.111 3.237)
 --Snap a 4d geometry
SELECT ST_AsEWKT(ST_SnapToGrid(
        ST_GeomFromEWKT('LINESTRING(-1.1115678 2.123 2.3456 1.11111,
                4.111111 3.2374897 3.1234 1.1111, -1.11111112 2.123 2.3456 1.1111112)'),
 ST_GeomFromEWKT('POINT(1.12 2.22 3.2 4.4444)'),
 0.1, 0.1, 0.1, 0.01) );
                                                                st_asewkt
------------------------------------------------------------------------------
 LINESTRING(-1.08 2.12 2.3 1.1144,4.12 3.22 3.1 1.1144,-1.08 2.12 2.3 1.1144)


--With a 4d geometry - the ST_SnapToGrid(geom,size) only touches x and y coords but keeps m ↩
    and z the same
SELECT ST_AsEWKT(ST_SnapToGrid(ST_GeomFromEWKT('LINESTRING(-1.1115678 2.123 3 2.3456,
                4.111111 3.2374897 3.1234 1.1111)'),
```

```
           0.01)      );
                                                  st_asewkt
-------------------------------------------------------------
 LINESTRING(-1.11 2.12 3 2.3456,4.11 3.24 3.1234 1.1111)
```

참고

ST_Snap, ST_AsEWKT, ST_AsText, ST_GeomFromText, ST_GeomFromEWKT, ST_Simplify

7.5.32 ST_Snap

ST_Snap — 입력 도형의 분절 구간과 꼭짓&
참조 도형의 꼭짓점으로 스냅시&#x

Synopsis

geometry **ST_Snap**(geometry input, geometry reference, float tolerance);

설명

Snaps the vertices and segments of a geometry to another Geometry's vertices. A snap distance tolerance is used to control where snapping is performed. The result geometry is the input geometry with the vertices snapped. If no snapping occurs then the input geometry is returned unchanged.

한 도형을 또다른 도형으로 스냅&#
(노드 및 교차점 계산 과정에서 문&#
일으킬 수 있는) 거의 일치하는 경&
제거함으로써 오버레이 연산을
강력하게 향상시킬 수 있습니다.

스냅을 너무 많이 하면 유효하지
않은 지형을 생성하는 결과를 가&#
수 있기 때문에, 경험식(heuristics)을 통해
어떤 경우 안전하게 스냅시킬 수
있는지 알아내서 스냅시킬 꼭짓&#x
개수 및 위치를 결정합니다. 하지&#
이런 방식은 몇몇 가능할 수도 있&#
스냅 작업을 제외하게 될 수도 있&#

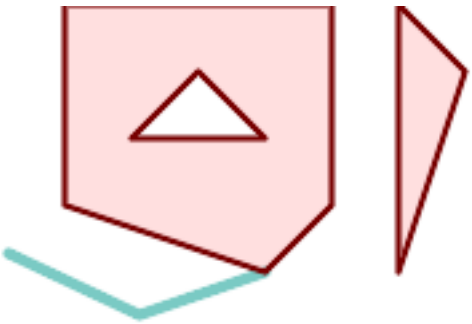
> **Note**
> 반환되는 도형이 단순성(ST_IsSimple 참조) 및 유효성(ST_IsValid 참조)을 잃을 수도 있습니다.

GEOS 모듈로 실행

2.0.0 버전부터 사용할 수 있습니다.

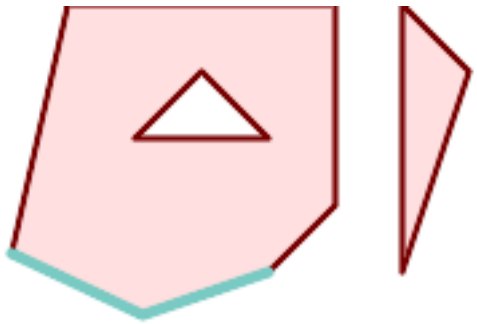
예시

라인스트링과 함께 표출된 멀티폴리곤(스냅 작업 전)



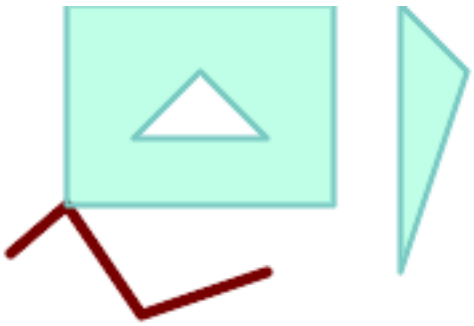
허용 거리 1.01을 기준으로 라인스트링에 스냅된 멀티폴리곤. 새로운 멀티폴리곤은 참조 라인스트링과 함께 표출됩니다.

```
SELECT ST_AsText(ST_Snap(poly,line,  ↩
    ST_Distance(poly,line)*1.01)) AS polysnapped
FROM (SELECT
   ST_GeomFromText('MULTIPOLYGON(
     ((26 125, 26 200, 126 200, 126 125,  ↩
     26 125 ),
      ( 51 150, 101 150, 76 175, 51 150 ) ↩
     ),
      (( 151 100, 151 200, 176 175, 151  ↩
     100 )))') As poly,
       ST_GeomFromText('LINESTRING (5  ↩
     107, 54 84, 101 100)') As line
        ) As foo;

                              polysnapped
-----------------------------------------------------------------

 MULTIPOLYGON(((26 125,26 200,126 200,126 ↩
      125,101 100,26 125),
 (51 150,101 150,76 175,51 150)),((151  ↩
     100,151 200,176 175,151 100)))
```



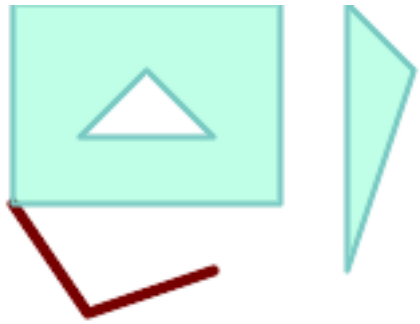
허용 거리 1.25를 기준으로 라인스트링에 스냅된 멀티폴리곤. 새로운 멀티폴리곤은 참조 라인스트링과 함께 표출됩니다.

```
SELECT ST_AsText(
    ST_Snap(poly,line, ST_Distance(poly, ↩
     line)*1.25)
  ) AS polysnapped
FROM (SELECT
  ST_GeomFromText('MULTIPOLYGON(
    (( 26 125, 26 200, 126 200, 126 125,  ↩
     26 125 ),
      ( 51 150, 101 150, 76 175, 51 150 ) ↩
     ),
      (( 151 100, 151 200, 176 175, 151  ↩
     100 )))') As poly,
       ST_GeomFromText('LINESTRING (5  ↩
     107, 54 84, 101 100)') As line
        ) As foo;

---------------------------------- ↩    polysnapped
-----------------------------------------------------------------

MULTIPOLYGON(((5 107,26 200,126 200,126  ↩
     125,101 100,54 84,5 107),
(51 150,101 150,76 175,51 150)),((151  ↩
     100,151 200,176 175,151 100)))
```



허용 거리 1.01을 기준으로 원래 멀티폴리곤에 스냅된 라인스트링. 새로운 라인스트링은 참조 멀티폴리곤과 함께 표출됩니다.

```
SELECT ST_AsText(
   ST_Snap(line, poly, ST_Distance(poly, ↩
     line)*1.01)
  ) AS linesnapped
FROM (SELECT
  ST_GeomFromText('MULTIPOLYGON(
     ((26 125, 26 200, 126 200, 126 125,  ↩
    26 125),
      (51 150, 101 150, 76 175, 51 150 )) ↩
    ,
      ((151 100, 151 200, 176 175, 151  ↩
    100)))') As poly,
       ST_GeomFromText('LINESTRING (5  ↩
    107, 54 84, 101 100)') As line
       ) As foo;

              linesnapped
----------------------------------------
 LINESTRING(5 107,26 125,54 84,101 100)
```



허용 거리 1.25를 기준으로 원래 멀티폴리곤에 스냅된 라인스트링. 새로운 라인스트링은 참조 멀티폴리곤과 함께 표출됩니다.

```
SELECT ST_AsText(
 ST_Snap(line, poly, ST_Distance(poly, ↩
     line)*1.25)
  ) AS linesnapped
FROM (SELECT
  ST_GeomFromText('MULTIPOLYGON(
     (( 26 125, 26 200, 126 200, 126 125, ↩
      26 125 ),
      (51 150, 101 150, 76 175, 51 150 )) ↩
    ,
      ((151 100, 151 200, 176 175, 151  ↩
    100 )))') As poly,
       ST_GeomFromText('LINESTRING (5  ↩
    107, 54 84, 101 100)') As line
       ) As foo;
              linesnapped
----------------------------------------
LINESTRING(26 125,54 84,101 100)
```

참고

ST_SnapToGrid

7.5.33 ST_SwapOrdinates

ST_SwapOrdinates — 입력 도형을 좌표값을 뒤바&
상태로 반환합니다.

Synopsis

geometry **ST_SwapOrdinates**(geometry geom, cstring ords);

설명

입력 도형을 좌표값을 뒤바꾼 상&#x
반환합니다.

`ords` 파라미터는 뒤바꿀 좌표를 명&#xba8
문자 2개 길이의 스트링입니다. 유&
명칭은 x, y, z, 그리고 m입니다.

2.2.0 버전부터 사용할 수 있습니다.

This method supports Circular Strings and Curves.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
-- M&#xac12;&#xc744; 2&#xbc30;&#xb85c; &#xb9cc;&#xb4ed;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(
  ST_SwapOrdinates(
    ST_Scale(
      ST_SwapOrdinates(g,'xm'),
      2, 1
    ),
  'xm')
) FROM ( SELECT 'POINT ZM (0 0 0 2)'::geometry g ) foo;
     st_astext
--------------------
 POINT ZM (0 0 0 4)
```

참고

ST_FlipCoordinates

7.6 Geometry Validation

7.6.1 ST_IsValid

ST_IsValid — Tests if a geometry is well-formed in 2D.

Synopsis

boolean **ST_IsValid**(geometry g);
boolean **ST_IsValid**(geometry g, integer flags);

Description

Tests if an ST_Geometry value is well-formed and valid in 2D according to the OGC rules. For geometries with 3 and 4 dimensions, the validity is still only tested in 2 dimensions. For geometries that are invalid, a PostgreSQL NOTICE is emitted providing details of why it is not valid.

For the version with the `flags` parameter, supported values are documented in ST_IsValidDetail This version does not print a NOTICE explaining invalidity.

For more information on the definition of geometry validity, refer to Section 4.4

Note
SQL-MM defines the result of ST_IsValid(NULL) to be 0, while PostGIS returns NULL.

Performed by the GEOS module.

The version accepting flags is available starting with 2.0.0.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.9

Note
Neither OGC-SFS nor SQL-MM specifications include a flag argument for ST_IsValid. The flag is a PostGIS extension.

Examples

```
SELECT ST_IsValid(ST_GeomFromText('LINESTRING(0 0, 1 1)')) As good_line,
        ST_IsValid(ST_GeomFromText('POLYGON((0 0, 1 1, 1 2, 1 1, 0 0))')) As bad_poly
--results
NOTICE:  Self-intersection at or near point 0 0
 good_line | bad_poly
-----------+----------
 t         | f
```

See Also

ST_IsSimple, ST_IsValidReason, ST_IsValidDetail,

7.6.2 ST_IsValidDetail

ST_IsValidDetail — Returns a `valid_detail` row stating if a geometry is valid or if not a reason and a location.

Synopsis

valid_detail **ST_IsValidDetail**(geometry geom, integer flags);

Description

Returns a `valid_detail` row, containing a boolean (`valid`) stating if a geometry is valid, a varchar (`reason`) stating a reason why it is invalid and a geometry (`location`) pointing out where it is invalid.

Useful to improve on the combination of ST_IsValid and ST_IsValidReason to generate a detailed report of invalid geometries.

The optional `flags` parameter is a bitfield. It can have the following values:

- 0: Use usual OGC SFS validity semantics.
- 1: Consider certain kinds of self-touching rings (inverted shells and exverted holes) as valid. This is also known as "the ESRI flag", since this is the validity model used by those tools. Note that this is invalid under the OGC model.

Performed by the GEOS module.

Availability: 2.0.0

Examples

```
--First 3 Rejects from a successful quintuplet experiment
SELECT gid, reason(ST_IsValidDetail(geom)), ST_AsText(location(ST_IsValidDetail(geom))) as ↩
    location
FROM
(SELECT ST_MakePolygon(ST_ExteriorRing(e.buff), array_agg(f.line)) As geom, gid
FROM (SELECT ST_Buffer(ST_Point(x1*10,y1), z1) As buff, x1*10 + y1*100 + z1*1000 As gid
        FROM generate_series(-4,6) x1
        CROSS JOIN generate_series(2,5) y1
        CROSS JOIN generate_series(1,8) z1
        WHERE x1 > y1*0.5 AND z1 < x1*y1) As e
        INNER JOIN (SELECT ST_Translate(ST_ExteriorRing(ST_Buffer(ST_Point(x1*10,y1), z1)), ↩
            y1*1, z1*2) As line
        FROM generate_series(-3,6) x1
        CROSS JOIN generate_series(2,5) y1
        CROSS JOIN generate_series(1,10) z1
        WHERE x1 > y1*0.75 AND z1 < x1*y1) As f
ON (ST_Area(e.buff) > 78 AND ST_Contains(e.buff, f.line))
GROUP BY gid, e.buff) As quintuplet_experiment
WHERE ST_IsValid(geom) = false
ORDER BY gid
LIMIT 3;

 gid  |      reason       |  location
------+-------------------+-------------
 5330 | Self-intersection | POINT(32 5)
 5340 | Self-intersection | POINT(42 5)
 5350 | Self-intersection | POINT(52 5)

 --simple example
SELECT * FROM ST_IsValidDetail('LINESTRING(220227 150406,2220227 150407,222020 150410)');

 valid | reason | location
-------+--------+----------
 t     |        |
```

See Also

ST_IsValid, ST_IsValidReason

7.6.3 ST_IsValidReason

ST_IsValidReason — Returns text stating if a geometry is valid, or a reason for invalidity.

Synopsis

text **ST_IsValidReason**(geometry geomA);
text **ST_IsValidReason**(geometry geomA, integer flags);

Description

Returns text stating if a geometry is valid, or if invalid a reason why.

Useful in combination with ST_IsValid to generate a detailed report of invalid geometries and reasons.

Allowed `flags` are documented in ST_IsValidDetail.

Performed by the GEOS module.

Availability: 1.4

Availability: 2.0 version taking flags.

Examples

```
-- invalid bow-tie polygon
SELECT ST_IsValidReason(
    'POLYGON ((100 200, 100 100, 200 200,
     200 100, 100 200))'::geometry) as validity_info;
validity_info
--------------------------
Self-intersection[150 150]
```

```
--First 3 Rejects from a successful quintuplet experiment
SELECT gid, ST_IsValidReason(geom) as validity_info
FROM
(SELECT ST_MakePolygon(ST_ExteriorRing(e.buff), array_agg(f.line)) As geom, gid
FROM (SELECT ST_Buffer(ST_Point(x1*10,y1), z1) As buff, x1*10 + y1*100 + z1*1000 As gid
        FROM generate_series(-4,6) x1
        CROSS JOIN generate_series(2,5) y1
        CROSS JOIN generate_series(1,8) z1
        WHERE x1 > y1*0.5 AND z1 < x1*y1) As e
        INNER JOIN (SELECT ST_Translate(ST_ExteriorRing(ST_Buffer(ST_Point(x1*10,y1), z1)), ↩
            y1*1, z1*2) As line
        FROM generate_series(-3,6) x1
        CROSS JOIN generate_series(2,5) y1
        CROSS JOIN generate_series(1,10) z1
        WHERE x1 > y1*0.75 AND z1 < x1*y1) As f
ON (ST_Area(e.buff) > 78 AND ST_Contains(e.buff, f.line))
GROUP BY gid, e.buff) As quintuplet_experiment
WHERE ST_IsValid(geom) = false
ORDER BY gid
LIMIT 3;

 gid  |      validity_info
```

```
------+-------------------------
 5330 | Self-intersection [32 5]
 5340 | Self-intersection [42 5]
 5350 | Self-intersection [52 5]

 --simple example
SELECT ST_IsValidReason('LINESTRING(220227 150406,2220227 150407,222020 150410)');

 st_isvalidreason
------------------
 Valid Geometry
```

See Also

ST_IsValid, ST_Summary

7.6.4 ST_MakeValid

ST_MakeValid — Attempts to make an invalid geometry valid without losing vertices.

Synopsis

geometry **ST_MakeValid**(geometry input);
geometry **ST_MakeValid**(geometry input, text params);

Description

The function attempts to create a valid representation of a given invalid geometry without losing any of the input vertices. Valid geometries are returned unchanged.

Supported inputs are: POINTS, MULTIPOINTS, LINESTRINGS, MULTILINESTRINGS, POLYGONS, MULTIPOLYGONS and GEOMETRYCOLLECTIONS containing any mix of them.

In case of full or partial dimensional collapses, the output geometry may be a collection of lower-to-equal dimension geometries, or a geometry of lower dimension.

Single polygons may become multi-geometries in case of self-intersections.

The `params` argument can be used to supply an options string to select the method to use for building valid geometry. The options string is in the format "method=linework|structure keepcollapsed=true|false". If no "params" argument is provided, the "linework" algorithm will be used as the default.

The "method" key has two values.

- "linework" is the original algorithm, and builds valid geometries by first extracting all lines, noding that linework together, then building a value output from the linework.
- "structure" is an algorithm that distinguishes between interior and exterior rings, building new geometry by unioning exterior rings, and then differencing all interior rings.

The "keepcollapsed" key is only valid for the "structure" algorithm, and takes a value of "true" or "false". When set to "false", geometry components that collapse to a lower dimensionality, for example a one-point linestring would be dropped.

Performed by the GEOS module.

Availability: 2.0.0

Enhanced: 2.0.1, speed improvements

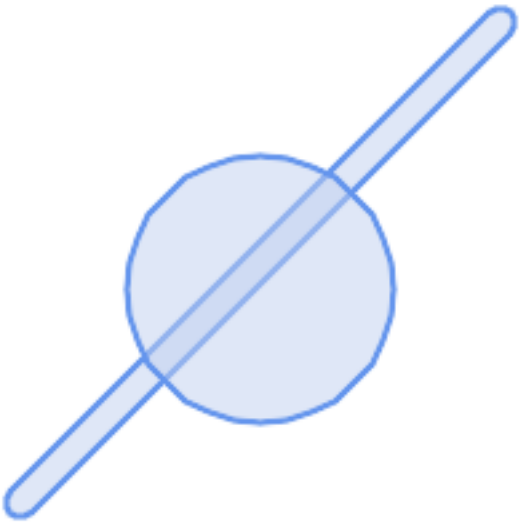
Enhanced: 2.1.0, added support for GEOMETRYCOLLECTION and MULTIPOINT.

Enhanced: 3.1.0, added removal of Coordinates with NaN values.

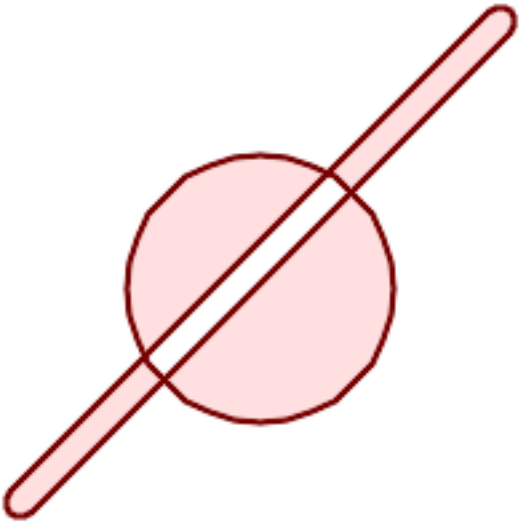
Enhanced: 3.2.0, added algorithm options, 'linework' and 'structure' which requires GEOS >= 3.10.0.

This function supports 3d and will not drop the z-index.

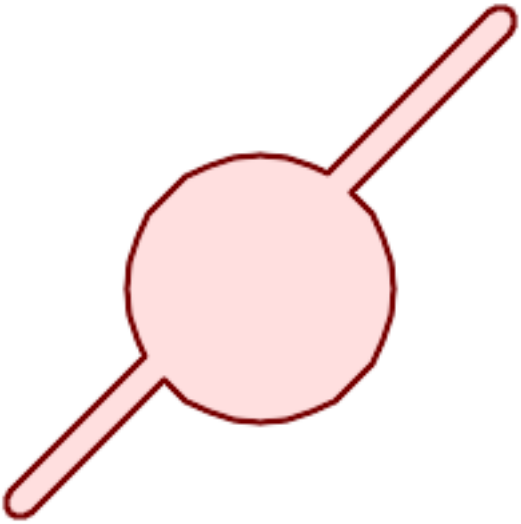
Examples



before_geom: MULTIPOLYGON of 2 overlapping polygons

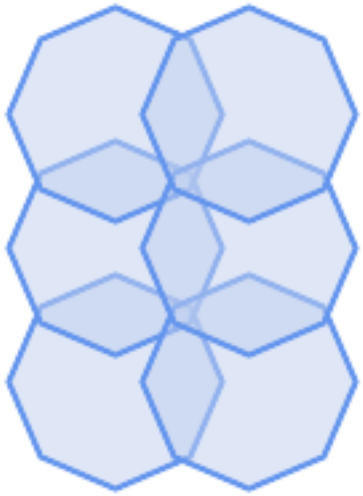


after_geom: MULTIPOLYGON of 4 non-overlapping polygons

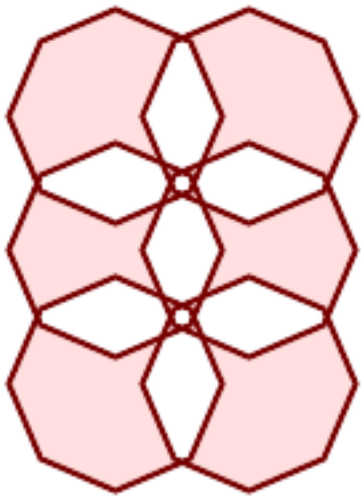


after_geom_structure: MULTIPOLYGON of 1 non-overlapping polygon

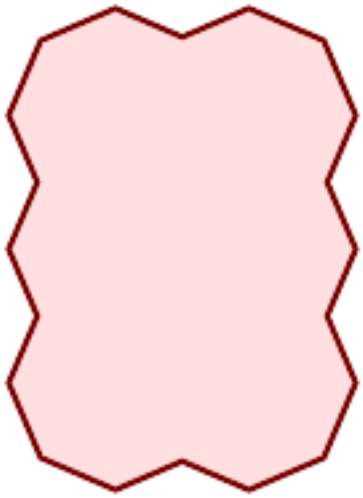
```
SELECT f.geom AS before_geom, ST_MakeValid(f.geom) AS after_geom, ST_MakeValid(f.geom,  ↩
    'method=structure') AS after_geom_structure
FROM (SELECT 'MULTIPOLYGON(((186 194,187 194,188 195,189 195,190 195,
191 195,192 195,193 194,194 194,194 194,193 195,192 195,191
```



before_geom: MULTIPOLYGON of 6 overlapping polygons



after_geom: MULTIPOLYGON of 14 Non-overlapping polygons



after_geom_structure: MULTIPOLYGON of 1 Non-overlapping polygon

```
SELECT c.geom AS before_geom,
                    ST_MakeValid(c.geom) AS after_geom,
                    ST_MakeValid(c.geom, 'method=structure') AS after_geom_structure
        FROM (SELECT 'MULTIPOLYGON(((91 50,79 22,51 10,23 22,11 50,23 78,51 90,79 78,91 ↩
```

Examples

```
SELECT ST_AsText(ST_MakeValid(
    'LINESTRING(0 0, 0 0)',
    'method=structure keepcollapsed=true'
    ));

 st_astext
------------
 POINT(0 0)


SELECT ST_AsText(ST_MakeValid(
    'LINESTRING(0 0, 0 0)',
    'method=structure keepcollapsed=false'
    ));

    st_astext
------------------
 LINESTRING EMPTY
```

See Also

ST_IsValid, ST_GeomCollFromText, ST_CollectionExtract

7.7 Spatial Reference System Functions

7.7.1 ST_InverseTransformPipeline

ST_InverseTransformPipeline — Return a new geometry with coordinates transformed to a different spatial reference system using the inverse of a defined coordinate transformation pipeline.

Synopsis

geometry **ST_InverseTransformPipeline**(geometry geom, text pipeline, integer to_srid);

Description

Return a new geometry with coordinates transformed to a different spatial reference system using a defined coordinate transformation pipeline to go in the inverse direction.

Refer to ST_TransformPipeline for details on writing a transformation pipeline.

Availability: 3.4.0

The SRID of the input geometry is ignored, and the SRID of the output geometry will be set to zero unless a value is provided via the optional `to_srid` parameter. When using ST_TransformPipeline the pipeline is executed in a forward direction. Using `ST_InverseTransformPipeline()` the pipeline is executed in the inverse direction.

Transforms using pipelines are a specialised version of ST_Transform. In most cases `ST_Transform` will choose the correct operations to convert between coordinate systems, and should be preferred.

Examples

Change WGS 84 long lat to UTM 31N using the EPSG:16031 conversion

```
-- Inverse direction
SELECT ST_AsText(ST_InverseTransformPipeline('POINT(426857.9877165967 5427937.523342293)':: ↩
    geometry,
  'urn:ogc:def:coordinateOperation:EPSG::16031')) AS wgs_geom;

          wgs_geom
----------------------------
 POINT(2 48.99999999999999)
(1 row)
```

GDA2020 example.

```
-- using ST_Transform with automatic selection of a conversion pipeline.
SELECT ST_AsText(ST_Transform('SRID=4939;POINT(143.0 -37.0)'::geometry, 7844)) AS  ↩
    gda2020_auto;

                gda2020_auto
---------------------------------------------
 POINT(143.00000635638918 -36.999986706128176)
(1 row)
```

See Also

ST_Transform, ST_TransformPipeline

7.7.2 ST_SetSRID

ST_SetSRID — Set the SRID on a geometry.

Synopsis

geometry **ST_SetSRID**(geometry geom, integer srid);

Description

Sets the SRID on a geometry to a particular integer value. Useful in constructing bounding boxes for queries.

Note
This function does not transform the geometry coordinates in any way - it simply sets the meta data defining the spatial reference system the geometry is assumed to be in. Use ST_Transform if you want to transform the geometry into a new projection.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method supports Circular Strings and Curves.

Examples

-- Mark a point as WGS 84 long lat --

```
SELECT ST_SetSRID(ST_Point(-123.365556, 48.428611),4326) As wgs84long_lat;
-- the ewkt representation (wrap with ST_AsEWKT) -
SRID=4326;POINT(-123.365556 48.428611)
```

-- Mark a point as WGS 84 long lat and then transform to web mercator (Spherical Mercator) --

```
SELECT ST_Transform(ST_SetSRID(ST_Point(-123.365556, 48.428611),4326),3785) As spere_merc;
-- the ewkt representation (wrap with ST_AsEWKT) -
SRID=3785;POINT(-13732990.8753491 6178458.96425423)
```

See Also

Section 4.5, ST_SRID, ST_Transform, UpdateGeometrySRID

7.7.3 ST_SRID

ST_SRID — Returns the spatial reference identifier for a geometry.

Synopsis

integer **ST_SRID**(geometry g1);

Description

Returns the spatial reference identifier for the ST_Geometry as defined in spatial_ref_sys table. Section 4.5

Note
spatial_ref_sys table is a table that catalogs all spatial reference systems known to PostGIS and is used for transformations from one spatial reference system to another. So verifying you have the right spatial reference system identifier is important if you plan to ever transform your geometries.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.5

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_SRID(ST_GeomFromText('POINT(-71.1043 42.315)',4326));
    --result
    4326
```

See Also

Section 4.5, ST_SetSRID, ST_Transform, ST_SRID, ST_SRID

7.7.4 ST_Transform

ST_Transform — Return a new geometry with coordinates transformed to a different spatial reference system.

Synopsis

geometry **ST_Transform**(geometry g1, integer srid);
geometry **ST_Transform**(geometry geom, text to_proj);
geometry **ST_Transform**(geometry geom, text from_proj, text to_proj);
geometry **ST_Transform**(geometry geom, text from_proj, integer to_srid);

Description

Returns a new geometry with its coordinates transformed to a different spatial reference system. The destination spatial reference `to_srid` may be identified by a valid SRID integer parameter (i.e. it must exist in the `spatial_ref_sys` table). Alternatively, a spatial reference defined as a PROJ.4 string can be used for `to_proj` and/or `from_proj`, however these methods are not optimized. If the destination spatial reference system is expressed with a PROJ.4 string instead of an SRID, the SRID of the output geometry will be set to zero. With the exception of functions with `from_proj`, input geometries must have a defined SRID.

ST_Transform is often confused with ST_SetSRID. ST_Transform actually changes the coordinates of a geometry from one spatial reference system to another, while ST_SetSRID() simply changes the SRID identifier of the geometry.

ST_Transform automatically selects a suitable conversion pipeline given the source and target spatial reference systems. To use a specific conversion method, use ST_TransformPipeline.

Note
Requires PostGIS be compiled with PROJ support. Use PostGIS_Full_Version to confirm you have PROJ support compiled in.

Note
If using more than one transformation, it is useful to have a functional index on the commonly used transformations to take advantage of index usage.

Note
Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

Enhanced: 2.0.0 support for Polyhedral surfaces was introduced.

Enhanced: 2.3.0 support for direct PROJ.4 text was introduced.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.6

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

Examples

Change Massachusetts state plane US feet geometry to WGS 84 long lat

```
SELECT ST_AsText(ST_Transform(ST_GeomFromText('POLYGON((743238 2967416,743238 2967450,
  743265 2967450,743265.625 2967416,743238 2967416))',2249),4326)) As wgs_geom;

 wgs_geom
---------------------------
 POLYGON((-71.1776848522251 42.3902896512902,-71.1776843766326 42.3903829478009,
-71.1775844305465 42.3903826677917,-71.1775825927231 42.3902893647987,-71.177684
8522251 42.3902896512902));
(1 row)

--3D Circular String example
SELECT ST_AsEWKT(ST_Transform(ST_GeomFromEWKT('SRID=2249;CIRCULARSTRING(743238 2967416  ↩
    1,743238 2967450 2,743265 2967450 3,743265.625 2967416 3,743238 2967416 4)'),4326));

         st_asewkt
-----------------------------------------------------------------------------------
 SRID=4326;CIRCULARSTRING(-71.1776848522251 42.3902896512902 1,-71.1776843766326  ↩
     42.3903829478009 2,
 -71.1775844305465 42.3903826677917 3,
 -71.1775825927231 42.3902893647987 3,-71.1776848522251 42.3902896512902 4)
```

Example of creating a partial functional index. For tables where you are not sure all the geometries will be filled in, its best to use a partial index that leaves out null geometries which will both conserve space and make your index smaller and more efficient.

```
CREATE INDEX idx_geom_26986_parcels
  ON parcels
  USING gist
  (ST_Transform(geom, 26986))
  WHERE geom IS NOT NULL;
```

Examples of using PROJ.4 text to transform with custom spatial references.

```
-- Find intersection of two polygons near the North pole, using a custom Gnomic projection
-- See http://boundlessgeo.com/2012/02/flattening-the-peel/
 WITH data AS (
   SELECT
     ST_GeomFromText('POLYGON((170 50,170 72,-130 72,-130 50,170 50))', 4326) AS p1,
     ST_GeomFromText('POLYGON((-170 68,-170 90,-141 90,-141 68,-170 68))', 4326) AS p2,
     '+proj=gnom +ellps=WGS84 +lat_0=70 +lon_0=-160 +no_defs'::text AS gnom
 )
 SELECT ST_AsText(
   ST_Transform(
     ST_Intersection(ST_Transform(p1, gnom), ST_Transform(p2, gnom)),
   gnom, 4326))
 FROM data;
                                          st_astext
 ------------------------------------------------------------------------------
  POLYGON((-170 74.053793645338,-141 73.4268621378904,-141 68,-170 68,-170 74.053793645338) ↩
      )
```

Configuring transformation behavior

Sometimes coordinate transformation involving a grid-shift can fail, for example if PROJ.4 has not been built with grid-shift files or the coordinate does not lie within the range for which the grid shift is defined. By default, PostGIS will throw an error if a

grid shift file is not present, but this behavior can be configured on a per-SRID basis either by testing different `to_proj` values of PROJ.4 text, or altering the `proj4text` value within the `spatial_ref_sys` table.

For example, the proj4text parameter +datum=NAD87 is a shorthand form for the following +nadgrids parameter:

```
+nadgrids=@conus,@alaska,@ntv2_0.gsb,@ntv1_can.dat
```

The @ prefix means no error is reported if the files are not present, but if the end of the list is reached with no file having been appropriate (ie. found and overlapping) then an error is issued.

If, conversely, you wanted to ensure that at least the standard files were present, but that if all files were scanned without a hit a null transformation is applied you could use:

```
+nadgrids=@conus,@alaska,@ntv2_0.gsb,@ntv1_can.dat,null
```

The null grid shift file is a valid grid shift file covering the whole world and applying no shift. So for a complete example, if you wanted to alter PostGIS so that transformations to SRID 4267 that didn't lie within the correct range did not throw an ERROR, you would use the following:

```
UPDATE spatial_ref_sys SET proj4text = '+proj=longlat +ellps=clrk66 +nadgrids=@conus, ↩
    @alaska,@ntv2_0.gsb,@ntv1_can.dat,null +no_defs' WHERE srid = 4267;
```

See Also

Section 4.5, ST_SetSRID, ST_SRID, UpdateGeometrySRID, ST_TransformPipeline

7.7.5 ST_TransformPipeline

ST_TransformPipeline — Return a new geometry with coordinates transformed to a different spatial reference system using a defined coordinate transformation pipeline.

Synopsis

geometry **ST_TransformPipeline**(geometry g1, text pipeline, integer to_srid);

Description

Return a new geometry with coordinates transformed to a different spatial reference system using a defined coordinate transformation pipeline.

Transformation pipelines are defined using any of the following string formats:

- `urn:ogc:def:coordinateOperation:AUTHORITY::CODE`. Note that a simple `EPSG:CODE` string does not uniquely identify a coordinate operation: the same EPSG code can be used for a CRS definition.
- A PROJ pipeline string of the form: `+proj=pipeline ...`. Automatic axis normalisation will not be applied, and if necessary the caller will need to add an additional pipeline step, or remove `axisswap` steps.
- Concatenated operations of the form: `urn:ogc:def:coordinateOperation,coordinateOperation:EPSG::3895,c`

Availability: 3.4.0

The SRID of the input geometry is ignored, and the SRID of the output geometry will be set to zero unless a value is provided via the optional `to_srid` parameter. When using `ST_TransformPipeline()` the pipeline is executed in a forward direction. Using ST_InverseTransformPipeline the pipeline is executed in the inverse direction.

Transforms using pipelines are a specialised version of ST_Transform. In most cases `ST_Transform` will choose the correct operations to convert between coordinate systems, and should be preferred.

Examples

Change WGS 84 long lat to UTM 31N using the EPSG:16031 conversion

```
-- Forward direction
SELECT ST_AsText(ST_TransformPipeline('SRID=4326;POINT(2 49)'::geometry,
  'urn:ogc:def:coordinateOperation:EPSG::16031') AS utm_geom);

                 utm_geom
-------------------------------------------
 POINT(426857.9877165967 5427937.523342293)
(1 row)

-- Inverse direction
SELECT ST_AsText(ST_InverseTransformPipeline('POINT(426857.9877165967 5427937.523342293)':: ↩
    geometry,
  'urn:ogc:def:coordinateOperation:EPSG::16031')) AS wgs_geom;

          wgs_geom
----------------------------
 POINT(2 48.99999999999999)
(1 row)
```

GDA2020 example.

```
-- using ST_Transform with automatic selection of a conversion pipeline.
SELECT ST_AsText(ST_Transform('SRID=4939;POINT(143.0 -37.0)'::geometry, 7844)) AS  ↩
    gda2020_auto;

                gda2020_auto
---------------------------------------------
 POINT(143.00000635638918 -36.999986706128176)
(1 row)

-- using a defined conversion (EPSG:8447)
SELECT ST_AsText(ST_TransformPipeline('SRID=4939;POINT(143.0 -37.0)'::geometry,
  'urn:ogc:def:coordinateOperation:EPSG::8447')) AS gda2020_code;

                 gda2020_code
---------------------------------------------
 POINT(143.0000063280214 -36.999986718287545)
(1 row)

-- using a PROJ pipeline definition matching EPSG:8447, as returned from
-- 'projinfo -s EPSG:4939 -t EPSG:7844'.
-- NOTE: any 'axisswap' steps must be removed.
SELECT ST_AsText(ST_TransformPipeline('SRID=4939;POINT(143.0 -37.0)'::geometry,
  '+proj=pipeline
   +step +proj=unitconvert +xy_in=deg +xy_out=rad
   +step +proj=hgridshift +grids=au_icsm_GDA94_GDA2020_conformal_and_distortion.tif
   +step +proj=unitconvert +xy_in=rad +xy_out=deg')) AS gda2020_pipeline;

                 gda2020_pipeline
---------------------------------------------
 POINT(143.0000063280214 -36.999986718287545)
(1 row)
```

See Also

ST_Transform, ST_InverseTransformPipeline

7.7.6 postgis_srs_codes

postgis_srs_codes — Return the list of SRS codes associated with the given authority.

Synopsis

setof text **postgis_srs_codes**(text auth_name);

Description

Returns a set of all `auth_srid` for the given `auth_name`.

Availability: 3.4.0

Proj version 6+

Examples

List the first ten codes associated with the EPSG authority.

```
SELECT * FROM postgis_srs_codes('EPSG') LIMIT 10;

 postgis_srs_codes
-------------------
 2000
 20004
 20005
 20006
 20007
 20008
 20009
 2001
 20010
 20011
```

See Also

postgis_srs, postgis_srs_all, postgis_srs_search

7.7.7 postgis_srs

postgis_srs — Return a metadata record for the requested authority and srid.

Synopsis

setof record **postgis_srs**(text auth_name, text auth_srid);

Description

Returns a metadata record for the requested `auth_srid` for the given `auth_name`. The record will have the `auth_name`, `auth_srid`, `srname`, `srtext`, `proj4text`, and the corners of the area of usage, `point_sw` and `point_ne`.

Availability: 3.4.0

Proj version 6+

Examples

Get the metadata for EPSG:3005.

```
SELECT * FROM postgis_srs('EPSG', '3005');

auth_name | EPSG
auth_srid | 3005
srname    | NAD83 / BC Albers
srtext    | PROJCS["NAD83 / BC Albers", ... ]]
proj4text | +proj=aea +lat_0=45 +lon_0=-126 +lat_1=50 +lat_2=58.5 +x_0=1000000 +y_0=0 + ↩
    datum=NAD83 +units=m +no_defs +type=crs
point_sw  | 0101000020E6100000E17A14AE476161C00000000000204840
point_ne  | 0101000020E610000085EB51B81E855CC0E17A14AE47014E40
```

See Also

postgis_srs_codes, postgis_srs_all, postgis_srs_search

7.7.8 postgis_srs_all

postgis_srs_all — Return metadata records for every spatial reference system in the underlying Proj database.

Synopsis

setof record **postgis_srs_all**(void);

Description

Returns a set of all metadata records in the underlying Proj database. The records will have the `auth_name`, `auth_srid`, `srname`, `srtext`, `proj4text`, and the corners of the area of usage, `point_sw` and `point_ne`.

Availability: 3.4.0

Proj version 6+

Examples

Get the first 10 metadata records from the Proj database.

```
SELECT auth_name, auth_srid, srname FROM postgis_srs_all() LIMIT 10;

 auth_name | auth_srid |                  srname
-----------+-----------+-----------------------------------------
 EPSG      | 2000      | Anguilla 1957 / British West Indies Grid
 EPSG      | 20004     | Pulkovo 1995 / Gauss-Kruger zone 4
 EPSG      | 20005     | Pulkovo 1995 / Gauss-Kruger zone 5
 EPSG      | 20006     | Pulkovo 1995 / Gauss-Kruger zone 6
 EPSG      | 20007     | Pulkovo 1995 / Gauss-Kruger zone 7
 EPSG      | 20008     | Pulkovo 1995 / Gauss-Kruger zone 8
 EPSG      | 20009     | Pulkovo 1995 / Gauss-Kruger zone 9
 EPSG      | 2001      | Antigua 1943 / British West Indies Grid
 EPSG      | 20010     | Pulkovo 1995 / Gauss-Kruger zone 10
 EPSG      | 20011     | Pulkovo 1995 / Gauss-Kruger zone 11
```

See Also

postgis_srs_codes, postgis_srs, postgis_srs_search

7.7.9 postgis_srs_search

postgis_srs_search — Return metadata records for projected coordinate systems that have areas of useage that fully contain the bounds parameter.

Synopsis

setof record **postgis_srs_search**(geometry bounds, text auth_name=EPSG);

Description

Return a set of metadata records for projected coordinate systems that have areas of useage that fully contain the bounds parameter. Each record will have the `auth_name`, `auth_srid`, `srname`, `srtext`, `proj4text`, and the corners of the area of usage, `point_sw` and `point_ne`.

The search only looks for projected coordinate systems, and is intended for users to explore the possible systems that work for the extent of their data.

Availability: 3.4.0

Proj version 6+

Examples

Search for projected coordinate systems in Louisiana.

```
SELECT auth_name, auth_srid, srname,
  ST_AsText(point_sw) AS point_sw,
  ST_AsText(point_ne) AS point_ne
FROM postgis_srs_search('SRID=4326;LINESTRING(-90 30, -91 31)')
LIMIT 3;

 auth_name | auth_srid |                srname                |      point_sw       |       ↩
    point_ne
-----------+-----------+--------------------------------------+---------------------+---------------

 EPSG      | 2801      | NAD83(HARN) / Louisiana South        | POINT(-93.94 28.85) | POINT ↩
    (-88.75 31.07)
 EPSG      | 3452      | NAD83 / Louisiana South (ftUS)       | POINT(-93.94 28.85) | POINT ↩
    (-88.75 31.07)
 EPSG      | 3457      | NAD83(HARN) / Louisiana South (ftUS) | POINT(-93.94 28.85) | POINT ↩
    (-88.75 31.07)
```

Scan a table for max extent and find projected coordinate systems that might suit.

```
WITH ext AS (
  SELECT ST_Extent(geom) AS geom, Max(ST_SRID(geom)) AS srid
  FROM foo
)
SELECT auth_name, auth_srid, srname,
  ST_AsText(point_sw) AS point_sw,
  ST_AsText(point_ne) AS point_ne
FROM ext
CROSS JOIN postgis_srs_search(ST_SetSRID(ext.geom, ext.srid))
LIMIT 3;
```

See Also

postgis_srs_codes, postgis_srs_all, postgis_srs

7.8 Geometry Input

7.8.1 Well-Known Text (WKT)

7.8.1.1 ST_BdPolyFromText

ST_BdPolyFromText — 멀티라인스트링 WKT 텍스트 표현식으로 주어진 임의의 폐쇄&#x 라인스트링 집합으로 폴리곤을 작성합니다.

Synopsis

geometry **ST_BdPolyFromText**(text WKT, integer srid);

설명

멀티라인스트링 WKT 텍스트 표현&#xc2d 주어진 임의의 폐쇄형 라인스트&#x 집합으로 폴리곤을 작성합니다.

Note

WKT가 멀티라인스트링이 아닐 경우 오류가 발생합니다. 출력물이 멀티폴리곤일 경우 오류가 발생하는데 이런 경우 ST_BdMPolyFromText를 사용하거나, 또는 PostGIS 특화 접근법을 사용하려면 ST_BuildArea()를 참조하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

GEOS 모듈로 실행

1.1.0 버전부터 사용할 수 있습니다.

관련 정보

ST_BuildArea, ST_BdMPolyFromText

7.8.1.2 ST_BdMPolyFromText

ST_BdMPolyFromText — 멀티라인스트링 WKT 텍스트 표현식으로 주어진 임의의 폐쇄&#x 라인스트링 집합으로 멀티폴리&#xa 작성합니다.

Synopsis

geometry **ST_BdMPolyFromText**(text WKT, integer srid);

설명

멀티라인스트링 WKT 텍스트 표현&#xc2d
주어진 임의의 폐쇄형 라인스트&#x
집합으로 멀티폴리곤을 작성합&#xb

Note

WKT가 멀티라인스트링이 아닐
경우 오류가 발생합니다.
출력물이 단일 폴리곤으로
이루어졌을 경우에도 멀티폴리&#
강제합니다. 해당 연산시
단일 폴리곤을 출력할
것이라고 확신한다면 ST_BdPolyFromText
를 사용하거나, 또는 PostGIS 특화
접근법을 사용하려 할 경우
ST_BuildArea() 를 참조하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

GEOS 모듈로 실행

1.1.0 버전부터 사용할 수 있습니다.

관련 정보

ST_BuildArea, ST_BdPolyFromText

7.8.1.3 ST_GeogFromText

ST_GeogFromText — WKT (확장) 표현식으로부터 지&#
지리형 값을 반환합니다.

Synopsis

geography **ST_GeogFromText**(text EWKT);

설명

WKT 표현식 또는 확장 WKT 표현식으로&
지리형 객체를 반환합니다. 투영&#
따로 설정하지 않은 경우 SRID 4326으로
가정합니다. 이 함수는 ST_GeographyFromText와
동일합니다. 포인트는 항상 경위&#
형식으로 표현됩니다.

예시

```
--- &#xacbd;&#xc704;&#xb3c4; &#xc88c;&#xd45c;&#xb97c;  ↩
    &#xc9c0;&#xb9ac;&#xd615;&#xc73c;&#xb85c; &#xbcc0;&#xd658;&#xd558;&#xae30;
ALTER TABLE sometable ADD COLUMN geog geography(POINT,4326);
UPDATE sometable SET geog = ST_GeogFromText('SRID=4326;POINT(' || lon || ' ' || lat || ')') ↩
    ;

--- EPSG:4267, NAD27&#xc744; &#xc774;&#xc6a9;&#xd574;&#xc11c; &#xc9c0;&#xb9ac;&#xd615;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xc9c0;&#xc815;&#xd558;&#xae30;
SELECT ST_AsEWKT(ST_GeogFromText('SRID=4267;POINT(-77.0092 38.889588)'));
```

관련 정보

ST_AsText, ST_GeographyFromText

7.8.1.4 ST_GeographyFromText

ST_GeographyFromText — WKT (확장) 표현식으로부터 지정된 지리형 값을 반환합니다.

Synopsis

geography **ST_GeographyFromText**(text EWKT);

설명

WKT 표현식으로부터 지리형 객체&#xb97
반환합니다. 투영체를 따로 설정&#
않은 경우 SRID 4326으로 가정합니다.

관련 정보

ST_GeogFromText, ST_AsText

7.8.1.5 ST_GeomCollFromText

ST_GeomCollFromText — Makes a collection Geometry from collection WKT with the given SRID. If SRID is not given, it defaults to 0.

Synopsis

geometry **ST_GeomCollFromText**(text WKT, integer srid);
geometry **ST_GeomCollFromText**(text WKT);

설명

Makes a collection Geometry from the Well-Known-Text (WKT) representation with the given SRID. If SRID is not given, it defaults to 0.

OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스&#
suite)로부터 가져오십시오.

WKT가 도형 집합(GEOMETRYCOLLECTION)이 아닌 경&#xc6
null을 반환합니다.

Note

사용자 WKT 도형이 모두 집합이라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification.

예시

```
SELECT ST_GeomCollFromText('GEOMETRYCOLLECTION(POINT(1 2),LINESTRING(1 2, 3 4))');
```

관련 정보

ST_GeomFromText, ST_SRID

7.8.1.6 ST_GeomFromEWKT

ST_GeomFromEWKT — EWKT(Extended Well-Known Text)로부터 지정된 ST_Geome 값을 반환합니다.

Synopsis

geometry **ST_GeomFromEWKT**(text EWKT);

설명

OGC EWKT(Extended Well-Known Text) 표현식으로부터 PostGIS ST_Geometr 객체를 작성합니다.

Note

EWKT 형식이 OGC 표준은 아니지만, SRID(공간 참조 시스템 식별자)를 포함하는 PostGIS 특화 형식입니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba surface) 및 TIN을 지원합니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_GeomFromEWKT('SRID=4269;LINESTRING(-71.160281 42.258729,-71.160837  ↩
    42.259113,-71.161144 42.25932)');
SELECT ST_GeomFromEWKT('SRID=4269;MULTILINESTRING((-71.160281 42.258729,-71.160837  ↩
    42.259113,-71.161144 42.25932))');

SELECT ST_GeomFromEWKT('SRID=4269;POINT(-71.064544 42.28787)');

SELECT ST_GeomFromEWKT('SRID=4269;POLYGON((-71.1776585052917  ↩
    42.3902909739571,-71.1776820268866 42.3903701743239,
-71.1776063012595 42.3903825660754,-71.1775826583081 42.3903033653531,-71.1776585052917  ↩
    42.3902909739571))');

SELECT ST_GeomFromEWKT('SRID=4269;MULTIPOLYGON(((-71.1031880899493 42.3152774590236,
-71.1031627617667 42.3152960829043,-71.102923838298 42.3149156848307,
-71.1023097974109 42.3151969047397,-71.1019285062273 42.3147384934248,
-71.102505233663 42.3144722937587,-71.10277487471 42.3141658254797,
-71.103113945163 42.3142739188902,-71.10324876416 42.31402489987,
-71.1033002961013 42.3140393340215,-71.1033488797549 42.3139495090772,
-71.103396240451 42.3138632439557,-71.1041521907712 42.3141153348029,
-71.1041411411543 42.3141545014533,-71.1041287795912 42.3142114839058,
-71.1041188134329 42.3142693656241,-71.1041112482575 42.3143272556118,
-71.1041072845732 42.3143851580048,-71.1041057218871 42.3144430686681,
-71.1041065602059 42.3145009876017,-71.1041097995362 42.3145589148055,
-71.1041166403905 42.3146168544148,-71.1041258822717 42.3146748022936,
-71.1041375307579 42.3147318674446,-71.1041492906949 42.3147711126569,
-71.1041598612795 42.314808571739,-71.1042515013869 42.3151287620809,
-71.1041173835118 42.3150739481917,-71.1040809891419 42.3151344119048,
-71.1040438678912 42.3151191367447,-71.1040194562988 42.3151832057859,
-71.1038734225584 42.3151140942995,-71.1038446938243 42.3151006300338,
-71.1038315271889 42.315094347535,-71.1037393329282 42.315054824985,
-71.1035447555574 42.3152608696313,-71.1033436658644 42.3151648370544,
-71.1032580383161 42.3152269126061,-71.103223066939 42.3152517403219,
-71.1031880899493 42.3152774590236)),
((-71.1043632495873 42.315113108546,-71.1043583974082 42.3151211109857,
-71.1043443253471 42.3150676015829,-71.1043850704575 42.3150793250568,-71.1043632495873  ↩
    42.315113108546)))');
```

```
-- 3D &#xc6d0;&#xd615; &#xc2a4;&#xd2b8;&#xb9c1;
SELECT ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227 150406 3)');
```

```
-- &#xb2e4;&#xba74;&#xccb4; &#xd45c;&#xba74; &#xc608;&#xc2dc;
SELECT ST_GeomFromEWKT('POLYHEDRALSURFACE(
        ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
        ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)),
        ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
        ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
        ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)),
        ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1))
)');
```

관련 정보

ST_AsEWKT, ST_GeomFromText

7.8.1.7 ST_GeomFromMARC21

ST_GeomFromMARC21 — Takes MARC21/XML geographic data as input and returns a PostGIS geometry object.

Synopsis

geometry **ST_GeomFromMARC21** (text marcxml);

설명

This function creates a PostGIS geometry from a MARC21/XML record, which can contain a `POINT` or a `POLYGON`. In case of multiple geographic data entries in the same MARC21/XML record, a `MULTIPOINT` or `MULTIPOLYGON` will be returned. If the record contains mixed geometry types, a `GEOMETRYCOLLECTION` will be returned. It returns NULL if the MARC21/XML record does not contain any geographic data (datafield:034).

LOC MARC21/XML versions supported:

- MARC21/XML 1.1

Availability: 3.3.0, requires libxml2 2.6+

Note
The MARC21/XML Coded Cartographic Mathematical Data currently does not provide any means to describe the Spatial Reference System of the encoded coordinates, so this function will always return a geometry with `SRID 0`.

Note
Returned `POLYGON` geometries will always be clockwise oriented.

예시

Converting MARC21/XML geographic data containing a single `POINT` encoded as `hddd.dddddd`

```
SELECT
                ST_AsText(
                    ST_GeomFromMARC21('
                        <record xmlns="http://www.loc.gov/MARC21/slim">
                            <leader>00000nz a2200000nc 4500</leader>
                            <controlfield tag="001">040277569</controlfield>
                            <datafield tag="034" ind1=" " ind2=" ">
                                <subfield code="d">W004.500000</subfield>
                                <subfield code="e">W004.500000</subfield>
                                <subfield code="f">N054.250000</subfield>
                                <subfield code="g">N054.250000</subfield>
                            </datafield>
                        </record>'));

                st_astext
                --------------------
                POINT(-4.5 54.25)
                (1 row)
```

Converting MARC21/XML geographic data containing a single `POLYGON` encoded as `hdddmmss`

```
SELECT
                ST_AsText(
                    ST_GeomFromMARC21('
                        <record xmlns="http://www.loc.gov/MARC21/slim">
```

```
                        <leader>01062cem a2200241 a 4500</leader>
                        <controlfield tag="001">   84696781 </controlfield>
                        <datafield tag="034" ind1="1" ind2=" ">
                            <subfield code="a">a</subfield>
                            <subfield code="b">50000</subfield>
                            <subfield code="d">E0130600</subfield>
                            <subfield code="e">E0133100</subfield>
                            <subfield code="f">N0523900</subfield>
                            <subfield code="g">N0522300</subfield>
                        </datafield>
                    </record>'));

                st_astext
                ----------------------------------------------------------------------------------

                POLYGON((13.1 52.65,13.516666666666667 52.65,13.516666666666667  ↩
                    52.38333333333333,13.1 52.38333333333333,13.1 52.65))
                (1 row)
```

Converting MARC21/XML geographic data containing a `POLYGON` and a `POINT`:

```
SELECT
                ST_AsText(
                    ST_GeomFromMARC21('
                <record xmlns="http://www.loc.gov/MARC21/slim">
                    <datafield tag="034" ind1="1" ind2=" ">
                        <subfield code="a">a</subfield>
                        <subfield code="b">50000</subfield>
                        <subfield code="d">E0130600</subfield>
                        <subfield code="e">E0133100</subfield>
                        <subfield code="f">N0523900</subfield>
                        <subfield code="g">N0522300</subfield>
                    </datafield>
                    <datafield tag="034" ind1=" " ind2=" ">
                        <subfield code="d">W004.500000</subfield>
                        <subfield code="e">W004.500000</subfield>
                        <subfield code="f">N054.250000</subfield>
                        <subfield code="g">N054.250000</subfield>
                    </datafield>
                </record>'));
                                                                                st_astext ↩

                ----------------------------------------------------------------------------------

                GEOMETRYCOLLECTION(POLYGON((13.1 52.65,13.516666666666667  ↩
                    52.65,13.516666666666667 52.38333333333333,13.1 52.38333333333333,13.1  ↩
                    52.65)),POINT(-4.5 54.25))
                (1 row)
```

관련 정보

ST_AsMARC21

7.8.1.8 ST_GeometryFromText

ST_GeometryFromText — WKT(Well-Known Text)로부터 지정된 ST_Geometry 값을 반환합니다. 이 함수는 ST_GeomFromText 함수와 동일합니다.

Synopsis

geometry **ST_GeometryFromText**(text WKT);
geometry **ST_GeometryFromText**(text WKT, integer srid);

설명

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.40

관련 정보

ST_GeomFromText

7.8.1.9 ST_GeomFromText

ST_GeomFromText — WKT 표현식으로부터 지정된 ST_Geometry 값을 반환합니다.

Synopsis

geometry **ST_GeomFromText**(text WKT);
geometry **ST_GeomFromText**(text WKT, integer srid);

설명

OGC WKT(Well-Known Text) 표현식으로부터 PostGIS ST_Geometry 객체를 작성합니다.

Note

ST_GeomFromText 함수의 변종이 2개 있는데, 첫 번째는 SRID를 입력받지 않고 공간 참조 시스템이 정의되지 않은(SRID=0) 도형을 반환합니다. 두 번째는 SRID를 두 번째 인수로 입력받아 해당 SRID를 자체 메타데이터의 일부로 포함하는 도형을 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.40

This method supports Circular Strings and Curves.

Note
While not OGC-compliant, ST_MakePoint is faster than ST_GeomFromText and ST_PointFromText. It is also easier to use for numeric coordinate values. ST_Point is another option similar in speed to ST_MakePoint and is OGC-compliant, but doesn't support anything but 2D points.

Warning
변경 사항: PostGIS 2.0.0 미만 버전에서는 ST_GeomFromText('GEOMETRYCOLLECTION(EMPTY)') 를 사용할 수 있었습니다. PostGIS 2.0.0 버전부터, SQL/MM 표준을 더 잘 준수하기 위해 이런 사용법은 금지됐습니다. 이제는 ST_GeomFromText('GEOMETRYCOLLECTION EMPTY') 라고 작성해야 합니다.

예시

```
SELECT ST_GeomFromText('LINESTRING(-71.160281 42.258729,-71.160837 42.259113,-71.161144 ↩
    42.25932)');
SELECT ST_GeomFromText('LINESTRING(-71.160281 42.258729,-71.160837 42.259113,-71.161144 ↩
    42.25932)',4269);

SELECT ST_GeomFromText('MULTILINESTRING((-71.160281 42.258729,-71.160837 ↩
    42.259113,-71.161144 42.25932))');

SELECT ST_GeomFromText('POINT(-71.064544 42.28787)');

SELECT ST_GeomFromText('POLYGON((-71.1776585052917 42.3902909739571,-71.1776820268866 ↩
    42.3903701743239,
-71.1776063012595 42.3903825660754,-71.1775826583081 42.3903033653531,-71.1776585052917 ↩
    42.3902909739571))');

SELECT ST_GeomFromText('MULTIPOLYGON(((-71.1031880899493 42.3152774590236,
-71.1031627617667 42.3152960829043,-71.102923838298 42.3149156848307,
-71.1023097974109 42.3151969047397,-71.1019285062273 42.3147384934248,
-71.102505233663 42.3144722937587,-71.10277487471 42.3141658254797,
-71.103113945163 42.3142739188902,-71.10324876416 42.31402489987,
-71.1033002961013 42.3140393340215,-71.1033488797549 42.3139495090772,
-71.103396240451 42.3138632439557,-71.1041521907712 42.3141153348029,
-71.1041411411543 42.3141545014533,-71.1041287795912 42.3142114839058,
-71.1041188134329 42.3142693656241,-71.1041112482575 42.3143272556118,
-71.1041072845732 42.3143851580048,-71.1041057218871 42.3144430686681,
-71.1041065602059 42.3145009876017,-71.1041097995362 42.3145589148055,
-71.1041166403905 42.3146168544148,-71.1041258822717 42.3146748022936,
-71.1041375307579 42.3147318674446,-71.1041492906949 42.3147711126569,
-71.1041598612795 42.314808571739,-71.1042515013869 42.3151287620809,
-71.1041173835118 42.3150739481917,-71.1040809891419 42.3151344119048,
-71.1040438678912 42.3151191367447,-71.1040194562988 42.3151832057859,
-71.1038734225584 42.3151140942995,-71.1038446938243 42.3151006300338,
-71.1038315271889 42.315094347535,-71.1037393329282 42.315054824985,
-71.1035447555574 42.3152608696313,-71.1033436658644 42.3151648370544,
-71.1032580383161 42.3152269126061,-71.103223066939 42.3152517403219,
-71.1031880899493 42.3152774590236)),
((-71.1043632495873 42.315113108546,-71.1043583974082 42.3151211109857,
-71.1043443253471 42.3150676015829,-71.1043850704575 42.3150793250568,-71.1043632495873 ↩
    42.315113108546)))',4326);

SELECT ST_GeomFromText('CIRCULARSTRING(220268 150415,220227 150505,220227 150406)');
```

관련 정보

ST_GeomFromEWKT, ST_GeomFromWKB, ST_SRID

7.8.1.10 ST_LineFromText

ST_LineFromText — 주어진 SRID와 함께 WKT 표현식으
도형을 만듭니다. SRID가 주어지지
않은 경우, 기본값인 0을 씁니다.

Synopsis

geometry **ST_LineFromText**(text WKT);
geometry **ST_LineFromText**(text WKT, integer srid);

설명

Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. If WKT passed in is not a LINESTRING, then null is returned.

Note
OGC 사양 3.2.6.2 - 선택적인 SRID를
적합성 스위트(conformance suite)로부터
가져오십시오.

Note
사용자 도형이 모두 라인스트링
걸 알고 있다면, 그냥 ST_GeomFromText
함수를 쓰는 편이 더 효율적입니
이 함수는 ST_GeomFromText만 호출하고,
라인스트링을 반환한다는
유효성 검사를 추가합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 7.2.8

예시

```
SELECT ST_LineFromText('LINESTRING(1 2, 3 4)') AS aline, ST_LineFromText('POINT(1 2)') AS  ↩
    null_return;
aline                              | null_return
-----------------------------------------------
0102000000020000000000000000F ... | t
```

관련 정보

ST_GeomFromText

7.8.1.11 ST_MLineFromText

ST_MLineFromText — WKT 표현식으로부터 지정된 ST_MultiLineString 값을 반환합니다.

Synopsis

geometry **ST_MLineFromText**(text WKT, integer srid);
geometry **ST_MLineFromText**(text WKT);

설명

Makes a Geometry from Well-Known-Text (WKT) with the given SRID. If SRID is not given, it defaults to 0.

OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스&#
suite)로부터 가져오십시오.

WKT가 멀티라인스트링이 아닌 경&#xc6b0
null을 반환합니다.

> **Note**
> 사용자 WKT 도형이 모두 포인트라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 9.4.4

예시

```
SELECT ST_MLineFromText('MULTILINESTRING((1 2, 3 4), (4 5, 6 7))');
```

관련 정보

ST_GeomFromText

7.8.1.12 ST_MPointFromText

ST_MPointFromText — Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0.

Synopsis

geometry **ST_MPointFromText**(text WKT, integer srid);
geometry **ST_MPointFromText**(text WKT);

설명

Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0.

OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스&#suite)로부터 가져오십시오.

WKT가 멀티포인트가 아닌 경우 null을 반환합니다.

Note

사용자 WKT 도형이 모두 포인트라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 9.2.4

예시

```
SELECT ST_MPointFromText('MULTIPOINT((1 2),(3 4))');
SELECT ST_MPointFromText('MULTIPOINT((-70.9590 42.1180),(-70.9611 42.1223))', 4326);
```

관련 정보

ST_GeomFromText

7.8.1.13 ST_MPolyFromText

ST_MPolyFromText — Makes a MultiPolygon Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0.

Synopsis

geometry **ST_MPolyFromText**(text WKT, integer srid);
geometry **ST_MPolyFromText**(text WKT);

설명

Makes a MultiPolygon from WKT with the given SRID. If SRID is not given, it defaults to 0.

OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스&#suite)로부터 가져오십시오.

WKT가 멀티폴리곤이 아닌 경우 오류발생합니다.

Note

사용자 WKT 도형이 모두 멀티폴리곤이라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 9.6.4

예시

```
SELECT ST_MPolyFromText('MULTIPOLYGON(((0 0 1,20 0 1,20 20 1,0 20 1,0 0 1),(5 5 3,5 7 3,7 7 ↩
    3,7 5 3,5 5 3)))');
SELECt ST_MPolyFromText('MULTIPOLYGON(((-70.916 42.1002,-70.9468 42.0946,-70.9765  ↩
   42.0872,-70.9754 42.0875,-70.9749 42.0879,-70.9752 42.0881,-70.9754 42.0891,-70.9758  ↩
   42.0894,-70.9759 42.0897,-70.9759 42.0899,-70.9754 42.0902,-70.9756 42.0906,-70.9753  ↩
   42.0907,-70.9753 42.0917,-70.9757 42.0924,-70.9755 42.0928,-70.9755 42.0942,-70.9751  ↩
   42.0948,-70.9755 42.0953,-70.9751 42.0958,-70.9751 42.0962,-70.9759 42.0983,-70.9767  ↩
   42.0987,-70.9768 42.0991,-70.9771 42.0997,-70.9771 42.1003,-70.9768 42.1005,-70.977  ↩
   42.1011,-70.9766 42.1019,-70.9768 42.1026,-70.9769 42.1033,-70.9775 42.1042,-70.9773  ↩
   42.1043,-70.9776 42.1043,-70.9778 42.1048,-70.9773 42.1058,-70.9774 42.1061,-70.9779  ↩
   42.1065,-70.9782 42.1078,-70.9788 42.1085,-70.9798 42.1087,-70.9806 42.109,-70.9807  ↩
   42.1093,-70.9806 42.1099,-70.9809 42.1109,-70.9808 42.1112,-70.9798 42.1116,-70.9792  ↩
   42.1127,-70.979 42.1129,-70.9787 42.1134,-70.979 42.1139,-70.9791 42.1141,-70.9987  ↩
   42.1116,-71.0022 42.1273,
       -70.9408 42.1513,-70.9315 42.1165,-70.916 42.1002)))',4326);
```

관련 정보

ST_GeomFromText, ST_SRID

7.8.1.14 ST_PointFromText

ST_PointFromText — 주어진 SRID와 함께 WKT 표현식으포인트 도형을 만듭니다. SRID가 주어않은 경우, 기본값인 0을 씁니다.

Synopsis

geometry **ST_PointFromText**(text WKT);
geometry **ST_PointFromText**(text WKT, integer srid);

설명

Constructs a PostGIS ST_Geometry point object from the OGC Well-Known text representation. If SRID is not given, it defaults to unknown (currently 0). If geometry is not a WKT point representation, returns null. If completely invalid WKT, then throws an error.

Note

ST_PointFromText 함수의 변종이 2개 있는데, 첫 번째는 SRID를 입력받지 않고 공간 참조 시스템이 정의되지 않은 도형을 반환합니다. 두 번째는 SRID를 두 번째 인수로 입력받아 자체 메타데이터의 일부로 해당 SRID를 포함하는 ST_Geometry를 반환합니다. spatial_ref_sys 테이블에 정의되어 있는 SRID여야 합니다.

Note

사용자 WKT 도형이 모두 포인트라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다. 사용자가 경위도 좌표로부터 포인트를 빌드하고 OGC 준수 여부보다 성능 및 정확도에 더 관심이 있다면, ST_MakePoint 또는 OGC를 준수하는 동일한 ST_Point 함수를 이용하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오.

This method implements the SQL/MM specification. SQL-MM 3: 6.1.8

예시

```
SELECT ST_PointFromText('POINT(-71.064544 42.28787)');
SELECT ST_PointFromText('POINT(-71.064544 42.28787)', 4326);
```

관련 정보

ST_GeomFromText, ST_MakePoint, ST_Point, ST_SRID

7.8.1.15 ST_PolygonFromText

ST_PolygonFromText — Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0.

Synopsis

geometry **ST_PolygonFromText**(text WKT);
geometry **ST_PolygonFromText**(text WKT, integer srid);

설명

Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. Returns null if WKT is not a polygon.

OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스&#suite)로부터 가져오십시오.

Note

사용자 WKT 도형이 모두 폴리곤이라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단계를 거치므로 ST_GeomFromText보다 느립니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 8.3.6

예시

```
SELECT ST_PolygonFromText('POLYGON((-71.1776585052917 42.3902909739571,-71.1776820268866  ↩
    42.3903701743239,
-71.1776063012595 42.3903825660754,-71.1775826583081 42.3903033653531,-71.1776585052917  ↩
    42.3902909739571))');
st_polygonfromtext
------------------
0103000000010000000500000006...


SELECT ST_PolygonFromText('POINT(1 2)') IS NULL as point_is_notpoly;

point_is_not_poly
----------
t
```

관련 정보

ST_GeomFromText

7.8.1.16 ST_WKTToSQL

ST_WKTToSQL — WKT(Well-Known Text)로부터 지정된 ST_Geometry 값반환합니다. 이 함수는 ST_GeomFromText 함수동일합니다.

Synopsis

geometry **ST_WKTToSQL**(text WKT);

설명

This method implements the SQL/MM specification. SQL-MM 3: 5.1.34

관련 정보

ST_GeomFromText

7.8.2 Well-Known Binary (WKB)

7.8.2.1 ST_GeogFromWKB

ST_GeogFromWKB — WKB 도형 표현식 또는 EWKB(확장 WKB)로부터 지리형 인스턴스를 생&#xc1

Synopsis

geography **ST_GeogFromWKB**(bytea wkb);

설명

`ST_GeogFromWKB` 함수는 도형의 WKB 표현식 또&#xb PostGIS 확장 WKB를 받아 적절한 지리형 유형의 인스턴스를 생성합니다. 이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다.

SRID를 설정하지 않은 경우, 기본값&#xc73 4326(WGS84 경위도)을 씁니다.

This method supports Circular Strings and Curves.

예시

```
-- bytea &#xd45c;&#xd604;&#xc2dd;&#xc774; &#xb2e8;&#xc77c;&#xd55c;  ↩
    &#xc5ed;&#xc2ac;&#xb798;&#xc2dc;(\)&#xb97c; &#xd3ec;&#xd568;&#xd558;&#xae34;  ↩
    &#xd574;&#xb3c4;, &#xd14c;&#xc774;&#xbe14; &#xc0bd;&#xc785;&#xc2dc;&#xc5d0;&#xb294;  ↩
    &#xbe7c;&#xb193;&#xc544;&#xc57c; &#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(
ST_GeogFromWKB(E'\\001\\002\\000\\000\\000\\002\\000\\000\\000\\037\\205\\353Q ↩
    \\270~\\\\\\300\\323Mb\\020X\\231C@\\020X9\\264\\310~\\\\\\300)\\\\\\217\\302\\365\\230 ↩
    C@')
);
                                          st_astext
-----------------------------------------------------
 LINESTRING(-113.98 39.198,-113.981 39.195)
(1 row)
```

관련 정보

ST_GeogFromText, ST_AsBinary

7.8.2.2 ST_GeomFromEWKB

ST_GeomFromEWKB — EWKB(Extended Well-Known Binary)로부터 지정된 ST_Geometry 값을 반환합니다.

Synopsis

geometry **ST_GeomFromEWKB**(bytea EWKB);

설명

OGC EWKB(Extended Well-Known Binary) 표현식으로부터 PostGIS ST_Geom
객체를 작성합니다.

Note
EWKB 형식이 OGC 표준은 아니지만, SRID(공간 참조 시스템 식별자)를 포함하는 PostGIS 특화 형식입니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface) 및 TIN을 지원합니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

NAD83 경위도(SRID 4269)로 투영된 LINESTRING(-71.160281 42.258729,-
71.160837 42.259113,-71.161144 42.25932)의 라인스트링 바이&#xb108
표현식

Note
주의: 바이트 배열이 역슬래시(\)&#xb85c
구분되고 작은따옴표(')를
가지고 있을 수도 있지만, stan-
dard_conforming_strings가 비활성화돼 있을
경우 \ 및 " 둘 다 빼놓아야
합니다. 그래야만 AsEWKB 표현식과
똑같이 보이지 않기 때문입니다.

```
SELECT ST_GeomFromEWKB(E'\\001\\002\\000\\000 \\255\\020\\000\\000\\003\\000\\000\\000\\344 ↩
    J=
\\013B\\312Q\\300n\\303(\\010\\036!E@''\\277E''K
\\312Q\\300\\366{b\\235*!E@\\225|\\354.P\\312Q
\\300p\\231\\323e1!E@');
```

Note
In PostgreSQL 9.1+ - standard_conforming_strings is set to on by default, where as in past versions it was set to off. You can change defaults as needed for a single query or at the database or server level. Below is how you would do it with standard_conforming_strings = on. In this case we escape the ' with standard ansi ', but slashes are not escaped

```
set standard_conforming_strings = on;
SELECT ST_GeomFromEWKB('\001\002\000\000 \255\020\000\000\003\000\000\000\344J=\012\013B
\312Q\300n\303(\010\036!E@''\277E''K\012\312Q\300\366{b\235*!E@\225|\354.P\312Q\012\300p ↩
    \231\323e1')
```

관련 정보

ST_AsBinary, ST_AsEWKB, ST_GeomFromWKB

7.8.2.3 ST_GeomFromWKB

ST_GeomFromWKB — WKB(Well-Known Binary) 도형 표현식과 선택&
SRID로부터 도형 인스턴스를 생성&#xd56

Synopsis

geometry **ST_GeomFromWKB**(bytea geom);
geometry **ST_GeomFromWKB**(bytea geom, integer srid);

설명

ST_GeogFromWKB 함수는 도형의 WKB 표현식과 SRID(공간 참조 시스템 ID)를 받아 적절&#
도형 유형의 인스턴스를 생성합&#
이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다. 이 함수는 ST_WKBToSQL 함&#x 대체할 수 있습니다.

SRID를 설정하지 않은 경우, 기본값&#xc73 0(unkown)을 씁니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.7.2 - 선택&#xc80 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.41

This method supports Circular Strings and Curves.

예시

```
-- standard_conforming_strings&#xc774; &#xd65c;&#xc131;&#xd654;&#xb3fc; &#xc788;&#xc9c0; ↩
    &#xc54a;&#xc740; &#xacbd;&#xc6b0;
                -- bytea &#xd45c;&#xd604;&#xc2dd;&#xc774; &#xb2e8;&#xc77c;&#xd55c; ↩
                    &#xc5ed;&#xc2ac;&#xb798;&#xc2dc;(\)&#xb97c; ↩
                    &#xd3ec;&#xd568;&#xd558;&#xae34; &#xd574;&#xb3c4;, ↩
                    &#xd14c;&#xc774;&#xbe14; &#xc0bd;&#xc785;&#xc2dc;&#xc5d0;&#xb294; ↩
                    &#xbe7c;&#xb193;&#xc544;&#xc57c; &#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(
ST_GeomFromWKB(E'\\001\\002\\000\\000\\000\\002\\000\\000\\000\\037\\205\\353Q ↩
    \\270~\\\\\\300\\323Mb\\020X\\231C@\\020X9\\264\\310~\\\\\\300)\\\\\\217\\302\\365\\230 ↩
    C@',4326)
);
                                        st_asewkt
```

```
----------------------------------------------------
 SRID=4326;LINESTRING(-113.98 39.198,-113.981 39.195)
(1 row)

SELECT
  ST_AsText(
        ST_GeomFromWKB(
          ST_AsEWKB('POINT(2 5)'::geometry)
        )
  );
 st_astext
------------
 POINT(2 5)
(1 row)
```

관련 정보

ST_WKBToSQL, ST_AsBinary, ST_GeomFromEWKB

7.8.2.4 ST_LineFromWKB

ST_LineFromWKB — 주어진 SRID와 함께 WKB로부터 LINESTRING 을 만듭니다.

Synopsis

geometry **ST_LineFromWKB**(bytea WKB);
geometry **ST_LineFromWKB**(bytea WKB, integer srid);

설명

ST_LineFromWKB 함수는 도형의 WKB 표현식과 SRID(공간 참조 시스템 ID)를 받아 적절&#
도형 유형의 인스턴스 - 이 경우, LINESTR
도형 - 를 생성합니다. 이 함수는
SQL에서 도형 공장(Geometry Factory) 역할을 합&#xb2c8

SRID를 설정하지 않은 경우, 기본값&#xc77
0을 씁니다. 입력된 bytea가 라인스트&#
아닌 경우, NULL을 반환합니다.

Note
OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오.

Note
사용자 도형이 모두 LINESTRING이란 걸 알고 있다면, 그냥 ST_GeomFromWKB 함수를 쓰는 편이 더 효율적입니
이 함수는 ST_GeomFromWKB 만 호출하고,
라인스트링을 반환한다는
유효성 검사를 추가합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 7.2.9

예시

```
SELECT ST_LineFromWKB(ST_AsBinary(ST_GeomFromText('LINESTRING(1 2, 3 4)'))) AS aline,
                ST_LineFromWKB(ST_AsBinary(ST_GeomFromText('POINT(1 2)'))) IS NULL AS  ↩
                    null_return;
aline                              | null_return
-----------------------------------------------
0102000000020000000000000000F ... | t
```

관련 정보

ST_GeomFromWKB, ST_LinestringFromWKB

7.8.2.5 ST_LinestringFromWKB

ST_LinestringFromWKB — 주어진 SRID와 함께 WKB로부터 도형을 만듭니다.

Synopsis

geometry **ST_LinestringFromWKB**(bytea WKB);
geometry **ST_LinestringFromWKB**(bytea WKB, integer srid);

설명

ST_LinestringFromWKB 함수는 도형의 WKB 표현식&#xac SRID(공간 참조 시스템 ID)를 받아 적절&#x 도형 유형의 인스턴스 - 이 경우, LINESTR 도형 - 를 생성합니다. 이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합&#xb2c8

SRID를 설정하지 않은 경우, 기본값&#xc77 0을 씁니다. 입력된 bytea가 LINESTRING 도형&#xc77 아닌 경우, NULL을 반환합니다.

Note
OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오.

Note
사용자 도형이 모두 LINESTRING이란 걸 알고 있다면, 그냥 ST_GeomFromWKB 함수를 쓰는 편이 더 효율적입니 이 함수는 ST_GeomFromWKB 만 호출하고, LINESTRING을 반환한다는 유효성 검사를 추가합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2

This method implements the SQL/MM specification. SQL-MM 3: 7.2.9

예시

```
SELECT
  ST_LineStringFromWKB(
        ST_AsBinary(ST_GeomFromText('LINESTRING(1 2, 3 4)'))
  ) AS aline,
  ST_LinestringFromWKB(
        ST_AsBinary(ST_GeomFromText('POINT(1 2)'))
  ) IS NULL AS null_return;
   aline                            | null_return
-----------------------------------------------
0102000000020000000000000000F ... | t
```

관련 정보

ST_GeomFromWKB, ST_LineFromWKB

7.8.2.6 ST_PointFromWKB

ST_PointFromWKB — 주어진 SRID와 함께 WKB로부터 도형을 만듭니다.

Synopsis

geometry **ST_GeomFromWKB**(bytea geom);
geometry **ST_GeomFromWKB**(bytea geom, integer srid);

설명

`ST_PointFromWKB` 함수는 도형의 WKB 표현식과 `SRID`(공간 참조 시스템 ID)를 받아 적절&#x
도형 유형의 인스턴스 - 이 경우, `POINT` 도형 - 를 생성합니다. 이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합&#xb2c8

SRID를 설정하지 않은 경우, 기본값&#xc77
0을 씁니다. 입력된 `bytea`가 포인트가 아닌 경우, `NULL`을 반환합니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.7.2

This method implements the SQL/MM specification. SQL-MM 3: 6.1.9

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT
  ST_AsText(
        ST_PointFromWKB(
          ST_AsEWKB('POINT(2 5)'::geometry)
        )
  );
 st_astext
------------
 POINT(2 5)
(1 row)

SELECT
  ST_AsText(
        ST_PointFromWKB(
          ST_AsEWKB('LINESTRING(2 5, 2 6)'::geometry)
        )
  );
 st_astext
-----------

(1 row)
```

관련 정보

ST_GeomFromWKB, ST_LineFromWKB

7.8.2.7 ST_WKBToSQL

ST_WKBToSQL — WKB(Well-Known Binary) 표현식으로부터 지&#xc
ST_Geometry 값을 반환합니다. 이 함수는
SRID를 입력받지 않는 ST_GeomFromWKB 함수와
동일합니다.

Synopsis

geometry **ST_WKBToSQL**(bytea WKB);

설명

This method implements the SQL/MM specification. SQL-MM 3: 5.1.36

관련 정보

ST_GeomFromWKB

7.8.3 Other Formats

7.8.3.1 ST_Box2dFromGeoHash

ST_Box2dFromGeoHash — GeoHash 스트링으로부터 BOX2D를
반환합니다.

Synopsis

box2d **ST_Box2dFromGeoHash**(text geohash, integer precision=full_precision_of_geohash);

설명

GeoHash 스트링으로부터 BOX2D를 반환합&#xb

If no `precision` is specified ST_Box2dFromGeoHash returns a BOX2D based on full precision of the input GeoHash string.

`precision` 을 설정한 경우, ST_Box2dFromGeoHash가 GeoHash에&#x
나온 그만큼의 문자를 이용해서
BOX2D를 생성합니다. 정확도 값이 낮&#x
BOX2D의 용량이 커지고 값이 높을수&#xb
정확도가 올라갑니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_Box2dFromGeoHash('9qqj7nmxncgyy4d0dbxqz0');

                st_geomfromgeohash
-------------------------------------------------
 BOX(-115.172816 36.114646,-115.172816 36.114646)

SELECT ST_Box2dFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 0);

 st_box2dfromgeohash
----------------------
 BOX(-180 -90,180 90)

 SELECT ST_Box2dFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 10);
                            st_box2dfromgeohash
-------------------------------------------------------------------------------
 BOX(-115.17282128334 36.1146408319473,-115.172810554504 36.1146461963654)
```

관련 정보

ST_GeoHash, ST_GeomFromGeoHash, ST_PointFromGeoHash

7.8.3.2 ST_GeomFromGeoHash

ST_GeomFromGeoHash — GeoHash 스트링으로부터 도형&#xc7
반환합니다.

Synopsis

geometry **ST_GeomFromGeoHash**(text geohash, integer precision=full_precision_of_geohash);

설명

GeoHash 스트링으로부터 도형을 반환&#x
해당 도형은 GeoHash 범위를 표현하는
폴리곤이 될 것입니다.

`precision` 을 설정하지 않은 경우, ST_GeomFromGeoHash&#x
입력 GeoHash 스트링의 전체 정확도를
기반으로 폴리곤을 반환합니다.

`precision` 을 설정한 경우, ST_GeomFromGeoHash가 GeoHash에&#x
나온 그만큼의 문자를 이용해서
폴리곤을 생성합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_GeomFromGeoHash('9qqj7nmxncgyy4d0dbxqz0'));
                                                    st_astext
------------------------------------------------------------------------------------------------------------

 POLYGON((-115.172816 36.114646,-115.172816 36.114646,-115.172816 36.114646,-115.172816  ↩
     36.114646,-115.172816 36.114646))

SELECT ST_AsText(ST_GeomFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 4));
                                                      st_astext
------------------------------------------------------------------------------------------------------------

 POLYGON((-115.3125 36.03515625,-115.3125 36.2109375,-114.9609375 36.2109375,-114.9609375  ↩
     36.03515625,-115.3125 36.03515625))

SELECT ST_AsText(ST_GeomFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 10));
                                                                                st_astext ↩

------------------------------------------------------------------------------------------------------------

 POLYGON((-115.17282128334 36.1146408319473,-115.17282128334  ↩
     36.1146461963654,-115.172810554504 36.1146461963654,-115.172810554504  ↩
     36.1146408319473,-115.17282128334 36.1146408319473))
```

관련 정보

ST_GeoHash,ST_Box2dFromGeoHash, ST_PointFromGeoHash

7.8.3.3 ST_GeomFromGML

ST_GeomFromGML — 도형의 GML 표현식을 입력받&#
PostGIS 도형 객체를 출력합니다.

Synopsis

geometry **ST_GeomFromGML**(text geomgml);
geometry **ST_GeomFromGML**(text geomgml, integer srid);

설명

OGC GML 표현식으로부터 PostGIS ST_Geometry 객체&#xb97c 작성합니다.

ST_GeomFromGML은 GML 도형 조각(geometry fragment)에 대해&#xc 작동합니다. 완전한 GML 문서를 사&#xc6 할 경우 오류가 발생합니다.

지원하는 OGC GML 버전은 다음과 같습&#

- GML 3.2.1 네임스페이스
- GML 3.1.1 단순 피처 프로파일 SF-2 (GML 3.1.0 및 3.0.0 하위 호환)
- GML 2.1.2

OGC GML 표준: http://www.opengeospatial.org/standards/gml

1.5 버전부터 사용할 수 있습니다. LibXML2 1.6 이상 버전이 필요합니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba surface) 및 TIN을 지원합니다.

개선 사항: 2.0.0 버전에서 선택적인 기본 SRID 파라미터가 추가됐습니&#xb2e

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

GML은 혼합 차원을 (예를 들어 동일&#xd 멀티 도형(MultiGeometry) 안에서 2D와 3D를 함&#xaed8 쓸 수 있습니다. PostGIS 도형은 그렇지 않기 때문에, 사라진 Z 차원을 찾은 경우 ST_GeomFromGML이 전체 도형을 2D로 변&#xd65

GML은 동일한 멀티 도형 안에서 혼&#xd5 SRS를 지원합니다. PostGIS 도형은 그렇지 않기 때문에, 이 경우 ST_GeomFromGML이 모든 하위 도형들을 SRS 루트 노드로 재&#xd22 GML 루트 노드로 쓸 수 있는 srsName 속성&#xc7 없을 경우, 오류가 발생합니다.

ST_GeomFromGML은 분명한 GML 네임스페이스&#xb9 꼼꼼히 따지지 않습니다. 일반적&#x 사용시에는 네임스페이스를 명&#x 언급하지 않아도 됩니다. 하지만 GML 내부에 XLink 피처를 사용하고 싶다& 그래야 합니다.

Note

ST_GeomFromGML 함수는 SQL/MM 만곡 도형을 지원하지 않습니다.

예시: srsName을 가진 단일 도형

```
SELECT ST_GeomFromGML('
                <gml:LineString srsName="EPSG:4269">
                        <gml:coordinates>
                                -71.16028,42.258729 -71.160837,42.259112  ↩
                                    -71.161143,42.25932
                        </gml:coordinates>
                </gml:LineString
>');
```

예시: XLink 사용

```
SELECT ST_GeomFromGML('
                <gml:LineString xmlns:gml="http://www.opengis.net/gml"
                                xmlns:xlink="http://www.w3.org/1999/xlink"
                                srsName="urn:ogc:def:crs:EPSG::4269">
                        <gml:pointProperty>
                                <gml:Point gml:id="p1"
><gml:pos
>42.258729 -71.16028</gml:pos
></gml:Point>
                        </gml:pointProperty>
                        <gml:pos
>42.259112 -71.160837</gml:pos>
                        <gml:pointProperty>
                                <gml:Point xlink:type="simple" xlink:href="#p1"/>
                        </gml:pointProperty>
                </gml:LineString
>'););
```

예시: 다면체 표면

```
SELECT ST_AsEWKT(ST_GeomFromGML('
<gml:PolyhedralSurface>
<gml:polygonPatches>
  <gml:PolygonPatch>
    <gml:exterior>
      <gml:LinearRing
><gml:posList srsDimension="3"
>0 0 0 0 0 1 0 1 1 0 1 0 0 0 0</gml:posList
></gml:LinearRing>
    </gml:exterior>
  </gml:PolygonPatch>
  <gml:PolygonPatch>
    <gml:exterior>
        <gml:LinearRing
><gml:posList srsDimension="3"
>0 0 0 0 1 0 1 1 0 1 0 0 0 0 0</gml:posList
></gml:LinearRing>
    </gml:exterior>
  </gml:PolygonPatch>
  <gml:PolygonPatch>
    <gml:exterior>
        <gml:LinearRing
><gml:posList srsDimension="3"
>0 0 0 1 0 0 1 0 1 0 0 1 0 0 0</gml:posList
></gml:LinearRing>
    </gml:exterior>
```

```
  </gml:PolygonPatch>
  <gml:PolygonPatch>
    <gml:exterior>
        <gml:LinearRing
><gml:posList srsDimension="3"
>1 1 0 1 1 1 1 0 1 1 0 0 1 1 0</gml:posList
></gml:LinearRing>
    </gml:exterior>
  </gml:PolygonPatch>
  <gml:PolygonPatch>
    <gml:exterior>
        <gml:LinearRing
><gml:posList srsDimension="3"
>0 1 0 0 1 1 1 1 1 1 1 0 0 1 0</gml:posList
></gml:LinearRing>
    </gml:exterior>
  </gml:PolygonPatch>
  <gml:PolygonPatch>
    <gml:exterior>
        <gml:LinearRing
><gml:posList srsDimension="3"
>0 0 1 1 0 1 1 1 1 0 1 1 0 0 1</gml:posList
></gml:LinearRing>
    </gml:exterior>
  </gml:PolygonPatch>
</gml:polygonPatches>
</gml:PolyhedralSurface
>'));

-- &#xacb0;&#xacfc; --
 POLYHEDRALSURFACE(((0 0 0,0 0 1,0 1 1,0 1 0,0 0 0)),
 ((0 0 0,0 1 0,1 1 0,1 0 0,0 0 0)),
 ((0 0 0,1 0 0,1 0 1,0 0 1,0 0 0)),
 ((1 1 0,1 1 1,1 0 1,1 0 0,1 1 0)),
 ((0 1 0,0 1 1,1 1 1,1 1 0,0 1 0)),
 ((0 0 1,1 0 1,1 1 1,0 1 1,0 0 1)))
```

관련 정보

Section 2.2.3, ST_AsGML, ST_GMLToSQL

7.8.3.4 ST_GeomFromGeoJSON

ST_GeomFromGeoJSON — GeoJSON 표현식을 입력받아 PostGIS 도형 객체를 출력합니다.

Synopsis

geometry **ST_GeomFromGeoJSON**(text geomjson);
geometry **ST_GeomFromGeoJSON**(json geomjson);
geometry **ST_GeomFromGeoJSON**(jsonb geomjson);

설명

GeoJSON 표현식으로부터 PostGIS 도형 객체&#x
작성합니다.

ST_GeomFromGML은 JSON 도형 조각(geometry fragment)에 대해&#xc
작동합니다. 완전한 JSON 문서를 사&#xc6
할 경우 오류가 발생합니다.

Enhanced: 3.0.0 parsed geometry defaults to SRID=4326 if not specified otherwise.

Enhanced: 2.5.0 can now accept json and jsonb as inputs.

2.0.0 버전부터 사용할 수 있습니다.
JSON-C 0.9 이상 버전이 필요합니다.

Note

JSON-C 지원을 활성화시키지
않았다면, 출력물 대신 오류
메시지를 보게 될 것입니다.
JSON-C를 활성화하려면, "--with-jsondir=/path/to/json-c"
인자와 함께 설정하십시오.
자세한 내용은 Section 2.2.3 을
참조하십시오.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsText(ST_GeomFromGeoJSON('{"type":"Point","coordinates":[-48.23456,20.12345]}')) ↩
     As wkt;
wkt
------
POINT(-48.23456 20.12345)
```

```
-- a 3D linestring
SELECT ST_AsText(ST_GeomFromGeoJSON('{"type":"LineString","coordinates ↩
    ":[[1,2,3],[4,5,6],[7,8,9]]}')) As wkt;

wkt
--------------------
LINESTRING(1 2,4 5,7 8)
```

관련 정보

ST_AsText, ST_AsGeoJSON, Section 2.2.3

7.8.3.5 ST_GeomFromKML

ST_GeomFromKML — 도형의 KML 표현식을 입력받&#
PostGIS 도형 객체를 출력합니다.

Synopsis

geometry **ST_GeomFromKML**(text geomkml);

설명

OGC KML 표현식으로부터 PostGIS ST_Geometry 객체를 작성합니다.

ST_GeomFromKML은 KML 도형 조각(geometry fragment)에 대해줜 작동합니다. 완전한 KML 문서를 사용할 경우 오류가 발생합니다.

지원하는 OGC KML 버전은 다음과 같습&#

- KML 2.2.0 네임스페이스

OGC KML 표준: http://www.opengeospatial.org/standards/kml

Availability: 1.5, requires libxml2 2.6+

This function supports 3d and will not drop the z-index.

Note
ST_GeomFromKML 함수는 SQL/MM 만곡 도형을 지원하지 않습니다.

예시: srsName을 가진 단일 도형

```
SELECT ST_GeomFromKML('
                <LineString>
                        <coordinates
>-71.1663,42.2614
                                    -71.1667,42.2616</coordinates>
                </LineString
>');
```

관련 정보

Section 2.2.3, ST_AsKML

7.8.3.6 ST_GeomFromTWKB

ST_GeomFromTWKB — TWKB("Tiny Well-Known Binary") 도형 표현식으로도형 인스턴스를 생성합니다.

Synopsis

geometry **ST_GeomFromTWKB**(bytea twkb);

설명

ST_GeomFromTWKB 함수는 TWKB("Tiny Well-Known Binary") 도형 표현받아 적절한 도형 유형의 인스턴생성합니다.

예시

```
SELECT ST_AsText(ST_GeomFromTWKB(ST_AsTWKB('LINESTRING(126 34, 127 35)'::geometry)));

         st_astext
----------------------------
 LINESTRING(126 34, 127 35)
(1 row)


SELECT ST_AsEWKT(
  ST_GeomFromTWKB(E'\\x620002f7f40dbce4040105')
);
                                          st_asewkt
-------------------------------------------------------
LINESTRING(-113.98 39.198,-113.981 39.195)
(1 row)
```

관련 정보

ST_AsTWKB

7.8.3.7 ST_GMLToSQL

ST_GMLToSQL — GML로부터 지정된 ST_Geometry 값을 반&#
이 함수는 ST_GeomFromGML 함수와 동일합니&

Synopsis

geometry **ST_GMLToSQL**(text geomgml);
geometry **ST_GMLToSQL**(text geomgml, integer srid);

설명

This method implements the SQL/MM specification. SQL-MM 3: 5.1.50 (만곡 도형 지&#xc6
제외)

1.5 버전부터 사용할 수 있습니다.
LibXML2 1.6 이상 버전이 필요합니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface) 및 TIN을 지원합니다.

개선 사항: 2.0.0 버전에서 선택적인
기본 SRID 파라미터가 추가됐습니&#xb2e4

관련 정보

Section 2.2.3, ST_GeomFromGML, ST_AsGML

7.8.3.8 ST_LineFromEncodedPolyline

ST_LineFromEncodedPolyline — 인코딩된 폴리라인(polyline)으&
라인스트링을 생성합니다.

Synopsis

geometry **ST_LineFromEncodedPolyline**(text polyline, integer precision=5);

설명

인코딩된 폴리라인 스트링으로&#xb
라인스트링을 생성합니다.

Optional `precision` specifies how many decimal places will be preserved in Encoded Polyline. Value should be the same on encoding and decoding, or coordinates will be incorrect.

참조: http://developers.google.com/maps/documentation/utilities/polylinealgorithm

2.2.0 버전부터 사용할 수 있습니다.

예시

```
-- Create a line string from a polyline
SELECT ST_AsEWKT(ST_LineFromEncodedPolyline('_p~iF~ps|U_ulLnnqC_mqNvxq`@'));
-- result --
SRID=4326;LINESTRING(-120.2 38.5,-120.95 40.7,-126.453 43.252)

-- Select different precision that was used for polyline encoding
SELECT ST_AsEWKT(ST_LineFromEncodedPolyline('_p~iF~ps|U_ulLnnqC_mqNvxq`@',6));
-- result --
SRID=4326;LINESTRING(-12.02 3.85,-12.095 4.07,-12.6453 4.3252)
```

관련 정보

ST_AsEncodedPolyline

7.8.3.9 ST_PointFromGeoHash

ST_PointFromGeoHash — GeoHash 스트링으로부터 포인&#xd2
반환합니다.

Synopsis

point **ST_PointFromGeoHash**(text geohash, integer precision=full_precision_of_geohash);

설명

GeoHash 스트링으로부터 포인트를 반&#x
해당 포인트는 GeoHash의 중심점입니&#x

`precision` 을 설정하지 않은 경우, ST_PointFromGeoHash&#x
입력 GeoHash 스트링의 전체 정확도를
기반으로 포인트를 반환합니다.

`precision` 을 설정한 경우, ST_PointFromGeoHash가 GeoHash에&#xc
나온 그만큼의 문자를 이용해서
포인트를 생성합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_PointFromGeoHash('9qqj7nmxncgyy4d0dbxqz0'));
          st_astext
-----------------------------
 POINT(-115.172816 36.114646)

SELECT ST_AsText(ST_PointFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 4));
             st_astext
-----------------------------------
 POINT(-115.13671875 36.123046875)

SELECT ST_AsText(ST_PointFromGeoHash('9qqj7nmxncgyy4d0dbxqz0', 10));
                 st_astext
-------------------------------------------
 POINT(-115.172815918922 36.1146435141563)
```

관련 정보

ST_GeoHash, ST_Box2dFromGeoHash, ST_GeomFromGeoHash

7.8.3.10 ST_FromFlatGeobufToTable

ST_FromFlatGeobufToTable — Creates a table based on the structure of FlatGeobuf data.

Synopsis

geometry **ST_BdPolyFromText**(text WKT, integer srid);

설명

Creates a table based on the structure of FlatGeobuf data. (http://flatgeobuf.org).

`schema` Schema name.

`table` Table name.

`data` Input FlatGeobuf data.

Availability: 3.2.0

7.8.3.11 ST_FromFlatGeobuf

ST_FromFlatGeobuf — Reads FlatGeobuf data.

Synopsis

setof anyelement **ST_FromFlatGeobuf**(anyelement Table reference, bytea FlatGeobuf input data);

설명

Reads FlatGeobuf data (http://flatgeobuf.org). NOTE: PostgreSQL bytea cannot exceed 1GB.

`tabletype` reference to a table type.

`data` input FlatGeobuf data.

Availability: 3.2.0

7.9 Geometry Output

7.9.1 Well-Known Text (WKT)

7.9.1.1 ST_AsEWKT

ST_AsEWKT — 도형의 WKT(Well-Known Text) 표현식을 SRID 메&#x
함께 반환합니다.

Synopsis

text **ST_AsEWKT**(geometry g1);
text **ST_AsEWKT**(geometry g1, integer maxdecimaldigits=15);
text **ST_AsEWKT**(geography g1);
text **ST_AsEWKT**(geography g1, integer maxdecimaldigits=15);

설명

Returns the Well-Known Text representation of the geometry prefixed with the SRID. The optional `maxdecimaldigits` argument may be used to reduce the maximum number of decimal digits after floating point used in output (defaults to 15).

To perform the inverse conversion of EWKT representation to PostGIS geometry use ST_GeomFromEWKT.

Warning
Using the `maxdecimaldigits` parameter can cause output geometry to become invalid. To avoid this use ST_ReducePrecision with a suitable gridsize first.

Note
The WKT spec does not include the SRID. To get the OGC WKT format use ST_AsText.

Warning
WKT format does not maintain precision so to prevent floating truncation, use ST_AsBinary or ST_AsEWKB format for transport.

Enhanced: 3.1.0 support for optional precision parameter.

개선 사항: 2.0.0 버전부터 지리형, 다&#xba
표면, 삼각형 및 TIN을 지원하기 시&#xc79

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_AsEWKT('0103000020E6100000010000005000000000000
                        0000000000000000000000000000000000000000000000000000000
                        F03F000000000000F03F000000000000F03F000000000000F03
                        F000000000000000000000000000000000000000000000000000'::geometry);

                    st_asewkt
--------------------------------
SRID=4326;POLYGON((0 0,0 1,1 1,1 0,0 0))
(1 row)

SELECT ST_AsEWKT('0108000080030000000000000060 ↩
    E30A4100000000785C0241000000000000F03F0000000018
E20A4100000000485F0241000000000000400000000018
E20A4100000000305C0241000000000000840')

--st_asewkt---
CIRCULARSTRING(220268 150415 1,220227 150505 2,220227 150406 3)
```

참고

ST_AsBinary, ST_AsEWKB, ST_AsText, ST_GeomFromEWKT

7.9.1.2 ST_AsText

ST_AsText — 도형/지리형의 WKT(Well-Known Text) 표현식&#x
SRID 메타데이터 없이 반환합니다.

Synopsis

text **ST_AsText**(geometry g1);
text **ST_AsText**(geometry g1, integer maxdecimaldigits = 15);
text **ST_AsText**(geography g1);
text **ST_AsText**(geography g1, integer maxdecimaldigits = 15);

설명

Returns the OGC Well-Known Text (WKT) representation of the geometry/geography. The optional *maxdecimaldigits* argument may be used to limit the number of digits after the decimal point in output ordinates (defaults to 15).

To perform the inverse conversion of WKT representation to PostGIS geometry use ST_GeomFromText.

Note
The standard OGC WKT representation does not include the SRID. To include the SRID as part of the output representation, use the non-standard PostGIS function ST_AsEWKT

Warning
The textual representation of numbers in WKT may not maintain full floating-point precision. To ensure full accuracy for data storage or transport it is best to use Well-Known Binary (WKB) format (see ST_AsBinary and *maxdecimaldigits*).

Warning
Using the *maxdecimaldigits* parameter can cause output geometry to become invalid. To avoid this use ST_ReducePrecision with a suitable gridsize first.

1.5.0 버전부터 지리형을 지원합니&#xb2e4

Enhanced: 2.5 - optional parameter precision introduced.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.25

This method supports Circular Strings and Curves.

예시

```
SELECT ST_AsText('0103000000010000000500000000000000000
0000000000000000000000000000000000000000000000000
F03F000000000000F03F000000000000F03F000000000000F03
F000000000000000000000000000000000000000000000000');

    st_astext
-------------------------------
 POLYGON((0 0,0 1,1 1,1 0,0 0))
```

Full precision output is the default.

```
SELECT ST_AsText('POINT(111.1111111 1.1111111)'));
    st_astext
-----------------------------
 POINT(111.1111111 1.1111111)
```

The *maxdecimaldigits* argument can be used to limit output precision.

```
SELECT ST_AsText('POINT(111.1111111 1.1111111)'), 2);
    st_astext
--------------------
 POINT(111.11 1.11)
```

참고

ST_AsBinary, ST_AsEWKB, ST_AsEWKT, ST_GeomFromText

7.9.2 Well-Known Binary (WKB)

7.9.2.1 ST_AsBinary

ST_AsBinary — Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.

Synopsis

bytea **ST_AsBinary**(geometry g1);
bytea **ST_AsBinary**(geometry g1, text NDR_or_XDR);
bytea **ST_AsBinary**(geography g1);
bytea **ST_AsBinary**(geography g1, text NDR_or_XDR);

설명

Returns the OGC/ISO Well-Known Binary (WKB) representation of the geometry. The first function variant defaults to encoding using server machine endian. The second function variant takes a text argument specifying the endian encoding, either little-endian ('NDR') or big-endian ('XDR').

WKB format is useful to read geometry data from the database and maintaining full numeric precision. This avoids the precision rounding that can happen with text formats such as WKT.

To perform the inverse conversion of WKB to PostGIS geometry use ST_GeomFromWKB.

Note
The OGC/ISO WKB format does not include the SRID. To get the EWKB format which does include the SRID use ST_AsEWKB

Note
The default behavior in PostgreSQL 9.0 has been changed to output bytea in hex encoding. If your GUI tools require the old behavior, then SET bytea_output='escape' in your database.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

개선 사항: 2.0.0 버전부터 더 높은 좌&#xd4
차원을 지원합니다.

개선 사항: 2.0.0 버전부터 지리형과
함께 엔디안을 설정하는 방식을
지원합니다.

1.5.0 버전부터 지리형을 지원합니&#xb2e

변경 사항: 2.0.0버전부터 이 함수에
알려지지 않은 유형을 입력할 수
없게 됐습니다. 반드시 도형을 입&#
합니다. `ST_AsBinary('POINT(1 2)')` 같은 구조는 더
이상 유효하지 않아, `n st_asbinary(unknown) is not unique error` 오류가 발생합니다. 이런 코드&#xb
`ST_AsBinary('POINT(1 2)'::geometry);` 로 변경돼야 합니다
이렇게 변경할 수 없는 경우, `legacy.sql`
을 설치하십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1

This method implements the SQL/MM specification. SQL-MM 3: 5.1.37

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsBinary(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326));

                  st_asbinary
----------------------------------
\x0103000000010000000500000000000000000000000000000000000000000000000000000000000000000000000000000000
000000f03f000000000000f03f000000000000f03f000000000000f03f000000000000000000000000
00000000000000000000000000
```

```
SELECT ST_AsBinary(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326), 'XDR');
                  st_asbinary
----------------------------------
\x0000000003000000010000000500000000000000000000000000000000000000000000000000000000000000000000003ff000
00000000003ff0000000000000003ff0000000000003ff0000000000000000000000000000000000
00000000000000000000000000
```

참고

ST_GeomFromWKB, ST_AsEWKB, ST_AsTWKB, ST_AsText,

7.9.2.2 ST_AsEWKB

ST_AsEWKB — Return the Extended Well-Known Binary (EWKB) representation of the geometry with SRID meta data.

Synopsis

bytea **ST_AsEWKB**(geometry g1);
bytea **ST_AsEWKB**(geometry g1, text NDR_or_XDR);

설명

Returns the Extended Well-Known Binary (EWKB) representation of the geometry with SRID metadata. The first function variant defaults to encoding using server machine endian. The second function variant takes a text argument specifying the endian encoding, either little-endian ('NDR') or big-endian ('XDR').

WKB format is useful to read geometry data from the database and maintaining full numeric precision. This avoids the precision rounding that can happen with text formats such as WKT.

To perform the inverse conversion of EWKB to PostGIS geometry use ST_GeomFromEWKB.

Note
To get the OGC/ISO WKB format use ST_AsBinary. Note that OGC/ISO WKB format does not include the SRID.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
삼각형 및 TIN을 지원하기 시작했&#xc2b5

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_AsEWKB(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326));

                    st_asewkb
--------------------------------
\x0103000020e6100000010000000500000000000000000000000000000000000000000000000000000000000000000000
000000000000000f03f000000000000f03f000000000000f03f000000000000f03f000000000000000000000000000000000
0000000000000000000000000000000000
```

```
SELECT ST_AsEWKB(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326), 'XDR');
                    st_asewkb
--------------------------------
\x0020000003000010e60000000100000005000000000000000000000000000000000000000000000000000000000000000
003ff0000000000003ff0000000000003ff0000000000003ff0000000000000000000000000000000000
0000000000000000000000000000000000
```

참고

ST_AsBinary, ST_GeomFromEWKB, ST_SRID

7.9.2.3 ST_AsHEXEWKB

ST_AsHEXEWKB — 도형을 소 엔디안(NDR) 또는 대 엔디안(XDR) 인코딩을 통해 HEXEWKB (텍스&#형식으로 반환합니다.

Synopsis

text **ST_AsHEXEWKB**(geometry g1, text NDRorXDR);
text **ST_AsHEXEWKB**(geometry g1);

설명

도형을 소 엔디안(NDR) 또는 대 엔디&#x인코딩을 통해 HEXEWKB (텍스트) 형식으반환합니다. 인코딩을 설정하지 않으면 NDR을 씁니다.

Note
1.2.2 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_AsHEXEWKB(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326));
-- &#xc774; &#xd568;&#xc218;&#xb294; &#xb2e4;&#xc74c; &#xd568;&#xc218;&#xc640;  ↩
    &#xb3d9;&#xc77c;&#xd55c; &#xb2f5;&#xc744; &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;.

                SELECT ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326)::text;

                st_ashexewkb
                --------
                0103000020E6100000010000000500
                00000000000000000000000000000000
                00000000000000000000000000000F03F
                000000000000F03F000000000000F03F000000000000F03
                F00000000000000000000000000000000000000000000000
```

7.9.3 Other Formats

7.9.3.1 ST_AsEncodedPolyline

ST_AsEncodedPolyline — 라인스트링 도형으로부&#xd1
인코딩된 폴리라인을 반환합니&#x

Synopsis

text **ST_AsEncodedPolyline**(geometry geom, integer precision=5);

설명

Returns the geometry as an Encoded Polyline. This format is used by Google Maps with precision=5 and by Open Source Routing Machine with precision=5 and 6.

Optional `precision` specifies how many decimal places will be preserved in Encoded Polyline. Value should be the same on encoding and decoding, or coordinates will be incorrect.

2.2.0 버전부터 사용할 수 있습니다.

예시

기본

```
SELECT ST_AsEncodedPolyline(GeomFromEWKT('SRID=4326;LINESTRING(-120.2 38.5,-120.95  ↩
    40.7,-126.453 43.252)'));
        -- &#xacb0;&#xacfc; --
        |_p~iF~ps|U_ulLnnqC_mqNvxq`@
```

지리형 라인스트링 및 지리형 분&#x
결합해서 사용하고, 구글 지도에
올립니다.

```
-- &#xbcf4;&#xc2a4;&#xd134;&#xc5d0;&#xc11c;  ↩
    &#xc0cc;&#xd504;&#xb780;&#xc2dc;&#xc2a4;&#xcf54;&#xae4c;&#xc9c0; 100km&#xb9c8;&#xb2e4;  ↩
    &#xbd84;&#xc808;&#xd558;&#xb294; SQL &#xad6c;&#xbb38;
        SELECT ST_AsEncodedPolyline(
                ST_Segmentize(
                        ST_GeogFromText('LINESTRING(-71.0519 42.4935,-122.4483 37.64)'),
                                100000)::geometry) As encodedFlightPath;
```

사용자가 $ 변수를 쿼리 결과로 대&#x
자바스크립트는 다음과 같이 보&#x
것입니다.

```
<script type="text/javascript" src="http://maps.googleapis.com/maps/api/js?libraries= ↩
    geometry"
></script>
<script type="text/javascript">
         flightPath = new google.maps.Polyline({
                        path:  google.maps.geometry.encoding.decodePath("$encodedFlightPath ↩
                            "),
                        map: map,
                        strokeColor: '#0000CC',
                        strokeOpacity: 1.0,
                        strokeWeight: 4
                });
</script>
```

참고

ST_LineFromEncodedPolyline, ST_Segmentize

7.9.3.2 ST_AsFlatGeobuf

ST_AsFlatGeobuf — Return a FlatGeobuf representation of a set of rows.

Synopsis

bytea **ST_AsFlatGeobuf**(anyelement set row);
bytea **ST_AsFlatGeobuf**(anyelement row, bool index);
bytea **ST_AsFlatGeobuf**(anyelement row, bool index, text geom_name);

설명

Return a FlatGeobuf representation (http://flatgeobuf.org) of a set of rows corresponding to a FeatureCollection. NOTE: PostgreSQL bytea cannot exceed 1GB.

`row` row data with at least a geometry column.

`index` toggle spatial index creation. Default is false.

`geom_name` is the name of the geometry column in the row data. If NULL it will default to the first found geometry column.

Availability: 3.2.0

7.9.3.3 ST_AsGeobuf

ST_AsGeobuf — Return a Geobuf representation of a set of rows.

Synopsis

bytea **ST_AsGeobuf**(anyelement set row);
bytea **ST_AsGeobuf**(anyelement row, text geom_name);

설명

Return a Geobuf representation (https://github.com/mapbox/geobuf) of a set of rows corresponding to a FeatureCollection. Every input geometry is analyzed to determine maximum precision for optimal storage. Note that Geobuf in its current form cannot be streamed so the full output will be assembled in memory.

`row` row data with at least a geometry column.

`geom_name` is the name of the geometry column in the row data. If NULL it will default to the first found geometry column.

Availability: 2.4.0

예시

```
SELECT encode(ST_AsGeobuf(q, 'geom'), 'base64')
    FROM (SELECT ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))') AS geom) AS q;
 st_asgeobuf
---------------------------------
 GAAiEAoOCgwIBBoIAAAAAgIAAAE=
```

7.9.3.4 ST_AsGeoJSON

ST_AsGeoJSON — Return a geometry as a GeoJSON element.

Synopsis

text **ST_AsGeoJSON**(record feature, text geomcolumnname, integer maxdecimaldigits=9, boolean pretty_bool=false);
text **ST_AsGeoJSON**(geometry geom, integer maxdecimaldigits=9, integer options=8);
text **ST_AsGeoJSON**(geography geog, integer maxdecimaldigits=9, integer options=0);

설명

Returns a geometry as a GeoJSON "geometry", or a row as a GeoJSON "feature". (See the GeoJSON specifications RFC 7946). 2D and 3D Geometries are both supported. GeoJSON only support SFS 1.1 geometry types (no curve support for example).

The `maxdecimaldigits` argument may be used to reduce the maximum number of decimal places used in output (defaults to 9). If you are using EPSG:4326 and are outputting the geometry only for display, `maxdecimaldigits`=6 can be a good choice for many maps.

Warning
Using the *`maxdecimaldigits`* parameter can cause output geometry to become invalid. To avoid this use ST_ReducePrecision with a suitable gridsize first.

The `options` argument can be used to add BBOX or CRS in GeoJSON output:

- 0: means no option
- 1: GeoJSON BBOX
- 2: GeoJSON Short CRS (예: EPSG:4326)
- 4: GeoJSON Long CRS (예: urn:ogc:def:crs:EPSG::4326)
- 8: GeoJSON Short CRS if not EPSG:4326 (default)

The GeoJSON specification states that polygons are oriented using the Right-Hand Rule, and some clients require this orientation. This can be ensured by using ST_ForcePolygonCCW . The specification also requires that geometry be in the WGS84 coordinate system (SRID = 4326). If necessary geometry can be projected into WGS84 using ST_Transform: `ST_Transform( geom, 4326 )`.

GeoJSON can be tested and viewed online at geojson.io and geojsonlint.com. It is widely supported by web mapping frameworks:

- OpenLayers GeoJSON Example
- Leaflet GeoJSON Example
- Mapbox GL GeoJSON Example

1.3.4 버전부터 사용할 수 있습니다.

1.5.0 버전부터 지리형을 지원합니&#xb2e4

변경 사항: 2.0.0 버전부터 기본 독립 변수(default arg) 및 명명된 독립 변수(named arg)&#xb97c 지원합니다.

Changed: 3.0.0 support records as input

Changed: 3.0.0 output SRID if not EPSG:4326.

This function supports 3d and will not drop the z-index.

예시

Generate a FeatureCollection:

```
SELECT json_build_object(
    'type', 'FeatureCollection',
    'features', json_agg(ST_AsGeoJSON(t.*)::json)
    )
FROM ( VALUES (1, 'one', 'POINT(1 1)'::geometry),
              (2, 'two', 'POINT(2 2)'),
              (3, 'three', 'POINT(3 3)')
     ) as t(id, name, geom);
```

```
{"type" : "FeatureCollection", "features" : [{"type": "Feature", "geometry": {"type":"Point ↩
    ","coordinates":[1,1]}, "properties": {"id": 1, "name": "one"}}, {"type": "Feature", " ↩
    geometry": {"type":"Point","coordinates":[2,2]}, "properties": {"id": 2, "name": "two ↩
    "}}, {"type": "Feature", "geometry": {"type":"Point","coordinates":[3,3]}, "properties": ↩
     {"id": 3, "name": "three"}}]}
```

Generate a Feature:

```
SELECT ST_AsGeoJSON(t.*)
FROM (VALUES (1, 'one', 'POINT(1 1)'::geometry)) AS t(id, name, geom);
```

```
st_asgeojson
----------------------------------------------------------------------------------------------------

 {"type": "Feature", "geometry": {"type":"Point","coordinates":[1,1]}, "properties": {"id": ↩
      1, "name": "one"}}
```

An alternate way to generate Features with an `id` property is to use JSONB functions and operators:

```
SELECT jsonb_build_object(
    'type',       'Feature',
    'id',         id,
    'geometry',   ST_AsGeoJSON(geom)::jsonb,
    'properties', to_jsonb( t.* ) - 'id' - 'geom'
    ) AS json
FROM (VALUES (1, 'one', 'POINT(1 1)'::geometry)) AS t(id, name, geom);
```

```
json
----------------------------------------------------------------------------------------------------------

 {"id": 1, "type": "Feature", "geometry": {"type": "Point", "coordinates": [1, 1]}, " ↩
    properties": {"name": "one"}}
```

Don't forget to transform your data to WGS84 longitude, latitude to conform with the GeoJSON specification:

```
SELECT ST_AsGeoJSON(ST_Transform(geom,4326)) from fe_edges limit 1;
```

```
st_asgeojson
----------------------------------------------------------------------------------------------------------



{"type":"MultiLineString","coordinates":[[[-89.734634999999997,31.492072000000000],
[-89.734955999999997,31.492237999999997]]]}
```

3D geometries are supported:

```
SELECT ST_AsGeoJSON('LINESTRING(1 2 3, 4 5 6)');
```

```
{"type":"LineString","coordinates":[[1,2,3],[4,5,6]]}
```

참고

ST_GeomFromGeoJSON, ST_ForcePolygonCCW , ST_Transform

7.9.3.5 ST_AsGML

ST_AsGML — 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.

Synopsis

text **ST_AsGML**(geometry geom, integer maxdecimaldigits=15, integer options=0);
text **ST_AsGML**(geography geog, integer maxdecimaldigits=15, integer options=0, text nprefix=null, text id=null);
text **ST_AsGML**(integer version, geometry geom, integer maxdecimaldigits=15, integer options=0, text nprefix=null, text id=null);
text **ST_AsGML**(integer version, geography geog, integer maxdecimaldigits=15, integer options=0, text nprefix=null, text id=null);

설명

Return the geometry as a Geography Markup Language (GML) element. The version parameter, if specified, may be either 2 or 3. If no version parameter is specified then the default is assumed to be 2. The `maxdecimaldigits` argument may be used to reduce the maximum number of decimal places used in output (defaults to 15).

Warning

Using the *maxdecimaldigits* parameter can cause output geometry to become invalid. To avoid this use ST_ReducePrecision with a suitable gridsize first.

GML 2는 2.1.2 버전을, GML 3은 3.1.1 버전을 가리&#xd0

'옵션' 인수는 비트필드(bitfield) 구조체&#
CRS 출력 유형을 GML 출력으로 정의하&#
데이터를 위도/경도로 선언하는
데 쓸 수 있습니다.

- 0: GML Short CRS (예: EPSG:4326), 기본값
- 1: GML Long CRS (예: urn:ogc:def:crs:EPSG::4326)
- 2: GML 3에 한해, 출력물에서 srsDimension 속성&#xc7
제거합니다.
- 4: GML 3에 한해, 라인을 위해 <Curve> 보다
<LineString> 태그를 사용합니다.
- 16: 데이터가 위도/경도(예: srid=4326)라고
선언합니다. 기본적으로는 데이&
평면 좌표라고 가정합니다. 이 옵
축의 순서(axis order)와 관련돼 있어, GML 3.1.1
출력물에 대해서만 쓸모가 있습&
따라서 이 옵션을 설정하면, 데이
경도 위도 대신 위도 경도로 좌표&
순서를 바꿀 것입니다.
- 32: 도형을 둘러싼 상자(envelope)를 출력&#xd56

사용자 지정 네임스페이스 접두&#x
설정하거나 접두사를 사용하지
않도록 설정(비어 있는 경우)하는
데 '네임스페이스 접두사' 인수를
사용할 수도 있습니다. 이 인수가
NULL이거나 생략된 경우 'gml' 접두사를
씁니다.

1.3.2 버전부터 사용할 수 있습니다.

1.5.0 버전부터 지리형을 지원합니&#xb2e

개선 사항: 2.0.0 버전부터 접두사를
지원합니다. 라인에 대해 커브 대&
라인스트링 태그를 이용할 수 있&#
GML 3용 옵션 '4'가 등장했습니다. GML 3가
다면체 표면 및 TIN을 지원하기 시&#xc791
상자를 출력하는 옵션 '32'도 새롭&#xac8c
등장했습니다.

변경 사항: 2.0.0 버전부터 명명된 독&#xb9
arg)를 기본값으로 씁니다.

개선 사항: 2.1.0 버전부터 GML 3를 위해
ID를 지원하기 시작했습니다.

Note
ST_AsGML 함수의 3 이상 버전만이 다면체 표면 및 TIN을 지원합니다.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 17.2

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시: 버전 2

```
SELECT ST_AsGML(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326));
                st_asgml
                --------
                <gml:Polygon srsName="EPSG:4326"
><gml:outerBoundaryIs
><gml:LinearRing
><gml:coordinates
>0,0 0,1 1,1 1,0 0,0</gml:coordinates
></gml:LinearRing
></gml:outerBoundaryIs
></gml:Polygon
>
```

예시: 버전 3

```
-- &#xc88c;&#xd45c;&#xc758; &#xc21c;&#xc11c;&#xb97c; &#xb4a4;&#xc9d1;&#xace0;  ↩
    &#xd655;&#xc7a5; EPSG&#xb97c; &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;. (16 | 1) --
SELECT ST_AsGML(3, ST_GeomFromText('POINT(5.234234233242 6.34534534534)',4326), 5, 17);
                        st_asgml
                        --------
                <gml:Point srsName="urn:ogc:def:crs:EPSG::4326"
><gml:pos
>6.34535 5.23423</gml:pos
></gml:Point
>
```

```
-- &#xc0c1;&#xc790;(envelope)&#xb97c; &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;. (32) --
SELECT ST_AsGML(3, ST_GeomFromText('LINESTRING(1 2, 3 4, 10 20)',4326), 5, 32);
                st_asgml
                --------
        <gml:Envelope srsName="EPSG:4326">
                <gml:lowerCorner
>1 2</gml:lowerCorner>
                <gml:upperCorner
>10 20</gml:upperCorner>
        </gml:Envelope
>
```

```
-- &#xc0c1;&#xc790;(envelope)&#xb97c; &#xcd9c;&#xb825;&#xd558;&#xace0; (32),  ↩
    &#xc88c;&#xd45c;&#xb97c; &#xb4a4;&#xc9d1;&#xace0;(&#xacbd;&#xb3c4; &#xc704;&#xb3c4;  ↩
    &#xb300;&#xc2e0; &#xc704;&#xb3c4; &#xacbd;&#xb3c4;) (16), long SRS&#xb97c;  ↩
    &#xc0ac;&#xc6a9; (1) = 32 | 16 | 1 = 49 --
SELECT ST_AsGML(3, ST_GeomFromText('LINESTRING(1 2, 3 4, 10 20)',4326), 5, 49);
        st_asgml
        --------
<gml:Envelope srsName="urn:ogc:def:crs:EPSG::4326">
        <gml:lowerCorner
>2 1</gml:lowerCorner>
        <gml:upperCorner
>20 10</gml:upperCorner>
</gml:Envelope
>
```

```
-- &#xb2e4;&#xba74;&#xccb4; &#xc608;&#xc2dc; --
SELECT ST_AsGML(3, ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0) ↩
    ),
((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )'));
        st_asgml
        --------
 <gml:PolyhedralSurface>
<gml:polygonPatches>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
>0 0 0 0 0 1 0 1 1 0 1 0 0 0 0</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
>0 0 0 0 1 0 1 1 0 1 0 0 0 0 0</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
>0 0 0 1 0 0 1 0 1 0 0 1 0 0 0</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
>1 1 0 1 1 1 1 0 1 1 0 0 1 1 0</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
```

```
>0 1 0 0 1 1 1 1 1 1 0 0 1 0</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
   <gml:PolygonPatch>
                <gml:exterior>
                        <gml:LinearRing>
                                <gml:posList srsDimension="3"
>0 0 1 1 0 1 1 1 1 0 1 1 0 0 1</gml:posList>
                        </gml:LinearRing>
                </gml:exterior>
   </gml:PolygonPatch>
</gml:polygonPatches>
</gml:PolyhedralSurface
>
```

참고

ST_GeomFromGML

7.9.3.6 ST_AsKML

ST_AsKML — 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.

Synopsis

text **ST_AsKML**(geometry geom, integer maxdecimaldigits=15, text nprefix=NULL);
text **ST_AsKML**(geography geog, integer maxdecimaldigits=15, text nprefix=NULL);

설명

도형을 KML(Keyhole Markup Language) 요소로 반환합&#xb2c8
이 함수에는 몇 가지 변종이 있습&#
출력물에 쓰이는 소수점 이하 자&#
최대값(기본값은 15), 버전의 기본값
2이며 기본 네임스페이스는 접두&#
쓰지 않습니다.

Warning
Using the *maxdecimaldigits* parameter can cause output geometry to become invalid. To avoid this use ST_ReducePrecision with a suitable gridsize first.

Note
PostGIS를 Proj 지원과 함께 컴파일해야
합니다. Proj 지원과 함께
컴파일됐는지 여부를 확인하려&
PostGIS_Full_Version 을 이용하십시오.

Note
1.2.2 버전부터 사용할 수 있습니다. 버전 파라미터를 포함하는 최신 변종은 1.3.2 버전부터 등장했습니다.

Note
개선 사항: 2.0.0 버전부터 네임스페이스에 접두사를 추가할 수 있습니다. 기본값은 접두사를 쓰지 않는 것입니다.

Note
Changed: 3.0.0 - Removed the "versioned" variant signature

Note
ST_AsKML 출력물은 SRID가 없는 도형과는 동작하지 않을 것입니다.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsKML(ST_GeomFromText('POLYGON((0 0,0 1,1 1,1 0,0 0))',4326));

                st_askml
                --------
                <Polygon
><outerBoundaryIs
><LinearRing
><coordinates
>0,0 0,1 1,1 1,0 0,0</coordinates
></LinearRing
></outerBoundaryIs
></Polygon>

-- 3D &#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1;
                SELECT ST_AsKML('SRID=4326;LINESTRING(1 2 3, 4 5 6)');
                <LineString
><coordinates
>1,2,3 4,5,6</coordinates
></LineString>
```

참고

ST_AsSVG, ST_AsGML

7.9.3.7 ST_AsLatLonText

ST_AsLatLonText — 주어진 포인트의 도, 분, 초 표현식을 반환합니다.

Synopsis

text **ST_AsLatLonText**(geometry pt, text format='');

설명

포인트의 도, 분, 초 표현식을 반환&

Note

이 함수는 포인트가 위도/경도 투영체 안에 있다고 가정합니다. 출력물에서 X(경도) 및 Y(위도) 좌표는 "정규" 범위(경도는 -180도에서 180도, 위도는 -90도에서 90도)로 정규화됩니다.

텍스트 파라미터는 결과물의 텍&#x 위한 형식을 담고 있는 형식 스트&# 날짜 형식 스트링과 비슷합니다. 유효한 토큰은 도를 나타내는 "D", 분을 나타내는 "M", 초를 나타내는 "S", 그리고 기본방향(북남동서, cardinal direction)을 나타내는 "C"입니다. D, M, S 토큰들&# 원하는 폭 및 정밀도를 표시하기 위해 반복될 수도 있습니다("SSS.SSSS"는 "1.0023"처럼 표기하라는 뜻입니다).

M, S, C는 선택적입니다. "C"가 생략된 경우, 도는 남쪽 또는 서쪽일 경우 "-" 부호와 함께 표시됩니다. "S"가 생&#xb 경우, 사용자가 설정한 대로의 소&# 이하 자릿수 정밀도로 분이 표시&# 것입니다. "M"도 생략된 경우, 사용&#xc79 설정한 대로의 소수점 이하 자릿&# 정밀도로 도가 표시될 것입니다.

형식 스트링이 빠진 (또는 길이가 0인) 경우 기본 형식을 쓸 것입니다.

2.0 버전부터 사용할 수 있습니다.

예시

기본 형식

```
SELECT (ST_AsLatLonText('POINT (-3.2342342 -2.32498)'));
      st_aslatlontext
----------------------------
 2\textdegree{}19'29.928"S 3\textdegree{}14'3.243"W
```

(기본값과 동일한) 형식을 제공합&#x

```
SELECT (ST_AsLatLonText('POINT (-3.2342342 -2.32498)', 'D\textdegree{}M''S.SSS"C'));
      st_aslatlontext
---------------------------
 2\textdegree{}19'29.928"S 3\textdegree{}14'3.243"W
```

D, M, S, C 및 .이 아닌 다른 문자들은 그냥 무시됩니다.

```
SELECT (ST_AsLatLonText('POINT (-3.2342342 -2.32498)', 'D degrees, M minutes, S seconds to ↩
    the C'));
                                  st_aslatlontext
-------------------------------------------------------------------------------------
 2 degrees, 19 minutes, 30 seconds to the S 3 degrees, 14 minutes, 3 seconds to the W
```

기본방향 대신 부호가 붙은 도를 사용합니다.

```
SELECT (ST_AsLatLonText('POINT (-3.2342342 -2.32498)', 'D\textdegree{}M''S.SSS"'));
      st_aslatlontext
---------------------------
 -2\textdegree{}19'29.928" -3\textdegree{}14'3.243"
```

소수점이 붙은 도를 사용합니다.

```
SELECT (ST_AsLatLonText('POINT (-3.2342342 -2.32498)', 'D.DDDD degrees C'));
          st_aslatlontext
-----------------------------------
 2.3250 degrees S 3.2342 degrees W
```

지나치게 큰 값은 정규화됩니다.

```
SELECT (ST_AsLatLonText('POINT (-302.2342342 -792.32498)'));
        st_aslatlontext
------------------------------
 72\textdegree{}19'29.928"S 57\textdegree{}45'56.757"E
```

7.9.3.8 ST_AsMARC21

ST_AsMARC21 — Returns geometry as a MARC21/XML record with a geographic datafield (034).

Synopsis

text **ST_AsMARC21** (geometry geom , text format='hdddmmss');

설명

This function returns a MARC21/XML record with Coded Cartographic Mathematical Data representing the bounding box of a given geometry. The `format` parameter allows to encode the coordinates in subfields `$d`,`$e`,`$f` and `$g` in all formats supported by the MARC21/XML standard. Valid formats are:

- cardinal direction, degrees, minutes and seconds (default): `hdddmmss`
- decimal degrees with cardinal direction: `hddd.dddddd`
- decimal degrees without cardinal direction: `ddd.dddddd`
- decimal minutes with cardinal direction: `hdddmm.mmmm`

- decimal minutes without cardinal direction: `dddmm.mmmm`
- decimal seconds with cardinal direction: `hdddmmss.sss`

The decimal sign may be also a comma, e.g. `hdddmm,mmmm`.

The precision of decimal formats can be limited by the number of characters after the decimal sign, e.g. `hdddmm.mm` for decimal minutes with a precision of two decimals.

This function ignores the Z and M dimensions.

LOC MARC21/XML versions supported:

- MARC21/XML 1.1

Availability: 3.3.0

Note
This function does not support non lon/lat geometries, as they are not supported by the MARC21/XML standard (Coded Cartographic Mathematical Data).

Note
The MARC21/XML Standard does not provide any means to annotate the spatial reference system for Coded Cartographic Mathematical Data, which means that this information will be lost after conversion to MARC21/XML.

예시

Converting a `POINT` to MARC21/XML formated as hdddmmss (default)

```
SELECT ST_AsMARC21('SRID=4326;POINT(-4.504289 54.253312)'::geometry);

                st_asmarc21
-----------------------------------------------
<record xmlns="http://www.loc.gov/MARC21/slim">
    <datafield tag="034" ind1="1" ind2=" ">
        <subfield code="a">a</subfield>
        <subfield code="d">W0043015</subfield>
        <subfield code="e">W0043015</subfield>
        <subfield code="f">N0541512</subfield>
        <subfield code="g">N0541512</subfield>
    </datafield>
</record>
```

Converting a `POLYGON` to MARC21/XML formated in decimal degrees

```
SELECT ST_AsMARC21('SRID=4326;POLYGON((-4.5792388916015625  ↩
    54.18172660239091,-4.56756591796875  ↩
    54.196993557130355,-4.546623229980469  ↩
    54.18313300502024,-4.5792388916015625 54.18172660239091))'::geometry,' ↩
    hddd.dddd');

<record xmlns="http://www.loc.gov/MARC21/slim">
    <datafield tag="034" ind1="1" ind2=" ">
```

```
            <subfield code="a">a</subfield>
            <subfield code="d">W004.5792</subfield>
            <subfield code="e">W004.5466</subfield>
            <subfield code="f">N054.1970</subfield>
            <subfield code="g">N054.1817</subfield>
        </datafield>
    </record>
```

Converting a GEOMETRYCOLLECTION to MARC21/XML formated in decimal minutes. The geometries order in the MARC21/XML output correspond to their order in the collection.

```
SELECT ST_AsMARC21('SRID=4326;GEOMETRYCOLLECTION(POLYGON((13.1 ↩
    52.65,13.516666666666667 52.65,13.516666666666667 52.38333333333333,13.1 ↩
     52.38333333333333,13.1 52.65)),POINT(-4.5 54.25))'::geometry,'hdddmm. ↩
    mmmm');

                st_asmarc21
-------------------------------------------------
<record xmlns="http://www.loc.gov/MARC21/slim">
    <datafield tag="034" ind1="1" ind2=" ">
        <subfield code="a">a</subfield>
        <subfield code="d">E01307.0000</subfield>
        <subfield code="e">E01331.0000</subfield>
        <subfield code="f">N05240.0000</subfield>
        <subfield code="g">N05224.0000</subfield>
    </datafield>
    <datafield tag="034" ind1="1" ind2=" ">
        <subfield code="a">a</subfield>
        <subfield code="d">W00430.0000</subfield>
        <subfield code="e">W00430.0000</subfield>
        <subfield code="f">N05415.0000</subfield>
        <subfield code="g">N05415.0000</subfield>
    </datafield>
</record>
```

참고

ST_GeomFromMARC21

7.9.3.9 ST_AsMVTGeom

ST_AsMVTGeom — Transforms a geometry into the coordinate space of a MVT tile.

Synopsis

geometry **ST_AsMVTGeom**(geometry geom, box2d bounds, integer extent=4096, integer buffer=256, boolean clip_geom=true);

설명

Transforms a geometry into the coordinate space of a MVT (Mapbox Vector Tile) tile, clipping it to the tile bounds if required. The geometry must be in the coordinate system of the target map (using ST_Transform if needed). Commonly this is Web Mercator (SRID:3857).

The function attempts to preserve geometry validity, and corrects it if needed. This may cause the result geometry to collapse to a lower dimension.

The rectangular bounds of the tile in the target map coordinate space must be provided, so the geometry can be transformed, and clipped if required. The bounds can be generated using ST_MakeEnvelope.

This function is used to convert geometry into the tile coordinate space required by ST_AsMVT.

`geom` is the geometry to transform, in the coordinate system of the target map.

`bounds` is the rectangular bounds of the tile in map coordinate space, with no buffer.

`extent` is the tile extent size in tile coordinate space as defined by the MVT specification. Defaults to 4096.

`buffer` is the buffer size in tile coordinate space for geometry clippig. Defaults to 256.

`clip_geom` is a boolean to control if geometries are clipped or encoded as-is. Defaults to true.

Availability: 2.4.0

Note
From 3.0, Wagyu can be chosen at configure time to clip and validate MVT polygons. This library is faster and produces more correct results than the GEOS default, but it might drop small polygons.

예시

```
SELECT ST_AsText(ST_AsMVTGeom(
        ST_GeomFromText('POLYGON ((0 0, 10 0, 10 5, 0 -5, 0 0))'),
        ST_MakeBox2D(ST_Point(0, 0), ST_Point(4096, 4096)),
        4096, 0, false));
                             st_astext
-------------------------------------------------------------------
 MULTIPOLYGON(((5 4096,10 4091,10 4096,5 4096)),((5 4096,0 4101,0 4096,5 4096)))
```

Canonical example for a Web Mercator tile using a computed tile bounds to query and clip geometry.

```
SELECT ST_AsMVTGeom(
            ST_Transform( geom, 3857 ),
            ST_TileEnvelope(12, 513, 412), extent => 4096, buffer => 64) AS geom
  FROM data
  WHERE geom && ST_TileEnvelope(12, 513, 412, margin => (64.0 / 4096))
```

참고

ST_AsMVT, ST_MakeEnvelope, PostGIS_Wagyu_Version

7.9.3.10 ST_AsMVT

ST_AsMVT — Aggregate function returning a MVT representation of a set of rows.

Synopsis

bytea **ST_AsMVT**(anyelement set row);
bytea **ST_AsMVT**(anyelement row, text name);
bytea **ST_AsMVT**(anyelement row, text name, integer extent);
bytea **ST_AsMVT**(anyelement row, text name, integer extent, text geom_name);
bytea **ST_AsMVT**(anyelement row, text name, integer extent, text geom_name, text feature_id_name);

설명

An aggregate function which returns a binary Mapbox Vector Tile representation of a set of rows corresponding to a tile layer. The rows must contain a geometry column which will be encoded as a feature geometry. The geometry must be in tile coordinate space and valid as per the MVT specification. ST_AsMVTGeom can be used to transform geometry into tile coordinate space. Other row columns are encoded as feature attributes.

The Mapbox Vector Tile format can store features with varying sets of attributes. To use this capability supply a JSONB column in the row data containing Json objects one level deep. The keys and values in the JSONB values will be encoded as feature attributes.

Tiles with multiple layers can be created by concatenating multiple calls to this function using `||` or `STRING_AGG`.

Important
Do not call with a `GEOMETRYCOLLECTION` as an element in the row. However you can use ST_AsMVTGeom to prepare a geometry collection for inclusion.

`row` row data with at least a geometry column.

`name` is the name of the layer. Default is the string "default".

`extent` is the tile extent in screen space as defined by the specification. Default is 4096.

`geom_name` is the name of the geometry column in the row data. Default is the first geometry column. Note that PostgreSQL by default automatically folds unquoted identifiers to lower case, which means that unless the geometry column is quoted, e.g. `"MyMVTGeom"`, this parameter must be provided as lowercase.

`feature_id_name` is the name of the Feature ID column in the row data. If NULL or negative the Feature ID is not set. The first column matching name and valid type (smallint, integer, bigint) will be used as Feature ID, and any subsequent column will be added as a property. JSON properties are not supported.

Enhanced: 3.0 - added support for Feature ID.

Enhanced: 2.5.0 - added support parallel query.

Availability: 2.4.0

예시

```
WITH mvtgeom AS
(
  SELECT ST_AsMVTGeom(geom, ST_TileEnvelope(12, 513, 412), extent => 4096, buffer => 64) AS ↩
       geom, name, description
  FROM points_of_interest
  WHERE geom && ST_TileEnvelope(12, 513, 412, margin => (64.0 / 4096))
)
SELECT ST_AsMVT(mvtgeom.*)
FROM mvtgeom;
```

참고

ST_AsMVTGeom, ST_MakeEnvelope

7.9.3.11 ST_AsSVG

ST_AsSVG — Returns SVG path data for a geometry.

Synopsis

text **ST_AsSVG**(geometry geom, integer rel=0, integer maxdecimaldigits=15);
text **ST_AsSVG**(geography geog, integer rel=0, integer maxdecimaldigits=15);

설명

도형을 SVG(Scalar Vector Graphics) 경로 데이터로 반&#
상대 이동(relative move) 관점에서 구현된
경로 데이터를 얻으려면 두 번째
인수로 1을 사용하고, 절대 이동(absolute
move) 관점에서 구현된 경로 데이터&#xb9
얻으려면 기본값 0을 사용하십시&#
출력물에 쓰인 소수점 이하 자릿&#
최대값(기본값은 15)을 줄이는 데 &#xc138
번째 인수를 쓸 수도 있습니다. 'rel'
독립 변수가 0일 때 포인트 도형을
cx/cy로 렌더링하고, 'rel' 독립 변수가 1일
때 x/y로 렌더링합니다. 멀티포인&#xd2b8
도형들은 쉼표(",")로 구분하고, 도&#xd61
집합의 도형들은 쌍반점(";")으로 &#xad6c

For working with PostGIS SVG graphics, checkout pg_svg library which provides plpgsql functions for working with outputs from ST_AsSVG.

Enhanced: 3.4.0 to support all curve types

변경 사항: 2.0.0 버전부터 기본 독립
변수(default arg)를 사용하고 명명된 독립
변수(named arg)를 지원합니다.

Note

1.2.2 버전부터 사용할 수 있습니다. 1.4.0버전에서 http://www.w3.org/-TR/SVG/paths.html#PathDataBNF 를 준수하기 위해 절대 경로에 L 명령어를 포함시켰습니다.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_AsSVG('POLYGON((0 0,0 1,1 1,1 0,0 0))'::geometry);

st_assvg
--------
M 0 0 L 0 -1 1 -1 1 0 Z
```

Circular string

```
SELECT ST_AsSVG( ST_GeomFromText('CIRCULARSTRING(-2 0,0 2,2 0,0 2,2 4)') );

st_assvg
--------
M -2 0 A 2 2 0 0 1 2 0 A 2 2 0 0 1 2 -4
```

Multi-curve

```
SELECT ST_AsSVG('MULTICURVE((5 5,3 5,3 3,0 3),
 CIRCULARSTRING(0 0,2 1,2 2))'::geometry, 0, 0);
 st_assvg
------------------------------------------------
 M 5 -5 L 3 -5 3 -3 0 -3 M 0 0 A 2 2 0 0 0 2 -2
```

Multi-surface

```
SELECT ST_AsSVG('MULTISURFACE(
CURVEPOLYGON(CIRCULARSTRING(-2 0,-1 -1,0 0,1 -1,2 0,0 2,-2 0),
    (-1 0,0 0.5,1 0,0 1,-1 0)),
((7 8,10 10,6 14,4 11,7 8)))'::geometry, 0, 2);

st_assvg
-------------------------------------------------------
M -2 0 A 1 1 0 0 0 0 0 A 1 1 0 0 0 2 0 A 2 2 0 0 0 -2 0 Z
M -1 0 L 0 -0.5 1 0 0 -1 -1 0 Z
M 7 -8 L 10 -10 6 -14 4 -11 Z
```

7.9.3.12 ST_AsTWKB

ST_AsTWKB — 도형을 TWKB(Tiny Well-Known Binary)로 반환합니&

Synopsis

bytea **ST_AsTWKB**(geometry geom, integer prec=0, integer prec_z=0, integer prec_m=0, boolean with_sizes=false, boolean with_boxes=false);
bytea **ST_AsTWKB**(geometry[] geom, bigint[] ids, integer prec=0, integer prec_z=0, integer prec_m=0, boolean with_sizes=false, boolean with_boxes=false);

설명

도형을 TWKB(Tiny Well-Known Binary) 형식으로 반환&#xd569
TWKB는 출력물의 용량을 최소화하&#xb2
데 집중한 압축 바이너리 형식 입&

소수점 이하 자릿수 파라미터가
출력물에 어느 정도의 정밀도를
저장할지 결정합니다. 기본적으&#x
모든 값은 인코딩하기 전에 가장
가까운 단위로 반올림됩니다. 더
높은 정밀도를 복사하고 싶다면,
자릿수를 올리십시오. 예를 들어,
값이 1이라면 소수점 오른쪽의 &#xc-
cab; 번째 숫자까지 보전될 것입니다

크기 및 경계 상자 파라미터는 객&#x
인코딩된 길이 및 경계에 대한 선&#x
정보를 출력물에 포함시킬지 말&#x
결정합니다. 기본적으로는 포함&#x
않습니다. 사용자의 클라이언트
소프트웨어가 필요로하지 않는&#x
활성화시키지 마십시오. 디스크
공간을 소비할 뿐입니다(디스크
공간을 절약하는 것이 TWKB의 목적&#xc7

이 함수의 배열 입력 형식은 도형 집합 및 유일 식별자를 식별자를 보전하는 TWKB 집합으로 변환하는 데 쓰입니다. 집합의 압축을 풀어 그 안에 있는 객체들에 대한 상세 정보에 접근하는 기능을 가진 클&#x 유용합니다. array_agg 함수를 이용해서 배열을 생성할 수 있습니다. 다른 파라미터들은 이 함수의 단순 형&# 경우와 동일하게 실행됩니다.

Note

https://github.com/TWKB/Specification 에서 형식 사양서를 찾아볼 수 있으며, https://github.com/-TWKB/twkb.js 에서 자바스크립트 클라이언트를 빌드하기 위한 코드를 찾을 수 있습니다.

Enhanced: 2.4.0 memory and speed improvements.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsTWKB('LINESTRING(1 1,5 5)'::geometry);
                st_astwkb
------------------------------------------
\x02000202020808
```

식별자를 포함하는 종합 TWKB 객체&#xb 생성하려면, 먼저 "array_agg()"를 통해 원&#xd55 도형과 객체를 합친 다음 적절한 TWKB 함수를 호출하십시오.

```
SELECT ST_AsTWKB(array_agg(geom), array_agg(gid)) FROM mytable;
                st_astwkb
------------------------------------------
\x040402020400000202
```

참고

ST_GeomFromTWKB, ST_AsBinary, ST_AsEWKB, ST_AsEWKT, ST_GeomFromText

7.9.3.13 ST_AsX3D

ST_AsX3D — 도형을 X3D XML 노드 요소 형식: ISO-IEC-19776-1.2-X3DEncodings-XML로 반환합니다.

Synopsis

text **ST_AsX3D**(geometry g1, integer maxdecimaldigits=15, integer options=0);

설명

도형을 http://www.web3d.org/standards/number/19776-1 에서 정의하&#x
X3D XML 형식화 노드 요소로 반환합니&
`maxdecimaldigits` (정밀도)를 설정하지 않을
경우 기본값인 15를 씁니다.

Note

X3D 도형 유형이 PostGIS 도형 유형을 직접 매핑하지 않기 때문에 PostGIS 도형을 X3D 도형으로 번역하는 다양한 방법이 있습니다. 또 현재 렌더링 도구 대부분이 새로운 X3D 유형을 지원하지 않기 때문에, 더 잘 매핑돼 있는 몇몇 X3D 유형을 다루지 않습니다. 이 단원에서 다루는 것이 우리가 결정한 매핑입니다. 사용자가 선호하는 매핑을 표시할 수 있게 해주는 아이디어나 방법이 떠올랐다면 부디 버그 티켓(bug ticket)을 포스팅해주십시오. 다음은 현재 PostGIS 2D/3D 유형을 X3D 유형으로 매핑하는 방법입니다.

'옵션' 인수는 비트필드 구조체입&
PostGIS 2.2 이상 버전의 경우, 좌표를 X3D 지&#xb
지리공간 노드로 표현할지, 그리&#x
또 x/y 축을 뒤집을지 말지를 표시&#xd558
데 쓰입니다. 기본적으로 `ST_AsX3D` 는 데
형식 (long,lat or X,Y)로 출력하지만, X3D의 기본
위도/경도, y/x를 선호할 수도 있습&#xb2c

- 0: 데이터베이스 순서로 정렬된 X/Y(예를 들어 경도/위도 = X,Y가 표준 데이터베이스 순서입니다), 데이&
  값, 비(非) 공간 좌표(구식 정규 좌&#xd45
  태그).
- 1: X 및 Y를 뒤집습니다. 지리좌표(GeoCoordinat
  옵션 스위치와 연결해서 사용할
  경우, 출력물이 기본값인 "latitude_first"(위&#xb
  먼저)가 될 것이고 좌표도 마찬가&
  뒤집힐 것입니다.
- 2: 좌표를 지리공간 지리좌표로 출
  도형이 WGS84 경위도(SRID 4326)가 아닐 경우
  이 옵션은 오류를 발생시킬 것입&
  현재 이 지리좌표 유형만 지원합&
  공간 참조 시스템을 정의하는 X3D
  사양 을 참조하십시오. 출력물은
  기본각으로 `GeoCoordinate geoSystem='"GD" "WE" "longitude_first"'`
  가 됩니다. X3D 기본값인 `GeoCoordinate geoSystem='"GD"
  "WE" "latitude_first"'` 를 선호한다면, `(2 + 1) = 3` 을 쓰&#

PostGIS 유형	2D X3D 유형	3D X3D 유형
LINESTRING	아직 구현되지 않았습니다. 구현시 PolyLine2D가 될 것입니다.	LineSet
MULTILINESTRING	아직 구현되지 않았습니다. 구현시 PolyLine2D가 될 것입니다.	IndexedLineSet
MULTIPOINT	Polypoint2D	PointSet
POINT	공백으로 구분된 좌표를 출력합니다.	공백으로 구분된 좌표를 출력합니다
(MULTI) POLYGON, POLYHEDRALSURFACE	유효하지 않은 X3D 마크업(markup)를 지원합니다.	IndexedFaceSet (현재 내곽 고리를 또다른 집합(faceset)으로 출력합니다
TIN	TriangleSet2D (아직 구현되지 않았습니다.)	IndexedTriangleSet

Note

2차원 도형 지원이 아직 완성되지 않았습니다. 현재 내곽 고리를 그저 개별적인 폴리곤으로 그립니다. 이 부분은 현재 작업중입니다.

Lots of advancements happening in 3D space particularly with X3D Integration with HTML5

또 렌더링된 도형을 보는 데 이용&#x
수 있는 멋진 오픈소스 X3D 뷰어가
있습니다. 맥, 리눅스, 윈도우 용 Free
Wrl 바이너리를 http://freewrl.sourceforge.net/ 에서 다운&#xb85c
수 있습니다. 도형을 보기 위해 패&
FreeWRL_Launcher를 이용하십시오.

Also check out PostGIS minimalist X3D viewer that utilizes this function and x3dDom html/js open source toolkit.

2.0.0 버전부터 ISO-IEC-19776-1.2-X3DEncodings-XML을 이용할
수 있습니다.

개선 사항: 2.2.0 버전부터 지리좌표
및 축(x/y, 경도/위도) 뒤집기를 지원&#xd56
자세한 내용은 옵션을 살펴보십&#x

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시: 완전히 기능하는 X3D 문서를 생성합니다. 다음 예시는 FreeWrl 및 다&#x X3D 뷰어에서 볼 수 있는 정육면체를 생성할 것입니다.

```
SELECT '<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.0//EN" "http://www.web3d.org/specifications/x3d ↩
    -3.0.dtd">
<X3D>
  <Scene>
    <Transform>
      <Shape>
       <Appearance>
            <Material emissiveColor=''0 0 1''/>
       </Appearance
> ' ||
       ST_AsX3D( ST_GeomFromEWKT('POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )')) ||
      '</Shape>
    </Transform>
  </Scene>
</X3D
>' As x3ddoc;

               x3ddoc
               --------
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.0//EN" "http://www.web3d.org/specifications/x3d ↩
    -3.0.dtd">
<X3D>
  <Scene>
    <Transform>
      <Shape>
       <Appearance>
            <Material emissiveColor='0 0 1'/>
       </Appearance>
       <IndexedFaceSet  coordIndex='0 1 2 3 -1 4 5 6 7 -1 8 9 10 11 -1 12 13 14 15 -1 16 17 ↩
            18 19 -1 20 21 22 23'>
            <Coordinate point='0 0 0 0 0 1 0 1 1 0 1 0 0 0 0 0 1 0 1 1 0 1 0 0 0 0 0 1 0 0  ↩
                1 0 1 0 0 1 1 1 0 1 1 1 1 0 1 1 0 0 0 1 0 0 1 1 1 1 1 1 1 0 0 0 1 1 0 1 1 1  ↩
                1 0 1 1' />
      </IndexedFaceSet>
      </Shape>
    </Transform>
  </Scene>
</X3D
>
```

PostGIS buildings

Copy and paste the output of this query to x3d scene viewer and click Show

```
SELECT string_agg('<Shape>' || ST_AsX3D(ST_Extrude(geom, 0,0, i*0.5)) ||
    '<Appearance>
          <Material diffuseColor="' || (0.01*i)::text || ' 0.8 0.2" specularColor="' ||  ↩
              (0.05*i)::text || ' 0 0.5"/>
        </Appearance>
    </Shape>', '')
FROM ST_Subdivide(ST_Letters('PostGIS'),20) WITH ORDINALITY AS f(geom,i);
```

Buildings formed by subdividing PostGIS and extrusion

예시: 소수점 정밀도 6이며 3단위 상승한 팔각형

```
SELECT ST_AsX3D(
ST_Translate(
    ST_Force_3d(
        ST_Buffer(ST_Point(10,10),5, 'quad_segs=2')), 0,0,
    3)
  ,6) As x3dfrag;

x3dfrag
--------
<IndexedFaceSet coordIndex="0 1 2 3 4 5 6 7">
    <Coordinate point="15 10 3 13.535534 6.464466 3 10 5 3 6.464466 6.464466 3 5 10 3  ↩
        6.464466 13.535534 3 10 15 3 13.535534 13.535534 3 " />
</IndexedFaceSet
>
```

예시: TIN

```
SELECT ST_AsX3D(ST_GeomFromEWKT('TIN (((
                0 0 0,
                0 0 1,
                0 1 0,
                0 0 0
            )), ((
                0 0 0,
                0 1 0,
                1 1 0,
                0 0 0
            ))
            )')) As x3dfrag;

                x3dfrag
                --------
<IndexedTriangleSet  index='0 1 2 3 4 5'
><Coordinate point='0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 1 1 0'/></IndexedTriangleSet
>
```

예시: 닫힌 멀티라인스트링(구멍가진 폴리곤의 경계선)

```
SELECT ST_AsX3D(
                    ST_GeomFromEWKT('MULTILINESTRING((20 0 10,16 -12 10,0 -16 10,-12 -12  ↩
                       10,-20 0 10,-12 16 10,0 24 10,16 16 10,20 0 10),
  (12 0 10,8 8 10,0 12 10,-8 8 10,-8 0 10,-8 -4 10,0 -8 10,8 -4 10,12 0 10))')
) As x3dfrag;

                x3dfrag
                --------
<IndexedLineSet  coordIndex='0 1 2 3 4 5 6 7 0 -1 8 9 10 11 12 13 14 15 8'>
    <Coordinate point='20 0 10 16 -12 10 0 -16 10 -12 -12 10 -20 0 10 -12 16 10 0 24 10 16  ↩
        16 10 12 0 10 8 8 10 0 12 10 -8 8 10 -8 0 10 -8 -4 10 0 -8 10 8 -4 10 ' />
 </IndexedLineSet
>
```

7.9.3.14 ST_GeoHash

ST_GeoHash — 도형의 GeoHash 표현식을 반환합&#xb2

Synopsis

text **ST_GeoHash**(geometry geom, integer maxchars=full_precision_of_point);

설명

Computes a GeoHash representation of a geometry. A GeoHash encodes a geographic Point into a text form that is sortable and searchable based on prefixing. A shorter GeoHash is a less precise representation of a point. It can be thought of as a box that contains the point.

Non-point geometry values with non-zero extent can also be mapped to GeoHash codes. The precision of the code depends on the geographic extent of the geometry.

If `maxchars` is not specified, the returned GeoHash code is for the smallest cell containing the input geometry. Points return a GeoHash with 20 characters of precision (about enough to hold the full double precision of the input). Other geometric types may return a GeoHash with less precision, depending on the extent of the geometry. Larger geometries are represented with less precision, smaller ones with more precision. The box determined by the GeoHash code always contains the input feature.

If `maxchars` is specified the returned GeoHash code has at most that many characters. It maps to a (possibly) lower precision representation of the input geometry. For non-points, the starting point of the calculation is the center of the bounding box of the geometry.

1.4.0 버전부터 사용할 수 있습니다.

Note
ST_GeoHash requires input geometry to be in geographic (lon/lat) coordinates.

This method supports Circular Strings and Curves.

예시

```
SELECT ST_GeoHash( ST_Point(-126,48) );

         st_geohash
----------------------
```

```
 c0w3hf1s70w3hf1s70w3

SELECT ST_GeoHash( ST_Point(-126,48), 5);

 st_geohash
------------
 c0w3h

-- This line contains the point, so the GeoHash is a prefix of the point code
SELECT ST_GeoHash('LINESTRING(-126 48, -126.1 48.1)'::geometry);

 st_geohash
------------
 c0w3
```

참고

ST_GeomFromGeoHash, ST_PointFromGeoHash, ST_Box2dFromGeoHash

7.10 연산자(operator)

7.10.1 Bounding Box Operators

7.10.1.1 &&

&& — A의 2D 경계 상자와 B의 2D 경계 상자&#xac
교차하는 경우 TRUE 를 반환합니다.

Synopsis

boolean **&&**(geometry A , geometry B);
boolean **&&**(geography A , geography B);

설명

`&&` 연산자는 도형 A의 2D 경계 상자와
도형 B의 2D 경계 상자가 교차하는
경우 TRUE 를 반환합니다.

Note
이 피연산자(operand)는 도형에서
이용할 수도 있는 모든
인덱스를 활용할 것입니다.

개선 사항: 2.0.0 버전부터 다면체 표&#xba
surface)을 지원합니다.

1.5.0 버전부터 지리형을 지원합니&#xb2e

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 && tbl2.column2 AS overlaps
FROM ( VALUES
        (1, 'LINESTRING(0 0, 3 3)'::geometry),
        (2, 'LINESTRING(0 1, 0 5)'::geometry)) AS tbl1,
( VALUES
        (3, 'LINESTRING(1 2, 4 6)'::geometry)) AS tbl2;

 column1 | column1 | overlaps
---------+---------+----------
           1 |       3 | t
           2 |       3 | f
(2 rows)
```

참고

ST_Intersects, ST_Extent, |&>, &>, &<|, &<, ~, @

7.10.1.2 &&(geometry,box2df)

&&(geometry,box2df) — Returns `TRUE` if a geometry's (cached) 2D bounding box intersects a 2D float precision bounding box (BOX2DF).

Synopsis

boolean **&&**(geometry A , box2df B);

설명

The `&&` operator returns `TRUE` if the cached 2D bounding box of geometry A intersects the 2D bounding box B, using float precision. This means that if B is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_Point(1,1) && ST_MakeBox2D(ST_Point(0,0), ST_Point(2,2)) AS overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.3 &&(box2df,geometry)

&&(box2df,geometry) — Returns TRUE if a 2D float precision bounding box (BOX2DF) intersects a geometry's (cached) 2D bounding box.

Synopsis

boolean **&&**(box2df A , geometry B);

설명

The && operator returns TRUE if the 2D bounding box A intersects the cached 2D bounding box of geometry B, using float precision. This means that if A is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(0,0), ST_Point(2,2)) && ST_Point(1,1) AS overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.4 &&(box2df,box2df)

&&(box2df,box2df) — Returns TRUE if two 2D float precision bounding boxes (BOX2DF) intersect each other.

Synopsis

boolean **&&**(box2df A , box2df B);

설명

The `&&` operator returns `TRUE` if two 2D bounding boxes A and B intersect each other, using float precision. This means that if A (or B) is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operator is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(0,0), ST_Point(2,2)) && ST_MakeBox2D(ST_Point(1,1), ST_Point ↩
    (3,3)) AS overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.5 &&&

&&& — A의 n차원 경계 상자와 B의 n차원 경계 상자가 교차하는 경우 `TRUE` 를 반환합니다.

Synopsis

boolean **&&&**(geometry A , geometry B);

설명

`&&&` 연산자는 도형 A의 n차원 경계 상&#xc 도형 B의 n차원 경계 상자가 교차하& 경우 `TRUE` 를 반환합니다.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

예시: 3󌰨원 라인스트링

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 &&& tbl2.column2 AS overlaps_3d,
                                    tbl1.column2 && tbl2.column2 AS overlaps_2d
FROM ( VALUES
        (1, 'LINESTRING Z(0 0 1, 3 3 2)'::geometry),
        (2, 'LINESTRING Z(1 2 0, 0 5 -1)'::geometry)) AS tbl1,
( VALUES
        (3, 'LINESTRING Z(1 2 1, 4 6 1)'::geometry)) AS tbl2;

 column1 | column1 | overlaps_3d | overlaps_2d
---------+---------+-------------+-------------
       1 |       3 | t           | t
       2 |       3 | f           | t
```

예시: 3DM 라인스트링

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 &&& tbl2.column2 AS overlaps_3zm,
                                    tbl1.column2 && tbl2.column2 AS overlaps_2d
FROM ( VALUES
        (1, 'LINESTRING M(0 0 1, 3 3 2)'::geometry),
        (2, 'LINESTRING M(1 2 0, 0 5 -1)'::geometry)) AS tbl1,
( VALUES
        (3, 'LINESTRING M(1 2 1, 4 6 1)'::geometry)) AS tbl2;

 column1 | column1 | overlaps_3zm | overlaps_2d
---------+---------+-------------+-------------
       1 |       3 | t           | t
       2 |       3 | f           | t
```

참고

&&

7.10.1.6 &&&(geometry,gidx)

&&&(geometry,gidx) — Returns `TRUE` if a geometry's (cached) n-D bounding box intersects a n-D float precision bounding box (GIDX).

Synopsis

boolean **&&&**(geometry A , gidx B);

설명

The `&&&` operator returns `TRUE` if the cached n-D bounding box of geometry A intersects the n-D bounding box B, using float precision. This means that if B is a (double precision) box3d, it will be internally converted to a float precision 3D bounding box (GIDX)

Note
This operator is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_MakePoint(1,1,1) &&& ST_3DMakeBox(ST_MakePoint(0,0,0), ST_MakePoint(2,2,2)) AS  ↩
    overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&&(gidx,geometry), &&&(gidx,gidx)

7.10.1.7 &&&(gidx,geometry)

&&&(gidx,geometry) — Returns `TRUE` if a n-D float precision bounding box (GIDX) intersects a geometry's (cached) n-D bounding box.

Synopsis

boolean **&&&**(gidx A , geometry B);

설명

The `&&&` operator returns `TRUE` if the n-D bounding box A intersects the cached n-D bounding box of geometry B, using float precision. This means that if A is a (double precision) box3d, it will be internally converted to a float precision 3D bounding box (GIDX)

Note
This operator is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_3DMakeBox(ST_MakePoint(0,0,0), ST_MakePoint(2,2,2)) &&& ST_MakePoint(1,1,1) AS  ↩
    overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&&(geometry,gidx), &&&(gidx,gidx)

7.10.1.8 &&&(gidx,gidx)

&&&(gidx,gidx) — Returns `TRUE` if two n-D float precision bounding boxes (GIDX) intersect each other.

Synopsis

boolean **&&&**(gidx A , gidx B);

설명

The `&&&` operator returns `TRUE` if two n-D bounding boxes A and B intersect each other, using float precision. This means that if A (or B) is a (double precision) box3d, it will be internally converted to a float precision 3D bounding box (GIDX)

Note
This operator is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_3DMakeBox(ST_MakePoint(0,0,0), ST_MakePoint(2,2,2)) &&& ST_3DMakeBox(ST_MakePoint ↩
    (1,1,1), ST_MakePoint(3,3,3)) AS overlaps;

 overlaps
----------
 t
(1 row)
```

참고

&&&(geometry,gidx), &&&(gidx,geometry)

7.10.1.9 &<

&< — A의 경계 상자가 B의 경계 상자와 겹치거나 그 왼쪽에 있을 경우 TRUE 를 반환합니다.

Synopsis

boolean **&<**(geometry A , geometry B);

설명

&< 연산자는 도형 A의 경계 상자가 도형 B의 경계 상자와 겹치거나 그 왼쪽에 있을 경우, 또는 더 정확히 말하자면 도형 B의 경계 상자와 겹그 오른쪽에 있지 않을 경우, TRUE 를 반환합니다.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 &< tbl2.column2 AS overleft
FROM
  ( VALUES
        (1, 'LINESTRING(1 2, 4 6)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING(0 0, 3 3)'::geometry),
        (3, 'LINESTRING(0 1, 0 5)'::geometry),
        (4, 'LINESTRING(6 0, 6 1)'::geometry)) AS tbl2;

 column1 | column1 | overleft
---------+---------+----------
       1 |       2 | f
       1 |       3 | f
       1 |       4 | t
(3 rows)
```

참고

&&, |&>, &>, &<|

7.10.1.10 &<|

&<| — A의 경계 상자가 B의 경계 상자와 겹치거나 그 아래에 있을 경우 `TRUE` 를 반환합니다.

Synopsis

boolean **&<|**(geometry A , geometry B);

설명

`&<|` 연산자는 도형 A의 경계 상자가 도형 B의 경계 상자와 겹치거나 그 아래에 있을 경우, 또는 더 정확히 말하자면 도형 B의 경계 상자와 겹위에 있지 않을 경우, `TRUE` 를 반환합니다.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 &<| tbl2.column2 AS overbelow
FROM
  ( VALUES
        (1, 'LINESTRING(6 0, 6 4)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING(0 0, 3 3)'::geometry),
        (3, 'LINESTRING(0 1, 0 5)'::geometry),
        (4, 'LINESTRING(1 2, 4 6)'::geometry)) AS tbl2;

 column1 | column1 | overbelow
---------+---------+-----------
           1 |       2 | f
           1 |       3 | t
           1 |       4 | t
(3 rows)
```

참고

&&, |&>, &>, &<

7.10.1.11 &>

&> — A의 경계 상자가 B의 경계 상자와 겹치거나 그 오른쪽에 있을 경우 TRUE 를 반환합니다.

Synopsis

boolean **&>**(geometry A , geometry B);

설명

&> 연산자는 도형 A의 경계 상자가 도형 B의 경계 상자와 겹치거나 그 오른쪽에 있을 경우, 또는 더 정확말하자면 도형 B의 경계 상자와 겹그 왼쪽에 있지 않을 경우, TRUE 를 반&#xd

> **Note**
> 이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 &> tbl2.column2 AS overright
FROM
  ( VALUES
        (1, 'LINESTRING(1 2, 4 6)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING(0 0, 3 3)'::geometry),
        (3, 'LINESTRING(0 1, 0 5)'::geometry),
        (4, 'LINESTRING(6 0, 6 1)'::geometry)) AS tbl2;

 column1 | column1 | overright
---------+---------+-----------
           1 |       2 | t
           1 |       3 | t
           1 |       4 | f
(3 rows)
```

참고

&&, |&>, &<|, &<

7.10.1.12 <<

<< — A의 경계 상자가 오로지 B의 경계 상자 왼쪽에 있을 경우에만 TRUE 를 반환합니다.

Synopsis

boolean **<<**(geometry A , geometry B);

설명

<< 연산자는 도형 A의 경계 상자가 오로지 도형 B의 경계 상자 왼쪽에 있을 경우에만 TRUE 를 반환합니다.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 << tbl2.column2 AS left
FROM
  ( VALUES
        (1, 'LINESTRING (1 2, 1 5)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (0 0, 4 3)'::geometry),
        (3, 'LINESTRING (6 0, 6 5)'::geometry),
        (4, 'LINESTRING (2 2, 5 6)'::geometry)) AS tbl2;

 column1 | column1 | left
---------+---------+------
           1 |       2 | f
           1 |       3 | t
           1 |       4 | t
(3 rows)
```

참고

>>, |>>, <<|

7.10.1.13 <<|

<<| — A의 경계 상자가 오로지 B의 경계 상자 아래에 있을 경우에만 TRUE 를 반환합니다.

Synopsis

boolean **<<|**(geometry A , geometry B);

설명

<< | 연산자는 도형 A의 경계 상자가 오로지 도형 B의 경계 상자 아래에 있을 경우에만 TRUE 를 반환합니다.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 <<| tbl2.column2 AS below
FROM
  ( VALUES
        (1, 'LINESTRING (0 0, 4 3)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (1 4, 1 7)'::geometry),
        (3, 'LINESTRING (6 1, 6 5)'::geometry),
        (4, 'LINESTRING (2 3, 5 6)'::geometry)) AS tbl2;

 column1 | column1 | below
---------+---------+-------
           1 |       2 | t
           1 |       3 | f
           1 |       4 | f
(3 rows)
```

참고

<<, >>, |>>

7.10.1.14 =

= — Returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B.

Synopsis

boolean =(geometry A , geometry B);
boolean =(geography A , geography B);

설명

The = operator returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B. PostgreSQL uses the =, <, and > operators defined for geometries to perform internal orderings and comparison of geometries (ie. in a GROUP BY or ORDER BY clause).

Note
Only geometry/geography that are exactly equal in all respects, with the same coordinates, in the same order, are considered equal by this operator. For "spatial equality", that ignores things like coordinate order, and can detect features that cover the same spatial area with different representations, use ST_OrderingEquals or ST_Equals

Caution
This operand will NOT make use of any indexes that may be available on the geometries. For an index assisted exact equality test, combine = with &&.

Changed: 2.4.0, in prior versions this was bounding box equality not a geometric equality. If you need bounding box equality, use ~= instead.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT 'LINESTRING(0 0, 0 1, 1 0)'::geometry = 'LINESTRING(1 1, 0 0)'::geometry;
 ?column?
----------
 f
(1 row)

SELECT ST_AsText(column1)
FROM ( VALUES
        ('LINESTRING(0 0, 1 1)'::geometry),
        ('LINESTRING(1 1, 0 0)'::geometry)) AS foo;
          st_astext
---------------------
 LINESTRING(0 0,1 1)
 LINESTRING(1 1,0 0)
(2 rows)

-- Note: the GROUP BY uses the "=" to compare for geometry equivalency.
SELECT ST_AsText(column1)
FROM ( VALUES
        ('LINESTRING(0 0, 1 1)'::geometry),
        ('LINESTRING(1 1, 0 0)'::geometry)) AS foo
GROUP BY column1;
      st_astext
---------------------
 LINESTRING(0 0,1 1)
 LINESTRING(1 1,0 0)
(2 rows)

-- In versions prior to 2.0, this used to return true --
 SELECT ST_GeomFromText('POINT(1707296.37 4820536.77)') =
        ST_GeomFromText('POINT(1707296.27 4820536.87)') As pt_intersect;

--pt_intersect --
f
```

참고

ST_Equals, ST_OrderingEquals, ~=

7.10.1.15 >>

>> — A의 경계 상자가 오로지 B의 경계 상자 오른쪽에 있을 경우에만 TRUE 를 반환합니다.

Synopsis

boolean **>>**(geometry A , geometry B);

설명

>> 연산자는 도형 A의 경계 상자가 오로지 도형 B의 경계 상자 오른쪽있을 경우에만 TRUE 를 반환합니다.

Note

이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 >> tbl2.column2 AS right
FROM
  ( VALUES
        (1, 'LINESTRING (2 3, 5 6)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (1 4, 1 7)'::geometry),
        (3, 'LINESTRING (6 1, 6 5)'::geometry),
        (4, 'LINESTRING (0 0, 4 3)'::geometry)) AS tbl2;

 column1 | column1 | right
---------+---------+-------
           1 |       2 | t
           1 |       3 | f
           1 |       4 | f
(3 rows)
```

참고

<<, |>>, <<|

7.10.1.16 @

@ — B의 경계 상자가 A의 경계 상자를 담고 있을 경우 TRUE 를 반환합니다.

Synopsis

boolean @(geometry A , geometry B);

설명

@ 연산자는 도형 B의 경계 상자가 도형 A의 경계 상자를 완전히 담고 있을 경우 TRUE 를 반환합니다.

Note

이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 @ tbl2.column2 AS contained
FROM
  ( VALUES
        (1, 'LINESTRING (1 1, 3 3)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (0 0, 4 4)'::geometry),
        (3, 'LINESTRING (2 2, 4 4)'::geometry),
        (4, 'LINESTRING (1 1, 3 3)'::geometry)) AS tbl2;

 column1 | column1 | contained
---------+---------+-----------
           1 |       2 | t
           1 |       3 | f
           1 |       4 | t
(3 rows)
```

참고

~, &&

7.10.1.17 @(geometry,box2df)

@(geometry,box2df) — Returns `TRUE` if a geometry's 2D bounding box is contained into a 2D float precision bounding box (BOX2DF).

Synopsis

boolean @(geometry A , box2df B);

설명

The `@` operator returns `TRUE` if the A geometry's 2D bounding box is contained the 2D bounding box B, using float precision. This means that if B is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_Buffer(ST_GeomFromText('POINT(2 2)'), 1) @ ST_MakeBox2D(ST_Point(0,0), ST_Point ↩
    (5,5)) AS is_contained;

 is_contained
--------------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.18 @(box2df,geometry)

@(box2df,geometry) — Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into a geometry's 2D bounding box.

Synopsis

boolean @(box2df A , geometry B);

설명

The @ operator returns TRUE if the 2D bounding box A is contained into the B geometry's 2D bounding box, using float precision. This means that if B is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(2,2), ST_Point(3,3)) @ ST_Buffer(ST_GeomFromText('POINT(1 1)') ↩
    , 10) AS is_contained;

 is_contained
--------------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,box2df)

7.10.1.19 @(box2df,box2df)

@(box2df,box2df) — Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into another 2D float precision bounding box.

Synopsis

boolean @(box2df A , box2df B);

설명

The `@` operator returns `TRUE` if the 2D bounding box A is contained into the 2D bounding box B, using float precision. This means that if A (or B) is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(2,2), ST_Point(3,3)) @ ST_MakeBox2D(ST_Point(0,0), ST_Point ↩
    (5,5)) AS is_contained;

 is_contained
--------------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry)

7.10.1.20 |&>

|&> — A의 경계 상자가 B의 경계 상자와 겹치거나 그 위에 있을 경우 `TRUE` 를 반환합니다.

Synopsis

boolean **|&>**(geometry A , geometry B);

설명

`|&>` 연산자는 도형 A의 경계 상자가 도형 B의 경계 상자와 겹치거나 그 위에 있을 경우, 또는 더 정확히 말도형 B의 경계 상자와 겹치거나 아있지 않을 경우, `TRUE` 를 반환합니다.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 |&> tbl2.column2 AS overabove
FROM
  ( VALUES
        (1, 'LINESTRING(6 0, 6 4)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING(0 0, 3 3)'::geometry),
        (3, 'LINESTRING(0 1, 0 5)'::geometry),
        (4, 'LINESTRING(1 2, 4 6)'::geometry)) AS tbl2;

 column1 | column1 | overabove
---------+---------+-----------
       1 |       2 | t
       1 |       3 | f
       1 |       4 | f
(3 rows)
```

참고

&&, &>, &<|, &<

7.10.1.21 |>>

|>> — A의 경계 상자가 오로지 B의 경계 상자 위에 있을 경우에만 TRUE 를 반&#xd6

Synopsis

boolean **|>>**(geometry A , geometry B);

설명

The |>> operator returns TRUE if the bounding box of geometry A is strictly above the bounding box of geometry B.

Note
이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 |>> tbl2.column2 AS above
FROM
  ( VALUES
        (1, 'LINESTRING (1 4, 1 7)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (0 0, 4 2)'::geometry),
        (3, 'LINESTRING (6 1, 6 5)'::geometry),
        (4, 'LINESTRING (2 3, 5 6)'::geometry)) AS tbl2;

 column1 | column1 | above
---------+---------+-------
       1 |       2 | t
```

```
           1 |        3 | f
           1 |        4 | f
(3 rows)
```

참고

<<, >>, <<|

7.10.1.22 ~

~ — A의 경계 상자가 B의 경계 상자를 담고 있을 경우 TRUE 를 반환합니다.

Synopsis

boolean ~(geometry A , geometry B);

설명

~ 연산자는 도형 A의 경계 상자가 도형 B의 경계 상자를 완전히 담고 있을 경우 TRUE 를 반환합니다.

Note

이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

예시

```
SELECT tbl1.column1, tbl2.column1, tbl1.column2 ~ tbl2.column2 AS contains
FROM
  ( VALUES
        (1, 'LINESTRING (0 0, 3 3)'::geometry)) AS tbl1,
  ( VALUES
        (2, 'LINESTRING (0 0, 4 4)'::geometry),
        (3, 'LINESTRING (1 1, 2 2)'::geometry),
        (4, 'LINESTRING (0 0, 3 3)'::geometry)) AS tbl2;

 column1 | column1 | contains
---------+---------+----------
           1 |        2 | f
           1 |        3 | t
           1 |        4 | t
(3 rows)
```

참고

@, &&

7.10.1.23 ~(geometry,box2df)

~(geometry,box2df) — Returns TRUE if a geometry's 2D bonding box contains a 2D float precision bounding box (GIDX).

Synopsis

boolean ~(geometry A , box2df B);

설명

The ~ operator returns TRUE if the 2D bounding box of a geometry A contains the 2D bounding box B, using float precision. This means that if B is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_Buffer(ST_GeomFromText('POINT(1 1)'), 10) ~ ST_MakeBox2D(ST_Point(0,0), ST_Point ↩
    (2,2)) AS contains;

 contains
----------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(box2df,geometry), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.24 ~(box2df,geometry)

~(box2df,geometry) — Returns TRUE if a 2D float precision bounding box (BOX2DF) contains a geometry's 2D bonding box.

Synopsis

boolean ~(box2df A , geometry B);

설명

The ~ operator returns TRUE if the 2D bounding box A contains the B geometry's bounding box, using float precision. This means that if A is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(0,0), ST_Point(5,5)) ~ ST_Buffer(ST_GeomFromText('POINT(2 2)') ↩
    , 1) AS contains;

 contains
----------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,box2df), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.25 ~(box2df,box2df)

~(box2df,box2df) — Returns `TRUE` if a 2D float precision bounding box (BOX2DF) contains another 2D float precision bounding box (BOX2DF).

Synopsis

boolean ~(box2df A , box2df B);

설명

The ~ operator returns `TRUE` if the 2D bounding box A contains the 2D bounding box B, using float precision. This means that if A is a (double precision) box2d, it will be internally converted to a float precision 2D bounding box (BOX2DF)

Note
This operand is intended to be used internally by BRIN indexes, more than by users.

Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

예시

```
SELECT ST_MakeBox2D(ST_Point(0,0), ST_Point(5,5)) ~ ST_MakeBox2D(ST_Point(2,2), ST_Point ↩
    (3,3)) AS contains;

 contains
----------
 t
(1 row)
```

참고

&&(geometry,box2df), &&(box2df,geometry), &&(box2df,box2df), ~(geometry,box2df), ~(box2df,geometry), @(geometry,box2df), @(box2df,geometry), @(box2df,box2df)

7.10.1.26 ~=

~= — A의 경계 상자와 B의 경계 상자가 동일할 경우 TRUE 를 반환합니다.

Synopsis

boolean ~=(geometry A , geometry B);

설명

~= 연산자는 도형/지리형 A의 경계 상자와 도형/지리형 B의 경계 상자동일할 경우 TRUE 를 반환합니다.

> **Note**
> 이 피연산자(operand)는 도형에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

1.5.0 버전에서 습성이 변경됐습니&#xb2e4

This function supports Polyhedral surfaces.

> **Warning**
> This operator has changed behavior in PostGIS 1.5 from testing for actual geometric equality to only checking for bounding box equality. To complicate things it also depends on if you have done a hard or soft upgrade which behavior your database has. To find out which behavior your database has you can run the query below. To check for true equality use ST_OrderingEquals or ST_Equals.

예시

```
select 'LINESTRING(0 0, 1 1)'::geometry ~= 'LINESTRING(0 1, 1 0)'::geometry as equality;
 equality   |
------------------+
          t     |
```

참고

ST_Equals, ST_OrderingEquals, =

7.10.2 연산자(operator)

7.10.2.1 <->

<-> — A와 B 사이의 2차원 거리를 반환합&

Synopsis

double precision **<->**(geometry A , geometry B);
double precision **<->**(geography A , geography B);

설명

<-> 연산자는 두 도형 사이의 2차원 거리를 반환합니다. "ORDER BY" 절 안에&#xc11 이용하면 인덱스 지원형(index-assisted) 최&#xadf neighbor) 결과 집합을 출력합니다. PostgreSQL 9.5 미만 버전은 경계 상자의 중심점 사이의 거리만 출력하고, 9.5 이상 버 도형 사이의 진정한 거리, 그리고 지리형 사이의 구면 거리(distance sphere)를 산출하는 진정한 KNN 거리 탐색을 실행합니다.

Note

이 피연산자(operand)는 도형에 대해 이용할 수 있을지도 모르는 2차원 GiST 인덱스를 활용할 것입니다. 연산자가 ORDER BY 절 안에 있을 때만 공간 인덱스를 쓴다는 점에서 공간 인덱스를 이용하는 다른 연산자들과는 다릅니다.

Note

도형 가운데 하나가, 예를 들어 a.geom이 아니라 'SRID=3005;POINT(1011102 450541)'::geometry와 같이, (하위 쿼리/CTE(common table expression) 안에 있지 않은) 상수일 경우에만 인덱스의 효과가 나타납니다.

실제 사용례를 살펴보려면 OpenGeo workshop: Nearest-Neighbour Searching 을 참조하십시오.

개선 사항: 2.2.0 버전 -- PostgreSQL 9.5 이상 버전&#xc5d0 도형 및 지리형에 대해 진정한 KNN("K nearest neighbor") 습성을 도입했습니다. 지리&#x KNN이 타원체가 아니라 구체를 기&#xbc1 한다는 점에 주의하십시오. PostgreSQL 9.4 이하 버전에서 지리형을 쓸 수 있&# 하지만, 중심점 상자만 지원합니&#x

변경 사항: 2.2.0 버전 -- PostgreSQL 9.5 버전 사용&#xc790 경우, 예전의 하이브리드 문법(Hybrid syntax)이 느릴 수도 있기 때문에 PostGIS 2.2 이& PostgreSQL 9.5 이상 버전에서만 사용자 코&#xb4d 실행하는 경우 이 꼼수를 제거하&#x 편이 좋을 수도 있습니다. 다음 예& 참조하세요.

2.0.0 버전부터 사용할 수 있습니다. 약한 KNN이 실제 거리 대신 도형 중&#xc2

거리에 기반한 최근접 탐색을 제&#x
포인트의 경우 정확한 결과를 출&#x
다른 모든 유형에 대해서는 부정&#
결과를 냅니다. PostgreSQL 9.1 이상 버전에&#xc11
이용할 수 있습니다.

예시

```
SELECT ST_Distance(geom, 'SRID=3005;POINT(1011102 450541)'::geometry) as d,edabbr, vaabbr
FROM va2005
ORDER BY d limit 10;

        d         | edabbr | vaabbr
------------------+--------+--------
                0 | ALQ    | 128
 5541.57712511724 | ALQ    | 129A
 5579.67450712005 | ALQ    | 001
  6083.4207708641 | ALQ    | 131
  7691.2205404848 | ALQ    | 003
 7900.75451037313 | ALQ    | 122
 8694.20710669982 | ALQ    | 129B
 9564.24289057111 | ALQ    | 130
  12089.665931705 | ALQ    | 127
 18472.5531479404 | ALQ    | 002
(10 rows)
```

그리고 KNN의 가공되지 않은 답은:

```
SELECT st_distance(geom, 'SRID=3005;POINT(1011102 450541)'::geometry) as d,edabbr, vaabbr
FROM va2005
ORDER BY geom <-> 'SRID=3005;POINT(1011102 450541)'::geometry limit 10;

        d         | edabbr | vaabbr
------------------+--------+--------
                0 | ALQ    | 128
 5541.57712511724 | ALQ    | 129A
 5579.67450712005 | ALQ    | 001
  6083.4207708641 | ALQ    | 131
  7691.2205404848 | ALQ    | 003
 7900.75451037313 | ALQ    | 122
 8694.20710669982 | ALQ    | 129B
 9564.24289057111 | ALQ    | 130
  12089.665931705 | ALQ    | 127
 18472.5531479404 | ALQ    | 002
(10 rows)
```

사용자가 이 두 쿼리에 대해 "EXPLAIN AN-
ALYZE"를 실행하면 두 번째 쿼리의 성&#x
향상되는 것을 볼 수 있을 겁니다.

PostgreSQL 9.5 미만 버전을 실행하는 사용&#xc79
경우, 실제 최근접 거리를 찾으려&#x
하이브리드 쿼리를 이용하십시&#xc
먼저 인덱스 지원형 KNN을 이용한
CTE(common table expression) 쿼리를 실행한 다음, 올바&#
정렬 순서를 얻기 위해 정확한 쿼&#x
실행합니다:

```
WITH index_query AS (
  SELECT ST_Distance(geom, 'SRID=3005;POINT(1011102 450541)'::geometry) as d,edabbr, vaabbr
```

```
        FROM va2005
  ORDER BY geom <-> 'SRID=3005;POINT(1011102 450541)'::geometry LIMIT 100)
  SELECT *
        FROM index_query
  ORDER BY d limit 10;

        d          | edabbr | vaabbr
-------------------+--------+--------
                0  | ALQ    | 128
 5541.57712511724  | ALQ    | 129A
 5579.67450712005  | ALQ    | 001
  6083.4207708641  | ALQ    | 131
  7691.2205404848  | ALQ    | 003
 7900.75451037313  | ALQ    | 122
 8694.20710669982  | ALQ    | 129B
 9564.24289057111  | ALQ    | 130
  12089.665931705  | ALQ    | 127
 18472.5531479404  | ALQ    | 002
(10 rows)
```

참고

ST_DWithin, ST_Distance, <#>

7.10.2.2 |=|

|=| — A와 B 사이의 최근접점(closest point of approach)을 잇는 궤도(trajectory)의 거리를 반환합니&#

Synopsis

double precision |=|(geometry A , geometry B);

설명

| = | 연산자는 두 궤도(ST_IsValidTrajectory 참조) 사&#xc 3차원 거리를 반환합니다. 이 연산& ST_DistanceCPA 함수와 동일하지만, 연산자&#xc 때문에 (PostgreSQL 9.5.0 이상 버전이 필요한) N차원 인덱스를 이용하는 최근접(ne neightbor) 탐색을 실행하는 데 사용할 수 있습니다.

Note

이 피연산자(operand)는 도형에 대해 이용할 수 있을지도 모르는 N차원 GiST 인덱스를 활용할 것입니다. 연산자가 ORDER BY 절 안에 있을 때만 공간 인덱스를 쓴다는 점에서 공간 인덱스를 이용하는 다른 연산자들과는 다릅니다.

Note

도형 가운데 하나가, 예를 들어 a.geom이 아니라 'SRID=3005;LINESTRINGM(0 0 0,0 0 1)'::geometry와 같이, (하위 쿼리/CTE(common table expression) 안에 있지 않은) 상수일 경우에만 인덱스의 효과가 나타납니다.

2.2.0 버전부터 사용할 수 있습니다. PostgreSQL 9.5 이상 버전에서만 인덱스 지&#xc6d supported)을 사용할 수 있습니다.

예시

```
-- &#xae00;&#xc790; &#xadf8;&#xb300;&#xb85c;&#xc758; &#xcffc;&#xb9ac; ↩
    &#xada4;&#xb3c4;&#xb97c; psql &#xbcc0;&#xc218;&#xb85c; ↩
    &#xc800;&#xc7a5;&#xd569;&#xb2c8;&#xb2e4;...
\set qt 'ST_AddMeasure(ST_MakeLine(ST_MakePointM(-350,300,0),ST_MakePointM(-410,490,0)) ↩
    ,10,20)'
-- &#xcffc;&#xb9ac;&#xb97c; &#xc2e4;&#xd589;&#xd569;&#xb2c8;&#xb2e4;!
SELECT track_id, dist FROM (
  SELECT track_id, ST_DistanceCPA(tr,:qt) dist
  FROM trajectories
  ORDER BY tr |=| :qt
  LIMIT 5
) foo;
 track_id        dist
----------+------------------
      395 | 0.576496831518066
      380 |  5.06797130410151
      390 |  7.72262293958322
      385 |   9.8004461358071
      405 |  10.9534397988433
(5 rows)
```

참고

ST_DistanceCPA, ST_ClosestPointOfApproach, ST_IsValidTrajectory

7.10.2.3 <#>

<#> — A와 B의 경계 상자 사이의 2차원 거리를 반환합니다.

Synopsis

double precision **<#>**(geometry A , geometry B);

설명

<#> 연산자는 두 부동소수점(floating point) 경&#x 상자 사이의 거리를 반환합니다. 공간 인덱스(PostgreSQL 9.1 이상 버전 필요)&#xb8 경계 상자들을 읽어 올 수도 있습&# 최근접 **근사치** 거리의 Ȝ서를 정&#x 데 유용합니다.

Note

이 피연산자(operand)는 도형에 대해 이용할 수 있을지도 모르는 어떤 인덱스라도 활용할 것입니다. 연산자가 ORDER BY 절 안에 있을 때만 공간 인덱스를 쓴다는 점에서 공간 인덱스를 이용하는 다른 연산자들과는 다릅니다.

Note

도형 가운데 하나가, 예를 들어 g1.geom <#>가 아니라 ORDER BY (ST_GeomFromText('POINT(1 2)') <#> geom)과 같이, 상수일 경우에만 인덱스의 효과가 나타납니다.

2.0.0 버전부터 사용할 수 있습니다. PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수 있&

예시

```
SELECT *
FROM (
SELECT b.tlid, b.mtfcc,
        b.geom <#
> ST_GeomFromText('LINESTRING(746149 2948672,745954 2948576,
                745787 2948499,745740 2948468,745712 2948438,
                745690 2948384,745677 2948319)',2249) As b_dist,
                ST_Distance(b.geom, ST_GeomFromText('LINESTRING(746149 2948672,745954  ↩
                    2948576,
                745787 2948499,745740 2948468,745712 2948438,
                745690 2948384,745677 2948319)',2249)) As act_dist
    FROM bos_roads As b
    ORDER BY b_dist, b.tlid
    LIMIT 100) As foo
    ORDER BY act_dist, tlid LIMIT 10;

   tlid    | mtfcc |      b_dist      |     act_dist
-----------+-------+------------------+------------------
  85732027 | S1400 |                0 |                0
  85732029 | S1400 |                0 |                0
  85732031 | S1400 |                0 |                0
  85734335 | S1400 |                0 |                0
  85736037 | S1400 |                0 |                0
 624683742 | S1400 |                0 | 128.528874268666
  85719343 | S1400 | 260.839270432962 | 260.839270432962
  85741826 | S1400 | 164.759294123275 | 260.839270432962
  85732032 | S1400 |           277.75 | 311.830282365264
  85735592 | S1400 |           222.25 | 311.830282365264
(10 rows)
```

참고

ST_DWithin, ST_Distance, <->

7.10.2.4 <<->>

<<->> — A 경계 상자와 B의 경계 상자의 중심점 사이의 N󌰨원 거리를 반환&

Synopsis

double precision **<<->>**(geometry A , geometry B);

설명

<<->> 연산자는 두 도형의 경계 상자&#xc
중심점 사이의 N󌰨 (유클리드) 거리
반환합니다. 최근접 **근사치** 거리&#
순서를 정렬하는 데 유용합니다.

Note

이 피연산자(operand)는 도형에 대해 이용할 수 있을지도 모르는 N󌰨원 GiST 인덱스를 활용할 것입니다. 연산자가 ORDER BY 절 안에 있을 때만 공간 인덱스를 쓴다는 점에서 공간 인덱스를 이용하는 다른 연산자들과는 다릅니다.

Note

도형 가운데 하나가, 예를 들어 a.geom이 아니라 'SRID=3005;POINT(1011102 450541)'::geometry와 같이, (하위 쿼리/CTE(common table expression) 안에 있지 않은) 상수일 경우에만 인덱스의 효과가 나타납니다.

2.2.0 버전부터 사용할 수 있습니다. PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수 있&

참고

<<#>>, <->

7.10.2.5 <<#>>

<<#>> — A와 B의 경계 상자 사이의 N󌰨원 거리를 반환합니다.

Synopsis

double precision **<<#>>**(geometry A , geometry B);

설명

<#> 연산자는 두 부동소수점(floating point) 경&#x
상자 사이의 거리를 반환합니다.
공간 인덱스(PostgreSQL 9.1 이상 버전 필요)&#xb8
경계 상자들을 읽어 올 수도 있습&#
최근접 **근사치** 거리의 순서를 정&#x
데 유용합니다.

Note

이 피연산자(operand)는 도형에 대해
이용할 수 있을지도 모르는
어떤 인덱스라도 활용할
것입니다. 연산자가 ORDER BY 절
안에 있을 때만 공간 인덱스를
쓴다는 점에서 공간 인덱스를
이용하는 다른 연산자들과는
다릅니다.

Note

도형 가운데 하나가, 예를 들어
g1.geom <<#>>가 아니라 ORDER BY (ST_GeomFromText('POINT(1 2)')
<<#>> geom)과 같이, 상수일 경우에만
인덱스의 효과가 나타납니다.

2.2.0 버전부터 사용할 수 있습니다.
PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수 있&

참고

<<->>, <#>

7.11 Spatial Relationships

7.11.1 Topological Relationships

7.11.1.1 ST_3DIntersects

ST_3DIntersects — Tests if two geometries spatially intersect in 3D - only for points, linestrings, polygons, polyhedral surface (area)

Synopsis

boolean **ST_3DIntersects**(geometry geomA , geometry geomB);

Description

Overlaps, Touches, Within all imply spatial intersection. If any of the aforementioned returns true, then the geometries also spatially intersect. Disjoint implies false for spatial intersection.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

Changed: 3.0.0 SFCGAL backend removed, GEOS backend supports TINs.

Availability: 2.0.0

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

Geometry Examples

```
SELECT ST_3DIntersects(pt, line), ST_Intersects(pt, line)
  FROM (SELECT 'POINT(0 0 2)'::geometry As pt, 'LINESTRING (0 0 1, 0 2 3)'::geometry As  ↩
      line) As foo;
 st_3dintersects | st_intersects
-----------------+---------------
 f               | t
(1 row)
```

TIN Examples

```
SELECT ST_3DIntersects('TIN(((0 0 0,1 0 0,0 1 0,0 0 0)))'::geometry, 'POINT(.1 .1 0)':: ↩
    geometry);
 st_3dintersects
-----------------
 t
```

See Also

ST_Intersects

7.11.1.2 ST_Contains

ST_Contains — Tests if every point of B lies in A, and their interiors have a point in common

Synopsis

boolean **ST_Contains**(geometry geomA, geometry geomB);

Description

Returns TRUE if geometry A contains geometry B. A contains B if and only if all points of B lie inside (i.e. in the interior or boundary of) A (or equivalently, no points of B lie in the exterior of A), and the interiors of A and B have at least one point in common.

In mathematical terms: $ST_Contains(A, B) \Leftrightarrow (A \bigcap B = B) \wedge (Int(A) \bigcap Int(B) \neq \varnothing)$

The contains relationship is reflexive: every geometry contains itself. (In contrast, in the ST_ContainsProperly predicate a geometry does *not* properly contain itself.) The relationship is antisymmetric: if `ST_Contains(A,B) = true` and `ST_Contains(B,A) = true`, then the two geometries must be topologically equal (`ST_Equals(A,B) = true`).

ST_Contains is the converse of ST_Within. So, `ST_Contains(A,B) = ST_Within(B,A)`.

Note
Because the interiors must have a common point, a subtlety of the definition is that polygons and lines do *not* contain lines and points lying fully in their boundary. For further details see Subtleties of OGC Covers, Contains, Within. The ST_Covers predicate provides a more inclusive relationship.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_Contains`.

Performed by the GEOS module

Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon.

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Important
Do not use this function with invalid geometries. You will get unexpected results.

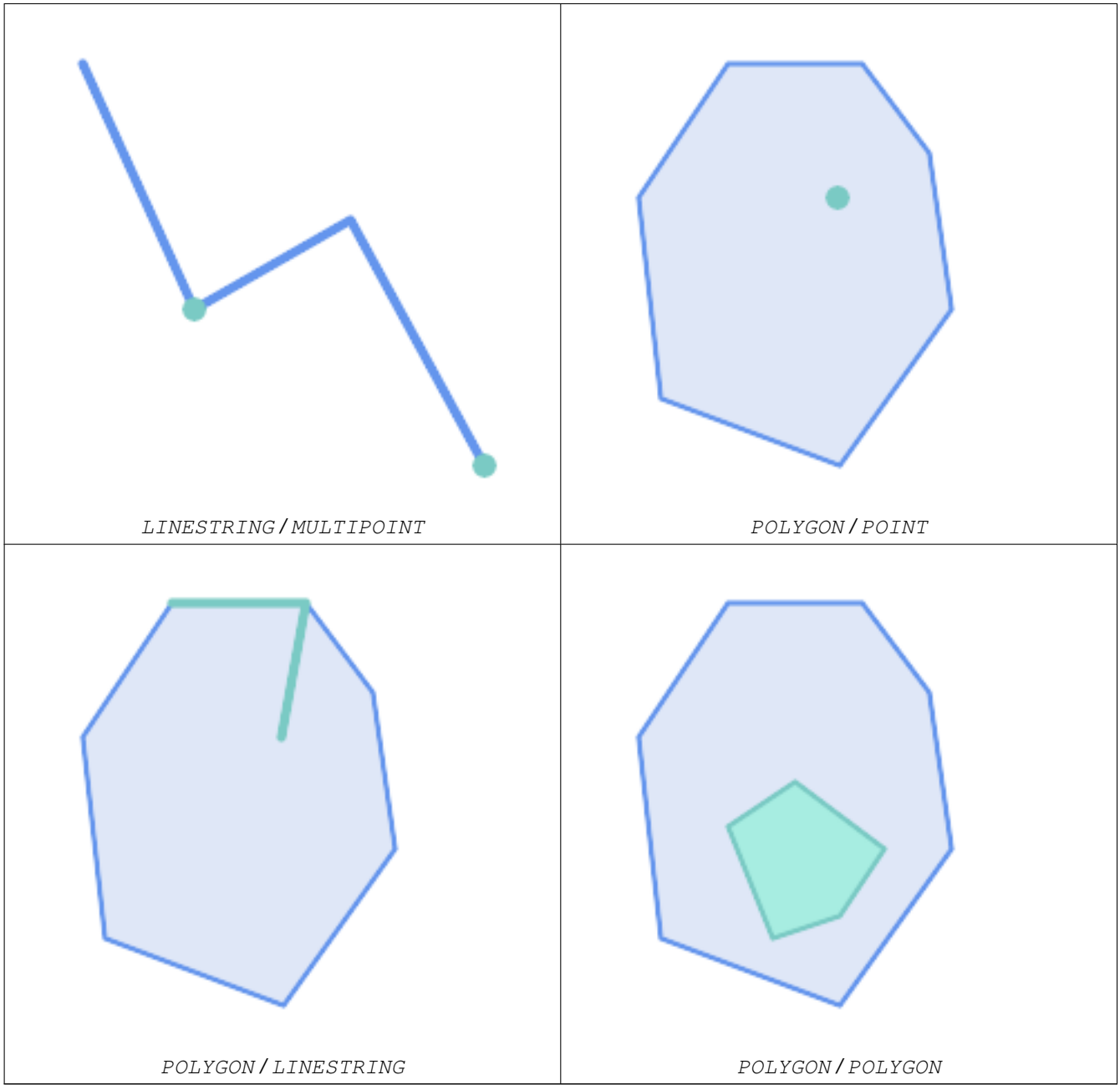
NOTE: this is the "allowable" version that returns a boolean, not an integer.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 - same as within(geometry B, geometry A)

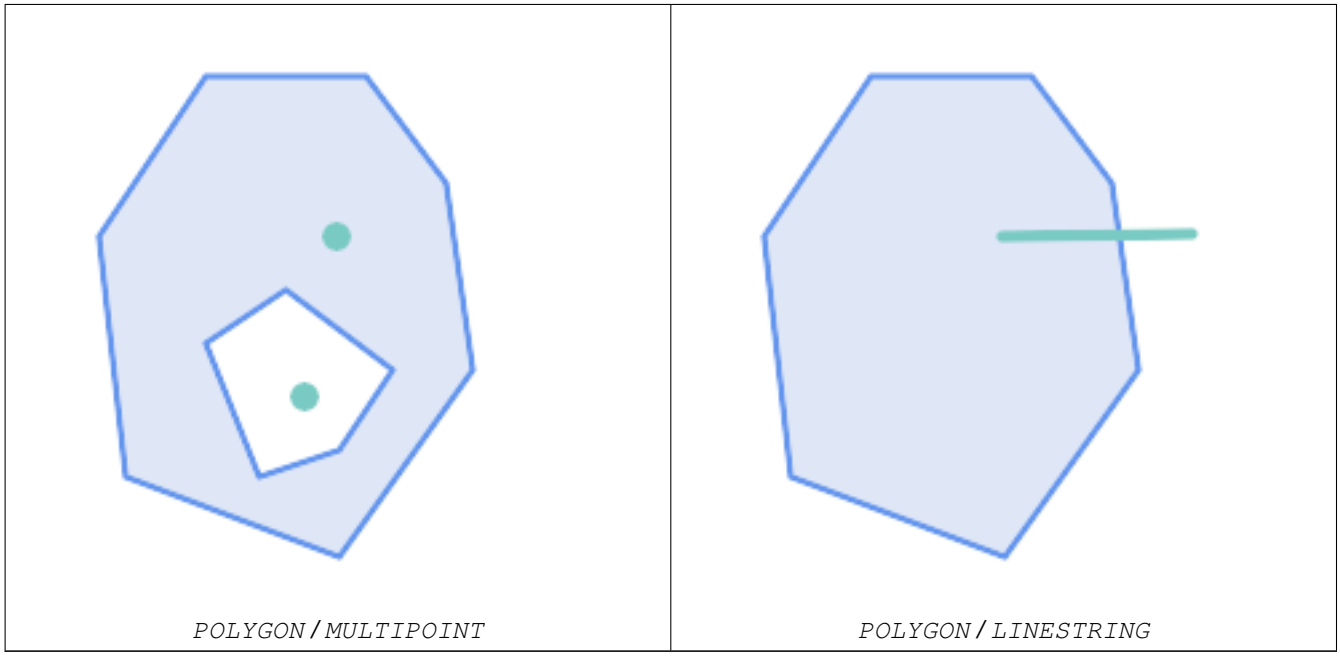
This method implements the SQL/MM specification. SQL-MM 3: 5.1.31

Examples

`ST_Contains` returns `TRUE` in the following situations:



`ST_Contains` returns `FALSE` in the following situations:



POLYGON/MULTIPOINT | *POLYGON/LINESTRING*

Due to the interior intersection condition `ST_Contains` returns `FALSE` in the following situations (whereas `ST_Covers` returns `TRUE`):

LINESTRING/POINT | *POLYGON/LINESTRING*

```
-- A circle within a circle
SELECT ST_Contains(smallc, bigc) As smallcontainsbig,
     ST_Contains(bigc,smallc) As bigcontainssmall,
     ST_Contains(bigc, ST_Union(smallc, bigc)) as bigcontainsunion,
     ST_Equals(bigc, ST_Union(smallc, bigc)) as bigisunion,
     ST_Covers(bigc, ST_ExteriorRing(bigc)) As bigcoversexterior,
     ST_Contains(bigc, ST_ExteriorRing(bigc)) As bigcontainsexterior
FROM (SELECT ST_Buffer(ST_GeomFromText('POINT(1 2)'), 10) As smallc,
       ST_Buffer(ST_GeomFromText('POINT(1 2)'), 20) As bigc) As foo;
```

```
-- Result
  smallcontainsbig | bigcontainssmall | bigcontainsunion | bigisunion | bigcoversexterior | ↩
      bigcontainsexterior
-----------------+------------------+------------------+------------+-------------------+----------

 f                | t                | t                | t          | t         | f

-- Example demonstrating difference between contains and contains properly
SELECT ST_GeometryType(geomA) As geomtype, ST_Contains(geomA,geomA) AS acontainsa,  ↩
    ST_ContainsProperly(geomA, geomA) AS acontainspropa,
   ST_Contains(geomA, ST_Boundary(geomA)) As acontainsba, ST_ContainsProperly(geomA,  ↩
       ST_Boundary(geomA)) As acontainspropba
FROM (VALUES ( ST_Buffer(ST_Point(1,1), 5,1) ),
       ( ST_MakeLine(ST_Point(1,1), ST_Point(-1,-1) ) ),
       ( ST_Point(1,1) )
    ) As foo(geomA);

  geomtype    | acontainsa | acontainspropa | acontainsba | acontainspropba
--------------+------------+----------------+-------------+-----------------
ST_Polygon    | t          | f              | f           | f
ST_LineString | t          | f              | f           | f
ST_Point      | t          | t              | f           | f
```

See Also

ST_Boundary, ST_ContainsProperly, ST_Covers, ST_CoveredBy, ST_Equals, ST_Within

7.11.1.3 ST_ContainsProperly

ST_ContainsProperly — Tests if every point of B lies in the interior of A

Synopsis

boolean **ST_ContainsProperly**(geometry geomA, geometry geomB);

Description

Returns `true` if every point of B lies in the interior of A (or equivalently, no point of B lies in the the boundary or exterior of A).

In mathematical terms: *ST_ContainsProperly(A, B)* $\Leftrightarrow$ *Int(A)* $\bigcap$ *B = B*

A contains B properly if the DE-9IM Intersection Matrix for the two geometries matches [T**FF*FF*]

A does not properly contain itself, but does contain itself.

A use for this predicate is computing the intersections of a set of geometries with a large polygonal geometry. Since intersection is a fairly slow operation, it can be more efficient to use containsProperly to filter out test geometries which lie fully inside the area. In these cases the intersection is known a priori to be exactly the original test geometry.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_ContainsProperly`.

Note
The advantage of this predicate over ST_Contains and ST_Intersects is that it can be computed more efficiently, with no need to compute topology at individual points.

Performed by the GEOS module.

Availability: 1.4.0

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Important
Do not use this function with invalid geometries. You will get unexpected results.

Examples

```
--a circle within a circle
  SELECT ST_ContainsProperly(smallc, bigc) As smallcontainspropbig,
  ST_ContainsProperly(bigc,smallc) As bigcontainspropsmall,
  ST_ContainsProperly(bigc, ST_Union(smallc, bigc)) as bigcontainspropunion,
  ST_Equals(bigc, ST_Union(smallc, bigc)) as bigisunion,
  ST_Covers(bigc, ST_ExteriorRing(bigc)) As bigcoversexterior,
  ST_ContainsProperly(bigc, ST_ExteriorRing(bigc)) As bigcontainsexterior
  FROM (SELECT ST_Buffer(ST_GeomFromText('POINT(1 2)'), 10) As smallc,
  ST_Buffer(ST_GeomFromText('POINT(1 2)'), 20) As bigc) As foo;
  --Result
  smallcontainspropbig | bigcontainspropsmall | bigcontainspropunion | bigisunion |  ↩
      bigcoversexterior | bigcontainsexterior
------------------+------------------+------------------+------------+------------------+----------

 f                    | t                   | f                    | t          | t  ↩
                     | f

 --example demonstrating difference between contains and contains properly
 SELECT ST_GeometryType(geomA) As geomtype, ST_Contains(geomA,geomA) AS acontainsa,  ↩
     ST_ContainsProperly(geomA, geomA) AS acontainspropa,
 ST_Contains(geomA, ST_Boundary(geomA)) As acontainsba, ST_ContainsProperly(geomA,  ↩
     ST_Boundary(geomA)) As acontainspropba
 FROM (VALUES ( ST_Buffer(ST_Point(1,1), 5,1) ),
      ( ST_MakeLine(ST_Point(1,1), ST_Point(-1,-1) ) ),
      ( ST_Point(1,1) )
  ) As foo(geomA);

  geomtype    | acontainsa | acontainspropa | acontainsba | acontainspropba
--------------+------------+----------------+-------------+-----------------
ST_Polygon    | t          | f              | f           | f
ST_LineString | t          | f              | f           | f
ST_Point      | t          | t              | f           | f
```

See Also

ST_GeometryType, ST_Boundary, ST_Contains, ST_Covers, ST_CoveredBy, ST_Equals, ST_Relate, ST_Within

7.11.1.4 ST_CoveredBy

ST_CoveredBy — Tests if every point of A lies in B

Synopsis

boolean **ST_CoveredBy**(geometry geomA, geometry geomB);
boolean **ST_CoveredBy**(geography geogA, geography geogB);

Description

Returns `true` if every point in Geometry/Geography A lies inside (i.e. intersects the interior or boundary of) Geometry/Geography B. Equivalently, tests that no point of A lies outside (in the exterior of) B.

In mathematical terms: *ST_CoveredBy(A, B)* $\Leftrightarrow A \bigcap B = A$

ST_CoveredBy is the converse of ST_Covers. So, `ST_CoveredBy(A,B) = ST_Covers(B,A)`.

Generally this function should be used instead of ST_Within, since it has a simpler definition which does not have the quirk that "boundaries are not within their geometry".

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_CoveredBy`.

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Important
Do not use this function with invalid geometries. You will get unexpected results.

Performed by the GEOS module

Availability: 1.2.2

NOTE: this is the "allowable" version that returns a boolean, not an integer.

Not an OGC standard, but Oracle has it too.

Examples

```
--a circle coveredby a circle
SELECT ST_CoveredBy(smallc,smallc) As smallinsmall,
  ST_CoveredBy(smallc, bigc) As smallcoveredbybig,
  ST_CoveredBy(ST_ExteriorRing(bigc), bigc) As exteriorcoveredbybig,
  ST_Within(ST_ExteriorRing(bigc),bigc) As exeriorwithinbig
FROM (SELECT ST_Buffer(ST_GeomFromText('POINT(1 2)'), 10) As smallc,
  ST_Buffer(ST_GeomFromText('POINT(1 2)'), 20) As bigc) As foo;
  --Result
 smallinsmall | smallcoveredbybig | exteriorcoveredbybig | exeriorwithinbig
--------------+-------------------+----------------------+------------------
 t            | t                 | t                    | f
(1 row)
```

See Also

ST_Contains, ST_Covers, ST_ExteriorRing, ST_Within

7.11.1.5 ST_Covers

ST_Covers — Tests if every point of B lies in A

Synopsis

boolean **ST_Covers**(geometry geomA, geometry geomB);
boolean **ST_Covers**(geography geogpolyA, geography geogpointB);

Description

Returns `true` if every point in Geometry/Geography B lies inside (i.e. intersects the interior or boundary of) Geometry/Geography A. Equivalently, tests that no point of B lies outside (in the exterior of) A.

In mathematical terms: *ST_Covers(A, B)* $\Leftrightarrow A \bigcap B = B$

ST_Covers is the converse of ST_CoveredBy. So, `ST_Covers(A,B) = ST_CoveredBy(B,A)`.

Generally this function should be used instead of ST_Contains, since it has a simpler definition which does not have the quirk that "geometries do not contain their boundary".

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_Covers`.

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Important
Do not use this function with invalid geometries. You will get unexpected results.

Performed by the GEOS module

Enhanced: 2.4.0 Support for polygon in polygon and line in polygon added for geography type

Enhanced: 2.3.0 Enhancement to PIP short-circuit for geometry extended to support MultiPoints with few points. Prior versions only supported point in polygon.

Availability: 1.5 - support for geography was introduced.

Availability: 1.2.2

NOTE: this is the "allowable" version that returns a boolean, not an integer.

Not an OGC standard, but Oracle has it too.

Examples

Geometry example

```
--a circle covering a circle
SELECT ST_Covers(smallc,smallc) As smallinsmall,
  ST_Covers(smallc, bigc) As smallcoversbig,
  ST_Covers(bigc, ST_ExteriorRing(bigc)) As bigcoversexterior,
  ST_Contains(bigc, ST_ExteriorRing(bigc)) As bigcontainsexterior
FROM (SELECT ST_Buffer(ST_GeomFromText('POINT(1 2)'), 10) As smallc,
  ST_Buffer(ST_GeomFromText('POINT(1 2)'), 20) As bigc) As foo;
  --Result
 smallinsmall | smallcoversbig | bigcoversexterior | bigcontainsexterior
--------------+----------------+-------------------+---------------------
 t            | f              | t                 | f
(1 row)
```

Geeography Example

```
-- a point with a 300 meter buffer compared to a point, a point and its 10 meter buffer
SELECT ST_Covers(geog_poly, geog_pt) As poly_covers_pt,
  ST_Covers(ST_Buffer(geog_pt,10), geog_pt) As buff_10m_covers_cent
  FROM (SELECT ST_Buffer(ST_GeogFromText('SRID=4326;POINT(-99.327 31.4821)'), 300) As  ↩
      geog_poly,
        ST_GeogFromText('SRID=4326;POINT(-99.33 31.483)') As geog_pt ) As foo;

 poly_covers_pt | buff_10m_covers_cent
----------------+----------------------
 f              | t
```

See Also

ST_Contains, ST_CoveredBy, ST_Within

7.11.1.6 ST_Crosses

ST_Crosses — Tests if two geometries have some, but not all, interior points in common

Synopsis

boolean **ST_Crosses**(geometry g1, geometry g2);

Description

Compares two geometry objects and returns `true` if their intersection "spatially crosses"; that is, the geometries have some, but not all interior points in common. The intersection of the interiors of the geometries must be non-empty and must have dimension less than the maximum dimension of the two input geometries, and the intersection of the two geometries must not equal either geometry. Otherwise, it returns `false`. The crosses relation is symmetric and irreflexive.

In mathematical terms: $ST_Crosses(A, B) \Leftrightarrow (dim(\ Int(A) \bigcap Int(B)\ ) < max(\ dim(\ Int(A)\ ), dim(\ Int(B)\ )\ )) \wedge (A \bigcap B \neq A) \wedge (A \bigcap B \neq B)$

Geometries cross if their DE-9IM Intersection Matrix matches:

- `T*T******` for Point/Line, Point/Area, and Line/Area situations
- `T*****T**` for Line/Point, Area/Point, and Area/Line situations

- `0********` for Line/Line situations
- the result is `false` for Point/Point and Area/Area situations

Note
The OpenGIS Simple Features Specification defines this predicate only for Point/Line, Point/Area, Line/Line, and Line/Area situations. JTS / GEOS extends the definition to apply to Line/Point, Area/Point and Area/Line situations as well. This makes the relation symmetric.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

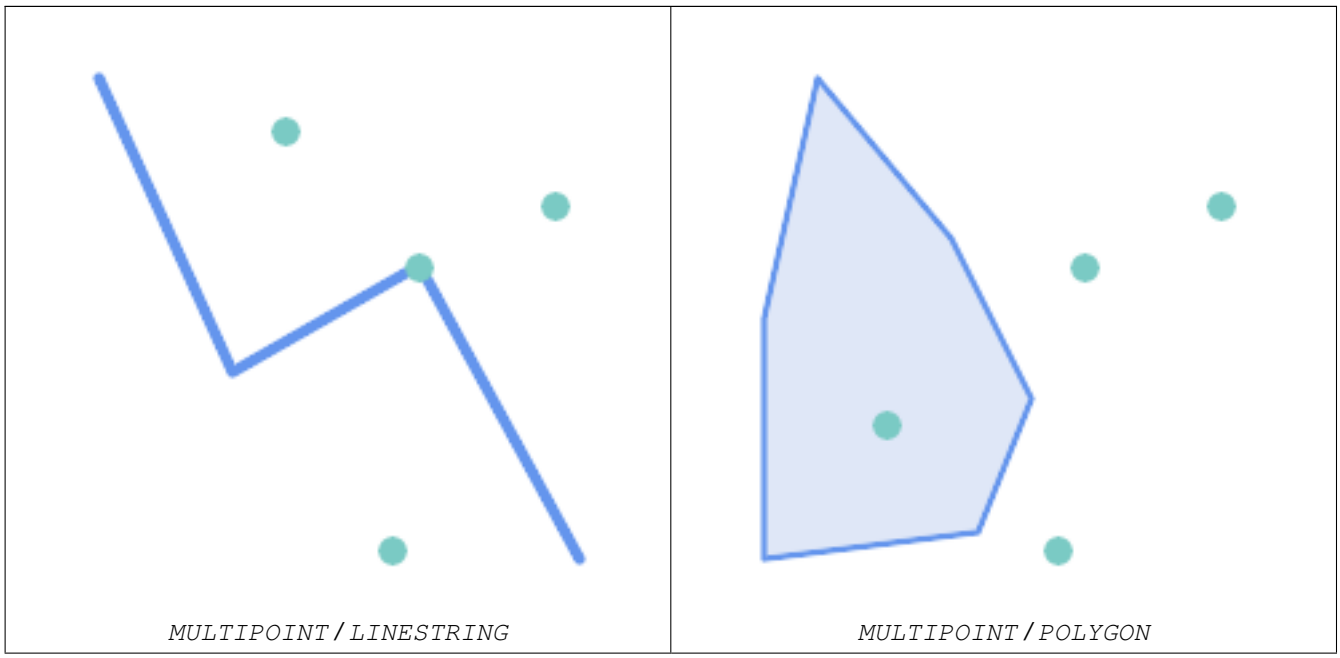
Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

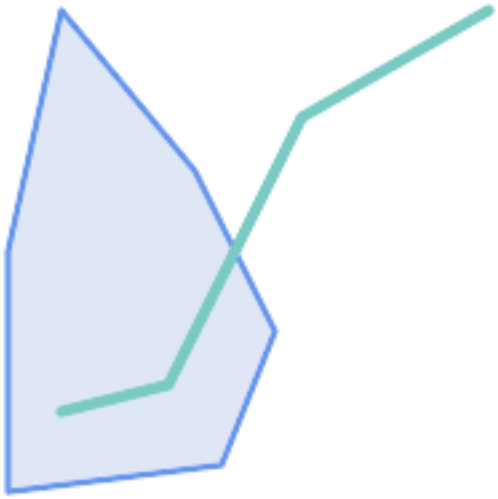
This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.13.3

This method implements the SQL/MM specification. SQL-MM 3: 5.1.29

Examples

The following situations all return `true`.





LINESTRING/POLYGON

LINESTRING/LINESTRING

Consider a situation where a user has two tables: a table of roads and a table of highways.

```
CREATE TABLE roads (
  id serial NOT NULL,
  geom geometry,
  CONSTRAINT roads_pkey PRIMARY KEY ( ↩
     road_id)
);
```

```
CREATE TABLE highways (
  id serial NOT NULL,
  the_gem geometry,
  CONSTRAINT roads_pkey PRIMARY KEY ( ↩
     road_id)
);
```

To determine a list of roads that cross a highway, use a query similiar to:

```
SELECT roads.id
FROM roads, highways
WHERE ST_Crosses(roads.geom, highways.geom);
```

See Also

ST_Contains, ST_Overlaps

7.11.1.7 ST_Disjoint

ST_Disjoint — Tests if two geometries have no points in common

Synopsis

boolean **ST_Disjoint**(geometry A , geometry B);

Description

Returns `true` if two geometries are disjoint. Geometries are disjoint if they have no point in common.

If any other spatial relationship is true for a pair of geometries, they are not disjoint. Disjoint implies that ST_Intersects is false.

In mathematical terms: *ST_Disjoint(A, B)* $\Leftrightarrow A \bigcap B = \varnothing$

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Performed by the GEOS module

Note
This function call does not use indexes. A negated ST_Intersects predicate can be used as a more performant alternative that uses indexes: `ST_Disjoint(A,B) = NOT ST_Intersects(A,B)`

Note
NOTE: this is the "allowable" version that returns a boolean, not an integer.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 //s2.1.13.3 - a.Relate(b, 'FF*FF****')

This method implements the SQL/MM specification. SQL-MM 3: 5.1.26

Examples

```
SELECT ST_Disjoint('POINT(0 0)'::geometry, 'LINESTRING ( 2 0, 0 2 )'::geometry);
 st_disjoint
---------------
 t
(1 row)
SELECT ST_Disjoint('POINT(0 0)'::geometry, 'LINESTRING ( 0 0, 0 2 )'::geometry);
 st_disjoint
---------------
 f
(1 row)
```

See Also

ST_Intersects

7.11.1.8 ST_Equals

ST_Equals — Tests if two geometries include the same set of points

Synopsis

boolean **ST_Equals**(geometry A, geometry B);

Description

Returns `true` if the given geometries are "topologically equal". Use this for a 'better' answer than '='. Topological equality means that the geometries have the same dimension, and their point-sets occupy the same space. This means that the order of vertices may be different in topologically equal geometries. To verify the order of points is consistent use ST_OrderingEquals (it must be noted ST_OrderingEquals is a little more stringent than simply verifying order of points are the same).

In mathematical terms: *ST_Equals(A, B)* $\Leftrightarrow$ *A = B*

The following relation holds: *ST_Equals(A, B)* $\Leftrightarrow$ *ST_Within(A,B)* $\wedge$ *ST_Within(B,A)*

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2

This method implements the SQL/MM specification. SQL-MM 3: 5.1.24

Changed: 2.2.0 Returns true even for invalid geometries if they are binary equal

Examples

```
SELECT ST_Equals(ST_GeomFromText('LINESTRING(0 0, 10 10)'),
    ST_GeomFromText('LINESTRING(0 0, 5 5, 10 10)'));
 st_equals
-----------
 t
(1 row)

SELECT ST_Equals(ST_Reverse(ST_GeomFromText('LINESTRING(0 0, 10 10)')),
    ST_GeomFromText('LINESTRING(0 0, 5 5, 10 10)'));
 st_equals
-----------
 t
(1 row)
```

See Also

ST_IsValid, ST_OrderingEquals, ST_Reverse, ST_Within

7.11.1.9 ST_Intersects

ST_Intersects — Tests if two geometries intersect (they have at least one point in common)

Synopsis

boolean **ST_Intersects**(geometry geomA , geometry geomB);
boolean **ST_Intersects**(geography geogA , geography geogB);

Description

Returns `true` if two geometries intersect. Geometries intersect if they have any point in common.

For geography, a distance tolerance of 0.00001 meters is used (so points that are very close are considered to intersect).

In mathematical terms: *ST_Intersects(A, B)* $\Leftrightarrow A \bigcap B \neq \varnothing$

Geometries intersect if their DE-9IM Intersection Matrix matches one of:

- `T********`
- `*T*******`
- `***T*****`
- `****T****`

Spatial intersection is implied by all the other spatial relationship tests, except ST_Disjoint, which tests that geometries do NOT intersect.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

Changed: 3.0.0 SFCGAL version removed and native support for 2D TINS added.

Enhanced: 2.5.0 Supports GEOMETRYCOLLECTION.

Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon.

Performed by the GEOS module (for geometry), geography is native

Availability: 1.5 support for geography was introduced.

Note
For geography, this function has a distance tolerance of about 0.00001 meters and uses the sphere rather than spheroid calculation.

Note
NOTE: this is the "allowable" version that returns a boolean, not an integer.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 //s2.1.13.3 - ST_Intersects(g1, g2) --> Not (ST_Disjoint(g1, g2))

This method implements the SQL/MM specification. SQL-MM 3: 5.1.27

This method supports Circular Strings and Curves.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Geometry Examples

```
SELECT ST_Intersects('POINT(0 0)'::geometry, 'LINESTRING ( 2 0, 0 2 )'::geometry);
 st_intersects
---------------
 f
(1 row)
SELECT ST_Intersects('POINT(0 0)'::geometry, 'LINESTRING ( 0 0, 0 2 )'::geometry);
 st_intersects
---------------
 t
(1 row)

-- Look up in table. Make sure table has a GiST index on geometry column for faster lookup.
SELECT id, name FROM cities WHERE ST_Intersects(geom, 'SRID=4326;POLYGON((28 53,27.707  ↩
    52.293,27 52,26.293 52.293,26 53,26.293 53.707,27 54,27.707 53.707,28 53))');
 id | name
----+-------
  2 | Minsk
(1 row)
```

Geography Examples

```
SELECT ST_Intersects(
    'SRID=4326;LINESTRING(-43.23456 72.4567,-43.23456 72.4568)'::geography,
    'SRID=4326;POINT(-43.23456 72.4567772)'::geography
    );

 st_intersects
---------------
t
```

See Also

&&, ST_3DIntersects, ST_Disjoint

7.11.1.10 ST_LineCrossingDirection

ST_LineCrossingDirection — Returns a number indicating the crossing behavior of two LineStrings

Synopsis

integer **ST_LineCrossingDirection**(geometry linestringA, geometry linestringB);

Description

Given two linestrings returns an integer between -3 and 3 indicating what kind of crossing behavior exists between them. 0 indicates no crossing. This is only supported for `LINESTRING`s.

The crossing number has the following meaning:

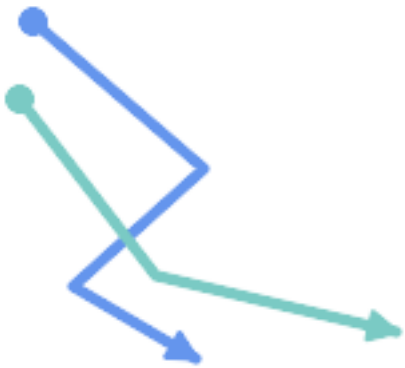
- 0: LINE NO CROSS
- -1: LINE CROSS LEFT
- 1: LINE CROSS RIGHT

- -2: LINE MULTICROSS END LEFT
- 2: LINE MULTICROSS END RIGHT
- -3: LINE MULTICROSS END SAME FIRST LEFT
- 3: LINE MULTICROSS END SAME FIRST RIGHT

Availability: 1.4

Examples

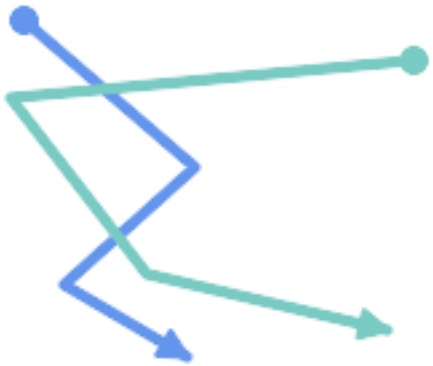
Example: LINE CROSS LEFT and LINE CROSS RIGHT



Blue: Line A; Green: Line B

```
SELECT ST_LineCrossingDirection(lineA, lineB) As A_cross_B,
       ST_LineCrossingDirection(lineB, lineA) As B_cross_A
FROM (SELECT
  ST_GeomFromText('LINESTRING(25 169,89 114,40 70,86 43)') As lineA,
  ST_GeomFromText('LINESTRING (20 140, 71 74, 161 53)') As lineB
  ) As foo;

 A_cross_B | B_cross_A
-----------+-----------
        -1 |         1
```

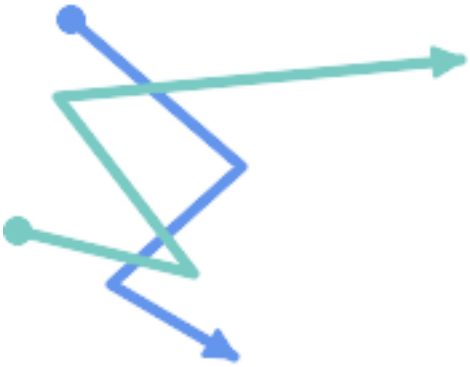
Example: LINE MULTICROSS END SAME FIRST LEFT and LINE MULTICROSS END SAME FIRST RIGHT



Blue: Line A; Green: Line B

```
SELECT ST_LineCrossingDirection(lineA, lineB) As A_cross_B,
       ST_LineCrossingDirection(lineB, lineA) As B_cross_A
FROM (SELECT
 ST_GeomFromText('LINESTRING(25 169,89 114,40 70,86 43)') As lineA,
 ST_GeomFromText('LINESTRING(171 154,20 140,71 74,161 53)') As lineB
  ) As foo;

 A_cross_B | B_cross_A
-----------+-----------
         3 |        -3
```

Example: LINE MULTICROSS END LEFT and LINE MULTICROSS END RIGHT



Blue: Line A; Green: Line B

```
SELECT ST_LineCrossingDirection(lineA, lineB) As A_cross_B,
       ST_LineCrossingDirection(lineB, lineA) As B_cross_A
FROM (SELECT
  ST_GeomFromText('LINESTRING(25 169,89 114,40 70,86 43)') As lineA,
  ST_GeomFromText('LINESTRING(5 90, 71 74, 20 140, 171 154)') As lineB
  ) As foo;
```

```
 A_cross_B | B_cross_A
-----------+-----------
        -2 |         2
```

Example: Finds all streets that cross

```
SELECT s1.gid, s2.gid, ST_LineCrossingDirection(s1.geom, s2.geom)
  FROM streets s1 CROSS JOIN streets s2
         ON (s1.gid != s2.gid AND s1.geom && s2.geom )
WHERE ST_LineCrossingDirection(s1.geom, s2.geom) > 0;
```

See Also

ST_Crosses

7.11.1.11 ST_OrderingEquals

ST_OrderingEquals — Tests if two geometries represent the same geometry and have points in the same directional order

Synopsis

boolean **ST_OrderingEquals**(geometry A, geometry B);

Description

ST_OrderingEquals compares two geometries and returns t (TRUE) if the geometries are equal and the coordinates are in the same order; otherwise it returns f (FALSE).

Note
This function is implemented as per the ArcSDE SQL specification rather than SQL-MM. http://edndoc.esri.com/arcsde/9.1/sql_api/sqlapi3.htm#ST_OrderingEquals

This method implements the SQL/MM specification. SQL-MM 3: 5.1.43

Examples

```
SELECT ST_OrderingEquals(ST_GeomFromText('LINESTRING(0 0, 10 10)'),
    ST_GeomFromText('LINESTRING(0 0, 5 5, 10 10)'));
 st_orderingequals
-----------
 f
(1 row)

SELECT ST_OrderingEquals(ST_GeomFromText('LINESTRING(0 0, 10 10)'),
    ST_GeomFromText('LINESTRING(0 0, 0 0, 10 10)'));
 st_orderingequals
-----------
 t
(1 row)

SELECT ST_OrderingEquals(ST_Reverse(ST_GeomFromText('LINESTRING(0 0, 10 10)')),
    ST_GeomFromText('LINESTRING(0 0, 0 0, 10 10)'));
```

```
 st_orderingequals
-----------
 f
(1 row)
```

See Also

&&, ST_Equals, ST_Reverse

7.11.1.12 ST_Overlaps

ST_Overlaps — Tests if two geometries have the same dimension and intersect, but each has at least one point not in the other

Synopsis

boolean **ST_Overlaps**(geometry A, geometry B);

Description

Returns TRUE if geometry A and B "spatially overlap". Two geometries overlap if they have the same dimension, their interiors intersect in that dimension. and each has at least one point inside the other (or equivalently, neither one covers the other). The overlaps relation is symmetric and irreflexive.

In mathematical terms: $ST_Overlaps(A, B) \Leftrightarrow (dim(A) = dim(B) = dim(Int(A) \bigcap Int(B))) \wedge (A \bigcap B \neq A) \wedge (A \bigcap B \neq B)$

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_Overlaps`.

Performed by the GEOS module

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

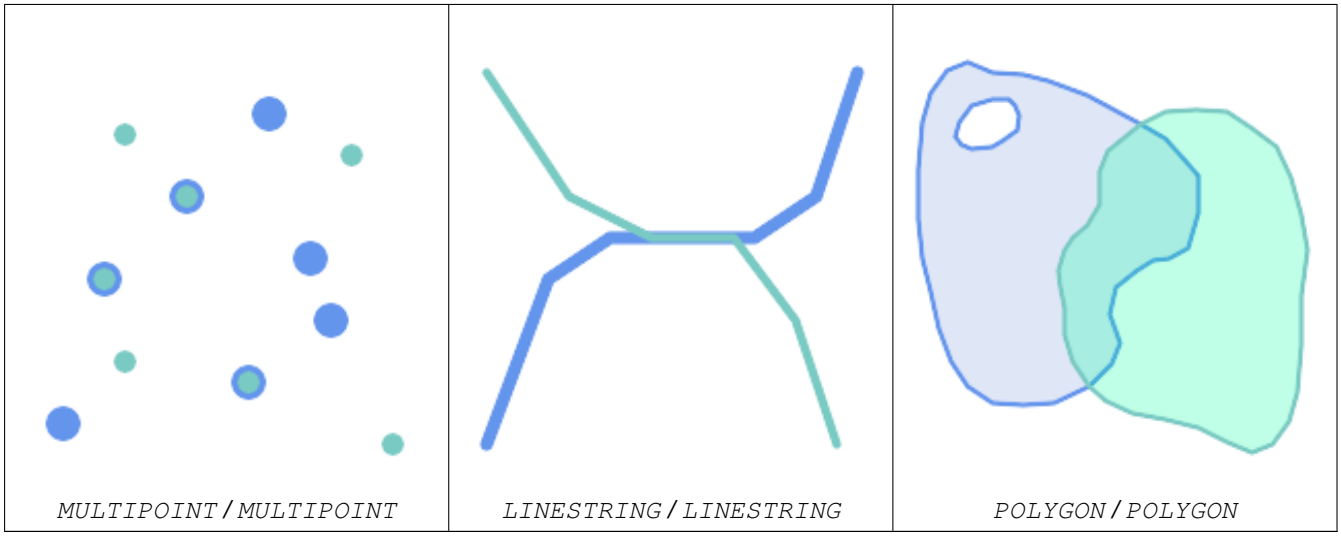
NOTE: this is the "allowable" version that returns a boolean, not an integer.

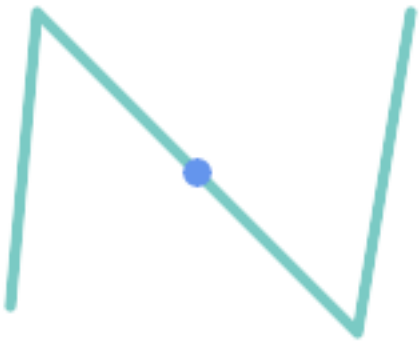
This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3

This method implements the SQL/MM specification. SQL-MM 3: 5.1.32

Examples

`ST_Overlaps` returns `TRUE` in the following situations:



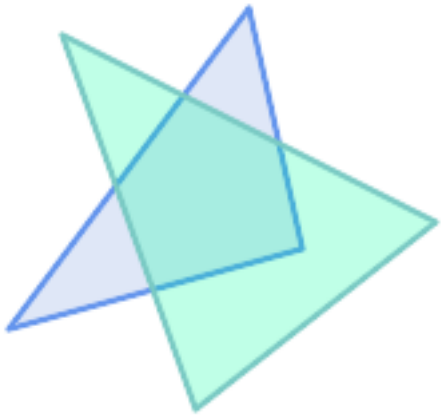


A Point on a LineString is contained, but since it has lower dimension it does not overlap or cross.

```
SELECT ST_Overlaps(a,b) AS overlaps,       ST_Crosses(a,b) AS crosses,
       ST_Intersects(a, b) AS intersects,  ST_Contains(b,a) AS b_contains_a
FROM (SELECT ST_GeomFromText('POINT (100 100)') As a,
             ST_GeomFromText('LINESTRING (30 50, 40 160, 160 40, 180 160)')  AS b) AS t

overlaps | crosses | intersects | b_contains_a
---------+---------------------+--------------
f        | f       | t          | t
```

A LineString that partly covers a Polygon intersects and crosses, but does not overlap since it has different dimension.

```
SELECT ST_Overlaps(a,b) AS overlaps,        ST_Crosses(a,b) AS crosses,
       ST_Intersects(a, b) AS intersects,   ST_Contains(a,b) AS contains
FROM (SELECT ST_GeomFromText('POLYGON ((40 170, 90 30, 180 100, 40 170))') AS a,
             ST_GeomFromText('LINESTRING(10 10, 190 190)') AS b) AS t;

 overlap | crosses | intersects | contains
---------+---------+------------+--------------
 f       | t       | t          | f
```



Two Polygons that intersect but with neither contained by the other overlap, but do not cross because their intersection has the same dimension.

```
SELECT ST_Overlaps(a,b) AS overlaps,       ST_Crosses(a,b) AS crosses,
       ST_Intersects(a, b) AS intersects,  ST_Contains(b, a) AS b_contains_a,
       ST_Dimension(a) AS dim_a, ST_Dimension(b) AS dim_b,
       ST_Dimension(ST_Intersection(a,b)) AS dim_int
FROM (SELECT ST_GeomFromText('POLYGON ((40 170, 90 30, 180 100, 40 170))') AS a,
             ST_GeomFromText('POLYGON ((110 180, 20 60, 130 90, 110 180))') AS b) As t;

 overlaps | crosses | intersects | b_contains_a | dim_a | dim_b | dim_int
```

```
----------+---------+------------+--------------+-------+-------+-----------
 t        | f       | t          | f            |     2 |     2 |         2
```

See Also

ST_Contains, ST_Crosses, ST_Dimension, ST_Intersects

7.11.1.13 ST_Relate

ST_Relate — Tests if two geometries have a topological relationship matching an Intersection Matrix pattern, or computes their Intersection Matrix

Synopsis

boolean **ST_Relate**(geometry geomA, geometry geomB, text intersectionMatrixPattern);
text **ST_Relate**(geometry geomA, geometry geomB);
text **ST_Relate**(geometry geomA, geometry geomB, integer boundaryNodeRule);

Description

These functions allow testing and evaluating the spatial (topological) relationship between two geometries, as defined by the Dimensionally Extended 9-Intersection Model (DE-9IM).

The DE-9IM is specified as a 9-element matrix indicating the dimension of the intersections between the Interior, Boundary and Exterior of two geometries. It is represented by a 9-character text string using the symbols 'F', '0', '1', '2' (e.g. `'FF1FF0102'`).

A specific kind of spatial relationship can be tested by matching the intersection matrix to an *intersection matrix pattern*. Patterns can include the additional symbols 'T' (meaning "intersection is non-empty") and '*' (meaning "any value"). Common spatial relationships are provided by the named functions ST_Contains, ST_ContainsProperly, ST_Covers, ST_CoveredBy, ST_Crosses, ST_Disjoint, ST_Equals, ST_Intersects, ST_Overlaps, ST_Touches, and ST_Within. Using an explicit pattern allows testing multiple conditions of intersects, crosses, etc in one step. It also allows testing spatial relationships which do not have a named spatial relationship function. For example, the relationship "Interior-Intersects" has the DE-9IM pattern `T********`, which is not evaluated by any named predicate.

For more information refer to Section 5.1.

Variant 1: Tests if two geometries are spatially related according to the given `intersectionMatrixPattern`.

Note
Unlike most of the named spatial relationship predicates, this does NOT automatically include an index call. The reason is that some relationships are true for geometries which do NOT intersect (e.g. Disjoint). If you are using a relationship pattern that requires intersection, then include the && index call.

Note
It is better to use a named relationship function if available, since they automatically use a spatial index where one exists. Also, they may implement performance optimizations which are not available with full relate evalation.

Variant 2: Returns the DE-9IM matrix string for the spatial relationship between the two input geometries. The matrix string can be tested for matching a DE-9IM pattern using ST_RelateMatch.

Variant 3: Like variant 2, but allows specifying a **Boundary Node Rule**. A boundary node rule allows finer control over whether the endpoints of MultiLineStrings are considered to lie in the DE-9IM Interior or Boundary. The `boundaryNodeRule` values are:

- `1`: **OGC-Mod2** - line endpoints are in the Boundary if they occur an odd number of times. This is the rule defined by the OGC SFS standard, and is the default for `ST_Relate`.
- `2`: **Endpoint** - all endpoints are in the Boundary.
- `3`: **MultivalentEndpoint** - endpoints are in the Boundary if they occur more than once. In other words, the boundary is all the "attached" or "inner" endpoints (but not the "unattached/outer" ones).
- `4`: **MonovalentEndpoint** - endpoints are in the Boundary if they occur only once. In other words, the boundary is all the "unattached" or "outer" endpoints.

This function is not in the OGC spec, but is implied. see s2.1.13.2

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3

This method implements the SQL/MM specification. SQL-MM 3: 5.1.25

Performed by the GEOS module

Enhanced: 2.0.0 - added support for specifying boundary node rule.

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Examples

Using the boolean-valued function to test spatial relationships.

```
SELECT ST_Relate('POINT(1 2)', ST_Buffer( 'POINT(1 2)', 2), '0FFFFF212');
st_relate
-----------
t

SELECT ST_Relate(POINT(1 2)', ST_Buffer( 'POINT(1 2)', 2), '*FF*FF212');
st_relate
-----------
t
```

Testing a custom spatial relationship pattern as a query condition, with `&&` to enable using a spatial index.

```
-- Find compounds that properly intersect (not just touch) a poly (Interior Intersects)

SELECT c.* , p.name As poly_name
    FROM polys AS p
    INNER JOIN compounds As c
          ON c.geom && p.geom
             AND ST_Relate(p.geom, c.geom,'T********');
```

Computing the intersection matrix for spatial relationships.

```
SELECT ST_Relate( 'POINT(1 2)',
                  ST_Buffer( 'POINT(1 2)', 2));
-----------
0FFFFF212

SELECT ST_Relate( 'LINESTRING(1 2, 3 4)',
                  'LINESTRING(5 6, 7 8)' );
-----------
FF1FF0102
```

Using different Boundary Node Rules to compute the spatial relationship between a LineString and a MultiLineString with a duplicate endpoint `(3 3)`:

- Using the **OGC-Mod2** rule (1) the duplicate endpoint is in the **interior** of the MultiLineString, so the DE-9IM matrix entry [aB:bI] is `0` and [aB:bB] is `F`.
- Using the **Endpoint** rule (2) the duplicate endpoint is in the **boundary** of the MultiLineString, so the DE-9IM matrix entry [aB:bI] is `F` and [aB:bB] is `0`.

```
WITH data AS (SELECT
  'LINESTRING(1 1, 3 3)'::geometry AS a_line,
  'MULTILINESTRING((3 3, 3 5), (3 3, 5 3))':: geometry AS b_multiline
)
SELECT ST_Relate( a_line, b_multiline, 1) AS bnr_mod2,
       ST_Relate( a_line, b_multiline, 2) AS bnr_endpoint
    FROM data;

 bnr_mod2  | bnr_endpoint
-----------+--------------
 FF10F0102 | FF1F00102
```

See Also

Section 5.1, ST_RelateMatch, ST_Contains, ST_ContainsProperly, ST_Covers, ST_CoveredBy, ST_Crosses, ST_Disjoint, ST_Equals, ST_Intersects, ST_Overlaps, ST_Touches, ST_Within

7.11.1.14 ST_RelateMatch

ST_RelateMatch — Tests if a DE-9IM Intersection Matrix matches an Intersection Matrix pattern

Synopsis

boolean **ST_RelateMatch**(text intersectionMatrix, text intersectionMatrixPattern);

Description

Tests if a Dimensionally Extended 9-Intersection Model (DE-9IM) `intersectionMatrix` value satisfies an `intersectionMatr`
Intersection matrix values can be computed by ST_Relate.

For more information refer to Section 5.1.

Performed by the GEOS module

Availability: 2.0.0

Examples

```
SELECT ST_RelateMatch('101202FFF', 'TTTTTTFFF') ;
-- result --
t
```

Patterns for common spatial relationships matched against intersection matrix values, for a line in various positions relative to a polygon

```
SELECT pat.name AS relationship, pat.val AS pattern,
       mat.name AS position, mat.val AS matrix,
       ST_RelateMatch(mat.val, pat.val) AS match
    FROM (VALUES ( 'Equality', 'T1FF1FFF1' ),
                 ( 'Overlaps', 'T*T***T**' ),
                 ( 'Within',   'T*F**F***' ),
                 ( 'Disjoint', 'FF*FF****' )) AS pat(name,val)
    CROSS JOIN
        (VALUES  ('non-intersecting', 'FF1FF0212'),
                 ('overlapping',      '1010F0212'),
                 ('inside',           '1FF0FF212')) AS mat(name,val);

 relationship |  pattern  |     position     |  matrix   | match
--------------+-----------+------------------+-----------+-------
 Equality     | T1FF1FFF1 | non-intersecting | FF1FF0212 | f
 Equality     | T1FF1FFF1 | overlapping      | 1010F0212 | f
 Equality     | T1FF1FFF1 | inside           | 1FF0FF212 | f
 Overlaps     | T*T***T** | non-intersecting | FF1FF0212 | f
 Overlaps     | T*T***T** | overlapping      | 1010F0212 | t
 Overlaps     | T*T***T** | inside           | 1FF0FF212 | f
 Within       | T*F**F*** | non-intersecting | FF1FF0212 | f
 Within       | T*F**F*** | overlapping      | 1010F0212 | f
 Within       | T*F**F*** | inside           | 1FF0FF212 | t
 Disjoint     | FF*FF**** | non-intersecting | FF1FF0212 | t
 Disjoint     | FF*FF**** | overlapping      | 1010F0212 | f
 Disjoint     | FF*FF**** | inside           | 1FF0FF212 | f
```

See Also

Section 5.1, ST_Relate

7.11.1.15 ST_Touches

ST_Touches — Tests if two geometries have at least one point in common, but their interiors do not intersect

Synopsis

boolean **ST_Touches**(geometry A, geometry B);

Description

Returns `TRUE` if A and B intersect, but their interiors do not intersect. Equivalently, A and B have at least one point in common, and the common points lie in at least one boundary. For Point/Point inputs the relationship is always `FALSE`, since points do not have a boundary.

In mathematical terms: *ST_Touches(A, B)* $\Leftrightarrow$ *(Int(A)* $\bigcap$ *Int(B)* $\neq \varnothing$*)* $\wedge$ *(A* $\bigcap$ *B* $\neq \varnothing$*)*

This relationship holds if the DE-9IM Intersection Matrix for the two geometries matches one of:

- FT*******
- F**T*****
- F***T****

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid using an index, use `_ST_Touches` instead.

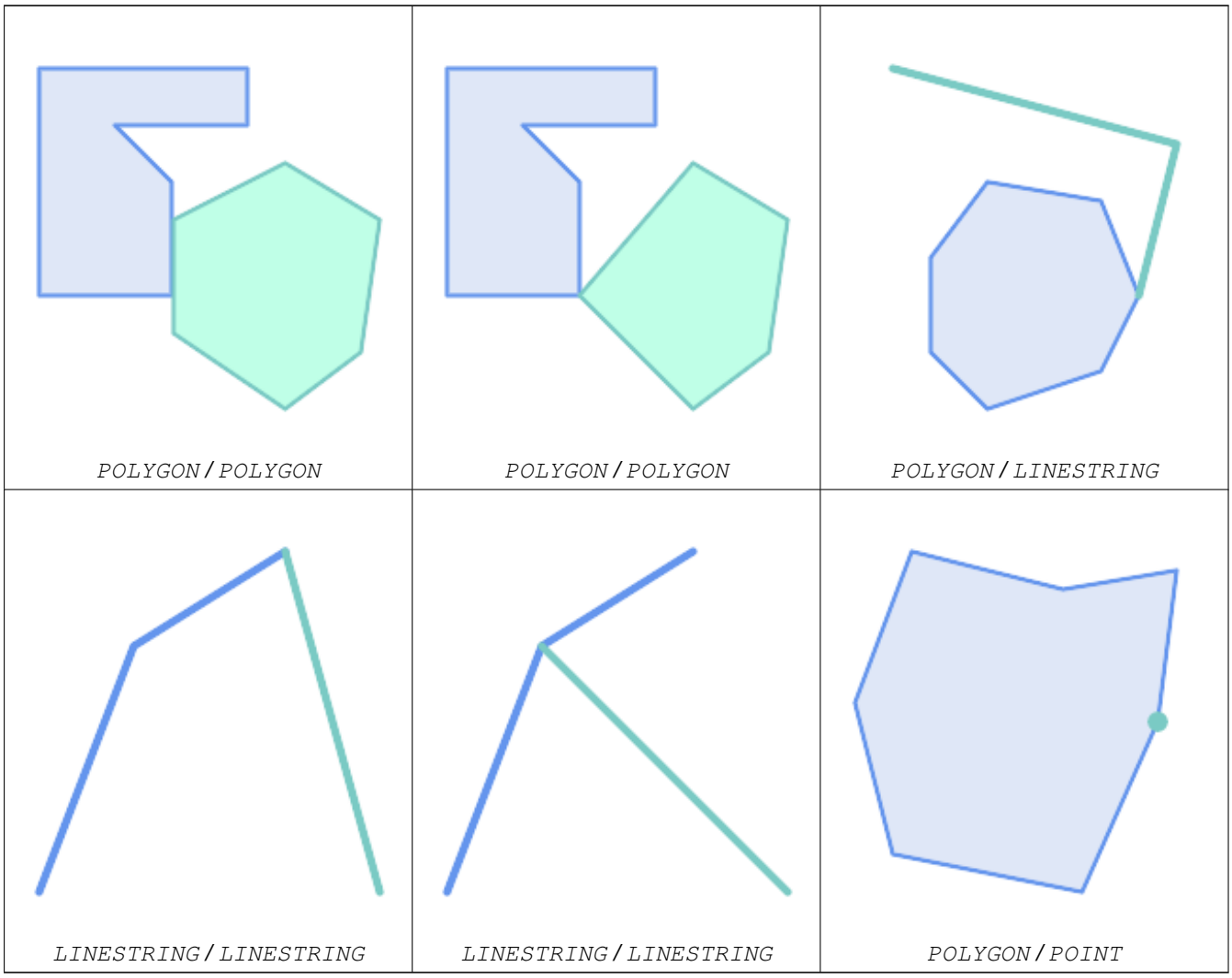
Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3

This method implements the SQL/MM specification. SQL-MM 3: 5.1.28

Examples

The `ST_Touches` predicate returns `TRUE` in the following examples.




```
SELECT ST_Touches('LINESTRING(0 0, 1 1, 0 2)'::geometry, 'POINT(1 1)'::geometry);
```

```
 st_touches
------------
 f
(1 row)

SELECT ST_Touches('LINESTRING(0 0, 1 1, 0 2)'::geometry, 'POINT(0 2)'::geometry);
 st_touches
------------
 t
(1 row)
```

7.11.1.16 ST_Within

ST_Within — Tests if every point of A lies in B, and their interiors have a point in common

Synopsis

boolean **ST_Within**(geometry A, geometry B);

Description

Returns TRUE if geometry A is within geometry B. A is within B if and only if all points of A lie inside (i.e. in the interior or boundary of) B (or equivalently, no points of A lie in the exterior of B), and the interiors of A and B have at least one point in common.

For this function to make sense, the source geometries must both be of the same coordinate projection, having the same SRID.

In mathematical terms: $ST_Within(A, B) \Leftrightarrow (A \bigcap B = A) \wedge (Int(A) \bigcap Int(B) \neq \varnothing)$

The within relation is reflexive: every geometry is within itself. The relation is antisymmetric: if `ST_Within(A,B) = true` and `ST_Within(B,A) = true`, then the two geometries must be topologically equal (`ST_Equals(A,B) = true`).

ST_Within is the converse of ST_Contains. So, `ST_Within(A,B) = ST_Contains(B,A)`.

Note
Because the interiors must have a common point, a subtlety of the definition is that lines and points lying fully in the boundary of polygons or lines are *not* within the geometry. For further details see Subtleties of OGC Covers, Contains, Within. The ST_CoveredBy predicate provides a more inclusive relationship.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function `_ST_Within`.

Performed by the GEOS module

Enhanced: 2.3.0 Enhancement to PIP short-circuit for geometry extended to support MultiPoints with few points. Prior versions only supported point in polygon.

Important
Enhanced: 3.0.0 enabled support for `GEOMETRYCOLLECTION`

Important
Do not use this function with invalid geometries. You will get unexpected results.

NOTE: this is the "allowable" version that returns a boolean, not an integer.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 - a.Relate(b, 'T*F**F***')

This method implements the SQL/MM specification. SQL-MM 3: 5.1.30

Examples

```
--a circle within a circle
SELECT ST_Within(smallc,smallc) As smallinsmall,
  ST_Within(smallc, bigc) As smallinbig,
  ST_Within(bigc,smallc) As biginsmall,
  ST_Within(ST_Union(smallc, bigc), bigc) as unioninbig,
  ST_Within(bigc, ST_Union(smallc, bigc)) as biginunion,
  ST_Equals(bigc, ST_Union(smallc, bigc)) as bigisunion
FROM
(
SELECT ST_Buffer(ST_GeomFromText('POINT(50 50)'), 20) As smallc,
  ST_Buffer(ST_GeomFromText('POINT(50 50)'), 40) As bigc) As foo;
--Result
 smallinsmall | smallinbig | biginsmall | unioninbig | biginunion | bigisunion
--------------+------------+------------+------------+------------+------------
 t            | t          | f          | t          | t          | t
(1 row)
```

See Also

ST_Contains, ST_CoveredBy, ST_Equals, ST_IsValid

7.11.2 Distance Relationships

7.11.2.1 ST_3DDWithin

ST_3DDWithin — Tests if two 3D geometries are within a given 3D distance

Synopsis

boolean **ST_3DDWithin**(geometry g1, geometry g2, double precision distance_of_srid);

Description

Returns true if the 3D distance between two geometry values is no larger than distance `distance_of_srid`. The distance is specified in units defined by the spatial reference system of the geometries. For this function to make sense the source geometries must be in the same coordinate system (have the same SRID).

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This method implements the SQL/MM specification. SQL-MM ?

Availability: 2.0.0

Examples

```
-- Geometry example - units in meters (SRID: 2163 US National Atlas Equal area) (3D point  ↩
    and line compared 2D point and line)
-- Note: currently no vertical datum support so Z is not transformed and assumed to be same ↩
     units as final.
SELECT ST_3DDWithin(
      ST_Transform(ST_GeomFromEWKT('SRID=4326;POINT(-72.1235 42.3521 4)'),2163),
      ST_Transform(ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45 15, -72.123 42.1546 ↩
          20)'),2163),
      126.8
    ) As within_dist_3d,
ST_DWithin(
      ST_Transform(ST_GeomFromEWKT('SRID=4326;POINT(-72.1235 42.3521 4)'),2163),
      ST_Transform(ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45 15, -72.123 42.1546 ↩
          20)'),2163),
      126.8
    ) As within_dist_2d;

 within_dist_3d | within_dist_2d
----------------+----------------
 f              | t
```

See Also

ST_3DDFullyWithin, ST_DWithin, ST_DFullyWithin, ST_3DDistance, ST_Distance, ST_3DMaxDistance, ST_Transform

7.11.2.2 ST_3DDFullyWithin

ST_3DDFullyWithin — Tests if two 3D geometries are entirely within a given 3D distance

Synopsis

boolean **ST_3DDFullyWithin**(geometry g1, geometry g2, double precision distance);

Description

Returns true if the 3D geometries are fully within the specified distance of one another. The distance is specified in units defined by the spatial reference system of the geometries. For this function to make sense, the source geometries must both be of the same coordinate projection, having the same SRID.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

Availability: 2.0.0

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

Examples

```
-- This compares the difference between fully within and distance within as well
    -- as the distance fully within for the 2D footprint of the line/point vs. the 3d fully ↩
        within
    SELECT ST_3DDFullyWithin(geom_a, geom_b, 10) as D3DFullyWithin10, ST_3DDWithin(geom_a,  ↩
        geom_b, 10) as D3DWithin10,
  ST_DFullyWithin(geom_a, geom_b, 20) as D2DFullyWithin20,
  ST_3DDFullyWithin(geom_a, geom_b, 20) as D3DFullyWithin20 from
    (select ST_GeomFromEWKT('POINT(1 1 2)') as geom_a,
    ST_GeomFromEWKT('LINESTRING(1 5 2, 2 7 20, 1 9 100, 14 12 3)') as geom_b) t1;
 d3dfullywithin10 | d3dwithin10 | d2dfullywithin20 | d3dfullywithin20
------------------+-------------+------------------+------------------
 f                | t           | t                | f
```

See Also

ST_3DDWithin, ST_DWithin, ST_DFullyWithin, ST_3DMaxDistance

7.11.2.3 ST_DFullyWithin

ST_DFullyWithin — Tests if two geometries are entirely within a given distance

Synopsis

boolean **ST_DFullyWithin**(geometry g1, geometry g2, double precision distance);

Description

Returns true if the geometries are entirely within the specified distance of one another. The distance is specified in units defined by the spatial reference system of the geometries. For this function to make sense, the source geometries must both be of the same coordinate projection, having the same SRID.

Note
This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries.

Availability: 1.5.0

Examples

```
postgis=# SELECT ST_DFullyWithin(geom_a, geom_b, 10) as DFullyWithin10, ST_DWithin(geom_a,  ↩
    geom_b, 10) as DWithin10, ST_DFullyWithin(geom_a, geom_b, 20) as DFullyWithin20 from
     (select ST_GeomFromText('POINT(1 1)') as geom_a,ST_GeomFromText('LINESTRING(1 5, 2 7, 1 ↩
          9, 14 12)') as geom_b) t1;

-----------------
 DFullyWithin10 | DWithin10 | DFullyWithin20 |
---------------+-----------+----------------+
 f              | t         | t              |
```

See Also

ST_MaxDistance, ST_DWithin, ST_3DDWithin, ST_3DDFullyWithin

7.11.2.4 ST_DWithin

ST_DWithin — Tests if two geometries are within a given distance

Synopsis

boolean **ST_DWithin**(geometry g1, geometry g2, double precision distance_of_srid);
boolean **ST_DWithin**(geography gg1, geography gg2, double precision distance_meters, boolean use_spheroid = true);

Description

Returns true if the geometries are within a given distance

For geometry: The distance is specified in units defined by the spatial reference system of the geometries. For this function to make sense, the source geometries must be in the same coordinate system (have the same SRID).

For geography: units are in meters and distance measurement defaults to `use_spheroid = true`. For faster evaluation use `use_spheroid = false` to measure on the sphere.

Note
Use ST_3DDWithin for 3D geometries.

Note
This function call includes a bounding box comparison that makes use of any indexes that are available on the geometries.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

Availability: 1.5.0 support for geography was introduced

Enhanced: 2.1.0 improved speed for geography. See Making Geography faster for details.

Enhanced: 2.1.0 support for curved geometries was introduced.

Prior to 1.3, ST_Expand was commonly used in conjunction with && and ST_Distance to test for distance, and in pre-1.3.4 this function used that logic. From 1.3.4, ST_DWithin uses a faster short-circuit distance function.

Examples

```
-- Find the nearest hospital to each school
-- that is within 3000 units of the school.
--  We do an ST_DWithin search to utilize indexes to limit our search list
--  that the non-indexable ST_Distance needs to process
-- If the units of the spatial reference is meters then units would be meters
SELECT DISTINCT ON (s.gid) s.gid, s.school_name, s.geom, h.hospital_name
  FROM schools s
    LEFT JOIN hospitals h ON ST_DWithin(s.geom, h.geom, 3000)
  ORDER BY s.gid, ST_Distance(s.geom, h.geom);

-- The schools with no close hospitals
-- Find all schools with no hospital within 3000 units
-- away from the school.  Units is in units of spatial ref (e.g. meters, feet, degrees)
SELECT s.gid, s.school_name
  FROM schools s
    LEFT JOIN hospitals h ON ST_DWithin(s.geom, h.geom, 3000)
  WHERE h.gid IS NULL;

-- Find broadcasting towers that receiver with limited range can receive.
-- Data is geometry in Spherical Mercator (SRID=3857), ranges are approximate.

-- Create geometry index that will check proximity limit of user to tower
CREATE INDEX ON broadcasting_towers using gist (geom);

-- Create geometry index that will check proximity limit of tower to user
CREATE INDEX ON broadcasting_towers using gist (ST_Expand(geom, sending_range));

-- Query towers that 4-kilometer receiver in Minsk Hackerspace can get
-- Note: two conditions, because shorter LEAST(b.sending_range, 4000) will not use index.
SELECT b.tower_id, b.geom
  FROM broadcasting_towers b
  WHERE ST_DWithin(b.geom, 'SRID=3857;POINT(3072163.4 7159374.1)', 4000)
    AND ST_DWithin(b.geom, 'SRID=3857;POINT(3072163.4 7159374.1)', b.sending_range);
```

See Also

ST_Distance, ST_3DDWithin

7.11.2.5 ST_PointInsideCircle

ST_PointInsideCircle — Tests if a point geometry is inside a circle defined by a center and radius

Synopsis

boolean **ST_PointInsideCircle**(geometry a_point, float center_x, float center_y, float radius);

Description

Returns true if the geometry is a point and is inside the circle with center `center_x`,`center_y` and radius `radius`.

Warning
Does not use spatial indexes. Use ST_DWithin instead.

Availability: 1.2

Changed: 2.2.0 In prior versions this was called ST_Point_Inside_Circle

Examples

```
SELECT ST_PointInsideCircle(ST_Point(1,2), 0.5, 2, 3);
 st_pointinsidecircle
----------------------
 t
```

See Also

ST_DWithin

7.12 Measurement Functions

7.12.1 ST_Area

ST_Area — 도형의 기하학적 중심을 반환&

Synopsis

float **ST_Area**(geometry g1);
float **ST_Area**(geography geog, boolean use_spheroid = true);

설명

도형이 폴리곤이나 멀티폴리곤&#xc
경우 표면의 면적을 - ST_Surface 또는 ST_MultiSurface
함수의 면적 측정값을 - 반환합니&
도형 유형의 경우, SRID가 지정한 단&#xc7
2차원 데카르트 면적을 구합니다.
지리형 유형의 경우, 평방미터 단&
곡면(curved surface)의 면적을 구합니다. 구&#xccb
면적에 대해 덜 정확하지만 더 빠&
측정하려면, ST_Area(geog,false) 함수를 이용하&

개선 사항: 2.0.0 버전부터 2차원 다면&#xc
표면(polyhedral surface)을 지원합니다.

개선 사항: 2.2.0 버전부터 회전타원&#xccb
측정시 정확도와 강력함을 향상&#x
위해 GeographicLib을 이용합니다. 이 새 기&#xb2
장점을 취하려면 Proj 4.9.0 이상 버전이
필요합니다.

Changed: 3.0.0 - does not depend on SFCGAL anymore.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 8.1.2, 9.5.3

This function supports Polyhedral surfaces.

Note

다면체 표면의 경우, (2.5차원이
아니라) 2차원 다면체 표면만
지원합니다. 2.5차원일 경우
0이 아닌(non-zero) 답을 내놓을 수도
있지만, XY 평면상에 완벽하게
놓이는 면들의 면적만
반환하는 것입니다.

예시

매사추세츠 토지의 부지(plot)에 대&#xd57
평방피트 단위로 면적을 반환하&#
이에 환산값을 곱해서 평방미터
면적을 구합니다. EPSG:2249가 매사추세&
주 피트 단위 평면이기 때문에 평&#
단위의 값을 반환한다는 점에 주&#

```
select ST_Area(geom) sqft,
    ST_Area(geom) * 0.3048 ^ 2 sqm
from (
         select 'SRID=2249;POLYGON((743238 2967416,743238 2967450,
                                    743265 2967450,743265.625 2967416,743238 2967416))' ::  ↩
                                        geometry geom
     ) subquery;
&#x250c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x252c;&#x2500;&#x2
&#x2502;   sqft    &#x2502;      sqm      &#x2502;
&#x251c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x253c;&#x2500;&#x2
&#x2502; 928.625 &#x2502; 86.27208552 &#x2502;
&#x2514;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2534;&#x2500;&#x2
```

평방피트 면적을 반환하며, 평방&#
값을 구하려면 매사추세츠 주 미&#x
단위 평면((EPSG:26986))으로 변환해야 합&#xb2
EPSG:2249가 매사추세츠 주 피트 단위 평&
때문에 평방피트 단위의 값을 반&#
EPSG:26986이 매사추세츠 주 미터 단위 평&
때문에 변환된 면적이 평방미터
단위가 된다는 점에 주의하십시&#x

```
select ST_Area(geom) sqft,
    ST_Area(ST_Transform(geom, 26986)) As sqm
from (
         select
             'SRID=2249;POLYGON((743238 2967416,743238 2967450,
             743265 2967450,743265.625 2967416,743238 2967416))' :: geometry geom
     ) subquery;
&#x250c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x252c;&#x2500;&#x2
&#x2502;  sqft   &#x2502;       sqm       &#x2502;
&#x251c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x253c;&#x2500;&#x2
&#x2502; 928.625 &#x2502; 86.272430607008 &#x2502;
&#x2514;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2534;&#x2500;&#x2
```

지리형 데이터 유형을 이용해서
평방피트 및 평방미터 면적을 반&#
도형을 지리형으로 변환시킨다&#x
점에 주의하십시오(변환하기 전&#x
사용자 도형의 투영체가 WGS84 4326 경위
좌표계인지 확인해야 합니다). 지&#
항상 미터 단위로 측정됩니다. 이
예시는 그저 비교해보기 위한 보&#x
불과합니다. 일반적으로 이미 사&#x
테이블에 지리형 데이터 유형으&#
저장되어 있을 겁니다.

```
select ST_Area(geog) / 0.3048 ^ 2 sqft_spheroid,
    ST_Area(geog, false) / 0.3048 ^ 2 sqft_sphere,
    ST_Area(geog) sqm_spheroid
from (
         select ST_Transform(
                    'SRID=2249;POLYGON((743238 2967416,743238 2967450,743265  ↩
                       2967450,743265.625 2967416,743238 2967416))'::geometry,
                    4326
                ) :: geography geog
     ) as subquery;
&#x250c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2
&#x2502;  sqft_spheroid   &#x2502;   sqft_sphere    &#x2502;   sqm_spheroid   &#x2502;
&#x251c;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2
&#x2502; 928.684405784452 &#x2502; 927.049336105925 &#x2502; 86.2776044979692 &#x2502;
&#x2514;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2
```

If your data is in geography already:

```
select ST_Area(geog) / 0.3048 ^ 2 sqft,
    ST_Area(the_geog) sqm
from somegeogtable;
```

참고

ST_3DArea, ST_GeomFromEWKT, ST_LengthSpheroid, ST_Perimeter, ST_Transform

7.12.2 ST_Azimuth

ST_Azimuth — 두 도형 사이의 2차원 최단 라&#xc
반환합니다.

Synopsis

float **ST_Azimuth**(geometry origin, geometry target);
float **ST_Azimuth**(geography origin, geography target);

설명

Returns the azimuth in radians of the target point from the origin point, or NULL if the two points are coincident. The azimuth angle is a positive clockwise angle referenced from the positive Y axis (geometry) or the North meridian (geography): North = 0; Northeast = $\pi/4$; East = $\pi/2$; Southeast = $3\pi/4$; South = π; Southwest $5\pi/4$; West = $3\pi/2$; Northwest = $7\pi/4$.

For the geography type, the azimuth solution is known as the inverse geodesic problem.

The azimuth is a mathematical concept defined as the angle between a reference vector and a point, with angular units in radians. The result value in radians can be converted to degrees using the PostgreSQL function `degrees()`.

객체를 해당 객체의 수직축을 따&#x 이동시키기 위해 ST_Translate 함수와 방&#xc704 함께 이용할 때 방위각이 특히 유&# 이런 내용의 예시를 보려면 Plpgsqlfunctions PostGIS wiki section 의 upgis_lineshift 단원을 살펴보십시&#xc62

1.1.0 버전부터 사용할 수 있습니다.

개선 사항: 2.0.0 버전부터 지리형을 지원합니다.

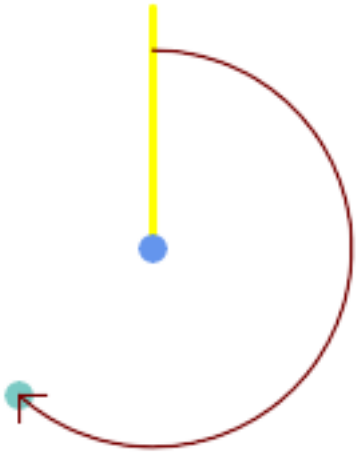
개선 사항: 2.2.0 버전부터 회전타원&#xccb 측정시 정확도와 강력함을 향상&# 위해 GeographicLib을 이용합니다. 이 새 기&#xb2 장점을 취하려면 Proj 4.9.0 이상 버전이 필요합니다.

예시

도 단위의 도형 방위각

```
SELECT degrees(ST_Azimuth( ST_Point(25, 45),  ST_Point(75, 100))) AS degA_B,
       degrees(ST_Azimuth( ST_Point(75, 100), ST_Point(25, 45) )) AS degB_A;

      dega_b       |      degb_a
-------------------+-------------------
 42.2736890060937 | 222.273689006094
```

Blue: origin Point(25,45); Green: target Point(75, 100); Yellow: Y axis or North; Red: azimuth angle.



Blue: origin Point(75, 100); Green: target Point(25, 45); Yellow: Y axis or North; Red: azimuth angle.

참고

ST_Angle, ST_Translate, ST_Project, PostgreSQL Math Functions

7.12.3 ST_Angle

ST_Angle — 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.

Synopsis

float **ST_Angle**(geometry point1, geometry point2, geometry point3, geometry point4);
float **ST_Angle**(geometry line1, geometry line2);

설명

두 도형 사이의 3차원 최장(longest) 라인&#x 반환합니다.

Variant 1: computes the angle enclosed by the points P1-P2-P3. If a 4th point provided computes the angle points P1-P2 and P3-P4

Variant 2: computes the angle between two vectors S1-E1 and S2-E2, defined by the start and end points of the input lines

방위각은 참조 평면과 포인트 사&#x 라디안 단위의 각도로 정의되는 수학적 개념입니다. PostgreSQL 내장 함수 degrees()를 써서 라디안 단위를 도 단위&#x 변환할 수 있습니다. 예시 코드를 확인해보십시오.

Note that `ST_Angle(P1,P2,P3) = ST_Angle(P2,P1,P2,P3)`.

Availability: 2.5.0

예시

폴리곤과 폴리곤 사이의 최장 라&#xc

```
SELECT degrees( ST_Angle('POINT(0 0)', 'POINT(10 10)', 'POINT(20 0)') );

 degrees
---------
     270
```

Angle between vectors defined by four points

```
SELECT degrees( ST_Angle('POINT (10 10)', 'POINT (0 0)', 'POINT(90 90)', 'POINT (100 80)')  ↩
    );

      degrees
-------------------
 269.9999999999999
```

Angle between vectors defined by the start and end points of lines

```
SELECT degrees( ST_Angle('LINESTRING(0 0, 0.3 0.7, 1 1)', 'LINESTRING(0 0, 0.2 0.5, 1 0)')  ↩
    );

      degrees
--------------
           45
```

참고

ST_Azimuth

7.12.4 ST_ClosestPoint

ST_ClosestPoint — Returns the 2D point on g1 that is closest to g2. This is the first point of the shortest line from one geometry to the other.

Synopsis

geometry **ST_ClosestPoint**(geometry geom1, geometry geom2);
geography **ST_ClosestPoint**(geography geom1, geography geom2, boolean use_spheroid = true);

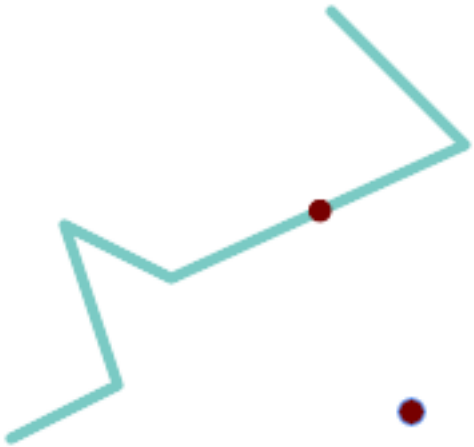
설명

Returns the 2-dimensional point on `geom1` that is closest to `geom2`. This is the first point of the shortest line between the geometries (as computed by ST_ShortestLine).

Note
3차원 도형의 경우엔 ST_3DClosestPoint 함수를 이용하는 편이 좋습니다.

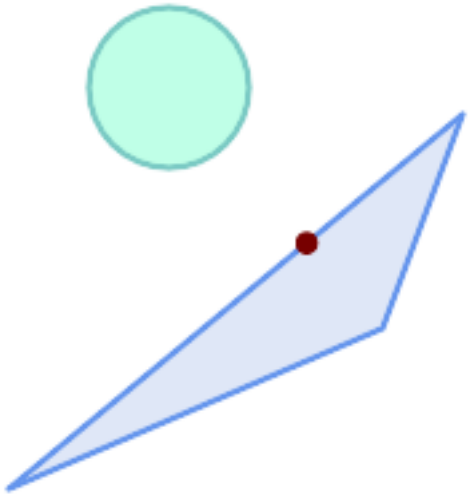
1.5.0 버전부터 사용할 수 있습니다.

예시



The closest point for a Point and a LineString is the point itself. The closest point for a LineString and a Point is a point on the line.

```
SELECT ST_AsText( ST_ClosestPoint(pt,line)) AS cp_pt_line,
       ST_AsText( ST_ClosestPoint(line,pt)) AS cp_line_pt
    FROM (SELECT 'POINT (160 40)'::geometry AS pt,
                 'LINESTRING (10 30, 50 50, 30 110, 70 90, 180 140, 130 190)'::geometry AS  ↩
                    line ) AS t;

   cp_pt_line   |               cp_line_pt
----------------+-----------------------------------------
 POINT(160 40)  | POINT(125.75342465753425 115.34246575342466)
```



The closest point on polygon A to polygon B

```
SELECT ST_AsText( ST_ClosestPoint(
                'POLYGON ((190 150, 20 10, 160 70, 190 150))',
                ST_Buffer('POINT(80 160)', 30)        )) As ptwkt;
-----------------------------------------
 POINT(131.59149149528952 101.89887534906197)
```

참고

ST_3DClosestPoint, ST_Distance, ST_LongestLine, ST_ShortestLine, ST_MaxDistance

7.12.5 ST_3DClosestPoint

ST_3DClosestPoint — g2에 가장 가까운 g1 상에 있는 3차원 포인트를 반환합니다. 해당 포인트는 3D 최단 라인의 첫 번째 포인트입니다.

Synopsis

geometry **ST_3DClosestPoint**(geometry g1, geometry g2);

설명

g2에 가장 가까운 g1 상에 있는 3차원 포인트를 반환합니다. 해당 포인&#x
3D 최단 라인의 첫 번째 포인트입니&
3D 최단 라인의 3D 길이가 3D 거리입니&#x

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

2.0.0 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 버전부터 2D 도형 두 개&#
입력할 경우, (존재하지 않는 Z을
0으로 가정하는 예전 습성 대신) 2D
포인트를 반환합니다. 2D 및 3D의 경&#xc0
더 이상 Z가 없을 때 Z를 0으로 가정&#xd55
않습니다.

예시

라인스트링과 포인트 -- 3D, 2D
모두의 최근접점(closest point)

```
SELECT ST_AsEWKT(ST_3DClosestPoint(line,pt)) AS cp3d_line_pt,
                ST_AsEWKT(ST_ClosestPoint(line,pt)) As cp2d_line_pt
        FROM (SELECT 'POINT(100 100 30)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 1000)':: ↩
    geometry As line
                ) As foo;


 cp3d_line_pt                                                  |                ↩
    cp2d_line_pt
---------------------------------------------------------------+-----------------------------------

 POINT(54.6993798867619 128.935022917228 11.5475869506606) | POINT(73.0769230769231  ↩
    115.384615384615)
```

라인스트링과 멀티포인트 -- 3D, 2D 모두의 최근접점(closest point)

```
SELECT ST_AsEWKT(ST_3DClosestPoint(line,pt)) AS cp3d_line_pt,
                ST_AsEWKT(ST_ClosestPoint(line,pt)) As cp2d_line_pt
        FROM (SELECT 'MULTIPOINT(100 100 30, 50 74 1000)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 900)':: ↩
     geometry As line
                ) As foo;


                       cp3d_line_pt                          | cp2d_line_pt
-------------------------------------------------------------+--------------
 POINT(54.6993798867619 128.935022917228 11.5475869506606) | POINT(50 75)
```

멀티라인스트링과 폴리곤 -- 3D, 2D 모두의 최근접점(closest point)

```
SELECT ST_AsEWKT(ST_3DClosestPoint(poly, mline)) As cp3d,
    ST_AsEWKT(ST_ClosestPoint(poly, mline)) As cp2d
        FROM (SELECT  ST_GeomFromEWKT('POLYGON((175 150 5, 20 40 5, 35 45 5, 50 60 5,  ↩
     100 100 5, 175 150 5))') As poly,
                ST_GeomFromEWKT('MULTILINESTRING((175 155 2, 20 40 20, 50 60 -2, 125  ↩
     100 1, 175 155 1),
                (1 10 2, 5 20 1))') As mline ) As foo;
                   cp3d                    |     cp2d
-------------------------------------------+--------------
 POINT(39.993580415989 54.1889925532825 5) | POINT(20 40)
```

참고

ST_AsEWKT, ST_ClosestPoint, ST_3DDistance, ST_3DShortestLine

7.12.6 ST_Distance

ST_Distance — 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.

Synopsis

float **ST_Distance**(geometry g1, geometry g2);
float **ST_Distance**(geography geog1, geography geog2, boolean use_spheroid = true);

설명

도형 유형에 대해, 두 도형 사이의 3차원 데카르트 최단 거리를 두 도형투영 단위(SRS 단위)로 반환합니다.

For geography types defaults to return the minimum geodesic distance between two geographies in meters, compute on the spheroid determined by the SRID. If `use_spheroid` is false, a faster spherical calculation is used.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.23

This method supports Circular Strings and Curves.

1.5.0 버전부터 지리형을 지원합니&#xb2e4
대용량 또는 수많은 꼭짓점을 가&#
도형을 더 잘 처리하기 위해 평면&#
대한 속도를 향상시켰습니다.

개선 사항: 2.1.0 버전부터 지리형에
대한 속도가 향상됐습니다. 자세&#
내용은 Making Geography faster 를 참조하십시오.

개선 사항: 2.1.0 버전부터 만곡 도형&#xc7
지원하기 시작했습니다.

개선 사항: 2.2.0 버전부터 회전타원&#xccb
측정시 정확도와 강력함을 향상&#
위해 GeographicLib을 이용합니다. 이 새 기&#xb2
장점을 취하려면 Proj 4.9.0 이상 버전이
필요합니다.

Changed: 3.0.0 - does not depend on SFCGAL anymore.

도형 예시

Geometry example - units in planar degrees 4326 is WGS 84 long lat, units are degrees.

```
SELECT ST_Distance(
    'SRID=4326;POINT(-72.1235 42.3521)'::geometry,
    'SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geometry );
-----------------
0.00150567726382282
```

Geometry example - units in meters (SRID: 3857, proportional to pixels on popular web maps). Although the value is off, nearby ones can be compared correctly, which makes it a good choice for algorithms like KNN or KMeans.

```
SELECT ST_Distance(
    ST_Transform('SRID=4326;POINT(-72.1235 42.3521)'::geometry, 3857),
    ST_Transform('SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geometry, 3857) ) ↩
        ;
-----------------
167.441410065196
```

Geometry example - units in meters (SRID: 3857 as above, but corrected by cos(lat) to account for distortion)

```
SELECT ST_Distance(
    ST_Transform('SRID=4326;POINT(-72.1235 42.3521)'::geometry, 3857),
    ST_Transform('SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geometry, 3857)
                ) * cosd(42.3521);
-----------------
123.742351254151
```

Geometry example - units in meters (SRID: 26986 Massachusetts state plane meters) (most accurate for Massachusetts)

```
SELECT ST_Distance(
    ST_Transform('SRID=4326;POINT(-72.1235 42.3521)'::geometry, 26986),
    ST_Transform('SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geometry, 26986)  ↩
        );
-----------------
123.797937878454
```

Geometry example - units in meters (SRID: 2163 US National Atlas Equal area) (least accurate)

```
SELECT ST_Distance(
    ST_Transform('SRID=4326;POINT(-72.1235 42.3521)'::geometry, 2163),
    ST_Transform('SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geometry, 2163) ) ↩
        ;
------------------
126.664256056812
```

지리형 예시

Same as geometry example but note units in meters - use sphere for slightly faster and less accurate computation.

```
SELECT ST_Distance(gg1, gg2) As spheroid_dist, ST_Distance(gg1, gg2, false) As sphere_dist
FROM (SELECT
    'SRID=4326;POINT(-72.1235 42.3521)'::geography as gg1,
    'SRID=4326;LINESTRING(-72.1260 42.45, -72.123 42.1546)'::geography as gg2
        ) As foo  ;

  spheroid_dist    |   sphere_dist
-------------------+------------------
 123.802076746848 | 123.475736916397
```

참고

ST_3DDistance, ST_DWithin, ST_DistanceSphere, ST_DistanceSpheroid, ST_MaxDistance, ST_HausdorffDistance, ST_FrechetDistan
ST_Transform

7.12.7 ST_3DDistance

ST_3DDistance — 도형 유형에 대해, 두 도형 사&
(SRS에 기반한) 3차원 데카르트 최단
거리를 투영 단위로 반환합니다.

Synopsis

float **ST_3DDistance**(geometry g1, geometry g2);

설명

도형 유형에 대해, 두 도형 사이의
3차원 데카르트 최단 거리를 두 도&
투영 단위(SRS 단위)로 반환합니다.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3

2.0.0 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 버전부터, 2D 및 3D의 경우
더 이상 Z가 없을 때 Z를 0으로 가정&#xd55
않습니다.

Changed: 3.0.0 - SFCGAL version removed

예시

```
-- &#xb3c4;&#xd615; &#xc608;&#xc2dc; - &#xbbf8;&#xd130; &#xb2e8;&#xc704; (SRID 2163 ↩
    &#xbbf8;&#xad6d; &#xb4f1;&#xc801; &#xc804;&#xb3c4;) (2D &#xd3ec;&#xc778;&#xd2b8; ↩
    &#xbc0f; &#xb77c;&#xc778;&#xacfc; &#xbe44;&#xad50;&#xd55c; 3D &#xd3ec;&#xc778;&#xd2b8; ↩
    &#xbc0f; &#xb77c;&#xc778;)
-- &#xc8fc;&#xc758;: &#xd604;&#xc7ac; &#xc218;&#xc9c1; &#xb370;&#xc774;&#xd130;&#xb97c; ↩
    &#xc9c0;&#xc6d0;&#xd558;&#xc9c0; &#xc54a;&#xc73c;&#xbbc0;&#xb85c; Z&#xb97c; ↩
    &#xbcc0;&#xd658;&#xd558;&#xc9c0; &#xc54a;&#xace0; &#xcd5c;&#xc885; ↩
    &#xacb0;&#xacfc;&#xbb3c;&#xacfc; &#xb3d9;&#xc77c;&#xd55c; &#xb2e8;&#xc704;&#xb85c; ↩
    &#xac00;&#xc815;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_3DDistance(
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;POINT(-72.1235 42.3521 4)') ↩
                            ,2163),
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45 ↩
                            15, -72.123 42.1546 20)'),2163)
                ) As dist_3d,
                ST_Distance(
                        ST_Transform(ST_GeomFromText('POINT(-72.1235 42.3521)',4326),2163),
                        ST_Transform(ST_GeomFromText('LINESTRING(-72.1260 42.45, -72.123 ↩
                            42.1546)', 4326),2163)
                ) As dist_2d;

     dist_3d      |     dist_2d
------------------+-----------------
 127.295059324629 | 126.66425605671
```

```
-- &#xba40;&#xd2f0;&#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1;&#xacfc; ↩
    &#xd3f4;&#xb9ac;&#xace4; &#xbaa8;&#xb450;&#xc758; 3D &#xbc0f; 2D &#xac70;&#xb9ac;
-- 3D &#xcd5c;&#xadfc;&#xc811;&#xc810;(closest point) &#xc608;&#xc2dc;&#xc640; ↩
    &#xb3d9;&#xc77c;
SELECT ST_3DDistance(poly, mline) As dist3d,
    ST_Distance(poly, mline) As dist2d
        FROM (SELECT  ST_GeomFromEWKT('POLYGON((175 150 5, 20 40 5, 35 45 5, 50 60 5, 100 ↩
            100 5, 175 150 5))') As poly,
                ST_GeomFromEWKT('MULTILINESTRING((175 155 2, 20 40 20, 50 60 -2, 125 100 1, ↩
                    175 155 1),
                (1 10 2, 5 20 1))') As mline ) As foo;
      dist3d       | dist2d
-------------------+--------
 0.716635696066337 |      0
```

참고

ST_Distance, ST_3DClosestPoint, ST_3DDWithin, ST_3DMaxDistance, ST_3DShortestLine, ST_Transform

7.12.8 ST_DistanceSphere

ST_DistanceSphere — 특정 회전타원체가 주어진
두 경위도 도형 사이의 최단 거리&#
반환합니다. PostGIS 1.5 미만 버전은 포인&
지원했습니다.

Synopsis

float **ST_DistanceSphere**(geometry geomlonlatA, geometry geomlonlatB, float8 radius=6371008);

설명

경위도 포인트 2개 사이의 최단 거&#
미터 단위로 반환합니다. SRID가 정&#xc7
회전타원체에서 추출한 반경을
가진 지구 구체를 이용합니다. ST_Distance
보다는 처리 속도가 빠르지만, 정&#
떨어집니다. PostGIS 1.5 미만 버전에서는
포인트에 대해서만 구현돼 있었&#x

1.5 버전부터 포인트가 아닌 다른
도형 유형을 지원하기 시작했습&#
1.5 미만 버전에서는 포인트에 대해
구현돼 있었습니다.

변경 사항: 2.2.0 미만 버전에서는 ST_Distance_Sph
명칭이었습니다.

예시

```
SELECT round(CAST(ST_DistanceSphere(ST_Centroid(the_geom), ST_GeomFromText('POINT(-118 38) ↩
    ',4326)) As numeric),2) As dist_meters,
round(CAST(ST_Distance(ST_Transform(ST_Centroid(the_geom),32611),
                ST_Transform(ST_GeomFromText('POINT(-118 38)', 4326),32611)) As numeric),2) ↩
                    As dist_utm11_meters,
round(CAST(ST_Distance(ST_Centroid(the_geom), ST_GeomFromText('POINT(-118 38)', 4326)) As  ↩
    numeric),5) As dist_degrees,
round(CAST(ST_Distance(ST_Transform(the_geom,32611),
                ST_Transform(ST_GeomFromText('POINT(-118 38)', 4326),32611)) As numeric),2) ↩
                    As min_dist_line_point_meters
FROM
        (SELECT ST_GeomFromText('LINESTRING(-118.584 38.374,-118.583 38.5)', 4326) As  ↩
           the_geom) as foo;
         dist_meters | dist_utm11_meters | dist_degrees | min_dist_line_point_meters
        -------------+-------------------+--------------+----------------------------
                70424.47 |          70438.00 |      0.72900 |                   65871.18
```

참고

ST_Distance, ST_DistanceSpheroid

7.12.9 ST_DistanceSpheroid

ST_DistanceSpheroid — 특정 회전타원체가 주어&#xc9c4
두 경위도 도형 사이의 최단 거리&#
반환합니다. PostGIS 1.5 미만 버전은 포인&
지원했습니다.

Synopsis

float **ST_DistanceSpheroid**(geometry geomlonlatA, geometry geomlonlatB, spheroid measurement_spheroid=WGS84);

설명

특정 회전타원체가 주어진 두 경&#x
도형 사이의 최단 거리를 반환합&#
주어진 회전타원체에 대한 설명&#x
ST_LengthSpheroid 를 참조하십시오. PostGIS 1.5 미만
버전은 포인트만 지원했습니다.

Note

현재 이 함수는 도형의 SRID를 찾아보지 않고 주어진 회전타원체의 좌표로 쓰여 있다고 가정할 것입니다. 이 함수의 이전 버전은 포인트만 지원했습니다.

1.5 버전부터 포인트가 아닌 다른
도형 유형을 지원하기 시작했습&#x
1.5 미만 버전에서는 포인트에 대해
구현돼 있었습니다.

변경 사항: 2.2.0 미만 버전에서는 ST_Distance_Sph
명칭이었습니다.

예시

```
SELECT round(CAST(
                ST_DistanceSpheroid(ST_Centroid(the_geom), ST_GeomFromText('POINT(-118 38) ↩
                    ',4326), 'SPHEROID["WGS 84",6378137,298.257223563]')
                        As numeric),2) As dist_meters_spheroid,
                round(CAST(ST_DistanceSphere(ST_Centroid(the_geom), ST_GeomFromText('POINT ↩
                    (-118 38)',4326)) As numeric),2) As dist_meters_sphere,
round(CAST(ST_Distance(ST_Transform(ST_Centroid(the_geom),32611),
                ST_Transform(ST_GeomFromText('POINT(-118 38)', 4326),32611)) As numeric),2) ↩
                     As dist_utm11_meters
FROM
        (SELECT ST_GeomFromText('LINESTRING(-118.584 38.374,-118.583 38.5)', 4326) As  ↩
           the_geom) as foo;
 dist_meters_spheroid | dist_meters_sphere | dist_utm11_meters
----------------------+--------------------+-------------------
                       70454.92 |           70424.47 |          70438.00
```

참고

ST_Distance, ST_DistanceSphere

7.12.10 ST_FrechetDistance

ST_FrechetDistance — 두 도형 사이의 3차원 최단(shortest
라인을 반환합니다.

Synopsis

float **ST_FrechetDistance**(geometry g1, geometry g2, float densifyFrac = -1);

설명

Implements algorithm for computing the Fréchet distance restricted to discrete points for both geometries, based on Computing Discrete Fréchet Distance. The Fréchet distance is a measure of similarity between curves that takes into account the location and ordering of the points along the curves. Therefore it is often better than the Hausdorff distance.

When the optional densifyFrac is specified, this function performs a segment densification before computing the discrete Fréchet distance. The densifyFrac parameter sets the fraction by which to densify each segment. Each segment will be split into a number of equal-length subsegments, whose fraction of the total length is closest to the given fraction.

Units are in the units of the spatial reference system of the geometries.

Note

현재 구현된 함수는 불연속 위치로 꼭짓점만 지원합니다. 이를 임의 밀도의 포인트들을 사용할 수 있도록 확장할 수 있습니다.

Note

The smaller densifyFrac we specify, the more acurate Fréchet distance we get. But, the computation time and the memory usage increase with the square of the number of subsegments.

GEOS 모듈로 실행

Availability: 2.4.0 - requires GEOS >= 3.7.0

예시

```
postgres=# SELECT st_frechetdistance('LINESTRING (0 0, 100 0)'::geometry, 'LINESTRING (0 0, ↩
     50 50, 100 0)'::geometry);
 st_frechetdistance
--------------------
   70.7106781186548
(1 row)
```

```
SELECT st_frechetdistance('LINESTRING (0 0, 100 0)'::geometry, 'LINESTRING (0 0, 50 50, 100 ↩
     0)'::geometry, 0.5);
 st_frechetdistance
--------------------
                 50
(1 row)
```

참고

ST_HausdorffDistance

7.12.11 ST_HausdorffDistance

ST_HausdorffDistance — 두 도형 사이의 3차원 최단(short 라인을 반환합니다.

Synopsis

float **ST_HausdorffDistance**(geometry g1, geometry g2);
float **ST_HausdorffDistance**(geometry g1, geometry g2, float densifyFrac);

설명

Returns the Hausdorff distance between two geometries. The Hausdorff distance is a measure of how similar or dissimilar 2 geometries are.

The function actually computes the "Discrete Hausdorff Distance". This is the Hausdorff distance computed at discrete points on the geometries. The `densifyFrac` parameter can be specified, to provide a more accurate answer by densifying segments before computing the discrete Hausdorff distance. Each segment is split into a number of equal-length subsegments whose fraction of the segment length is closest to the given fraction.

Units are in the units of the spatial reference system of the geometries.

Note
This algorithm is NOT equivalent to the standard Hausdorff distance. However, it computes an approximation that is correct for a large subset of useful cases. One important case is Linestrings that are roughly parallel to each other, and roughly equal in length. This is a useful metric for line matching.

1.5.0 버전부터 사용할 수 있습니다.

예시

Hausdorff distance (red) and distance (yellow) between two lines

```
SELECT ST_HausdorffDistance(geomA, geomB),
       ST_Distance(geomA, geomB)
    FROM (SELECT 'LINESTRING (20 70, 70 60, 110 70, 170 70)'::geometry AS geomA,
                 'LINESTRING (20 90, 130 90, 60 100, 190 100)'::geometry AS geomB) AS t;
 st_hausdorffdistance | st_distance
----------------------+-------------
    37.26206567625497 |          20
```

Example: Hausdorff distance with densification.

```
SELECT ST_HausdorffDistance(
            'LINESTRING (130 0, 0 0, 0 150)'::geometry,
            'LINESTRING (10 10, 10 150, 130 10)'::geometry,
            0.5);
 ----------------------
          70
```

Example: For each building, find the parcel that best represents it. First we require that the parcel intersect with the building geometry. `DISTINCT ON` guarantees we get each building listed only once. `ORDER BY ..` `ST_HausdorffDistance` selects the parcel that is most similar to the building.

```
SELECT DISTINCT ON (buildings.gid) buildings.gid, parcels.parcel_id
   FROM buildings
       INNER JOIN parcels
       ON ST_Intersects(buildings.geom, parcels.geom)
   ORDER BY buildings.gid, ST_HausdorffDistance(buildings.geom, parcels.geom);
```

참고

ST_FrechetDistance

7.12.12 ST_Length

ST_Length — 도형의 기하학적 중심을 반&#xd658

Synopsis

float **ST_Length**(geometry a_2dlinestring);
float **ST_Length**(geography geog, boolean use_spheroid = true);

설명

도형의 경우: 도형이 라인스트링, 멀티라인스트링, ST_Curve, ST_MultiCurve일 경우 도형의 2차원 데카르트 길이를 반면 도형의 경우 0을 반환합니다. 도형에 대해서는 ST_Perimeter 를 이용하&#xc2ed 도형 유형의 경우, 도형의 공간 참&#x 시스템이 해당 길이의 측정 단위&#x 설정합니다.

For geography types: computation is performed using the inverse geodesic calculation. Units of length are in meters. If PostGIS is compiled with PROJ version 4.8.0 or later, the spheroid is specified by the SRID, otherwise it is exclusive to WGS84. If `use_spheroid = false`, then the calculation is based on a sphere instead of a spheroid.

도형의 경우 이 함수는 현재 ST_Length2D&#xc64 동일하지만, 향후 더 높은 차원을 지원하기 위해 변경될 수도 있습&#x

Warning

변경 사항: 2.0.0 버전에서 중요한 변경이 이루어졌습니다. 2.0.0 이전 버전에서 이 함수에 폴리곤/멀티폴리곤 유형의 지리형을 입력하면 폴리곤/멀티둘레를 반환했을 겁니다. 2.0.0 버전부터 도형 습성과 맞추기 위해 0을 반환하도록 변경됐습니다. 폴리곤의 둘레를 원한다면 ST_Perimeter 함수를 이용하십시오.

Note

지리형 측정시 기본값은 회전타원체 상의 측정입니다. 더 빠르지만 덜 정확한 구체를 이용하려면 ST_Length(gg,false); 를 쓰십시오.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.5.1

This method implements the SQL/MM specification. SQL-MM 3: 7.1.2, 9.3.4

1.5.0 버전부터 지리형을 지원합니&#xb2e4

도형 예시

라인스트링의 길이를 피트 단위&#x 반환합니다. 투영체 EPSG:2249가 매사추&#x 주 피트 단위 평면이기 때문에 피&#x 단위라는 사실을 주의하십시오.

```
SELECT ST_Length(ST_GeomFromText('LINESTRING(743238 2967416,743238 2967450,743265 2967450,
743265.625 2967416,743238 2967416)',2249));
st_length
---------
 122.630744000095


-- WGS84 &#xb77c;&#xc778;&#xc2a4;&#xd2b8;&#xb9c1;&#xc744;  ↩
    &#xb9e4;&#xc0ac;&#xcd94;&#xc138;&#xce20; &#xc8fc; &#xd53c;&#xd2b8; &#xb2e8;&#xc704;  ↩
    &#xd3c9;&#xba74;&#xc73c;&#xb85c; &#xbcc0;&#xd658;
SELECT ST_Length(
        ST_Transform(
                ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45, -72.1240 42.45666,  ↩
                    -72.123 42.1546)'),
                26986
        )
);
st_length
---------
34309.4563576191
```

지리형 예시

WGS84 지리형 라인의 길이를 반환합&#xb

```
-- &#xacc4;&#xc0b0;&#xc2dc;  ↩
    &#xd68c;&#xc804;&#xd0c0;&#xc6d0;&#xccb4;&#xbcf4;&#xb2e4;&#xb294;  ↩
    &#xad6c;&#xccb4;&#xb97c; &#xc774;&#xc6a9;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_Length(the_geog) As length_spheroid,  ST_Length(the_geog,false) As length_sphere
FROM (SELECT ST_GeographyFromText(
'SRID=4326;LINESTRING(-72.1260 42.45, -72.1240 42.45666, -72.123 42.1546)') As the_geog)
 As foo;
 length_spheroid  |  length_sphere
------------------+------------------
 34310.5703627288 | 34346.2060960742
```

참고

ST_GeographyFromText, ST_GeomFromEWKT, ST_LengthSpheroid, ST_Perimeter, ST_Transform

7.12.13 ST_Length2D

ST_Length2D — 도형이 라인스트링 또는 멀&#xd
경우 도형의 2차원 길이를 반환합&
이 함수는 ST_Length 와 동일합니다.

Synopsis

float **ST_Length2D**(geometry a_2dlinestring);

설명

도형이 라인스트링 또는 멀티라&#
경우 도형의 2차원 길이를 반환합&
이 함수는 ST_Length 와 동일합니다.

참고

ST_Length, ST_3DLength

7.12.14 ST_3DLength

ST_3DLength — 도형의 기하학적 중심을 반&#xd

Synopsis

float **ST_3DLength**(geometry a_3dlinestring);

설명

도형이 라인스트링 또는 멀티라&#
경우 도형의 3차원 또는 2차원 길이
반환합니다. 2차원 라인의 경우 2차
길이만 반환할 것입니다(ST_Length 및 ST_Length
동일합니다).

This function supports 3d and will not drop the z-index.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 7.1, 10.3

변경 사항: 2.0.0 미만 버전에서는 ST_Length3D&#
명칭이었습니다.

예시

3차원 케이블의 길이를 피트 단위&#
반환합니다. 투영체 EPSG:2249가 매사추&
주 피트 단위 평면이기 때문에 피&#
단위라는 사실을 주의하십시오.

```
SELECT ST_3DLength(ST_GeomFromText('LINESTRING(743238 2967416 1,743238 2967450 1,743265  ↩
    2967450 3,
743265.625 2967416 3,743238 2967416 3)',2249));
ST_3DLength
------------
122.704716741457
```

참고

ST_Length, ST_Length2D

7.12.15 ST_LengthSpheroid

ST_LengthSpheroid — 도형의 기하학적 중심을 반

Synopsis

float **ST_LengthSpheroid**(geometry a_geometry, spheroid a_spheroid);

설명

타원체 상에 있는 도형의 길이/둘&#
계산합니다. 이 함수는 도형의 좌&
경도/위도이며 재투영하지 않고
길이를 얻고 싶을 때 유용합니다.
이 타원체는 개별적인 데이터베&#
유형으로 다음과 같이 작성할 수
있습니다:

```
SPHEROID[<NAME>,<SEMI-MAJOR AXIS>,<INVERSE FLATTENING>]
```

도형 예시

```
SPHEROID["GRS_1980",6378137,298.257222101]
```

1.2.2 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 미만 버전에서는 ST_Length_Sphe
명칭이었으며, ST_3DLength_Spheroid라는 동일 &#xd568
있었습니다.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_LengthSpheroid( geometry_column,
                          'SPHEROID["GRS_1980",6378137,298.257222101]' )
                          FROM geometry_table;

SELECT ST_LengthSpheroid( the_geom, sph_m ) As tot_len,
ST_LengthSpheroid(ST_GeometryN(the_geom,1), sph_m) As len_line1,
ST_LengthSpheroid(ST_GeometryN(the_geom,2), sph_m) As len_line2
                          FROM (SELECT ST_GeomFromText('MULTILINESTRING((-118.584  ↩
                              38.374,-118.583 38.5),
        (-71.05957 42.3589 , -71.061 43))') As the_geom,
CAST('SPHEROID["GRS_1980",6378137,298.257222101]' As spheroid) As sph_m)  as foo;
        tot_len      |    len_line1     |    len_line2
-----------------+-----------------+-----------------
 85204.5207562955 | 13986.8725229309 | 71217.6482333646

 -- 3D
SELECT ST_LengthSpheroid( the_geom, sph_m ) As tot_len,
ST_LengthSpheroid(ST_GeometryN(the_geom,1), sph_m) As len_line1,
ST_LengthSpheroid(ST_GeometryN(the_geom,2), sph_m) As len_line2
                          FROM (SELECT ST_GeomFromEWKT('MULTILINESTRING((-118.584 38.374  ↩
                              20,-118.583 38.5 30),
        (-71.05957 42.3589 75, -71.061 43 90))') As the_geom,
CAST('SPHEROID["GRS_1980",6378137,298.257222101]' As spheroid) As sph_m)  as foo;

         tot_len      |    len_line1    |    len_line2
-----------------+-----------------+-----------------
 85204.5259107402 | 13986.876097711 | 71217.6498130292
```

참고

ST_GeometryN, ST_Length

7.12.16 ST_LongestLine

ST_LongestLine — 두 도형 사이의 3차원 최장(longest)
라인을 반환합니다.

Synopsis

geometry **ST_LongestLine**(geometry g1, geometry g2);

설명

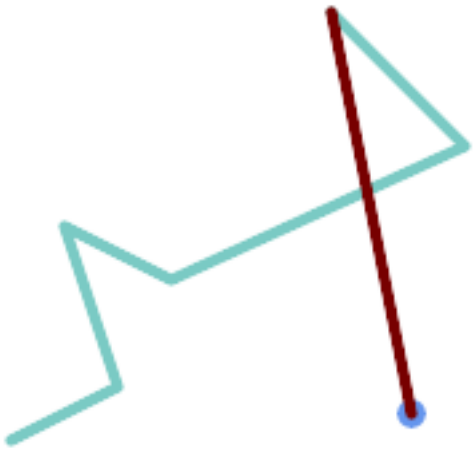
Returns the 2-dimensional longest line between the points of two geometries. The line returned starts on `g1` and ends on `g2`.

The longest line always occurs between two vertices. The function returns the first longest line if more than one is found. The length of the line is equal to the distance returned by ST_MaxDistance.

If g1 and g2 are the same geometry, returns the line between the two vertices farthest apart in the geometry. The endpoints of the line lie on the circle computed by ST_MinimumBoundingCircle.

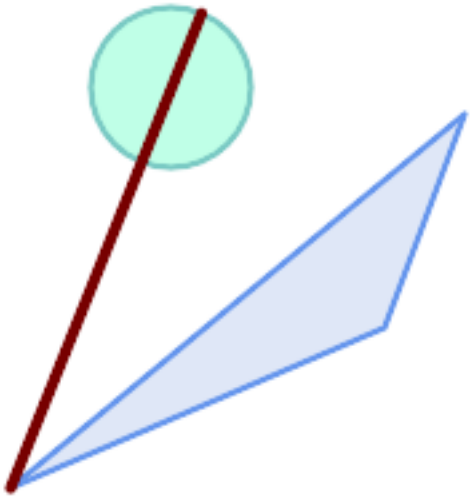
1.5.0 버전부터 사용할 수 있습니다.

예시



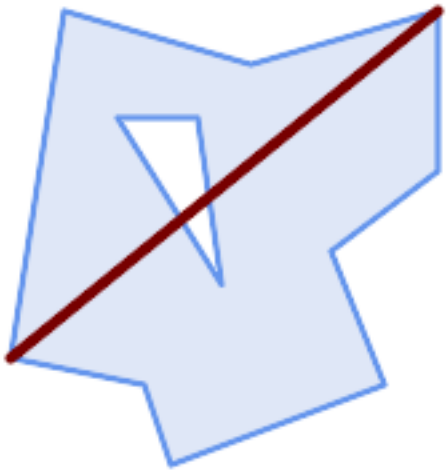
포인트와 라인 사이의 최장 라인

```
SELECT ST_AsText( ST_LongestLine(
        'POINT (160 40)',
        'LINESTRING (10 30, 50 50, 30 110, 70 90, 180 140, 130 190)' )
        ) AS lline;
-----------------
LINESTRING(160 40,130 190)
```



폴리곤과 폴리곤 사이의 최장 라인

```
SELECT ST_AsText( ST_LongestLine(
        'POLYGON ((190 150, 20 10, 160 70, 190 150))',
        ST_Buffer('POINT(80 160)', 30)
            ) ) AS llinewkt;
-----------------
LINESTRING(20 10,105.3073372946034 186.95518130045156)
```



Longest line across a single geometry. The length of the line is equal to the Maximum Distance. The endpoints of the line lie on the Minimum Bounding Circle.

```
SELECT ST_AsText( ST_LongestLine( geom, geom)) AS llinewkt,
                  ST_MaxDistance( geom, geom) AS max_dist,
                  ST_Length( ST_LongestLine(geom, geom)) AS lenll
FROM (SELECT 'POLYGON ((40 180, 110 160, 180 180, 180 120, 140 90, 160 40, 80 10, 70 40, 20 ↩
     50, 40 180),
              (60 140, 99 77.5, 90 140, 60 140))'::geometry AS geom) AS t;

         llinewkt          |      max_dist      |       lenll
---------------------------+--------------------+--------------------
 LINESTRING(20 50,180 180) | 206.15528128088303 | 206.15528128088303
```

참고

ST_MaxDistance, ST_ShortestLine, ST_3DLongestLine, ST_MinimumBoundingCircle

7.12.17 ST_3DLongestLine

ST_3DLongestLine — 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.

Synopsis

geometry **ST_3DLongestLine**(geometry g1, geometry g2);

설명

두 도형 사이의 3차원 최장(longest) 라인반환합니다. 하나 이상의 최장 라인을 경우, 이 함수는 첫 번째 최장 라인만 반환할 것입니다. 반환되라인은 항상 g1에서 시작해서 g2에끝납니다. 이 함수가 반환하는 라인 3차원 길이는 ST_3DMaxDistance 함수가 g1과 g2에 대해 반환하는 길이와 언제나 동&#

2.0.0 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 버전부터 2D 도형 두 개입력할 경우, (존재하지 않는 Z을 0으로 가정하는 예전 습성 대신) 2D 포인트를 반환합니다. 2D 및 3D의 경&#xc0더 이상 Z가 없을 때 Z를 0으로 가정&#xd55않습니다.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

라인스트링과 포인트 -- 3D, 2D
모두의 최장 라인

```
SELECT ST_AsEWKT(ST_3DLongestLine(line,pt)) AS lol3d_line_pt,
                ST_AsEWKT(ST_LongestLine(line,pt)) As lol2d_line_pt
        FROM (SELECT 'POINT(100 100 30)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 1000)':: ↩
    geometry As line
                ) As foo;


           lol3d_line_pt            |       lol2d_line_pt
------------------------------------+---------------------------
 LINESTRING(50 75 1000,100 100 30) | LINESTRING(98 190,100 100)
```

라인스트링과 멀티포인트 -- 3D, 2D 모두의 최장 라인

```
SELECT ST_AsEWKT(ST_3DLongestLine(line,pt)) AS lol3d_line_pt,
                ST_AsEWKT(ST_LongestLine(line,pt)) As lol2d_line_pt
        FROM (SELECT 'MULTIPOINT(100 100 30, 50 74 1000)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 900)':: ↩
     geometry As line
                ) As foo;


          lol3d_line_pt          |      lol2d_line_pt
---------------------------------+--------------------------
 LINESTRING(98 190 1,50 74 1000) | LINESTRING(98 190,50 74)
```

멀티라인스트링과 폴리곤 -- 3D, 2D 모두의 최장 라인

```
SELECT ST_AsEWKT(ST_3DLongestLine(poly, mline)) As lol3d,
    ST_AsEWKT(ST_LongestLine(poly, mline)) As lol2d
        FROM (SELECT  ST_GeomFromEWKT('POLYGON((175 150 5, 20 40 5, 35 45 5, 50 60 5,  ↩
     100 100 5, 175 150 5))') As poly,
                ST_GeomFromEWKT('MULTILINESTRING((175 155 2, 20 40 20, 50 60 -2, 125  ↩
     100 1, 175 155 1),
                (1 10 2, 5 20 1))') As mline ) As foo;
            lol3d             |          lol2d
------------------------------+--------------------------
 LINESTRING(175 150 5,1 10 2) | LINESTRING(175 150,1 10)
```

참고

ST_3DClosestPoint, ST_3DDistance, ST_LongestLine, ST_3DShortestLine, ST_3DMaxDistance

7.12.18 ST_MaxDistance

ST_MaxDistance — 두 도형 사이의 2차원 최장 거리를 투영 단위로 반환합니다.

Synopsis

float **ST_MaxDistance**(geometry g1, geometry g2);

설명

두 도형 사이의 2차원 최장 거리를 투영 단위로 반환합니다. g1과 g2가 동일한 도형일 경우 이 함수는 해&#x
도형 내에서 서로 가장 멀리 있는 두 꼭짓점 사이의 거리를 반환합&#x

두 도형 사이의 2차원 최장 거리를 투영 단위로 반환합니다. g1과 g2가 동일한 도형일 경우 이 함수는 해&#x
도형 내에서 서로 가장 멀리 있는 두 꼭짓점 사이의 거리를 반환합&#x

1.5.0 버전부터 사용할 수 있습니다.

예시

포인트와 라인 사이의 최장 라인

```
SELECT ST_MaxDistance('POINT(0 0)'::geometry, 'LINESTRING ( 2 0, 0 2 )'::geometry);
-----------------
 2

SELECT ST_MaxDistance('POINT(0 0)'::geometry, 'LINESTRING ( 2 2, 2 2 )'::geometry);
------------------
 2.82842712474619
```

Maximum distance between vertices of a single geometry.

```
SELECT ST_MaxDistance('POLYGON ((10 10, 10 0, 0 0, 10 10))'::geometry,
                      'POLYGON ((10 10, 10 0, 0 0, 10 10))'::geometry);
------------------
 14.142135623730951
```

참고

ST_Distance, ST_LongestLine, ST_DFullyWithin

7.12.19 ST_3DMaxDistance

ST_3DMaxDistance — 도형 유형에 대해, 두 도형 사이의 (SRS에 기반한) 3차원 데카르&#xd2
최장 거리를 투영 단위로 반환합&#

Synopsis

float **ST_3DMaxDistance**(geometry g1, geometry g2);

설명

도형 유형에 대해, 두 도형 사이의 3차원 데카르트 최대 거리를 두 도&#
투영 단위(SRS 단위)로 반환합니다.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

2.0.0 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 버전부터, 2D 및 3D의 경우
더 이상 Z가 없을 때 Z를 0으로 가정&#xd55
않습니다.

예시

```
-- &#xb3c4;&#xd615; &#xc608;&#xc2dc; - &#xbbf8;&#xd130; &#xb2e8;&#xc704; (SRID 2163 ↩
    &#xbbf8;&#xad6d; &#xb4f1;&#xc801; &#xc804;&#xb3c4;) (2D &#xd3ec;&#xc778;&#xd2b8; ↩
    &#xbc0f; &#xb77c;&#xc778;&#xacfc; &#xbe44;&#xad50;&#xd55c; 3D &#xd3ec;&#xc778;&#xd2b8; ↩
    &#xbc0f; &#xb77c;&#xc778;)
-- &#xc8fc;&#xc758;: &#xd604;&#xc7ac; &#xc218;&#xc9c1; &#xb370;&#xc774;&#xd130;&#xb97c; ↩
    &#xc9c0;&#xc6d0;&#xd558;&#xc9c0; &#xc54a;&#xc73c;&#xbbc0;&#xb85c; Z&#xb97c; ↩
    &#xbcc0;&#xd658;&#xd558;&#xc9c0; &#xc54a;&#xace0; &#xcd5c;&#xc885; ↩
    &#xacb0;&#xacfc;&#xbb3c;&#xacfc; &#xb3d9;&#xc77c;&#xd55c; &#xb2e8;&#xc704;&#xb85c; ↩
    &#xac00;&#xc815;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_3DMaxDistance(
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;POINT(-72.1235 42.3521 ↩
                            10000)'),2163),
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45 ↩
                            15, -72.123 42.1546 20)'),2163)
                ) As dist_3d,
                ST_MaxDistance(
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;POINT(-72.1235 42.3521 ↩
                            10000)'),2163),
                        ST_Transform(ST_GeomFromEWKT('SRID=4326;LINESTRING(-72.1260 42.45 ↩
                            15, -72.123 42.1546 20)'),2163)
                ) As dist_2d;

     dist_3d      |     dist_2d
------------------+------------------
 24383.7467488441 | 22247.8472107251
```

참고

ST_Distance, ST_3DDWithin, ST_3DMaxDistance, ST_Transform

7.12.20 ST_MinimumClearance

ST_MinimumClearance — 도형의 튼튼함(robustness)의 척도&#x
도형의 최소 여유(clearance)를 반환합니&#

Synopsis

float **ST_MinimumClearance**(geometry g);

설명

(폴리곤일 경우) ST_IsValid 또는 (라인일 경
ST_IsSimple 함수에 따라 유효성에 대한
기준을 만족시키지만, 텍스트 기&#x
형식(WKT, KML, GML GeoJSON 등) 또는 이중 정밀도
부동소수점 좌표를 이용하지 않&#x
바이너리 형식(MapInfo TAB 등)으로 변환&#xd55
과정에서 일어날 수 있는 것처럼,
꼭짓점 가운데 하나가 살짝 이동&#
유효하지 않아지는 도형이 그렇&#x
희귀한 것은 아닙니다.

The minimum clearance is a quantitative measure of a geometry's robustness to change in coordinate precision. It is the largest distance by which vertices of the geometry can be moved without creating an invalid geometry. Larger values of minimum clearance indicate greater robustness.

도형이 e 라는 최소 여유를 가지고 있을 경우, 다음과 같이 말할 수 있&#

- 도형 내부의 어떤 서로 다른 꼭짓&
  2개도 e 보다 더 떨어져 있지 않습&#xb2c
- 종단점이 아닌 한 어떤 꼭짓점도
  라인 선분에 e 보다 가까이 있을
  수는 없습니다.

도형에 대해 최소 여유가 존재하&#
않을 경우 (예를 들어 단일 포인트
또는 포인트들이 서로 동일한 멀&#
경우) ST_MinimumClearance 함수는 무한을 반환&#xd56
것입니다.

To avoid validity issues caused by precision loss, ST_ReducePrecision can reduce coordinate precision while ensuring that polygonal geometry remains valid.

2.3.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_MinimumClearance('POLYGON ((0 0, 1 0, 1 1, 0.5 3.2e-4, 0 0))');
 st_minimumclearance
---------------------
             0.00032
```

참고

ST_MinimumClearanceLine, ST_Crosses, ST_Dimension, ST_Intersects

7.12.21 ST_MinimumClearanceLine

ST_MinimumClearanceLine — 포인트 2개로 이루어진, 도
최소 여유를 나타내는 라인스트&#
반환합니다.

Synopsis

Geometry **ST_MinimumClearanceLine**(geometry g);

설명

Returns the two-point LineString spanning a geometry's minimum clearance. If the geometry does not have a minimum clearance, LINESTRING EMPTY is returned.

GEOS 모듈로 실행

2.3.0 버전부터 사용할 수 있습니다.
GEOS 3.6.0 이상 버전이 필요합니다.

예시

```
SELECT ST_AsText(ST_MinimumClearanceLine('POLYGON ((0 0, 1 0, 1 1, 0.5 3.2e-4, 0 0))'));
------------------------------
LINESTRING(0.5 0.00032,0.5 0)
```

참고

ST_MinimumClearance

7.12.22 ST_Perimeter

ST_Perimeter — Returns the length of the boundary of a polygonal geometry or geography.

Synopsis

float **ST_Perimeter**(geometry g1);
float **ST_Perimeter**(geography geog, boolean use_spheroid = true);

설명

도형/지리형이 ST_Surface, ST_MultiSurface(폴리곤, 멀&#
경우 도형/지리형의 2차원 둘레를
반환합니다. 면이 없는 도형의 경&
0을 반환합니다. 선형 도형의 경우
ST_Length 를 이용하십시오. 도형 유형의
경우, 도형의 공간 참조 시스템이
해당 둘레의 측정 단위를 설정합&#

For geography types, the calculations are performed using the inverse geodesic problem, where perimeter units are in meters. If PostGIS is compiled with PROJ version 4.8.0 or later, the spheroid is specified by the SRID, otherwise it is exclusive to WGS84. If `use_spheroid = false`, then calculations will approximate a sphere instead of a spheroid.

이 함수는 현재 ST_Perimeter2D와 동일하지&#xb
향후 더 높은 차원을 지원하기 위&#
변경될 수도 있습니다.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.5.1

This method implements the SQL/MM specification. SQL-MM 3: 8.1.3, 9.5.4

개선 사항: 2.0.0 버전부터 지리형을
지원합니다.

예시: 도형

폴리곤 및 멀티폴리곤의 둘레를
피트 단위로 반환합니다. 투영체
EPSG:2249가 매사추세츠 주 피트 단위 평&
때문에 피트 단위라는 사실을 주&#

```
SELECT ST_Perimeter(ST_GeomFromText('POLYGON((743238 2967416,743238 2967450,743265 2967450,
743265.625 2967416,743238 2967416))', 2249));
st_perimeter
---------
```

```
 122.630744000095
(1 row)

SELECT ST_Perimeter(ST_GeomFromText('MULTIPOLYGON(((763104.471273676 2949418.44119003,
763104.477769673 2949418.42538203,
763104.189609677 2949418.22343004,763104.471273676 2949418.44119003)),
((763104.471273676 2949418.44119003,763095.804579742 2949436.33850239,
763086.132105649 2949451.46730207,763078.452329651 2949462.11549407,
763075.354136904 2949466.17407812,763064.362142565 2949477.64291974,
763059.953961626 2949481.28983009,762994.637609571 2949532.04103014,
762990.568508415 2949535.06640477,762986.710889563 2949539.61421415,
763117.237897679 2949709.50493431,763235.236617789 2949617.95619822,
763287.718121842 2949562.20592617,763111.553321674 2949423.91664605,
763104.471273676 2949418.44119003)))', 2249));
st_perimeter
---------
 845.227713366825
(1 row)
```

예시: 지리형

폴리곤 및 멀티폴리곤의 둘레를 미터 단위로 반환합니다. 지리형&#
때문에 투영체가 WGS84 경위도라는
점에 주의하십시오.

```
SELECT  ST_Perimeter(geog) As per_meters, ST_Perimeter(geog)/0.3048 As per_ft
FROM ST_GeogFromText('POLYGON((-71.1776848522251 42.3902896512902,-71.1776843766326  ↩
    42.3903829478009,
-71.1775844305465 42.3903826677917,-71.1775825927231 42.3902893647987,-71.1776848522251  ↩
    42.3902896512902))') As geog;

   per_meters    |      per_ft
-----------------+------------------
37.3790462565251 | 122.634666195949


-- &#xba40;&#xd2f0;&#xd3f4;&#xb9ac;&#xace4; &#xc608;&#xc2dc; --
SELECT  ST_Perimeter(geog) As per_meters, ST_Perimeter(geog,false) As per_sphere_meters,   ↩
    ST_Perimeter(geog)/0.3048 As per_ft
FROM ST_GeogFromText('MULTIPOLYGON(((-71.1044543107478 42.340674480411,-71.1044542869917  ↩
    42.3406744369506,
-71.1044553562977 42.340673886454,-71.1044543107478 42.340674480411)),
((-71.1044543107478 42.340674480411,-71.1044860600303 42.3407237015564,-71.1045215770124  ↩
    42.3407653385914,
-71.1045498002983 42.3407946553165,-71.1045611902745 42.3408058316308,-71.1046016507427  ↩
    42.340837442371,
-71.104617893173 42.3408475056957,-71.1048586153981 42.3409875993595,-71.1048736143677  ↩
    42.3409959528211,
-71.1048878050242 42.3410084812078,-71.1044020965803 42.3414730072048,
-71.1039672113619 42.3412202916693,-71.1037740497748 42.3410666421308,
-71.1044280218456 42.3406894151355,-71.1044543107478 42.340674480411)))') As geog;

    per_meters    | per_sphere_meters |      per_ft
------------------+-------------------+------------------
 257.634283683311 |  257.412311446337 | 845.256836231335
```

참고

ST_GeogFromText, ST_GeomFromText, ST_Length

7.12.23 ST_Perimeter2D

ST_Perimeter2D — Returns the 2D perimeter of a polygonal geometry. Alias for `ST_Perimeter`.

Synopsis

float **ST_Perimeter2D**(geometry geomA);

설명

도형이 폴리곤 또는 멀티폴리곤&#x
경우 도형의 2차원 둘레를 반환합&

> **Note**
> 이 함수는 현재 `ST_Perimeter` 와 동일합니다. 향후 버전에서 `ST_Perimeter` 는 도형에 대해 최고 차원의 둘레를 반환할 수도 있습니다. 이는 아직 고려 대상입니다.

참고

ST_Perimeter

7.12.24 ST_3DPerimeter

ST_3DPerimeter — 도형의 기하학적 중심을 반&#

Synopsis

float **ST_3DPerimeter**(geometry geomA);

설명

도형이 폴리곤 또는 멀티폴리곤&#x
경우 도형의 3차원 둘레를 반환합&
2차원 도형의 경우 2차원 둘레를 반
것입니다.

This function supports 3d and will not drop the z-index.

This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.1, 10.5

변경 사항: 2.0.0 미만 버전에서는 ST_Perimeter3D&
명칭이었습니다.

예시

매사추세츠 주 피트 단위 평면에&#x
공중에 살짝 떠 있는 폴리곤의 둘&#

```
SELECT ST_3DPerimeter(the_geom), ST_Perimeter2d(the_geom), ST_Perimeter(the_geom) FROM
                        (SELECT ST_GeomFromEWKT('SRID=2249;POLYGON((743238 2967416 2,743238 ↩
                            2967450 1,
743265.625 2967416 1,743238 2967416 2))') As the_geom) As foo;

  ST_3DPerimeter   |  st_perimeter2d  |   st_perimeter
-------------------+------------------+------------------
 105.465793597674 | 105.432997272188 | 105.432997272188
```

참고

ST_GeomFromEWKT, ST_Perimeter, ST_Perimeter2D

7.12.25 ST_ShortestLine

ST_ShortestLine — 두 도형 사이의 2차원 최단 라&
반환합니다.

Synopsis

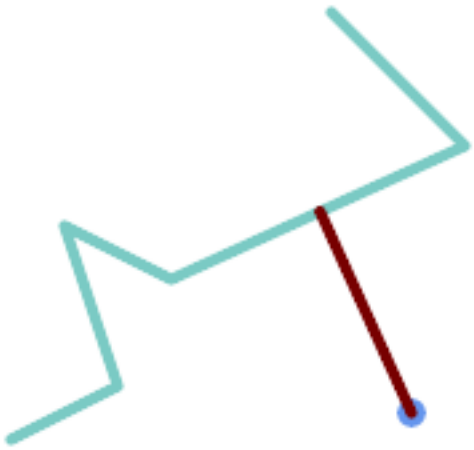
geometry **ST_ShortestLine**(geometry geom1, geometry geom2);
geography **ST_ShortestLine**(geography geom1, geography geom2, boolean use_spheroid = true);

설명

Returns the 2-dimensional shortest line between two geometries. The line returned starts in `geom1` and ends in `geom2`. If `geom1` and `geom2` intersect the result is a line with start and end at an intersection point. The length of the line is the same as ST_Distance returns for g1 and g2.

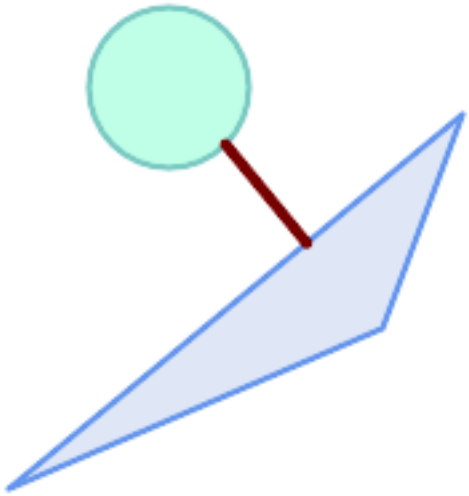
1.5.0 버전부터 사용할 수 있습니다.

예시



Shortest line between Point and LineString

```
SELECT ST_AsText(  ST_ShortestLine(
        'POINT (160 40)',
        'LINESTRING (10 30, 50 50, 30 110, 70 90, 180 140, 130 190)')
        ) As sline;
-------------------------------------------------------
 LINESTRING(160 40,125.75342465753425 115.34246575342466)
```



Shortest line between Polygons

```
SELECT ST_AsText( ST_ShortestLine(
         'POLYGON ((190 150, 20 10, 160 70, 190 150))',
         ST_Buffer('POINT(80 160)', 30)
              ) ) AS llinewkt;
-----------------
LINESTRING(131.59149149528952 101.89887534906197,101.21320343559644 138.78679656440357)
```

참고

ST_ClosestPoint, ST_Distance, ST_LongestLine, ST_MaxDistance

7.12.26 ST_3DShortestLine

ST_3DShortestLine — 두 도형 사이의 3차원 최단(shortest 라인을 반환합니다.

Synopsis

geometry **ST_3DShortestLine**(geometry g1, geometry g2);

설명

두 도형 사이의 3차원 최단(shortest) 라인&# 반환합니다. 하나 이상의 최단 라&# 있을 경우, 이 함수는 첫 번째 최단 라인만 반환할 것입니다. g1과 g2가 단 한 개의 포인트에서만 교차할 경우, 이 함수는 교차점에서 시작&# 끝나는 라인을 반환할 것입니다. g1과 g2가 한 개 이상의 포인트에서 교차할 경우, 이 함수는 동일한 포&# 시작하고 끝나는 라인을 반환하&# 해당 포인트는 교차하는 포인트&# 가운데 어떤 포인트라도 될 수 있&# 반환되는 라인은 항상 g1에서 시작& g2에서 끝납니다. 이 함수가 반환&#xd558 라인의 3차원 길이는 ST_3DDistance 함수가 g1과 g2에 대해 반환하는 길이와 언&#xc81 동일합니다.

2.0.0 버전부터 사용할 수 있습니다.

변경 사항: 2.2.0 버전부터 2D 도형 두 개&# 입력할 경우, (존재하지 않는 Z을 0으로 가정하는 예전 습성 대신) 2D 포인트를 반환합니다. 2D 및 3D의 경&#xc0 더 이상 Z가 없을 때 Z를 0으로 가정&#xd55 않습니다.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

예시

라인스트링과 포인트 -- 3D, 2D 모두의 최단 라인

```
SELECT ST_AsEWKT(ST_3DShortestLine(line,pt)) AS shl3d_line_pt,
                ST_AsEWKT(ST_ShortestLine(line,pt)) As shl2d_line_pt
        FROM (SELECT 'POINT(100 100 30)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 1000)':: ↩
    geometry As line
                ) As foo;


 shl3d_line_pt                                                          |  ↩
                  shl2d_line_pt
------------------------------------------------------------------------------+--------------------

 LINESTRING(54.6993798867619 128.935022917228 11.5475869506606,100 100 30)  |  ↩
    LINESTRING(73.0769230769231 115.384615384615,100 100)
```

라인스트링과 멀티포인트 -- 3D, 2D 모두의 최단 라인

```
SELECT ST_AsEWKT(ST_3DShortestLine(line,pt)) AS shl3d_line_pt,
                ST_AsEWKT(ST_ShortestLine(line,pt)) As shl2d_line_pt
        FROM (SELECT 'MULTIPOINT(100 100 30, 50 74 1000)'::geometry As pt,
                        'LINESTRING (20 80 20, 98 190 1, 110 180 3, 50 75 900)':: ↩
    geometry As line
                ) As foo;


                       shl3d_line_pt                                    |  ↩
    shl2d_line_pt
------------------------------------------------------------------------------+--------------------

 LINESTRING(54.6993798867619 128.935022917228 11.5475869506606,100 100 30) | LINESTRING ↩
    (50 75,50 74)
```

멀티라인스트링과 폴리곤 -- 3D, 2D 모두의 최단 라인

```
SELECT ST_AsEWKT(ST_3DShortestLine(poly, mline)) As shl3d,
    ST_AsEWKT(ST_ShortestLine(poly, mline)) As shl2d
        FROM (SELECT  ST_GeomFromEWKT('POLYGON((175 150 5, 20 40 5, 35 45 5, 50 60 5,  ↩
    100 100 5, 175 150 5))') As poly,
                ST_GeomFromEWKT('MULTILINESTRING((175 155 2, 20 40 20, 50 60 -2, 125  ↩
    100 1, 175 155 1),
                (1 10 2, 5 20 1))') As mline ) As foo;
                   shl3d  ↩
                                                                        |     shl2d
------------------------------------------------------------------------------------------------------

 LINESTRING(39.993580415989 54.1889925532825 5,40.4078575708294 53.6052383805529  ↩
    5.03423778139177) | LINESTRING(20 40,20 40)
```

참고

ST_3DClosestPoint, ST_3DDistance, ST_LongestLine, ST_ShortestLine, ST_3DMaxDistance

7.13 Overlay Functions

7.13.1 ST_ClipByBox2D

ST_ClipByBox2D — Computes the portion of a geometry falling within a rectangle.

Synopsis

geometry **ST_ClipByBox2D**(geometry geom, box2d box);

Description

Clips a geometry by a 2D box in a fast and tolerant but possibly invalid way. Topologically invalid input geometries do not result in exceptions being thrown. The output geometry is not guaranteed to be valid (in particular, self-intersections for a polygon may be introduced).

Performed by the GEOS module.

Availability: 2.2.0

Examples

```
-- Rely on implicit cast from geometry to box2d for the second parameter
SELECT ST_ClipByBox2D(geom, ST_MakeEnvelope(0,0,10,10)) FROM mytab;
```

See Also

ST_Intersection, ST_MakeBox2D, ST_MakeEnvelope

7.13.2 ST_Difference

ST_Difference — Computes a geometry representing the part of geometry A that does not intersect geometry B.

Synopsis

geometry **ST_Difference**(geometry geomA, geometry geomB, float8 gridSize = -1);

Description

Returns a geometry representing the part of geometry A that does not intersect geometry B. This is equivalent to `A - ST_Intersecti`
If A is completely contained in B then an empty atomic geometry of appropriate type is returned.

Note
This is the only overlay function where input order matters. ST_Difference(A, B) always returns a portion of A.

If the optional `gridSize` argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher)

Performed by the GEOS module

Enhanced: 3.1.0 accept a gridSize parameter.

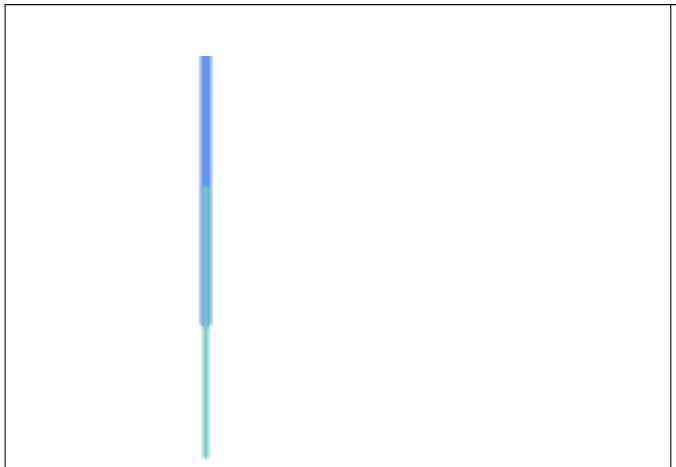
Requires GEOS >= 3.9.0 to use the gridSize parameter.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

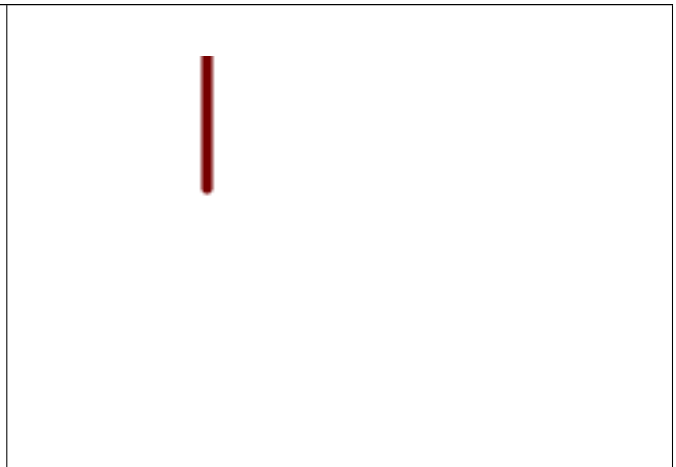
This method implements the SQL/MM specification. SQL-MM 3: 5.1.20

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Examples



The input linestrings



The difference of the two linestrings

The difference of 2D linestrings.

```
SELECT ST_AsText(
    ST_Difference(
            'LINESTRING(50 100, 50 200)'::geometry,
            'LINESTRING(50 50, 50 150)'::geometry
        )
    );

st_astext
---------
LINESTRING(50 150,50 200)
```

The difference of 3D points.

```
SELECT ST_AsEWKT( ST_Difference(
                  'MULTIPOINT(-118.58 38.38 5,-118.60 38.329 6,-118.614 38.281 7)' ::  ↩
                     geometry,
                  'POINT(-118.614 38.281 5)' :: geometry
```

```
                    ) );

st_asewkt
---------
MULTIPOINT(-118.6 38.329 6,-118.58 38.38 5)
```

See Also

ST_SymDifference, ST_Intersection, ST_Union

7.13.3 ST_Intersection

ST_Intersection — Computes a geometry representing the shared portion of geometries A and B.

Synopsis

geometry **ST_Intersection**(geometry geomA , geometry geomB , float8 gridSize = -1);
geography **ST_Intersection**(geography geogA , geography geogB);

Description

Returns a geometry representing the point-set intersection of two geometries. In other words, that portion of geometry A and geometry B that is shared between the two geometries.

If the geometries have no points in common (i.e. are disjoint) then an empty atomic geometry of appropriate type is returned.

If the optional `gridSize` argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher)

ST_Intersection in conjunction with ST_Intersects is useful for clipping geometries such as in bounding box, buffer, or region queries where you only require the portion of a geometry that is inside a country or region of interest.

Note

For geography this is a thin wrapper around the geometry implementation. It first determines the best SRID that fits the bounding box of the 2 geography objects (if geography objects are within one half zone UTM but not same UTM will pick one of those) (favoring UTM or Lambert Azimuthal Equal Area (LAEA) north/south pole, and falling back on mercator in worst case scenario) and then intersection in that best fit planar spatial ref and retransforms back to WGS84 geography.

Warning

This function will drop the M coordinate values if present.

Warning

If working with 3D geometries, you may want to use SFGCAL based ST_3DIntersection which does a proper 3D intersection for 3D geometries. Although this function works with Z-coordinate, it does an averaging of Z-Coordinate.

Performed by the GEOS module

Enhanced: 3.1.0 accept a gridSize parameter

Requires GEOS >= 3.9.0 to use the gridSize parameter

Changed: 3.0.0 does not depend on SFCGAL.

Availability: 1.5 support for geography data type was introduced.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

This method implements the SQL/MM specification. SQL-MM 3: 5.1.18

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Examples

```
SELECT ST_AsText(ST_Intersection('POINT(0 0)'::geometry, 'LINESTRING ( 2 0, 0 2 )':: ↩
    geometry));
 st_astext
---------------
GEOMETRYCOLLECTION EMPTY

SELECT ST_AsText(ST_Intersection('POINT(0 0)'::geometry, 'LINESTRING ( 0 0, 0 2 )':: ↩
    geometry));
 st_astext
---------------
POINT(0 0)
```

Clip all lines (trails) by country. Here we assume country geom are POLYGON or MULTIPOLYGONS. NOTE: we are only keeping intersections that result in a LINESTRING or MULTILINESTRING because we don't care about trails that just share a point. The dump is needed to expand a geometry collection into individual single MULT* parts. The below is fairly generic and will work for polys, etc. by just changing the where clause.

```
select clipped.gid, clipped.f_name, clipped_geom
from (
         select trails.gid, trails.f_name,
             (ST_Dump(ST_Intersection(country.geom, trails.geom))).geom clipped_geom
         from country
              inner join trails on ST_Intersects(country.geom, trails.geom)
     ) as clipped
where ST_Dimension(clipped.clipped_geom) = 1;
```

For polys e.g. polygon landmarks, you can also use the sometimes faster hack that buffering anything by 0.0 except a polygon results in an empty geometry collection. (So a geometry collection containing polys, lines and points buffered by 0.0 would only leave the polygons and dissolve the collection shell.)

```
select poly.gid,
    ST_Multi(
        ST_Buffer(
            ST_Intersection(country.geom, poly.geom),
            0.0
        )
    ) clipped_geom
from country
     inner join poly on ST_Intersects(country.geom, poly.geom)
where not ST_IsEmpty(ST_Buffer(ST_Intersection(country.geom, poly.geom), 0.0));
```

Examples: 2.5Dish

Note this is not a true intersection, compare to the same example using ST_3DIntersection.

```
select ST_AsText(ST_Intersection(linestring, polygon)) As wkt
from  ST_GeomFromText('LINESTRING Z (2 2 6,1.5 1.5 7,1 1 8,0.5 0.5 8,0 0 10)') AS  ↩
    linestring
 CROSS JOIN ST_GeomFromText('POLYGON((0 0 8, 0 1 8, 1 1 8, 1 0 8, 0 0 8))') AS polygon;

               st_astext
---------------------------------------
 LINESTRING Z (1 1 8,0.5 0.5 8,0 0 10)
```

See Also

ST_3DIntersection, ST_Difference, ST_Union, ST_Dimension, ST_Dump, ST_Force2D, ST_SymDifference, ST_Intersects, ST_Multi

7.13.4 ST_MemUnion

ST_MemUnion — Aggregate function which unions geometries in a memory-efficent but slower way

Synopsis

geometry **ST_MemUnion**(geometry set geomfield);

Description

An aggregate function that unions the input geometries, merging them to produce a result geometry with no overlaps. The output may be a single geometry, a MultiGeometry, or a Geometry Collection.

Note
Produces the same result as ST_Union, but uses less memory and more processor time. This aggregate function works by unioning the geometries incrementally, as opposed to the ST_Union aggregate which first accumulates an array and then unions the contents using a fast algorithm.

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Examples

```
SELECT id,
       ST_MemUnion(geom) as singlegeom
FROM sometable f
GROUP BY id;
```

See Also

ST_Union

7.13.5 ST_Node

ST_Node — Nodes a collection of lines.

Synopsis

geometry **ST_Node**(geometry geom);

Description

Returns a (Multi)LineString representing the fully noded version of a collection of linestrings. The noding preserves all of the input nodes, and introduces the least possible number of new nodes. The resulting linework is dissolved (duplicate lines are removed).

This is a good way to create fully-noded linework suitable for use as input to ST_Polygonize.

ST_UnaryUnion can also be used to node and dissolve linework. It provides an option to specify a gridSize, which can provide simpler and more robust output. See also ST_Union for an aggregate variant.

This function supports 3d and will not drop the z-index.

Performed by the GEOS module.

Availability: 2.0.0

Changed: 2.4.0 this function uses GEOSNode internally instead of GEOSUnaryUnion. This may cause the resulting linestrings to have a different order and direction compared to PostGIS < 2.4.

Examples

Noding a 3D LineString which self-intersects

```
SELECT ST_AsText(
        ST_Node('LINESTRINGZ(0 0 0, 10 10 10, 0 10 5, 10 0 3)'::geometry)
    ) As  output;
output
-----------
MULTILINESTRING Z ((0 0 0,5 5 4.5),(5 5 4.5,10 10 10,0 10 5,5 5 4.5),(5 5 4.5,10 0 3))
```

Noding two LineStrings which share common linework. Note that the result linework is dissolved.

```
SELECT ST_AsText(
        ST_Node('MULTILINESTRING ((2 5, 2 1, 7 1), (6 1, 4 1, 2 3, 2 5))'::geometry)
    ) As  output;
output
-----------
MULTILINESTRING((2 5,2 3),(2 3,2 1,4 1),(4 1,2 3),(4 1,6 1),(6 1,7 1))
```

See Also

ST_UnaryUnion, ST_Union

7.13.6 ST_Split

ST_Split — Returns a collection of geometries created by splitting a geometry by another geometry.

Synopsis

geometry **ST_Split**(geometry input, geometry blade);

Description

The function supports splitting a LineString by a (Multi)Point, (Multi)LineString or (Multi)Polygon boundary, or a (Multi)Polygon by a LineString. When a (Multi)Polygon is used as as the blade, its linear components (the boundary) are used for splitting the input. The result geometry is always a collection.

This function is in a sense the opposite of ST_Union. Applying ST_Union to the returned collection should theoretically yield the original geometry (although due to numerical rounding this may not be exactly the case).

Note
If the the input and blade do not intersect due to numerical precision issues, the input may not be split as expected. To avoid this situation it may be necessary to snap the input to the blade first, using ST_Snap with a small tolerance.

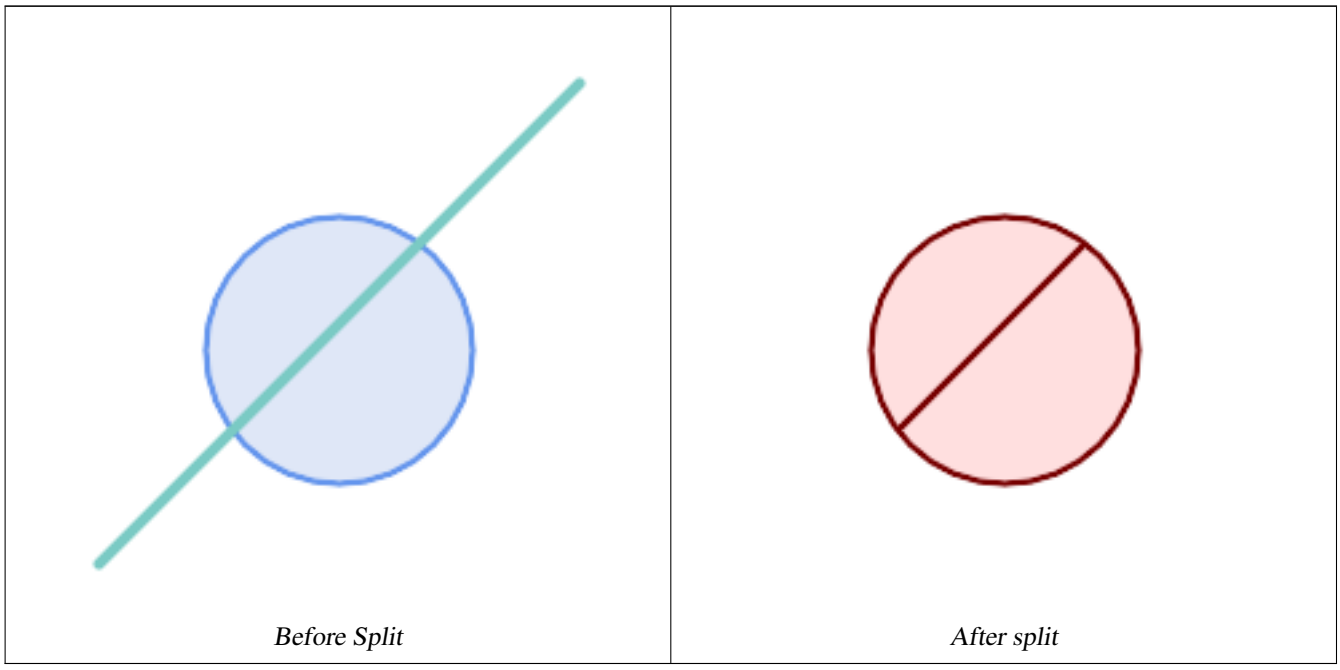
Availability: 2.0.0 requires GEOS

Enhanced: 2.2.0 support for splitting a line by a multiline, a multipoint or (multi)polygon boundary was introduced.

Enhanced: 2.5.0 support for splitting a polygon by a multiline was introduced.

Examples

Split a Polygon by a Line.

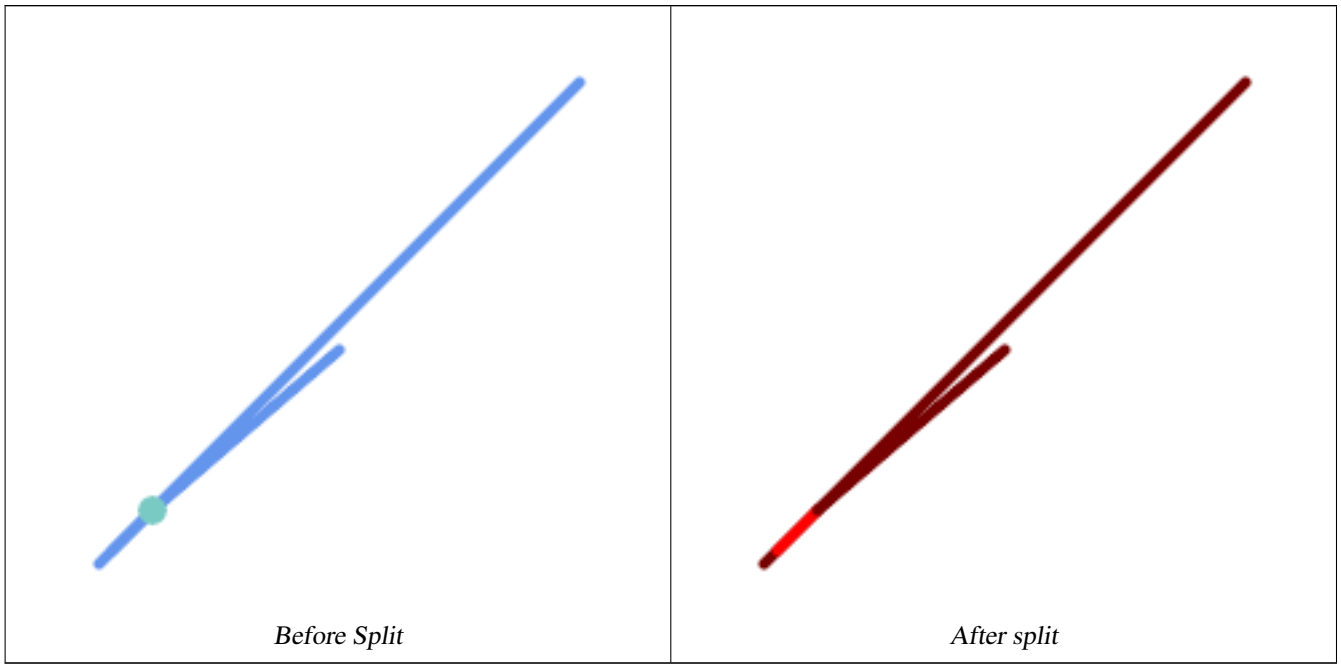


Before Split | *After split*

```
SELECT ST_AsText( ST_Split(
                ST_Buffer(ST_GeomFromText('POINT(100 90)'), 50), -- circle
                ST_MakeLine(ST_Point(10, 10),ST_Point(190, 190)) -- line
    ));

-- result --
```

```
 GEOMETRYCOLLECTION(
            POLYGON((150 90,149.039264020162 80.2454838991936,146.193976625564  ↩
                70.8658283817455,..),
            POLYGON(..))
)
```

Split a MultiLineString a Point, where the point lies exactly on both LineStrings elements.



Before Split | *After split*

```
SELECT ST_AsText(ST_Split(
    'MULTILINESTRING((10 10, 190 191), (15 15, 30 30, 100 90))',
    ST_Point(30,30))) As split;

split
------
GEOMETRYCOLLECTION(
    LINESTRING(10 10,30 30),
    LINESTRING(30 30,190 190),
    LINESTRING(15 15,30 30),
    LINESTRING(30 30,100 90)
)
```

Split a LineString by a Point, where the point does not lie exactly on the line. Shows using ST_Snap to snap the line to the point to allow it to be split.

```
WITH data AS (SELECT
  'LINESTRING(0 0, 100 100)'::geometry AS line,
  'POINT(51 50)':: geometry AS point
)
SELECT ST_AsText( ST_Split( ST_Snap(line, point, 1), point)) AS snapped_split,
       ST_AsText( ST_Split(line, point)) AS not_snapped_not_split
       FROM data;

                             snapped_split                              |             ↩
                                 not_snapped_not_split
------------------------------------------------------------------------+-----------------------------
```

```
GEOMETRYCOLLECTION(LINESTRING(0 0,51 50),LINESTRING(51 50,100 100)) | GEOMETRYCOLLECTION( ↩
    LINESTRING(0 0,100 100))
```

See Also

ST_Snap, ST_Union

7.13.7 ST_Subdivide

ST_Subdivide — Computes a rectilinear subdivision of a geometry.

Synopsis

setof geometry **ST_Subdivide**(geometry geom, integer max_vertices=256, float8 gridSize = -1);

Description

Returns a set of geometries that are the result of dividing `geom` into parts using rectilinear lines, with each part containing no more than `max_vertices`.

`max_vertices` must be 5 or more, as 5 points are needed to represent a closed box. `gridSize` can be specified to have clipping work in fixed-precision space (requires GEOS-3.9.0+).

Point-in-polygon and other spatial operations are normally faster for indexed subdivided datasets. Since the bounding boxes for the parts usually cover a smaller area than the original geometry bbox, index queries produce fewer "hit" cases. The "hit" cases are faster because the spatial operations executed by the index recheck process fewer points.

Note
This is a set-returning function (SRF) that return a set of rows containing single geometry values. It can be used in a SELECT list or a FROM clause to produce a result set with one record for each result geometry.

Performed by the GEOS module.

Availability: 2.2.0

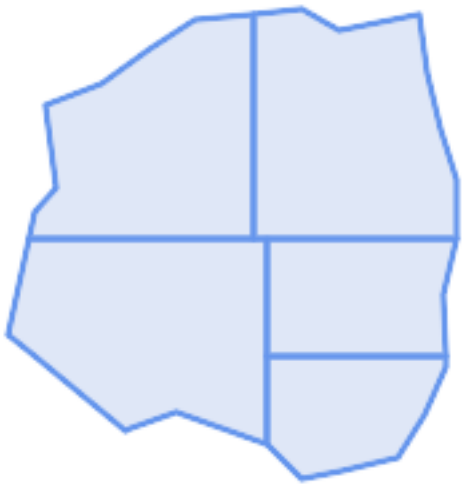
Enhanced: 2.5.0 reuses existing points on polygon split, vertex count is lowered from 8 to 5.

Enhanced: 3.1.0 accept a gridSize parameter.

Requires GEOS >= 3.9.0 to use the gridSize parameter

Examples

Example: Subdivide a polygon into parts with no more than 10 vertices, and assign each part a unique id.



Subdivided to maximum 10 vertices

```
SELECT row_number() OVER() As rn, ST_AsText(geom) As wkt
    FROM (SELECT ST_SubDivide(
        'POLYGON((132 10,119 23,85 35,68 29,66 28,49 42,32 56,22 64,32 110,40 119,36 150,
        57 158,75 171,92 182,114 184,132 186,146 178,176 184,179 162,184 141,190 122,
        190 100,185 79,186 56,186 52,178 34,168 18,147 13,132 10))'::geometry,10))  AS f( ↩
            geom);
```

```
rn &amp;#x2502;                                                    wkt
&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x253c;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2500;&amp;#x2
  1 &amp;#x2502; POLYGON((119 23,85 35,68 29,66 28,32 56,22 64,29.8260869565217 100,119 100,119 ↩
       23))
  2 &amp;#x2502; POLYGON((132 10,119 23,119 56,186 56,186 52,178 34,168 18,147 13,132 10))
  3 &amp;#x2502; POLYGON((119 56,119 100,190 100,185 79,186 56,119 56))
  4 &amp;#x2502; POLYGON((29.8260869565217 100,32 110,40 119,36 150,57 158,75 171,92 182,114  ↩
      184,114 100,29.8260869565217 100))
  5 &amp;#x2502; POLYGON((114 184,132 186,146 178,176 184,179 162,184 141,190 122,190 100,114  ↩
      100,114 184))
```

Example: Densify a long geography line using ST_Segmentize(geography, distance), and use ST_Subdivide to split the resulting line into sublines of 8 vertices.

The densified and split lines.

```
SELECT ST_AsText( ST_Subdivide(
            ST_Segmentize('LINESTRING(0 0, 85 85)'::geography,
                          1200000)::geometry,    8));
```

```
LINESTRING(0 0,0.487578359029357 5.57659056746196,0.984542144675897  ↩
    11.1527721155093,1.50101059639722 16.7281035483571,1.94532113630331 21.25)
LINESTRING(1.94532113630331 21.25,2.04869538062779 22.3020741387339,2.64204641967673  ↩
    27.8740533545155,3.29994062412787 33.443216802941,4.04836719489742  ↩
    39.0084282520239,4.59890468420694 42.5)
LINESTRING(4.59890468420694 42.5,4.92498503922732 44.5680389206321,5.98737409390639  ↩
    50.1195229244701,7.3290919767674 55.6587646879025,8.79638749938413 60.1969505994924)
LINESTRING(8.79638749938413 60.1969505994924,9.11375579533779  ↩
    61.1785363177625,11.6558166691368 66.6648504160202,15.642041247655  ↩
    72.0867690601745,22.8716627200212 77.3609628116894,24.6991785131552 77.8939011989848)
LINESTRING(24.6991785131552 77.8939011989848,39.4046096622744  ↩
    82.1822848017636,44.7994523421035 82.5156766227011)
LINESTRING(44.7994523421035 82.5156766227011,85 85)
```

Example: Subdivide the complex geometries of a table in-place. The original geometry records are deleted from the source table, and new records for each subdivided result geometry are inserted.

```
WITH complex_areas_to_subdivide AS (
    DELETE from polygons_table
    WHERE ST_NPoints(geom) > 255
    RETURNING id, column1, column2, column3, geom
)
INSERT INTO polygons_table (fid, column1, column2, column3, geom)
    SELECT fid, column1, column2, column3,
           ST_Subdivide(geom, 255) as geom
    FROM complex_areas_to_subdivide;
```

Example: Create a new table containing subdivided geometries, retaining the key of the original geometry so that the new table can be joined to the source table. Since ST_Subdivide is a set-returning (table) function that returns a set of single-value rows, this syntax automatically produces a table with one row for each result part.

```
CREATE TABLE subdivided_geoms AS
    SELECT pkey, ST_Subdivide(geom) AS geom
    FROM original_geoms;
```

See Also

ST_ClipByBox2D, ST_Segmentize, ST_Split, ST_NPoints

7.13.8 ST_SymDifference

ST_SymDifference — Computes a geometry representing the portions of geometries A and B that do not intersect.

Synopsis

geometry **ST_SymDifference**(geometry geomA, geometry geomB, float8 gridSize = -1);

Description

Returns a geometry representing the portions of geonetries A and B that do not intersect. This is equivalent to `ST_Union(A,B) - ST_Intersection(A,B)`. It is called a symmetric difference because `ST_SymDifference(A,B) = ST_SymDifference`

If the optional `gridSize` argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher)

Performed by the GEOS module

Enhanced: 3.1.0 accept a gridSize parameter.

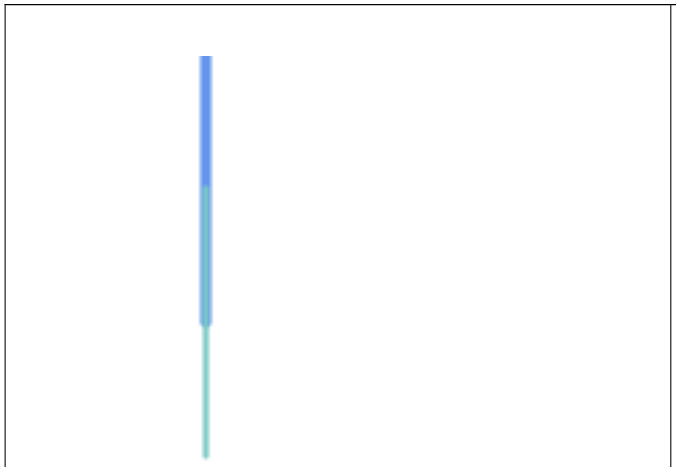
Requires GEOS >= 3.9.0 to use the gridSize parameter

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

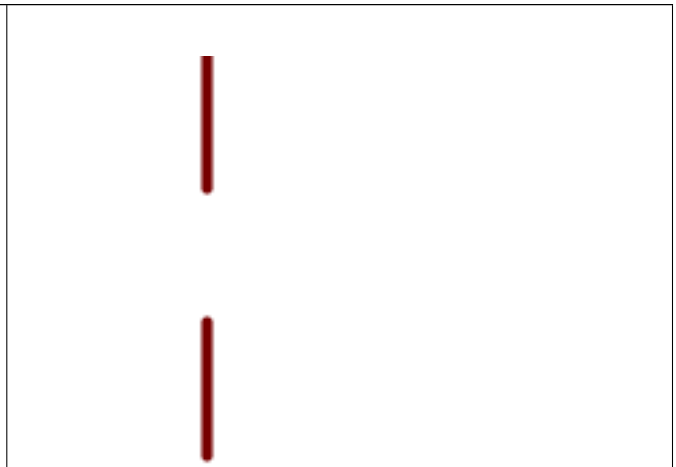
This method implements the SQL/MM specification. SQL-MM 3: 5.1.21

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Examples



The original linestrings shown together



The symmetric difference of the two linestrings

```
--Safe for 2d - symmetric difference of 2 linestrings
SELECT ST_AsText(
    ST_SymDifference(
        ST_GeomFromText('LINESTRING(50 100, 50 200)'),
        ST_GeomFromText('LINESTRING(50 50, 50 150)')
    )
);

st_astext
---------
MULTILINESTRING((50 150,50 200),(50 50,50 100))
```

```
--When used in 3d doesn't quite do the right thing
SELECT ST_AsEWKT(ST_SymDifference(ST_GeomFromEWKT('LINESTRING(1 2 1, 1 4 2)'),
    ST_GeomFromEWKT('LINESTRING(1 1 3, 1 3 4)')))

st_astext
------------
```

```
MULTILINESTRING((1 3 2.75,1 4 2),(1 1 3,1 2 2.25))
```

See Also

ST_Difference, ST_Intersection, ST_Union

7.13.9 ST_UnaryUnion

ST_UnaryUnion — Computes the union of the components of a single geometry.

Synopsis

geometry **ST_UnaryUnion**(geometry geom, float8 gridSize = -1);

Description

A single-input variant of ST_Union. The input may be a single geometry, a MultiGeometry, or a GeometryCollection. The union is applied to the individual elements of the input.

This function can be used to fix MultiPolygons which are invalid due to overlapping components. However, the input components must each be valid. An invalid input component such as a bow-tie polygon may cause an error. For this reason it may be better to use ST_MakeValid.

Another use of this function is to node and dissolve a collection of linestrings which cross or overlap to make them simple. (ST_Node also does this, but it does not provide the `gridSize` option.)

It is possible to combine ST_UnaryUnion with ST_GeomCollFromText to fine-tune how many geometries are be unioned at once. This allows trading off between memory usage and compute time, striking a balance between ST_Union and ST_MemUnion.

If the optional `gridSize` argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher)

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Enhanced: 3.1.0 accept a gridSize parameter.

Requires GEOS >= 3.9.0 to use the gridSize parameter

Availability: 2.0.0

See Also

ST_Union, ST_MemUnion, ST_MakeValid, ST_GeomCollFromText, ST_Node

7.13.10 ST_Union

ST_Union — Computes a geometry representing the point-set union of the input geometries.

Synopsis

geometry **ST_Union**(geometry g1, geometry g2);
geometry **ST_Union**(geometry g1, geometry g2, float8 gridSize);
geometry **ST_Union**(geometry[] g1_array);
geometry **ST_Union**(geometry set g1field);
geometry **ST_Union**(geometry set g1field, float8 gridSize);

Description

Unions the input geometries, merging geometry to produce a result geometry with no overlaps. The output may be an atomic geometry, a MultiGeometry, or a Geometry Collection. Comes in several variants:

Two-input variant: returns a geometry that is the union of two input geometries. If either input is NULL, then NULL is returned.

Array variant: returns a geometry that is the union of an array of geometries.

Aggregate variant: returns a geometry that is the union of a rowset of geometries. The ST_Union() function is an "aggregate" function in the terminology of PostgreSQL. That means that it operates on rows of data, in the same way the SUM() and AVG() functions do and like most aggregates, it also ignores NULL geometries.

See ST_UnaryUnion for a non-aggregate, single-input variant.

The ST_Union array and set variants use the fast Cascaded Union algorithm described in http://blog.cleverelephant.ca/2009/01/-must-faster-unions-in-postgis-14.html

A `gridSize` can be specified to work in fixed-precision space. The inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher)

Note
ST_GeomCollFromText may sometimes be used in place of ST_Union, if the result is not required to be non-overlapping. ST_Collect is usually faster than ST_Union because it performs no processing on the collected geometries.

Performed by the GEOS module.

ST_Union creates MultiLineString and does not sew LineStrings into a single LineString. Use ST_LineMerge to sew LineStrings.

NOTE: this function was formerly called GeomUnion(), which was renamed from "Union" because UNION is an SQL reserved word.

Enhanced: 3.1.0 accept a gridSize parameter.

Requires GEOS >= 3.9.0 to use the gridSize parameter

Changed: 3.0.0 does not depend on SFCGAL.

Availability: 1.4.0 - ST_Union was enhanced. ST_Union(geomarray) was introduced and also faster aggregate collection in PostgreSQL.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

Note
Aggregate version is not explicitly defined in OGC SPEC.

This method implements the SQL/MM specification. SQL-MM 3: 5.1.19 the z-index (elevation) when polygons are involved.

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

Examples

Aggregate example

```
SELECT id,
       ST_Union(geom) as singlegeom
FROM sometable f
GROUP BY id;
```

Non-Aggregate example

```
select ST_AsText(ST_Union('POINT(1 2)' :: geometry, 'POINT(-2 3)' :: geometry))

st_astext
----------
MULTIPOINT(-2 3,1 2)

select ST_AsText(ST_Union('POINT(1 2)' :: geometry, 'POINT(1 2)' :: geometry))

st_astext
----------
POINT(1 2)
```

3D example - sort of supports 3D (and with mixed dimensions!)

```
select ST_AsEWKT(ST_Union(geom))
from (
         select 'POLYGON((-7 4.2,-7.1 4.2,-7.1 4.3, -7 4.2))'::geometry geom
         union all
         select 'POINT(5 5 5)'::geometry geom
         union all
         select 'POINT(-2 3 1)'::geometry geom
         union all
         select 'LINESTRING(5 5 5, 10 10 10)'::geometry geom
     ) as foo;

st_asewkt
---------
GEOMETRYCOLLECTION(POINT(-2 3 1),LINESTRING(5 5 5,10 10 10),POLYGON((-7 4.2 5,-7.1 4.2  ↩
    5,-7.1 4.3 5,-7 4.2 5)));
```

3d example not mixing dimensions

```
select ST_AsEWKT(ST_Union(geom))
from (
         select 'POLYGON((-7 4.2 2,-7.1 4.2 3,-7.1 4.3 2, -7 4.2 2))'::geometry geom
         union all
         select 'POINT(5 5 5)'::geometry geom
         union all
         select 'POINT(-2 3 1)'::geometry geom
         union all
         select 'LINESTRING(5 5 5, 10 10 10)'::geometry geom
     ) as foo;

st_asewkt
---------
GEOMETRYCOLLECTION(POINT(-2 3 1),LINESTRING(5 5 5,10 10 10),POLYGON((-7 4.2 2,-7.1 4.2  ↩
    3,-7.1 4.3 2,-7 4.2 2)))

--Examples using new Array construct
SELECT ST_Union(ARRAY(SELECT geom FROM sometable));

SELECT ST_AsText(ST_Union(ARRAY[ST_GeomFromText('LINESTRING(1 2, 3 4)'),
            ST_GeomFromText('LINESTRING(3 4, 4 5)')])) As wktunion;
```

```
--wktunion---
MULTILINESTRING((3 4,4 5),(1 2,3 4))
```

See Also

ST_GeomCollFromText, ST_UnaryUnion, ST_MemUnion, ST_Intersection, ST_Difference, ST_SymDifference

7.14 도형 공간 처리

7.14.1 ST_Buffer

ST_Buffer — Computes a geometry covering all points within a given distance from a geometry.

Synopsis

geometry **ST_Buffer**(geometry g1, float radius_of_buffer, text buffer_style_parameters = '');
geometry **ST_Buffer**(geometry g1, float radius_of_buffer, integer num_seg_quarter_circle);
geography **ST_Buffer**(geography g1, float radius_of_buffer, text buffer_style_parameters);
geography **ST_Buffer**(geography g1, float radius_of_buffer, integer num_seg_quarter_circle);

설명

Computes a POLYGON or MULTIPOLYGON that represents all points whose distance from a geometry/geography is less than or equal to a given distance. A negative distance shrinks the geometry rather than expanding it. A negative distance may shrink a polygon completely, in which case POLYGON EMPTY is returned. For points and lines negative distances always return empty results.

For geometry, the distance is specified in the units of the Spatial Reference System of the geometry. For geography, the distance is specified in meters.

The optional third parameter controls the buffer accuracy and style. The accuracy of circular arcs in the buffer is specified as the number of line segments used to approximate a quarter circle (default is 8). The buffer style can be specifed by providing a list of blank-separated key=value pairs as follows:

- 'quad_segs=#' : number of line segments used to approximate a quarter circle (default is 8).
- 'endcap=round|flat|square' : endcap style (defaults to "round"). 'butt' is accepted as a synonym for 'flat'.
- 'join=round|mitre|bevel' : join style (defaults to "round"). 'miter' is accepted as a synonym for 'mitre'.
- 'mitre_limit=#.#' : mitre ratio limit (only affects mitered join style). 'miter_limit' is accepted as a synonym for 'mitre_limit'.
- 'side=both|left|right' : 'left' or 'right' performs a single-sided buffer on the geometry, with the buffered side relative to the direction of the line. This is only applicable to LINESTRING geometry and does not affect POINT or POLYGON geometries. By default end caps are square.

Note

For geography this is a thin wrapper around the geometry implementation. It determines a planar spatial reference system that best fits the bounding box of the geography object (trying UTM, Lambert Azimuthal Equal Area (LAEA) North/South pole, and finally Mercator). The buffer is computed in the planar space, and then transformed back to WGS84. This may not produce the desired behavior if the input object is much larger than a UTM zone or crosses the dateline

---

Note
Buffer output is always a valid polygonal geometry. Buffer can handle invalid inputs, so buffering by distance 0 is sometimes used as a way of repairing invalid polygons. ST_MakeValid can also be used for this purpose.

Note
Buffering is sometimes used to perform a within-distance search. For this use case it is more efficient to use ST_DWithin.

Note
This function ignores the Z dimension. It always gives a 2D result even when used on a 3D geometry.

Enhanced: 2.5.0 - ST_Buffer geometry support was enhanced to allow for side buffering specification `side=both|left|right`.

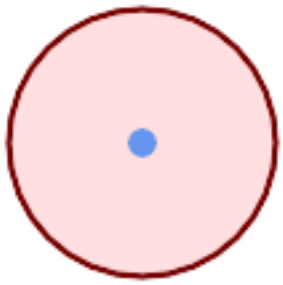
Availability: 1.5 - ST_Buffer was enhanced to support different endcaps and join types. These are useful for example to convert road linestrings into polygon roads with flat or square edges instead of rounded edges. Thin wrapper for geography was added.

GEOS 모듈로 실행

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

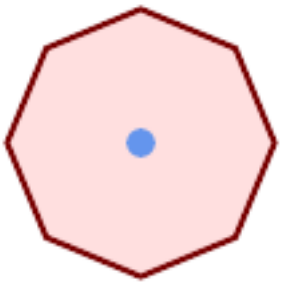
This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.30

예시



quad_segs=8 (기본값)

```
SELECT ST_Buffer(
 ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=8');
```



quad_segs=2 (저질)

```
SELECT ST_Buffer(
 ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2');
```

endcap=round join=round (기본값)

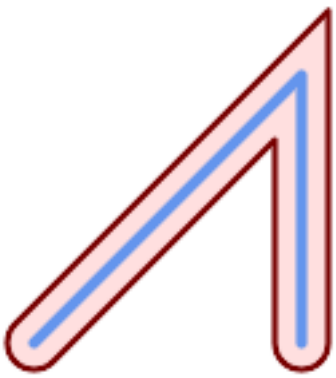
```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'endcap=round join=round');
```

endcap=square

```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'endcap=square join=round');
```

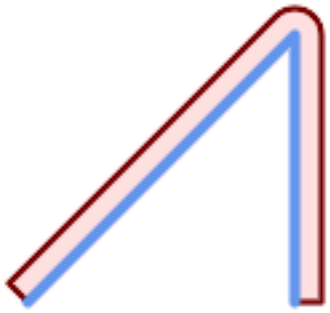
join=bevel

```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'join=bevel');
```



join=mitre mitre_limit=5.0 (마이터 제한 기본값)

```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'join=mitre mitre_limit=5.0');
```

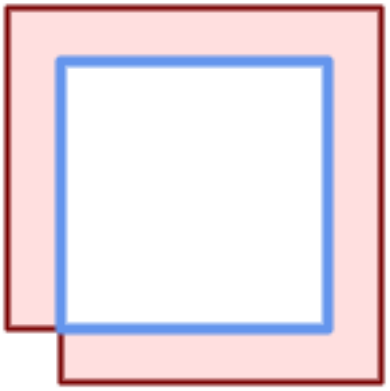


side=left

```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'side=left');
```

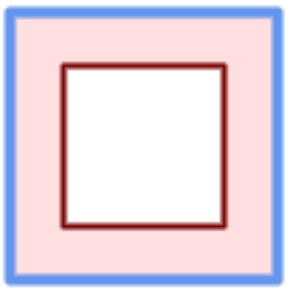
side=right

```
SELECT ST_Buffer(
 ST_GeomFromText(
  'LINESTRING(50 50,150 150,150 50)'
 ), 10, 'side=right');
```



right-hand-winding, polygon boundary side=left

```
SELECT ST_Buffer(
ST_ForceRHR(
ST_Boundary(
 ST_GeomFromText(
'POLYGON ((50 50, 50 150, 150 150, 150  ↩
    50, 50 50))'))),
 ), 20, 'side=left');
```



right-hand-winding, polygon boundary side=right

```
SELECT ST_Buffer(
ST_ForceRHR(
ST_Boundary(
 ST_GeomFromText(
'POLYGON ((50 50, 50 150, 150 150, 150  ↩
    50, 50 50))'))
), 20,'side=right')
```

```
--A buffered point approximates a circle
-- A buffered point forcing approximation of (see diagram)
```

```
-- 2 points per quarter circle is poly with 8 sides (see diagram)
SELECT ST_NPoints(ST_Buffer(ST_GeomFromText('POINT(100 90)'), 50)) As  ↩
    promisingcircle_pcount,
ST_NPoints(ST_Buffer(ST_GeomFromText('POINT(100 90)'), 50, 2)) As lamecircle_pcount;

promisingcircle_pcount | lamecircle_pcount
-----------------------+-------------------
             33 |                 9

--A lighter but lamer circle
-- only 2 points per quarter circle is an octagon
--Below is a 100 meter octagon
-- Note coordinates are in NAD 83 long lat which we transform
to Mass state plane meter and then buffer to get measurements in meters;
SELECT ST_AsText(ST_Buffer(
ST_Transform(
ST_SetSRID(ST_Point(-71.063526, 42.35785),4269), 26986)
,100,2)) As octagon;
----------------------
POLYGON((236057.59057465 900908.759918696,236028.301252769 900838.049240578,235
957.59057465 900808.759918696,235886.879896532 900838.049240578,235857.59057465
900908.759918696,235886.879896532 900979.470596815,235957.59057465 901008.759918
696,236028.301252769 900979.470596815,236057.59057465 900908.759918696))
```

참고

ST_GeomCollFromText, ST_DWithin, ST_SetSRID, ST_Transform, ST_Union, ST_MakeValid

7.14.2 ST_BuildArea

ST_BuildArea — Creates a polygonal geometry formed by the linework of a geometry.

Synopsis

geometry **ST_BuildArea**(geometry geom);

설명

Creates an areal geometry formed by the constituent linework of the input geometry. The input can be LINESTRINGS, MULTILINESTRINGS, POLYGONS, MULTIPOLYGONS, and GeometryCollections. The result is a Polygon or MultiPolygon, depending on input. If the input linework does not form polygons, NULL is returned.

This function assumes all inner geometries represent holes

Note
입력 선분의 교점(node)이 정확히 구성돼야만 이 함수가 제대로 동작합니다.

1.1.0 버전부터 사용할 수 있습니다.

예시

These will create a donut

```
using polygons
SELECT ST_BuildArea(ST_Collect(smallc,bigc))
FROM (SELECT
    ST_Buffer(
      ST_GeomFromText('POINT(100 90)'), 25) As smallc,
    ST_Buffer(ST_GeomFromText('POINT(100 90)'), 50) As bigc) As foo;

using linestrings
SELECT ST_BuildArea(ST_Collect(smallc,bigc))
FROM (SELECT
    ST_ExteriorRing(ST_Buffer(
      ST_GeomFromText('POINT(100 90)'), 25)) As smallc,
    ST_ExteriorRing(ST_Buffer(ST_GeomFromText('POINT(100 90)'), 50)) As bigc) As foo;
```

참고

ST_Node, ST_MakePolygon, ST_MakeValid, ST_BdPolyFromText, ST_BdMPolyFromText (wrappers to this function with standard OGC interface)

7.14.3 ST_Centroid

ST_Centroid — 도형의 기하학적 중심을 반&#xd6

Synopsis

geometry **ST_Centroid**(geometry g1);
geography **ST_Centroid**(geography g1, boolean use_spheroid = true);

설명

Computes a point which is the geometric center of mass of a geometry. For [MULTI]POINTs, the centroid is the arithmetic mean of the input coordinates. For [MULTI]LINESTRINGs, the centroid is computed using the weighted length of each line segment. For [MULTI]POLYGONs, the centroid is computed in terms of area. If an empty geometry is supplied, an empty

GEOMETRYCOLLECTION is returned. If NULL is supplied, NULL is returned. If CIRCULARSTRING or COMPOUNDCURVE are supplied, they are converted to linestring with CurveToLine first, then same than for LINESTRING

For mixed-dimension input, the result is equal to the centroid of the component Geometries of highest dimension (since the lower-dimension geometries contribute zero "weight" to the centroid).

Note that for polygonal geometries the centroid does not necessarily lie in the interior of the polygon. For example, see the diagram below of the centroid of a C-shaped polygon. To construct a point guaranteed to lie in the interior of a polygon use ST_PointOnSurface.

New in 2.3.0 : supports CIRCULARSTRING and COMPOUNDCURVE (using CurveToLine)

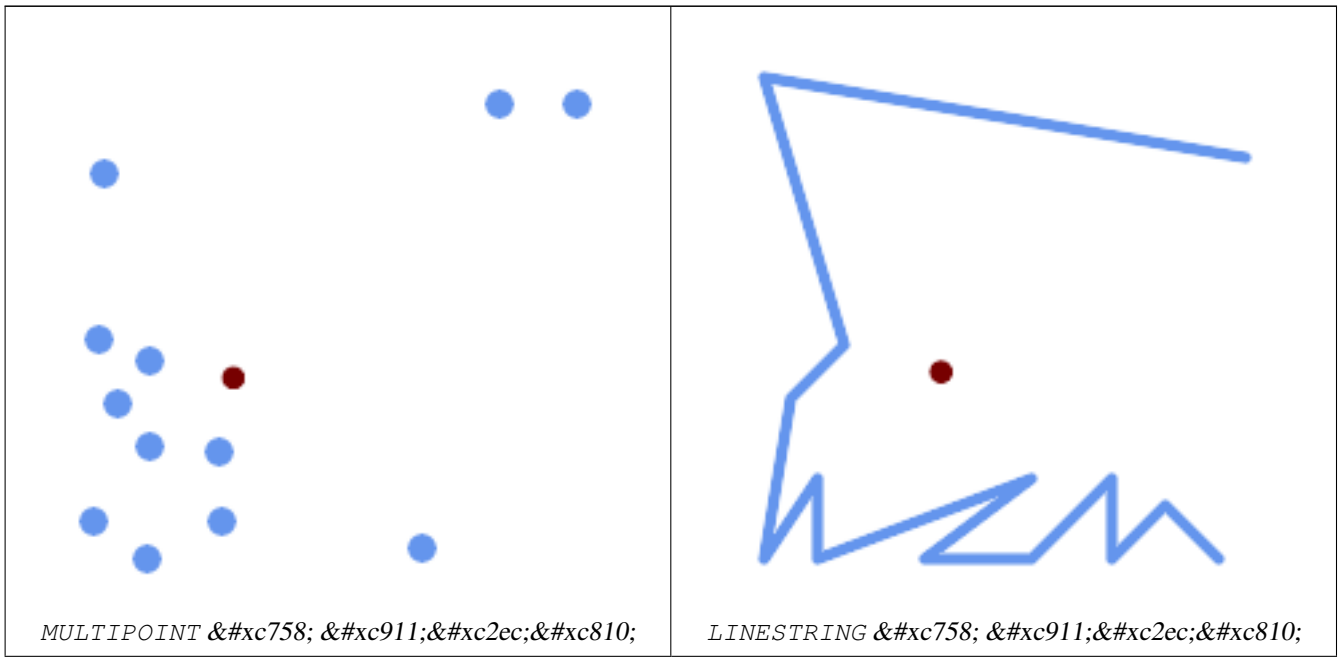
Availability: 2.4.0 support for geography was introduced.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1.

This method implements the SQL/MM specification. SQL-MM 3: 8.1.4, 9.5.5

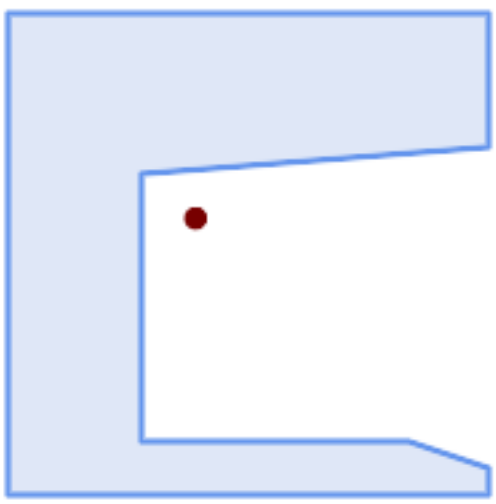
예시

In the following illustrations the red dot is the centroid of the source geometry.

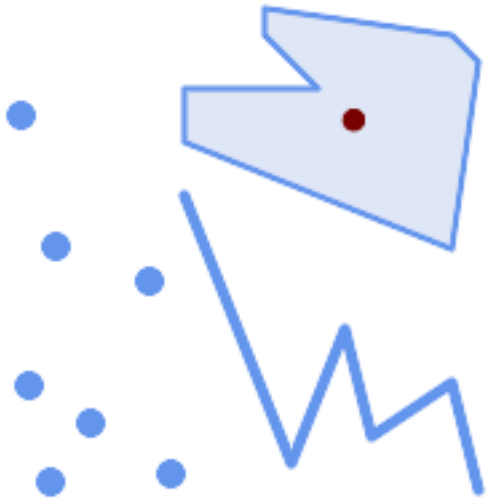


MULTIPOINT 의 중심점

LINESTRING 의 중심점



POLYGON 의 중심점



GEOMETRYCOLLECTION 의 중심점

```
SELECT ST_AsText(ST_Centroid('MULTIPOINT ( -1 0, -1 2, -1 3, -1 4, -1 7, 0 1, 0 3, 1 1, 2  ↩
    0, 6 0, 7 8, 9 8, 10 6 )'));
                st_astext
------------------------------------------
 POINT(2.30769230769231 3.30769230769231)
(1 row)

SELECT ST_AsText(ST_centroid(g))
FROM  ST_GeomFromText('CIRCULARSTRING(0 2, -1 1,0 0, 0.5 0, 1 0, 2 1, 1 2, 0.5 2, 0 2)')   ↩
    AS g ;
------------------------------------------
POINT(0.5 1)


SELECT ST_AsText(ST_centroid(g))
FROM  ST_GeomFromText('COMPOUNDCURVE(CIRCULARSTRING(0 2, -1 1,0 0),(0 0, 0.5 0, 1 0), ↩
    CIRCULARSTRING( 1 0, 2 1, 1 2),(1 2, 0.5 2, 0 2))' ) AS g;
------------------------------------------
POINT(0.5 1)
```

참고

ST_PointOnSurface, ST_GeometricMedian

7.14.4 ST_ChaikinSmoothing

ST_ChaikinSmoothing — Returns a smoothed version of a geometry, using the Chaikin algorithm

Synopsis

geometry **ST_ChaikinSmoothing**(geometry geom, integer nIterations = 1, boolean preserveEndPoints = false);

설명

Smoothes a linear or polygonal geometry using Chaikin's algorithm. The degree of smoothing is controlled by the `nIterations` parameter. On each iteration, each interior vertex is replaced by two vertices located at 1/4 of the length of the line segments before and after the vertex. A reasonable degree of smoothing is provided by 3 iterations; the maximum is limited to 5.

If `preserveEndPoints` is true, the endpoints of Polygon rings are not smoothed. The endpoints of LineStrings are always preserved.

Note
The number of vertices doubles with each iteration, so the result geometry may have many more points than the input. To reduce the number of points use a simplification function on the result (see ST_Simplify, ST_SimplifyPreserveTopology and ST_SimplifyVW).

The result has interpolated values for the Z and M dimenions when present.

This function supports 3d and will not drop the z-index.

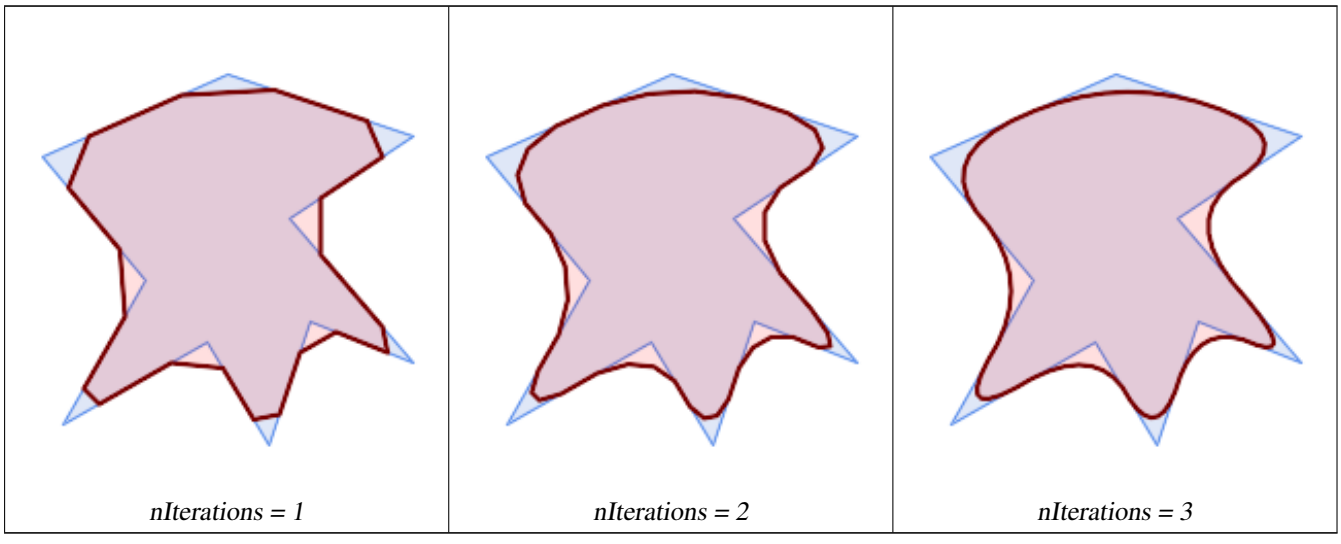
Availability: 2.5.0

예시

Smoothing a triangle:

```
SELECT ST_AsText(ST_ChaikinSmoothing(geom)) smoothed
FROM (SELECT  'POLYGON((0 0, 8 8, 0 16, 0 0))'::geometry geom) AS foo;

                  smoothed
&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2500;&#x2
 POLYGON((2 2,6 6,6 10,2 14,0 12,0 4,2 2))
```

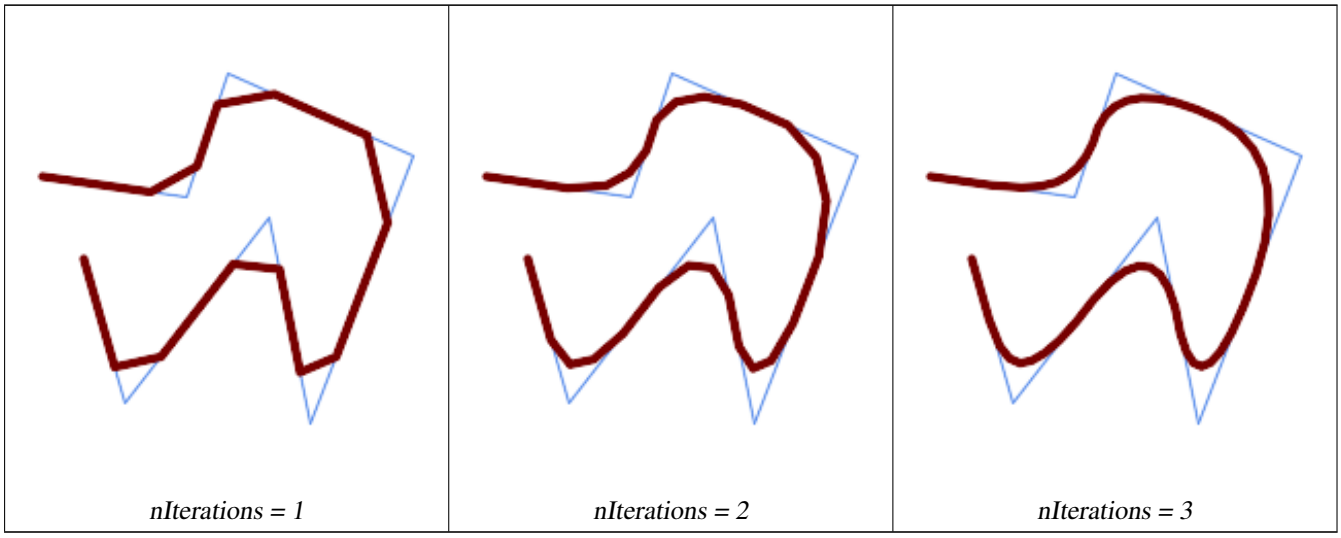
Smoothing a Polygon using 1, 2 and 3 iterations:



nIterations = 1 | *nIterations = 2* | *nIterations = 3*

```
SELECT ST_ChaikinSmoothing(
            'POLYGON ((20 20, 60 90, 10 150, 100 190, 190 160, 130 120, 190 50, 140 70, 120 ↩
                10, 90 60, 20 20))',
            generate_series(1, 3) );
```

Smoothing a LineString using 1, 2 and 3 iterations:



nIterations = 1 | *nIterations = 2* | *nIterations = 3*

```
SELECT ST_ChaikinSmoothing(
            'LINESTRING (10 140, 80 130, 100 190, 190 150, 140 20, 120 120, 50 30, 30 100) ↩
                ',
            generate_series(1, 3) );
```

참고

ST_Simplify, ST_SimplifyPreserveTopology, ST_SimplifyVW

7.14.5 ST_ConcaveHull

ST_ConcaveHull — Computes a possibly concave geometry that contains all input geometry vertices

Synopsis

geometry **ST_ConcaveHull**(geometry param_geom, float param_pctconvex, boolean param_allow_holes = false);

설명

A concave hull is a (usually) concave geometry which contains the input, and whose vertices are a subset of the input vertices. In the general case the concave hull is a Polygon. The concave hull of two or more collinear points is a two-point LineString. The concave hull of one or more identical points is a Point. The polygon will not contain holes unless the optional `param_allow_holes` argument is specified as true.

One can think of a concave hull as "shrink-wrapping" a set of points. This is different to the convex hull, which is more like wrapping a rubber band around the points. A concave hull generally has a smaller area and represents a more natural boundary for the input points.

The `param_pctconvex` controls the concaveness of the computed hull. A value of 1 produces the convex hull. Values between 1 and 0 produce hulls of increasing concaveness. A value of 0 produces a hull with maximum concaveness (but still a single polygon). Choosing a suitable value depends on the nature of the input data, but often values between 0.3 and 0.1 produce reasonable results.

Note

Technically, the `param_pctconvex` determines a length as a fraction of the difference between the longest and shortest edges in the Delaunay Triangulation of the input points. Edges longer than this length are "eroded" from the triangulation. The triangles remaining form the concave hull.

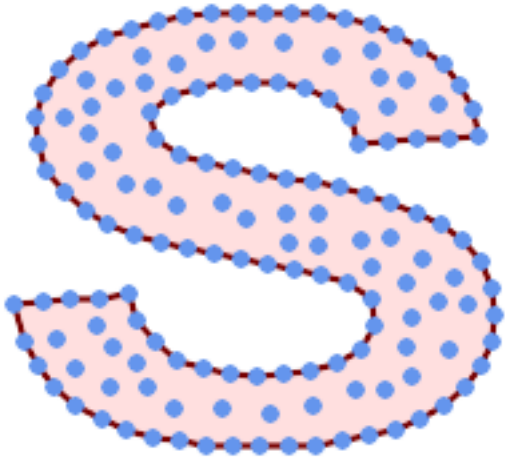
For point and linear inputs, the hull will enclose all the points of the inputs. For polygonal inputs, the hull will enclose all the points of the input *and also* all the areas covered by the input. If you want a point-wise hull of a polygonal input, convert it to points first using ST_Points.

This is not an aggregate function. To compute the concave hull of a set of geometries use ST_GeomCollFromText (e.g. `ST_ConcaveHull( ST_Collect( geom ), 0.80)`.

2.0.0 버전부터 사용할 수 있습니다.

Enhanced: 3.3.0, GEOS native implementation enabled for GEOS 3.11+

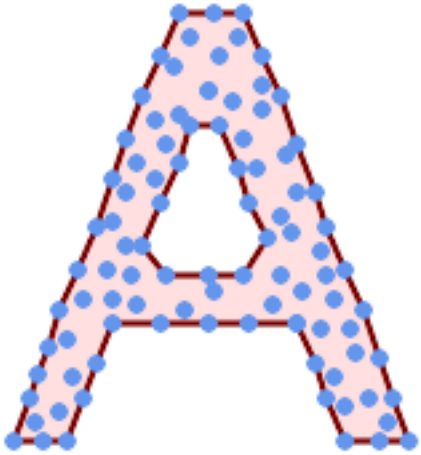
예시



Concave Hull of a MultiPoint

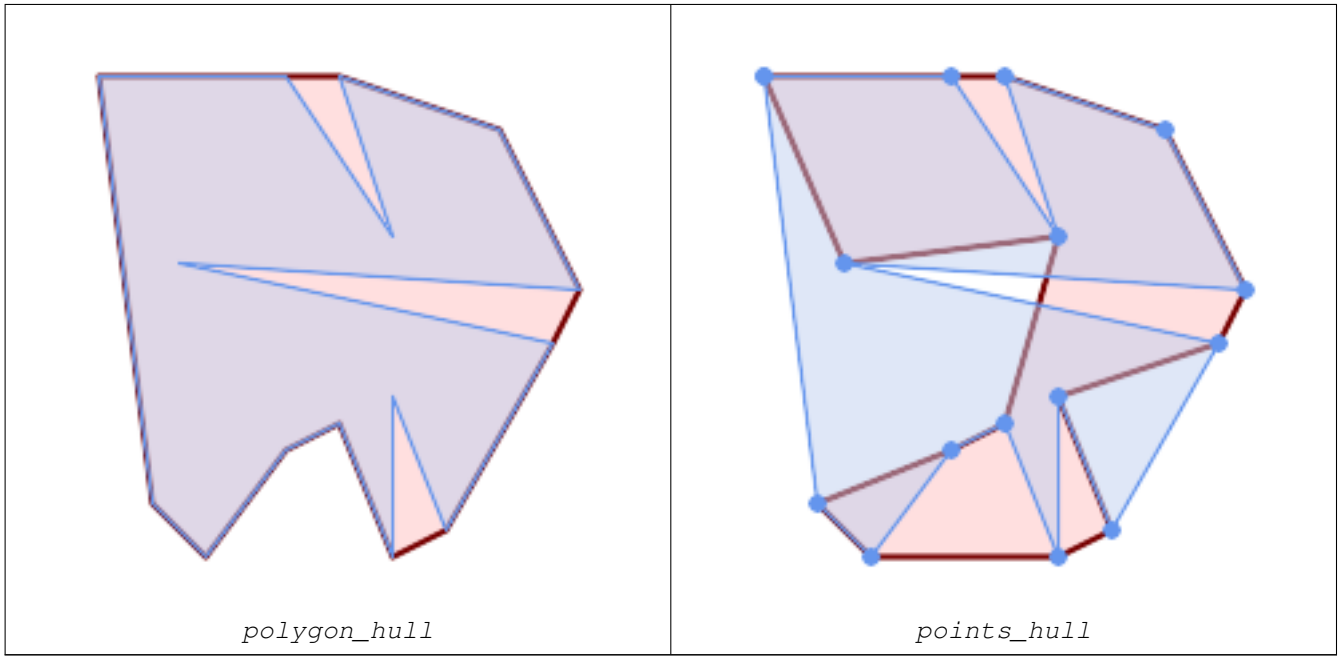
```
SELECT ST_AsText( ST_ConcaveHull(
        'MULTIPOINT ((10 72), (53 76), (56 66), (63 58), (71 51), (81 48), (91 46), (101  ↩
            45), (111 46), (121 47), (131 50), (140 55), (145 64), (144 74), (135 80), (125  ↩
            83), (115 85), (105 87), (95 89), (85 91), (75 93), (65 95), (55 98), (45 102),  ↩
            (37 107), (29 114), (22 122), (19 132), (18 142), (21 151), (27 160), (35 167),  ↩
            (44 172), (54 175), (64 178), (74 180), (84 181), (94 181), (104 181), (114 181) ↩
            , (124 181), (134 179), (144 177), (153 173), (162 168), (171 162), (177 154),  ↩
            (182 145), (184 135), (139 132), (136 142), (128 149), (119 153), (109 155), (99 ↩
             155), (89 155), (79 153), (69 150), (61 144), (63 134), (72 128), (82 125), (92 ↩
             123), (102 121), (112 119), (122 118), (132 116), (142 113), (151 110), (161  ↩
            106), (170 102), (178 96), (185 88), (189 78), (190 68), (189 58), (185 49),  ↩
            (179 41), (171 34), (162 29), (153 25), (143 23), (133 21), (123 19), (113 19),  ↩
            (102 19), (92 19), (82 19), (72 21), (62 22), (52 25), (43 29), (33 34), (25 41) ↩
            , (19 49), (14 58), (21 73), (31 74), (42 74), (173 134), (161 134), (150 133),  ↩
            (97 104), (52 117), (157 156), (94 171), (112 106), (169 73), (58 165), (149 40) ↩
            , (70 33), (147 157), (48 153), (140 96), (47 129), (173 55), (144 86), (159 67) ↩
            , (150 146), (38 136), (111 170), (124 94), (26 59), (60 41), (71 162), (41 64), ↩
             (88 110), (122 34), (151 97), (157 56), (39 146), (88 33), (159 45), (47 56),  ↩
            (138 40), (129 165), (33 48), (106 31), (169 147), (37 122), (71 109), (163 89), ↩
             (37 156), (82 170), (180 72), (29 142), (46 41), (59 155), (124 106), (157 80), ↩
             (175 82), (56 50), (62 116), (113 95), (144 167))',
```

```
        0.1 ) );
---st_astext--
POLYGON ((18 142, 21 151, 27 160, 35 167, 44 172, 54 175, 64 178, 74 180, 84 181, 94 181,  ↩
    104 181, 114 181, 124 181, 134 179, 144 177, 153 173, 162 168, 171 162, 177 154, 182  ↩
    145, 184 135, 173 134, 161 134, 150 133, 139 132, 136 142, 128 149, 119 153, 109 155, 99 ↩
     155, 89 155, 79 153, 69 150, 61 144, 63 134, 72 128, 82 125, 92 123, 102 121, 112 119,  ↩
    122 118, 132 116, 142 113, 151 110, 161 106, 170 102, 178 96, 185 88, 189 78, 190 68,  ↩
    189 58, 185 49, 179 41, 171 34, 162 29, 153 25, 143 23, 133 21, 123 19, 113 19, 102 19,  ↩
    92 19, 82 19, 72 21, 62 22, 52 25, 43 29, 33 34, 25 41, 19 49, 14 58, 10 72, 21 73, 31  ↩
    74, 42 74, 53 76, 56 66, 63 58, 71 51, 81 48, 91 46, 101 45, 111 46, 121 47, 131 50, 140 ↩
     55, 145 64, 144 74, 135 80, 125 83, 115 85, 105 87, 95 89, 85 91, 75 93, 65 95, 55 98,  ↩
    45 102, 37 107, 29 114, 22 122, 19 132, 18 142))
```



Concave Hull of a MultiPoint, allowing holes

```
SELECT ST_AsText( ST_ConcaveHull(
        'MULTIPOINT ((132 64), (114 64), (99 64), (81 64), (63 64), (57 49), (52 36), (46  ↩
            20), (37 20), (26 20), (32 36), (39 55), (43 69), (50 84), (57 100), (63 118),  ↩
            (68 133), (74 149), (81 164), (88 180), (101 180), (112 180), (119 164), (126  ↩
            149), (132 131), (139 113), (143 100), (150 84), (157 69), (163 51), (168 36),  ↩
            (174 20), (163 20), (150 20), (143 36), (139 49), (132 64), (99 151), (92 138),  ↩
            (88 124), (81 109), (74 93), (70 82), (83 82), (99 82), (112 82), (126 82), (121 ↩
             96), (114 109), (110 122), (103 138), (99 151), (34 27), (43 31), (48 44), (46  ↩
            58), (52 73), (63 73), (61 84), (72 71), (90 69), (101 76), (123 71), (141 62),  ↩
            (166 27), (150 33), (159 36), (146 44), (154 53), (152 62), (146 73), (134 76),  ↩
            (143 82), (141 91), (130 98), (126 104), (132 113), (128 127), (117 122), (112  ↩
            133), (119 144), (108 147), (119 153), (110 171), (103 164), (92 171), (86 160), ↩
             (88 142), (79 140), (72 124), (83 131), (79 118), (68 113), (63 102), (68 93),  ↩
            (35 45))',
         0.15, true ) );
---st_astext--
POLYGON ((43 69, 50 84, 57 100, 63 118, 68 133, 74 149, 81 164, 88 180, 101 180, 112 180,  ↩
    119 164, 126 149, 132 131, 139 113, 143 100, 150 84, 157 69, 163 51, 168 36, 174 20, 163 ↩
     20, 150 20, 143 36, 139 49, 132 64, 114 64, 99 64, 81 64, 63 64, 57 49, 52 36, 46 20,  ↩
    37 20, 26 20, 32 36, 35 45, 39 55, 43 69), (88 124, 81 109, 74 93, 83 82, 99 82, 112 82, ↩
     121 96, 114 109, 110 122, 103 138, 92 138, 88 124))
```



Comparing a concave hull of a Polygon to the concave hull of the constituent points. The hull respects the boundary of the polygon, whereas the points-based hull does not.

```
WITH data(geom) AS (VALUES
   ('POLYGON ((10 90, 39 85, 61 79, 50 90, 80 80, 95 55, 25 60, 90 45, 70 16, 63 38, 60 10, ↩
       50 30, 43 27, 30 10, 20 20, 10 90))'::geometry)
)
SELECT  ST_ConcaveHull( geom,            0.1) AS polygon_hull,
        ST_ConcaveHull( ST_Points(geom), 0.1) AS points_hull
    FROM data;
```

Using with ST_Collect to compute the concave hull of a geometry set.

```
-- Compute estimate of infected area based on point observations
SELECT disease_type,
    ST_ConcaveHull( ST_Collect(obs_pnt), 0.3 ) AS geom
  FROM disease_obs
  GROUP BY disease_type;
```

참고

ST_ConvexHull, ST_GeomCollFromText, ST_AlphaShape, ST_OptimalAlphaShape

7.14.6 ST_ConvexHull

ST_ConvexHull — Computes the convex hull of a geometry.

Synopsis

geometry **ST_ConvexHull**(geometry geomA);

설명

Computes the convex hull of a geometry. The convex hull is the smallest convex geometry that encloses all geometries in the input.

One can think of the convex hull as the geometry obtained by wrapping an rubber band around a set of geometries. This is different from a concave hull which is analogous to "shrink-wrapping" the geometries. A convex hull is often used to determine an affected area based on a set of point observations.

In the general case the convex hull is a Polygon. The convex hull of two or more collinear points is a two-point LineString. The convex hull of one or more identical points is a Point.

This is not an aggregate function. To compute the convex hull of a set of geometries, use ST_GeomCollFromText to aggregate them into a geometry collection (e.g. `ST_ConvexHull(ST_Collect(geom))`.

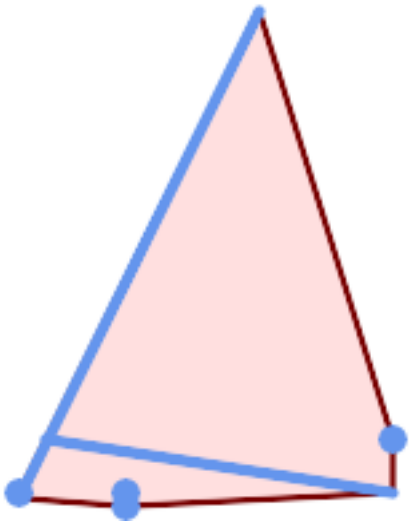
GEOS 모듈로 실행

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.16

This function supports 3d and will not drop the z-index.

예시



Convex Hull of a MultiLinestring and a MultiPoint

```
SELECT ST_AsText(ST_ConvexHull(
    ST_Collect(
        ST_GeomFromText('MULTILINESTRING((100 190,10 8),(150 10, 20 30))'),
            ST_GeomFromText('MULTIPOINT(50 5, 150 30, 50 10, 10 10)')
            )) );
---st_astext--
POLYGON((50 5,10 8,10 10,100 190,150 30,150 10,50 5))
```

Using with ST_Collect to compute the convex hulls of geometry sets.

```
--Get estimate of infected area based on point observations
SELECT d.disease_type,
    ST_ConvexHull(ST_Collect(d.geom)) As geom
    FROM disease_obs As d
    GROUP BY d.disease_type;
```

참고

ST_GeomCollFromText, ST_ConcaveHull, ST_MinimumBoundingCircle

7.14.7 ST_DelaunayTriangles

ST_DelaunayTriangles — Returns the Delaunay triangulation of the vertices of a geometry.

Synopsis

geometry **ST_DelaunayTriangles**(geometry g1, float tolerance = 0.0, int4 flags = 0);

설명

Computes the Delaunay triangulation of the vertices of the input geometry. The optional `tolerance` can be used to snap nearby input vertices together, which improves robustness in some situations. The result geometry is bounded by the convex hull of the input vertices. The result geometry representation is determined by the `flags` code:

- `0` - a GEOMETRYCOLLECTION of triangular POLYGONs (default)
- `1` - a MULTILINESTRING of the edges of the triangulation
- `2` - A TIN of the triangulation

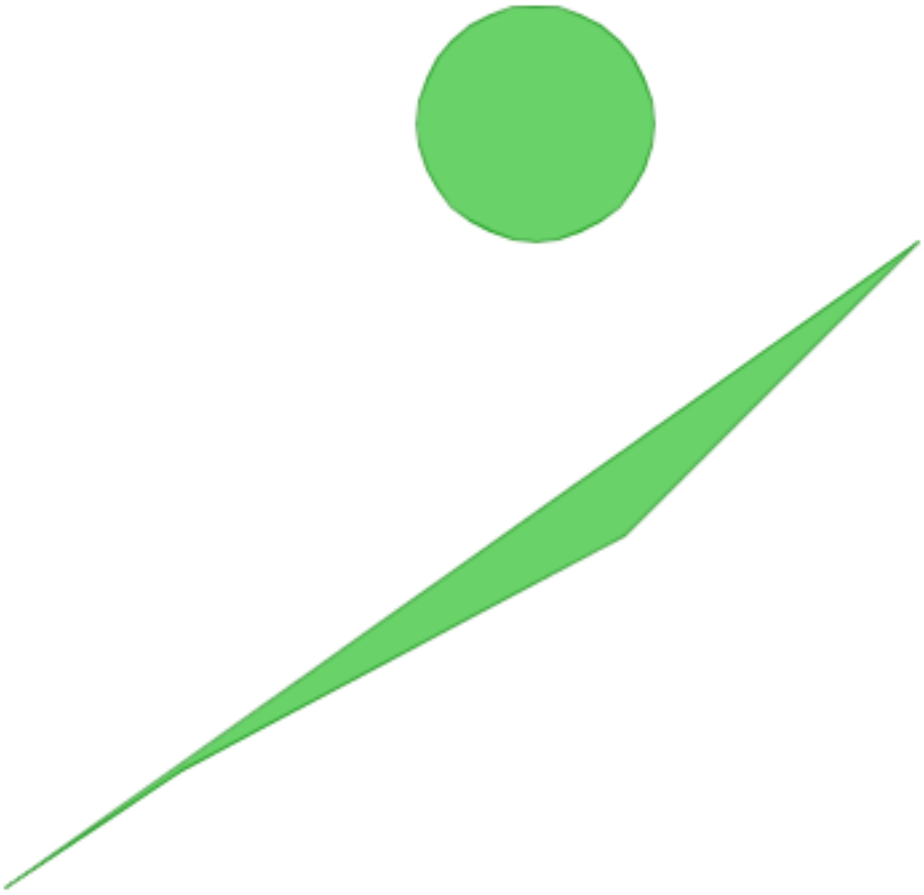
GEOS 모듈로 실행

2.1.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

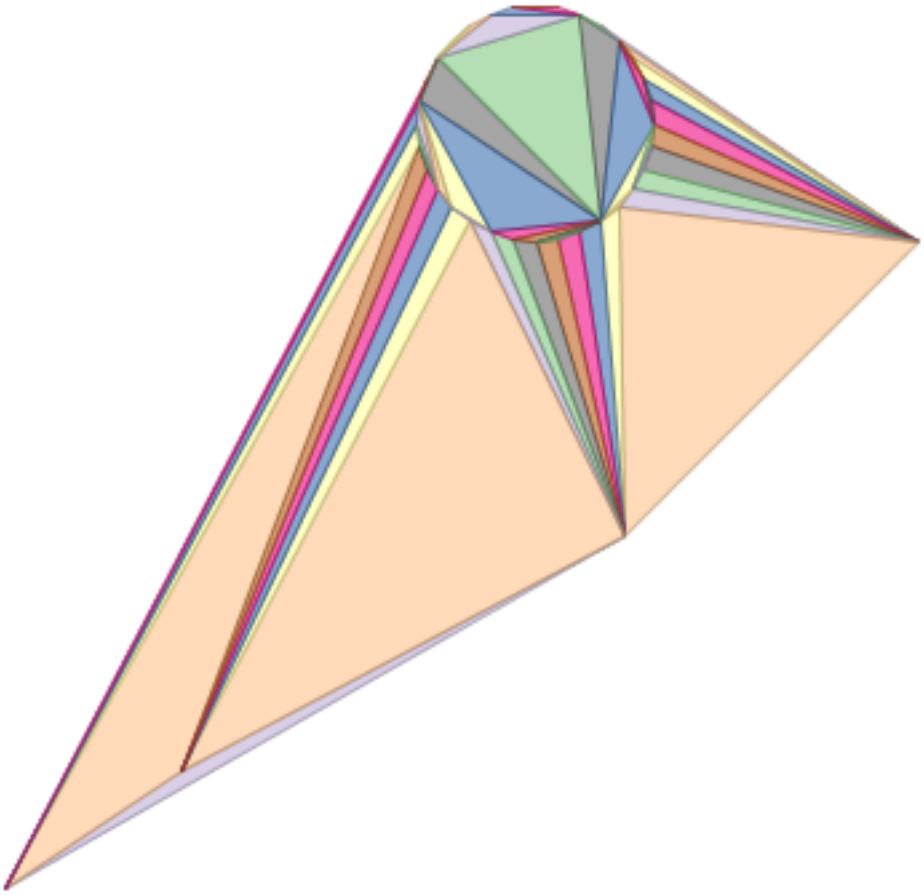
This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시



원본 폴리곤

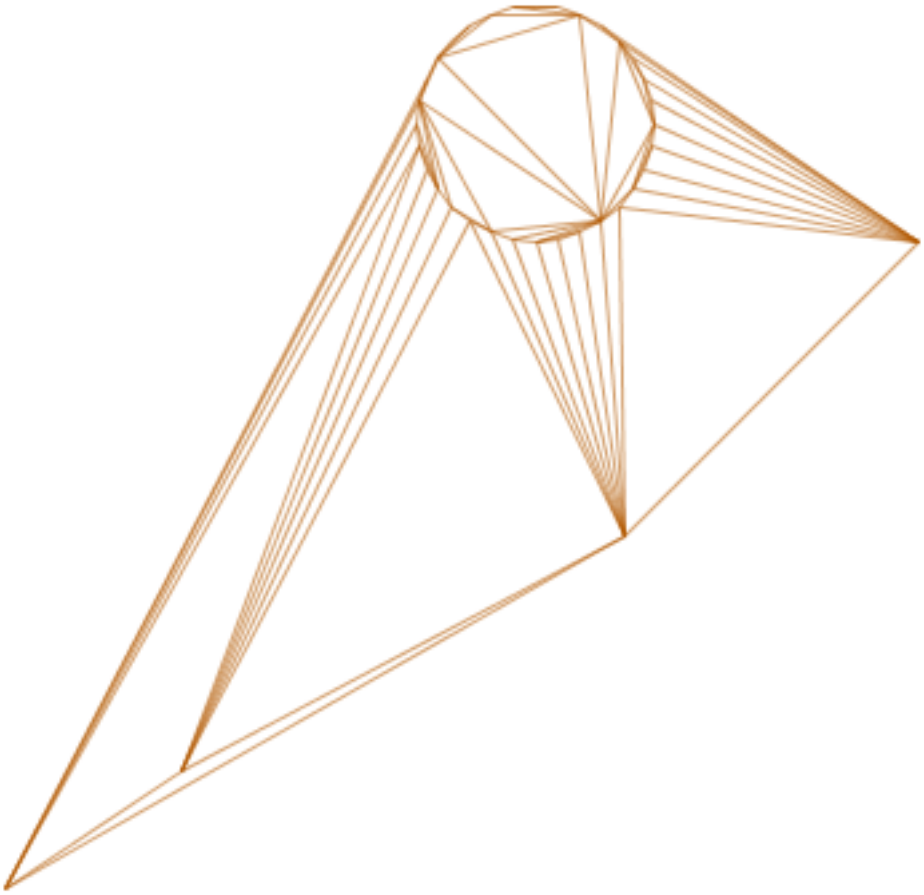
```
our original geometry
    ST_Union(ST_GeomFromText('POLYGON((175 150, 20 40,
            50 60, 125 100, 175 150))'),
        ST_Buffer(ST_GeomFromText('POINT(110 170)'), 20)
        )
```



두 폴리곤의 ST_DelaunayTriangles: 각 삼각형이 서로 다른 색으로 칠해진 들로네 삼각형 폴리곤

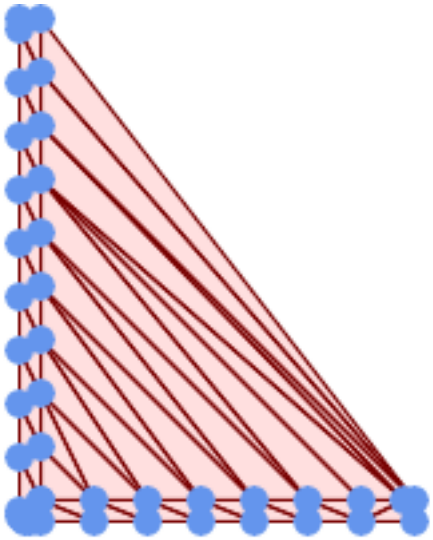
geometries overlaid multilinestring triangles

```
SELECT
    ST_DelaunayTriangles(
        ST_Union(ST_GeomFromText('POLYGON((175 150, 20 40,
            50 60, 125 100, 175 150))'),
        ST_Buffer(ST_GeomFromText('POINT(110 170)'), 20)
        ))
     As  dtriag;
```



-- 멀티라인스트링인 들로네삼각형

```
SELECT
    ST_DelaunayTriangles(
        ST_Union(ST_GeomFromText('POLYGON((175 150, 20 40,
            50 60, 125 100, 175 150))'),
        ST_Buffer(ST_GeomFromText('POINT(110 170)'), 20)
        ),0.001,1)
     As  dtriag;
```



-- 삼각형 폴리곤 55개인 포인트 45개의 들로네 삼각형

```
this produces a table of 42 points that form an L shape

SELECT (ST_DumpPoints(ST_GeomFromText(
'MULTIPOINT(14 14,34 14,54 14,74 14,94 14,114 14,134 14,
150 14,154 14,154 6,134 6,114 6,94 6,74 6,54 6,34 6,
14 6,10 6,8 6,7 7,6 8,6 10,6 30,6 50,6 70,6 90,6 110,6 130,
6 150,6 170,6 190,6 194,14 194,14 174,14 154,14 134,14 114,
14 94,14 74,14 54,14 34,14 14)'))).geom
    INTO TABLE l_shape;

output as individual polygon triangles

SELECT ST_AsText((ST_Dump(geom)).geom) As wkt
FROM ( SELECT ST_DelaunayTriangles(ST_Collect(geom)) As geom
FROM l_shape) As foo;


wkt

POLYGON((6 194,6 190,14 194,6 194))
POLYGON((14 194,6 190,14 174,14 194))
POLYGON((14 194,14 174,154 14,14 194))
POLYGON((154 14,14 174,14 154,154 14))
POLYGON((154 14,14 154,150 14,154 14))
POLYGON((154 14,150 14,154 6,154 14))
```

Example using vertices with Z values.

```
3D multipoint

SELECT ST_AsText(ST_DelaunayTriangles(ST_GeomFromText(
         'MULTIPOINT Z(14 14 10, 150 14 100,34 6 25, 20 10 150)'))) As wkt;


wkt

GEOMETRYCOLLECTION Z (POLYGON Z ((14 14 10,20 10 150,34 6 25,14 14 10))
```

```
,POLYGON Z ((14 14 10,34 6 25,150 14 100,14 14 10)))
```

참고

ST_VoronoiPolygons, ST_TriangulatePolygon, ST_ConstrainedDelaunayTriangles, ST_VoronoiLines, ST_ConvexHull

7.14.8 ST_FilterByM

ST_FilterByM — Removes vertices based on their M value

Synopsis

geometry **ST_FilterByM**(geometry geom, double precision min, double precision max = null, boolean returnM = false);

설명

Filters out vertex points based on their M-value. Returns a geometry with only vertex points that have a M-value larger or equal to the min value and smaller or equal to the max value. If max-value argument is left out only min value is considered. If fourth argument is left out the m-value will not be in the resulting geometry. If resulting geometry have too few vertex points left for its geometry type an empty geometry will be returned. In a geometry collection geometries without enough points will just be left out silently.

This function is mainly intended to be used in conjunction with ST_SetEffectiveArea. ST_EffectiveArea sets the effective area of a vertex in its m-value. With ST_FilterByM it then is possible to get a simplified version of the geometry without any calculations, just by filtering

Note
There is a difference in what ST_SimplifyVW returns when not enough points meet the criteria compared to ST_FilterByM. ST_SimplifyVW returns the geometry with enough points while ST_FilterByM returns an empty geometry

Note
Note that the returned geometry might be invalid

Note
This function returns all dimensions, including the Z and M values

Availability: 2.5.0

예시

A linestring is filtered

```
SELECT ST_AsText(ST_FilterByM(geom,30)) simplified
FROM (SELECT  ST_SetEffectiveArea('LINESTRING(5 2, 3 8, 6 20, 7 25, 10 10)'::geometry) geom ↩
    ) As foo;

result

         simplified
----------------------------
 LINESTRING(5 2,7 25,10 10)
```

참고

ST_SetEffectiveArea, ST_SimplifyVW

7.14.9 ST_GeneratePoints

ST_GeneratePoints — Generates random points contained in a Polygon or MultiPolygon.

Synopsis

geometry **ST_GeneratePoints**(g geometry , npoints integer);
geometry **ST_GeneratePoints**(geometry g , integer npoints , integer seed = 0);

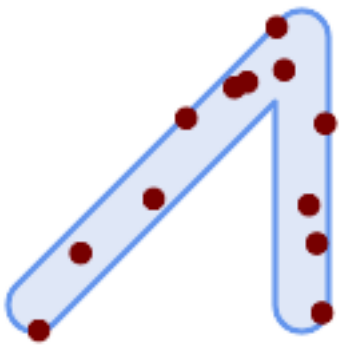
설명

ST_GeneratePoints generates a given number of pseudo-random points which lie within the input area. The optional `seed` is used to regenerate a deterministic sequence of points, and must be greater than zero.

2.3.0 버전부터 사용할 수 있습니다.

Enhanced: 3.0.0, added seed parameter

예시



Generated 12 Points overlaid on top of original polygon using a random seed value 1996

```
SELECT ST_GeneratePoints(geom, 12, 1996)
FROM (
    SELECT ST_Buffer(
        ST_GeomFromText(
        'LINESTRING(50 50,150 150,150 50)'),
        10, 'endcap=round join=round') AS geom
) AS s;
```

7.14.10 ST_GeometricMedian

ST_GeometricMedian — 멀티 포인트의 기하학적중심값(median)을 반환합니다.

Synopsis

geometry **ST_GeometricMedian** (geometry geom, float8 tolerance = NULL, int max_iter = 10000, boolean fail_if_not_converged = false);

설명

Computes the approximate geometric median of a MultiPoint geometry using the Weiszfeld algorithm. The geometric median is the point minimizing the sum of distances to the input points. It provides a centrality measure that is less sensitive to outlier points than the centroid (center of mass).

The algorithm iterates until the distance change between successive iterations is less than the supplied `tolerance` parameter. If this condition has not been met after `max_iterations` iterations, the function produces an error and exits, unless `fail_if_not_converged` is set to `false` (the default).

If a `tolerance` argument is not provided, the tolerance value is calculated based on the extent of the input geometry.

If present, the input point M values are interpreted as their relative weights.

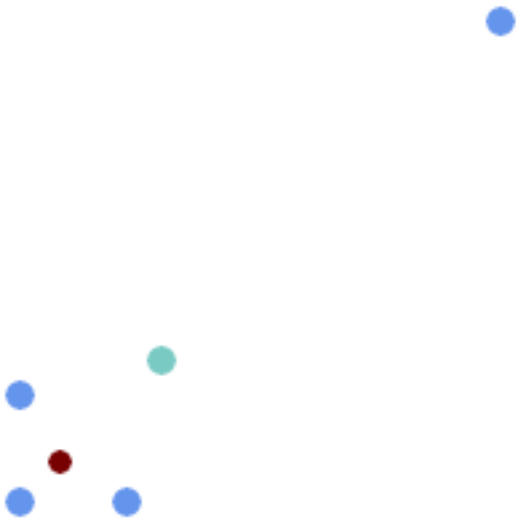
2.3.0 버전부터 사용할 수 있습니다.

Enhanced: 2.5.0 Added support for M as weight of points.

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

예시



Comparison of the geometric median (red) and centroid (turquoise) of a MultiPoint.

```
WITH test AS (
SELECT 'MULTIPOINT((10 10), (10 40), (40 10), (190 190))'::geometry geom)
SELECT
  ST_AsText(ST_Centroid(geom)) centroid,
  ST_AsText(ST_GeometricMedian(geom)) median
FROM test;

      centroid      |                 median
--------------------+----------------------------------------
   POINT(62.5 62.5) | POINT(25.01778421249728 25.01778421249728)
(1 row)
```

참고

ST_Centroid

7.14.11 ST_LineMerge

ST_LineMerge — Return the lines formed by sewing together a MultiLineString.

Synopsis

geometry **ST_LineMerge**(geometry amultilinestring);
geometry **ST_LineMerge**(geometry amultilinestring, boolean directed);

설명

Returns a LineString or MultiLineString formed by joining together the line elements of a MultiLineString. Lines are joined at their endpoints at 2-way intersections. Lines are not joined across intersections of 3-way or greater degree.

If **directed** is TRUE, then ST_LineMerge will not change point order within LineStrings, so lines with opposite directions will not be merged

Note
Only use with MultiLineString/LineStrings. Other geometry types return an empty GeometryCollection

GEOS 모듈로 실행

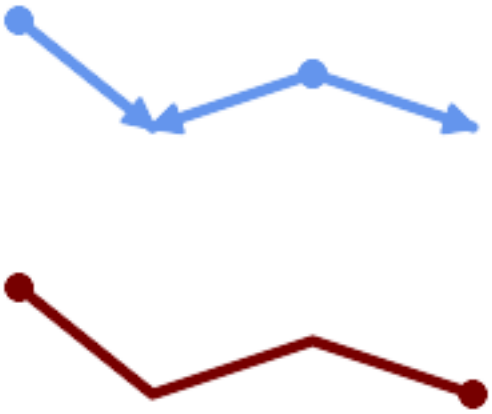
Enhanced: 3.3.0 accept a directed parameter.

Requires GEOS >= 3.11.0 to use the directed parameter.

1.1.0 버전부터 사용할 수 있습니다.

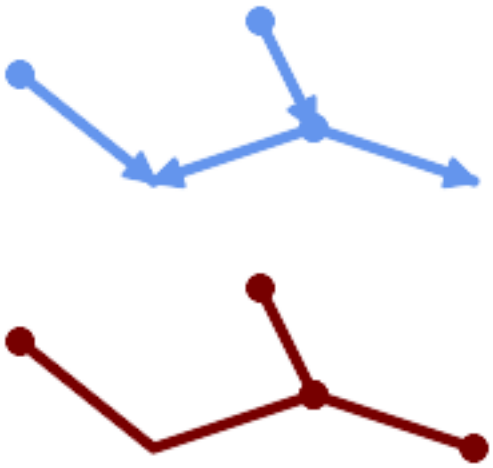
Warning
This function strips the M dimension.

예시



Merging lines with different orientation.

```
SELECT ST_AsText(ST_LineMerge(
'MULTILINESTRING((10 160, 60 120), (120 140, 60 120), (120 140, 180 120))'
                ));
------------------------------------------
 LINESTRING(10 160,60 120,120 140,180 120)
```

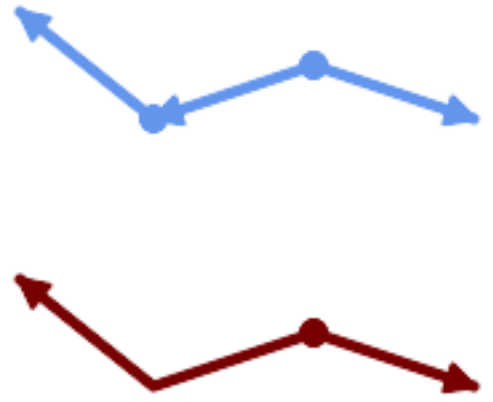


Lines are not merged across intersections with degree > 2.

```
SELECT ST_AsText(ST_LineMerge(
'MULTILINESTRING((10 160, 60 120), (120 140, 60 120), (120 140, 180 120), (100 180, 120  ↩
    140))'
                ));
------------------------------------------
 MULTILINESTRING((10 160,60 120,120 140),(100 180,120 140),(120 140,180 120))
```

If merging is not possible due to non-touching lines, the original MultiLineString is returned.

```
SELECT ST_AsText(ST_LineMerge(
'MULTILINESTRING((-29 -27,-30 -29.7,-36 -31,-45 -33),(-45.2 -33.2,-46 -32))'
));
----------------
MULTILINESTRING((-45.2 -33.2,-46 -32),(-29 -27,-30 -29.7,-36 -31,-45 -33))
```



Lines with opposite directions are not merged if directed = TRUE.

```
SELECT ST_AsText(ST_LineMerge(
'MULTILINESTRING((60 30, 10 70), (120 50, 60 30), (120 50, 180 30))',
TRUE));
```

```
-----------------------------------------------------
 MULTILINESTRING((120 50,60 30,10 70),(120 50,180 30))
```

Example showing Z-dimension handling.

```
SELECT ST_AsText(ST_LineMerge(
      'MULTILINESTRING((-29 -27 11,-30 -29.7 10,-36 -31 5,-45 -33 6), (-29 -27 12,-30 -29.7 ↩
          5), (-45 -33 1,-46 -32 11))'
        ));
------------------------------------------------------------------------------------------------ ←

LINESTRING Z (-30 -29.7 5,-29 -27 11,-30 -29.7 10,-36 -31 5,-45 -33 1,-46 -32 11)
```

참고

ST_Segmentize, ST_LineSubstring

7.14.12 ST_MaximumInscribedCircle

ST_MaximumInscribedCircle — 도형의 기하학적 중심을 반환합니다.

Synopsis

(geometry, geometry, double precision) **ST_MaximumInscribedCircle**(geometry geom);

설명

Finds the largest circle that is contained within a (multi)polygon, or which does not overlap any lines and points. Returns a record with fields:

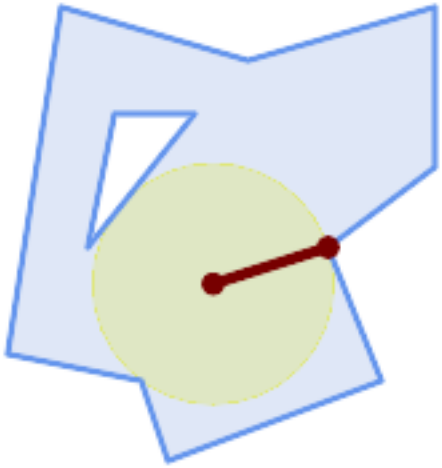
- `center` - center point of the circle
- `nearest` - a point on the geometry nearest to the center
- `radius` - radius of the circle

For polygonal inputs, the circle is inscribed within the boundary rings, using the internal rings as boundaries. For linear and point inputs, the circle is inscribed within the convex hull of the input, using the input lines and points as further boundaries.

Availability: 3.1.0.

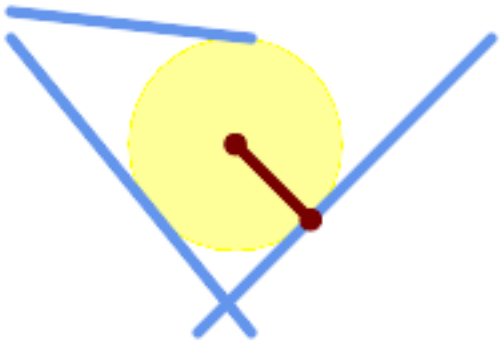
Requires GEOS >= 3.9.0.

예시



Maximum inscribed circle of a polygon. Center, nearest point, and radius are returned.

```
SELECT radius, ST_AsText(center) AS center, ST_AsText(nearest) AS nearest
    FROM ST_MaximumInscribedCircle(
        'POLYGON ((40 180, 110 160, 180 180, 180 120, 140 90, 160 40, 80 10, 70 40, 20 50,  ↩
            40 180),
        (60 140, 50 90, 90 140, 60 140))');

     radius      |           center           |    nearest
-----------------+----------------------------+---------------
 45.165845650018 | POINT(96.953125 76.328125) | POINT(140 90)
```



Maximum inscribed circle of a multi-linestring. Center, nearest point, and radius are returned.

참고

ST_MinimumBoundingRadius, ST_LargestEmptyCircle

7.14.13 ST_LargestEmptyCircle

ST_LargestEmptyCircle — Computes the largest circle not overlapping a geometry.

Synopsis

(geometry, geometry, double precision) **ST_LargestEmptyCircle**(geometry geom, double precision tolerance=0.0, geometry boundary=POINT EMPTY);

설명

Finds the largest circle which does not overlap a set of point and line obstacles. (Polygonal geometries may be included as obstacles, but only their boundary lines are used.) The center of the circle is constrained to lie inside a polygonal boundary, which by default is the convex hull of the input geometry. The circle center is the point in the interior of the boundary which has the farthest distance from the obstacles. The circle itself is provided by the center point and a nearest point lying on an obstacle detemining the circle radius.

The circle center is determined to a given accuracy specified by a distance tolerance, using an iterative algorithm. If the accuracy distance is not specified a reasonable default is used.

Returns a record with fields:

- `center` - center point of the circle
- `nearest` - a point on the geometry nearest to the center
- `radius` - radius of the circle

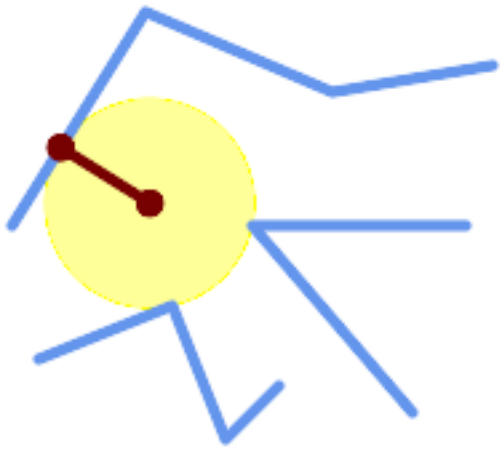
To find the largest empty circle in the interior of a polygon, see ST_MaximumInscribedCircle.

Availability: 3.4.0.

Requires GEOS >= 3.9.0.

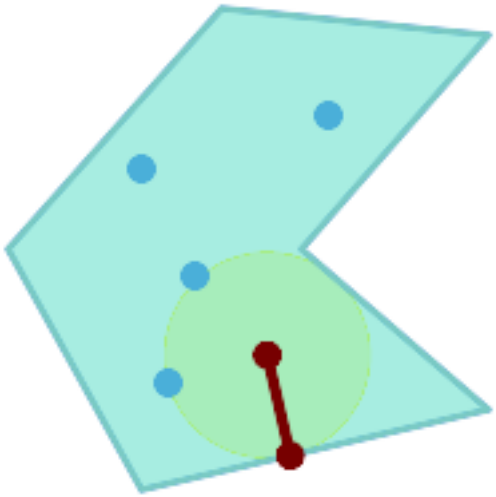
예시

```
SELECT radius,
       ST_AsText(center) AS center,
       ST_AsText(nearest) AS nearest
  FROM ST_LargestEmptyCircle(
       'MULTILINESTRING (
          (10 100, 60 180, 130 150, 190 160),
          (20 50, 70 70, 90 20, 110 40),
          (160 30, 100 100, 180 100))');
```



Largest Empty Circle within a set of lines.

```
SELECT radius,
       ST_AsText(center) AS center,
       ST_AsText(nearest) AS nearest
  FROM ST_LargestEmptyCircle(
         St_Collect(
           'MULTIPOINT ((70 50), (60 130), (130 150), (80 90))',
           'POLYGON ((90 190, 10 100, 60 10, 190 40, 120 100, 190 180, 90 190))'),
         'POLYGON ((90 190, 10 100, 60 10, 190 40, 120 100, 190 180, 90 190))'
       );
```



Largest Empty Circle within a set of points, constrained to lie in a polygon. The constraint polygon boundary must be included as an obstacle, as well as specified as the constraint for the circle center.

참고

ST_MinimumBoundingRadius

7.14.14 ST_MinimumBoundingCircle

ST_MinimumBoundingCircle — Returns the smallest circle polygon that contains a geometry.

Synopsis

geometry **ST_MinimumBoundingCircle**(geometry geomA, integer num_segs_per_qt_circ=48);

설명

Returns the smallest circle polygon that contains a geometry.

Note

사분원 당 구간 48개라는 기본값으로 원에 가까운 폴리곤을 생성합니다. 이 폴리곤이 최소 경계 원(minimum bounding circle)의 근사치이기 때문에, 입력 도형 안에 있는 포인트 몇 개는 폴리곤 내부에 담기지 않을 수도 있습니다. 구간의 개수를 늘리면 성능을 거의 저하시키지 않고도 근사치를 향상시킬 수 있습니다. 폴리곤 근사치가 적당하지 않은 경우, ST_MinimumBoundingRadius 함수를 사용할 수도 있습니다.

Use with ST_GeomCollFromText to get the minimum bounding circle of a set of geometries.

To compute two points lying on the mimimum circle (the "maximum diameter") use ST_LongestLine.

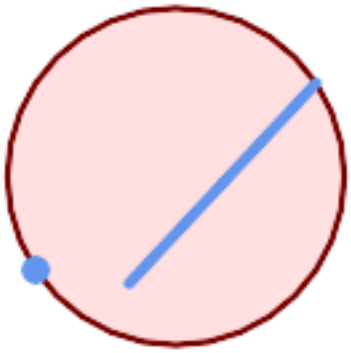
폴리곤의 면적을 최소 경계 원의 면적으로 나눈 비율을 종종 루크(Ro 테스트라고 부릅니다.

GEOS 모듈로 실행

유효버전: 1.4.0

예시

```
SELECT d.disease_type,
    ST_MinimumBoundingCircle(ST_Collect(d.geom)) As geom
    FROM disease_obs As d
    GROUP BY d.disease_type;
```



포인트 및 라인스트링의 최소 경계 원. 사분원의 근사치를 구하는 데 구간 8개를 이용합니다.

```
SELECT ST_AsText(ST_MinimumBoundingCircle(
        ST_Collect(
            ST_GeomFromText('LINESTRING(55 75,125 150)'),
                ST_Point(20, 80)), 8
                )) As wktmbc;
wktmbc
-----------
POLYGON((135.59714732062 115,134.384753327498 102.690357210921,130.79416296937  ↩
    90.8537670908995,124.963360620072 79.9451031602111,117.116420743937  ↩
    70.3835792560632,107.554896839789 62.5366393799277,96.6462329091006  ↩
    56.70583703063,84.8096427890789 53.115246672502,72.5000000000001  ↩
    51.9028526793802,60.1903572109213 53.1152466725019,48.3537670908996  ↩
    56.7058370306299,37.4451031602112 62.5366393799276,27.8835792560632  ↩
    70.383579256063,20.0366393799278 79.9451031602109,14.20583703063  ↩
    90.8537670908993,10.615246672502 102.690357210921,9.40285267938019 115,10.6152466725019  ↩
    127.309642789079,14.2058370306299 139.1462329091,20.0366393799275  ↩
    150.054896839789,27.883579256063 159.616420743937,
37.4451031602108 167.463360620072,48.3537670908992 173.29416296937,60.190357210921  ↩
    176.884753327498,
72.4999999999998 178.09714732062,84.8096427890786 176.884753327498,96.6462329091003  ↩
    173.29416296937,107.554896839789 167.463360620072,
117.116420743937 159.616420743937,124.963360620072 150.054896839789,130.79416296937  ↩
    139.146232909101,134.384753327498 127.309642789079,135.59714732062 115))
```

참고

ST_GeomCollFromText, ST_MinimumBoundingRadius, ST_LargestEmptyCircle, ST_LongestLine

7.14.15 ST_MinimumBoundingRadius

ST_MinimumBoundingRadius — Returns the center point and radius of the smallest circle that contains a geometry.

Synopsis

(geometry, double precision) **ST_MinimumBoundingRadius**(geometry geom);

설명

Computes the center point and radius of the smallest circle that contains a geometry. Returns a record with fields:

- `center` - center point of the circle
- `radius` - radius of the circle

Use with ST_GeomCollFromText to get the minimum bounding circle of a set of geometries.

To compute two points lying on the mimimum circle (the "maximum diameter") use ST_LongestLine.

2.3.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(center), radius FROM ST_MinimumBoundingRadius('POLYGON((26426 65078,26531 ↩
    65242,26075 65136,26096 65427,26426 65078))');

                st_astext                 |      radius
------------------------------------------+------------------
 POINT(26284.8418027133 65267.1145090825) | 247.436045591407
```

참고

ST_GeomCollFromText, ST_MinimumBoundingCircle, ST_LongestLine

7.14.16 ST_OrientedEnvelope

ST_OrientedEnvelope — Returns a minimum-area rectangle containing a geometry.

Synopsis

geometry **ST_OrientedEnvelope**(geometry geom);

설명

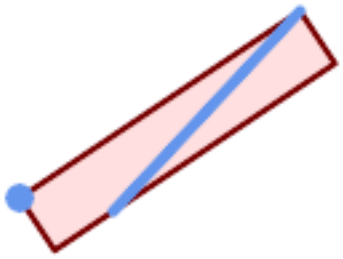
Returns the minimum-area rotated rectangle enclosing a geometry. Note that more than one such rectangle may exist. May return a Point or LineString in the case of degenerate inputs.

Availability: 2.5.0.

Requires GEOS >= 3.6.0.

예시

```
SELECT ST_AsText(ST_OrientedEnvelope('MULTIPOINT ((0 0), (-1 -1), (3 2))'));

                st_astext
                -----------------------------------------------
                POLYGON((3 2,2.88 2.16,-1.12 -0.84,-1 -1,3 2))
```



Oriented envelope of a point and linestring.

```
SELECT ST_AsText(ST_OrientedEnvelope(
        ST_Collect(
            ST_GeomFromText('LINESTRING(55 75,125 150)'),
                ST_Point(20, 80))
                )) As wktenv;
wktenv
-----------
POLYGON((19.9999999999997 79.9999999999999,33.0769230769229  ↩
    60.3846153846152,138.076923076924 130.384615384616,125.000000000001  ↩
    150.000000000001,19.9999999999997 79.9999999999999))
```

참고

ST_Envelope ST_MinimumBoundingCircle

7.14.17 ST_OffsetCurve

ST_OffsetCurve — Returns an offset line at a given distance and side from an input line.

Synopsis

geometry **ST_OffsetCurve**(geometry line, float signed_distance, text style_parameters='');

설명

Return an offset line at a given distance and side from an input line. All points of the returned geometries are not further than the given distance from the input geometry. Useful for computing parallel lines about a center line.

For positive distance the offset is on the left side of the input line and retains the same direction. For a negative distance it is on the right side and in the opposite direction.

거리의 단위는 공간 참조 시스템&#x
단위로 측정됩니다.

Note that output may be a MULTILINESTRING or EMPTY for some jigsaw-shaped input geometries.

다음과 같이 연산을 조정하기 위&#x
선택적인 세 번째 파라미터로 공&#x
구분된 키=값 쌍의 목록을 설정할
수 있습니다:

- 'quad_segs=#' : 사분원(quarter circle)의 근사치를 계산&
  데 쓰이는 선분의 개수(기본값은
  8)
- 'join=round|mitre|bevel' : 접합 스타일(기본값은 "원&#x
  '마이터(mitre)'의 동의어로 '마이터(miter)'&#x
  쓸 수 있습니다.
- 'mitre_limit=#.#' : 마이터 비율 제한(마이터 접&
  스타일만 영향을 받습니다). 'mitre_limit'&#xc7
  동의어로 'miter_limit'도 쓸 수 있습니다.

GEOS 모듈로 실행

2.0 버전부터 사용할 수 있습니다.

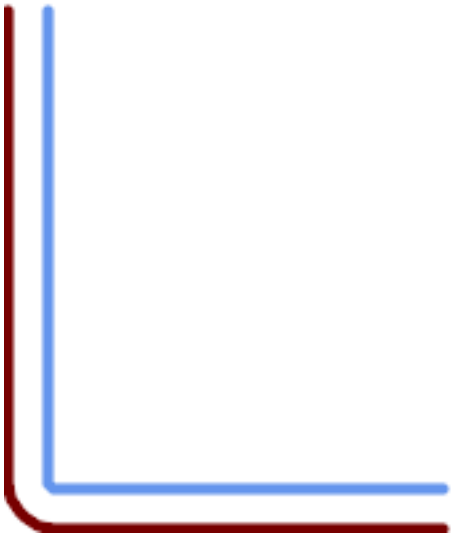
Enhanced: 2.5 - added support for GEOMETRYCOLLECTION and MULTILINESTRING

Note
This function ignores the Z dimension. It always gives a 2D result even when used on a 3D geometry.

예시

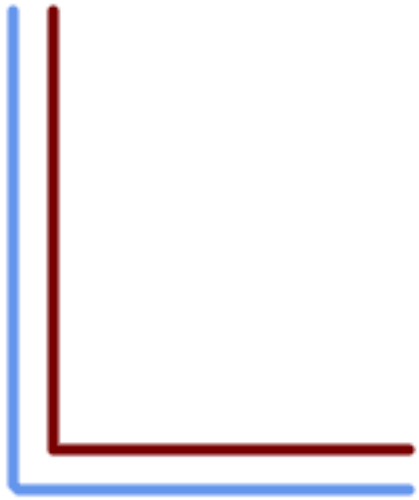
도로 주위로 열린 버퍼를 계산합&#x

```
SELECT ST_Union(
 ST_OffsetCurve(f.geom,  f.width/2, 'quad_segs=4 join=round'),
 ST_OffsetCurve(f.geom, -f.width/2, 'quad_segs=4 join=round')
) as track
FROM someroadstable;
```



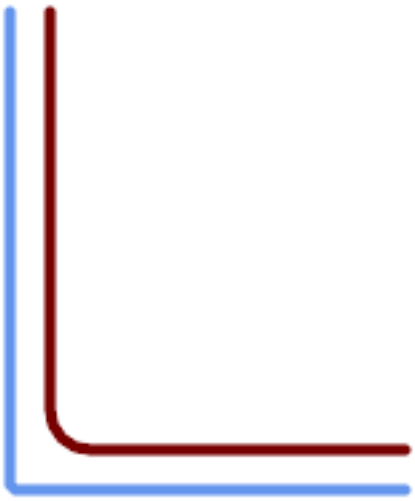
거리 15, 원본 라인에서 'quad_segs=4 join=round' 및 오프셋은 15단위

```
SELECT ST_AsText(ST_OffsetCurve( ↩
    ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
    ,
    15, 'quad_segs=4 join=round'));

output

LINESTRING(164 1,18 1,12.2597485145237  ↩
    2.1418070123307,
    7.39339828220179 5.39339828220179,
    5.39339828220179 7.39339828220179,
    2.14180701233067 12.2597485145237,1  ↩
    18,1 195)
```



거리 -15, 원본 라인에서 'quad_segs=4 join=round' 및 오프셋은 -15단위

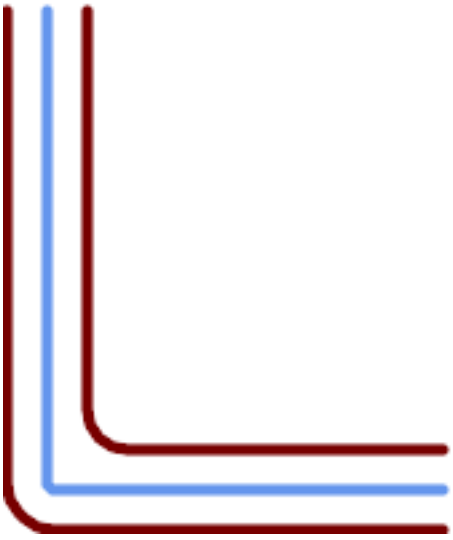
```
SELECT ST_AsText(ST_OffsetCurve(geom,
    -15, 'quad_segs=4 join=round')) As  ↩
    notsocurvy
    FROM ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
     As geom;
notsocurvy

LINESTRING(31 195,31 31,164 31)
```



더 둥글게 만들기 위한 이중 오프셋, 첫 번째 쿼리가 방향을 역전시킨다는 점에 주의하십시오. 즉 -30 + 15 = -15 입니다.

```
SELECT ST_AsText(ST_OffsetCurve( ↩
    ST_OffsetCurve(geom,
    -30, 'quad_segs=4 join=round'), -15,  ↩
    'quad_segs=4 join=round')) As morecurvy
    FROM ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
     As geom;
```

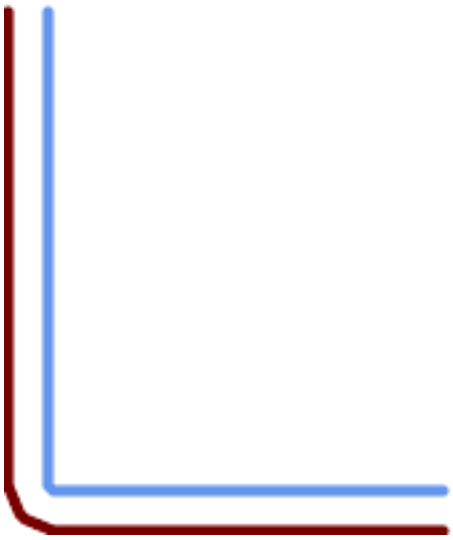
```
morecurvy

LINESTRING(164 31,46 31,40.2597485145236  ↩
    32.1418070123307,
35.3933982822018 35.3933982822018,
32.1418070123307 40.2597485145237,31  ↩
    46,31 195)
```



평행한 라인을 얻기 위한 정규 오프셋 15와 결합된, 더 둥글게 만들기 위한 이중 오프셋. 원본 과 중첩.

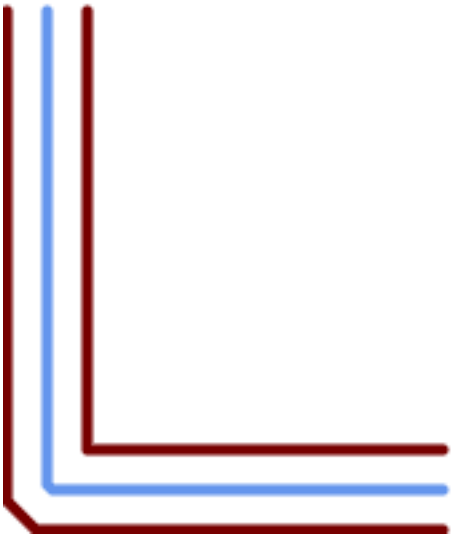
```
SELECT ST_AsText(ST_Collect(
    ST_OffsetCurve(geom, 15, 'quad_segs=4 ↩
     join=round'),
    ST_OffsetCurve(ST_OffsetCurve(geom,
    -30, 'quad_segs=4 join=round'), -15,  ↩
    'quad_segs=4 join=round')
    )
) As parallel_curves
    FROM ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
     As geom;
```

```
parallel curves

MULTILINESTRING((164 1,18  ↩
    1,12.2597485145237 2.1418070123307,
7.39339828220179  ↩
    5.39339828220179,5.39339828220179 7.393398282201
2.14180701233067 12.2597485145237,1 18,1  ↩
    195),
(164 31,46 31,40.2597485145236  ↩
    32.1418070123307,35.3933982822018 35.39339828220
32.1418070123307 40.2597485145237,31  ↩
    46,31 195))
```



거리 15, 원본 라인과 함께 표출된 'quad_segs=4 join=round'

```
SELECT ST_AsText(ST_OffsetCurve( ↩
    ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
    ,
        15, 'quad_segs=4 join=bevel'));

output

LINESTRING(164 1,18 1,7.39339828220179  ↩
    5.39339828220179,
    5.39339828220179 7.39339828220179,1  ↩
    18,1 195)
```



수집된 15, -15. join=mitre mitre_limit=2.1

```
SELECT ST_AsText(ST_Collect(
    ST_OffsetCurve(geom, 15, 'quad_segs=4 ↩
     join=mitre mitre_limit=2.2'),
    ST_OffsetCurve(geom, -15, 'quad_segs ↩
    =4 join=mitre mitre_limit=2.2')
    ) )
    FROM ST_GeomFromText(
'LINESTRING(164 16,144 16,124 16,104  ↩
    16,84 16,64 16,
    44 16,24 16,20 16,18 16,17 17,
    16 18,16 20,16 40,16 60,16 80,16 100,
    16 120,16 140,16 160,16 180,16 195)') ↩
     As geom;

output

MULTILINESTRING((164 1,11.7867965644036  ↩
    1,1 11.7867965644036,1 195),
    (31 195,31 31,164 31))
```

참고

ST_Buffer

7.14.18 ST_PointOnSurface

ST_PointOnSurface — Computes a point guaranteed to lie in a polygon, or on a geometry.

Synopsis

geometry **ST_PointOnSurface**(geometry g1);

설명

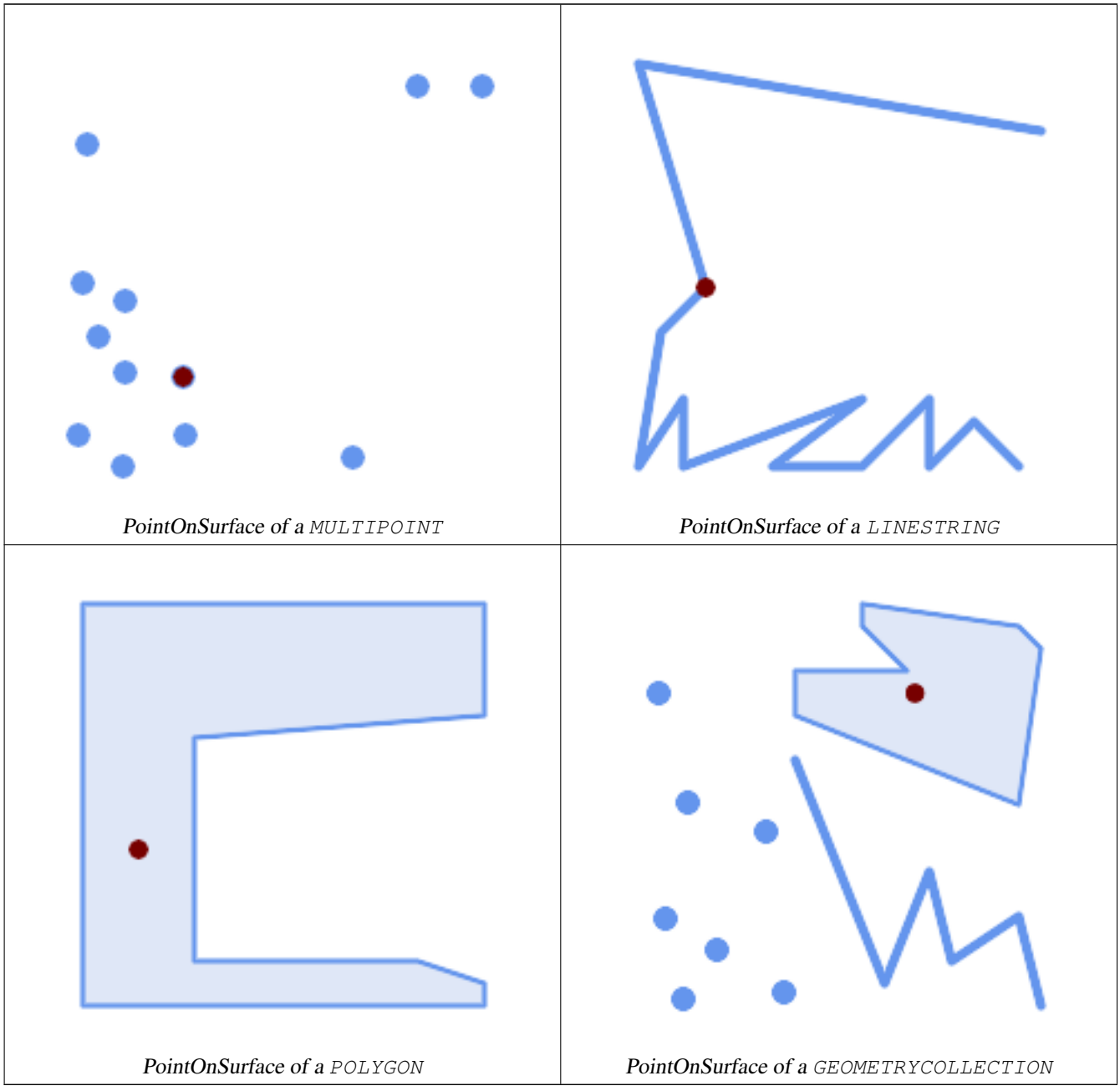
Returns a `POINT` which is guaranteed to lie in the interior of a surface (POLYGON, MULTIPOLYGON, and CURVED POLYGON). In PostGIS this function also works on line and point geometries.

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.14.2 // s3.2.18.2

This method implements the SQL/MM specification. SQL-MM 3: 8.1.5, 9.5.6. The specifications define ST_PointOnSurface for surface geometries only. PostGIS extends the function to support all common geometry types. Other databases (Oracle, DB2, ArcSDE) seem to support this function only for surfaces. SQL Server 2008 supports all common geometry types.

This function supports 3d and will not drop the z-index.

예시



PointOnSurface of a `MULTIPOINT`

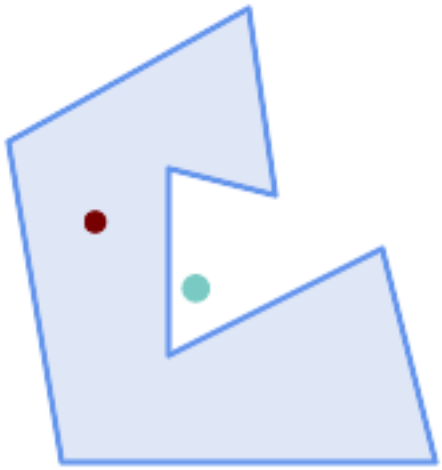
PointOnSurface of a `LINESTRING`

PointOnSurface of a `POLYGON`

PointOnSurface of a `GEOMETRYCOLLECTION`

```
SELECT ST_AsText(ST_PointOnSurface('POINT(0 5)'::geometry));
------------
 POINT(0 5)

SELECT ST_AsText(ST_PointOnSurface('LINESTRING(0 5, 0 10)'::geometry));
------------
 POINT(0 5)

SELECT ST_AsText(ST_PointOnSurface('POLYGON((0 0, 0 5, 5 5, 5 0, 0 0))'::geometry));
----------------
 POINT(2.5 2.5)

SELECT ST_AsEWKT(ST_PointOnSurface(ST_GeomFromEWKT('LINESTRING(0 5 1, 0 0 1, 0 10 2)')));
----------------
 POINT(0 0 1)
```

Example: The result of ST_PointOnSurface is guaranteed to lie within polygons, whereas the point computed by ST_Centroid may be outside.



Red: point on surface; Green: centroid

```
SELECT ST_AsText(ST_PointOnSurface(geom)) AS pt_on_surf,
       ST_AsText(ST_Centroid(geom)) AS centroid
    FROM (SELECT 'POLYGON ((130 120, 120 190, 30 140, 50 20, 190 20,
                      170 100, 90 60, 90 130, 130 120))'::geometry AS geom) AS t;

   pt_on_surf    |                  centroid
-----------------+-------------------------------------------
 POINT(62.5 110) | POINT(100.18264840182648 85.11415525114155)
```

참고

ST_Centroid, ST_MaximumInscribedCircle

7.14.19 ST_Polygonize

ST_Polygonize — Computes a collection of polygons formed from the linework of a set of geometries.

Synopsis

geometry **ST_Polygonize**(geometry set geomfield);
geometry **ST_Polygonize**(geometry[] geom_array);

설명

Creates a GeometryCollection containing the polygons formed by the constituent linework of a set of geometries. Input linework must be correctly noded for this function to work properly.

Note
To ensure input is fully noded use ST_Node on the input geometry before polygonizing.

Note
GeometryCollections are often difficult to deal with with third party tools. Use ST_Dump to convert the polygonize result into separate polygons.

GEOS 모듈로 실행

유효버전: 1.0.0RC1

예시: 단일 라인스트링의 폴리곤&#x

```
SELECT ST_AsEWKT(ST_Polygonize(geom_4269)) As geomtextrep
FROM (SELECT geom_4269 FROM ma.suffolk_edges ORDER BY tlid LIMIT 45) As foo;

geomtextrep
------------------------------------
 SRID=4269;GEOMETRYCOLLECTION(POLYGON((-71.040878 42.285678,-71.040943 42.2856,-71.04096  ↩
     42.285752,-71.040878 42.285678)),
 POLYGON((-71.17166 42.353675,-71.172026 42.354044,-71.17239 42.354358,-71.171794  ↩
     42.354971,-71.170511 42.354855,
 -71.17112 42.354238,-71.17166 42.353675)))
(1 row)

--Use ST_Dump to dump out the polygonize geoms into individual polygons
SELECT ST_AsEWKT((ST_Dump(foofoo.polycoll)).geom) As geomtextrep
FROM (SELECT ST_Polygonize(geom_4269) As polycoll
    FROM (SELECT geom_4269 FROM ma.suffolk_edges
        ORDER BY tlid LIMIT 45) As foo) As foofoo;

geomtextrep
------------------------
 SRID=4269;POLYGON((-71.040878 42.285678,-71.040943 42.2856,-71.04096 42.285752,
-71.040878 42.285678))
 SRID=4269;POLYGON((-71.17166 42.353675,-71.172026 42.354044,-71.17239 42.354358
,-71.171794 42.354971,-71.170511 42.354855,-71.17112 42.354238,-71.17166 42.353675))
(2 rows)
```

참고

ST_Node, ST_Dump

7.14.20 ST_ReducePrecision

ST_ReducePrecision — Returns a valid geometry with points rounded to a grid tolerance.

Synopsis

geometry **ST_ReducePrecision**(geometry g, float8 gridsize);

설명

Returns a valid geometry with all points rounded to the provided grid tolerance, and features below the tolerance removed.

Unlike ST_SnapToGrid the returned geometry will be valid, with no ring self-intersections or collapsed components.

Precision reduction can be used to:

- match coordinate precision to the data accuracy
- reduce the number of coordinates needed to represent a geometry
- ensure valid geometry output to formats which use lower precision (e.g. text formats such as WKT, GeoJSON or KML when the number of output decimal places is limited).
- export valid geometry to systems which use lower or limited precision (e.g. SDE, Oracle tolerance value)

Availability: 3.1.0.

Requires GEOS >= 3.9.0.

예시

```
SELECT ST_AsText(ST_ReducePrecision('POINT(1.412 19.323)', 0.1));
    st_astext
-----------------
 POINT(1.4 19.3)

SELECT ST_AsText(ST_ReducePrecision('POINT(1.412 19.323)', 1.0));
  st_astext
-------------
 POINT(1 19)

SELECT ST_AsText(ST_ReducePrecision('POINT(1.412 19.323)', 10));
  st_astext
-------------
 POINT(0 20)
```

Precision reduction can reduce number of vertices

```
SELECT ST_AsText(ST_ReducePrecision('LINESTRING (10 10, 19.6 30.1, 20 30, 20.3 30, 40 40)', ↩
    1));
  st_astext
-------------
 LINESTRING (10 10, 20 30, 40 40)
```

Precision reduction splits polygons if needed to ensure validity

```
SELECT ST_AsText(ST_ReducePrecision('POLYGON ((10 10, 60 60.1, 70 30, 40 40, 50 10, 10 10)) ↩
    ', 10));
  st_astext
-------------
 MULTIPOLYGON (((60 60, 70 30, 40 40, 60 60)), ((40 40, 50 10, 10 10, 40 40)))
```

참고

ST_SnapToGrid, ST_Simplify, ST_SimplifyVW

7.14.21 ST_SharedPaths

ST_SharedPaths — 두 입력 라인스트링/멀티라&#
공유하는 경로를 담고 있는 집합&#
반환합니다.

Synopsis

geometry **ST_SharedPaths**(geometry lineal1, geometry lineal2);

설명

두 입력 도형이 공유하는 경로를
담고 있는 집합을 반환합니다. 동&
방향을 향하는 경로가 이 집합의
첫 번째 요소이며, 반대 방향을 향&
경로가 두 번째 요소입니다. 경로
그 자체는 첫 번째 도형의 방향을
따릅니다.

GEOS 모듈로 실행

2.0.0 버전부터 사용할 수 있습니다.

예시: 공유된 경로 찾기

*멀티라인스트링과
라인스트링*

멀티라인스트링과 라인스트링이 공유하는 경로와 원본 도형들을 중첩

```
SELECT ST_AsText(
  ST_SharedPaths(
    ST_GeomFromText('MULTILINESTRING((26 125,26 200,126 200,126 125,26 125),
       (51 150,101 150,76 175,51 150))'),
    ST_GeomFromText('LINESTRING(151 100,126 156.25,126 125,90 161, 76 175)')
    )
  ) As wkt

                                wkt
------------------------------------------------------------
GEOMETRYCOLLECTION(MULTILINESTRING((126 156.25,126 125),
 (101 150,90 161),(90 161,76 175)),MULTILINESTRING EMPTY)
```

same example but linestring orientation flipped

```
SELECT ST_AsText(
  ST_SharedPaths(
   ST_GeomFromText('LINESTRING(76 175,90 161,126 125,126 156.25,151 100)'),
   ST_GeomFromText('MULTILINESTRING((26 125,26 200,126 200,126 125,26 125),
       (51 150,101 150,76 175,51 150))')
    )
  ) As wkt

                                wkt
------------------------------------------------------------
GEOMETRYCOLLECTION(MULTILINESTRING EMPTY,
MULTILINESTRING((76 175,90 161),(90 161,101 150),(126 125,126 156.25)))
```

참고

ST_Dump, ST_GeometryN, ST_NumGeometries

7.14.22 ST_Simplify

ST_Simplify — Returns a simplified version of a geometry, using the Douglas-Peucker algorithm.

Synopsis

geometry **ST_Simplify**(geometry geomA, float tolerance);
geometry **ST_Simplify**(geometry geomA, float tolerance, boolean preserveCollapsed);

설명

더글러스-패커(Douglas-Peucker) 알고리즘을 이용해서 입력 도형의 "단순화"된 버전을 반환합니다. 실제로는 [멀&[멀티]폴리곤과만 작동하지만, 어종류의 도형도 입력할 수 있다고 해도 과언은 아닙니다. 객체별 기단순화 작업을 하기 때문에 이 함도형 집합도 입력할 수 있습니다.

The "preserve collapsed" flag will retain objects that would otherwise be too small given the tolerance. For example, a 1m long line simplified with a 10m tolerance. If `preserveCollapsed` argument is specified as true, the line will not disappear. This flag is useful for rendering engines, to avoid having large numbers of very small objects disappear from a map leaving surprising gaps.

Note
반환되는 도형이 단순성을 잃을 수도 있다는 점에 주의하십시오(ST_IsSimple 참조).

Note
위상(topology)이 보전되지 않아 유효하지 않은 도형이 반환될 수도 있습니다. 위상을 유지하려면 ST_SimplifyPreserveTopology 함수를 이용하십시오.

1.2.2 버전부터 사용할 수 있습니다.

예시

원을 너무 단순화시키면 팔각형거쳐 삼각형이 되고 맙니다.

```
SELECT ST_Npoints(geom) AS np_before,
       ST_NPoints(ST_Simplify(geom,0.1)) AS np01_notbadcircle,
       ST_NPoints(ST_Simplify(geom,0.5)) AS np05_notquitecircle,
       ST_NPoints(ST_Simplify(geom,1)) AS np1_octagon,
       ST_NPoints(ST_Simplify(geom,10)) AS np10_triangle,
       (ST_Simplify(geom,100) is null) AS  np100_geometrygoesaway
  FROM
    (SELECT ST_Buffer('POINT(1 3)', 10,12) As geom) AS foo;
```

```
 np_before | np01_notbadcircle | np05_notquitecircle | np1_octagon | np10_triangle |  ↩
    np100_geometrygoesaway
-----------+-------------------+---------------------+-------------+---------------+----------------

        49 |                33 |                  17 |           9 |             4 | t
```

참고

ST_IsSimple, ST_SimplifyPreserveTopology, ST_SimplifyVW, Topology ST_Simplify

7.14.23 ST_SimplifyPreserveTopology

ST_SimplifyPreserveTopology — Returns a simplified and valid version of a geometry, using the Douglas-Peucker algorithm.

Synopsis

geometry **ST_SimplifyPreserveTopology**(geometry geomA, float tolerance);

설명

더글러스-패커(Douglas-Peucker) 알고리즘을 이용해서 입력 도형의 "단순화"된 버전을 반환합니다. 유효하지 않&#x 파생 도형(특히 폴리곤)을 생성하&# 않을 것입니다. 실제로는 [멀티]라&# [멀티]폴리곤과만 작동하지만, 어&#x 종류의 도형도 입력할 수 있다고 해도 과언은 아닙니다. 객체별 기&# 단순화 작업을 하기 때문에 이 함&# 도형 집합도 입력할 수 있습니다.

GEOS 모듈로 실행

1.3.3 버전부터 사용할 수 있습니다.

예시

ST_Simplify 함수와 동일하지만, ST_SimplifyPreserveTopology&#xb294 과단순화(oversimplification)를 막아준다는 사&#xc 알 수 있습니다. 원을 단순화해도 기껏해야 사각형에서 끝납니다.

```
SELECT ST_Npoints(geom) As np_before, ST_NPoints(ST_SimplifyPreserveTopology(geom,0.1)) As  ↩
    np01_notbadcircle, ST_NPoints(ST_SimplifyPreserveTopology(geom,0.5)) As  ↩
    np05_notquitecircle,
ST_NPoints(ST_SimplifyPreserveTopology(geom,1)) As np1_octagon, ST_NPoints( ↩
    ST_SimplifyPreserveTopology(geom,10)) As np10_square,
ST_NPoints(ST_SimplifyPreserveTopology(geom,100)) As  np100_stillsquare
FROM (SELECT ST_Buffer('POINT(1 3)', 10,12) As geom) As foo;

--result--
 np_before | np01_notbadcircle | np05_notquitecircle | np1_octagon | np10_square |  ↩
    np100_stillsquare
-----------+-------------------+---------------------+-------------+---------------+----------------

        49 |                33 |                  17 |           9 |             5 |  ↩
                              5
```

참고

ST_Simplify

7.14.24 ST_SimplifyPolygonHull

ST_SimplifyPolygonHull — Computes a simplifed topology-preserving outer or inner hull of a polygonal geometry.

Synopsis

geometry **ST_SimplifyPolygonHull**(geometry param_geom, float vertex_fraction, boolean is_outer = true);

설명

Computes a simplified topology-preserving outer or inner hull of a polygonal geometry. An outer hull completely covers the input geometry. An inner hull is completely covered by the input geometry. The result is a polygonal geometry formed by a subset of the input vertices. MultiPolygons and holes are handled and produce a result with the same structure as the input.

The reduction in vertex count is controlled by the `vertex_fraction` parameter, which is a number in the range 0 to 1. Lower values produce simpler results, with smaller vertex count and less concaveness. For both outer and inner hulls a vertex fraction of 1.0 produces the orginal geometry. For outer hulls a value of 0.0 produces the convex hull (for a single polygon); for inner hulls it produces a triangle.

The simplification process operates by progressively removing concave corners that contain the least amount of area, until the vertex count target is reached. It prevents edges from crossing, so the result is always a valid polygonal geometry.

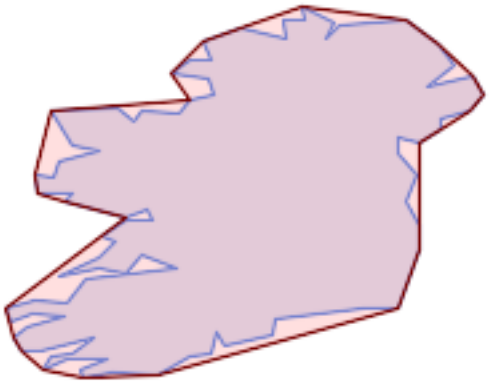
To get better results with geometries that contain relatively long line segments, it might be necessary to "segmentize" the input, as shown below.

GEOS 모듈로 실행

Availability: 3.3.0.

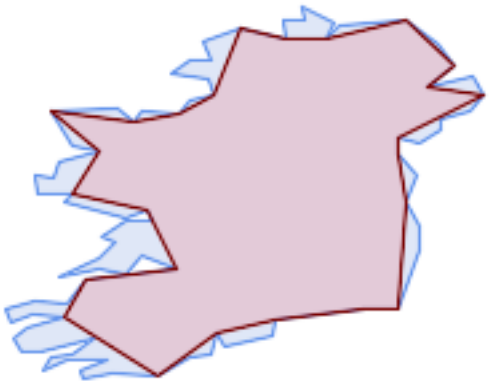
Requires GEOS >= 3.11.0.

예시



Outer hull of a Polygon

```
SELECT ST_SimplifyPolygonHull(
  'POLYGON ((131 158, 136 163, 161 165, 173 156, 179 148, 169 140, 186 144, 190 137, 185  ↩
      131, 174 128, 174 124, 166 119, 158 121, 158 115, 165 107, 161 97, 166 88, 166 79, 158 ↩
       57, 145 57, 112 53, 111 47, 93 43, 90 48, 88 40, 80 39, 68 32, 51 33, 40 31, 39 34,  ↩
      49 38, 34 38, 25 34, 28 39, 36 40, 44 46, 24 41, 17 41, 14 46, 19 50, 33 54, 21 55, 13 ↩
       52, 11 57, 22 60, 34 59, 41 68, 75 72, 62 77, 56 70, 46 72, 31 69, 46 76, 52 82, 47  ↩
      84, 56 90, 66 90, 64 94, 56 91, 33 97, 36 100, 23 100, 22 107, 29 106, 31 112, 46 116, ↩
       36 118, 28 131, 53 132, 59 127, 62 131, 76 130, 80 135, 89 137, 87 143, 73 145, 80  ↩
      150, 88 150, 85 157, 99 162, 116 158, 115 165, 123 165, 122 170, 134 164, 131 158))',
    0.3);
```



Inner hull of a Polygon

```
SELECT ST_SimplifyPolygonHull(
  'POLYGON ((131 158, 136 163, 161 165, 173 156, 179 148, 169 140, 186 144, 190 137, 185  ↩
      131, 174 128, 174 124, 166 119, 158 121, 158 115, 165 107, 161 97, 166 88, 166 79, 158 ↩
       57, 145 57, 112 53, 111 47, 93 43, 90 48, 88 40, 80 39, 68 32, 51 33, 40 31, 39 34,  ↩
      49 38, 34 38, 25 34, 28 39, 36 40, 44 46, 24 41, 17 41, 14 46, 19 50, 33 54, 21 55, 13 ↩
       52, 11 57, 22 60, 34 59, 41 68, 75 72, 62 77, 56 70, 46 72, 31 69, 46 76, 52 82, 47  ↩
      84, 56 90, 66 90, 64 94, 56 91, 33 97, 36 100, 23 100, 22 107, 29 106, 31 112, 46 116, ↩
       36 118, 28 131, 53 132, 59 127, 62 131, 76 130, 80 135, 89 137, 87 143, 73 145, 80  ↩
      150, 88 150, 85 157, 99 162, 116 158, 115 165, 123 165, 122 170, 134 164, 131 158))',
    0.3, false);
```

Outer hull simplification of a MultiPolygon, with segmentization

```
SELECT ST_SimplifyPolygonHull(
  ST_Segmentize(ST_Letters('xt'), 2.0),
    0.1);
```

참고

ST_ConvexHull, ST_SimplifyVW, ST_ConcaveHull, ST_Segmentize

7.14.25 ST_SimplifyVW

ST_SimplifyVW — Returns a simplified version of a geometry, using the Visvalingam-Whyatt algorithm

Synopsis

geometry **ST_SimplifyVW**(geometry geomA, float tolerance);

설명

비스베일링검-와이어트(Visvalingam-Whyatt) 알&
이용해서 입력 도형의 "단순화"된
버전을 반환합니다. 실제로는 [멀&
[멀티]폴리곤과만 작동하지만, 어&#
종류의 도형도 입력할 수 있다고
해도 과언은 아닙니다. 객체별 기&#
단순화 작업을 하기 때문에 이 함&#
도형 집합도 입력할 수 있습니다.

> **Note**
> 반환되는 도형이 단순성을 잃을 수도 있다는 점에 주의하십시오(ST_IsSimple 참조).

Note

위상(topology)이 보전되지 않아 유효하지 않은 도형이 반환될 수도 있습니다. 위상을 유지하려면 ST_SimplifyPreserveTopology 함수를 이용하십시오.

Note

이 함수는 3차원을 처리하며, 세 번째 차원이 결과에 영향을 미칠 것입니다.

2.2.0 버전부터 사용할 수 있습니다.

예시

라인스트링을 최소 임계 면적(minimum area threshold) 30으로 단순화합니다.

```
select ST_AsText(ST_SimplifyVW(geom,30)) simplified
FROM (SELECT  'LINESTRING(5 2, 3 8, 6 20, 7 25, 10 10)'::geometry geom) As foo;
-result
 simplified
------------------------------
LINESTRING(5 2,7 25,10 10)
```

참고

ST_SetEffectiveArea, ST_Simplify, ST_SimplifyPreserveTopology, 위상(topology) ST_Simplify

7.14.26 ST_SetEffectiveArea

ST_SetEffectiveArea — Sets the effective area for each vertex, using the Visvalingam-Whyatt algorithm.

Synopsis

geometry **ST_SetEffectiveArea**(geometry geomA, float threshold = 0, integer set_area = 1);

설명

비스베일링검-와이어트 알고리&#x
이용해서 각 꼭짓점에 대한 유효
범위를 설정합니다. 유효 범위는
꼭짓점의 M값으로 저장됩니다. 선&
"임계" 파라미터를 설정할 경우, 임&
이상의 유효 범위를 가진 꼭짓점&#x
담고 있는 단순화된 도형을 반환&#
것입니다.

임계치를 설정할 경우 이 함수를
서버측 단순화 작업에 이용할 수

있습니다. 또다른 옵션은 임계치&#
0으로 설정하는 것입니다. 이럴 경&
유효 범위를 M값으로 가진 전체 도&
반환하는데, 이 도형을 클라이언&
매우 빨리 단순화하는 데 쓸 수 있&

실제로는 [멀티]라인, [멀티]폴리곤&
작동하지만, 어떤 종류의 도형도
입력할 수 있다고 해도 과언은 아&#
객체별 기반으로 단순화 작업을
하기 때문에 이 함수에 도형 집합&
입력할 수 있습니다.

Note
반환되는 도형이 단순성을
잃을 수도 있다는 점에
주의하십시오(ST_IsSimple 참조).

Note
위상(topology)이 보전되지 않아
유효하지 않은 도형이 반환될
수도 있습니다. 위상을
유지하려면 ST_SimplifyPreserveTopology 함수를
이용하십시오.

Note
출력 도형은 M값으로 가지고
있던 정보를 모두 잃게 될
것입니다.

Note
이 함수는 3차원을 처리하며,
세 번째 차원이 유효 범위에
영향을 미칠 것입니다.

2.2.0 버전부터 사용할 수 있습니다.

예시

라인스트링의 유효 범위를 계산&#x
임계치를 0으로 설정하기 때문에,
입력 도형 안에 있는 모든 꼭짓점&#
반환합니다.

```
select ST_AsText(ST_SetEffectiveArea(geom)) all_pts, ST_AsText(ST_SetEffectiveArea(geom,30) ↩
    ) thrshld_30
FROM (SELECT  'LINESTRING(5 2, 3 8, 6 20, 7 25, 10 10)'::geometry geom) As foo;
-- &#xacb0;&#xacfc; --
 all_pts | thrshld_30
-----------+-------------------+
LINESTRING M (5 2 3.40282346638529e+38,3 8 29,6 20 1.5,7 25 49.5,10 10 3.40282346638529e ↩
   +38) | LINESTRING M (5 2 3.40282346638529e+38,7 25 49.5,10 10 3.40282346638529e+38)
```

참고

ST_SimplifyVW

7.14.27 ST_TriangulatePolygon

ST_TriangulatePolygon — Computes the constrained Delaunay triangulation of polygons

Synopsis

geometry **ST_TriangulatePolygon**(geometry geom);

설명

Computes the constrained Delaunay triangulation of polygons. Holes and Multipolygons are supported.

The "constrained Delaunay triangulation" of a polygon is a set of triangles formed from the vertices of the polygon, and covering it exactly, with the maximum total interior angle over all possible triangulations. It provides the "best quality" triangulation of the polygon.

Availability: 3.3.0.

Requires GEOS >= 3.11.0.

Example

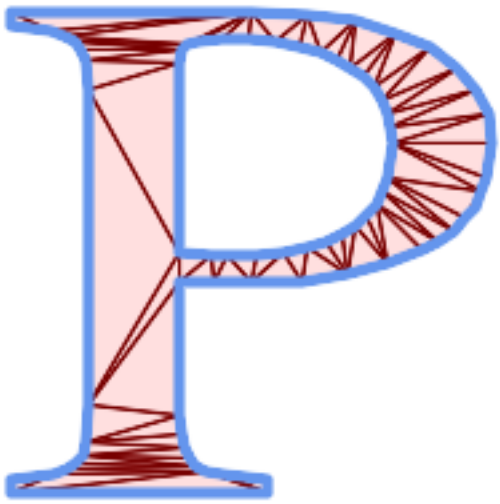
Triangulation of a square.

```
SELECT ST_AsText(
    ST_TriangulatePolygon('POLYGON((0 0, 0 1, 1 1, 1 0, 0 0))'));

                                st_astext
-------------------------------------------------------------------------
 GEOMETRYCOLLECTION(POLYGON((0 0,0 1,1 1,0 0)),POLYGON((1 1,1 0,0 0,1 1)))
```

Example

Triangulation of the letter P.

```
SELECT ST_AsText(ST_TriangulatePolygon(
    'POLYGON ((26 17, 31 19, 34 21, 37 24, 38 29, 39 43, 39 161, 38 172, 36 176, 34 179, 30 ↩
         181, 25 183, 10 185, 10 190, 100 190, 121 189, 139 187, 154 182, 167 177, 177 169,  ↩
        184 161, 189 152, 190 141, 188 128, 186 123, 184 117, 180 113, 176 108, 170 104, 164 ↩
         101, 151 96, 136 92, 119 89, 100 89, 86 89, 73 89, 73 39, 74 32, 75 27, 77 23, 79  ↩
        20, 83 18, 89 17, 106 15, 106 10, 10 10, 10 15, 26 17), (152 147, 151 152, 149 157,  ↩
        146 162, 142 166, 137 169, 132 172, 126 175, 118 177, 109 179, 99 180, 89 180, 80  ↩
        179, 76 178, 74 176, 73 171, 73 100, 85 99, 91 99, 102 99, 112 100, 121 102, 128  ↩
        104, 134 107, 139 110, 143 114, 147 118, 149 123, 151 128, 153 141, 152 147))'
    ));
```



Polygon Triangulation

참고

ST_DelaunayTriangles, ST_ConstrainedDelaunayTriangles, ST_Tesselate

7.14.28 ST_VoronoiLines

ST_VoronoiLines — Returns the boundaries of the Voronoi diagram of the vertices of a geometry.

Synopsis

geometry **ST_VoronoiLines**(geometry geom , float8 tolerance = 0.0 , geometry extend_to = NULL);

설명

Computes a two-dimensional Voronoi diagram from the vertices of the supplied geometry and returns the boundaries between cells in the diagram as a MultiLineString. Returns null if input geometry is null. Returns an empty geometry collection if the input geometry contains only one vertex. Returns an empty geometry collection if the `extend_to` envelope has zero area.

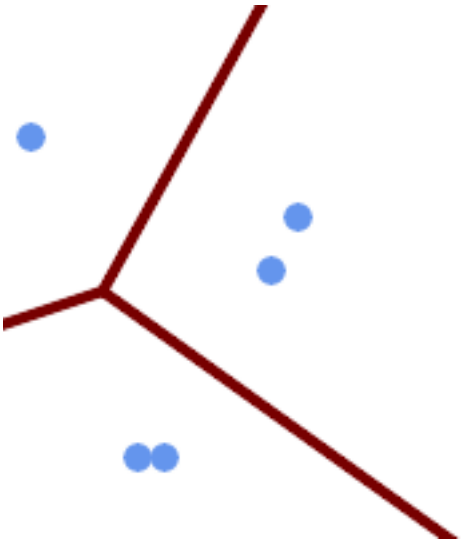
선택할 수 있는 파라미터:

- `tolerance`: The distance within which vertices will be considered equivalent. Robustness of the algorithm can be improved by supplying a nonzero tolerance distance. (default = 0.0)
- `extend_to`: If present, the diagram is extended to cover the envelope of the supplied geometry, unless smaller than the default envelope (default = NULL, default envelope is the bounding box of the input expanded by about 50%).

GEOS 모듈로 실행

2.3.0 버전부터 사용할 수 있습니다.

예시



Voronoi diagram lines, with tolerance of 30 units

```
SELECT ST_VoronoiLines(
            'MULTIPOINT (50 30, 60 30, 100 100,10 150, 110 120)'::geometry,
            30) AS geom;
```

```
ST_AsText output
MULTILINESTRING((135.555555555556 270,36.8181818181818 92.2727272727273),(36.8181818181818  ↩
    92.2727272727273,-110 43.3333333333333),(230 -45.7142857142858,36.8181818181818  ↩
    92.2727272727273))
```

참고

ST_DelaunayTriangles, ST_VoronoiPolygons

7.14.29 ST_VoronoiPolygons

ST_VoronoiPolygons — Returns the cells of the Voronoi diagram of the vertices of a geometry.

Synopsis

geometry **ST_VoronoiPolygons**(geometry geom , float8 tolerance = 0.0 , geometry extend_to = NULL);

설명

Computes a two-dimensional Voronoi diagram from the vertices of the supplied geometry. The result is a GEOMETRYCOLLECTION of POLYGONs that covers an envelope larger than the extent of the input vertices. Returns null if input geometry is null. Returns an empty geometry collection if the input geometry contains only one vertex. Returns an empty geometry collection if the `extend_to` envelope has zero area.

선택할 수 있는 파라미터:

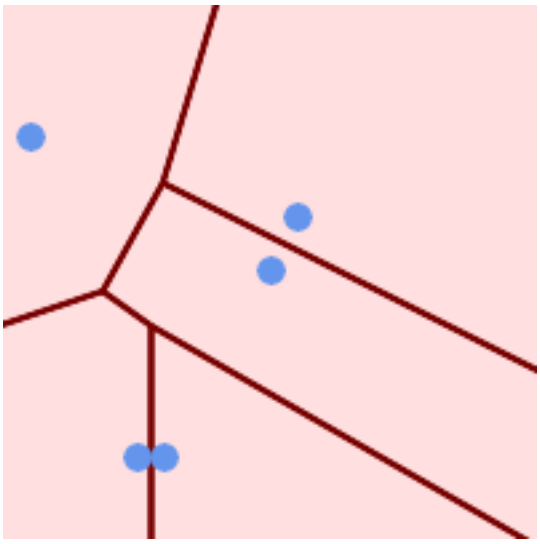
- `tolerance`: The distance within which vertices will be considered equivalent. Robustness of the algorithm can be improved by supplying a nonzero tolerance distance. (default = 0.0)

- `extend_to`: If present, the diagram is extended to cover the envelope of the supplied geometry, unless smaller than the default envelope (default = NULL, default envelope is the bounding box of the input expanded by about 50%).

GEOS 모듈로 실행

2.3.0 버전부터 사용할 수 있습니다.

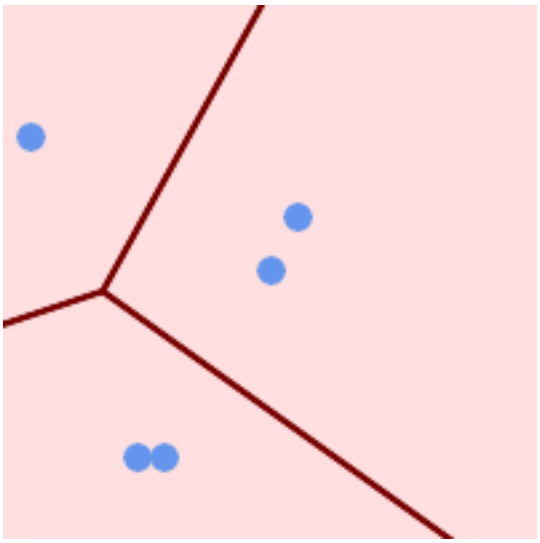
예시



Points overlaid on top of Voronoi diagram

```
SELECT ST_VoronoiPolygons(
                'MULTIPOINT (50 30, 60 30, 100 100,10 150, 110 120)'::geometry
            ) AS geom;
```

```
ST_AsText output
GEOMETRYCOLLECTION(POLYGON((-110 43.3333333333333,-110 270,100.5 270,59.3478260869565  ↩
    132.826086956522,36.8181818181818 92.2727272727273,-110 43.3333333333333)),
POLYGON((55 -90,-110 -90,-110 43.3333333333333,36.8181818181818 92.2727272727273,55  ↩
    79.2857142857143,55 -90)),
POLYGON((230 47.5,230 -20.7142857142857,55 79.2857142857143,36.8181818181818  ↩
    92.2727272727273,59.3478260869565 132.826086956522,230 47.5)),POLYGON((230  ↩
    -20.7142857142857,230 -90,55 -90,55 79.2857142857143,230 -20.7142857142857)),
POLYGON((100.5 270,230 270,230 47.5,59.3478260869565 132.826086956522,100.5 270)))
```



Voronoi diagram, with tolerance of 30 units

```
SELECT ST_VoronoiPolygons(
            'MULTIPOINT (50 30, 60 30, 100 100,10 150, 110 120)'::geometry,
            30) AS geom;
```

```
ST_AsText output
GEOMETRYCOLLECTION(POLYGON((-110 43.3333333333333,-110 270,100.5 270,59.3478260869565  ↩
    132.826086956522,36.8181818181818 92.2727272727273,-110 43.3333333333333)),
POLYGON((230 47.5,230 -45.7142857142858,36.8181818181818 92.2727272727273,59.3478260869565  ↩
    132.826086956522,230 47.5)),POLYGON((230 -45.7142857142858,230 -90,-110 -90,-110  ↩
    43.3333333333333,36.8181818181818 92.2727272727273,230 -45.7142857142858)),
POLYGON((100.5 270,230 270,230 47.5,59.3478260869565 132.826086956522,100.5 270)))
```

참고

ST_DelaunayTriangles, ST_VoronoiLines

7.15 Coverages

7.15.1 ST_CoverageInvalidEdges

ST_CoverageInvalidEdges — Window function that finds locations where polygons fail to form a valid coverage.

Synopsis

geometry **ST_CoverageInvalidEdges**(geometry winset geom, float8 tolerance = 0);

Description

A window function which checks if the polygons in the window partition form a valid polygonal coverage. It returns linear indicators showing the location of invalid edges (if any) in each polygon.

A set of valid polygons is a valid coverage if the following conditions hold:

- **Non-overlapping** - polygons do not overlap (their interiors do not intersect)

- **Edge-Matched** - vertices along shared edges are identical

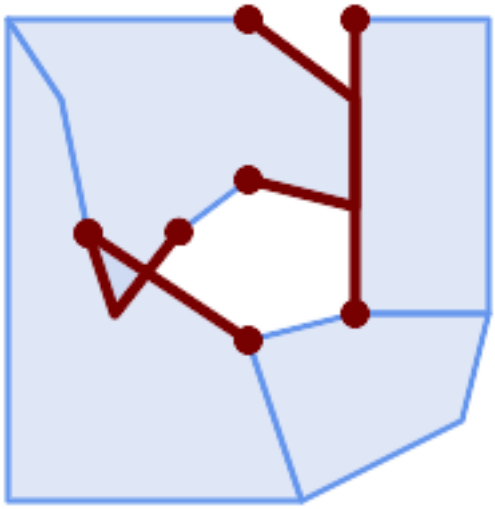
As a window function a value is returned for every input polygon. For polygons which violate one or more of the validity conditions the return value is a MULTILINESTRING containing the problematic edges. Coverage-valid polygons return the value NULL. Non-polygonal or empty geometries also produce NULL values.

The conditions allow a valid coverage to contain holes (gaps between polygons), as long as the surrounding polygons are edge-matched. However, very narrow gaps are often undesirable. If the `tolerance` parameter is specified with a non-zero distance, edges forming narrower gaps will also be returned as invalid.

The polygons being checked for coverage validity must also be valid geometries. This can be checked with ST_IsValid.

Availability: 3.4.0 - requires GEOS >= 3.12.0

Examples



Invalid edges caused by overlap and non-matching vertices

```
WITH coverage(id, geom) AS (VALUES
  (1, 'POLYGON ((10 190, 30 160, 40 110, 100 70, 120 10, 10 10, 10 190))'::geometry),
  (2, 'POLYGON ((100 190, 10 190, 30 160, 40 110, 50 80, 74 110.5, 100 130, 140 120, 140  ↩
     160, 100 190))'::geometry),
  (3, 'POLYGON ((140 190, 190 190, 190 80, 140 80, 140 190))'::geometry),
  (4, 'POLYGON ((180 40, 120 10, 100 70, 140 80, 190 80, 180 40))'::geometry)
)
SELECT id, ST_AsText(ST_CoverageInvalidEdges(geom) OVER ())
  FROM coverage;

 id |               st_astext
----+----------------------------------------
  1 | LINESTRING (40 110, 100 70)
  2 | MULTILINESTRING ((100 130, 140 120, 140 160, 100 190), (40 110, 50 80, 74 110.5))
  3 | LINESTRING (140 80, 140 190)
  3 | null
```

```
-- Test entire table for coverage validity
SELECT true = ALL (
    SELECT ST_CoverageInvalidEdges(geom) OVER () IS NULL
    FROM coverage
    );
```

See Also

ST_IsValid, ST_CoverageUnion, ST_CoverageSimplify

7.15.2 ST_CoverageSimplify

ST_CoverageSimplify — Window function that simplifies the edges of a polygonal coverage.

Synopsis

geometry **ST_CoverageSimplify**(geometry winset geom, float8 tolerance, boolean simplifyBoundary = true);

Description

A window function which simplifies the edges of polygons in a polygonal coverage. The simplification preserves the coverage topology. This means the simplified output polygons are consisent along shared edges, and still form a valid coverage.

The simplification uses a variant of the Visvalingam–Whyatt algorithm. The `tolerance` parameter has units of distance, and is roughly equal to the square root of triangular areas to be simplified.

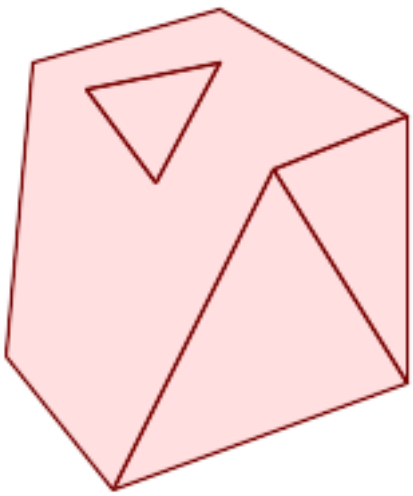
To simplify only the "internal" edges of the coverage (those that are shared by two polygons) set the `simplifyBoundary` parameter to false.

Note
If the input is not a valid coverage there may be unexpected artifacts in the output (such as boundary intersections, or separated boundaries which appeared to be shared). Use ST_CoverageInvalidEdges to determine if a coverage is valid.

Availability: 3.4.0 - requires GEOS >= 3.12.0

Examples

Input coverage



Simplified coverage

```
WITH coverage(id, geom) AS (VALUES
  (1, 'POLYGON ((160 150, 110 130, 90 100, 90 70, 60 60, 50 10, 30 30, 40 50, 25 40, 10 60, ↩
       30 100, 30 120, 20 170, 60 180, 90 190, 130 180, 130 160, 160 150), (40 160, 50 140,  ↩
      66 125, 60 100, 80 140, 90 170, 60 160, 40 160))'::geometry),
  (2, 'POLYGON ((40 160, 60 160, 90 170, 80 140, 60 100, 66 125, 50 140, 40 160))':: ↩
      geometry),
  (3, 'POLYGON ((110 130, 160 50, 140 50, 120 33, 90 30, 50 10, 60 60, 90 70, 90 100, 110  ↩
      130))'::geometry),
  (4, 'POLYGON ((160 150, 150 120, 160 90, 160 50, 110 130, 160 150))'::geometry)
)
SELECT id, ST_AsText(ST_CoverageSimplify(geom, 30) OVER ())
  FROM coverage;

 id |               st_astext
----+---------------------------------------
  1 | POLYGON ((160 150, 110 130, 50 10, 10 60, 20 170, 90 190, 160 150), (40 160, 66 125,  ↩
      90 170, 40 160))
  2 | POLYGON ((40 160, 66 125, 90 170, 40 160))
  3 | POLYGON ((110 130, 160 50, 50 10, 110 130))
  3 | POLYGON ((160 150, 160 50, 110 130, 160 150))
```

See Also

ST_CoverageInvalidEdges

7.15.3 ST_CoverageUnion

ST_CoverageUnion — Computes the union of a set of polygons forming a coverage by removing shared edges.

Synopsis

geometry **ST_CoverageUnion**(geometry set geom);

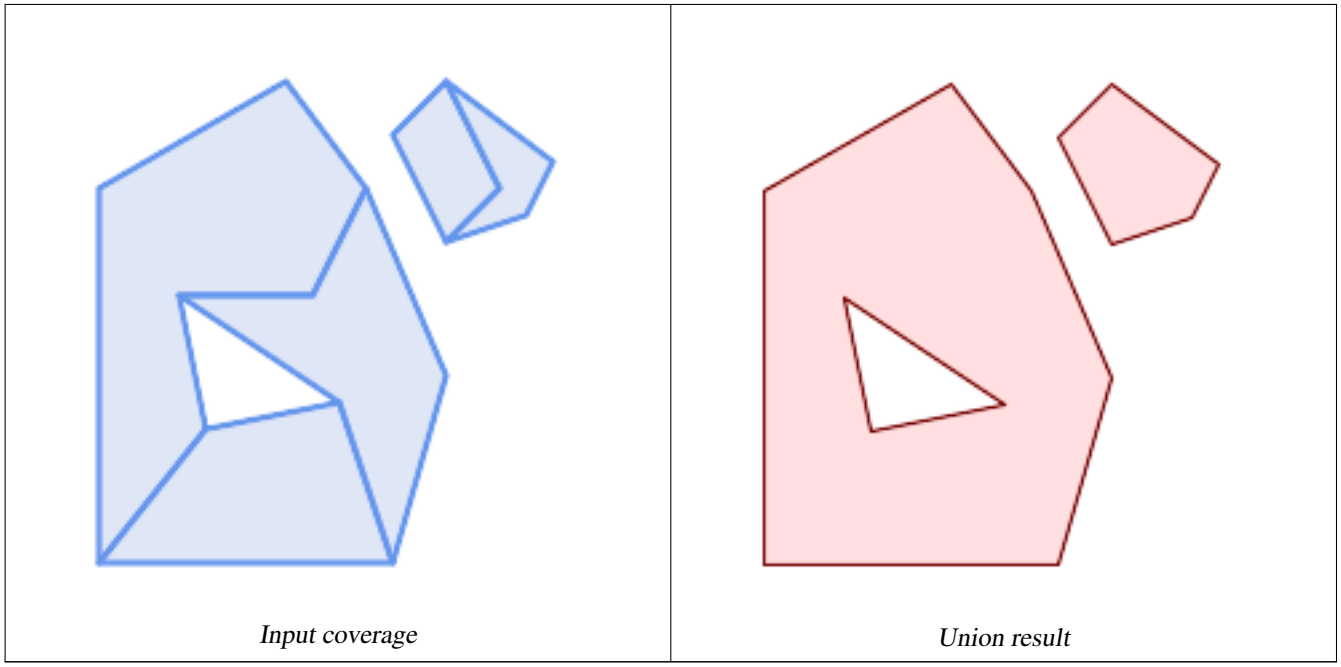
Description

An aggregate function which unions a set of polygons forming a polygonal coverage. The result is a polygonal geometry covering the same area as the coverage. This function produces the same result as ST_Union, but uses the coverage structure to compute the union much faster.

Note
If the input is not a valid coverage there may be unexpected artifacts in the output (such as unmerged or overlapping polygons). Use ST_CoverageInvalidEdges to determine if a coverage is valid.

Availability: 3.4.0 - requires GEOS >= 3.8.0

Examples



Input coverage | *Union result*

```
WITH coverage(id, geom) AS (VALUES
  (1, 'POLYGON ((10 10, 10 150, 80 190, 110 150, 90 110, 40 110, 50 60, 10 10))'::geometry) ↩
      ,
  (2, 'POLYGON ((120 10, 10 10, 50 60, 100 70, 120 10))'::geometry),
  (3, 'POLYGON ((140 80, 120 10, 100 70, 40 110, 90 110, 110 150, 140 80))'::geometry),
  (4, 'POLYGON ((140 190, 120 170, 140 130, 160 150, 140 190))'::geometry),
  (5, 'POLYGON ((180 160, 170 140, 140 130, 160 150, 140 190, 180 160))'::geometry)
)
SELECT ST_AsText(ST_CoverageUnion(geom))
  FROM coverage;

--------------------------------------
MULTIPOLYGON (((10 150, 80 190, 110 150, 140 80, 120 10, 10 10, 10 150), (50 60, 100 70, 40 ↩
     110, 50 60)), ((120 170, 140 190, 180 160, 170 140, 140 130, 120 170)))
```

See Also

ST_CoverageInvalidEdges, ST_Union

7.16 Affine Transformations

7.16.1 ST_Affine

ST_Affine — Apply a 3D affine transformation to a geometry.

Synopsis

geometry **ST_Affine**(geometry geomA, float a, float b, float c, float d, float e, float f, float g, float h, float i, float xoff, float yoff, float zoff);
geometry **ST_Affine**(geometry geomA, float a, float b, float d, float e, float xoff, float yoff);

Description

Applies a 3D affine transformation to the geometry to do things like translate, rotate, scale in one step.

Version 1: The call

```
ST_Affine(geom, a, b, c, d, e, f, g, h, i, xoff, yoff, zoff)
```

represents the transformation matrix

```
/ a  b  c  xoff \
| d  e  f  yoff |
| g  h  i  zoff |
\ 0  0  0     1 /
```

and the vertices are transformed as follows:

```
x' = a*x + b*y + c*z + xoff
y' = d*x + e*y + f*z + yoff
z' = g*x + h*y + i*z + zoff
```

All of the translate / scale functions below are expressed via such an affine transformation.

Version 2: Applies a 2d affine transformation to the geometry. The call

```
ST_Affine(geom, a, b, d, e, xoff, yoff)
```

represents the transformation matrix

```
/  a  b  0  xoff  \       /  a  b  xoff  \
|  d  e  0  yoff  | rsp.  |  d  e  yoff  |
|  0  0  1     0  |       \  0  0     1  /
\  0  0  0     1  /
```

and the vertices are transformed as follows:

```
x' = a*x + b*y + xoff
y' = d*x + e*y + yoff
z' = z
```

This method is a subcase of the 3D method above.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Availability: 1.1.2. Name changed from Affine to ST_Affine in 1.2.2

Note

Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
--Rotate a 3d line 180 degrees about the z axis.  Note this is long-hand for doing  ↩
    ST_Rotate();
 SELECT ST_AsEWKT(ST_Affine(geom,  cos(pi()), -sin(pi()), 0,  sin(pi()), cos(pi()), 0,  0,  ↩
     0, 1,  0, 0, 0)) As using_affine,
          ST_AsEWKT(ST_Rotate(geom, pi())) As using_rotate
        FROM (SELECT ST_GeomFromEWKT('LINESTRING(1 2 3, 1 4 3)') As geom) As foo;
        using_affine         |        using_rotate
-----------------------------+-----------------------------
 LINESTRING(-1 -2 3,-1 -4 3) | LINESTRING(-1 -2 3,-1 -4 3)
(1 row)

--Rotate a 3d line 180 degrees in both the x and z axis
SELECT ST_AsEWKT(ST_Affine(geom, cos(pi()), -sin(pi()), 0, sin(pi()), cos(pi()), -sin(pi()) ↩
    , 0, sin(pi()), cos(pi()), 0, 0, 0))
        FROM (SELECT ST_GeomFromEWKT('LINESTRING(1 2 3, 1 4 3)') As geom) As foo;
           st_asewkt
-------------------------------
 LINESTRING(-1 -2 -3,-1 -4 -3)
(1 row)
```

See Also

ST_Rotate, ST_Scale, ST_Translate, ST_TransScale

7.16.2 ST_Rotate

ST_Rotate — Rotates a geometry about an origin point.

Synopsis

geometry **ST_Rotate**(geometry geomA, float rotRadians);
geometry **ST_Rotate**(geometry geomA, float rotRadians, float x0, float y0);
geometry **ST_Rotate**(geometry geomA, float rotRadians, geometry pointOrigin);

Description

Rotates geometry rotRadians counter-clockwise about the origin point. The rotation origin can be specified either as a POINT geometry, or as x and y coordinates. If the origin is not specified, the geometry is rotated about POINT(0 0).

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Enhanced: 2.0.0 additional parameters for specifying the origin of rotation were added.

Availability: 1.1.2. Name changed from Rotate to ST_Rotate in 1.2.2

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
--Rotate 180 degrees
SELECT ST_AsEWKT(ST_Rotate('LINESTRING (50 160, 50 50, 100 50)', pi()));
               st_asewkt
---------------------------------------
 LINESTRING(-50 -160,-50 -50,-100 -50)
(1 row)

--Rotate 30 degrees counter-clockwise at x=50, y=160
SELECT ST_AsEWKT(ST_Rotate('LINESTRING (50 160, 50 50, 100 50)', pi()/6, 50, 160));
                                st_asewkt
--------------------------------------------------------------------------
 LINESTRING(50 160,105 64.7372055837117,148.301270189222 89.7372055837117)
(1 row)

--Rotate 60 degrees clockwise from centroid
SELECT ST_AsEWKT(ST_Rotate(geom, -pi()/3, ST_Centroid(geom)))
FROM (SELECT 'LINESTRING (50 160, 50 50, 100 50)'::geometry AS geom) AS foo;
                            st_asewkt
-----------------------------------------------------------
 LINESTRING(116.4225 130.6721,21.1597 75.6721,46.1597 32.3708)
(1 row)
```

See Also

ST_Affine, ST_RotateX, ST_RotateY, ST_RotateZ

7.16.3 ST_RotateX

ST_RotateX — Rotates a geometry about the X axis.

Synopsis

geometry **ST_RotateX**(geometry geomA, float rotRadians);

Description

Rotates a geometry geomA - rotRadians about the X axis.

Note

`ST_RotateX(geomA, rotRadians)` is short-hand for `ST_Affine(geomA, 1, 0, 0, 0, cos(rotRadians), -sin(rotRadians), 0, sin(rotRadians), cos(rotRadians), 0, 0, 0).`

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Availability: 1.1.2. Name changed from RotateX to ST_RotateX in 1.2.2

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
--Rotate a line 90 degrees along x-axis
SELECT ST_AsEWKT(ST_RotateX(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), pi()/2));
                 st_asewkt
---------------------------
 LINESTRING(1 -3 2,1 -1 1)
```

See Also

ST_Affine, ST_RotateY, ST_RotateZ

7.16.4 ST_RotateY

ST_RotateY — Rotates a geometry about the Y axis.

Synopsis

geometry **ST_RotateY**(geometry geomA, float rotRadians);

Description

Rotates a geometry geomA - rotRadians about the y axis.

Note

`ST_RotateY(geomA, rotRadians)` is short-hand for `ST_Affine(geomA, cos(rotRadians), 0, sin(rotRadians), 0, 1, 0, -sin(rotRadians), 0, cos(rotRadians), 0, 0, 0)`.

Availability: 1.1.2. Name changed from RotateY to ST_RotateY in 1.2.2

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
--Rotate a line 90 degrees along y-axis
 SELECT ST_AsEWKT(ST_RotateY(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), pi()/2));
                 st_asewkt
---------------------------
 LINESTRING(3 2 -1,1 1 -1)
```

See Also

ST_Affine, ST_RotateX, ST_RotateZ

7.16.5 ST_RotateZ

ST_RotateZ — Rotates a geometry about the Z axis.

Synopsis

geometry **ST_RotateZ**(geometry geomA, float rotRadians);

Description

Rotates a geometry geomA - rotRadians about the Z axis.

Note
This is a synonym for ST_Rotate

Note
`ST_RotateZ(geomA, rotRadians)` is short-hand for `SELECT ST_Affine(geomA, cos(rotRadians), -sin(rotRadians), 0, sin(rotRadians), cos(rotRadians), 0, 0, 0, 1, 0, 0, 0).`

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Availability: 1.1.2. Name changed from RotateZ to ST_RotateZ in 1.2.2

Note
Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
--Rotate a line 90 degrees along z-axis
SELECT ST_AsEWKT(ST_RotateZ(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), pi()/2));
                 st_asewkt
---------------------------
 LINESTRING(-2 1 3,-1 1 1)

 --Rotate a curved circle around z-axis
SELECT ST_AsEWKT(ST_RotateZ(geom, pi()/2))
FROM (SELECT ST_LineToCurve(ST_Buffer(ST_GeomFromText('POINT(234 567)'), 3)) As geom) As  ↩
    foo;
```

```
--------------------------------------------------------------------------------------------------------------

CURVEPOLYGON(CIRCULARSTRING(-567 237,-564.87867965644 236.12132034356,-564  ↩
    234,-569.12132034356 231.87867965644,-567 237))
```

See Also

ST_Affine, ST_RotateX, ST_RotateY

7.16.6 ST_Scale

ST_Scale — Scales a geometry by given factors.

Synopsis

geometry **ST_Scale**(geometry geomA, float XFactor, float YFactor, float ZFactor);
geometry **ST_Scale**(geometry geomA, float XFactor, float YFactor);
geometry **ST_Scale**(geometry geom, geometry factor);
geometry **ST_Scale**(geometry geom, geometry factor, geometry origin);

Description

Scales the geometry to a new size by multiplying the ordinates with the corresponding factor parameters.

The version taking a geometry as the `factor` parameter allows passing a 2d, 3dm, 3dz or 4d point to set scaling factor for all supported dimensions. Missing dimensions in the `factor` point are equivalent to no scaling the corresponding dimension.

The three-geometry variant allows a "false origin" for the scaling to be passed in. This allows "scaling in place", for example using the centroid of the geometry as the false origin. Without a false origin, scaling takes place relative to the actual origin, so all coordinates are just multipled by the scale factor.

Note
Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

Availability: 1.1.0.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Enhanced: 2.2.0 support for scaling all dimension (`factor` parameter) was introduced.

Enhanced: 2.5.0 support for scaling relative to a local origin (`origin` parameter) was introduced.

This function supports Polyhedral surfaces.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports M coordinates.

Examples

```
--Version 1: scale X, Y, Z
SELECT ST_AsEWKT(ST_Scale(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), 0.5, 0.75, 0.8));
                           st_asewkt
-------------------------------------
 LINESTRING(0.5 1.5 2.4,0.5 0.75 0.8)

--Version 2: Scale X Y
 SELECT ST_AsEWKT(ST_Scale(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), 0.5, 0.75));
                         st_asewkt
---------------------------------
 LINESTRING(0.5 1.5 3,0.5 0.75 1)

--Version 3: Scale X Y Z M
 SELECT ST_AsEWKT(ST_Scale(ST_GeomFromEWKT('LINESTRING(1 2 3 4, 1 1 1 1)'),
   ST_MakePoint(0.5, 0.75, 2, -1)));
                                st_asewkt
-----------------------------------------
 LINESTRING(0.5 1.5 6 -4,0.5 0.75 2 -1)

--Version 4: Scale X Y using false origin
SELECT ST_AsText(ST_Scale('LINESTRING(1 1, 2 2)', 'POINT(2 2)', 'POINT(1 1)'::geometry));
      st_astext
---------------------
 LINESTRING(1 1,3 3)
```

See Also

ST_Affine, ST_TransScale

7.16.7 ST_Translate

ST_Translate — Translates a geometry by given offsets.

Synopsis

geometry **ST_Translate**(geometry g1, float deltax, float deltay);
geometry **ST_Translate**(geometry g1, float deltax, float deltay, float deltaz);

Description

Returns a new geometry whose coordinates are translated delta x,delta y,delta z units. Units are based on the units defined in spatial reference (SRID) for this geometry.

Note
Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

Availability: 1.2.2

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

Move a point 1 degree longitude

```
SELECT ST_AsText(ST_Translate(ST_GeomFromText('POINT(-71.01 42.37)',4326),1,0)) As  ↩
    wgs_transgeomtxt;

        wgs_transgeomtxt
        ---------------------
        POINT(-70.01 42.37)
```

Move a linestring 1 degree longitude and 1/2 degree latitude

```
SELECT ST_AsText(ST_Translate(ST_GeomFromText('LINESTRING(-71.01 42.37,-71.11 42.38)',4326) ↩
    ,1,0.5)) As wgs_transgeomtxt;
                    wgs_transgeomtxt
        ---------------------------------------
        LINESTRING(-70.01 42.87,-70.11 42.88)
```

Move a 3d point

```
SELECT ST_AsEWKT(ST_Translate(CAST('POINT(0 0 0)' As geometry), 5, 12,3));
        st_asewkt
        ---------
        POINT(5 12 3)
```

Move a curve and a point

```
SELECT ST_AsText(ST_Translate(ST_Collect('CURVEPOLYGON(CIRCULARSTRING(4 3,3.12 0.878,1  ↩
    0,-1.121 5.1213,6 7, 8 9,4 3))','POINT(1 3)'),1,2));


-------------------------------------------------------------------------------------------------------------

 GEOMETRYCOLLECTION(CURVEPOLYGON(CIRCULARSTRING(5 5,4.12 2.878,2 2,-0.121 7.1213,7 9,9 11,5 ↩
     5)),POINT(2 5))
```

See Also

ST_Affine, ST_AsText, ST_GeomFromText

7.16.8 ST_TransScale

ST_TransScale — Translates and scales a geometry by given offsets and factors.

Synopsis

geometry **ST_TransScale**(geometry geomA, float deltaX, float deltaY, float XFactor, float YFactor);

Description

Translates the geometry using the deltaX and deltaY args, then scales it using the XFactor, YFactor args, working in 2D only.

Note

`ST_TransScale(geomA, deltaX, deltaY, XFactor, YFactor)` is short-hand for `ST_Affine(geomA, XFactor, 0, 0, 0, YFactor, 0, 0, 0, 1, deltaX*XFactor, deltaY*YFactor, 0)`.

Note

Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+

Availability: 1.1.0.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_AsEWKT(ST_TransScale(ST_GeomFromEWKT('LINESTRING(1 2 3, 1 1 1)'), 0.5, 1, 1, 2));
                  st_asewkt
------------------------------
 LINESTRING(1.5 6 3,1.5 4 1)


--Buffer a point to get an approximation of a circle, convert to curve and then translate  ↩
    1,2 and scale it 3,4
  SELECT ST_AsText(ST_Transscale(ST_LineToCurve(ST_Buffer('POINT(234 567)', 3)),1,2,3,4));


----------------------------------------------------------------------------------------------------------------

 CURVEPOLYGON(CIRCULARSTRING(714 2276,711.363961030679 2267.51471862576,705  ↩
     2264,698.636038969321 2284.48528137424,714 2276))
```

See Also

ST_Affine, ST_Translate

7.17 Clustering Functions

7.17.1 ST_ClusterDBSCAN

ST_ClusterDBSCAN — Window function that returns a cluster id for each input geometry using the DBSCAN algorithm.

Synopsis

integer **ST_ClusterDBSCAN**(geometry winset geom, float8 eps, integer minpoints);

Description

Returns cluster number for each input geometry, based on a 2D implementation of the Density-based spatial clustering of applications with noise (DBSCAN) algorithm. Unlike ST_ClusterKMeans, it does not require the number of clusters to be specified, but instead uses the desired distance (`eps`) and density (`minpoints`) parameters to construct each cluster.

An input geometry will be added to a cluster if it is either:

- A "core" geometry, that is within `eps` distance of at least `minpoints` input geometries (including itself) or
- A "border" geometry, that is within `eps` distance of a core geometry.

Note that border geometries may be within `eps` distance of core geometries in more than one cluster; in this case, either assignment would be correct, and the border geometry will be arbitrarily asssigned to one of the available clusters. In these cases, it is possible for a correct cluster to be generated with fewer than `minpoints` geometries. When assignment of a border geometry is ambiguous, repeated calls to ST_ClusterDBSCAN will produce identical results if an ORDER BY clause is included in the window definition, but cluster assignments may differ from other implementations of the same algorithm.

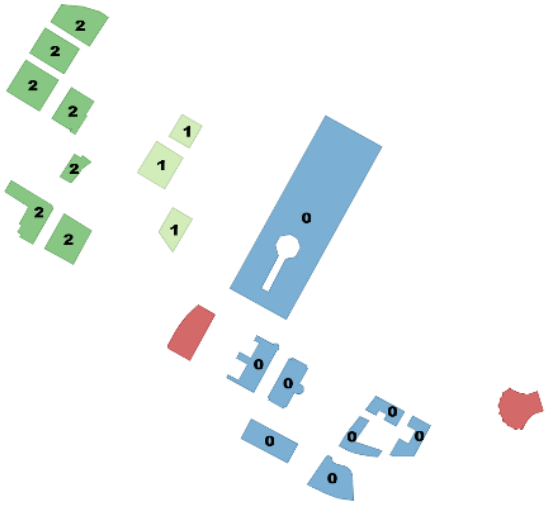
Note
Input geometries that do not meet the criteria to join any other cluster will be assigned a cluster number of NULL.

Availability: 2.3.0

This method supports Circular Strings and Curves.

Examples

Assigning a cluster number to each polygon within 50 meters of each other. Require at least 2 polygons per cluster



within 50 meters at least 2 per cluster. singletons have NULL for cid

```
SELECT name, ST_ClusterDBSCAN(geom, eps  ↩
    := 50, minpoints := 2) over () AS cid
FROM boston_polys
WHERE name > '' AND building > ''
        AND ST_DWithin(geom,
        ST_Transform(
            ST_GeomFromText('POINT ↩
    (-71.04054 42.35141)', 4326), 26986),
          500);
```

```
                name                   |  ↩
    bucket
-----------------------------------------+--------- ↩

 Manulife Tower                         |  ↩
         0
 Park Lane Seaport I                    |  ↩
         0
 Park Lane Seaport II                   |  ↩
         0
 Renaissance Boston Waterfront Hotel    |  ↩
         0
 Seaport Boston Hotel                   |  ↩
         0
 Seaport Hotel & World Trade Center     |  ↩
         0
 Waterside Place                        |  ↩
         0
 World Trade Center East                |  ↩
         0
 100 Northern Avenue                    |  ↩
         1
 100 Pier 4                             |  ↩
         1
 The Institute of Contemporary Art      |  ↩
         1
 101 Seaport                            |  ↩
         2
 District Hall                          |  ↩
         2
 One Marina Park Drive                  |  ↩
         2
 Twenty Two Liberty                     |  ↩
         2
 Vertex                                 |  ↩
         2
 Vertex                                 |  ↩
         2
 Watermark Seaport                      |  ↩
         2
 Blue Hills Bank Pavilion               |    ↩
     NULL
 World Trade Center West                |    ↩
     NULL
(20 rows)
```

Combining parcels with the same cluster number into a single geometry. This uses named argument calling

```
SELECT cid, ST_Collect(geom) AS cluster_geom, array_agg(parcel_id) AS ids_in_cluster FROM (
    SELECT parcel_id, ST_ClusterDBSCAN(geom, eps := 0.5, minpoints := 5) over () AS cid,  ↩
        geom
    FROM parcels) sq
GROUP BY cid;
```

See Also

ST_DWithin, ST_ClusterKMeans, ST_ClusterIntersecting, ST_ClusterWithin ST_ClusterIntersectingWin

7.17.2 ST_ClusterIntersectingWin

ST_ClusterIntersectingWin — Window function that returns a cluster id for each input geometry, clustering input geometries into connected sets.

Synopsis

integer **ST_ClusterIntersectingWin**(geometry winset geom);

Description

ST_ClusterIntersectingWin is a windowing function that builds inter-connecting clusters of geometries that intersect. It is possible to traverse all geometries in a cluster without leaving the cluster. The return value is the cluster number that the geometry argument participates in, or null for null inputs.

Availability: 3.4.0

Examples

```
WITH testdata AS (
  SELECT id, geom::geometry FROM (
  VALUES  (1, 'LINESTRING (0 0, 1 1)'),
          (2, 'LINESTRING (5 5, 4 4)'),
          (3, 'LINESTRING (6 6, 7 7)'),
          (4, 'LINESTRING (0 0, -1 -1)'),
          (5, 'POLYGON ((0 0, 4 0, 4 4, 0 4, 0 0))')) AS t(id, geom)
)
SELECT id,
  ST_AsText(geom),
  ST_ClusterIntersectingWin(geom) OVER () AS cluster
FROM testdata;

 id |           st_astext             | cluster
----+---------------------------------+---------
  1 | LINESTRING(0 0,1 1)             |       0
  2 | LINESTRING(5 5,4 4)             |       0
  3 | LINESTRING(6 6,7 7)             |       1
  4 | LINESTRING(0 0,-1 -1)           |       0
  5 | POLYGON((0 0,4 0,4 4,0 4,0 0)) |       0
```

See Also

ST_ClusterDBSCAN, ST_ClusterKMeans, ST_ClusterWithinWin ST_ClusterWithin ST_ClusterIntersecting

7.17.3 ST_ClusterIntersecting

ST_ClusterIntersecting — Aggregate function that clusters input geometries into connected sets.

Synopsis

geometry[] **ST_ClusterIntersecting**(geometry set g);

Description

ST_ClusterIntersecting is an aggregate function that returns an array of GeometryCollections, where each GeometryCollection represents an interconnected set of geometries.

Availability: 2.2.0

Examples

```
WITH testdata AS
  (SELECT unnest(ARRAY['LINESTRING (0 0, 1 1)'::geometry,
           'LINESTRING (5 5, 4 4)'::geometry,
           'LINESTRING (6 6, 7 7)'::geometry,
           'LINESTRING (0 0, -1 -1)'::geometry,
           'POLYGON ((0 0, 4 0, 4 4, 0 4, 0 0))'::geometry]) AS geom)

SELECT ST_AsText(unnest(ST_ClusterIntersecting(geom))) FROM testdata;

--result

st_astext
---------
GEOMETRYCOLLECTION(LINESTRING(0 0,1 1),LINESTRING(5 5,4 4),LINESTRING(0 0,-1 -1),POLYGON((0 ↩
     0,4 0,4 4,0 4,0 0)))
GEOMETRYCOLLECTION(LINESTRING(6 6,7 7))
```

See Also

ST_ClusterDBSCAN, ST_ClusterKMeans, ST_ClusterWithinWin ST_ClusterWithin

7.17.4 ST_ClusterKMeans

ST_ClusterKMeans — Window function that returns a cluster id for each input geometry using the K-means algorithm.

Synopsis

integer **ST_ClusterKMeans**(geometry winset geom, integer number_of_clusters, float max_radius);

Description

Returns K-means cluster number for each input geometry. The distance used for clustering is the distance between the centroids for 2D geometries, and distance between bounding box centers for 3D geometries. For POINT inputs, M coordinate will be treated as weight of input and has to be larger than 0.

`max_radius`, if set, will cause ST_ClusterKMeans to generate more clusters than `k` ensuring that no cluster in output has radius larger than `max_radius`. This is useful in reachability analysis.

Enhanced: 3.2.0 Support for `max_radius`

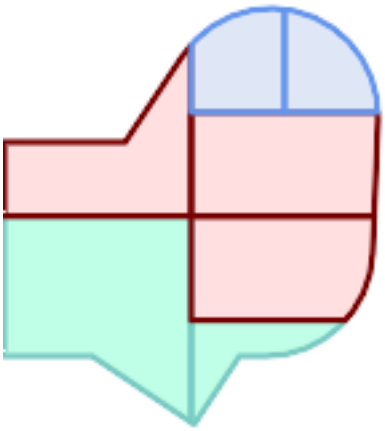
Enhanced: 3.1.0 Support for 3D geometries and weights

Availability: 2.3.0

Examples

Generate dummy set of parcels for examples:

```
CREATE TABLE parcels AS
SELECT lpad((row_number() over())::text,3,'0') As parcel_id, geom,
('{residential, commercial}'::text[])[1 + mod(row_number()OVER(),2)] As type
FROM
    ST_Subdivide(ST_Buffer('SRID=3857;LINESTRING(40 100, 98 100, 100 150, 60 90)'::geometry ↩
        ,
    40, 'endcap=square'),12) As geom;
```



Parcels color-coded by cluster number (cid)

```
SELECT ST_ClusterKMeans(geom, 3) OVER() AS cid, parcel_id, geom
    FROM parcels;
```

```
cid | parcel_id |   geom
-----+-----------+---------------
   0 | 001       | 0103000000...
   0 | 002       | 0103000000...
   1 | 003       | 0103000000...
   0 | 004       | 0103000000...
   1 | 005       | 0103000000...
   2 | 006       | 0103000000...
   2 | 007       | 0103000000...
```

Partitioning parcel clusters by type:

```
SELECT ST_ClusterKMeans(geom, 3) over (PARTITION BY type) AS cid, parcel_id, type
    FROM parcels;
```

```
cid | parcel_id |    type
-----+-----------+-------------
   1 | 005       | commercial
   1 | 003       | commercial
   2 | 007       | commercial
   0 | 001       | commercial
   1 | 004       | residential
   0 | 002       | residential
   2 | 006       | residential
```

Example: Clustering a preaggregated planetary-scale data population dataset using 3D clusering and weighting. Identify at least 20 regions based on Kontur Population Data that do not span more than 3000 km from their center:

```
create table kontur_population_3000km_clusters as
select
    geom,
    ST_ClusterKMeans(
        ST_Force4D(
            ST_Transform(ST_Force3D(geom), 4978), -- cluster in 3D XYZ CRS
            mvalue := population -- set clustering to be weighed by population
        ),
        20,                      -- aim to generate at least 20 clusters
        max_radius := 3000000    -- but generate more to make each under 3000 km radius
    ) over () as cid
from
    kontur_population;
```

World population clustered to above specs produces 46 clusters. Clusters are centered at well-populated regions (New York, Moscow). Greenland is one cluster. There are island clusters that span across the antimeridian. Cluster edges follow Earth's curvature.

See Also

ST_ClusterDBSCAN, ST_ClusterIntersectingWin, ST_ClusterWithinWin, ST_ClusterIntersecting, ST_ClusterWithin, ST_Subdivide, ST_Force3D, ST_Force4D,

7.17.5 ST_ClusterWithin

ST_ClusterWithin — Aggregate function that clusters input geometries by separation distance.

Synopsis

geometry[] **ST_ClusterWithin**(geometry set g, float8 distance);

Description

ST_ClusterWithin is an aggregate function that returns an array of GeometryCollections, where each GeometryCollection represents a set of geometries separated by no more than the specified distance. (Distances are Cartesian distances in the units of the SRID.)

Availability: 2.2.0

This method supports Circular Strings and Curves.

Examples

```
WITH testdata AS
  (SELECT unnest(ARRAY['LINESTRING (0 0, 1 1)'::geometry,
                       'LINESTRING (5 5, 4 4)'::geometry,
                       'LINESTRING (6 6, 7 7)'::geometry,
                       'LINESTRING (0 0, -1 -1)'::geometry,
                       'POLYGON ((0 0, 4 0, 4 4, 0 4, 0 0))'::geometry]) AS geom)

SELECT ST_AsText(unnest(ST_ClusterWithin(geom, 1.4))) FROM testdata;

--result

st_astext
---------
GEOMETRYCOLLECTION(LINESTRING(0 0,1 1),LINESTRING(5 5,4 4),LINESTRING(0 0,-1 -1),POLYGON((0 ↩
     0,4 0,4 4,0 4,0 0)))
GEOMETRYCOLLECTION(LINESTRING(6 6,7 7))
```

See Also

ST_ClusterDBSCAN, ST_ClusterKMeans, ST_ClusterIntersectingWin, ST_ClusterWithinWin, ST_ClusterIntersecting

7.17.6 ST_ClusterWithinWin

ST_ClusterWithinWin — Window function that returns a cluster id for each input geometry, clustering using separation distance.

Synopsis

integer **ST_ClusterWithinWin**(geometry winset geom, float8 distance);

Description

ST_ClusterWithinWin is a window function that returns an integer for each input geometry, where the integer the cluster number the geometry is a member of. Clusters represent a set of input geometries separated by no more than the specified distance. (Distances are Cartesian distances in the units of the SRID.)

ST_ClusterWithinWin is equivalent to running ST_ClusterDBSCAN with a `minpoints` of zero.

Availability: 3.4.0

This method supports Circular Strings and Curves.

Examples

```
WITH testdata AS (
  SELECT id, geom::geometry FROM (
  VALUES  (1, 'LINESTRING (0 0, 1 1)'),
          (2, 'LINESTRING (5 5, 4 4)'),
          (3, 'LINESTRING (6 6, 7 7)'),
          (4, 'LINESTRING (0 0, -1 -1)'),
          (5, 'POLYGON ((0 0, 4 0, 4 4, 0 4, 0 0))')) AS t(id, geom)
)
SELECT id,
  ST_AsText(geom),
  ST_ClusterWithinWin(geom, 1.4) OVER () AS cluster
```

```
FROM testdata;


 id |           st_astext             | cluster
----+---------------------------------+---------
  1 | LINESTRING(0 0,1 1)             |       0
  2 | LINESTRING(5 5,4 4)             |       0
  3 | LINESTRING(6 6,7 7)             |       1
  4 | LINESTRING(0 0,-1 -1)           |       0
  5 | POLYGON((0 0,4 0,4 4,0 4,0 0)) |       0
```

See Also

ST_ClusterDBSCAN, ST_ClusterKMeans, ST_ClusterIntersectingWin, ST_ClusterWithin, ST_ClusterIntersecting

7.18 Bounding Box Functions

7.18.1 Box2D

Box2D — Returns a BOX2D representing the 2D extent of a geometry.

Synopsis

box2d **Box2D**(geometry geom);

Description

Returns a box2d representing the 2D extent of the geometry.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
SELECT Box2D(ST_GeomFromText('LINESTRING(1 2, 3 4, 5 6)'));

box2d
---------
BOX(1 2,5 6)
```

```
SELECT Box2D(ST_GeomFromText('CIRCULARSTRING(220268 150415,220227 150505,220227 150406)'));

box2d
--------
BOX(220186.984375 150406,220288.25 150506.140625)
```

See Also

Box3D, ST_GeomFromText

7.18.2 Box3D

Box3D — Returns a BOX3D representing the 3D extent of a geometry.

Synopsis

box3d **Box3D**(geometry geom);

Description

Returns a box3d representing the 3D extent of the geometry.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This function supports 3d and will not drop the z-index.

Examples

```
SELECT Box3D(ST_GeomFromEWKT('LINESTRING(1 2 3, 3 4 5, 5 6 5)'));

Box3d
---------
BOX3D(1 2 3,5 6 5)
```

```
SELECT Box3D(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 1,220227 150406 ↩
    1)'));

Box3d
--------
BOX3D(220227 150406 1,220268 150415 1)
```

See Also

Box2D, ST_GeomFromEWKT

7.18.3 ST_EstimatedExtent

ST_EstimatedExtent — Returns the estimated extent of a spatial table.

Synopsis

box2d **ST_EstimatedExtent**(text schema_name, text table_name, text geocolumn_name, boolean parent_only);
box2d **ST_EstimatedExtent**(text schema_name, text table_name, text geocolumn_name);
box2d **ST_EstimatedExtent**(text table_name, text geocolumn_name);

Description

Returns the estimated extent of a spatial table as a box2d. The current schema is used if not specified. The estimated extent is taken from the geometry column's statistics. This is usually much faster than computing the exact extent of the table using ST_Extent or ST_3DExtent.

The default behavior is to also use statistics collected from child tables (tables with INHERITS) if available. If `parent_only` is set to TRUE, only statistics for the given table are used and child tables are ignored.

For PostgreSQL >= 8.0.0 statistics are gathered by VACUUM ANALYZE and the result extent will be about 95% of the actual one. For PostgreSQL < 8.0.0 statistics are gathered by running `update_geometry_stats()` and the result extent is exact.

Note
In the absence of statistics (empty table or no ANALYZE called) this function returns NULL. Prior to version 1.5.4 an exception was thrown instead.

Availability: 1.0.0

Changed: 2.1.0. Up to 2.0.x this was called ST_Estimated_Extent.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_EstimatedExtent('ny', 'edges', 'geom');
--result--
BOX(-8877653 4912316,-8010225.5 5589284)

SELECT ST_EstimatedExtent('feature_poly', 'geom');
--result--
BOX(-124.659652709961 24.6830825805664,-67.7798080444336 49.0012092590332)
```

See Also

ST_Extent, ST_3DExtent

7.18.4 ST_Expand

ST_Expand — Returns a bounding box expanded from another bounding box or a geometry.

Synopsis

geometry **ST_Expand**(geometry geom, float units_to_expand);
geometry **ST_Expand**(geometry geom, float dx, float dy, float dz=0, float dm=0);
box2d **ST_Expand**(box2d box, float units_to_expand);
box2d **ST_Expand**(box2d box, float dx, float dy);
box3d **ST_Expand**(box3d box, float units_to_expand);
box3d **ST_Expand**(box3d box, float dx, float dy, float dz=0);

Description

Returns a bounding box expanded from the bounding box of the input, either by specifying a single distance with which the box should be expanded on both axes, or by specifying an expansion distance for each axis. Uses double-precision. Can be used for distance queries, or to add a bounding box filter to a query to take advantage of a spatial index.

In addition to the version of ST_Expand accepting and returning a geometry, variants are provided that accept and return box2d and box3d data types.

Distances are in the units of the spatial reference system of the input.

ST_Expand is similar to ST_Buffer, except while buffering expands a geometry in all directions, ST_Expand expands the bounding box along each axis.

Note
Pre version 1.3, ST_Expand was used in conjunction with ST_Distance to do indexable distance queries. For example, `geom && ST_Expand('POINT(10 20)', 10) AND ST_Distance(geom, 'POINT(10 20)') < 10`. This has been replaced by the simpler and more efficient ST_DWithin function.

Availability: 1.5.0 behavior changed to output double precision instead of float4 coordinates.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Enhanced: 2.3.0 support was added to expand a box by different amounts in different dimensions.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

Note
Examples below use US National Atlas Equal Area (SRID=2163) which is a meter projection

```
--10 meter expanded box around bbox of a linestring
SELECT CAST(ST_Expand(ST_GeomFromText('LINESTRING(2312980 110676,2312923 110701,2312892  ↩
    110714)', 2163),10) As box2d);
                                        st_expand
-----------------------------------
 BOX(2312882 110666,2312990 110724)

--10 meter expanded 3D box of a 3D box
SELECT ST_Expand(CAST('BOX3D(778783 2951741 1,794875 2970042.61545891 10)' As box3d),10)
                                                        st_expand
-----------------------------------------------------
 BOX3D(778773 2951731 -9,794885 2970052.61545891 20)

 --10 meter geometry astext rep of a expand box around a point geometry
 SELECT ST_AsEWKT(ST_Expand(ST_GeomFromEWKT('SRID=2163;POINT(2312980 110676)'),10));
                                                                                    st_asewkt ↩

------------------------------------------------------------------------------------------------ ↩

 SRID=2163;POLYGON((2312970 110666,2312970 110686,2312990 110686,2312990 110666,2312970  ↩
     110666))
```

See Also

ST_Buffer, ST_DWithin, ST_SRID

7.18.5 ST_Extent

ST_Extent — Aggregate function that returns the bounding box of geometries.

Synopsis

box2d **ST_Extent**(geometry set geomfield);

Description

An aggregate function that returns a box2d bounding box that bounds a set of geometries.

The bounding box coordinates are in the spatial reference system of the input geometries.

ST_Extent is similar in concept to Oracle Spatial/Locator's SDO_AGGR_MBR.

Note
ST_Extent returns boxes with only X and Y ordinates even with 3D geometries. To return XYZ ordinates use ST_3DExtent.

Note
The returned `box3d` value does not include a SRID. Use ST_SetSRID to convert it into a geometry with SRID metadata. The SRID is the same as the input geometries.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

Note
Examples below use Massachusetts State Plane ft (SRID=2249)

```
SELECT ST_Extent(geom) as bextent FROM sometable;
                                          st_bextent
-----------------------------------
BOX(739651.875 2908247.25,794875.8125 2970042.75)


--Return extent of each category of geometries
SELECT ST_Extent(geom) as bextent
FROM sometable
```

```
GROUP BY category ORDER BY category;

                                          bextent                          |         name
-----------------------------------------------------+----------------
 BOX(778783.5625 2951741.25,794875.8125 2970042.75) | A
 BOX(751315.8125 2919164.75,765202.6875 2935417.25) | B
 BOX(739651.875 2917394.75,756688.375 2935866)      | C

 --Force back into a geometry
 -- and render the extended text representation of that geometry
SELECT ST_SetSRID(ST_Extent(geom),2249) as bextent FROM sometable;

                               bextent
------------------------------------------------------------------------------
 SRID=2249;POLYGON((739651.875 2908247.25,739651.875 2970042.75,794875.8125 2970042.75,
 794875.8125 2908247.25,739651.875 2908247.25))
```

See Also

ST_EstimatedExtent, ST_3DExtent, ST_SetSRID

7.18.6 ST_3DExtent

ST_3DExtent — Aggregate function that returns the 3D bounding box of geometries.

Synopsis

box3d **ST_3DExtent**(geometry set geomfield);

Description

An aggregate function that returns a box3d (includes Z ordinate) bounding box that bounds a set of geometries.

The bounding box coordinates are in the spatial reference system of the input geometries.

Note

The returned `box3d` value does not include a SRID. Use ST_SetSRID to convert it into a geometry with SRID metadata. The SRID is the same as the input geometries.

Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced.

Changed: 2.0.0 In prior versions this used to be called ST_Extent3D

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Examples

```
SELECT ST_3DExtent(foo.geom) As b3extent
FROM (SELECT ST_MakePoint(x,y,z) As geom
        FROM generate_series(1,3) As x
                CROSS JOIN generate_series(1,2) As y
                CROSS JOIN generate_series(0,2) As Z) As foo;
          b3extent
--------------------
 BOX3D(1 1 0,3 2 2)

--Get the extent of various elevated circular strings
SELECT ST_3DExtent(foo.geom) As b3extent
FROM (SELECT ST_Translate(ST_Force_3DZ(ST_LineToCurve(ST_Buffer(ST_Point(x,y),1))),0,0,z)  ↩
    As geom
        FROM generate_series(1,3) As x
                CROSS JOIN generate_series(1,2) As y
                CROSS JOIN generate_series(0,2) As Z) As foo;

        b3extent
--------------------
 BOX3D(1 0 0,4 2 2)
```

See Also

ST_Extent, ST_Force3DZ, ST_SetSRID

7.18.7 ST_MakeBox2D

ST_MakeBox2D — Creates a BOX2D defined by two 2D point geometries.

Synopsis

box2d **ST_MakeBox2D**(geometry pointLowLeft, geometry pointUpRight);

Description

Creates a box2d defined by two Point geometries. This is useful for doing range queries.

Examples

```
--Return all features that fall reside or partly reside in a US national atlas coordinate  ↩
    bounding box
--It is assumed here that the geometries are stored with SRID = 2163 (US National atlas  ↩
    equal area)
SELECT feature_id, feature_name, geom
FROM features
WHERE geom && ST_SetSRID(ST_MakeBox2D(ST_Point(-989502.1875, 528439.5625),
        ST_Point(-987121.375 ,529933.1875)),2163)
```

See Also

ST_Point, ST_SetSRID, ST_SRID

7.18.8 ST_3DMakeBox

ST_3DMakeBox — Creates a BOX3D defined by two 3D point geometries.

Synopsis

box3d **ST_3DMakeBox**(geometry point3DLowLeftBottom, geometry point3DUpRightTop);

Description

Creates a box3d defined by two 3D Point geometries.

This function supports 3D and will not drop the z-index.

Changed: 2.0.0 In prior versions this used to be called ST_MakeBox3D

Examples

```
SELECT ST_3DMakeBox(ST_MakePoint(-989502.1875, 528439.5625, 10),
        ST_MakePoint(-987121.375 ,529933.1875, 10)) As abb3d

--bb3d--
--------
BOX3D(-989502.1875 528439.5625 10,-987121.375 529933.1875 10)
```

See Also

ST_MakePoint, ST_SetSRID, ST_SRID

7.18.9 ST_XMax

ST_XMax — Returns the X maxima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_XMax**(box3d aGeomorBox2DorBox3D);

Description

Returns the X maxima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However, it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_XMax('BOX3D(1 2 3, 4 5 6)');
st_xmax
-------
4

SELECT ST_XMax(ST_GeomFromText('LINESTRING(1 3 4, 5 6 7)'));
st_xmax
-------
5

SELECT ST_XMax(CAST('BOX(-3 2, 3 4)' As box2d));
st_xmax
-------
3
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to  ↩
    a BOX3D
SELECT ST_XMax('LINESTRING(1 3, 5 6)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_XMax(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_xmax
--------
220288.248780547
```

See Also

ST_XMin, ST_YMax, ST_YMin, ST_ZMax, ST_ZMin

7.18.10 ST_XMin

ST_XMin — Returns the X minima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_XMin**(box3d aGeomorBox2DorBox3D);

Description

Returns the X minima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_XMin('BOX3D(1 2 3, 4 5 6)');
st_xmin
-------
1

SELECT ST_XMin(ST_GeomFromText('LINESTRING(1 3 4, 5 6 7)'));
st_xmin
-------
1

SELECT ST_XMin(CAST('BOX(-3 2, 3 4)' As box2d));
st_xmin
-------
-3
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to ↩
    a BOX3D
SELECT ST_XMin('LINESTRING(1 3, 5 6)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_XMin(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_xmin
--------
220186.995121892
```

See Also

ST_XMax, ST_YMax, ST_YMin, ST_ZMax, ST_ZMin

7.18.11 ST_YMax

ST_YMax — Returns the Y maxima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_YMax**(box3d aGeomorBox2DorBox3D);

Description

Returns the Y maxima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_YMax('BOX3D(1 2 3, 4 5 6)');
st_ymax
-------
5

SELECT ST_YMax(ST_GeomFromText('LINESTRING(1 3 4, 5 6 7)'));
st_ymax
-------
6

SELECT ST_YMax(CAST('BOX(-3 2, 3 4)' As box2d));
st_ymax
-------
4
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to ↩
    a BOX3D
SELECT ST_YMax('LINESTRING(1 3, 5 6)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_YMax(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_ymax
--------
150506.126829327
```

See Also

ST_XMin, ST_XMax, ST_YMin, ST_ZMax, ST_ZMin

7.18.12 ST_YMin

ST_YMin — Returns the Y minima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_YMin**(box3d aGeomorBox2DorBox3D);

Description

Returns the Y minima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_YMin('BOX3D(1 2 3, 4 5 6)');
st_ymin
-------
2

SELECT ST_YMin(ST_GeomFromText('LINESTRING(1 3 4, 5 6 7)'));
st_ymin
-------
3

SELECT ST_YMin(CAST('BOX(-3 2, 3 4)' As box2d));
st_ymin
-------
2
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to ↩
    a BOX3D
SELECT ST_YMin('LINESTRING(1 3, 5 6)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_YMin(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_ymin
--------
150406
```

See Also

ST_GeomFromEWKT, ST_XMin, ST_XMax, ST_YMax, ST_ZMax, ST_ZMin

7.18.13 ST_ZMax

ST_ZMax — Returns the Z maxima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_ZMax**(box3d aGeomorBox2DorBox3D);

Description

Returns the Z maxima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_ZMax('BOX3D(1 2 3, 4 5 6)');
st_zmax
-------
6

SELECT ST_ZMax(ST_GeomFromEWKT('LINESTRING(1 3 4, 5 6 7)'));
st_zmax
-------
7

SELECT ST_ZMax('BOX3D(-3 2 1, 3 4 1)' );
st_zmax
-------
1
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to ↩
    a BOX3D
SELECT ST_ZMax('LINESTRING(1 3 4, 5 6 7)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_ZMax(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_zmax
--------
3
```

See Also

ST_GeomFromEWKT, ST_XMin, ST_XMax, ST_YMax, ST_YMin, ST_ZMax

7.18.14 ST_ZMin

ST_ZMin — Returns the Z minima of a 2D or 3D bounding box or a geometry.

Synopsis

float **ST_ZMin**(box3d aGeomorBox2DorBox3D);

Description

Returns the Z minima of a 2D or 3D bounding box or a geometry.

Note
Although this function is only defined for box3d, it also works for box2d and geometry values due to automatic casting. However it will not accept a geometry or box2d text representation, since those do not auto-cast.

This function supports 3d and will not drop the z-index.

This method supports Circular Strings and Curves.

Examples

```
SELECT ST_ZMin('BOX3D(1 2 3, 4 5 6)');
st_zmin
-------
3

SELECT ST_ZMin(ST_GeomFromEWKT('LINESTRING(1 3 4, 5 6 7)'));
st_zmin
-------
4

SELECT ST_ZMin('BOX3D(-3 2 1, 3 4 1)' );
st_zmin
-------
1
--Observe THIS DOES NOT WORK because it will try to auto-cast the string representation to  ↩
    a BOX3D
SELECT ST_ZMin('LINESTRING(1 3 4, 5 6 7)');

--ERROR:  BOX3D parser - doesn't start with BOX3D(

SELECT ST_ZMin(ST_GeomFromEWKT('CIRCULARSTRING(220268 150415 1,220227 150505 2,220227  ↩
    150406 3)'));
st_zmin
--------
1
```

See Also

ST_GeomFromEWKT, ST_GeomFromText, ST_XMin, ST_XMax, ST_YMax, ST_YMin, ST_ZMax

7.19 선형 참조(Linear Referencing)

7.19.1 ST_LineInterpolatePoint

ST_LineInterpolatePoint — Returns a point interpolated along a line at a fractional location.

Synopsis

geometry **ST_LineInterpolatePoint**(geometry a_linestring, float8 a_fraction);
geography **ST_LineInterpolatePoint**(geography a_linestring, float8 a_fraction, boolean use_spheroid = true);

설명

라인을 따라 보간된 포인트를 반&#
첫 번째 인수는 라인스트링이어&#x
합니다. 두 번째 인수는 0과 1 사이의
Float8 데이터형으로 라인스트링의
전체 길이에서 포인트가 위치해&#x
하는 비율을 의미합니다.

포인트에 가장 가까운 라인의 위&#x
계산하는 방법에 대해서는 ST_LineLocatePoint
를 참조하십시오.

Note
This function computes points in 2D and then interpolates values for Z and M, while ST_LineInterpolatePoint computes points in 3D and only interpolates the M value.

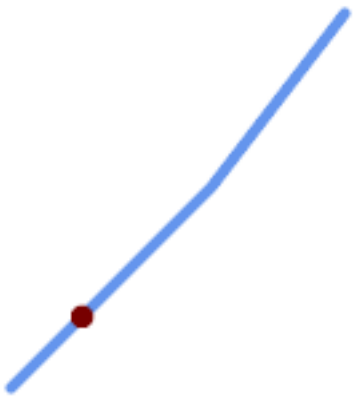
Note
1.1.1 배포판부터 이 함수는 M 및 Z값(이 있을 경우)도 보간합니다. 이전 배포판에서는 두 값을 0.0으로 고정시켰습니다.

0.8.2 버전부터 사용할 수 있습니다.
1.1.1 버전에서 Z과 M 좌표를 지원합니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까이 함수의 명칭은 ST_Line_Interpolate_Point였습니다.

This function supports 3d and will not drop the z-index.

예시



20% 위치 (0.20)에 있는 보간된 포인트를 가진 라인스트링

```
-- The point 20% along a line

SELECT ST_AsEWKT(  ST_LineInterpolatePoint(
        'LINESTRING(25 50, 100 125, 150 190)',
        0.2 ));
----------------
 POINT(51.5974135047432 76.5974135047432)
```

The mid-point of a 3D line:

```
SELECT ST_AsEWKT(  ST_LineInterpolatePoint('
        LINESTRING(1 2 3, 4 5 6, 6 7 8)',
        0.5 ));
--------------------
 POINT(3.5 4.5 5.5)
```

The closest point on a line to a point:

```
SELECT ST_AsText( ST_LineInterpolatePoint( line.geom,
                        ST_LineLocatePoint( line.geom, 'POINT(4 3)')))
FROM (SELECT ST_GeomFromText('LINESTRING(1 2, 4 5, 6 7)') As geom) AS line;
------------
 POINT(3 4)
```

참고

ST_LineInterpolatePoints, ST_LineInterpolatePoint, ST_LineMerge

7.19.2 ST_LineInterpolatePoint

ST_LineInterpolatePoint — Returns a point interpolated along a 3D line at a fractional location.

Synopsis

geometry **ST_LineInterpolatePoint**(geometry a_linestring, float8 a_fraction);

설명

라인을 따라 보간된 포인트를 반&#x
첫 번째 인수는 라인스트링이어&#x
합니다. 두 번째 인수는 0과 1 사이의
Float8 데이터형으로 라인스트링의
전체 길이에서 포인트가 위치해&#x
하는 비율을 의미합니다.

Note
ST_LineInterpolatePoint computes points in 2D and then interpolates the values for Z and M, while this function computes points in 3D and only interpolates the M value.

2.0.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

Return point 20% along 3D line

```
-- 2&#xcc28;&#xc6d0; &#xb77c;&#xc778;&#xc744; &#xb530;&#xb77c; 20%  ↩
    &#xc704;&#xce58;&#xc5d0; &#xc788;&#xb294; &#xd3ec;&#xc778;&#xd2b8;&#xb97c;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsEWKT(ST_LineInterpolatePoint(the_line, 0.20))
        FROM (SELECT ST_GeomFromEWKT('LINESTRING(25 50, 100 125, 150 190)') as the_line) As ↩
            foo;
   st_asewkt
----------------
 POINT(51.5974135047432 76.5974135047432)
```

참고

ST_LineInterpolatePoint, ST_LineInterpolatePoint, ST_LineMerge

7.19.3 ST_LineInterpolatePoints

ST_LineInterpolatePoints — Returns points interpolated along a line at a fractional interval.

Synopsis

geometry **ST_LineInterpolatePoints**(geometry a_linestring, float8 a_fraction, boolean repeat);
geography **ST_LineInterpolatePoints**(geography a_linestring, float8 a_fraction, boolean use_spheroid = true, boolean repeat = true);

설명

Returns one or more points interpolated along a line at a fractional interval. The first argument must be a LINESTRING. The second argument is a float8 between 0 and 1 representing the spacing between the points as a fraction of line length. If the third argument is false, at most one point will be constructed (which is equivalent to ST_LineInterpolatePoint.)

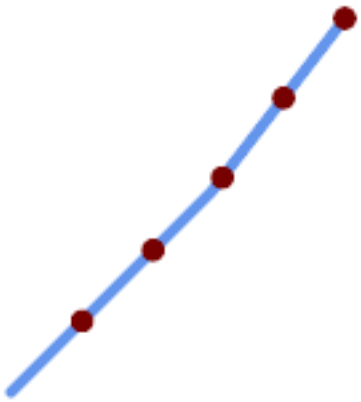
If the result has zero or one points, it is returned as a POINT. If it has two or more points, it is returned as a MULTIPOINT.

Availability: 2.5.0

This function supports 3d and will not drop the z-index.

This function supports M coordinates.

예시



A LineString with points interpolated every 20%

```
--Return points each 20% along a 2D line
SELECT ST_AsText(ST_LineInterpolatePoints('LINESTRING(25 50, 100 125, 150 190)', 0.20))
----------------
 MULTIPOINT((51.5974135047432 76.5974135047432),(78.1948270094864 103.194827009486) ↩
     ,(104.132163186446 130.37181214238),(127.066081593223 160.18590607119),(150 190))
```

참고

ST_LineInterpolatePoint, ST_LineLocatePoint

7.19.4 ST_LineLocatePoint

ST_LineLocatePoint — Returns the fractional location of the closest point on a line to a point.

Synopsis

float8 **ST_LineLocatePoint**(geometry a_linestring, geometry a_point);
float8 **ST_LineLocatePoint**(geography a_linestring, geography a_point, boolean use_spheroid = true);

설명

입력 포인트에 가장 가까운 위치&#x
있는 라인스트링 상의 포인트를
나타내는 2차원 라인 전체 길이의
비율을 0에서 1 사이의 부동소수점
데이터형(float)으로 반환합니다.

반환된 위치를 이용해서 포인트(ST
또는 부분 스트링(ST_LineSubstring)을 추출할
수 있습니다.

이 함수는 주소의 개수의 근사치&#x
구하는 데 유용합니다.

1.1.0 버전부터 사용할 수 있습니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Line_Locate_Point였습니다

예시

```
-- &#xac70;&#xb9ac;&#xb97c; &#xb530;&#xb77c; &#xc788;&#xb294;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xc758; &#xbc88;&#xc9c0;&#xc218;&#xb97c; &#xb300;&#xcda9;  ↩
    &#xc5b4;&#xb9bc;&#xc9d0;&#xc791;&#xd558;&#xae30;
-- foo &#xc804;&#xccb4;&#xac00; &#xc9d1; &#xc911;&#xc2ec;&#xc810; &#xbc0f;  ↩
    &#xac70;&#xb9ac;&#xcc98;&#xb7fc; &#xbcf4;&#xc774;&#xb294; &#xac00;&#xc9dc;  ↩
    &#xb370;&#xc774;&#xd130;&#xb97c; &#xc0dd;&#xc131;&#xd558;&#xae30; &#xc704;&#xd55c;  ↩
    &#xac83;&#xc774;&#xb77c;&#xb294; &#xc810;&#xc5d0; &#xc8fc;&#xc758;
-- ST_DWithin&#xc744; &#xc774;&#xc6a9;&#xd574;&#xc11c; &#xac70;&#xb9ac;&#xc5d0;&#xc11c;  ↩
    &#xb108;&#xbb34; &#xba40;&#xb9ac; &#xb5a8;&#xc5b4;&#xc9c4; &#xc9d1;&#xb4e4;&#xc744;  ↩
    &#xc81c;&#xc678;
SELECT ST_AsText(house_loc) As as_text_house_loc,
        startstreet_num +
                CAST( (endstreet_num - startstreet_num)
                        * ST_LineLocatePoint(street_line, house_loc) As integer) As  ↩
                            street_num
FROM
(SELECT ST_GeomFromText('LINESTRING(1 2, 3 4)') As street_line,
        ST_MakePoint(x*1.01,y*1.03) As house_loc, 10 As startstreet_num,
                20 As endstreet_num
FROM generate_series(1,3) x CROSS JOIN generate_series(2,4) As y)
As foo
WHERE ST_DWithin(street_line, house_loc, 0.2);
```

```
 as_text_house_loc | street_num
-------------------+------------
 POINT(1.01 2.06)  |         10
 POINT(2.02 3.09)  |         15
 POINT(3.03 4.12)  |         20

-- &#xd3ec;&#xc778;&#xd2b8; &#xb610;&#xb294; &#xb2e4;&#xb978; &#xb3c4;&#xd615;&#xc5d0;  ↩
    &#xac00;&#xc7a5; &#xac00;&#xae4c;&#xc6b4; &#xb77c;&#xc778; &#xc0c1;&#xc758;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb97c; &#xcc3e;&#xae30;
 SELECT ST_AsText(ST_LineInterpolatePoint(foo.the_line, ST_LineLocatePoint(foo.the_line,  ↩
     ST_GeomFromText('POINT(4 3)'))))
FROM (SELECT ST_GeomFromText('LINESTRING(1 2, 4 5, 6 7)') As the_line) As foo;
   st_astext
----------------
 POINT(3 4)
```

참고

ST_DWithin, ST_Length2D, ST_LineInterpolatePoint, ST_LineSubstring

7.19.5 ST_LineSubstring

ST_LineSubstring — Returns the part of a line between two fractional locations.

Synopsis

geometry **ST_LineSubstring**(geometry a_linestring, float8 startfraction, float8 endfraction);
geography **ST_LineSubstring**(geography a_linestring, float8 startfraction, float8 endfraction);

설명

Computes the line which is the section of the input line starting and ending at the given fractional locations. The first argument must be a LINESTRING. The second and third arguments are values in the range [0, 1] representing the start and end locations as fractions of line length. The Z and M values are interpolated for added endpoints if present.

'시작'과 '끝'이 동일한 값일 경우 이 함수는 ST_LineInterpolatePoint 함수와 같아집니&#xb2e4

Note
This only works with LINESTRINGs. To use on contiguous MULTILINESTRINGs first join them with ST_LineMerge.

Note
1.1.1 배포판부터 이 함수는 M 및 Z값(이 있을 경우)도 보간합니다. 이전 배포판에서는 두 값을 설정하지 않았습니다.

1.1.0 버전부터 사용할 수 있습니다.
1.1.1 버전부터 Z 및 M을 지원합니다.

변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까&
이 함수의 명칭은 ST_Line_Substring이었습니&#x

This function supports 3d and will not drop the z-index.

예시

중간 1/3 범위(0.333, 0.666)를 중첩해서 출력한 라인스트링

```
SELECT ST_AsText(ST_LineSubstring( 'LINESTRING (20 180, 50 20, 90 80, 120 40, 180 150)',  ↩
    0.333, 0.666));
------------------------------------------------------------------------------------------- ↩

LINESTRING (45.17311810399485 45.74337011202746, 50 20, 90 80, 112.97593050157862  ↩
    49.36542599789519)
```

If start and end locations are the same, the result is a POINT.

```
SELECT ST_AsText(ST_LineSubstring( 'LINESTRING(25 50, 100 125, 150 190)', 0.333, 0.333));
----------------------------------------
 POINT(69.2846934853974 94.2846934853974)
```

A query to cut a LineString into sections of length 100 or shorter. It uses `generate_series()` with a CROSS JOIN LATERAL to produce the equivalent of a FOR loop.

```
WITH data(id, geom) AS (VALUES
        ( 'A', 'LINESTRING( 0 0, 200 0)'::geometry ),
        ( 'B', 'LINESTRING( 0 100, 350 100)'::geometry ),
        ( 'C', 'LINESTRING( 0 200, 50 200)'::geometry )
    )
SELECT id, i,
       ST_AsText( ST_LineSubstring( geom, startfrac, LEAST( endfrac, 1 )) ) AS geom
FROM (
    SELECT id, geom, ST_Length(geom) len, 100 sublen FROM data
    ) AS d
CROSS JOIN LATERAL (
    SELECT i, (sublen * i) / len AS startfrac,
              (sublen * (i+1)) / len AS endfrac
    FROM generate_series(0, floor( len / sublen )::integer ) AS t(i)
    -- skip last i if line length is exact multiple of sublen
```

```
    WHERE (sublen * i) / len <> 1.0
    ) AS d2;

 id | i |            geom
----+---+----------------------------
 A  | 0 | LINESTRING(0 0,100 0)
 A  | 1 | LINESTRING(100 0,200 0)
 B  | 0 | LINESTRING(0 100,100 100)
 B  | 1 | LINESTRING(100 100,200 100)
 B  | 2 | LINESTRING(200 100,300 100)
 B  | 3 | LINESTRING(300 100,350 100)
 C  | 0 | LINESTRING(0 200,50 200)
```

참고

ST_Length, ST_LineInterpolatePoint, ST_LineMerge

7.19.6 ST_LocateAlong

ST_LocateAlong — Returns the point(s) on a geometry that match a measure value.

Synopsis

geometry **ST_LocateAlong**(geometry ageom_with_measure, float8 a_measure, float8 offset);

설명

Returns the location(s) along a measured geometry that have the given measure values. The result is a Point or MultiPoint. Polygonal inputs are not supported.

If `offset` is provided, the result is offset to the left or right of the input line by the specified distance. A positive offset will be to the left, and a negative one to the right.

Note
Use this function only for linear geometries with an M component

---

The semantic is specified by the *ISO/IEC 13249-3 SQL/MM Spatial* standard.

1.1.0 버전부터 예전 명칭인 ST_Locate_Along_Measure로
사용할 수 있습니다.

변경 사항: 2.0.0 미만 버전에서는 ST_Locate_Along
명칭이었습니다. 예전 명칭은 더
지원되지 않고 곧 삭제될 예정이&#x
아직은 사용할 수 있습니다.

This function supports M coordinates.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.13

예시

```
SELECT ST_AsText(
  ST_LocateAlong(
    'MULTILINESTRINGM((1 2 3, 3 4 2, 9 4 3),(1 2 3, 5 4 5))'::geometry,
    3 ));

----------------------------------
 MULTIPOINT M ((1 2 3),(9 4 3),(1 2 3))
```

참고

ST_LocateBetween, ST_LocateBetweenElevations, ST_InterpolatePoint

7.19.7 ST_LocateBetween

ST_LocateBetween — Returns the portions of a geometry that match a measure range.

Synopsis

geometry **ST_LocateBetween**(geometry geomA, float8 measure_start, float8 measure_end, float8 offset);

설명

설정한 척도와 일치하는 요소들&#x
가진 파생 도형 집합의 값을 반환&#
폴리곤 구성 요소는 지원되지 않&#x

오프셋을 설정할 경우, 그 결과 입&#
라인에서 설정한 단위 개수만큼
왼쪽 또는 오른쪽에 오프셋 도형
집합을 출력할 것입니다. 양의 오&#
왼쪽, 음의 오프셋은 오른쪽으로
출력할 것입니다.

Clipping a non-convex POLYGON may produce invalid geometry.

The semantic is specified by the *ISO/IEC 13249-3 SQL/MM Spatial* standard.

1.1.0 버전부터 예전 명칭인 ST_Locate_Between_Measures&#xb8
사용할 수 있습니다.

변경 사항: 2.0.0 미만 버전에서는 ST_Locate_Along
명칭이었습니다. 예전 명칭은 더
지원되지 않고 곧 삭제될 예정이&#x
아직은 사용할 수 있습니다.

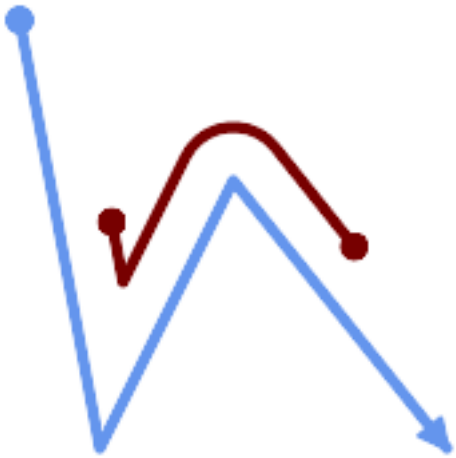
Enhanced: 3.0.0 - added support for POLYGON, TIN, TRIANGLE.

This function supports M coordinates.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

예시

```
SELECT ST_AsText(
  ST_LocateBetween(
       'MULTILINESTRING M ((1 2 3, 3 4 2, 9 4 3),(1 2 3, 5 4 5))':: geometry,
       1.5, 3 ));
------------------------------------------------------------------------
 GEOMETRYCOLLECTION M (LINESTRING M (1 2 3,3 4 2,9 4 3),POINT M (1 2 3))
```



A LineString with the section between measures 2 and 8, offset to the left

```
SELECT ST_AsText( ST_LocateBetween(
  ST_AddMeasure('LINESTRING (20 180, 50 20, 100 120, 180 20)', 0, 10),
  2, 8,
  20
));
------------------------------------------------------------------------
MULTILINESTRING((54.49835019899045 104.53426957938231,58.70056060327303  ↩
    82.12248075654186,69.16695286779743 103.05526528559065,82.11145618000168  ↩
    128.94427190999915,84.24893681714357 132.32493442618113,87.01636951231555  ↩
    135.21267035596549,90.30307285299679 137.49198684843182,93.97759758337769  ↩
    139.07172433557758,97.89298381958797 139.8887023914453,101.89263860095893  ↩
    139.9102465862721,105.81659870902816 139.13549527600819,109.50792827749828  ↩
    137.5954340631298,112.81899532549731 135.351656550512,115.6173761888606  ↩
    132.49390095108848,145.31017306064817 95.37790486135405))
```

참고

ST_LocateAlong, ST_LocateAlong, ST_LocateBetween

7.19.8 ST_LocateBetweenElevations

ST_LocateBetweenElevations — Returns the portions of a geometry that lie in an elevation (Z) range.

Synopsis

geometry **ST_LocateBetweenElevations**(geometry geom_mline, float8 elevation_start, float8 elevation_end);

설명

Returns a geometry (collection) with the portions of a geometry that lie in an elevation (Z) range.

Clipping a non-convex POLYGON may produce invalid geometry.

1.4.0 버전부터 사용할 수 있습니다.

Enhanced: 3.0.0 - added support for POLYGON, TIN, TRIANGLE.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsText(
  ST_LocateBetweenElevations(
    'LINESTRING(1 2 3, 4 5 6)'::geometry,
    2, 4 ));

             st_astext
-----------------------------------
 MULTILINESTRING Z ((1 2 3,2 3 4))

SELECT ST_AsText(
    ST_LocateBetweenElevations(
      'LINESTRING(1 2 6, 4 5 -1, 7 8 9)',
      6, 9)) As ewelev;

                                ewelev
----------------------------------------------------------------------
 GEOMETRYCOLLECTION Z (POINT Z (1 2 6),LINESTRING Z (6.1 7.1 6,7 8 9))
```

참고

ST_Dump, ST_LocateAlong, ST_LocateBetween

7.19.9 ST_InterpolatePoint

ST_InterpolatePoint — 입력 포인트에 가까운 포인도형의 척도 차원(M 차원)의 값을 반환합니다.

Synopsis

float8 **ST_InterpolatePoint**(geometry linear_geom_with_measure, geometry point);

설명

Returns an interpolated measure value of a linear measured geometry at the location closest to the given point.

Note

Use this function only for linear geometries with an M component

2.0.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_InterpolatePoint('LINESTRING M (0 0 0, 10 0 20)', 'POINT(5 5)');
 --------------------
         10
```

참고

ST_AddMeasure, ST_LocateAlong, ST_LocateBetween

7.19.10 ST_AddMeasure

ST_AddMeasure — Interpolates measures along a linear geometry.

Synopsis

geometry **ST_AddMeasure**(geometry geom_mline, float8 measure_start, float8 measure_end);

설명

시작점과 종단점 사이의 선형적&#x
보간된 척도 요소들을 가진 파생
도형을 반환합니다. 도형이 척도
차원을 가지고 있지 않을 경우, 척&#
차원을 추가합니다. 도형이 척도
차원을 가지고 있을 경우, 새 값들&#
덮어 씁니다. 라인스트링과 멀티&#
지원합니다.

1.5.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

```
SELECT ST_AsText(ST_AddMeasure(
ST_GeomFromEWKT('LINESTRING(1 0, 2 0, 4 0)'),1,4)) As ewelev;
           ewelev
-------------------------------
 LINESTRINGM(1 0 1,2 0 2,4 0 4)

SELECT ST_AsText(ST_AddMeasure(
ST_GeomFromEWKT('LINESTRING(1 0 4, 2 0 4, 4 0 4)'),10,40)) As ewelev;
                ewelev
---------------------------------------
 LINESTRING(1 0 4 10,2 0 4 20,4 0 4 40)

SELECT ST_AsText(ST_AddMeasure(
ST_GeomFromEWKT('LINESTRINGM(1 0 4, 2 0 4, 4 0 4)'),10,40)) As ewelev;
                ewelev
---------------------------------------
 LINESTRINGM(1 0 10,2 0 20,4 0 40)

SELECT ST_AsText(ST_AddMeasure(
```

```
ST_GeomFromEWKT('MULTILINESTRINGM((1 0 4, 2 0 4, 4 0 4),(1 0 4, 2 0 4, 4 0 4))'),10,70)) As ↩
     ewelev;
                              ewelev
-------------------------------------------------------------------
 MULTILINESTRINGM((1 0 10,2 0 20,4 0 40),(1 0 40,2 0 50,4 0 70))
```

7.20 Trajectory Functions

7.20.1 ST_IsValidTrajectory

ST_IsValidTrajectory — Tests if the geometry is a valid trajectory.

Synopsis

boolean **ST_IsValidTrajectory**(geometry line);

Description

Tests if a geometry encodes a valid trajectory. A valid trajectory is represented as a `LINESTRING` with measures (M values). The measure values must increase from each vertex to the next.

Valid trajectories are expected as input to spatio-temporal functions like ST_ClosestPointOfApproach

Availability: 2.2.0

This function supports 3d and will not drop the z-index.

Examples

```
-- A valid trajectory
SELECT ST_IsValidTrajectory(ST_MakeLine(
  ST_MakePointM(0,0,1),
  ST_MakePointM(0,1,2))
);
 t

-- An invalid trajectory
SELECT ST_IsValidTrajectory(ST_MakeLine(ST_MakePointM(0,0,1), ST_MakePointM(0,1,0)));
NOTICE:  Measure of vertex 1 (0) not bigger than measure of vertex 0 (1)
 st_isvalidtrajectory
----------------------
 f
```

See Also

ST_ClosestPointOfApproach

7.20.2 ST_ClosestPointOfApproach

ST_ClosestPointOfApproach — Returns a measure at the closest point of approach of two trajectories.

Synopsis

float8 **ST_ClosestPointOfApproach**(geometry track1, geometry track2);

Description

Returns the smallest measure at which points interpolated along the given trajectories are at the smallest distance.

Inputs must be valid trajectories as checked by ST_IsValidTrajectory. Null is returned if the trajectories do not overlap in their M ranges.

See ST_LocateAlong for getting the actual points at the given measure.

Availability: 2.2.0

This function supports 3d and will not drop the z-index.

Examples

```
-- Return the time in which two objects moving between 10:00 and 11:00
-- are closest to each other and their distance at that point
WITH inp AS ( SELECT
  ST_AddMeasure('LINESTRING Z (0 0 0, 10 0 5)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) a,
  ST_AddMeasure('LINESTRING Z (0 2 10, 12 1 2)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) b
), cpa AS (
  SELECT ST_ClosestPointOfApproach(a,b) m FROM inp
), points AS (
  SELECT ST_Force3DZ(ST_GeometryN(ST_LocateAlong(a,m),1)) pa,
         ST_Force3DZ(ST_GeometryN(ST_LocateAlong(b,m),1)) pb
  FROM inp, cpa
)
SELECT to_timestamp(m) t,
       ST_Distance(pa,pb) distance
FROM points, cpa;

               t               |     distance
-------------------------------+------------------
 2015-05-26 10:45:31.034483+02 | 1.96036833151395
```

See Also

ST_IsValidTrajectory, ST_DistanceCPA, ST_LocateAlong, ST_AddMeasure

7.20.3 ST_DistanceCPA

ST_DistanceCPA — Returns the distance between the closest point of approach of two trajectories.

Synopsis

float8 **ST_DistanceCPA**(geometry track1, geometry track2);

Description

Returns the minimum distance two moving objects have ever been each other.

Inputs must be valid trajectories as checked by ST_IsValidTrajectory. Null is returned if the trajectories do not overlap in their M ranges.

Availability: 2.2.0

This function supports 3d and will not drop the z-index.

Examples

```
-- Return the minimum distance of two objects moving between 10:00 and 11:00
WITH inp AS ( SELECT
  ST_AddMeasure('LINESTRING Z (0 0 0, 10 0 5)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) a,
  ST_AddMeasure('LINESTRING Z (0 2 10, 12 1 2)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) b
)
SELECT ST_DistanceCPA(a,b) distance FROM inp;

     distance
------------------
 1.96036833151395
```

See Also

ST_IsValidTrajectory, ST_ClosestPointOfApproach, ST_AddMeasure, |=|

7.20.4 ST_CPAWithin

ST_CPAWithin — Tests if the closest point of approach of two trajectories is within the specified distance.

Synopsis

boolean **ST_CPAWithin**(geometry track1, geometry track2, float8 dist);

Description

Tests whether two moving objects have ever been closer than the specified distance.

Inputs must be valid trajectories as checked by ST_IsValidTrajectory. False is returned if the trajectories do not overlap in their M ranges.

Availability: 2.2.0

This function supports 3d and will not drop the z-index.

Examples

```
WITH inp AS ( SELECT
  ST_AddMeasure('LINESTRING Z (0 0 0, 10 0 5)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) a,
  ST_AddMeasure('LINESTRING Z (0 2 10, 12 1 2)'::geometry,
    extract(epoch from '2015-05-26 10:00'::timestamptz),
    extract(epoch from '2015-05-26 11:00'::timestamptz)
  ) b
)
SELECT ST_CPAWithin(a,b,2), ST_DistanceCPA(a,b) distance FROM inp;

 st_cpawithin |     distance
--------------+------------------
 t            | 1.96521473776207
```

See Also

ST_IsValidTrajectory, ST_ClosestPointOfApproach, ST_DistanceCPA, |=|

7.21 SFCGAL 함수

7.21.1 postgis_sfcgal_version

postgis_sfcgal_version — 실행중인 SFCGAL의 버전을 반&#xd65

Synopsis

text **postgis_sfcgal_version**(void);

설명

실행중인 SFCGAL의 버전을 반환합니&#x
2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

참고

postgis_sfcgal_version

7.21.2 postgis_sfcgal_version

postgis_sfcgal_version — Returns the full version of SFCGAL in use including CGAL and Boost versions

Synopsis

text **postgis_sfcgal_version**(void);

설명

Returns the full version of SFCGAL in use including CGAL and Boost versions

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

참고

postgis_sfcgal_version

7.21.3 ST_3DArea

ST_3DArea — 3차원 표면 도형의 면적을 계&#xc0
입체일 경우 0을 반환할 것입니다.

Synopsis

float**ST_3DArea**(geometry geom1);

설명

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 8.1, 10.5

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

주의: 기본적으로 KWT로부터 빌드&#xb41
다면체 표면은 표면 도형이지 입&#
아닙니다. 따라서 표면 면적을 구&#
수 있습니다. 입체로 변환하면, 면&
구할 수 없습니다.

```
SELECT ST_3DArea(geom) As cube_surface_area,
        ST_3DArea(ST_MakeSolid(geom)) As solid_surface_area
  FROM (SELECT 'POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
    ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)),
    ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
    ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
    ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)),
    ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )'::geometry) As f(geom);

 cube_surface_area | solid_surface_area
-------------------+--------------------
                 6 |                  0
```

참고

ST_Area, ST_MakeSolid, ST_IsSolid, ST_Area

7.21.4 ST_3DConvexHull

ST_3DConvexHull — 면 도형의 근사 중심축을 계&

Synopsis

geometry **ST_3DConvexHull**(geometry geom1);

설명

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

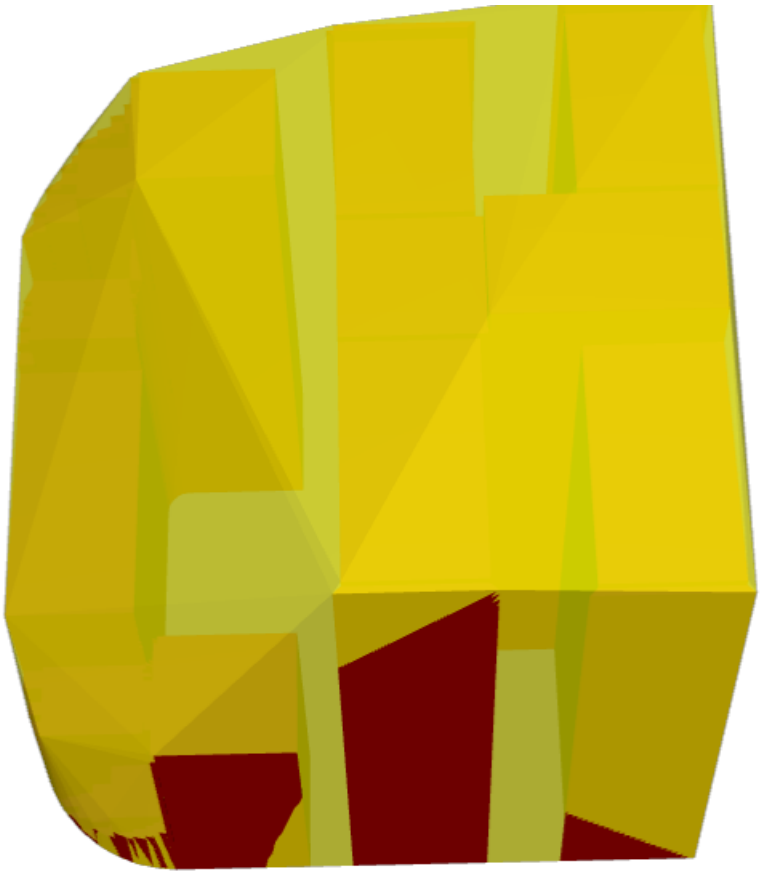
This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_AsText(ST_3DConvexHull('LINESTRING Z(0 0 5, 1 5 3, 5 7 6, 9 5 3 , 5 7 5, 6 3 5) ↩
    '::geometry));
```

```
POLYHEDRALSURFACE Z (((1 5 3,9 5 3,0 0 5,1 5 3)),((1 5 3,0 0 5,5 7 6,1 5 3)),((5 7 6,5 7  ↩
    5,1 5 3,5 7 6)),((0 0 5,6 3 5,5 7 6,0 0 5)),((6 3 5,9 5 3,5 7 6,6 3 5)),((0 0 5,9 5 3,6  ↩
    3 5,0 0 5)),((9 5 3,5 7 5,5 7 6,9 5 3)),((1 5 3,5 7 5,9 5 3,1 5 3)))
```

```
WITH f AS (SELECT i, ST_Extrude(geom, 0,0, i ) AS geom
FROM ST_Subdivide(ST_Letters('CH'),5) WITH ORDINALITY AS sd(geom,i)
      )
      SELECT ST_3DConvexHull(ST_Collect(f.geom) )
      FROM f;
```



Original geometry overlaid with 3D convex hull

참고

ST_Letters, ST_AsX3D

7.21.5 ST_3DIntersection

ST_3DIntersection — 3차원 교차를 수행합니다.

Synopsis

geometry **ST_3DIntersection**(geometry geom1, geometry geom2);

설명

geom1과 geom2가 공유하는 부분을 도형으
반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

This function supports 3d and will not drop the z-index.

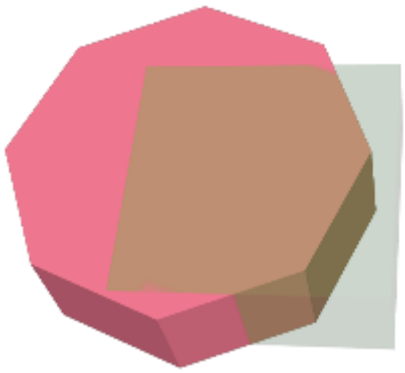
This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

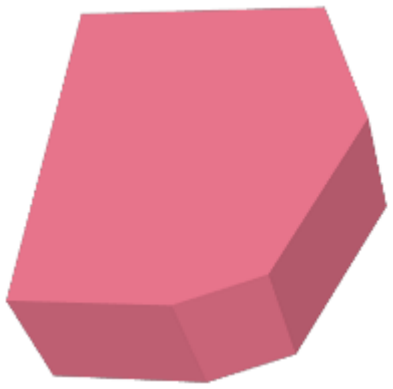
PostGIS ST_AsX3D 를 통해 3차원 영상을 생성한 다음 X3Dom HTML 자바스크립트 렌더링 라이브러리 를 이용해서 HTML로 렌&#xb3

```
SELECT ST_Extrude(ST_Buffer( ↩
          ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
        ST_Extrude(ST_Buffer( ↩
          ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2;
```



원본 3차원 도형들이 중첩합니다. geom2를 반투명하게 표현했습니다.

```
SELECT ST_3DIntersection(geom1,geom2)
FROM ( SELECT ST_Extrude(ST_Buffer( ↩
          ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
        ST_Extrude(ST_Buffer( ↩
          ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2 ) As ↩
          t;
```



geom1과 geom2가 교차한 부분

3차원 라인스트링과 폴리곤

```
SELECT ST_AsText(ST_3DIntersection(linestring, polygon)) As wkt
FROM  ST_GeomFromText('LINESTRING Z (2 2 6,1.5 1.5 7,1 1 8,0.5 0.5 8,0 0 10)') AS  ↩
    linestring
 CROSS JOIN ST_GeomFromText('POLYGON((0 0 8, 0 1 8, 1 1 8, 1 0 8, 0 0 8))') AS polygon;

              wkt
-------------------------------
 LINESTRING Z (1 1 8,0.5 0.5 8)
```

정육면체(닫힌 다면체 표면)과 폴&#x
Z

```
SELECT ST_AsText(ST_3DIntersection(
                ST_GeomFromText('POLYHEDRALSURFACE Z( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)) ↩
                    ,
        ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
        ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
```

```
        ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )'),
        'POLYGON Z ((0 0 0, 0 0 0.5, 0 0.5 0.5, 0 0.5 0, 0 0 0))'::geometry))
```

```
TIN Z (((0 0 0,0 0 0.5,0 0.5 0.5,0 0 0)),((0 0.5 0,0 0 0,0 0.5 0.5,0 0.5 0)))
```

두 물체의 입체 교차 또한 물체인 두 물체가 교차하는 부분(ST_Dimension 함ణ을 반환)

```
SELECT ST_AsText(ST_3DIntersection( ST_Extrude(ST_Buffer('POINT(10 20)'::geometry,10,1) ↩
    ,0,0,30),
 ST_Extrude(ST_Buffer('POINT(10 20)'::geometry,10,1),2,0,10) ));
```

```
POLYHEDRALSURFACE Z (((13.3333333333333 13.3333333333333 10,20 20 0,20 20  ↩
    10,13.3333333333333 13.3333333333333 10)),
        ((20 20 10,16.6666666666667 23.3333333333333 10,13.3333333333333 13.3333333333333  ↩
           10,20 20 10)),
        ((20 20 0,16.6666666666667 23.3333333333333 10,20 20 10,20 20 0)),
        ((13.3333333333333 13.3333333333333 10,10 10 0,20 20 0,13.3333333333333  ↩
           13.3333333333333 10)),
        ((16.6666666666667 23.3333333333333 10,12 28 10,13.3333333333333 13.3333333333333  ↩
           10,16.6666666666667 23.3333333333333 10)),
        ((20 20 0,9.99999999999995 30 0,16.6666666666667 23.3333333333333 10,20 20 0)),
        ((10 10 0,9.99999999999995 30 0,20 20 0,10 10 0)),((13.3333333333333  ↩
           13.3333333333333 10,12 12 10,10 10 0,13.3333333333333 13.3333333333333 10)),
        ((12 28 10,12 12 10,13.3333333333333 13.3333333333333 10,12 28 10)),
        ((16.6666666666667 23.3333333333333 10,9.99999999999995 30 0,12 28  ↩
           10,16.6666666666667 23.3333333333333 10)),
        ((10 10 0,0 20 0,9.99999999999995 30 0,10 10 0)),
        ((12 12 10,11 11 10,10 10 0,12 12 10)),((12 28 10,11 11 10,12 12 10,12 28 10)),
        ((9.99999999999995 30 0,11 29 10,12 28 10,9.99999999999995 30 0)),((0 20 0,2 20  ↩
           10,9.99999999999995 30 0,0 20 0)),
        ((10 10 0,2 20 10,0 20 0,10 10 0)),((11 11 10,2 20 10,10 10 0,11 11 10)),((12 28  ↩
           10,11 29 10,11 11 10,12 28 10)),
        ((9.99999999999995 30 0,2 20 10,11 29 10,9.99999999999995 30 0)),((11 11 10,11 29  ↩
           10,2 20 10,11 11 10)))
```

7.21.6 ST_3DDifference

ST_3DDifference — 3차원 차이를 수행합니다.

Synopsis

geometry **ST_3DDifference**(geometry geom1, geometry geom2);

설명

geom2의 일부분이 아닌 geom1의 부분을 반환합니다.

2.2.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

This function supports 3d and will not drop the z-index.

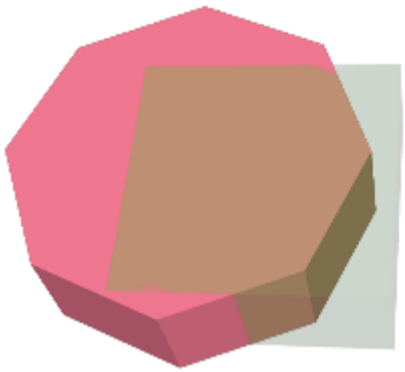
This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

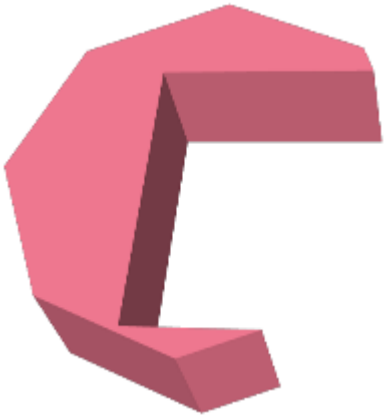
PostGIS ST_AsX3D 를 통해 3차원 영상을 생성한 다음 X3Dom HTML 자바스크립트 렌더링 라이브러리 를 이용해서 HTML로 렌&#xb3

```
SELECT ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
       ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2;
```



원본 3차원 도형들이 중첩합니다. geom2가 제거될 부분을 나타냅니다.

```
SELECT ST_3DDifference(geom1,geom2)
FROM ( SELECT ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
       ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2 ) As ↩
            t;
```



geom2를 제거하고 남은 부분

참고

ST_Extrude, ST_AsX3D, ST_3DIntersection ST_3DUnion

7.21.7 ST_3DUnion

ST_3DUnion — Perform 3D union.

Synopsis

geometry **ST_3DUnion**(geometry geom1, geometry geom2);
geometry **ST_3DUnion**(geometry set g1field);

설명

2.2.0 버전부터 사용할 수 있습니다.

Availability: 3.3.0 aggregate variant was added

This method needs SFCGAL backend.

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

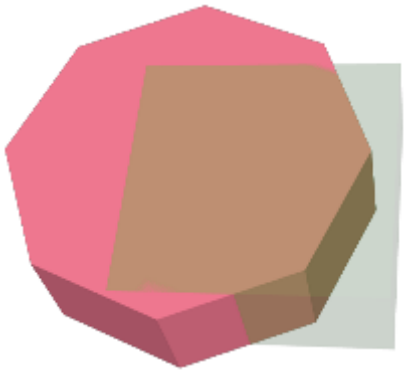
This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

Aggregate variant: returns a geometry that is the 3D union of a rowset of geometries. The ST_3DUnion() function is an "aggregate" function in the terminology of PostgreSQL. That means that it operates on rows of data, in the same way the SUM() and AVG() functions do and like most aggregates, it also ignores NULL geometries.

예시

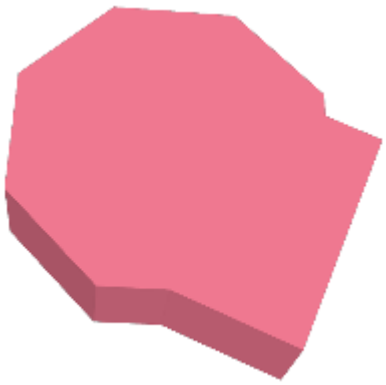
PostGIS ST_AsX3D 를 통해 3차원 영상을 생성한 다음 X3Dom HTML 자바스크립트 렌더링 라이브러리 를 이용해서 HTML로 렌&#xb3

```
SELECT ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
        ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2;
```



원본 3차원 도형들이 중첩합니다. geom2를 반투명하게 표현했습니다.

```
SELECT ST_3DUnion(geom1,geom2)
FROM ( SELECT ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30) AS geom1,
        ST_Extrude(ST_Buffer( ↩
            ST_GeomFromText('POINT(80 80)'),
 50, 'quad_segs=1'),0,0,30) AS geom2 ) As ↩
             t;
```



geom1과 geom2의 통합

참고

ST_Extrude, ST_AsX3D, ST_3DIntersection ST_3DDifference

7.21.8 ST_AlphaShape

ST_AlphaShape — Computes an Alpha-shape enclosing a geometry

Synopsis

geometry **ST_AlphaShape**(geometry geom, float alpha, boolean allow_holes = false);

설명

Computes the Alpha-Shape of the points in a geometry. An alpha-shape is a (usually) concave polygonal geometry which contains all the vertices of the input, and whose vertices are a subset of the input vertices. An alpha-shape provides a closer fit to the shape of the input than the shape produced by the convex hull.

The "closeness of fit" is controlled by the `alpha` parameter, which can have values from 0 to infinity. Smaller alpha values produce more concave results. Alpha values greater than some data-dependent value produce the convex hull of the input.

Note
Following the CGAL implementation, the alpha value is the *square* of the radius of the disc used in the Alpha-Shape algorithm to "erode" the Delaunay Triangulation of the input points. See CGAL Alpha-Shapes for more information. This is different from the original definition of alpha-shapes, which defines alpha as the radius of the eroding disc.

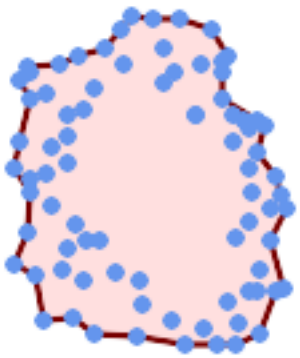
The computed shape does not contain holes unless the optional `allow_holes` argument is specified as true.

This function effectively computes a concave hull of a geometry in a similar way to ST_ConcaveHull, but uses CGAL and a different algorithm.

Availability: 3.3.0 - requires SFCGAL >= 1.4.1.

This method needs SFCGAL backend.

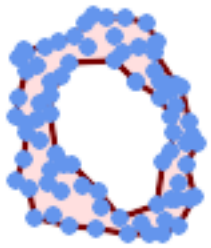
예시



Alpha-shape of a MultiPoint (same example As ST_OptimalAlphaShape)

```
SELECT ST_AsText(ST_AlphaShape('MULTIPOINT((63 84),(76 88),(68 73),(53 18),(91 50),(81 70),
                (88 29),(24 82),(32 51),(37 23),(27 54),(84 19),(75 87),(44 42),(77 67),(90 ↩
                    30),(36 61),(32 65),
                (81 47),(88 58),(68 73),(49 95),(81 60),(87 50),
                (78 16),(79 21),(30 22),(78 43),(26 85),(48 34),(35 35),(36 40),(31 79),(83 ↩
                    29),(27 84),(52 98),(72 95),(85 71),
                (75 84),(75 77),(81 29),(77 73),(41 42),(83 72),(23 36),(89 53),(27 57),(57 ↩
                    97),(27 77),(39 88),(60 81),
                (80 72),(54 32),(55 26),(62 22),(70 20),(76 27),(84 35),(87 42),(82 54),(83 ↩
                    64),(69 86),(60 90),(50 86),(43 80),(36 73),
                (36 68),(40 75),(24 67),(23 60),(26 44),(28 33),(40 32),(43 19),(65 16),(73 ↩
                    16),(38 46),(31 59),(34 86),(45 90),(64 97))'::geometry,80.2));
```

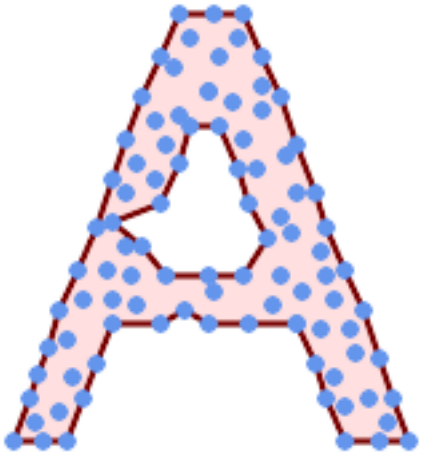
```
POLYGON((89 53,91 50,87 42,90 30,88 29,84 19,78 16,73 16,65 16,53 18,43 19,37 23,30 22,28  ↩
    33,23 36,26 44,27 54,23 60,24 67,
          27 77,24 82,26 85,34 86,39 88,45 90,49 95,52 98,57 97,64 97,72 95,76 88,75 84,83  ↩
              72,85 71,88 58,89 53))
```



Alpha-shape of a MultiPoint, allowing holes (same example as ST_OptimalAlphaShape)

```
SELECT ST_AsText(ST_AlphaShape('MULTIPOINT((63 84),(76 88),(68 73),(53 18),(91 50),(81 70) ↩
    ,(88 29),(24 82),(32 51),(37 23),(27 54),(84 19),(75 87),(44 42),(77 67),(90 30),(36 61) ↩
    ,(32 65),(81 47),(88 58),(68 73),(49 95),(81 60),(87 50),
                (78 16),(79 21),(30 22),(78 43),(26 85),(48 34),(35 35),(36 40),(31 79),(83 ↩
                    29),(27 84),(52 98),(72 95),(85 71),
                (75 84),(75 77),(81 29),(77 73),(41 42),(83 72),(23 36),(89 53),(27 57),(57 ↩
                    97),(27 77),(39 88),(60 81),
                (80 72),(54 32),(55 26),(62 22),(70 20),(76 27),(84 35),(87 42),(82 54),(83 ↩
                    64),(69 86),(60 90),(50 86),(43 80),(36 73),
                (36 68),(40 75),(24 67),(23 60),(26 44),(28 33),(40 32),(43 19),(65 16),(73 ↩
                    16),(38 46),(31 59),(34 86),(45 90),(64 97))'::geometry, 100.1,true))
```

```
POLYGON((89 53,91 50,87 42,90 30,88 29,84 19,78 16,73 16,65 16,53 18,43 19,37 23,30 22,28  ↩
    33,23 36,26 44,27 54,23 60,24 67,27 77,24 82,26 85,34 86,39 88,45 90,49 95,52 98,57  ↩
    97,64 97,72 95,76 88,75 84,83 72,85 71,88 58,89 53),
              (36 61,36 68,40 75,43 80,50 86,60 81,68 73,77 67,81 60,82 54,81 47,78 43,76  ↩
                 27,62 22,54 32,48 34,44 42,38 46,36 61))
```



Alpha-shape of a MultiPoint, allowing holes (same example as ST_ConcaveHull)

```
SELECT ST_AlphaShape(
            'MULTIPOINT ((132 64), (114 64), (99 64), (81 64), (63 64), (57 49), (52 36),  ↩
                (46 20), (37 20), (26 20), (32 36), (39 55), (43 69), (50 84), (57 100), (63 ↩
                 118), (68 133), (74 149), (81 164), (88 180), (101 180), (112 180), (119  ↩
                164), (126 149), (132 131), (139 113), (143 100), (150 84), (157 69), (163  ↩
                51), (168 36), (174 20), (163 20), (150 20), (143 36), (139 49), (132 64),  ↩
                (99 151), (92 138), (88 124), (81 109), (74 93), (70 82), (83 82), (99 82),  ↩
                (112 82), (126 82), (121 96), (114 109), (110 122), (103 138), (99 151), (34 ↩
                 27), (43 31), (48 44), (46 58), (52 73), (63 73), (61 84), (72 71), (90 69) ↩
                , (101 76), (123 71), (141 62), (166 27), (150 33), (159 36), (146 44), (154 ↩
                 53), (152 62), (146 73), (134 76), (143 82), (141 91), (130 98), (126 104), ↩
                 (132 113), (128 127), (117 122), (112 133), (119 144), (108 147), (119 153) ↩
                , (110 171), (103 164), (92 171), (86 160), (88 142), (79 140), (72 124),  ↩
                (83 131), (79 118), (68 113), (63 102), (68 93), (35 45))'::geometry,102.2,  ↩
                true);
```

```
POLYGON((134 80,136 75,130 63,135 45,132 44,126 28,117 24,110 24,98 24,80 27,82 39,72 51,60 ↩
     48,56 34,52 52,42 50,
                34 54,39 66,40 81,34 90,36 100,40 116,36 123,39 128,51 129,58 132,68 135,74 ↩
                     142,78 147,86 146,96 146,
                108 142,114 132,112 126,112 116,116 110,120 108,125 108,128 106,125 96,132  ↩
                    87,134 80))
```

참고

ST_ConcaveHull, ST_OptimalAlphaShape

7.21.9 ST_ApproximateMedialAxis

ST_ApproximateMedialAxis — 면 도형의 근사 중심축을 계산합니다.

Synopsis

geometry **ST_ApproximateMedialAxis**(geometry geom);

설명

입력 면 도형의 직선 골격을 바탕&#
근사 중심축(approximate medial axis)을 반환합니&#xb2e4
사용 가능한 버전(1.2.0 이상)에 대해
빌드했을 때 SFCGAL에 특화된 API를 이&#xc6a9
그렇지 않을 경우 이 함수는 (더 느&
ST_StraightSkeleton 함수를 둘러싼 래퍼(wrapper)에 불&#

2.2.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

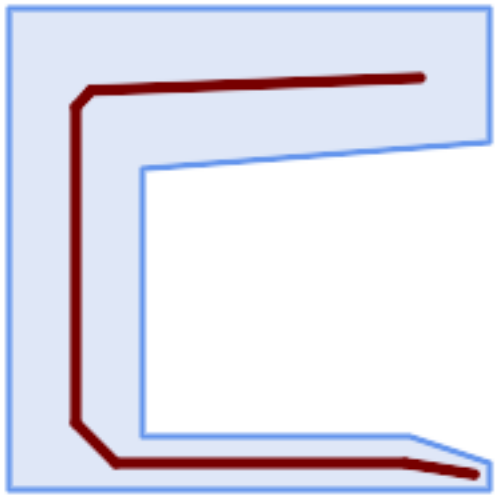
This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_ApproximateMedialAxis(ST_GeomFromText('POLYGON (( 190 190, 10 190, 10 10, 190 10, ↩
    190 20, 160 30, 60 30, 60 130, 190 140, 190 190 ))'));
```



폴리곤과 그 근사 중심축

참고

ST_StraightSkeleton

7.21.10 ST_ConstrainedDelaunayTriangles

ST_ConstrainedDelaunayTriangles — Return a constrained Delaunay triangulation around the given input geometry.

Synopsis

geometry **ST_Tesselate**(geometry geom);

설명

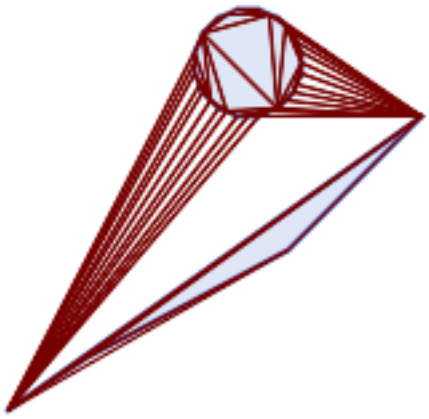
Return a Constrained Delaunay triangulation around the vertices of the input geometry. Output is a TIN.

This method needs SFCGAL backend.

2.1.0 버전부터 사용할 수 있습니다.

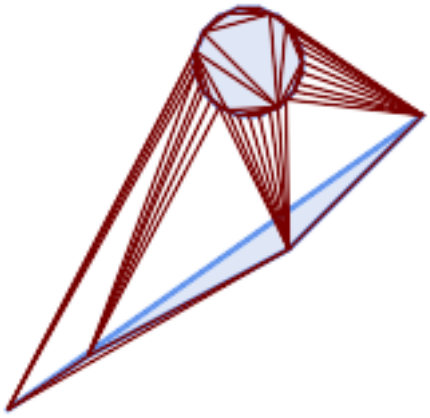
This function supports 3d and will not drop the z-index.

예시



ST_ConstrainedDelaunayTriangles of 2 polygons

```
select ST_ConstrainedDelaunayTriangles(
                ST_Union(
                        'POLYGON((175 150, ↩
     20 40, 50 60, 125 100, 175 150))'::geometry,
                        ST_Buffer('POINT ↩
    (110 170)'::geometry, 20)
                    )
            );
```



ST_DelaunayTriangles of 2 polygons. Triangle edges cross polygon boundaries.

```
select ST_DelaunayTriangles(
                ST_Union(
                        'POLYGON((175 150, ↩
     20 40, 50 60, 125 100, 175 150))'::geometry,
                        ST_Buffer('POINT ↩
    (110 170)'::geometry, 20)
                    )
            );
```

참고

ST_DelaunayTriangles, ST_TriangulatePolygon, ST_Tesselate, ST_ConcaveHull, ST_Dump

7.21.11 ST_Extrude

ST_Extrude — 표면을 관련 입체로 돌출시&#xd0b

Synopsis

geometry **ST_Extrude**(geometry geom, float x, float y, float z);

설명

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

PostGIS ST_AsX3D 를 통해 3차원 영상을 생성한 다음 X3Dom HTML 자바스크립트 렌더링 라이브러리 를 이용해서 HTML로 렌&#xb3

```
SELECT ST_Buffer(ST_GeomFromText('POINT ↩
    (100 90)'),
  50, 'quad_segs=2'),0,0,30);
```

버퍼를 적용한 포인트에서 생성된 원본 팔각형

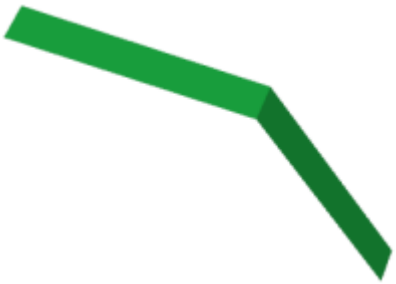
```
ST_Extrude(ST_Buffer(ST_GeomFromText(' ↩
    POINT(100 90)'),
 50, 'quad_segs=2'),0,0,30);
```

Z축을 따라 30단위만큼 돌출된 육각형이 다면체 표면 Z(PolyhedralSurfaceZ)을 생성합니다.

```
SELECT ST_GeomFromText('LINESTRING(50 50, ↩
    100 90, 95 150)')
```

원본 라인스트링

```
SELECT ST_Extrude(
 ST_GeomFromText('LINESTRING(50 50, 100  ↩
    90, 95 150)'),0,0,10));
```



Z축을 따라 돌출된 라인스트링이 다면체 표면 Z(PolyhedralSurfaceZ)을 생성합니다.

참고

ST_AsX3D

7.21.12 ST_ForceLHR

ST_ForceLHR — LHR(Left Hand Reverse; 시계 방향) 방향을 강제

Synopsis

geometry **ST_ForceLHR**(geometry geom);

설명

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

7.21.13 ST_IsPlanar

ST_IsPlanar — 표면이 평면인지 아닌지 확&#xc77

Synopsis

boolean **ST_IsPlanar**(geometry geom);

설명

2.2.0 버전부터 사용할 수 있습니다. 원래 2.1.0 버전에 문서화됐지만 2.1 배&#x 실수로 빠졌습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

7.21.14 ST_IsSolid

ST_IsSolid — 도형이 입체인지 테스트합&#xb2c8 어떤 유효성 검사도 수행하지 않&#

Synopsis

boolean **ST_IsSolid**(geometry geom1);

설명

2.2.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

7.21.15 ST_MakeSolid

ST_MakeSolid — 도형을 입체로 지정합니다. 어떤 확인 작업도 수행하지 않습&# 유효한 입체를 얻으려면, 입력 도&# 닫힌 다면체 표면 또는 닫힌 TIN이&#xc5b 합니다.

Synopsis

geometry **ST_MakeSolid**(geometry geom1);

설명

2.2.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

7.21.16 ST_MinkowskiSum

ST_MinkowskiSum — 민코프스키 합계를 수행합&

Synopsis

geometry **ST_MinkowskiSum**(geometry geom1, geometry geom2);

설명

이 함수는 폴리곤과, 포인트, 라인 또는 폴리곤의 2차원 민코프스키 합계를 수행합니다.

두 도형 A와 B의 민코프스키 합계란 A와 B에 있는 모든 포인트를 합한, 모든 포인트들의 집합입니다. 민&# 합계는 운동 계획(motion planning) 및 CAD(computer-aided design) 분야에서 자주 사용됩니다. 자&#xc13 내용은 Wikipedia Minkowski addition 을 참조하십시오.

첫 번째 파라미터는 어떤 2차원 도&# 라인스트링, 폴리곤)도 될 수 있습&# 만약 3차원 도형을 입력할 경우, Z 좌표를 0으로 강제해서 2차원으로 변환하기 때문에 유효하지 않은 도형으로 변할 가능성이 있습니&# 두 번째 파라미터는 2차원 폴리곤&# 합니다.

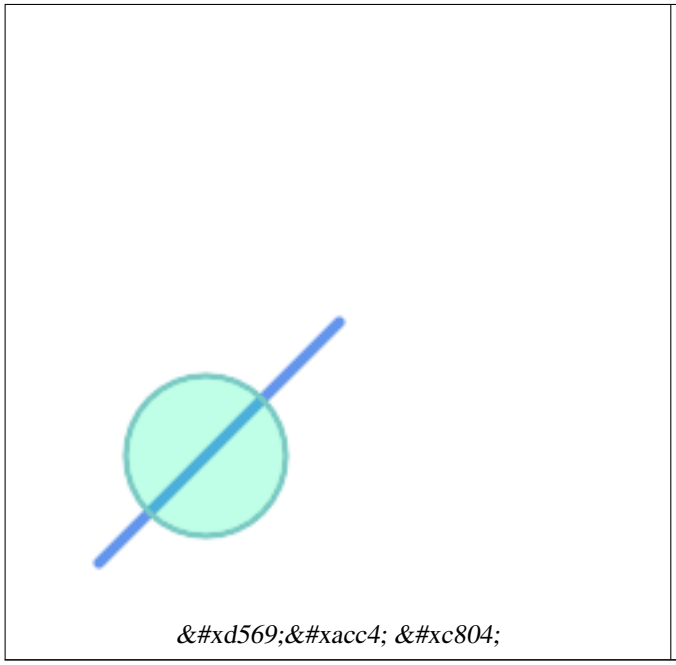
구현하는 데 CGAL 2D Minkowskisum 을 활용합니&#xb2

2.1.0 버전부터 사용할 수 있습니다.

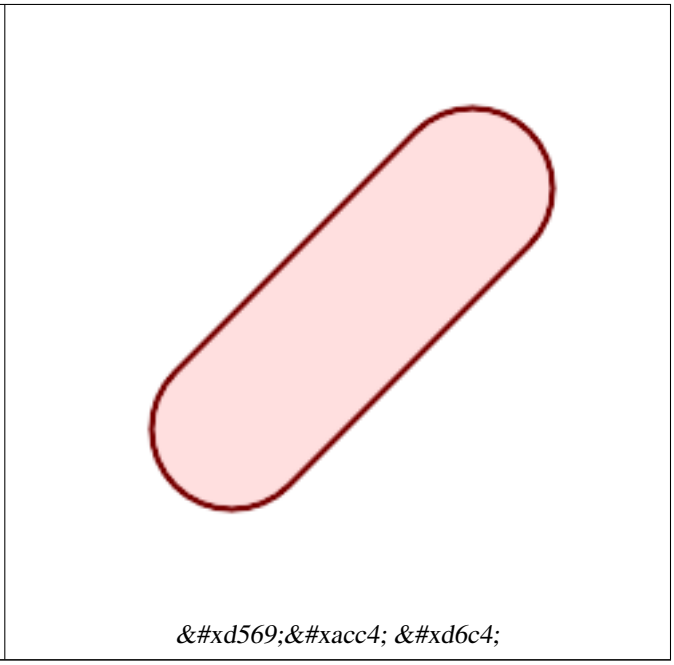
This method needs SFCGAL backend.

예시

라인스트링이 원을 뚫고 지나가&# 경우 라인스트링과 원형 폴리곤&#x 민코프스키 합계



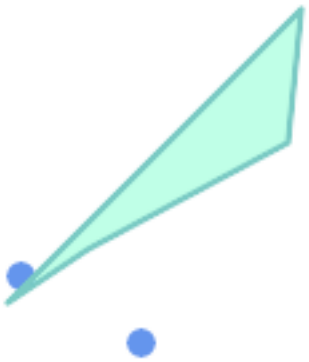
합계 전



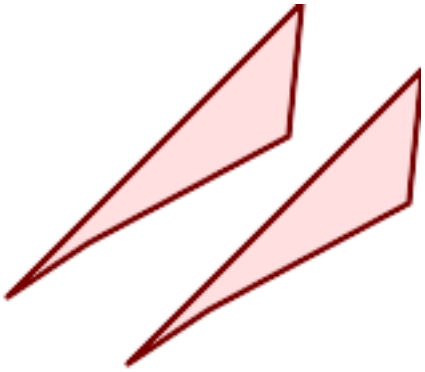
합계 후

```
SELECT ST_MinkowskiSum(line, circle))
FROM (SELECT
    ST_MakeLine(ST_MakePoint(10, 10),ST_MakePoint(100, 100)) As line,
    ST_Buffer(ST_GeomFromText('POINT(50 50)'), 30) As circle) As foo;

-- WKT --
MULTIPOLYGON(((30 59.9999999999999,30.5764415879031 54.1472903395161,32.2836140246614  ↩
    48.5194970290472,35.0559116309237 43.3328930094119,38.7867965644036  ↩
    38.7867965644035,43.332893009412 35.0559116309236,48.5194970290474  ↩
    32.2836140246614,54.1472903395162 30.5764415879031,60.0000000000001 30,65.8527096604839  ↩
    30.5764415879031,71.4805029709527 32.2836140246614,76.6671069905881  ↩
    35.0559116309237,81.2132034355964 38.7867965644036,171.213203435596  ↩
    128.786796564404,174.944088369076 133.332893009412,177.716385975339  ↩
    138.519497029047,179.423558412097 144.147290339516,180 150,179.423558412097  ↩
    155.852709660484,177.716385975339 161.480502970953,174.944088369076  ↩
    166.667106990588,171.213203435596 171.213203435596,166.667106990588 174.944088369076,
161.480502970953 177.716385975339,155.852709660484 179.423558412097,150  ↩
    180,144.147290339516 179.423558412097,138.519497029047 177.716385975339,133.332893009412 ↩
     174.944088369076,128.786796564403 171.213203435596,38.7867965644035  ↩
    81.2132034355963,35.0559116309236 76.667106990588,32.2836140246614  ↩
    71.4805029709526,30.5764415879031 65.8527096604838,30 59.9999999999999)))
```

폴리곤과 멀티 포인트의 민코프&#xc
합계



합계 전



합계 후: 폴리곤을 복제해서 포인트의 위치로 번역합니다.

```
SELECT ST_MinkowskiSum(mp, poly)
FROM (SELECT 'MULTIPOINT(25 50,70 25)'::geometry As mp,
   'POLYGON((130 150, 20 40, 50 60, 125 100, 130 150))'::geometry As poly
    ) As foo


-- WKT --
MULTIPOLYGON(
    ((70 115,100 135,175 175,225 225,70 115)),
    ((120 65,150 85,225 125,275 175,120 65))
    )
```

7.21.17 ST_OptimalAlphaShape

ST_OptimalAlphaShape — Computes an Alpha-shape enclosing a geometry using an "optimal" alpha value.

Synopsis

geometry **ST_OptimalAlphaShape**(geometry geom, boolean allow_holes = false, integer nb_components = 1);

설명

Computes the "optimal" alpha-shape of the points in a geometry. The alpha-shape is computed using a value of α chosen so that:

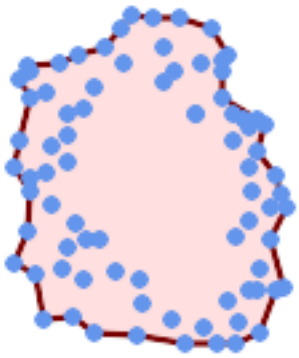
1. the number of polygon elements is equal to or smaller than `nb_components` (which defaults to 1)
2. all input points are contained in the shape

The result will not contain holes unless the optional `allow_holes` argument is specified as true.

Availability: 3.3.0 - requires SFCGAL >= 1.4.1.

This method needs SFCGAL backend.

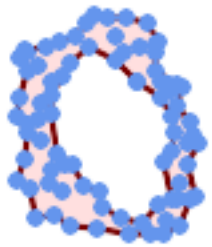
예시



Optimal alpha-shape of a MultiPoint (same example as ST_AlphaShape)

```
SELECT ST_AsText(ST_OptimalAlphaShape('MULTIPOINT((63 84),(76 88),(68 73),(53 18),(91 50) ↩
    ,(81 70),
                (88 29),(24 82),(32 51),(37 23),(27 54),(84 19),(75 87),(44 42),(77 67),(90 ↩
                    30),(36 61),(32 65),
                (81 47),(88 58),(68 73),(49 95),(81 60),(87 50),
                (78 16),(79 21),(30 22),(78 43),(26 85),(48 34),(35 35),(36 40),(31 79),(83 ↩
                    29),(27 84),(52 98),(72 95),(85 71),
                (75 84),(75 77),(81 29),(77 73),(41 42),(83 72),(23 36),(89 53),(27 57),(57 ↩
                    97),(27 77),(39 88),(60 81),
                (80 72),(54 32),(55 26),(62 22),(70 20),(76 27),(84 35),(87 42),(82 54),(83 ↩
                    64),(69 86),(60 90),(50 86),(43 80),(36 73),
                (36 68),(40 75),(24 67),(23 60),(26 44),(28 33),(40 32),(43 19),(65 16),(73 ↩
                    16),(38 46),(31 59),(34 86),(45 90),(64 97))'::geometry));
```

```
POLYGON((89 53,91 50,87 42,90 30,88 29,84 19,78 16,73 16,65 16,53 18,43 19,37 23,30 22,28  ↩
    33,23 36,
                26 44,27 54,23 60,24 67,27 77,24 82,26 85,34 86,39 88,45 90,49 95,52 98,57  ↩
                    97,64 97,72 95,76 88,75 84,75 77,83 72,85 71,83 64,88 58,89 53))
```



Optimal alpha-shape of a MultiPoint, allowing holes (same example as ST_AlphaShape)

```
SELECT ST_AsText(ST_OptimalAlphaShape('MULTIPOINT((63 84),(76 88),(68 73),(53 18),(91 50) ↩
    ,(81 70),(88 29),(24 82),(32 51),(37 23),(27 54),(84 19),(75 87),(44 42),(77 67),(90 30) ↩
    ,(36 61),(32 65),(81 47),(88 58),(68 73),(49 95),(81 60),(87 50),
                (78 16),(79 21),(30 22),(78 43),(26 85),(48 34),(35 35),(36 40),(31 79),(83 ↩
                    29),(27 84),(52 98),(72 95),(85 71),
                (75 84),(75 77),(81 29),(77 73),(41 42),(83 72),(23 36),(89 53),(27 57),(57 ↩
                    97),(27 77),(39 88),(60 81),
                (80 72),(54 32),(55 26),(62 22),(70 20),(76 27),(84 35),(87 42),(82 54),(83 ↩
                    64),(69 86),(60 90),(50 86),(43 80),(36 73),
                (36 68),(40 75),(24 67),(23 60),(26 44),(28 33),(40 32),(43 19),(65 16),(73 ↩
                    16),(38 46),(31 59),(34 86),(45 90),(64 97))'::geometry, allow_holes => ↩
                    true));
```

```
POLYGON((89 53,91 50,87 42,90 30,88 29,84 19,78 16,73 16,65 16,53 18,43 19,37 23,30 22,28  ↩
    33,23 36,26 44,27 54,23 60,24 67,27 77,24 82,26 85,34 86,39 88,45 90,49 95,52 98,57  ↩
    97,64 97,72 95,76 88,75 84,75 77,83 72,85 71,83 64,88 58,89 53),(36 61,36 68,40 75,43  ↩
    80,50 86,60 81,68 73,77 67,81 60,82 54,81 47,78 43,81 29,76 27,70 20,62 22,55 26,54  ↩
    32,48 34,44 42,38 46,36 61))
```

참고

ST_ConcaveHull, ST_AlphaShape

7.21.18 ST_Orientation

ST_Orientation — 표면의 방향(orientation)을 결정합니&#

Synopsis

integer **ST_Orientation**(geometry geom);

설명

이 함수는 폴리곤에만 적용됩니&#x
폴리곤이 반시계 방향이면 -1을, 시&
방향이면 1을 반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

7.21.19 ST_StraightSkeleton

ST_StraightSkeleton — 도형으로부터 직선 골격(straight skeleton)을 계산합니다.

Synopsis

geometry **ST_StraightSkeleton**(geometry geom);

설명

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

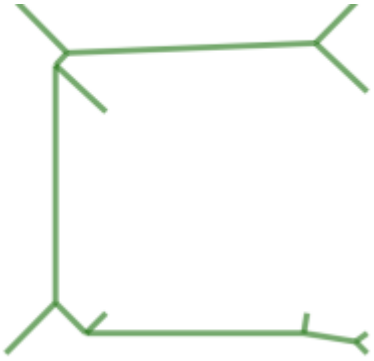
This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_StraightSkeleton(ST_GeomFromText('POLYGON (( 190 190, 10 190, 10 10, 190 10, 190  ↩
    20, 160 30, 60 30, 60 130, 190 140, 190 190 ))'));
```

원본 폴리곤



폴리곤의 직선 골격

7.21.20 ST_Tesselate

ST_Tesselate — 폴리곤 또는 다면체 표면의 표면 다듬기(tesselation) 작업을 수행한 다&
TIN 또는 TIN 집합으로 반환합니다.

Synopsis

geometry **ST_Tesselate**(geometry geom);

설명

[멀티]폴리곤 또는 다면체 표면 같&
표면 도형을 입력받아 삼각형을
이용한 다듬기(모자이크) 과정을
거친 TIN 표현식을 반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

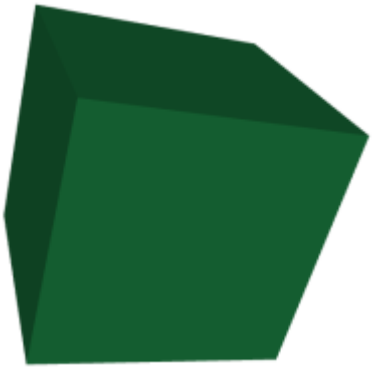
This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

예시

```
SELECT ST_GeomFromText('POLYHEDRALSURFACE ↩
    Z( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
               ((0 0 0, 0 1 0, 1 1 0, 1  ↩
0 0, 0 0 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
               ((1 1 0, 1 1 1, 1 0 1, 1  ↩
0 0, 1 1 0)),
               ((0 1 0, 0 1 1, 1 1 1, 1  ↩
1 0, 0 1 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )');
```



원본
정육면체

```
SELECT ST_Tesselate(ST_GeomFromText(' ↩
    POLYHEDRALSURFACE Z( ((0 0 0, 0 0 1, 0 1 1, 0 1
        ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 ↩
 0)), ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
        ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 ↩
 0)),
        ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 ↩
 0)), ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )'))
```

ST_AsText 출력물:

```
TIN Z (((0 0 0,0 0 1,0 1 1,0 0 0)),((0 1  ↩
 0,0 0 0,0 1 1,0 1 0)),
        ((0 0 0,0 1 0,1 1 0,0 0 0)),
        ((1 0 0,0 0 0,1 1 0,1 0 0)),((0 0 ↩
 1,1 0 0,1 0 1,0 0 1)),
        ((0 0 1,0 0 0,1 0 0,0 0 1)),
        ((1 1 0,1 1 1,1 0 1,1 1 0)),((1 0 ↩
 0,1 1 0,1 0 1,1 0 0)),
        ((0 1 0,0 1 1,1 1 1,0 1 0)),((1 1 ↩
 0,0 1 0,1 1 1,1 1 0)),
        ((0 1 1,1 0 1,1 1 1,0 1 1)),((0 1 ↩
 1,0 0 1,1 0 1,0 1 1)))
```

삼각형을
색으로
구분한
다듬어진
정육면체

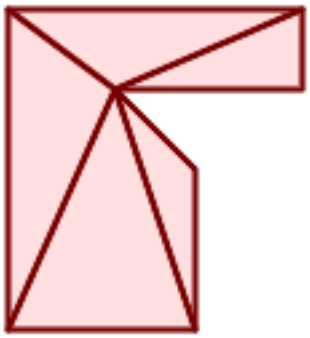
```
SELECT 'POLYGON (( 10 190, 10 70, 80 70,  ↩
    80 130, 50 160, 120 160, 120 190, 10 190 ))'::geometry;
```

원본 폴리곤

```
SELECT
        ST_Tesselate('POLYGON (( 10 190,  ↩
    10 70, 80 70, 80 130, 50 160, 120 160, 120 190,
```

ST_AsText 출력물:

```
TIN((80 130,50 160,80 70,80 130)),((50  ↩
    160,10 190,10 70,50 160)),
        ((80 70,50 160,10 70,80 70)) ↩
    ,((120 160,120 190,50 160,120 160)),
  ((120 190,10 190,50 160,120 190)))
```



다듬어진
폴리곤

참고

ST_ConstrainedDelaunayTriangles, ST_DelaunayTriangles

7.21.21 ST_Volume

ST_Volume — 3차원 입체의 부피를 계산합&#xb2
표면 도형을 입력하면 (닫힌 도형&
0을 반환할 것입니다.

Synopsis

float **ST_Volume**(geometry geom1);

설명

2.2.0 버전부터 사용할 수 있습니다.

This method needs SFCGAL backend.

This function supports 3d and will not drop the z-index.

This function supports Polyhedral surfaces.

This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 9.1 (same as ST_3DVolume)

예시

WKT로 닫힌 표면을 생성했을 때, 입&#xcc
면으로 취급됩니다. 이 닫힌 표면&#
입체로 만들려면, ST_MakeSolid 함수를 이&#xc6a
합니다. 면 도형은 부피가 없습니&#
다음은 그 사실을 보여주는 예시&#xc

```
SELECT ST_Volume(geom) As cube_surface_vol,
        ST_Volume(ST_MakeSolid(geom)) As solid_surface_vol
  FROM (SELECT 'POLYHEDRALSURFACE( ((0 0 0, 0 0 1, 0 1 1, 0 1 0, 0 0 0)),
    ((0 0 0, 0 1 0, 1 1 0, 1 0 0, 0 0 0)),
    ((0 0 0, 1 0 0, 1 0 1, 0 0 1, 0 0 0)),
    ((1 1 0, 1 1 1, 1 0 1, 1 0 0, 1 1 0)),
    ((0 1 0, 0 1 1, 1 1 1, 1 1 0, 0 1 0)),
    ((0 0 1, 1 0 1, 1 1 1, 0 1 1, 0 0 1)) )'::geometry) As f(geom);

 cube_surface_vol | solid_surface_vol
------------------+-------------------
                0 |                 1
```

참고

ST_3DArea, ST_MakeSolid, ST_IsSolid

7.22 장기 실행 트랜잭션(Long Transaction) 지원

Note

사용자는 직렬 가능 트랜잭션 레벨(serializable transaction level) 을 이용해야 합니다. 그렇지 않으면 잠금 기제(locking mechanism)가 중단될 것입니다.

7.22.1 AddAuth

AddAuth — 현재 트랜잭션에 이용될 승인 토큰을 추가합니다.

Synopsis

boolean **AddAuth**(text auth_token);

설명

현재 트랜잭션에 이용될 승인 토&#
추가합니다.

Adds the current transaction identifier and authorization token to a temporary table called `temp_lock_have_table`.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT LockRow('towns', '353', 'priscilla');
                BEGIN TRANSACTION;
                        SELECT AddAuth('joey');
                        UPDATE towns SET the_geom = ST_Translate(the_geom,2,2) WHERE gid =  ↩
                            353;
                COMMIT;


-- &#xc624;&#xb958; --
                ERROR:  UPDATE where "gid" = '353' requires authorization 'priscilla'
```

참고

LockRow

7.22.2 CheckAuth

CheckAuth — 승인 토큰을 바탕으로, 테이&#xbe1
대해 행들의 업데이트 및 삭제를
금지/허락하는 트리거를 생성합&#

Synopsis

integer **CheckAuth**(text a_schema_name, text a_table_name, text a_key_column_name);
integer **CheckAuth**(text a_table_name, text a_key_column_name);

설명

승인 토큰을 바탕으로, 테이블에
대해 행들의 업데이트 및 삭제를
금지/허락하는 트리거를 생성합&#
<rowid_col> 열을 이용해서 행을 식별합니&

a_schema_name을 설정하지 않으면, 현재 스&#xd0
테이블을 검색합니다.

> **Note**
> 해당 테이블에 이미 승인
> 트리거가 존재할 경우, 함수가
> 오류를 일으킵니다.
> 트랜잭션 지원이 활성화돼
> 있지 않을 경우, 함수가 예외를
> 발생시킵니다.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT CheckAuth('public', 'towns', 'gid');
                        result
                        ------
                        0
```

참고

EnableLongTransactions

7.22.3 DisableLongTransactions

DisableLongTransactions — DisableLongTransactions

Synopsis

text **DisableLongTransactions**();

설명

장기 실행 트랜잭션 지원을 비활&#
이 함수는 장기 실행 트랜잭션 지&#
메타데이터 테이블을 제거하고,
잠금을 확인한(lock-checked) 테이블에 부&#xc5ec
모든 트리거를 삭제합니다.

`authorization_table` 이라는 메타 테이블, `authorized_table`
라는 뷰, 그리고 `checkauthtrigger` 라는 모든
트리거들을 삭제합니다.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT DisableLongTransactions();
-- &#xacb0;&#xacfc; --
Long transactions support disabled
```

참고

EnableLongTransactions

7.22.4 EnableLongTransactions

EnableLongTransactions — EnableLongTransactions

Synopsis

text **EnableLongTransactions**();

설명

장기 실행 트랜잭션 지원을 활성&#x
이 함수는 필수적인 메타데이터
테이블들을 생성하는데, 이 단원&#x
있는 다른 함수들을 이용하기 전&#x
한번 호출해줘야 합니다. 두 번 호&
상관없습니다.

`authorization_table` 이라는 메타 테이블 및 `authorized`
라는 뷰를 생성합니다.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT EnableLongTransactions();
-- &#xacb0;&#xacfc; --
Long transactions support enabled
```

참고

DisableLongTransactions

7.22.5 LockRow

LockRow — 테이블 내부의 특정 행에 대&#xd55c
잠금/승인을 설정합니다.

Synopsis

integer **LockRow**(text a_schema_name, text a_table_name, text a_row_key, text an_auth_token, timestamp expire_dt);
integer **LockRow**(text a_table_name, text a_row_key, text an_auth_token, timestamp expire_dt);
integer **LockRow**(text a_table_name, text a_row_key, text an_auth_token);

설명

테이블 내부의 특정 행에 대한 잠&
설정합니다. <authid>는 텍스트 값, <expires>는
기본값이 now()+1시간인 타임스탬프&#xc7
잠금이 할당된 경우 1을 반환하고,
그렇지 않을 (이미 다른 승인을 받&#
잠겨 있는) 경우 0을 반환합니다.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT LockRow('public', 'towns', '2', 'joey');
LockRow
-------
1
```

```
-- &#xc870;&#xc774;&#xac00; &#xc774;&#xbbf8; &#xb808;&#xcf54;&#xb4dc;&#xb97c;  ↩
    &#xc7a0;&#xad9c;&#xae30; &#xb54c;&#xbb38;&#xc5d0;  ↩
    &#xd50c;&#xb9ac;&#xc2e4;&#xb77c;&#xac00; &#xc7a0;&#xae00; &#xc218;  ↩
    &#xc5c6;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT LockRow('public', 'towns', '2', 'priscilla');
LockRow
-------
0
```

참고

UnlockRows

7.22.6 UnlockRows

UnlockRows — Removes all locks held by an authorization token.

Synopsis

integer **UnlockRows**(text auth_token);

설명

특정 승인 ID가 실행한 모든 잠금을 제거합니다. 해제된 잠금 개수를 반환합니다.

1.1.3 버전부터 사용할 수 있습니다.

예시

```
SELECT LockRow('towns', '353', 'priscilla');
                SELECT LockRow('towns', '2', 'priscilla');
                SELECT UnLockRows('priscilla');
                UnLockRows
                ------------
                2
```

참고

LockRow

7.23 Version Functions

7.23.1 PostGIS_Extensions_Upgrade

PostGIS_Extensions_Upgrade — Packages and upgrades PostGIS extensions (e.g. postgis_raster, postgis_topology, postgis_sfcgal) to given or latest version.

Synopsis

text **PostGIS_Extensions_Upgrade**(text target_version=null);

Description

Packages and upgrades PostGIS extensions to given or latest version. Only extensions you have installed in the database will be packaged and upgraded if needed. Reports full PostGIS version and build configuration infos after. This is short-hand for doing multiple CREATE EXTENSION .. FROM unpackaged and ALTER EXTENSION .. UPDATE for each PostGIS extension. Currently only tries to upgrade extensions postgis, postgis_raster, postgis_sfcgal, postgis_topology, and postgis_tiger_geocoder.

Availability: 2.5.0

Note
Changed: 3.4.0 to add target_version argument.
Changed: 3.3.0 support for upgrades from any PostGIS version. Does not work on all systems.
Changed: 3.0.0 to repackage loose extensions and support postgis_raster.

Examples

```
SELECT PostGIS_Extensions_Upgrade();
```

```
NOTICE:  Packaging extension postgis
NOTICE:  Packaging extension postgis_raster
NOTICE:  Packaging extension postgis_sfcgal
NOTICE:  Extension postgis_topology is not available or not packagable for some reason
NOTICE:  Extension postgis_tiger_geocoder is not available or not packagable for some  ↩
    reason

                    postgis_extensions_upgrade
----------------------------------------------------------------------
 Upgrade completed, run SELECT postgis_full_version(); for details
(1 row)
```

See Also

Section 3.4, PostGIS_GEOS_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version, PostGIS_Version

7.23.2 PostGIS_Full_Version

PostGIS_Full_Version — Reports full PostGIS version and build configuration infos.

Synopsis

text **PostGIS_Full_Version**();

Description

Reports full PostGIS version and build configuration infos. Also informs about synchronization between libraries and scripts suggesting upgrades as needed.

Enhanced: 3.4.0 now includes extra PROJ configurations NETWORK_ENABLED, URL_ENDPOINT and DATABASE_PATH of proj.db location

Examples

```
SELECT PostGIS_Full_Version();
                                                                    postgis_full_version
-------------------------------------------------------------------------------------------
POSTGIS="3.4.0dev 3.3.0rc2-993-g61bdf43a7" [EXTENSION] PGSQL="160" GEOS="3.12.0dev-CAPI ↩
    -1.18.0" SFCGAL="1.3.8" PROJ="7.2.1 NETWORK_ENABLED=OFF URL_ENDPOINT=https://cdn.proj. ↩
    org USER_WRITABLE_DIRECTORY=/tmp/proj DATABASE_PATH=/usr/share/proj/proj.db" GDAL="GDAL  ↩
    3.2.2, released 2021/03/05" LIBXML="2.9.10" LIBJSON="0.15" LIBPROTOBUF="1.3.3" WAGYU ↩
    ="0.5.0 (Internal)" TOPOLOGY RASTER
(1 row)
```

See Also

Section 3.4, PostGIS_GEOS_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version, PostGIS_Wagyu_Ve
PostGIS_Version

7.23.3 PostGIS_GEOS_Version

PostGIS_GEOS_Version — Returns the version number of the GEOS library.

Synopsis

text **PostGIS_GEOS_Version**();

Description

Returns the version number of the GEOS library, or `NULL` if GEOS support is not enabled.

Examples

```
SELECT PostGIS_GEOS_Version();
 postgis_geos_version
----------------------
3.12.0dev-CAPI-1.18.0
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version, PostGIS_Version

7.23.4 PostGIS_GEOS_Compiled_Version

PostGIS_GEOS_Compiled_Version — Returns the version number of the GEOS library against which PostGIS was built.

Synopsis

text **PostGIS_GEOS_Compiled_Version**();

Description

Returns the version number of the GEOS library, or against which PostGIS was built.

Availability: 3.4.0

Examples

```
SELECT PostGIS_GEOS_Compiled_Version();
 postgis_geos_compiled_version
-------------------------------
 3.12.0
(1 row)
```

See Also

PostGIS_GEOS_Version, PostGIS_Full_Version

7.23.5 PostGIS_Liblwgeom_Version

PostGIS_Liblwgeom_Version — Returns the version number of the liblwgeom library. This should match the version of PostGIS.

Synopsis

text **PostGIS_Liblwgeom_Version**();

Description

Returns the version number of the liblwgeom library/

Examples

```
SELECT PostGIS_Liblwgeom_Version();
postgis_liblwgeom_version
--------------------------
3.4.0dev 3.3.0rc2-993-g61bdf43a7
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version, PostGIS_Version

7.23.6 PostGIS_LibXML_Version

PostGIS_LibXML_Version — Returns the version number of the libxml2 library.

Synopsis

text **PostGIS_LibXML_Version**();

Description

Returns the version number of the LibXML2 library.

Availability: 1.5

Examples

```
SELECT PostGIS_LibXML_Version();
 postgis_libxml_version
----------------------
 2.9.10
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_Lib_Version, PostGIS_PROJ_Version, PostGIS_GEOS_Version, PostGIS_Version

7.23.7 PostGIS_Lib_Build_Date

PostGIS_Lib_Build_Date — Returns build date of the PostGIS library.

Synopsis

text **PostGIS_Lib_Build_Date**();

Description

Returns build date of the PostGIS library.

Examples

```
SELECT PostGIS_Lib_Build_Date();
 postgis_lib_build_date
-----------------------
 2023-06-22 03:56:11
(1 row)
```

7.23.8 PostGIS_Lib_Version

PostGIS_Lib_Version — Returns the version number of the PostGIS library.

Synopsis

text **PostGIS_Lib_Version**();

Description

Returns the version number of the PostGIS library.

Examples

```
SELECT PostGIS_Lib_Version();
 postgis_lib_version
---------------------
 3.4.0dev
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_GEOS_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version, PostGIS_Version

7.23.9 PostGIS_PROJ_Version

PostGIS_PROJ_Version — Returns the version number of the PROJ4 library.

Synopsis

text **PostGIS_PROJ_Version**();

Description

Returns the version number of the PROJ library and some configuration options of proj.

Enhanced: 3.4.0 now includes NETWORK_ENABLED, URL_ENDPOINT and DATABASE_PATH of proj.db location

Examples

```
SELECT PostGIS_PROJ_Version();
  postgis_proj_version
-------------------------
7.2.1 NETWORK_ENABLED=OFF URL_ENDPOINT=https://cdn.proj.org USER_WRITABLE_DIRECTORY=/tmp/ ↩
    proj DATABASE_PATH=/usr/share/proj/proj.db
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_GEOS_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_Version

7.23.10 PostGIS_Wagyu_Version

PostGIS_Wagyu_Version — Returns the version number of the internal Wagyu library.

Synopsis

text **PostGIS_Wagyu_Version**();

Description

Returns the version number of the internal Wagyu library, or `NULL` if Wagyu support is not enabled.

Examples

```
SELECT PostGIS_Wagyu_Version();
 postgis_wagyu_version
-----------------------
 0.5.0 (Internal)
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_GEOS_Version, PostGIS_PROJ_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_Version

7.23.11 PostGIS_Scripts_Build_Date

PostGIS_Scripts_Build_Date — Returns build date of the PostGIS scripts.

Synopsis

text **PostGIS_Scripts_Build_Date**();

Description

Returns build date of the PostGIS scripts.

Availability: 1.0.0RC1

Examples

```
SELECT PostGIS_Scripts_Build_Date();
  postgis_scripts_build_date
-------------------------
 2023-06-22 03:56:11
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_GEOS_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_Version

7.23.12 PostGIS_Scripts_Installed

PostGIS_Scripts_Installed — Returns version of the PostGIS scripts installed in this database.

Synopsis

text **PostGIS_Scripts_Installed**();

Description

Returns version of the PostGIS scripts installed in this database.

Note
If the output of this function doesn't match the output of PostGIS_Scripts_Released you probably missed to properly upgrade an existing database. See the Upgrading section for more info.

Availability: 0.9.0

Examples

```
SELECT PostGIS_Scripts_Installed();
  postgis_scripts_installed
-------------------------
 3.4.0dev 3.3.0rc2-993-g61bdf43a7
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_Scripts_Released, PostGIS_Version

7.23.13 PostGIS_Scripts_Released

PostGIS_Scripts_Released — Returns the version number of the postgis.sql script released with the installed PostGIS lib.

Synopsis

text **PostGIS_Scripts_Released**();

Description

Returns the version number of the postgis.sql script released with the installed PostGIS lib.

Note
Starting with version 1.1.0 this function returns the same value of PostGIS_Lib_Version. Kept for backward compatibility.

Availability: 0.9.0

Examples

```
SELECT PostGIS_Scripts_Released();
  postgis_scripts_released
-------------------------
 3.4.0dev 3.3.0rc2-993-g61bdf43a7
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_Scripts_Installed, PostGIS_Lib_Version

7.23.14 PostGIS_Version

PostGIS_Version — Returns PostGIS version number and compile-time options.

Synopsis

text **PostGIS_Version**();

Description

Returns PostGIS version number and compile-time options.

Examples

```
SELECT PostGIS_Version();
                        postgis_version
-------------------------------------
 3.4 USE_GEOS=1 USE_PROJ=1 USE_STATS=1
(1 row)
```

See Also

PostGIS_Full_Version, PostGIS_GEOS_Version, PostGIS_Lib_Version, PostGIS_LibXML_Version, PostGIS_PROJ_Version

7.24 PostGIS GUC(Grand Unified Custom Variable)

7.24.1 postgis.backend

postgis.backend — GEOS와 SFCGAL 양쪽의 겹치는 함수&#xb97
서비스하는 백엔드입니다. geos 또&#xb29
sfcgal을 선택할 수 있는데, 기본값은
geos입니다.

설명

PostGIS를 sfcgal 지원과 함께 컴파일했을 경
GUC가 유의미해집니다. GEOS와 SFCGAL의 동&
함수명을 가진 함수를 위해 이용&#
`geos` 백엔드가 기본값입니다. 이 변&#xc2
변경하면 기본값을 무시하고 요&#x
서비스하는 백엔드를 sfcgal로 바꿀
수 있습니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

연결이 유지될 동안만 백엔드를 설정해봅시다.

```
set postgis.backend = sfcgal;
```

데이터베이스와의 새 연결에 백&#x
설정해봅시다.

```
ALTER DATABASE mygisdb SET postgis.backend = sfcgal;
```

참고

Section 7.21

7.24.2 postgis.gdal_datapath

postgis.gdal_datapath — GDAL의 GDAL_DATA 옵션의 값을 할당&#xd5
설정 옵션입니다. 설정하지 않을
경우, 환경적으로 설정된 GDAL_DATA 변&#xc218
사용합니다.

설명

GDAL의 GDAL_DATA 옵션의 값을 설정하기 위&
PostgreSQL GUC 변수입니다. `postgis.gdal_datapath` 값은 GDAL&#xc7
데이터 파일을 가리키는 완전한
물리적 경로여야 합니다.

이 설정 옵션은 GDAL의 데이터 파일
경로가 쉽게 변경할 수 없도록 기&#
coded)되지 않은 윈도우 플랫폼에서
가장 쓸모가 있습니다. GDAL의 데이&#xd1
파일이 GDAL의 예상 경로에 없을 때
이 옵션을 설정해야 합니다.

Note

PostgreSQL의 설정 파일 postgresql.conf 안에서 이
옵션을 설정할 수 있습니다.
또 연결이나 상호처리
단계에서도 설정할 수
있습니다.

2.2.0 버전부터 사용할 수 있습니다.

Note

GDAL의 설정 옵션 페이지에서
GDAL_DATA에 대한 추가 정보를 찾아볼
수 있습니다.

예시

postgis.gdal_datapath 를 설정한 다음 재설정해&

```
SET postgis.gdal_datapath TO '/usr/local/share/gdal.hidden';
SET postgis.gdal_datapath TO default;
```

특정 데이터베이스를 대상으로
윈도우 상에서 설정해보십시오.

```
ALTER DATABASE gisdb
SET postgis.gdal_datapath = 'C:/Program Files/PostgreSQL/9.3/gdal-data';
```

참고

PostGIS_GDAL_Version, ST_Transform

7.24.3 postgis.gdal_enabled_drivers

postgis.gdal_enabled_drivers — PostGIS 환경에서 사용할 수 있&#
GDAL 드라이버를 설정하는 설정 옵&#xc
GDAL 설정 변수 GDAL_SKIP에 영향을 미칩니&#

설명

PostGIS 환경에서 사용할 수 있는 GDAL 드&#xb7
설정하는 설정 옵션입니다. GDAL 설&#x
변수 GDAL_SKIP에 영향을 미칩니다. PostgreSQL&#xc7
설정 파일 postgresql.conf 안에서 이 옵션을
설정할 수 있습니다. 또 연결이나
상호처리 단계에서도 설정할 수
있습니다.

PostgreSQL을 구동시키는 과정에서 사용&#
수 있는 드라이버 목록과 함께 환&#
변수 POSTGIS_GDAL_ENABLED_DRIVERS 를 패스(pass)시켜 postgis.gda
의 초기값을 설정할 수도 있습니&#

드라이버의 축약명 또는 코드를
통해 활성화된 GDAL 특화 드라이버&#xb
지정할 수 있습니다. 드라이버의
축약명 또는 코드는 GDAL 래스터 형&#xc
에서 󌰾을 수 있습니다. 각 드라이&
사이에 공백을 삽입하면 복수의
드라이버를 지정할 수 있습니다.

Note

`postgis.gdal_enabled_drivers` 를 위해 사용할 수 있는 특별 코드가 세 개 있습니다. 이 코드들은 대소문자를 구분합니다.

- `DISABLE_ALL` 은 모든 GDAL 드라이버를 비활성화시킵니다. `DISABLE_ALL` 이 있을 경우, `postgis.gdal_enabled_drivers` 안에 있는 다른 모든 값을 무시합니다.
- `ENABLE_ALL` 은 모든 GDAL 드라이버를 활성화시킵니다.
- `VSICURL` 은 GDAL의 `/vsicurl/` 가상 파일 시스템을 활성화시킵니다.

`postgis.gdal_enabled_drivers` 가 DISABLE_ALL로 성정됐을 경우, DB 외부 래스터, ST_FromGDALRaster(), ST_AsGDALRaster(), ST_AsTIFF(), ST_AsJPEG() 그리고 ST_AsPNG()를 사용하려 한다면 모두 오류 메시지를 보게 될 것입니다.

Note

표준 PostGIS 설치시, `postgis.gdal_enabled_drivers` 는 DISABLE_ALL로 설정됩니다.

Note

GDAL_SKIP에 대한 추가 정보는 GDAL의 Configuration Options 에서 찾아볼 수 있습니다.

2.2.0 버전부터 사용할 수 있습니다.

예시

`postgis.gdal_enabled_drivers` 를 설정한 다음 재설정&

데이터베이스와의 모든 새 연결&#x
백엔드를 설정해봅시다.

```
ALTER DATABASE mygisdb SET postgis.gdal_enabled_drivers TO 'GTiff PNG JPEG';
```

서버와의 모든 새 연결에 기본
드라이버를 설정해봅시다. 슈퍼&
권한 및 PostgreSQL 9.4 이상 버전이 필요합&#xb2
또 데이터베이스, 세션, 사용자 설&
단계에서 이 설정을 무시할 수 없&

```
ALTER SYSTEM SET postgis.gdal_enabled_drivers TO 'GTiff PNG JPEG';
SELECT pg_reload_conf();
```

```
SET postgis.gdal_enabled_drivers TO 'GTiff PNG JPEG';
SET postgis.gdal_enabled_drivers = default;
```

모든 GDAL 드라이버를 활성화시키&#xc2

```
SET postgis.gdal_enabled_drivers = 'ENABLE_ALL';
```

모든 GDAL 드라이버를 비활성화시&#xd0

```
SET postgis.gdal_enabled_drivers = 'DISABLE_ALL';
```

참고

ST_FromGDALRaster, ST_AsGDALRaster, ST_AsTIFF, ST_AsPNG, ST_AsJPEG, postgis.enable_outdb_rasters

7.24.4 postgis.enable_outdb_rasters

postgis.enable_outdb_rasters — DB 외부 래스터 밴드에 접&#xad
수 있게 해주는 불 설정 옵션입니&#

설명

DB 외부 래스터 밴드에 접근할 수
있게 해주는 불 설정 옵션입니다.
PostgreSQL의 설정 파일 postgresql.conf 안에서 이 옵&#x
설정할 수 있습니다. 또 연결이나
상호처리 단계에서도 설정할 수
있습니다.

PostgreSQL을 구동시키는 과정에서 0이 아
값과 함께 환경 변수 `POSTGIS_ENABLE_OUTDB_RASTERS` 를
패스(pass)시켜 `postgis.enable_outdb_rasters` 의 초기값&#xc7
설정할 수도 있습니다.

Note
`postgis.enable_outdb_rasters` 가 참이라 할지라도,
GUC `postgis.enable_outdb_rasters` 가 접근 가능한
래스터 형식을 결정합니다.

Note
표준 PostGIS 설치시, `postgis.enable_outdb_rasters` 는
거짓으로 설정됩니다.

2.2.0 버전부터 사용할 수 있습니다.

예시

`postgis.enable_outdb_rasters` 를 설정한 다음 재설정&

```
SET postgis.enable_outdb_rasters TO True;
SET postgis.enable_outdb_rasters = default;
SET postgis.enable_outdb_rasters = True;
SET postgis.enable_outdb_rasters = False;
```

Set for specific database

```
ALTER DATABASE mygisdb SET postgis.backend = sfcgal;
```

Setting for whole database cluster. You need to reconnect to the database for changes to take effect.

```
--writes to postgres.auto.conf
ALTER SYSTEM postgis.enable_outdb_rasters = true;
 --Reloads postgres conf
SELECT pg_reload_conf();
```

참고

postgis.gdal_enabled_drivers postgis.gdal_datapath

7.24.5 postgis.gdal_datapath

postgis.gdal_datapath — DB 외부 래스터 밴드에 접근&#x
수 있게 해주는 불 설정 옵션입니&#

설명

A string configuration to set options used when working with an out-db raster. Configuration options control things like how much space GDAL allocates to local data cache, whether to read overviews, and what access keys to use for remote out-db data sources.

2.2.0 버전부터 사용할 수 있습니다.

예시

`postgis.enable_outdb_rasters` 를 설정한 다음 재설정&

```
SET postgis.gdal_config_options = 'AWS_ACCESS_KEY_ID=xxxxxxxxxxxxxxx AWS_SECRET_ACCESS_KEY= ↩
    yyyyyyyyyyyyyyyyyyyyyyyyyyy';
```

Set `postgis.gdal_vsi_options` just for the *current transaction* using the `LOCAL` keyword:

```
SET LOCAL postgis.gdal_config_options = 'AWS_ACCESS_KEY_ID=xxxxxxxxxxxxxxx  ↩
    AWS_SECRET_ACCESS_KEY=yyyyyyyyyyyyyyyyyyyyyyyyyy';
```

참고

postgis.enable_outdb_rasters postgis.gdal_enabled_drivers

7.25 Troubleshooting Functions

7.25.1 PostGIS_AddBBox

PostGIS_AddBBox — Add bounding box to the geometry.

Synopsis

geometry **PostGIS_AddBBox**(geometry geomA);

Description

Add bounding box to the geometry. This would make bounding box based queries faster, but will increase the size of the geometry.

Note
Bounding boxes are automatically added to geometries so in general this is not needed unless the generated bounding box somehow becomes corrupted or you have an old install that is lacking bounding boxes. Then you need to drop the old and readd.

This method supports Circular Strings and Curves.

Examples

```
UPDATE sometable
 SET geom =  PostGIS_AddBBox(geom)
 WHERE PostGIS_HasBBox(geom) = false;
```

See Also

PostGIS_DropBBox, PostGIS_HasBBox

7.25.2 PostGIS_DropBBox

PostGIS_DropBBox — Drop the bounding box cache from the geometry.

Synopsis

geometry **PostGIS_DropBBox**(geometry geomA);

Description

Drop the bounding box cache from the geometry. This reduces geometry size, but makes bounding-box based queries slower. It is also used to drop a corrupt bounding box. A tale-tell sign of a corrupt cached bounding box is when your ST_Intersects and other relation queries leave out geometries that rightfully should return true.

Note
Bounding boxes are automatically added to geometries and improve speed of queries so in general this is not needed unless the generated bounding box somehow becomes corrupted or you have an old install that is lacking bounding boxes. Then you need to drop the old and readd. This kind of corruption has been observed in 8.3-8.3.6 series whereby cached bboxes were not always recalculated when a geometry changed and upgrading to a newer version without a dump reload will not correct already corrupted boxes. So one can manually correct using below and readd the bbox or do a dump reload.

This method supports Circular Strings and Curves.

Examples

```
--This example drops bounding boxes where the cached box is not correct
                        --The force to ST_AsBinary before applying Box2D forces a  ↩
                            recalculation of the box, and Box2D applied to the table  ↩
                            geometry always
                        -- returns the cached bounding box.
                        UPDATE sometable
 SET geom =  PostGIS_DropBBox(geom)
 WHERE Not (Box2D(ST_AsBinary(geom)) = Box2D(geom));

        UPDATE sometable
 SET geom =  PostGIS_AddBBox(geom)
 WHERE Not PostGIS_HasBBOX(geom);
```

See Also

PostGIS_AddBBox, PostGIS_HasBBox, Box2D

7.25.3 PostGIS_HasBBox

PostGIS_HasBBox — Returns TRUE if the bbox of this geometry is cached, FALSE otherwise.

Synopsis

boolean **PostGIS_HasBBox**(geometry geomA);

Description

Returns TRUE if the bbox of this geometry is cached, FALSE otherwise. Use PostGIS_AddBBox and PostGIS_DropBBox to control caching.

This method supports Circular Strings and Curves.

Examples

```
SELECT geom
FROM sometable WHERE PostGIS_HasBBox(geom) = false;
```

See Also

PostGIS_AddBBox, PostGIS_DropBBox

Chapter 8

지형(topology)

PostGIS 지형 유형 및 함수는 표면(face), 가&#xc7a
노드(node)와 같은 위상기하학적 객&#xccb
관리했습니다.

Sandro Santilli's presentation at PostGIS Day Paris 2011 conference gives a good synopsis of PostGIS Topology and where it is headed Topology with PostGIS 2.0 slide deck.

Vincent Picavet provides a good synopsis and overview of what is Topology, how is it used, and various FOSS4G tools that support it in PostGIS Topology PGConf EU 2012.

지형에 기반한 GIS 데이터베이스의
예로는 US Census Topologically Integrated Geographic Encoding and Referencing System (TIGER)
데이터베이스가 있습니다. PostGIS 지&#x
유형을 테스트해보고 싶은데 데&#x
필요하다면, Topology_Load_Tiger 를 확인해보십&

PostGIS 지형 모듈은 PostGIS 이전 버전에도
있었지만, 공식 PostGIS 문서에 포함된
적은 없었습니다. PostGIS 2.0.0 버전에서,
지원이 중단된 모든 함수를 제거&#
알려진 사용성 문제들을 해결하&#x
기능 및 함수들을 새로이 문서화&#
새로운 함수들을 추가하고, SQL-MM 표&#
더 잘 준수하도록 개선하는 등 주&#
정리 작업이 이루어졌습니다.

이 프로젝트에 대한 자세한 내용&#
PostGIS Topology Wiki 에서 찾아볼 수 있습니다.

이 모듈과 관련된 모든 함수 및 테&#
`topology` 라는 스키마에 설치돼 있습니&

SQL/MM 표준이 정의하는 함수들은 접&#
ST_ 가 붙은 명칭을 가지고 있으며,
PostGIS에 특화된 함수들의 명칭에는
접두사가 붙지 않습니다.

Topology support is build by default starting with PostGIS 2.0, and can be disabled specifying --without-topology configure option at build time as described in Chapter 2

8.1 지형 유형

8.1.1 getfaceedges_returntype

getfaceedges_returntype — A composite type that consists of a sequence number and an edge number.

설명

A composite type that consists of a sequence number and an edge number. This is the return type for `ST_GetFaceEdges` and `GetNodeEdges` functions.

1. `sequence` 는 정수형입니다: 지형 스키&#x 및 SRID를 정의하는 topology.topology 테이블에 정의돼 있는 지형을 참조하십&#xc2d
2. `edge` 는 정수형입니다: 경계선의 식

8.1.2 TopoGeometry

TopoGeometry — A composite type representing a topologically defined geometry.

설명

특정 지형 레이어에 있는, 특정 유&
및 특정 ID를 가진 지형 도형을 참조
합성 유형입니다. TopoGeometry를 구성하&#xb29
요소는 topology_id, layer_id, id, type 정수형 속성입니&#x

1. `topology_id` 는 정수형입니다: 지형 스&#xd0a4 및 SRID를 정의하는 topology.topology 테이블에 정의돼 있는 지형을 참조하십&#xc2d
2. `layer_id` 는 정수형입니다: TopoGeometry가 속&#xd574 있는 레이어 테이블의 layer_id입니&#xb2e4 topology_id 와 layer_id를 조합하면 topology.layers 테이블&#x 유일한 참조(unique reference)를 제공합니다.
3. `id` 는 정수형입니다: 해당 지형 레&#x 지형 도형을 유일하게 정의하&#xb29 자동 생성된 순차 번호입니다.
4. 1에서 4까지의 `type` 정수가 도형 유&#xd61 정의합니다. 1: [멀티]포인트, 2: [멀&#xd2f0 3: [멀티]폴리곤, 4: 도형 집합.

형변환 습성

이 단원에서 이런 데이터 유형에 사용할 수 있는 자동 형변환은 물&# 명시적인 형변환도 소개합니다.

형변환 결과	습성
도형	자동적

참고

CreateTopoGeom

8.1.3 validatetopology_returntype

validatetopology_returntype — A composite type that consists of an error message and id1 and id2 to denote location of error. This is the return type for `ValidateTopology`.

설명

오류 메시지 및 정수형 2개로 이루&
합성 유형입니다. ValidateTopology 함수가 확&#x
오류 및 해당 오류에 연관된 지형
객체들의 ID를 표시하는 id1과 id2를 나&#x
이 집합을 반환합니다.

1. `error` 는 가변 길이 문자열(varchar)입니다:
   오류의 유형을 표시합니다.

   현재 오류 설명자(descriptor)는 다음과
   같습니다: coincident nodes(일치하는 노드&#xb4e4
   edge crosses node(노드를 가로지르는 경계&#xc120
   edge not simple(단순하지 않은 경계선), edge end node
   geometry mis-match(경계선의 종단 노드 도형
   불일치), edge start node geometry mismatch(경계선의 시작
   노드 도형 불일치), face overlaps face(표면 중&#xcc
   표면), face within face(표면 내부 표면)

2. `id1` 은 정수형입니다: 오류가 발생&
   경계선(edge)/표면(face)/노드(node)의 식별&#xc790
   나타냅니다.

3. `id2` 는 정수형입니다: 객체 2개와 연
   오류일 경우, 두 번째 경계선 또&#xb2
   노드를 표시합니다.

참고

ValidateTopology

8.2 지형 도메인

8.2.1 TopoElement

TopoElement — 일반적으로 TopoGeometry 구성 요소를
식별하는 데 쓰이는 정수형 2개의
배열입니다.

설명

단순 또는 계층 TopoGeometry 의 구성 요소 1개를 표현하는 데 쓰이는 정수형 2개의 배열입니다.

단순 TopoGeometry의 경우, 배열의 첫 번째 요소가 지형적 원시형(topological primitive)의 식나타내고 두 번째 요소가 그 유형(1: node, 2: edge, 3: face)을 나타냅니다. 계층 TopoGeometry의 경우 배열의 첫 번째 요소가 자식 TopoGeometry의 식별자를 나타내고 두 번째 요소가 해당 레이어 식별자를 나&#

Note

어떤 계층 TopoGeometry가 주어지더라도, 모든 자식 TopoGeometry 요소들은, 해당 TopoGeometry의 레이어에 대해 topology.layer 레코드에 지정된 동일한 자식 레이어에서 나옵니다.

예시

```
SELECT te[1] AS id, te[2] AS type FROM
( SELECT ARRAY[1,2]::topology.topoelement AS te ) f;
 id | type
----+------
  1 |    2
```

```
SELECT ARRAY[1,2]::topology.topoelement;
  te
-------
 {1,2}
```

```
-- topoelement&#xc5d0; &#xc694;&#xc18c; 3&#xac1c;&#xb97c; &#xac00;&#xc9c4;  ↩
    &#xbc30;&#xc5f4;&#xc744; &#xb123;&#xc73c;&#xba74; &#xc5b4;&#xb5bb;&#xac8c;  ↩
    &#xb418;&#xb294;&#xc9c0; &#xbcf4;&#xc5ec;&#xc8fc;&#xb294; &#xc608;&#xc2dc;
-- &#xc8fc;&#xc758;: topoelement&#xb294; &#xc694;&#xc18c; 2&#xac1c;&#xb97c;  ↩
    &#xac00;&#xc9c4; &#xbc30;&#xc5f4;&#xc774;&#xc5b4;&#xc57c; &#xd558;&#xbbc0;&#xb85c;  ↩
    &#xcc28;&#xc6d0; &#xd655;&#xc778;&#xc5d0; &#xc2e4;&#xd328;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ARRAY[1,2,3]::topology.topoelement;
ERROR:  value for domain topology.topoelement violates check constraint "dimensions"
```

참고

GetTopoGeomElements, TopoElementArray, TopoGeometry, TopoGeom_addElement, TopoGeom_remElement

8.2.2 TopoElementArray

TopoElementArray — An array of TopoElement objects.

설명

1개 이상의 TopoElement 객체들의 배열로, 일반적으로 TopoElement 객체의 구성 요소넘겨주는 데 쓰입니다.

예시

```
SELECT '{{1,2},{4,3}}'::topology.topoelementarray As tea;
  tea
-------
{{1,2},{4,3}}

-- &#xb354; &#xc124;&#xba85;&#xc801;&#xc778; &#xb3d9;&#xc77c;&#xd55c; &#xcffc;&#xb9ac; --
SELECT ARRAY[ARRAY[1,2], ARRAY[4,3]]::topology.topoelementarray As tea;

  tea
-------
{{1,2},{4,3}}

-- &#xc9c0;&#xd615;&#xacfc; &#xd568;&#xaed8; &#xd328;&#xd0a4;&#xc9d5;&#xb41c;  ↩
    &#xbc30;&#xc5f4; &#xc885;&#xd569; &#xd568;&#xc218;&#xb97c; &#xc774;&#xc6a9; --
SELECT topology.TopoElementArray_Agg(ARRAY[e,t]) As tea
  FROM generate_series(1,4) As e CROSS JOIN generate_series(1,3) As t;
  tea
--------------------------------------------------------------------------
{{1,1},{1,2},{1,3},{2,1},{2,2},{2,3},{3,1},{3,2},{3,3},{4,1},{4,2},{4,3}}
```

```
SELECT '{{1,2,4},{3,4,5}}'::topology.topoelementarray As tea;
ERROR:  value for domain topology.topoelementarray violates check constraint "dimensions"
```

참고

TopoElement, GetTopoGeomElementArray, TopoElementArray_Agg

8.3 지형 및 TopoGeometry 관리

8.3.1 AddTopoGeometryColumn

AddTopoGeometryColumn — 기존 테이블에 TopoGeometry 열을 추가하고, topology.layer에 이 새 열을 레이어추가하며, 새 layer_id를 반환합니다.

Synopsis

integer **AddTopoGeometryColumn**(varchar topology_name, varchar schema_name, varchar table_name, varchar column_name, varchar feature_type);
integer **AddTopoGeometryColumn**(varchar topology_name, varchar schema_name, varchar table_name, varchar column_name, varchar feature_type, integer child_layer);

설명

각 TopoGeometry 객체는 특정 지형의 특정 레이어에 속합니다. TopoGeometry 객체를 생성하기 전에 해당 지형 레이어생성해야 합니다. 지형 레이어란 지형과 피처 테이블의 조합입니유형 및 계층 정보도 담고 있습니&#x AddTopoGeometryColumn() 함수를 이용해서 레이어&#x 생성해보겠습니다:

이 함수는 요청한 열을 테이블에 추가하고 topology.layer 테이블에 레코드를 주어진 모든 정보와 함께 추가할 것입니다.

[child_layer]를 따로 설정하지 않을 (또는 NULL로 설정할) 경우, 해당 레이어가 (원시형 지형 요소들로 이루어진) 기본 TopoGeometry를 담을 것입니다. 그렇&#xc9c0 않을 경우, 이 레이어는 (child_layer에서 나 TopoGeometry들로 이루어진) 계층 TopoGeometry를 담&# 것입니다.

레이어를 생성했다면 (AddTopoGeometryColumn 함&#x 레이어의 ID를 반환합니다) 해당 &#xb808 TopoGeometry 객체를 작성할 준비가 된 것&#xc78

Valid `feature_types` are: POINT, MULTIPOINT, LINE, MULTILINE, POLYGON, MULTIPOLYGON, COLLECTION

Availability: 1.1

예시

```
-- &#xc774; &#xc608;&#xc2dc;&#xb97c; &#xc704;&#xd574; ma_topo  ↩
    &#xc2a4;&#xd0a4;&#xb9c8;&#xc5d0; &#xc0c8; &#xd14c;&#xc774;&#xbe14;&#xc744;  ↩
    &#xc0dd;&#xc131;&#xd588;&#xb2e4;&#xb294; &#xc810;&#xc5d0;  ↩
    &#xc8fc;&#xc758;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
-- &#xb2e4;&#xb978; &#xc2a4;&#xd0a4;&#xb9c8;&#xc5d0; &#xc0dd;&#xc131;&#xd560; &#xc218;  ↩
    &#xc788;&#xc5c8;&#xb294;&#xb370;&#xb3c4; &#xb9d0;&#xc785;&#xb2c8;&#xb2e4;.  ↩
    &#xadf8;&#xb7ac;&#xb354;&#xb77c;&#xba74; topology_name&#xacfc; schema_name&#xc774;  ↩
    &#xb2ec;&#xb77c;&#xc84c;&#xc744; &#xac81;&#xb2c8;&#xb2e4;.
CREATE SCHEMA ma;
CREATE TABLE ma.parcels(gid serial, parcel_id varchar(20) PRIMARY KEY, address text);
SELECT topology.AddTopoGeometryColumn('ma_topo', 'ma', 'parcels', 'topo', 'POLYGON');
```

```
CREATE SCHEMA ri;
CREATE TABLE ri.roads(gid serial PRIMARY KEY, road_name text);
SELECT topology.AddTopoGeometryColumn('ri_topo', 'ri', 'roads', 'topo', 'LINE');
```

참고

DropTopoGeometryColumn, toTopoGeom, CreateTopology, CreateTopoGeom

8.3.2 RenameTopoGeometryColumn

RenameTopoGeometryColumn — Renames a topogeometry column

Synopsis

topology.layer **RenameTopoGeometryColumn**(regclass layer_table, name feature_column, name new_name);

설명

This function changes the name of an existing TopoGeometry column ensuring metadata information about it is updated accordingly.

Availability: 3.4.0

예시

```
SELECT topology.RenameTopoGeometryColumn('public.parcels', 'topogeom', 'tgeom');
```

참고

AddTopoGeometryColumn, RenameTopology

8.3.3 DropTopology

DropTopology — 이용에 주의하십시오: 지형 스키마를 삭제하고 topology.topology 테이블&#xc5 해당 참조를, 그리고 geometry_columns 테이블&#x 해당 스키마에 있는 테이블의 참&# 삭제합니다.

Synopsis

integer **DropTopology**(varchar topology_schema_name);

설명

지형 스키마를 삭제하고 topology.topology 테&#xc 해당 참조를, 그리고 geometry_columns 테이블&#x 해당 스키마에 있는 테이블의 참&# 삭제합니다. 이 함수는 사용자의 관심 데이터를 파괴할 수도 있으&# 주의해서 사용해야 합니다. 스키&#x 존재하지 않을 경우, 해당 스키마&# 명칭으로 된 참조 항목만 제거합&#x

Availability: 1.1

예시

ma_topo 스키마를 삭제하고 topology.topology와 geometry_columns에 있는 모든 해당 스키마의 참& 차례로 제거합니다.

```
SELECT topology.DropTopology('ma_topo');
```

참고

DropTopoGeometryColumn

8.3.4 RenameTopology

RenameTopology — Renames a topology

Synopsis

varchar **RenameTopology**(varchar old_name, varchar new_name);

설명

Renames a topology schema, updating its metadata record in the `topology.topology` table.

Availability: 3.4.0

예시

Rename a topology from `topo_stage` to `topo_prod`.

```
SELECT topology.RenameTopology('topo_stage', 'topo_prod');
```

참고

CopyTopology, RenameTopoGeometryColumn

8.3.5 DropTopoGeometryColumn

DropTopoGeometryColumn — `schema_name` 스키마 안의 `table_name` 명칭&
테이블에서 Topogeometry 열을 삭제하고 topology.layer 테이블에서 해당 열을 등록 해&#x

Synopsis

text **DropTopoGeometryColumn**(varchar schema_name, varchar table_name, varchar column_name);

설명

`schema_name` 스키마 안의 `table_name` 명칭의 테이&
Topogeometry 열을 삭제하고 topology.layer 테이블에&#x
해당 열을 등록 해제합니다. 삭제
상태의 요약문을 반환합니다. 주&#
참조 무결성 확인 작업을 건너뛰&#
위해 삭제하기 전에 먼저 모든 값&#
NULL로 설정합니다.

Availability: 1.1

예시

```
SELECT topology.DropTopoGeometryColumn('ma_topo', 'parcel_topo', 'topo');
```

참고

AddTopoGeometryColumn

8.3.6 Populate_Topology_Layer

Populate_Topology_Layer — Adds missing entries to topology.layer table by reading metadata from topo tables.

Synopsis

setof record **Populate_Topology_Layer**();

설명

Adds missing entries to the `topology.layer` table by inspecting topology constraints on tables. This function is useful for fixing up entries in topology catalog after restores of schemas with topo data.

It returns the list of entries created. Returned columns are `schema_name`, `table_name`, `feature_column`.

2.3.0 버전부터 사용할 수 있습니다.

예시

```
SELECT CreateTopology('strk_topo');
CREATE SCHEMA strk;
CREATE TABLE strk.parcels(gid serial, parcel_id varchar(20) PRIMARY KEY, address text);
SELECT topology.AddTopoGeometryColumn('strk_topo', 'strk', 'parcels', 'topo', 'POLYGON');
-- this will return no records because this feature is already registered
SELECT *
  FROM topology.Populate_Topology_Layer();

-- let's rebuild
TRUNCATE TABLE topology.layer;

SELECT *
  FROM topology.Populate_Topology_Layer();

SELECT topology_id,layer_id, schema_name As sn, table_name As tn, feature_column As fc
FROM topology.layer;
```

```
schema_name | table_name | feature_column
-------------+------------+----------------
 strk        | parcels    | topo
(1 row)

 topology_id | layer_id |  sn  |   tn    |  fc
-------------+----------+------+---------+------
           2 |        2 | strk | parcels | topo
(1 row)
```

참고

AddTopoGeometryColumn

8.3.7 TopologySummary

TopologySummary — Takes a topology name and provides summary totals of types of objects in topology.

Synopsis

text **TopologySummary**(varchar topology_schema_name);

설명

Takes a topology name and provides summary totals of types of objects in topology.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT topology.topologysummary('city_data');
                    topologysummary
------------------------------------------------------
 Topology city_data (329), SRID 4326, precision: 0
 22 nodes, 24 edges, 10 faces, 29 topogeoms in 5 layers
 Layer 1, type Polygonal (3), 9 topogeoms
  Deploy: features.land_parcels.feature
 Layer 2, type Puntal (1), 8 topogeoms
  Deploy: features.traffic_signs.feature
 Layer 3, type Lineal (2), 8 topogeoms
  Deploy: features.city_streets.feature
 Layer 4, type Polygonal (3), 3 topogeoms
  Hierarchy level 1, child layer 1
  Deploy: features.big_parcels.feature
 Layer 5, type Puntal (1), 1 topogeoms
  Hierarchy level 1, child layer 2
  Deploy: features.big_signs.feature
```

참고

Topology_Load_Tiger

8.3.8 ValidateTopology

ValidateTopology — Returns a set of validatetopology_returntype objects detailing issues with topology.

Synopsis

setof validatetopology_returntype **ValidateTopology**(varchar toponame, geometry bbox);

설명

Returns a set of validatetopology_returntype objects detailing issues with topology, optionally limiting the check to the area specified by the `bbox` parameter.

List of possible errors, what they mean and what the returned ids represent are displayed below:

오류	id1	id2	Meaning
coincident nodes	Identifier of first node.	Identifier of second node.	Two nodes have the same geometry.
edge crosses node(노드를 가로지르는 경계선)	Identifier of the edge.	Identifier of the node.	An edge has a node in its interior. See ST_Relate.
invalid edge(유효하지 않은 경계선)	Identifier of the edge.		An edge geometry is invalid. See ST_IsValid.

오류	id1	id2	Meaning
edge not simple(단순하지 않은 경계선)	Identifier of the edge.		An edge geometry has self-intersections. See ST_IsSimple.
edge crosses edge(경계선을 가로지르는 경계선)	Identifier of first edge.	Identifier of second edge.	Two edges have an interior intersection. See ST_Relate.
edge start node geometry mismatch(경계선의 시작 노드 도형 불일치)	Identifier of the edge.	Identifier of the indicated start node.	The geometry of the node indicated as the starting node for an edge does not match the first point of the edge geometry. See ST_StartPoint.
edge end node geometry mismatch(경계선의 종단 노드 도형 불일치)	Identifier of the edge.	Identifier of the indicated end node.	The geometry of the node indicated as the ending node for an edge does not match the last point of the edge geometry. See ST_EndPoint.
face without edges(경계선이 없는 표면)	Identifier of the orphaned face.		No edge reports an existing face on either of its sides (left_face, right_face).
face has no rings(고리가 없는 표면)	Identifier of the partially-defined face.		Edges reporting a face on their sides do not form a ring.
face has wrong mbr	Identifier of the face with wrong mbr cache.		Minimum bounding rectangle of a face does not match minimum bounding box of the collection of edges reporting the face on their sides.
hole not in advertised face	Signed identifier of an edge, identifying the ring. See GetRingEdges.		A ring of edges reporting a face on its exterior is contained in different face.
not-isolated node has not-containing_face	Identifier of the ill-defined node.		A node which is reported as being on the boundary of one or more edges is indicating a containing face.
isolated node has containing_face	Identifier of the ill-defined node.		A node which is not reported as being on the boundary of any edges is lacking the indication of a containing face.
isolated node has wrong containing_face	Identifier of the misrepresented node.		A node which is not reported as being on the boundary of any edges indicates a containing face which is not the actual face containing it. See GetFaceContainingPoint.

오류	id1	id2	Meaning
invalid next_right_edge	Identifier of the misrepresented edge.	Signed id of the edge which should be indicated as the next right edge.	The edge indicated as the next edge encountered walking on the right side of an edge is wrong.
invalid next_left_edge	Identifier of the misrepresented edge.	Signed id of the edge which should be indicated as the next left edge.	The edge indicated as the next edge encountered walking on the left side of an edge is wrong.
mixed face labeling in ring	Signed identifier of an edge, identifying the ring. See GetRingEdges.		Edges in a ring indicate conflicting faces on the walking side. This is also known as a "Side Location Conflict".
non-closed ring	Signed identifier of an edge, identifying the ring. See GetRingEdges.		A ring of edges formed by following next_left_edge/next_right_edge attributes starts and ends on different nodes.
face has multiple shells	Identifier of the contended face.	Signed identifier of an edge, identifying the ring. See GetRingEdges.	More than a one ring of edges indicate the same face on its interior.

1.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.0.0 버전에서 경계선 가&#xb85
탐지를 더 효율적으로 개선하고,
이전 버전에 존재했던 긍정 오류(fal
positive)를 해결했습니다.

변경 사항: 2.2.0 버전에서 'edge crosses node'를 오&#xb95
설명문과 일치시키기 위해 id1과 id2&#xc75
값을 서로 바꿨습니다.

Changed: 3.2.0 added optional bbox parameter, perform face labeling and edge linking checks.

예시

```
SELECT * FROM  topology.ValidateTopology('ma_topo');
      error        | id1 | id2
-------------------+-----+-----
face without edges |   1 |
```

참고

validatetopology_returntype, Topology_Load_Tiger

8.3.9 ValidateTopologyRelation

ValidateTopologyRelation — Returns info about invalid topology relation records

Synopsis

setof record **ValidateTopologyRelation**(varchar toponame);

설명

Returns a set records giving information about invalidities in the relation table of the topology.

Availability: 3.2.0

참고

ValidateTopology

8.3.10 FindTopology

FindTopology — Returns a topology record by different means.

Synopsis

topology **FindTopology**(TopoGeometry topogeom);
topology **FindTopology**(regclass layerTable, name layerColumn);
topology **FindTopology**(name layerSchema, name layerTable, name layerColumn);
topology **FindTopology**(text topoName);
topology **FindTopology**(int id);

설명

Takes a topology identifier or the identifier of a topology-related object and returns a topology.topology record.

Availability: 3.2.0

예시

```
SELECT name(findTopology('features.land_parcels', 'feature'));
   name
-----------
 city_data
(1 row)
```

참고

FindLayer

8.3.11 FindLayer

FindLayer — Returns a topology.layer record by different means.

Synopsis

topology.layer **FindLayer**(TopoGeometry tg);
topology.layer **FindLayer**(regclass layer_table, name feature_column);
topology.layer **FindLayer**(name schema_name, name table_name, name feature_column);
topology.layer **FindLayer**(integer topology_id, integer layer_id);

설명

Takes a layer identifier or the identifier of a topology-related object and returns a topology.layer record.

Availability: 3.2.0

예시

```
SELECT layer_id(findLayer('features.land_parcels', 'feature'));
 layer_id
----------
        1
(1 row)
```

참고

FindTopology

8.4 Topology Statistics Management

Adding elements to a topology triggers many database queries for finding existing edges that will be split, adding nodes and updating edges that will node with the new linework. For this reason it is useful that statistics about the data in the topology tables are up-to-date.

PostGIS Topology population and editing functions do not automatically update the statistics because a updating stats after each and every change in a topology would be overkill, so it is the caller's duty to take care of that.

Note
That the statistics updated by autovacuum will NOT be visible to transactions which started before autovacuum process completed, so long-running transactions will need to run ANALYZE themselves, to use updated statistics.

8.5 지형 작성자

8.5.1 CreateTopology

CreateTopology — Creates a new topology schema and registers it in the topology.topology table.

Synopsis

integer **CreateTopology**(varchar topology_schema_name);
integer **CreateTopology**(varchar topology_schema_name, integer srid);
integer **CreateTopology**(varchar topology_schema_name, integer srid, double precision prec);
integer **CreateTopology**(varchar topology_schema_name, integer srid, double precision prec, boolean hasz);

설명

Creates a new topology schema with name `topology_name` and registers it in the `topology.topology` table. Topologies must be uniquely named. The topology tables (`edge_data`, `face`, `node`,and `relation` are created in the schema. It returns the id of the topology.

The `srid` is the spatial reference system SRID for the topology.

The tolerance `prec` is measured in the units of the spatial reference system. The tolerance defaults to 0.

`hasz` defaults to false if not specified.

This is similar to the SQL/MM ST_InitTopoGeo but has more functionality.

Availability: 1.1

Enhanced: 2.0 added the signature accepting hasZ

예시

Create a topology schema called `ma_topo` that stores edges and nodes in Massachusetts State Plane-meters (SRID = 26986). The tolerance represents 0.5 meters since the spatial reference system is meter-based.

```
SELECT topology.CreateTopology('ma_topo', 26986, 0.5);
```

Create a topology for Rhode Island called `ri_topo` in spatial reference system State Plane-feet (SRID = 3438)

```
SELECT topology.CreateTopology('ri_topo', 3438) AS topoid;
topoid
------
2
```

참고

Section 4.5, ST_InitTopoGeo, Topology_Load_Tiger

8.5.2 CopyTopology

CopyTopology — Makes a copy of a topology (nodes, edges, faces, layers and TopoGeometries) into a new schema

Synopsis

integer **CopyTopology**(varchar existing_topology_name, varchar new_name);

설명

Creates a new topology with name `new_name`, with SRID and precision copied from `existing_topology_name` The nodes, edges and faces in `existing_topology_name` are copied into the new topology, as well as Layers and their associated TopoGeometries.

Note
The new rows in the `topology.layer` table contain synthetic values for schema_name, table_name and feature_column. This is because the TopoGeometry objects exist only as a definition and are not yet available in a user-defined table.

2.0.0 버전부터 사용할 수 있습니다.

예시

Make a backup of a topology called `ma_topo`.

```
SELECT topology.CopyTopology('ma_topo', 'ma_topo_backup');
```

참고

Section 4.5, CreateTopology, RenameTopology

8.5.3 ST_InitTopoGeo

ST_InitTopoGeo — Creates a new topology schema and registers it in the topology.topology table.

Synopsis

text **ST_InitTopoGeo**(varchar topology_schema_name);

설명

This is the SQL-MM equivalent of CreateTopology. It lacks options for spatial reference system and tolerance. it returns a text description of the topology creation, instead of the topology id.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.17

예시

```
SELECT topology.ST_InitTopoGeo('topo_schema_to_create') AS topocreation;
                      astopocreation
---------------------------------------------------------------
 Topology-Geometry 'topo_schema_to_create' (id:7) created.
```

참고

CreateTopology

8.5.4 ST_CreateTopoGeo

ST_CreateTopoGeo — 텅 빈 입력 지형에 도형들&#xc758
집합을 추가한 다음 작업 성공 여&#x
상세하게 설명하는 메시지를 반&#x

Synopsis

text **ST_CreateTopoGeo**(varchar atopology, geometry acollection);

설명

텅 빈 입력 지형에 도형들의 집합&
추가한 다음 작업 성공 여부를 상&#x
설명하는 메시지를 반환합니다.

텅 빈 지형을 채우는 데 유용합니&#

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details -- X.3.18

예시

```
-- &#xc9c0;&#xd615;&#xc744; &#xcc44;&#xc6c1;&#xb2c8;&#xb2e4;. --
SELECT topology.ST_CreateTopoGeo('ri_topo',
 ST_GeomFromText('MULTILINESTRING((384744 236928,384750 236923,384769 236911,384799  ↩
     236895,384811 236890,384833 236884,
  384844 236882,384866 236881,384879 236883,384954 236898,385087 236932,385117 236938,
  385167 236938,385203 236941,385224 236946,385233 236950,385241 236956,385254 236971,
  385260 236979,385268 236999,385273 237018,385273 237037,385271 237047,385267 237057,
  385225 237125,385210 237144,385192 237161,385167 237192,385162 237202,385159 237214,
  385159 237227,385162 237241,385166 237256,385196 237324,385209 237345,385234 237375,
  385237 237383,385238 237399,385236 237407,385227 237419,385213 237430,385193 237439,
  385174 237451,385170 237455,385169 237460,385171 237475,385181 237503,385190 237521,
  385200 237533,385206 237538,385213 237541,385221 237542,385235 237540,385242 237541,
  385249 237544,385260 237555,385270 237570,385289 237584,385292 237589,385291  ↩
     237596,385284 237630))',3438)
  );

      st_createtopogeo
----------------------------
 Topology ri_topo populated


-- &#xd14c;&#xc774;&#xbe14; &#xbc0f; &#xc9c0;&#xd615; &#xb3c4;&#xd615;&#xc744;  ↩
    &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;. --
CREATE TABLE ri.roads(gid serial PRIMARY KEY, road_name text);

SELECT topology.AddTopoGeometryColumn('ri_topo', 'ri', 'roads', 'topo', 'LINE');
```

참고

AddTopoGeometryColumn, CreateTopology, DropTopology

8.5.5 TopoGeo_AddPoint

TopoGeo_AddPoint — 허용 오차를 이용해서 그리&
기존 경계선을 분할(split)하기도 해&#xc11
기존 지형에 포인트를 추가합니&#x

Synopsis

integer **TopoGeo_AddPoint**(varchar atopology, geometry apoint, float8 tolerance);

설명

Adds a point to an existing topology and returns its identifier. The given point will snap to existing nodes or edges within given tolerance. An existing edge may be split by the snapped point.

2.0.0 버전부터 사용할 수 있습니다.

참고

TopoGeo_AddLineString, TopoGeo_AddPolygon, AddNode, CreateTopology

8.5.6 TopoGeo_AddLineString

TopoGeo_AddLineString — Adds a linestring to an existing topology using a tolerance and possibly splitting existing edges/-faces. Returns edge identifiers.

Synopsis

SETOF integer **TopoGeo_AddLineString**(varchar atopology, geometry aline, float8 tolerance);

설명

Adds a linestring to an existing topology and returns a set of edge identifiers forming it up. The given line will snap to existing nodes or edges within given tolerance. Existing edges and faces may be split by the line.

Note
Updating statistics about topologies being loaded via this function is up to caller, see maintaining statistics during topology editing and population.

2.0.0 버전부터 사용할 수 있습니다.

참고

TopoGeo_AddPoint, TopoGeo_AddPolygon, AddEdge, CreateTopology

8.5.7 TopoGeo_AddPolygon

TopoGeo_AddPolygon — Adds a polygon to an existing topology using a tolerance and possibly splitting existing edges/faces. Returns face identifiers.

Synopsis

SETOF integer **TopoGeo_AddPolygon**(varchar atopology, geometry apoly, float8 tolerance);

설명

Adds a polygon to an existing topology and returns a set of face identifiers forming it up. The boundary of the given polygon will snap to existing nodes or edges within given tolerance. Existing edges and faces may be split by the boundary of the new polygon.

Note
Updating statistics about topologies being loaded via this function is up to caller, see maintaining statistics during topology editing and population.

2.0.0 버전부터 사용할 수 있습니다.

참고

TopoGeo_AddPoint, TopoGeo_AddLineString, AddFace, CreateTopology

8.6 지형 편집자

8.6.1 ST_AddIsoNode

ST_AddIsoNode — 지형 안의 표면에 고립된(isolated) 노드를 추가하고 새 노드의 ID를 반환합니다. 표면이 NULL일 경우, 그래도 노드를 생성합니다.

Synopsis

integer **ST_AddIsoNode**(varchar atopology, integer aface, geometry apoint);

설명

`atopology` 지형의 `aface` ID(faceid)를 가진 기존 표면포인트 위치가 `apoint` 인 고립된 노드추가하고 새 노드의 ID(nodeid)를 반환합

포인트 도형과 지형의 공간 참조 시스템(SRID)이 다를 경우, `apoint` 가 포인트도형이 아닐 경우, 포인트가 NULL일 경우, 또는 포인트가 기존 경계선(또는 외곽선일지라도) 교차하는 경우 예외가 발생합니다. 해당 포위치에 이미 노드가 존재할 경우예외가 발생합니다.

`aface` 가 NULL이 아닌데 `apoint` 가 표면 내부에 있지 않을 경우, 예외가 발생합니다

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X+1.3.1

예시

참고

AddNode, CreateTopology, DropTopology, ST_Intersects

8.6.2 ST_AddIsoEdge

ST_AddIsoEdge — 지형에 두 개의 고립된 기존 노드 `anode` 와 `anothernode` 를 연결하는 `alinestring` 도형이 정의하는 고립된 경계선을 추가하새 경계선의 ID를 반환합니다.

Synopsis

integer **ST_AddIsoEdge**(varchar atopology, integer anode, integer anothernode, geometry alinestring);

설명

지형에 두 개의 고립된 기존 노드 `anode` 와 `anothernode` 를 연결하는 `alinestring` 도형이 정의하는 고립된 경계선을 추가하새 경계선의 ID(edgeid)를 반환합니다.

`alinestring` 도형과 지형의 공간 참조 시&#xc2a 다를 경우, 입력 인수 가운데 하나&& NULL일 경우, 하나 이상의 표면이 노&#xb 담고 있을 경우, 또는 노드가 기존 경계선의 시작 또는 종단 노드일 경우, 예외가 발생합니다.

`alinestring` 이 `anode` 와 `anothernode` 가 속해 있는 표면 내부에 없을 경우, 예외가 발생합&#

`anode` 와 `anothernode` 가 `alinestring` 의 시작점 및 종단& 아닐 경우 예외가 발생합니다.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.4

예시

참고

ST_AddIsoNode, ST_IsSimple, ST_Within

8.6.3 ST_AddEdgeNewFaces

ST_AddEdgeNewFaces — 새 경계선을 추가하고, 그 과정에서 경계선이 표면을 분할&# 경우, 원본 표면을 삭제하고 새 표&# 2개로 교체합니다.

Synopsis

integer **ST_AddEdgeNewFaces**(varchar atopology, integer anode, integer anothernode, geometry acurve);

설명

새 경계선을 추가하고, 그 과정에&#x
경계선이 표면을 분할할 경우, 원&#
표면을 삭제하고 새 표면 2개로 교&
새로 추가된 경계선의 ID를 반환합&

모든 기존의 결합된 경계선 및 관&#x
결과에 맞춰 업데이트합니다.

어떤 인수가 NULL일 경우, 주어진 노&#xb4
알려지지 않은 경우(노드가 이미
지형 스키마의 `node` 테이블에 존재&#xd57
합니다), `acurve` 가 `LINESTRING` 이 아닐 경우, `anode`
와 `anothernode` 가 `acurve` 의 시작점 및 종단점&#xc7
아닐 경우 오류가 발생합니다.

`acurve` 도형과 지형의 공간 참조 시스&#xc
다를 경우 예외가 발생합니다.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.12

예시

참고

ST_RemEdgeNewFace

ST_AddEdgeModFace

8.6.4 ST_AddEdgeModFace

ST_AddEdgeModFace — 새 경계선을 추가하고, 그
과정에서 경계선이 표면을 분할&#x
경우, 원본 표면을 수정하고 새 표&#
추가합니다.

Synopsis

integer **ST_AddEdgeModFace**(varchar atopology, integer anode, integer anothernode, geometry acurve);

설명

새 경계선을 추가하고, 그 과정에&#x
경계선이 표면을 분할할 경우, 원&#
표면을 수정하고 새 표면을 추가&#

Note

가능한 경우, 새 경계선의 왼쪽에 새 표면을 생성할 것입니다. 왼쪽의 표면이 (무한한) 세계 표면(universe face)이어야 할 경우 이는 불가능할 것입니다.

새로 추가된 경계선의 ID를 반환합&

모든 기존의 결합된 경계선 및 관&#x 결과에 맞춰 업데이트합니다.

어떤 인수가 NULL일 경우, 주어진 노&#xb4 알려지지 않은 경우(노드가 이미 지형 스키마의 `node` 테이블에 존재&#xd57 합니다), `acurve` 가 `LINESTRING` 이 아닐 경우, `anode` 와 `anothernode` 가 `acurve` 의 시작점 및 종단점&#xc7 아닐 경우 오류가 발생합니다.

`acurve` 도형과 지형의 공간 참조 시스&#x 다를 경우 예외가 발생합니다.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.13

예시

참고

ST_RemEdgeModFace

ST_AddEdgeNewFaces

8.6.5 ST_RemEdgeNewFace

ST_RemEdgeNewFace — 경계선을 제거하고, 제거&#xd55 경계선이 두 표면을 분할하고 있&#x 경우, 원본 표면들을 삭제하고 새 표면 하나로 대체합니다.

Synopsis

integer **ST_RemEdgeNewFace**(varchar atopology, integer anedge);

설명

경계선을 제거하고, 제거한 경계&#x 두 표면을 분할하고 있을 경우, 원&# 표면들을 삭제하고 새 표면 하나&# 대체합니다.

새로 생성된 표면의 ID를 반환하거& 또는 새 표면이 생성되지 않은 경&#x NULL을 반환합니다. 제거한 경계선&#xc7

세계 표면에 매달려 있거나, 고립&#
있거나, 또는 (세계 표면이 다른 쪽&
표면을 침범하게 할 수 있게) 갇혀
있을 경우 새 표면을 생성할 수 없&

모든 기존의 결합된 경계선 및 관&#
결과에 맞춰 업데이트합니다.

Refuses to remove an edge participating in the definition of an existing TopoGeometry. Refuses to heal two faces if any TopoGeometry is defined by only one of them (and not the other).

어떤 인수가 NULL일 경우, 주어진 경&#xac
알려지지 않은 경우(경계선이 이&#
지형 스키마의 `edge` 테이블에 존재&#xd57
합니다), 지형 명칭이 유효하지 않&
경우 오류가 발생합니다.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.14

예시

참고

ST_RemEdgeModFace

ST_AddEdgeNewFaces

8.6.6 ST_RemEdgeModFace

ST_RemEdgeModFace — Removes an edge, and if the edge separates two faces deletes one face and modifies the other face to cover the space of both.

Synopsis

integer **ST_RemEdgeModFace**(varchar atopology, integer anedge);

설명

Removes an edge, and if the removed edge separates two faces deletes one face and modifies the other face to cover the space of both. Preferentially keeps the face on the right, to be consistent with ST_AddEdgeModFace. Returns the id of the face which is preserved.

모든 기존의 결합된 경계선 및 관&#
결과에 맞춰 업데이트합니다.

Refuses to remove an edge participating in the definition of an existing TopoGeometry. Refuses to heal two faces if any TopoGeometry is defined by only one of them (and not the other).

어떤 인수가 NULL일 경우, 주어진 경&#xac
알려지지 않은 경우(경계선이 이&#
지형 스키마의 `edge` 테이블에 존재&#xd57
합니다), 지형 명칭이 유효하지 않&
경우 오류가 발생합니다.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.15

예시

참고

ST_AddEdgeModFace

ST_RemEdgeNewFace

8.6.7 ST_ChangeEdgeGeom

ST_ChangeEdgeGeom — 지형 구조를 건드리는 일
없이 경계선의 형상을 변경합니&#x

Synopsis

integer **ST_ChangeEdgeGeom**(varchar atopology, integer anedge, geometry acurve);

설명

지형 구조를 건드리는 일 없이 경&#
형상을 변경합니다.

If any arguments are null, the given edge does not exist in the `edge` table of the topology schema, the `acurve` is not a `LINESTRING`, or the modification would change the underlying topology then an error is thrown.

`acurve` 도형과 지형의 공간 참조 시스&#xc
다를 경우 예외가 발생합니다.

새 `acurve` 가 단순 도형이 아닐 경우, 오&#
발생합니다.

예전 위치에서 새 위치로 경계선&#x
이동시킬 때 장애물에 부딪히는
경우 오류가 발생합니다.

1.1.0 버전부터 사용할 수 있습니다.

개선 사항: 2.0.0버전부터 지형의 일&#xad0
강제합니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details X.3.6

예시

```
SELECT topology.ST_ChangeEdgeGeom('ma_topo', 1,
                ST_GeomFromText('LINESTRING(227591.9 893900.4,227622.6 893844.3,227641.6  ↩
                    893816.6, 227704.5 893778.5)', 26986) );
 ----
 Edge 1 changed
```

참고

ST_AddEdgeModFace

ST_RemEdgeModFace

ST_ModEdgeSplit

8.6.8 ST_ModEdgeSplit

ST_ModEdgeSplit — 기존 경계선을 따라 새 노드&
추가한 다음, 원본 경계선을 수정&#
새 경계선을 추가해서 경계선을
분할합니다.

Synopsis

integer **ST_ModEdgeSplit**(varchar atopology, integer anedge, geometry apoint);

설명

기존 경계선을 따라 새 노드를 추&#
다음, 원본 경계선을 수정하고 새
경계선을 추가해서 경계선을 분&#x
기존의 모든 결합된 경계선들 및
관계성을 새로이 분할된 경계선&#x
맞춰 업데이트합니다. 새로 추가&#
노드의 식별자를 반환합니다.

Availability: 1.1

변경 사항: 2.0 미만 버전에서, 이 함&#xc21
ST_ModEdgesSplit이라는 잘못된 명칭이었습&#x

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9

예시

```
-- &#xacbd;&#xacc4;&#xc120; &#xcd94;&#xac00; --
 SELECT topology.AddEdge('ma_topo', ST_GeomFromText('LINESTRING(227592 893910, 227600  ↩
     893910)', 26986) ) As edgeid;

-- edgeid --
3


-- &#xacbd;&#xacc4;&#xc120; &#xbd84;&#xd560;  --
SELECT topology.ST_ModEdgeSplit('ma_topo',  3, ST_SetSRID(ST_Point(227594,893910),26986)  ) ↩
     As node_id;
        node_id
-------------------------
7
```

참고

ST_NewEdgesSplit, ST_ModEdgeHeal, ST_NewEdgeHeal, AddEdge

8.6.9 ST_ModEdgeHeal

ST_ModEdgeHeal — Heals two edges by deleting the node connecting them, modifying the first edge and deleting the second edge. Returns the id of the deleted node.

Synopsis

int **ST_ModEdgeHeal**(varchar atopology, integer anedge, integer anotheredge);

설명

Heals two edges by deleting the node connecting them, modifying the first edge and deleting the second edge. Returns the id of the deleted node. Updates all existing joined edges and relationships accordingly.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9

참고

ST_ModEdgeSplit ST_NewEdgesSplit

8.6.10 ST_NewEdgeHeal

ST_NewEdgeHeal — Heals two edges by deleting the node connecting them, deleting both edges, and replacing them with an edge whose direction is the same as the first edge provided.

Synopsis

int **ST_NewEdgeHeal**(varchar atopology, integer anedge, integer anotheredge);

설명

Heals two edges by deleting the node connecting them, deleting both edges, and replacing them with an edge whose direction is the same as the first edge provided. Returns the id of the new edge replacing the healed ones. Updates all existing joined edges and relationships accordingly.

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9

참고

ST_ModEdgeHeal ST_ModEdgeSplit ST_NewEdgesSplit

8.6.11 ST_MoveIsoNode

ST_MoveIsoNode — Moves an isolated node in a topology from one point to another. If new `apoint` geometry exists as a node an error is thrown. Returns description of move.

Synopsis

text **ST_MoveIsoNode**(varchar atopology, integer anode, geometry apoint);

설명

지형 안에 있는 고립된 노드를 어&#
위치에서 다른 위치로 이동합니&#x
새 `apoint` 도형의 위치에 노드가 존재&#x
경우 오류가 발생합니다.

If any arguments are null, the `apoint` is not a point, the existing node is not isolated (is a start or end point of an existing edge), new node location intersects an existing edge (even at the end points) or the new location is in a different face (since 3.2.0) then an exception is thrown.

포인트 도형과 지형의 공간 참조
시스템(SRID)이 다를 경우 예외가 발&#xc0

2.0.0 버전부터 사용할 수 있습니다.

Enhanced: 3.2.0 ensures the nod cannot be moved in a different face

This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X.3.2

예시

```
-- &#xd45c;&#xba74;&#xc774; &#xc5c6;&#xb294; &#xace0;&#xb9bd; &#xb178;&#xb4dc;&#xb97c;  ↩
    &#xcd94;&#xac00; --
SELECT topology.ST_AddIsoNode('ma_topo',  NULL, ST_GeomFromText('POINT(227579 893916)',  ↩
    26986) ) As nodeid;
 nodeid
--------
      7
-- &#xc0c8; &#xb178;&#xb4dc;&#xb97c; &#xc774;&#xb3d9; --
SELECT topology.ST_MoveIsoNode('ma_topo', 7,  ST_GeomFromText('POINT(227579.5 893916.5)',  ↩
    26986) ) As descrip;
                     descrip
-------------------------------------------------
Isolated Node 7 moved to location 227579.5,893916.5
```

참고

ST_AddIsoNode

8.6.12 ST_NewEdgesSplit

ST_NewEdgesSplit — 기존 경계선을 따라 새 노드&
추가한 다음, 원본 경계선을 삭제&#x
새 경계선 2개로 교체해서 경계선&#
분할합니다. 새 경계선들을 결합&#
새로 생성된 노드의 ID를 반환합니

Synopsis

integer **ST_NewEdgesSplit**(varchar atopology, integer anedge, geometry apoint);

설명

기존 경계선을 따라 `apoint` 포인트 위&#x
새 노드를 생성한 다음, 다음, 원본
경계선을 삭제하고 새 경계선 2개&#
교체해서 경계선 ID `anedge` 인 경계선을
분할합니다. 새 경계선들을 결합&#
새로 생성된 노드의 ID를 반환합니
기존의 모든 결합된 경계선들 및
관계성을 분할된 경계선에 맞춰
업데이트합니다.

포인트 도형과 지형의 공간 참조
시스템(SRID)이 다를 경우, `apoint` 가 포인&#xd2
도형이 아닐 경우, 포인트가 NULL일
경우, 해당 포인트의 위치에 이미
노드가 존재할 경우, 경계선이 기&#
경계선과 일치하지 않을 경우, 또&#x
포인트가 경계선 안에 있지 않을
경우 예외가 발생합니다.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X.3.8

예시

```
-- &#xacbd;&#xacc4;&#xc120; &#xcd94;&#xac00; --
SELECT topology.AddEdge('ma_topo', ST_GeomFromText('LINESTRING(227575 893917,227592 893900) ↩
    ', 26986) ) As edgeid;
-- &#xacb0;&#xacfc; --
edgeid
------
        2
-- &#xc0c8; &#xacbd;&#xacc4;&#xc120;&#xc744; &#xbd84;&#xd560; --
SELECT topology.ST_NewEdgesSplit('ma_topo', 2,  ST_GeomFromText('POINT(227578.5 893913.5)', ↩
     26986) ) As newnodeid;
 newnodeid
---------
       6
```

참고

ST_ModEdgeSplit ST_ModEdgeHeal ST_NewEdgeHeal AddEdge

8.6.13 ST_RemoveIsoNode

ST_RemoveIsoNode — 고립된 노드를 제거하고 작
내용을 설명하는 메시지를 반환&#
노드가 고립되지 않은 (경계선의
시작점이나 종단점인) 경우, 예외&#
발생합니다.

Synopsis

text **ST_RemoveIsoNode**(varchar atopology, integer anode);

설명

고립된 노드를 제거하고 작업 내&#x
설명하는 메시지를 반환합니다.
노드가 고립되지 않은 (경계선의
시작점이나 종단점인) 경우, 예외&#x
발생합니다.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X+1.3.3

예시

```
-- &#xd45c;&#xba74;&#xc774; &#xc5c6;&#xb294; &#xace0;&#xb9bd; &#xb178;&#xb4dc;&#xb97c;  ↩
    &#xc81c;&#xac70; --
SELECT topology.ST_RemoveIsoNode('ma_topo',  7 ) As result;
         result
-------------------------
 Isolated node 7 removed
```

참고

ST_AddIsoNode

8.6.14 ST_RemoveIsoEdge

ST_RemoveIsoEdge — Removes an isolated edge and returns description of action. If the edge is not isolated, then an exception is thrown.

Synopsis

text **ST_RemoveIsoEdge**(varchar atopology, integer anedge);

설명

Removes an isolated edge and returns description of action. If the edge is not isolated, then an exception is thrown.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X+1.3.3

예시

```
-- &#xd45c;&#xba74;&#xc774; &#xc5c6;&#xb294; &#xace0;&#xb9bd; &#xb178;&#xb4dc;&#xb97c;  ↩
    &#xc81c;&#xac70; --
SELECT topology.ST_RemoveIsoNode('ma_topo',  7 ) As result;
         result
-------------------------
 Isolated node 7 removed
```

참고

ST_AddIsoNode

8.7 지형 접근자

8.7.1 GetEdgeByPoint

GetEdgeByPoint — Finds the edge-id of an edge that intersects a given point.

Synopsis

integer **GetEdgeByPoint**(varchar atopology, geometry apoint, float8 tol1);

설명

Retrieves the id of an edge that intersects a Point.

이 함수는 지형, 포인트, 그리고 허&
오차를 입력받아 정수(edgeid)를 반환&#xc
tolerance = 0일 경우 포인트와 경계선이 교&
합니다.

If `apoint` doesn't intersect an edge, returns 0 (zero).

0보다 큰 허용 오차를 설정했는데
포인트 가까이에 하나 이상의 경&#
있을 경우 예외가 발생합니다.

> **Note**
> 이 함수는 tolerance = 0일 경우 ST_Intersects를, 그렇지 않을 경우 ST_DWithin을 이용합니다.

GEOS 모듈로 실행

2.0.0 버전부터 사용할 수 있습니다.

예시

다음 예시들은 AddEdge 에서 생성한 경&#
사용합니다.

```
SELECT topology.GetEdgeByPoint('ma_topo',geom, 1) As with1mtol, topology.GetEdgeByPoint(' ↩
    ma_topo',geom,0) As withnotol
FROM ST_GeomFromEWKT('SRID=26986;POINT(227622.6 893843)') As geom;
 with1mtol | withnotol
-----------+-----------
         2 |         0
```

```
SELECT topology.GetEdgeByPoint('ma_topo',geom, 1) As nearnode
FROM ST_GeomFromEWKT('SRID=26986;POINT(227591.9 893900.4)') As geom;

-- &#xc624;&#xb958; &#xbc1c;&#xc0dd; --
ERROR:  Two or more edges found
```

참고

AddEdge, GetNodeByPoint, GetFaceByPoint

8.7.2 GetFaceByPoint

GetFaceByPoint — Finds face intersecting a given point.

Synopsis

integer **GetFaceByPoint**(varchar atopology, geometry apoint, float8 tol1);

설명

Finds a face referenced by a Point, with given tolerance.

The function will effectively look for a face intersecting a circle having the point as center and the tolerance as radius.

If no face intersects the given query location, 0 is returned (universal face).

If more than one face intersect the query location an exception is thrown.

2.0.0 버전부터 사용할 수 있습니다.

Enhanced: 3.2.0 more efficient implementation and clearer contract, stops working with invalid topologies.

예시

```
SELECT topology.GetFaceByPoint('ma_topo',geom, 10) As with1mtol, topology.GetFaceByPoint(' ↩
    ma_topo',geom,0) As withnotol
        FROM ST_GeomFromEWKT('POINT(234604.6 899382.0)') As geom;

         with1mtol | withnotol
        -----------+-----------
                         1 |         0
```

```
SELECT topology.GetFaceByPoint('ma_topo',geom, 1) As nearnode
        FROM ST_GeomFromEWKT('POINT(227591.9 893900.4)') As geom;

-- &#xc624;&#xb958; &#xbc1c;&#xc0dd; --
ERROR:  Two or more faces found
```

참고

GetFaceContainingPoint, AddFace, GetNodeByPoint, GetEdgeByPoint

8.7.3 GetFaceContainingPoint

GetFaceContainingPoint — Finds the face containing a point.

Synopsis

integer **GetFaceContainingPoint**(text atopology, geometry apoint);

설명

Returns the id of the face containing a point.

An exception is thrown if the point falls on a face boundary.

Note
The function relies on a valid topology, using edge linking and face labeling.

Availability: 3.2.0

참고

ST_GetFaceGeometry

8.7.4 GetNodeByPoint

GetNodeByPoint — Finds the node-id of a node at a point location.

Synopsis

integer **GetNodeByPoint**(varchar atopology, geometry apoint, float8 tol1);

설명

Retrieves the id of a node at a point location.

The function returns an integer (id-node) given a topology, a POINT and a tolerance. If tolerance = 0 means exact intersection, otherwise retrieves the node from an interval.

If `apoint` doesn't intersect a node, returns 0 (zero).

If use tolerance > 0 and there is more than one node near the point then an exception is thrown.

Note
이 함수는 tolerance = 0일 경우 ST_Intersects를, 그렇지 않을 경우 ST_DWithin을 이용합니다.

GEOS 모듈로 실행

2.0.0 버전부터 사용할 수 있습니다.

예시

다음 예시들은 AddEdge 에서 생성한 경&#x
사용합니다.

```
SELECT topology.GetNodeByPoint('ma_topo',geom, 1) As nearnode
 FROM ST_GeomFromEWKT('SRID=26986;POINT(227591.9 893900.4)') As geom;
  nearnode
----------
         2
```

```
SELECT topology.GetNodeByPoint('ma_topo',geom, 1000) As too_much_tolerance
 FROM ST_GeomFromEWKT('SRID=26986;POINT(227591.9 893900.4)') As geom;

 -- &#xc624;&#xb958; &#xbc1c;&#xc0dd; --
 ERROR:  Two or more nodes found
```

참고

AddEdge, GetEdgeByPoint, GetFaceByPoint

8.7.5 GetTopologyID

GetTopologyID — 지형의 명칭을 입력받아 topology.topology 테이블에 있는 지형의 ID를 반&#xd6

Synopsis

integer **GetTopologyID**(varchar toponame);

설명

지형의 명칭을 입력받아 topology.topology 테&#xc
있는 지형의 ID를 반환합니다.

Availability: 1.1

예시

```
SELECT topology.GetTopologyID('ma_topo') As topo_id;
 topo_id
---------
       1
```

참고

CreateTopology, DropTopology, GetTopologyName, GetTopologySRID

8.7.6 GetTopologySRID

GetTopologySRID — 지형의 명칭을 입력받아 topology.topology 테이블에 있는 지형의 SRID를 반&#x

Synopsis

integer **GetTopologyID**(varchar toponame);

설명

지형의 명칭을 입력받아 topology.topology 테&#xc
있는 지형의 공간 참조 식별자를
반환합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT topology.GetTopologySRID('ma_topo') As SRID;
 SRID
-------
  4326
```

참고

CreateTopology, DropTopology, GetTopologyName, GetTopologyID

8.7.7 GetTopologyName

GetTopologyName — 지형의 ID를 입력받아 지형(&#xc2a
명칭을 반환합니다.

Synopsis

varchar **GetTopologyName**(integer topology_id);

설명

지형의 지형 ID를 입력받아 topology.topology 테&
지형의 지형명(스키마)을 반환합&

Availability: 1.1

예시

```
SELECT topology.GetTopologyName(1) As topo_name;
 topo_name
-----------
 ma_topo
```

참고

CreateTopology, DropTopology, GetTopologyID, GetTopologySRID

8.7.8 ST_GetFaceEdges

ST_GetFaceEdges — `aface` 의 경계를 이루는 정렬된
경계선들의 집합을 반환합니다.

Synopsis

getfaceedges_returntype **ST_GetFaceEdges**(varchar atopology, integer aface);

설명

`aface` 의 경계를 이루는 정렬된 경계&#xc
집합을 반환합니다. 각 출력물은
순차(sequence) 및 경계선 ID(edgeid)로 이루어집&#
순차 번호는 1부터 시작합니다.

각 고리의 경계선을 가장 작은 식&#
가진 경계선부터 열거합니다. 경&#
순서는 왼손 법칙을 따릅니다(각
경계선의 왼쪽 방향으로 표면의
경계선을 구성하게 됩니다).

2.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.5

예시

```
-- &#xd45c;&#xba74; 1&#xc758; &#xacbd;&#xacc4;&#xb97c; &#xc774;&#xb8e8;&#xb294;  ↩
    &#xacbd;&#xacc4;&#xc120;&#xb4e4;&#xc744; &#xbc18;&#xd658;
SELECT (topology.ST_GetFaceEdges('tt', 1)).*;
-- &#xacb0;&#xacfc; --
 sequence | edge
----------+------
        1 |   -4
        2 |    5
        3 |    7
        4 |   -6
        5 |    1
        6 |    2
        7 |    3
(7 rows)
```

```
-- &#xd45c;&#xba74; 1&#xc758; &#xacbd;&#xacc4;&#xb97c; &#xc774;&#xb8e8;&#xc740;  ↩
    &#xacbd;&#xacc4;&#xc120;&#xb4e4;&#xc758; &#xb3c4;&#xd615;&#xacfc;
-- &#xc21c;&#xcc28; &#xbc0f; &#xacbd;&#xacc4;&#xc120; ID&#xb97c; &#xbc18;&#xd658;
-- &#xb3c4;&#xd615;&#xacfc; &#xc21c;&#xcc28;&#xb9cc; &#xd544;&#xc694;&#xd560;  ↩
    &#xacbd;&#xc6b0;, ST_GetFaceGeometry &#xd568;&#xc218;&#xb97c; &#xc774;&#xc6a9;&#xd560;  ↩
    &#xc218; &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT t.seq, t.edge, geom
FROM topology.ST_GetFaceEdges('tt',1) As t(seq,edge)
        INNER JOIN tt.edge AS e ON abs(t.edge) = e.edge_id;
```

참고

GetRingEdges, AddFace, ST_GetFaceGeometry

8.7.9 ST_GetFaceGeometry

ST_GetFaceGeometry — 입력 지형으로부터 설정&#xb41
표면 ID를 가진 폴리곤을 반환합니&

Synopsis

geometry **ST_GetFaceGeometry**(varchar atopology, integer aface);

설명

입력 지형으로부터 설정된 표면 ID를 가진 폴리곤을 반환합니다. 표면구성하는 경계선들로부터 폴리곤빌드합니다.

Availability: 1.1

This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.16

예시

```
-- AddFace &#xd568;&#xc218;&#xb97c; &#xd1b5;&#xd574; &#xcd94;&#xac00;&#xb41c;  ↩
    &#xd3f4;&#xb9ac;&#xace4;&#xc758; WKT&#xb97c; &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(topology.ST_GetFaceGeometry('ma_topo', 1)) As facegeomwkt;
-- &#xacb0;&#xacfc; --
               facegeomwkt

------------------------------------------------------------------------------
 POLYGON((234776.9 899563.7,234896.5 899456.7,234914 899436.4,234946.6 899356.9,
234872.5 899328.7,234891 899285.4,234992.5 899145,234890.6 899069,
234755.2 899255.4,234612.7 899379.4,234776.9 899563.7))
```

참고

AddFace

8.7.10 GetRingEdges

GetRingEdges — 입력 경계선 쪽을 따라 탐색한 부호가 있는 경계선 식별자들의 정렬된 집합을 반환합니다.

Synopsis

getfaceedges_returntype **GetRingEdges**(varchar atopology, integer aring, integer max_edges=null);

설명

입력 경계선 쪽을 따라 탐색한 부호가 있는 경계선 식별자들의 정렬된 집합을 반환합니다. 각 출력물은 순차(sequence) 및 부호가 있는 경계선 ID(edgeid)이루어집니다. 순차 번호는 1부터 시작합니다.

양의 부호를 가진 경계선 ID를 넘겨경우, 해당 경계선의 왼쪽에서 탐시작해서 경계선의 방향으로 진음의 부호를 가진 경계선 ID를 넘겨경우, 해당 경계선의 오른쪽에서 탐색을 시작해서 경계선 방향의 반대로 진행합니다.

`max_edges` 가 NULL이 아닐 경우 함수가 해당 개수 이상의 레코드를 반환하지 않습니다. 유효하지 않을 수도 있&#
지형을 󌲘리할 때 이 파라미터를
안전 장치로 쓸 수 있다는 의미입&#

> **Note**
> 이 함수는 메타데이터를 링크하는 경계선 고리를 이용합니다.

2.0.0 버전부터 사용할 수 있습니다.

참고

ST_GetFaceEdges, GetNodeEdges

8.7.11 GetNodeEdges

GetNodeEdges — 입력 노드를 따르는 경계선&#x
정렬된 집합을 반환합니다.

Synopsis

getfaceedges_returntype **GetNodeEdges**(varchar atopology, integer anode);

설명

입력 노드를 따르는 경계선들의
정렬된 집합을 반환합니다. 각 출&
순차 및 부호를 가진 경계선 ID로
구성됩니다. 순차 번호는 1부터 시&
양의 부호를 가진 경계선은 입력
노드로부터 시작합니다. 음의 부&#
가진 경계선은 입력 노드로 끝납&#
페쇄형 경계선은 두 번 (두 부호를
가지고) 표출될 것입니다. 북쪽부&#
시작하는 시계 방향으로 정렬됩&#x

> **Note**
> 이 함수는 정렬 순서를 메타데이터에서 추출하기보다 계산하기 때문에 경계선 고리 링크를 빌드하는 데 유용합니다.

2.0 버전부터 사용할 수 있습니다.

참고

getfaceedges_returntype, GetRingEdges, ST_Azimuth

8.8 지형 공간 처리

8.8.1 Polygonize

Polygonize — Finds and registers all faces defined by topology edges.

Synopsis

text **Polygonize**(varchar toponame);

설명

Registers all faces that can be built out a topology edge primitives.

입력 지형이 스스로 교차하는 경&#
가지고 있지 않다고 가정합니다.

Note
이미 알려진 표면을 인식하기 때문에, 동일한 지형에 대해 Polygonize 함수를 반복해서 호출하는 편이 안전합니다.

Note
이 함수는 edge 테이블의 next_left_edge 및 next_right_edge 항목을 이용하지도 설정하지도 않습니다.

2.0.0 버전부터 사용할 수 있습니다.

참고

AddFace, ST_Polygonize

8.8.2 AddNode

AddNode — 설정한 지형 스키마의 노드
테이블에 포인트 노드를 추가하&#
새 노드의 노드 ID(nodeid)를 반환합니다.
새 포인트 위치에 이미 노드가 존&#
경우, 기존 노드 ID를 반환합니다.

Synopsis

integer **AddNode**(varchar toponame, geometry apoint, boolean allowEdgeSplitting=false, boolean computeContainingFace=false);

설명

설정한 지형 스키마의 노드 테이&#
포인트 노드를 추가합니다. AddEdge 함&#
호출할 때 경계선의 시작점 및 종&#
자동적으로 추가하므로, 경계선&#
노드를 따로 추가할 필요는 없습&#

새 노드를 가로지르는 경계선이
있을 경우, `allowEdgeSplitting` 파라미터 값에
따라 예외가 발생하거나 또는 해&#
경계선을 분할합니다.

`computeContainingFace` 가 참일 경우 새로 추가된
노드를 정확히 담고 있는 표면을
계산합니다.

Note

`apoint` 도형의 위치에 이미 노드가
존재할 경우, 새 노드를
추가하지 않고 기존 노드 ID(nodeid)를
반환합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT topology.AddNode('ma_topo', ST_GeomFromText('POINT(227641.6 893816.5)', 26986) ) As ↩
    nodeid;
-- &#xacb0;&#xacfc; --
nodeid
--------
 4
```

참고

AddEdge, CreateTopology

8.8.3 AddEdge

AddEdge — 설정한 지형 스키마의 경계선
테이블에 라인스트링 경계선을
추가하고, 설정한 라인스트링 도&#
이용해서 포인트 노드 테이블에
경계선의 시작점 및 종단점을 추&#x
다음 새 (또는 기존) 경계선의 경계&
ID(edgeid)를 반환합니다.

Synopsis

integer **AddEdge**(varchar toponame, geometry aline);

설명

설정한 라인스트링 도형을 이용&#x
설정한 toponame 스키마의 경계선 테이&
경계선을, 노드 테이블에 경계선&#x
노드를 추가한 다음 새 (또는 기존)
레코드의 경계선 ID(edgeid)를 반환합니&#
새로 추가된 경계선은 양쪽에 "세&#
표면을 가지며 자기 자신에게 링&#x

Note

기존 라인스트링 경계선이 aline 도형을 가로지르거나, 중첩하거나, 또는 담고 있을 경우 오류가 발생하고 경계선을 추가하지 않습니다.

Note

aline 도형의 srid 와 지형에 대해 정의된 srid 가 동일해야만 합니다. 그렇지 않을 경우 유효하지 않은 공간 참조 시스템 오류가 발생할 것입니다.

GEOS 모듈로 실행

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT topology.AddEdge('ma_topo', ST_GeomFromText('LINESTRING(227575.8 893917.2,227591.9  ↩
    893900.4)', 26986) ) As edgeid;
-- &#xacb0;&#xacfc; --
edgeid
--------
 1

SELECT topology.AddEdge('ma_topo', ST_GeomFromText('LINESTRING(227591.9 893900.4,227622.6  ↩
    893844.2,227641.6 893816.5,
 227704.5 893778.5)', 26986) ) As edgeid;
-- &#xacb0;&#xacfc; --
edgeid
--------
 2

 SELECT topology.AddEdge('ma_topo', ST_GeomFromText('LINESTRING(227591.2 893900, 227591.9  ↩
     893900.4,
  227704.5 893778.5)', 26986) ) As edgeid;
 -- &#xc624;&#xb958; &#xbc1c;&#xc0dd; --
 ERROR:  Edge intersects (not on endpoints) with existing edge 1
```

참고

TopoGeo_AddLineString, CreateTopology, Section 4.5

8.8.4 AddFace

AddFace — 지형에 표면 원시형(face primitive)을 등&#xb8
그 식별자를 반환합니다.

Synopsis

integer **AddFace**(varchar toponame, geometry apolygon, boolean force_new=false);

설명

지형에 표면 원시형(face primitive)을 등록&#xd55
그 식별자를 반환합니다.

새로 추가된 표면의 left_face 및 right_face 항목&#x
정확한 값을 가지도록 그 외곽선&#x
형성하는 경계선들 및 표면이 담&#x
있는 경계선들을 업데이트합니&#x
표면이 담고 있는 고립된 노드들&#
containing_face 항목이 정확한 값을 가지도&#xb8
업데이트할 것입니다.

> **Note**
> 이 함수는 edge 테이블의 next_left_edge 및 next_right_edge 항목을 이용하지도 설정하지도 않습니다.

대상 지형이 유효하다고 (자체 교&#
경계선을 담고 있지 않다고) 가정&#x
기존 경계선들이 폴리곤 외곽선&#xc
완전하게 정의하고 있지 않거나,
또는 폴리곤이 기존 표면과 중첩&#x
경우 예외가 발생합니다.

`apolygon` 도형과 동일한 표면이 이미 존&
경우, `force_new` 가 (기본값인) 거짓이면
기존 표면의 표면 ID를 반환하고,
`force_new` 가 참이면 새로 등록된 표면에
새 ID를 할당할 것입니다.

> **Note**
> 기존 표면을 새로 등록할 경우 (force_new = true) 경계선, 노드, 관계성 테이블에 있는 기존 표면에 대한 예전 참조들을 해결하기 위한 어떤 작동도 하지 않을 것입니다. 또 기존 표면 레코드의 MBR 항목도 업데이트하지 않을 것입니다. 호출자가 해결해야 할 문제입니다.

Note

apolygon 도형의 srid 와 지형에 대해 정의된 srid 가 동일해야만 합니다. 그렇지 않을 경우 유효하지 않은 공간 참조 시스템 오류가 발생할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xba3c;&#xc800; generate_series&#xb97c; &#xbc18;&#xbcf5;&#xc790;(iterator)&#xb85c;  ↩
    &#xc774;&#xc6a9;&#xd574;&#xc11c; &#xacbd;&#xacc4;&#xc120;&#xc744;  ↩
    &#xcd94;&#xac00;&#xd569;&#xb2c8;&#xb2e4;.
-- (&#xb2e4;&#xc74c; &#xcffc;&#xb9ac;&#xb294; generate_series&#xc758;  ↩
    &#xcd5c;&#xb300;&#xac12; &#xc124;&#xc815; &#xb54c;&#xbb38;&#xc5d0;  ↩
    &#xd3ec;&#xc778;&#xd2b8; 10,000&#xac1c; &#xbbf8;&#xb9cc;&#xc778;  ↩
    &#xd3f4;&#xb9ac;&#xace4;&#xc5d0; &#xb300;&#xd574;&#xc11c;&#xb9cc;  ↩
    &#xb3d9;&#xc791;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;.)
SELECT topology.AddEdge('ma_topo', ST_MakeLine(ST_PointN(geom,i), ST_PointN(geom, i + 1) )) ↩
     As edgeid
    FROM (SELECT  ST_NPoints(geom) AS npt, geom
            FROM
                (SELECT ST_Boundary(ST_GeomFromText('POLYGON((234896.5 899456.7,234914  ↩
                    899436.4,234946.6 899356.9,234872.5 899328.7,
                234891 899285.4,234992.5 899145, 234890.6 899069,234755.2 899255.4,
                234612.7 899379.4,234776.9 899563.7,234896.5 899456.7))', 26986) )  As geom
            )  As geoms) As facen CROSS JOIN generate_series(1,10000) As i
         WHERE i < npt;
-- &#xacb0;&#xacfc; --
 edgeid
--------
      3
      4
      5
      6
      7
      8
      9
     10
     11
     12
(10 rows)
-- &#xadf8; &#xb2e4;&#xc74c; &#xd45c;&#xba74;&#xc744;  ↩
    &#xcd94;&#xac00;&#xd569;&#xb2c8;&#xb2e4;. --

SELECT topology.AddFace('ma_topo',
    ST_GeomFromText('POLYGON((234896.5 899456.7,234914 899436.4,234946.6 899356.9,234872.5  ↩
        899328.7,
    234891 899285.4,234992.5 899145, 234890.6 899069,234755.2 899255.4,
    234612.7 899379.4,234776.9 899563.7,234896.5 899456.7))', 26986) ) As faceid;
-- &#xacb0;&#xacfc; --
faceid
--------
 1
```

참고

AddEdge, CreateTopology, Section 4.5

8.8.5 ST_Simplify

ST_Simplify — 더글러스-패커(Douglas-Peucker) 알고리즘통해 입력 TopoGeometry 의 "단순화된" 도형버전을 반환합니다.

Synopsis

geometry **ST_Simplify**(TopoGeometry tg, float8 tolerance);

설명

각 구성 요소의 경계선에 더글러&#x패커(Douglas-Peucker) 알고리즘을 작용해서 입력 TopoGeometry 의 "단순화된" 도형 버전&#xc반환합니다.

Note

반환된 도형이 단순하지 않거나, 유효하지 않을 수도 있습니다.
단순성/유효성을 유지하는 데 구성 요소의 경계선을 분할하는 것이 도움이 될 수도 있습니다.

GEOS 모듈로 실행

2.1.0 버전부터 사용할 수 있습니다.

참고

도형 ST_Simplify, ST_IsSimple, ST_IsValid, ST_ModEdgeSplit

8.8.6 RemoveUnusedPrimitives

RemoveUnusedPrimitives — Removes topology primitives which not needed to define existing TopoGeometry objects.

Synopsis

int **RemoveUnusedPrimitives**(text topology_name, geometry bbox);

설명

Finds all primitives (nodes, edges, faces) that are not strictly needed to represent existing TopoGeometry objects and removes them, maintaining topology validity (edge linking, face labeling) and TopoGeometry space occupation.

No new primitive identifiers are created, but rather existing primitives are expanded to include merged faces (upon removing edges) or healed edges (upon removing nodes).

Availability: 3.3.0

참고

ST_ModEdgeHeal, ST_RemEdgeModFace

8.9 TopoGeometry 작성자

8.9.1 CreateTopoGeom

CreateTopoGeom — 지형 요소 배열로부터 새 지&#
도형 객체를 생성합니다. tg_type은 1: [멀&
2: [멀티]라인, 3: [멀티]폴리곤, 4: 도형 집&#

Synopsis

topogeometry **CreateTopoGeom**(varchar toponame, integer tg_type, integer layer_id, topoelementarray tg_objs);
topogeometry **CreateTopoGeom**(varchar toponame, integer tg_type, integer layer_id);

설명

Creates a topogeometry object for layer denoted by `layer_id` and registers it in the relations table in the `toponame` schema.

`tg_type` is an integer: 1:[multi]point (punctal), 2:[multi]line (lineal), 3:[multi]poly (areal), 4:collection. `layer_id` is the layer id in the topology.layer table.

노드들의 집합이 점형 레이어를
형성하고, 경계선들의 집합이 선&#
레이어를 형성하고, 표면들의 집&#
면형 레이어를 형성하며, 노드, 경&
표면의 혼합 집합이 도형 집합을
형성할 수 있습니다.

구성 요소 배열을 생략하면 텅 빈
TopoGeometry 객체를 생성합니다.

Availability: 1.1

예시: 기존 경계선으로부터 형성

Create a topogeom in ri_topo schema for layer 2 (our ri_roads), of type (2) LINE, for the first edge (we loaded in `ST_CreateTopoGeo`)

```
INSERT INTO ri.ri_roads(road_name, topo) VALUES('Unknown', topology.CreateTopoGeom('ri_topo ↩
    ',2,2,'{{1,2}}'::topology.topoelementarray);
```

예시: 면형 도형을 가장 잘 추측한 TopoGeometry로 변환

표면들의 집합으로 형성돼야 하&#x
도형을 가지고 있다고 해봅시다.
예를 들어 blockgroups 테이블이 있는데 각
블록 그룹의 TopoGeometry를 알고 싶습니&#xb2e4
데이터가 완벽하게 정렬돼 있다&#x
다음과 같이 할 수 있습니다:

```
-- TopoGeometry &#xc5f4;&#xc744; &#xc0dd;&#xc131; --
SELECT topology.AddTopoGeometryColumn(
        'topo_boston',
        'boston', 'blockgroups', 'topo', 'POLYGON');

-- addtopgeometrycolumn --
1

-- &#xbaa8;&#xb4e0; &#xac83;&#xc774; &#xacbd;&#xacc4;&#xc120;&#xacfc;  ↩
    &#xc644;&#xbcbd;&#xd558;&#xac8c; &#xc815;&#xb82c;&#xb41c;&#xb2e4;&#xace0;  ↩
    &#xac00;&#xc815;&#xd558;&#xace0;
-- &#xc5f4;&#xc744; &#xc5c5;&#xb370;&#xc774;&#xd2b8;&#xd569;&#xb2c8;&#xb2e4;.
UPDATE boston.blockgroups AS bg
        SET topo = topology.CreateTopoGeom('topo_boston'
        ,3,1
        , foo.bfaces)
FROM (SELECT b.gid,  topology.TopoElementArray_Agg(ARRAY[f.face_id,3]) As bfaces
        FROM boston.blockgroups As b
            INNER JOIN topo_boston.face As f ON b.geom && f.mbr
        WHERE ST_Covers(b.geom, topology.ST_GetFaceGeometry('topo_boston', f.face_id))
            GROUP BY b.gid) As foo
WHERE foo.gid = bg.gid;
```

```
--the world is rarely perfect allow for some error
--count the face if 50% of it falls
-- within what we think is our blockgroup boundary
UPDATE boston.blockgroups AS bg
        SET topo = topology.CreateTopoGeom('topo_boston'
        ,3,1
        , foo.bfaces)
FROM (SELECT b.gid,  topology.TopoElementArray_Agg(ARRAY[f.face_id,3]) As bfaces
        FROM boston.blockgroups As b
            INNER JOIN topo_boston.face As f ON b.geom && f.mbr
        WHERE ST_Covers(b.geom, topology.ST_GetFaceGeometry('topo_boston', f.face_id))
        OR
 (  ST_Intersects(b.geom, topology.ST_GetFaceGeometry('topo_boston', f.face_id))
            AND ST_Area(ST_Intersection(b.geom, topology.ST_GetFaceGeometry('topo_boston',  ↩
                f.face_id) ) ) >
                ST_Area(topology.ST_GetFaceGeometry('topo_boston', f.face_id))*0.5
                )
            GROUP BY b.gid) As foo
WHERE foo.gid = bg.gid;

-- and if we wanted to convert our topogeometry back
-- to a denormalized geometry aligned with our faces and edges
-- cast the topo to a geometry
-- The really cool thing is my new geometries
-- are now aligned with my tiger street centerlines
UPDATE boston.blockgroups SET new_geom = topo::geometry;
```

참고

AddTopoGeometryColumn, toTopoGeom ST_CreateTopoGeo, ST_GetFaceGeometry, TopoElementArray, TopoElementArray_Agg

8.9.2 toTopoGeom

toTopoGeom — Converts a simple Geometry into a topo geometry.

Synopsis

topogeometry **toTopoGeom**(geometry geom, varchar toponame, integer layer_id, float8 tolerance);
topogeometry **toTopoGeom**(geometry geom, topogeometry topogeom, float8 tolerance);

설명

단순 도형을 TopoGeometry 로 변환합니다.

기저 지형에 입력 도형을 표현해&#
하는 지형 원시형을 추가할 것입&#
이 지형 원시형이 기존 지형을 분&#
수도 있습니다. 분할된 지형들은
`relation` 테이블에서 출력 TopoGeometry와 관련&#xb
것입니다.

기존 TopoGeometry 객체는 (`topogeom` 을 설정할 경&#x
제외할 수도 있습니다) 자기 형상&#
유지할 것입니다.

`tolerance` 를 설정하면 입력 도형을 기&#xc874
원시형에 스냅시키는 데 허용 오&#
이용할 것입니다.

변종 1의 경우 입력 지형(`toponame`)의 입&#xb82
레이어(`layer_id`)에 대해 새 TopoGeometry를 생성&#x
것입니다.

변종 2의 경우, 기존 TopoGeometry(`toponame`)에 작업&#
생성된 원시형을 추가할 것입니&#x
기존 TopoGeometry의 최종 형상에 공간을
추가할 수도 있습니다. 새 형상이
예전 형상을 완전히 대체하도록
하려면 clearTopoGeom 을 참조하십시오.

2.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 기존 TopoGeometry를
입력받는 버전을 추가했습니다.

예시

다음은 완전히 자급자족하는 독&#
작업 흐름(workflow)입니다.

```
-- &#xc544;&#xc9c1; &#xc9c0;&#xd615;&#xc744; &#xc124;&#xc815;&#xd558;&#xc9c0;  ↩
    &#xc54a;&#xc558;&#xb2e4;&#xba74; &#xb2e4;&#xc74c; &#xcffc;&#xb9ac;&#xb97c;  ↩
    &#xc2e4;&#xd589;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
-- &#xc5b4;&#xb5a4; &#xd5c8;&#xc6a9; &#xc624;&#xcc28;&#xb3c4;  ↩
    &#xd5c8;&#xc6a9;&#xd558;&#xc9c0; &#xc54a;&#xb294; &#xc9c0;&#xd615;&#xc744;  ↩
    &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
SELECT topology.CreateTopology('topo_boston_test', 2249);
-- &#xc0c8; &#xd14c;&#xc774;&#xbe14; &#xc0dd;&#xc131;
CREATE TABLE nei_topo(gid serial primary key, nei varchar(30));
-- &#xc0c8; &#xd14c;&#xc774;&#xbe14;&#xc5d0; TopoGeometry &#xc5f4;&#xc744; &#xcd94;&#xac00;
SELECT topology.AddTopoGeometryColumn('topo_boston_test', 'public', 'nei_topo', 'topo', ' ↩
    MULTIPOLYGON') As new_layer_id;
new_layer_id
------------
1
```

```
-- &#xc0c8; TopoGeometry &#xc5f4;&#xc744; &#xcc44;&#xc6b0;&#xb294; &#xb370; &#xc0c8;  ↩
    &#xb808;&#xc774;&#xc5b4; ID&#xb97c; &#xc774;&#xc6a9;
-- &#xc0c8; &#xb808;&#xc774;&#xc5b4;&#xc5d0; &#xd5c8;&#xc6a9; &#xc624;&#xcc28;&#xac00; 0 ↩
    &#xc778; TopoGeometry&#xb97c; &#xcd94;&#xac00;
INSERT INTO nei_topo(nei, topo)
SELECT nei,  topology.toTopoGeom(geom, 'topo_boston_test', 1)
FROM neighborhoods
WHERE gid BETWEEN 1 and 15;

-- &#xc791;&#xc5c5; &#xb0b4;&#xc6a9;&#xc744; &#xd655;&#xc778;&#xd558;&#xb824;&#xba74;  ↩
    &#xb2e4;&#xc74c; &#xcffc;&#xb9ac;&#xb97c; &#xc774;&#xc6a9;&#xd569;&#xb2c8;&#xb2e4;. --
SELECT * FROM
    topology.TopologySummary('topo_boston_test');

-- &#xc694;&#xc57d;&#xbb38; --
Topology topo_boston_test (5), SRID 2249, precision 0
61 nodes, 87 edges, 35 faces, 15 topogeoms in 1 layers
Layer 1, type Polygonal (3), 15 topogeoms
 Deploy: public.nei_topo.topo
```

```
-- &#xbaa8;&#xb4e0; TopoGeometry &#xd3f4;&#xb9ac;&#xace4;&#xc744; 10 ↩
    &#xbbf8;&#xd130;&#xc529; &#xc904;&#xc785;&#xb2c8;&#xb2e4;.
UPDATE nei_topo SET topo = ST_Buffer(clearTopoGeom(topo), -10);

-- &#xc704;&#xc758; &#xc5f0;&#xc0b0;&#xc73c;&#xb85c; &#xb0a8;&#xc740;  ↩
    &#xc544;&#xbb34;&#xac83;&#xb3c4; &#xc5c6;&#xb294; &#xd1a0;&#xc9c0;(no-one-lands) ↩
    &#xb97c; &#xc9d1;&#xacc4;&#xd569;&#xb2c8;&#xb2e4;.
-- GRASS&#xc5d0;&#xc11c;&#xb294; &#xc774;&#xac78; "polygon0 layer"&#xb77c;&#xace0;  ↩
    &#xbd80;&#xb97c; &#xac81;&#xb2c8;&#xb2e4;.
SELECT ST_GetFaceGeometry('topo_boston_test', f.face_id)
  FROM topo_boston_test.face f
  WHERE f.face_id
> 0 -- don't consider the universe face
  AND NOT EXISTS ( -- check that no TopoGeometry references the face
    SELECT * FROM topo_boston_test.relation
    WHERE layer_id = 1 AND element_id = f.face_id
  );
```

참고

CreateTopology, AddTopoGeometryColumn, CreateTopoGeom, TopologySummary, clearTopoGeom

8.9.3 TopoElementArray_Agg

TopoElementArray_Agg — Returns a `topoelementarray` for a set of element_id, type arrays (topoelements).

Synopsis

topoelementarray **TopoElementArray_Agg**(topoelement set tefield);

설명

TopoElement 집합으로부터 TopoElementArray 를 생성하데 쓰입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT topology.TopoElementArray_Agg(ARRAY[e,t]) As tea
  FROM generate_series(1,3) As e CROSS JOIN generate_series(1,4) As t;
  tea
---------------------------------------------------------------------------
{{1,1},{1,2},{1,3},{1,4},{2,1},{2,2},{2,3},{2,4},{3,1},{3,2},{3,3},{3,4}}
```

참고

TopoElement, TopoElementArray

8.9.4 TopoElement

TopoElement — Converts a topogeometry to a topoelement.

Synopsis

topoelement **TopoElement**(topogeometry topo);

설명

Converts a TopoGeometry to a TopoElement.

Availability: 3.4.0

예시

다음은 완전히 자급자족하는 독&#
작업 흐름(workflow)입니다.

```
-- do this if you don't have a topology setup already
-- Creates topology not allowing any tolerance
SELECT TopoElement(topo)
FROM neighborhoods;
```

```
-- using as cast
SELECT topology.TopoElementArray_Agg(topo::topoelement)
FROM neighborhoods
GROUP BY city;
```

참고

TopoElementArray_Agg, TopoGeometry, TopoElement

8.10 TopoGeometry 편집자

8.10.1 clearTopoGeom

clearTopoGeom — Clears the content of a topo geometry.

Synopsis

topogeometry **clearTopoGeom**(topogeometry topogeom);

설명

TopoGeometry 의 내용을 지워서 텅 빈 TopoGeometry 로 바꿉니다. toTopoGeom 함수와 결합해서 기 객체 및 더 높은 계층 레벨에 있는 모든 의존적인 객체의 형상을 교&# 데 가장 유용합니다.

2.1 버전부터 사용할 수 있습니다.

예시

```
-- &#xbaa8;&#xb4e0; TopoGeometry &#xd3f4;&#xb9ac;&#xace4;&#xc744; 10 ↩
    &#xbbf8;&#xd130;&#xc529; &#xc904;&#xc785;&#xb2c8;&#xb2e4;.
UPDATE nei_topo SET topo = ST_Buffer(clearTopoGeom(topo), -10);
```

참고

toTopoGeom

8.10.2 TopoGeom_addElement

TopoGeom_addElement — Adds an element to the definition of a TopoGeometry.

Synopsis

topogeometry **TopoGeom_addElement**(topogeometry tg, topoelement el);

설명

TopoGeometry 객체의 정의에 TopoElement 를 추가합&#x 해당 요소가 정의에 이미 존재하&#x 오류가 발생하지 않습니다.

2.3 버전부터 사용할 수 있습니다.

예시

```
-- TopoGeometry tg&#xc5d0; &#xacbd;&#xacc4;&#xc120; 5&#xb97c;  ↩
    &#xcd94;&#xac00;&#xd569;&#xb2c8;&#xb2e4;.
UPDATE mylayer SET tg = TopoGeom_addElement(tg, '{5,2}');
```

참고

TopoGeom_remElement, CreateTopoGeom

8.10.3 TopoGeom_remElement

TopoGeom_remElement — Removes an element from the definition of a TopoGeometry.

Synopsis

topogeometry **TopoGeom_remElement**(topogeometry tg, topoelement el);

설명

TopoGeometry 객체의 정의에서 TopoElement 를 제거&#x

2.3 버전부터 사용할 수 있습니다.

예시

```
-- TopoGeometry tg&#xc5d0;&#xc11c; &#xd45c;&#xba74; 43&#xc744;  ↩
    &#xc81c;&#xac70;&#xd569;&#xb2c8;&#xb2e4;.
UPDATE mylayer SET tg = TopoGeom_remElement(tg, '{43,3}');
```

참고

TopoGeom_addElement, CreateTopoGeom

8.10.4 TopoGeom_addTopoGeom

TopoGeom_addTopoGeom — Adds element of a TopoGeometry to the definition of another TopoGeometry.

Synopsis

topogeometry **TopoGeom_addTopoGeom**(topogeometry tgt, topogeometry src);

설명

Adds the elements of a TopoGeometry to the definition of another TopoGeometry, possibly changing its cached type (type attribute) to a collection, if needed to hold all elements in the source object.

The two TopoGeometry objects need be defined against the *same* topology and, if hierarchically defined, need be composed by elements of the same child layer.

Availability: 3.2

예시

```
-- Set an "overall" TopoGeometry value to be composed by all
-- elements of specific TopoGeometry values
UPDATE mylayer SET tg_overall = TopoGeom_addTopogeom(
    TopoGeom_addTopoGeom(
        clearTopoGeom(tg_overall),
        tg_specific1
    ),
    tg_specific2
);
```

참고

TopoGeom_addElement, clearTopoGeom, CreateTopoGeom

8.10.5 toTopoGeom

toTopoGeom — Adds a geometry shape to an existing topo geometry.

설명

Refer to toTopoGeom.

8.11 TopoGeometry 접근자

8.11.1 GetTopoGeomElementArray

GetTopoGeomElementArray — Returns a `topoelementarray` (an array of topoelements) containing the topological elements and type of the given TopoGeometry (primitive elements).

Synopsis

topoelementarray **GetTopoGeomElementArray**(varchar toponame, integer layer_id, integer tg_id);

topoelementarray **GetTopoGeomElementArray**(topogeometry tg);

설명

지형의 요소 및 입력 TopoGeometry 의 유형(&#xc6
요소)를 담고 있는 TopoElementArray 를 반환합&#
이 함수는 요소들을 데이터셋이
아니라 배열로 반환한다는 점만
제외하면 GetTopoGeomElements 함수와 비슷합&#xb2c8

tg_id는 topology.layer 테이블에 있는 `layer_id` 가 지정&
레이어 안의 지형이 가지고 있는
TopoGeometry 객체의 TopoGeometry ID입니다.

Availability: 1.1

예시

참고

GetTopoGeomElements, TopoElementArray

8.11.2 GetTopoGeomElements

GetTopoGeomElements — Returns a set of `topoelement` objects containing the topological element_id,element_type of the given TopoGeometry (primitive elements).

Synopsis

setof topoelement **GetTopoGeomElements**(varchar toponame, integer layer_id, integer tg_id);

setof topoelement **GetTopoGeomElements**(topogeometry tg);

설명

Returns a set of element_id,element_type (topoelements) corresponding to primitive topology elements TopoElement (1: nodes, 2: edges, 3: faces) that a given topogeometry object in `toponame` schema is composed of.

tg_id는 topology.layer 테이블에 있는 `layer_id` 가 지정&
레이어 안의 지형이 가지고 있는
TopoGeometry 객체의 TopoGeometry ID입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

참고

GetTopoGeomElementArray, TopoElement, TopoGeom_addElement, TopoGeom_remElement

8.11.3 ST_SRID

ST_SRID — Returns the spatial reference identifier for a topogeometry.

Synopsis

integer **ST_SRID**(topogeometry tg);

설명

Returns the spatial reference identifier for the ST_Geometry as defined in spatial_ref_sys table. Section 4.5

Note
spatial_ref_sys table is a table that catalogs all spatial reference systems known to PostGIS and is used for transformations from one spatial reference system to another. So verifying you have the right spatial reference system identifier is important if you plan to ever transform your geometries.

Availability: 3.2.0

This method implements the SQL/MM specification. SQL-MM 3: 14.1.5

예시

```
SELECT ST_SRID(ST_GeomFromText('POINT(-71.1043 42.315)',4326));
                --result
                4326
```

참고

Section 4.5, ST_SetSRID, ST_Transform, ST_SRID

8.12 TopoGeometry 출력물

8.12.1 AsGML

AsGML — TopoGeometry의 GML 표현식을 반환합니다.

Synopsis

text **AsGML**(topogeometry tg);
text **AsGML**(topogeometry tg, text nsprefix_in);
text **AsGML**(topogeometry tg, regclass visitedTable);
text **AsGML**(topogeometry tg, regclass visitedTable, text nsprefix);
text **AsGML**(topogeometry tg, text nsprefix_in, integer precision, integer options);
text **AsGML**(topogeometry tg, text nsprefix_in, integer precision, integer options, regclass visitedTable);
text **AsGML**(topogeometry tg, text nsprefix_in, integer precision, integer options, regclass visitedTable, text idprefix);
text **AsGML**(topogeometry tg, text nsprefix_in, integer precision, integer options, regclass visitedTable, text idprefix, int gmlversion);

설명

TopoGeometry의 GML 표현식을 GML3 버전 서식으&#xb
반환합니다. `nsprefix_in` 을 따로 설정하&#xc
않을 경우 `gml` 접두사를 이용합니&#xb2e4
nsprefix에 대해 텅 빈 문자열을 넘겨줄
경우 무자격(non-qualified) 네임스페이스&#xb97c
반환합니다. 정확도(기본값 15) 및
옵션(기본값 1) 파라미터를 설정한
경우, 손대는 일 없이 ST_AsGML 함수에
대한 기저 호출에 그대로 넘겨줍&#

`visitedTable` 파라미터는 접근한 노드 및
경계선 요소를 추적하는 데 쓰이&#
때문에, 설정할 경우, 정의를 복제&
게 아니라 교차 참조(xlink:xref)를 이용합&
정수형 항목 'element_type' 및 'element_id' (적어도) 2개&
테이블에 있어야 합니다. 함수 호&
입력 테이블에 대해 읽기 및 쓰기
권한을 가지고 있어야만 합니다.
최상의 성능을 내려면, `element_type` 과 `element_id`
에, 이 순서대로, 인덱스를 정의해&
합니다. 항목들에 유일한 제약조&#
추가하면 이 인덱스를 자동적으&#
생성할 것입니다. 다음은 그 예시&#

```
CREATE TABLE visited (
  element_type integer, element_id integer,
  unique(element_type, element_id)
);
```

idprefix 파라미터를 설정할 경우, 노드
및 경계선 태그 식별자에 접두사&#x
붙일 것입니다.

gmlver 파라미터를 설정할 경우, 기저
ST_AsGML 함수에 해당 파라미터를 넘겨&
것입니다. 기본값은 3입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

다음 예시는 CreateTopoGeom 에서 생성한 지&#x
도형을 사용합니다.

```
SELECT topology.AsGML(topo) As rdgml
  FROM ri.roads
  WHERE road_name = 'Unknown';

-- rdgml--
<gml:TopoCurve>
    <gml:directedEdge>
        <gml:Edge gml:id="E1">
            <gml:directedNode orientation="-">
                <gml:Node gml:id="N1"/>
            </gml:directedNode>
            <gml:directedNode
></gml:directedNode>
            <gml:curveProperty>
                <gml:Curve srsName="urn:ogc:def:crs:EPSG::3438">
                    <gml:segments>
                        <gml:LineStringSegment>
                            <gml:posList srsDimension="2"
>384744 236928 384750 236923 384769 236911 384799 236895 384811 236890
                            384833 236884 384844 236882 384866 236881 384879 236883 384954  ↩
                                236898 385087 236932 385117 236938
                            385167 236938 385203 236941 385224 236946 385233 236950 385241  ↩
                                236956 385254 236971
                            385260 236979 385268 236999 385273 237018 385273 237037 385271  ↩
                                237047 385267 237057 385225 237125
                            385210 237144 385192 237161 385167 237192 385162 237202 385159  ↩
                                237214 385159 237227 385162 237241
                            385166 237256 385196 237324 385209 237345 385234 237375 385237  ↩
                                237383 385238 237399 385236 237407
                            385227 237419 385213 237430 385193 237439 385174 237451 385170  ↩
                                237455 385169 237460 385171 237475
                            385181 237503 385190 237521 385200 237533 385206 237538 385213  ↩
                                237541 385221 237542 385235 237540 385242 237541
                            385249 237544 385260 237555 385270 237570 385289 237584 385292  ↩
                                237589 385291 237596 385284 237630</gml:posList>
                        </gml:LineStringSegment>
                    </gml:segments>
                </gml:Curve>
            </gml:curveProperty>
        </gml:Edge>
    </gml:directedEdge>
</gml:TopoCurve
>
```

이전 예시와 동일하지만 네임스&#x
쓰지 않습니다.

```
SELECT topology.AsGML(topo,'') As rdgml
  FROM ri.roads
  WHERE road_name = 'Unknown';

-- rdgml--
<TopoCurve>
    <directedEdge>
        <Edge id="E1">
            <directedNode orientation="-">
                <Node id="N1"/>
            </directedNode>
            <directedNode
></directedNode>
            <curveProperty>
                <Curve srsName="urn:ogc:def:crs:EPSG::3438">
                    <segments>
                        <LineStringSegment>
                            <posList srsDimension="2"
>384744 236928 384750 236923 384769 236911 384799 236895 384811 236890
                            384833 236884 384844 236882 384866 236881 384879 236883 384954  ↩
                                236898 385087 236932 385117 236938
                            385167 236938 385203 236941 385224 236946 385233 236950 385241  ↩
                                236956 385254 236971
                            385260 236979 385268 236999 385273 237018 385273 237037 385271  ↩
                                237047 385267 237057 385225 237125
                            385210 237144 385192 237161 385167 237192 385162 237202 385159  ↩
                                237214 385159 237227 385162 237241
                            385166 237256 385196 237324 385209 237345 385234 237375 385237  ↩
                                237383 385238 237399 385236 237407
                            385227 237419 385213 237430 385193 237439 385174 237451 385170  ↩
                                237455 385169 237460 385171 237475
                            385181 237503 385190 237521 385200 237533 385206 237538 385213  ↩
                                237541 385221 237542 385235 237540 385242 237541
                            385249 237544 385260 237555 385270 237570 385289 237584 385292  ↩
                                237589 385291 237596 385284 237630</posList>
                        </LineStringSegment>
                    </segments>
                </Curve>
            </curveProperty>
        </Edge>
    </directedEdge>
</TopoCurve
>
```

참고

CreateTopoGeom, ST_CreateTopoGeo

8.12.2 AsTopoJSON

AsTopoJSON — TopoGeometry의 TopoJSON 표현식을 반환합니

Synopsis

text **AsTopoJSON**(topogeometry tg, regclass edgeMapTable);

설명

TopoGeometry의 TopoJSON 표현식을 반환합니다. `edgeMapTable` 이 NULL이 아닐 경우, 경계선 식&#xbc
원호(arc) 인덱스에 매핑하는 탐색/&#xc80
쓰일 것입니다. 최종 문서에 조밀&#
"원호" 배열을 사용할 수 있게 하기
위해서입니다.

테이블을 설정할 경우, 테이블이
"순차(serial)" 유형 "arc_id" 항목과 정수형 "edge_id"
항목을 가지고 있어야 합니다. 코&#
"edge_id"에 대해 테이블을 쿼리할 것이&#x
해당 항목에 인덱스를 추가하는
편이 좋습니다.

> **Note**
> TopoJSON 출력물에서는 원호
> 인덱스가 0-기반이지만 "edgeMapTable"
> 테이블에서는 1-기반입니다.

완전한 TopoJSON 문서는, 이 함수가 반환&
토막 정보(snippet)에 더해, 일부 헤더와
함께 실제 원호를 담고 있어야 할
것입니다. TopoJSON 사양서 를 참조하십&

2.1.0 버전부터 사용할 수 있습니다.

개선 사항: 2.2.1 버전부터 점형(puntal) 입&#xb825
지원하기 시작했습니다.

참고

ST_AsGeoJSON

예시

```
CREATE TEMP TABLE edgemap(arc_id serial, edge_id int unique);

-- &#xd5e4;&#xb354;
SELECT '{ "type": "Topology", "transform": { "scale": [1,1], "translate": [0,0] }, "objects ↩
    ": {'

-- &#xac1d;&#xccb4;
UNION ALL SELECT '"' || feature_name || '": ' || AsTopoJSON(feature, 'edgemap')
FROM features.big_parcels WHERE feature_name = 'P3P4';

-- &#xc6d0;&#xd638;
WITH edges AS (
  SELECT m.arc_id, e.geom FROM edgemap m, city_data.edge e
  WHERE e.edge_id = m.edge_id
), points AS (
  SELECT arc_id, (st_dumppoints(geom)).* FROM edges
), compare AS (
  SELECT p2.arc_id,
         CASE WHEN p1.path IS NULL THEN p2.geom
              ELSE ST_Translate(p2.geom, -ST_X(p1.geom), -ST_Y(p1.geom))
```

```
        END AS geom
  FROM points p2 LEFT OUTER JOIN points p1
  ON ( p1.arc_id = p2.arc_id AND p2.path[1] = p1.path[1]+1 )
  ORDER BY arc_id, p2.path
), arcsdump AS (
  SELECT arc_id, (regexp_matches( ST_AsGeoJSON(geom), '\[.*\]'))[1] as t
  FROM compare
), arcs AS (
  SELECT arc_id, '[' || array_to_string(array_agg(t), ',') || ']' as a FROM arcsdump
  GROUP BY arc_id
  ORDER BY arc_id
)
SELECT '}, "arcs": [' UNION ALL
SELECT array_to_string(array_agg(a), E',\n') from arcs

-- &#xaf2c;&#xb9ac;&#xb9d0;
UNION ALL SELECT ']}'::text as t;

-- &#xacb0;&#xacfc;:
{ "type": "Topology", "transform": { "scale": [1,1], "translate": [0,0] }, "objects": {
"P3P4": { "type": "MultiPolygon", "arcs": [[[-1]],[[6,5,-5,-4,-3,1]]]}
}, "arcs": [
 [[25,30],[6,0],[0,10],[-14,0],[0,-10],[8,0]],
 [[35,6],[0,8]],
 [[35,6],[12,0]],
 [[47,6],[0,8]],
 [[47,14],[0,8]],
 [[35,22],[12,0]],
 [[35,14],[0,8]]
 ]}
```

8.13 지형 공간 관계성

8.13.1 Equals

Equals — 두 TopoGeometry가 동일한 지형 원시형&#xc73
이루어졌을 경우 참을 반환합니&#x

Synopsis

boolean **Equals**(topogeometry tg1, topogeometry tg2);

설명

두 TopoGeometry가 동일한 지형 원시형(표&#xba7
경계선, 노드)으로 이루어졌을 경&#
참을 반환합니다.

> **Note**
> 이 함수는 도형 집합인 TopoGeometry를 지원하지 않습니다. 또 서로 다른 지형으로 이루어진 두 TopoGeometry를 비교하지 못 합니다.

1.1.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

참고

GetTopoGeomElements, ST_Equals

8.13.2 교차

교차 — 두 TopoGeometry에서 나온 원시형의 쌍 가운데 하나라도 교차할 경우 참을 반환합니다.

Synopsis

boolean **Intersects**(topogeometry tg1, topogeometry tg2);

설명

두 TopoGeometry에서 나온 원시형의 쌍 가운데 하나라도 교차할 경우 참을 반환&#xd

> **Note**
> This function not supported for topogeometries that are geometry collections. It also can not compare topogeometries from different topologies. Also not currently supported for hierarchical topogeometries (topogeometries composed of other topogeometries).

1.1.0 버전부터 사용할 수 있습니다.

This function supports 3d and will not drop the z-index.

예시

참고

ST_Intersects

8.14 Importing and exporting Topologies

Once you have created topologies, and maybe associated topological layers, you might want to export them into a file-based format for backup or transfer into another database.

Using the standard dump/restore tools of PostgreSQL is problematic because topologies are composed by a set of tables (4 for primitives, an arbitrary number for layers) and records in metadata tables (topology.topology and topology.layer). Additionally, topology identifiers are not univoque across databases so that parameter of your topology will need to be changes upon restoring it.

In order to simplify export/restore of topologies a pair of executables are provided: `pgtopo_export` and `pgtopo_import`. Example usage:

```
pgtopo_export dev_db topo1 | pgtopo_import topo1 | psql staging_db
```

8.14.1 Using the Topology exporter

The `pgtopo_export` script takes the name of a database and a topology and outputs a dump file which can be used to import the topology (and associated layers) into a new database.

By default `pgtopo_export` writes the dump file to the standard output so that it can be piped to `pgtopo_import` or redirected to a file (refusing to write to terminal). You can optionally specify an output filename with the `-f` commandline switch.

By default `pgtopo_export` includes a dump of all layers defined against the given topology. This may be more data than you need, or may be non-working (in case your layer tables have complex dependencies) in which case you can request skipping the layers with the `--skip-layers` switch and deal with those separately.

Invoking `pgtopo_export` with the `--help` (or `-h` for short) switch will always print short usage string.

The dump file format is a compressed tar archive of a `pgtopo_export` directory containing at least a `pgtopo_dump_version` file with format version info. As of version `1` the directory contains tab-delimited CSV files with data of the topology primitive tables (node, edge_data, face, relation), the topology and layer records associated with it and (unless `--skip-layers` is given) a custom-format PostgreSQL dump of tables reported as being layers of the given topology.

8.14.2 Using the Topology importer

The `pgtopo_import` script takes a `pgtopo_export` format topology dump and a name to give to the topology to be created and outputs an SQL script reconstructing the topology and associated layers.

The generated SQL file will contain statements that create a topology with the given name, load primitive data in it, restores and registers all topology layers by properly linking all TopoGeometry values to their correct topology.

By default `pgtopo_import` reads the dump from the standard input so that it can be used in conjuction with `pgtopo_export` in a pipeline. You can optionally specify an input filename with the `-f` commandline switch.

By default `pgtopo_import` includes in the output SQL file the code to restore all layers found in the dump.

This may be unwanted or non-working in case your target database already have tables with the same name as the ones in the dump. In that case you can request skipping the layers with the `--skip-layers` switch and deal with those separately (or later).

SQL to only load and link layers to a named topology can be generated using the `--only-layers` switch. This can be useful to load layers AFTER resolving the naming conflicts or to link layers to a different topology (say a spatially-simplified version of the starting topology).

Chapter 9

래스터 데이&#x 관리, 쿼리 및 응용

9.1 래스터 로드 및 생성

대부분의 경우, 사용자는 패키징&#
있는 `raster2pgsql` 래스터 로더를 통해 기&#x
래스터 파일을 로드해서 PostGIS 래스&#x
생성할 것입니다.

9.1.1 raster2pgsql을 이용해 래스터를 로&

The `raster2pgsql` is a raster loader executable that loads GDAL supported raster formats into SQL suitable for loading into a PostGIS raster table. It is capable of loading folders of raster files as well as creating overviews of rasters.

Since the raster2pgsql is compiled as part of PostGIS most often (unless you compile your own GDAL library), the raster types supported by the executable will be the same as those compiled in the GDAL dependency library. To get a list of raster types your particular `raster2pgsql` supports use the `-G` switch.

Note

정렬된 래스터 집합에서 특정 인자(factor)의 오버뷰를 성생하는 경우, 오버뷰들이 정렬되지 않을 수도 있습니다. http://trac.osgeo.org/postgis/ticket/1764 페이지에서 오버뷰가 정렬되지 않는 예시를 찾아볼 수 있습니다.

9.1.1.1 Example Usage

로더를 통해 입력 파일을 생성하&#
100x100 타일 뭉치로 나누어 업로드하&#x
세션의 예시는 다음과 같습니다:

```
# -s use srid 4326
# -I create spatial index
# -C use standard raster constraints
# -M vacuum analyze after load
# *.tif load all these files
# -F include a filename column in the raster table
# -t tile the output 100x100
# public.demelevation load into this table
raster2pgsql -s 4326 -I -C -M -F -t 100x100 *.tif public.demelevation > elev.sql

# -d connect to this database
# -f read this file after connecting
psql -d gisdb -f elev.sql
```

Note
If you do not specify the schema as part of the target table name, the table will be created in the default schema of the database or user you are connecting with.

UNIX 파이프를 이용하면 변환 및 업&#xb8
작업을 한 번에 끝낼 수 있습니다:

```
raster2pgsql -s 4326 -I -C -M *.tif -F -t 100x100 public.demelevation | psql -d gisdb
```

매사추세츠 주의 미터 단위 항공&#x
타일 래스터들을 `aerial` 이라는 스키&#x
로드하고, 전체 뷰와 2레벨 및 4레벨
오버뷰 테이블을 생성한 다음, 복&#
모드를 통해 (중간 단계 파일 없이
DB로 직접) 삽입하며, 강제로 모든
작업을 상호처리하지 않도록 -e 플&
사용하십시오(작업이 완료되길
기다리지 않고 테이블에 들어오&#x
데이터를 바로 살펴보고자 할 때
유용합니다). 래스터를 128x128 픽셀 타&#
분절한 다음 래스터 제약조건을
적용하십시오. 테이블 삽입 대신
복사 모드를 이용하십시오. 타일&#x
잘라져 나온 타일 파일명을 담을
수 있도록 -F 플래그로 "filename"이라는 &#xd544
포함시키십시오.

```
raster2pgsql -I -C -e -Y -F -s 26986 -t 128x128  -l 2,4 bostonaerials2008/*.jpg aerials. ↩
    boston | psql -U postgres -d gisdb -h localhost -p 5432
```

```
-- &#xc9c0;&#xc6d0;&#xb418;&#xb294; &#xb798;&#xc2a4;&#xd130; &#xc720;&#xd615;&#xc758;  ↩
    &#xbaa9;&#xb85d;&#xc744; &#xc5bb;&#xc73c;&#xb824;&#xba74;:
raster2pgsql -G
```

-G 옵션이 다음과 같은 목록을 출력&
것입니다:

```
Available GDAL raster formats:
  Virtual Raster
  GeoTIFF
  National Imagery Transmission Format
```

```
Raster Product Format TOC format
ECRG TOC format
Erdas Imagine Images (.img)
CEOS SAR Image
CEOS Image
...
Arc/Info Export E00 GRID
ZMap Plus Grid
NOAA NGS Geoid Height Grids
```

9.1.1.2 raster2pgsql options

-? 도움말 화면을 표출합니다. 어&#xb5a4
인수도 쓰지 않을 경우에도 도&#xc6c
표출될 것입니다.

-G 지원하는 래스터 형식을 나열&#xd569

c|a|d|p -- 이들은 상호배타적인 옵션&#xb

-c 새 테이블을 생성한 다음 래스&#x
해당 테이블을 채웁니다. *이것&
기본 모드입니다.

-a 기존 테이블에 래스터(들)을 추&#

-d 기존 테이블을 삭제하고, 새 테&#
생성한 다음 래스터(들)로 해당
테이블을 채웁니다.

-p 준비 모드로, 테이블만 생성합&#

래스터 공간 처리: 래스터 카탈&#

-C `raster_columns` 뷰에 래스터를 제대로 등&
위한 SRID, 픽셀 크기 등의 래스터
제약조건을 적용합니다.

-x 최대 범위(extent) 제약조건을 해제&#xd
-C 플래그와 함께 쓰일 경우에만
적용됩니다.

-r 정규 블록화(regular blocking)를 위한 제약&#xc
유일성 및 커버리지 타일)을 설&
-C 플래그와 함께 쓰일 경우에만
적용됩니다.

래스터 공간 처리: 입력 래스터 &

-s <SRID> 출력 래스터에 지정된 SRID를
부여합니다. 기존에 없거나 0값
경우, 적절한 SRID를 결정하기 위&#xd
래스터의 메타데이터를 확인&
것입니다.

-b BAND 래스터에서 밴드의 (1-기반) 인&#
추출합니다. 하나 이상의 밴드
인덱스가 있을 경우, 쉼표(,)로
구분하십시오. 지정하지 않는
경우 래스터의 모든 밴드를 추&

-t TILE_SIZE 테이블 행 한 개당 하나씩 삽 래스터를 타일로 자릅니다. TILE_SI 는 너비x높이로 표현되거나, &#xb610 "auto" 값으로 설정하면 로더가 ಫ 번째 래스터를 이용해 적당&#xd55 크기를 계산해서 모든 래스터&# 적용합니다.

-P 맨 오른쪽 및 맨 아래 타일들의 여백을 메꿔넣어(padding) 모든 타일&# 동일한 너비와 높이를 갖도록 보장합니다.

-R, --register 래스터를 파일 시스템 (DB 외&#xbd8 래스터로 등록합니다.
데이터베이스에 래스터의 (픽& 아니라) 메타데이터 및 경로 위& 저장될 것입니다.

-l OVERVIEW_FACTOR 래스터의 오버뷰를 생성& 인자가 한 개 이상인 경우, 쉼표(구분하십시오. 오버뷰 테이블& o_overview factor_table 이라는 패턴을 따르&#xb29 이때 overview factor 는 숫자로 나타낸 오버뷰 인자의 위치지시자(placeholder) table 은 기저 테이블명으로 대체&#x 생성된 오버뷰는 데이터베이&# 저장되어, -R 플래그의 영향을 받지 않습니다. 사용자가 생성& SQL 파일이 주 테이블과 오버뷰 테이블을 모두 담게 될 것이라& 점에 주의하십시오.

-N NODATA "NODATA" 값이 없는 밴드에 사용할 NODATA 값입니다.

데이터베이스 객체를 조작하&#x

-f COLUMN 저장될 래스터 열의 명칭을 설정합니다. 기본값은 'rast'입니&#xb2

-F 파일명을 담은 열을 추가합니&#x

-n COLUMN 파일명 열의 명칭을 설정합&# -F 플래그와 함께 써야 합니다.

-q PostgreSQL 식별자를 따옴표로 감쌉니&

-I 래스터 열에 GiST 인덱스를 생성&#xd569

-M 래스터 테이블을 빈공간 분석(va analyze)합니다.

-k Keeps empty tiles and skips NODATA value checks for each raster band. Note you save time in checking, but could end up with far more junk rows in your database and those junk rows are not marked as empty tiles.

-T tablespace 새 테이블 용 테이블스페&#xc77 설정합니다. -X 플래그를 함께 사용하지 않으면 (기본 키를 포& 인덱스들이 여전히 기본 테이&# 사용할 것이라는 점에 주의하&#

-X tablespace 테이블의 새 인덱스 용 테&#xc77 설정합니다. -I 플래그를 함께 사용하면 기본 키와 공간 인덱&# 함께 적용됩니다.

-Y max_rows_per_copy=50 Use copy statements instead of insert statements. Optionally specify max_rows_per_copy; default 50 when not specified.

-e 각 선언문을 개별적으로 실행하&
상호처리(transaction)를 이용하지 않습&#xb

-E ENDIAN 생성된 래스터 바이너리 산&#xcd9c
메모리 내부 데이터 순서(endianness)를
조정합니다. XDR은 0, 기본값인 NDR은
1로 설정하십시오. 현재, NDR 산출&#xbb3c
지원합니다.

-V version 산출물 형식의 버전을 설정&#xd56
기본값은 0입니다. 현재, 0만 지원&#x

9.1.2 PostGIS 래스터 함수를 이용해 래스터 생성하기

사용자가 래스터와 래스터 테이&#x
데이터베이스 내부에 생성하려
하는 경우가 많을 것입니다. 그런
작업을 위한, 넘치고도 남을 많은
함수가 있습니다. 일반적인 단계&#
다음과 같습니다.

1. 새 래스터 레코드를 담을 래스&#xd1
열을 가진 테이블을 다음과 같&#xc77
생성하십시오:

```
CREATE TABLE myrasters(rid serial primary key, rast raster);
```

2. 해당 목표를 도와줄 함수가 많&#xc7
있습니다. 다른 래스터에서 파&#xc0
않은 래스터를 생성하는 경우,
ST_MakeEmptyRaster 함수와 ST_AddBand 함수를 순서대
사용하는 편이 좋습니다.

   도형으로부터도 래스터를 생&#xc1
수 있습니다. 그러려면 ST_AsRaster 함수&#
아마도 ST_Union , ST_MapAlgebraFct 또는 맵 대수(algebra)
함수 계열의 어떤 함수와도 같&#xc74
다른 함수와 함께 사용하는 편&#xc7
좋습니다.

   기존 테이블로부터 새 래스터
테이블을 생성하는 데에는 더&#xc6
많은 선택지가 있습니다. 예를
들어 ST_Transform 함수를 사용하면 기존
테이블과는 다른 투영이 적용&#xb41
래스터 테이블을 생성할 수 있&#xc2

3. 일단 사용자 테이블을 채우는
작업을 마쳤다면, 다음과 같이
래스터 열에 대해 공간 인덱스&#xb97
생성하는 편이 좋습니다:

```
CREATE INDEX myrasters_rast_st_convexhull_idx ON myrasters USING gist( ST_ConvexHull( ↩
    rast) );
```

래스터 연산자 대부분이 래스&#xd1
볼록 껍질(convex hull)을 기반으로 하기
때문에 ST_ConvexHull 함수를 사용했다는
점에 주의하십시오.

Note

PostGIS 2.0 미만 버전에서 래스터는
볼록 껍질보다는 엔벨로프(envelop)&#xb9
기반으로 하고 있었습니다.
공간 인덱스가 제대로
작동하려면 구식 인덱스를
삭제하고 볼록 껍질 기반
인덱스로 대체해야 합니다.

4. AddRasterConstraints 를 이용해 래스터 제약조&#xa
   적용

9.1.3 Using "out db" cloud rasters

The `raster2pgsql` tool uses GDAL to access raster data, and can take advantage of a key GDAL feature: the ability to read from rasters that are stored remotely in cloud "object stores" (e.g. AWS S3, Google Cloud Storage).

Efficient use of cloud stored rasters requires the use of a "cloud optimized" format. The most well-known and widely used is the "cloud optimized GeoTIFF" format. Using a non-cloud format, like a JPEG, or an un-tiled TIFF will result in very poor performance, as the system will have to download the entire raster each time it needs to access a subset.

First, load your raster into the cloud storage of your choice. Once it is loaded, you will have a URI to access it with, either an "http" URI, or sometimes a URI specific to the service. (e.g., "s3://bucket/object"). To access non-public buckets, you will need to supply GDAL config options to authenticate your connection. Note that this command is *reading* from the cloud raster and *writing* to the database.

```
AWS_ACCESS_KEY_ID=xxxxxxxxxxxxxxxxxx \
AWS_SECRET_ACCESS_KEY=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx \
raster2pgsql \
  -s 990000 \
  -t 256x256 \
  -I \
  -R \
  /vsis3/your.bucket.com/your_file.tif \
  your_table \
  | psql your_db
```

Once the table is loaded, you need to give the database permission to read from remote rasters, by setting two permissions, postgis.enable_outdb_rasters and postgis.gdal_enabled_drivers.

```
SET postgis.enable_outdb_rasters = true;
SET postgis.gdal_enabled_drivers TO 'ENABLE_ALL';
```

To make the changes sticky, set them directly on your database. You will need to re-connect to experience the new settings.

```
ALTER DATABASE your_db SET postgis.enable_outdb_rasters = true;
ALTER DATABASE your_db SET postgis.gdal_enabled_drivers TO 'ENABLE_ALL';
```

For non-public rasters, you may have to provide access keys to read from the cloud rasters. The same keys you used to write the `raster2pgsql` call can be set for use inside the database, with the postgis.gdal_datapath configuration. Note that multiple options can be set by space-separating the `key=value` pairs.

```
SET postgis.gdal_vsi_options = 'AWS_ACCESS_KEY_ID=xxxxxxxxxxxxxxxxxx
AWS_SECRET_ACCESS_KEY=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx';
```

Once you have the data loaded and permissions set you can interact with the raster table like any other raster table, using the same functions. The database will handle all the mechanics of connecting to the cloud data when it needs to read pixel data.

9.2 래스터 카탈로그

PostGIS와 함께 패키징되는 래스터 카&#x
뷰는 두 개입니다. 두 뷰 모두 래스&
테이블의 제약조건에 내장된 정&#x
활용합니다. 제약조건이 강제적&#x
때문에, 결과적ܼ로 카탈로그 뷰&#x
언제나 테이블 내부의 래스터 데&#
일관성을 유지합니다.

1. `raster_columns` 이 뷰는 사용자 데이터베&#xc7
   있는 모든 래스터 테이블 열을
   카탈로그화합니다.

2. `raster_overviews` 이 뷰는 더 세밀한 테이블&#
   위한 오버뷰 역할을 하는 사용&#xc7
   데이터베이스에 있는 모든 래&#xc2a
   테이블 열을 카탈로그화합니&#xb2e4
   로드 과정에서 `-l` 스위치를 사용&#xd
   경우 이 테이블 유형을 생성합&#xb2

9.2.1 래스터 열 카탈로그

`raster_columns` 는 사용자 데이터베이스에
있는 모든 래스터 테이블 열의 래&#
유형 카탈로그입니다. 래스터 열
카탈로그는 테이블에 대한 제약&#x
활용하기 때문에, 설령 사용자가
다른 데이터베이스의 백업으로&#x
래스터 테이블을 하나 복원했다
하더라도, 카탈로그 정보는 언제&#x
일관성을 유지합니다. 다음은 `raster_co`
카탈로그 안에 존재하는 열들입&#x

로더를 통해 사용자 테이블을 생&#
않았거나 로드 과정에서 `-C` 플래그
설정을 잊었을 경우, 테이블 생성
후에 `raster_columns` 카탈로그가 사용자의
래스터 타일에 관한 일반 정보를
등록하도록 AddRasterConstraints 함수를 통해 제&
강제할 수 있습니다.

- `r_table_catalog` 테이블을 담고 있는 데이&#xd130
  이 열은 언제나 현재 데이터베이&
  읽어들일 것입니다.

- `r_table_schema` 래스터 테이블이 속해 있&#xb294
  데이터베이스 스키마입니다.

- `r_table_name` 래스터 테이블 명입니다.

- `r_raster_column` 래스터 유형의 `r_table_name` 테이블
  안에 있는 열입니다. PostGIS는 사용자&#

테이블 하나 당 몇 개의 래스터 열을 가질 수 있는지 제한하지 않때문에, 래스터 테이블 하나를 각다른 래스터 열로 몇 번이고 나열수 있습니다.

- `srid` 래스터의 공간 참조 식별자입&#xb Section 4.5 목록에 있는 항목이어야 합니

- `scale_x` 기하하적 공간 좌표와 픽셀의 비례(축척)입니다. 래스터 열에 &#xc788 모든 타일이 동일한 `scale_x` 를 가지며 `scale_x` 제약조건이 적용될 경우에만 사용할 수 있습니다. 자세한 내용 ST_ScaleX 를 참조하십시오.

- `scale_y` 기하하적 공간 좌표와 픽셀의 비례(축척)입니다. 래스터 열에 &#xc788 모든 타일이 동일한 `scale_y` 를 가지며 `scale_y` 제약조건이 적용될 경우에만 사용할 수 있습니다. 자세한 내용 ST_ScaleY 를 참조하십시오.

- `blocksize_x` 각 래스터 타일의 너비(가로 방향의 픽셀 개수)입니다. 자세한 사항은 ST_Width 를 참조하십시오.

- `blocksize_y` 각 래스터 타일의 높이(세로 방향의 픽셀 개수)입니다. 자세한 사항은 ST_Height 를 참조하십시오.

- `same_alignment` 모든 래스터 타일이 동일한 방향으로 정렬된 경우 참인 불 값자세한 내용은 ST_SameAlignment 를 참조하십&

- `regular_blocking` 래스터 열이 공간적 유일&#xc13 제약조건 및 커버리지 타일 제약&# 가질 경우, 해당 값은 참입니다. 그 외의 경우는 거짓이 됩니다.

- `num_bands` 사용자 래스터 집합의 각 타&#xc7 내장한 밴드의 개수입니다. 다음 열과 동일한 정보를 제공합니다. ST_NumBands

- `pixel_types` 각 밴드에 대한 픽셀 유형을 정의하는 배열입니다. 이 배열에 사용자 밴드 개수와 동일한 개수&# 요소들이 들어갈 것입니다. pixel_types&#xb294 다음 ST_BandPixelType 에서 정의된 픽셀 유형 가운데 하나입니다.

- `nodata_values` 각 밴드에 대한 `nodata_value` 를 의미&# 배정밀도(double precision) 수(數)입니다. 이 배&# 사용자 밴드 개수와 동일한 개수&# 요소들이 들어갈 것입니다. 이 숫&# 대부분의 연산에서 무시되어야 할 각 밴드에 대한 픽셀 값을 정의 이 정보는 ST_BandNoDataValue 가 제공하는 정&#xbcf4 유사합니다.

- `out_db` 데이터베이스 외부에서 래스&#
  밴드 데이터를 유지하는지 여부&
  보여주는 불 값 플래그의 배열입&#
  이 배열에는 사용자 밴드 개수와
  동일한 개수의 요소들이 들어갈
  것입니다.
- `extent` 사용자 래스터 집합이 포함하&
  모든 래스터 열의 범위(extent)입니다.
  해당 집합의 범위를 변경시킬 추&
  데이터를 로드할 계획이라면, 로&
  작업 전에 DropRasterConstraints 함수를 실행하&#xace
  작업 후에 AddRasterConstraints 함수로 제약조&#xac74
  다시 적용시키는 편이 좋습니다.
- `spatial_index` 래스터 열이 공간 인덱스를
  가진 경우 참인 불 값입니다.

9.2.2 래스터 오버뷰

`raster_overviews` 는 오버뷰에 이용되는 래&#xc2a4
테이블 열에 관한 정보 및 오버뷰
활용시 알면 유용한 추가 정보를
카탈로그화합니다. 오버뷰 테이&#x
`raster_columns` 및 `raster_overviews` 양쪽에 모두 카탈&#xb85
오버뷰가 나름대로 래스터이긴
하지만, 동시에 고해상도 테이블&#
저해상도 썸네일이라는 추가적&#x
특별 목적을 담당하고 있기 때문&#x
래스터 로드 작업중 `-l` 스위치를 사
주 래스터 테이블과 함께 오버뷰
테이블을 생성합니다. 또는 AddOverview-
Constraints 함수를 통해 직접 생성할 수도
있습니다.

오버뷰 테이블은 다른 래스터 테&#
동일한 제약조건은 물론 오직 오&#
특화된 제약조건에 관한 추가 정&#
포함합니다.

> **Note**
> `raster_overviews` 에 담긴 정보는 `raster_columns` 의
> 정보를 복제한 것이 아닙니다.
> `raster_columns` 에서 현재 오버뷰
> 테이블에 관한 정보를 얻어야
> 할 경우 `raster_overviews` 와 `raster_columns` 을 함께
> 연결(join)시켜 필요한 완전한
> 정보를 얻으십시오.

오버뷰의 주된 존재 이유는 다음
두 가지입니다:

1. 빠른 매핑 확대를 위해 흔히 핵&#xc
   테이블의 저해상도 모사를 이&#xc6a

2. 고해상도 페어런트보다 오버&#xbdf0 기반으로 하는 계산이 일반적&#xc73 더 빠릅니다. 레코드 개수도 더 적고 각 픽셀이 커버하는 면적&#xb3 더 크기 때문입니다. 오버뷰가 지원하는 고해상도 테이블 대&#xc0c 계산보다야 정확하지 않지만, 어림잡이(rule-of-thumb) 계산의 경우 오버&# 충분할 수 있습니다.

`raster_overviews` 카탈로그는 다음과 같은 정& 열을 포함합니다.

- `o_table_catalog` 오버뷰 테이블을 담고 있&#xb294 데이터베이스입니다. 이 열은 언& 현재 데이터베이스를 읽어들일 것입니다.
- `o_table_schema` 오버뷰 테이블이 속해 있는 데이터베이스 스키마입니다.
- `o_table_name` 오버뷰 테이블 명입니다.
- `o_raster_column` 오버뷰 테이블이 담고 있&#xb294 래스터 열입니다.
- `r_table_catalog` 해당 오버뷰 서비스를 담고 있는 래스터 테이블 카탈로그입&# 이 열은 언제나 현재 데이터베이& 읽어들일 것입니다.
- `r_table_schema` 해당 오버뷰 서비스가 속해 있는 래스터 테이블 스키마입니&
- `r_table_name` 해당 오버뷰가 서비스하는 래스터 테이블 명입니다.
- `r_raster_column` 해당 오버뷰가 서비스하&#xb294 래스터 열입니다.
- `overview_factor` 오버뷰 테이블의 피라미&#xb4dc 레벨입니다. 숫자가 커질수록 테& 해상도는 낮아집니다. raster2pgsql은 이&#xbbf8 폴더를 받아 각 이미지 파일의 오& 계산하고 개별적으로 로드합니&# 항상 레벨 1을 원 파일로 가정합&#xb2c8 레벨 2는 각 타일이 원래 이미지 4장을 모사하게 됩니다. 따라서 예를 들어 사용자가 125x125로 뭉치려&# 5000x5000픽셀 이미지 파일들이 있는 폴 경우, 각 이미지 파일에 대해 사용& 기저 테이블이 (5000*5000)/(125*125) = 1600 레코드를 담게 되고, 사용자의 `o_2` (l=2) 테이블이 최대 (1600/2^2) = 400행, `o_3` (l=3) 테이블은 최대 (1600/2^3) = 200행의 레코드를 담게 될 것입니&#xb2 사용자 픽셀 수가 사용자 타일로 나눌 수 있는 숫자가 아닐 경우, 몇몇 파편(scrap) 타일(완전히 채워지&#x 않은 타일)을 얻게 될 것입니다.

raster2pgsql이 생성한 각 오버뷰 타일의 픽셀 개수가 해당 페어런트와 동개수이지만, 각 픽셀이 표현하는 영역이 더 넓은 (원 이미지의 2^overview_factor 픽셀에 해당하는) 저해상도라는 점에 주의하십시오.

9.3 PostGIS 래스터를 이용하&#xb294 사용자 지정 응용 프&#xb85 빌드하기

The fact that PostGIS raster provides you with SQL functions to render rasters in known image formats gives you a lot of options for rendering them. For example you can use OpenOffice / LibreOffice for rendering as demonstrated in Rendering PostGIS Raster graphics with LibreOffice Base Reports. In addition you can use a wide variety of languages as demonstrated in this section.

9.3.1 다른 래스터 함수와 함께 ST_AsPNG를 이용해서 PHP 예제를 출력하기

이 단원에서, PHP PostgreSQL 드라이버와 ST_AsGDALR 계열 함수를 사용해서 래스터의 1, 2, 3 밴드를 PHP 요청 스트림(request stream)으로 출력하는 방법을 설명할 것입니&#x 이후 PHP 요청 스트림을 "img src" HTML 태그로 임베딩할 수 있습니다.

예시 쿼리는 여러 래스터 함수를 함께 결합(combine)해서 특정 WGS84 경계 상&#x 교차하는 모든 타일을 얻은 다음, ST_Union 함수를 통해 교차하는 타일들&# 반환되는 모든 밴드를 통합(union)해&#xc ST_Transform 함수를 이용해 사용자가 지&#xc815 투영으로 변환한 후, ST_AsPNG 함수로 결 PNG 파일로 출력하는 방법을 보여&#xc90

```
http://mywebserver/test_raster.php?srid=2249
```

를 통해 메사추세츠 주의 피트 단&# 항공사진의 래스터 이미지를 얻&#x 후, 다음 쿼리를 호출하십시오.

```
<?php
/** test_raster.php&#xc758; &#xb0b4;&#xc6a9; **/
$conn_str ='dbname=mydb host=localhost port=5432 user=myuser password=mypwd';
$dbconn = pg_connect($conn_str);
header('Content-Type: image/png');
/** &#xd2b9;&#xc815; &#xd22c;&#xc601;&#xccb4;&#xb97c; &#xc694;&#xad6c;&#xd560;  ↩
    &#xacbd;&#xc6b0; &#xc774;&#xac78; &#xc0ac;&#xc6a9;&#xd558;&#xace0;,  ↩
    &#xadf8;&#xb807;&#xc9c0; &#xc54a;&#xc744; &#xacbd;&#xc6b0;  ↩
    &#xb9e4;&#xc0ac;&#xcd94;&#xc138;&#xce20; &#xc8fc; &#xbbf8;&#xd130; &#xb2e8;&#xc704;  ↩
    &#xd3c9;&#xba74;&#xc744; &#xc0ac;&#xc6a9;&#xd560; &#xac83; **/
if (!empty( $_REQUEST['srid'] ) && is_numeric( $_REQUEST['srid']) ){
                $input_srid = intval($_REQUEST['srid']);
}
```

```
else { $input_srid = 26986; }
/** PostgreSQL 9.0 &#xc774;&#xc0c1; &#xbc84;&#xc804;&#xc758; &#xacbd;&#xc6b0; bytea_output ↩
    &#xc9d1;&#xd569;&#xc774; &#xd544;&#xc694;&#xd560; &#xc218;&#xb3c4; ↩
    &#xc788;&#xc9c0;&#xb9cc;, 8.4 &#xbc84;&#xc804;&#xc740; &#xd544;&#xc694;&#xc5c6;&#xc74c; ↩
    **/
$sql = "set bytea_output='escape';
SELECT ST_AsPNG(ST_Transform(
                        ST_AddBand(ST_Union(rast,1), ARRAY[ST_Union(rast,2),ST_Union(rast ↩
                            ,3)])
                                ,$input_srid) ) As new_rast
 FROM aerials.boston
        WHERE
         ST_Intersects(rast, ST_Transform(ST_MakeEnvelope(-71.1217, 42.227, -71.1210, ↩
             42.218,4326),26986) )";
$result = pg_query($sql);
$row = pg_fetch_row($result);
pg_free_result($result);
if ($row === false) return;
echo pg_unescape_bytea($row[0]);
?>
```

9.3.2 다른 래스터 함수와 함께 ST_AsPNG를 이용해서 ASP.NET C# 예제를 출력하기

이 단원에서, npgsql PostgreSQL .NET 드라이버와 ST_AsGDALRaster 계열 함수를 사용해서 래스&#x 1, 2, 3 밴드를 PHP 요청 스트림(request stream)으로 출력하는 방법을 설명할 것입니&#x 이후 PHP 요청 스트림을 "img src" HTML 태그로 임베딩할 수 있습니다.

이 예제를 실행하려면 npgsql PostgreSQL .NET 드&#xb77 필요합니다. http://npgsql.projects.postgresql.org/ 에서 최신 버전을 다운로드할 수 있습니다. 최신 버전을 다운로드해서 사용&#x ASP.NET bin 폴더에 넣기만 하면 준비가 끝납니다.

예시 쿼리는 여러 래스터 함수를 함께 결합(combine)해서 특정 WGS84 경계 상&#x 교차하는 모든 타일을 얻은 다음, ST_Union 함수를 통해 교차하는 타일들&# 반환되는 모든 밴드를 통합(union)해&#xc ST_Transform 함수를 이용해 사용자가 지&#xc815 투영으로 변환한 후, ST_AsPNG 함수로 결 PNG 파일로 출력하는 방법을 보여&#xc90

이 예제는 C#으로 실행된다는 점만 제회하면 Section 9.3.1 예제와 동일합니다.

```
http://mywebserver/test_raster.php?srid=2249
```

를 통해 메사추세츠 주의 피트 단&# 항공사진의 래스터 이미지를 얻&#x 후, 다음 쿼리를 호출하십시오.

```
-- web.config &#xc811;&#xc18d; &#xbb38;&#xc790;&#xc5f4; &#xbd80;&#xbd84; --
<connectionStrings>
```

```
    <add name="DSN"
        connectionString="server=localhost;database=mydb;Port=5432;User Id=myuser;password= ↩
           mypwd"/>
</connectionStrings
>
```

```
// TestRaster.ashx &#xc6a9; &#xcf54;&#xb4dc;
<%@ WebHandler Language="C#" Class="TestRaster" %>
using System;
using System.Data;
using System.Web;
using Npgsql;

public class TestRaster : IHttpHandler
{
        public void ProcessRequest(HttpContext context)
        {

                context.Response.ContentType = "image/png";
                context.Response.BinaryWrite(GetResults(context));

        }

        public bool IsReusable {
                get { return false; }
        }

        public byte[] GetResults(HttpContext context)
        {
                byte[] result = null;
                NpgsqlCommand command;
                string sql = null;
                int input_srid = 26986;
        try {
                    using (NpgsqlConnection conn = new NpgsqlConnection(System. ↩
                        Configuration.ConfigurationManager.ConnectionStrings["DSN"]. ↩
                        ConnectionString)) {
                            conn.Open();

                if (context.Request["srid"] != null)
                {
                    input_srid = Convert.ToInt32(context.Request["srid"]);
                }
                sql = @"SELECT ST_AsPNG(
                            ST_Transform(
                                        ST_AddBand(
                                    ST_Union(rast,1), ARRAY[ST_Union(rast,2),ST_Union(rast,3)])
                                                ,:input_srid) ) As new_rast
                        FROM aerials.boston
                                WHERE
                                    ST_Intersects(rast,
                                    ST_Transform(ST_MakeEnvelope(-71.1217, 42.227,  ↩
                                        -71.1210, 42.218,4326),26986) )";
                            command = new NpgsqlCommand(sql, conn);
                command.Parameters.Add(new NpgsqlParameter("input_srid", input_srid));


                            result = (byte[]) command.ExecuteScalar();
                conn.Close();
                        }

                }
```

```
        catch (Exception ex)
        {
            result = null;
            context.Response.Write(ex.Message.Trim());
        }
                return result;
        }
}
```

9.3.3 래스터 쿼리를 이미지 파&#xc
출력하는 Java 콘솔 응용 프&#xb85c

이미지 한 장을 반환해서 지정된
파일로 출력하는 쿼리를 이용하&#x
단순한 Java 콘솔 응용 프로그램입니

http://jdbc.postgresql.org/download.html에서 최신 PostgreSQL JDBC 드라이&#x
다운로드할 수 있습니다.

다음과 같은 명령어를 통해 예시
코드를 컴파일할 수 있습니다:

```
set env CLASSPATH .:..\postgresql-9.0-801.jdbc4.jar
javac SaveQueryImage.java
jar cfm SaveQueryImage.jar Manifest.txt *.class
```

다음과 같은 명령행을 이용해서
컴파일한 코드를 호출하십시오:

```
java -jar SaveQueryImage.jar "SELECT ST_AsPNG(ST_AsRaster(ST_Buffer(ST_Point(1,5),10, ' ↩
    quad_segs=2'),150, 150, '8BUI',100));" "test.png"
```

```
-- Manifest.txt --
Class-Path: postgresql-9.0-801.jdbc4.jar
Main-Class: SaveQueryImage
```

```
// SaveQueryImage.java &#xc6a9; &#xcf54;&#xb4dc;
import java.sql.Connection;
import java.sql.SQLException;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.io.*;

public class SaveQueryImage {
  public static void main(String[] argv) {
      System.out.println("Checking if Driver is registered with DriverManager.");

      try {
        //java.sql.DriverManager.registerDriver (new org.postgresql.Driver());
        Class.forName("org.postgresql.Driver");
      }
      catch (ClassNotFoundException cnfe) {
        System.out.println("Couldn't find the driver!");
        cnfe.printStackTrace();
        System.exit(1);
      }

      Connection conn = null;
```

```
      try {
        conn = DriverManager.getConnection("jdbc:postgresql://localhost:5432/mydb","myuser ↩
            ", "mypwd");
        conn.setAutoCommit(false);

        PreparedStatement sGetImg = conn.prepareStatement(argv[0]);

        ResultSet rs = sGetImg.executeQuery();

                FileOutputStream fout;
                try
                {
                        rs.next();
                        /** &#xc0ac;&#xc6a9;&#xc790;&#xac00; &#xc694;&#xccad;&#xd55c;  ↩
                            &#xd30c;&#xc77c;&#xba85;&#xc73c;&#xb85c; &#xcd9c;&#xb825; **/
                        fout = new FileOutputStream(new File(argv[1]) );
                        fout.write(rs.getBytes(1));
                        fout.close();
                }
                catch(Exception e)
                {
                        System.out.println("Can't create file");
                        e.printStackTrace();
                }

        rs.close();
                sGetImg.close();
        conn.close();
      }
      catch (SQLException se) {
        System.out.println("Couldn't connect: print out a stack trace and exit.");
        se.printStackTrace();
        System.exit(1);
      }
  }
}
```

9.3.4 PLPython을 이용해서 SQL을 통해 &#xc774 덤프하기

서버 디렉터리에 각 레코드를 파&#x 생성하는 PLPython 저장 함수입니다. PLPython& 설치해야 합니다. PLPythonu와 PLPythonu3u 모두 잘 작동할 것입니다.

```
CREATE OR REPLACE FUNCTION write_file (param_bytes bytea, param_filepath text)
RETURNS text
AS $$
f = open(param_filepath, 'wb+')
f.write(param_bytes)
return param_filepath
$$ LANGUAGE plpythonu;
```

```
-- PostgreSQL &#xc11c;&#xbc84;&#xc5d0; &#xc5ec;&#xb7ec; &#xd06c;&#xae30;&#xb85c;  ↩
    &#xc774;&#xbbf8;&#xc9c0; 5&#xc7a5;&#xc744; &#xc791;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
-- PostgreSQL &#xb370;&#xbaac;(daemon) &#xacc4;&#xc815;&#xc774; &#xd3f4;&#xb354;&#xc758;  ↩
    &#xc4f0;&#xae30; &#xad8c;&#xd55c;&#xc744; &#xac00;&#xc838;&#xc57c;  ↩
    &#xd55c;&#xb2e4;&#xb294; &#xc810;&#xc5d0;  ↩
    &#xc8fc;&#xc758;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
```

```
-- &#xc774; &#xcffc;&#xb9ac;&#xb294; &#xc0dd;&#xc131;&#xb41c;  ↩
    &#xd30c;&#xc77c;&#xba85;&#xc744; &#xd654;&#xba74;&#xc5d0;  ↩
    &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;;
 SELECT write_file(ST_AsPNG(
        ST_AsRaster(ST_Buffer(ST_Point(1,5),j*5, 'quad_segs=2'),150*j, 150*j, '8BUI',100)),
         'C:/temp/slices'|| j || '.png')
         FROM generate_series(1,5) As j;

     write_file
---------------------
 C:/temp/slices1.png
 C:/temp/slices2.png
 C:/temp/slices3.png
 C:/temp/slices4.png
 C:/temp/slices5.png
```

9.3.5 PSQL을 이용해서 래스터 출&#xb82

안타깝게도 PSQL은 바이너리 출력 작업에 쉽게 사용할 수 있는 내장 기능성을 가지고 있지 않습니다. PostgreSQL의 레거시 대용량 객체 지원에 어느 정도 숟가락만 얹는 꼼수에 가깝습니다. PSQL을 사용하려면, 먼&#xc8 사용자 데이터베이스에 연결된 사용자의 PSQL 명령행을 실행하십&#xc2d

파이썬 접근법과는 달리, 이 접근&#x 사용자의 로컬 시스템에 파일을 생성합니다.

```
SELECT oid, lowrite(lo_open(oid, 131072), png) As num_bytes
 FROM
 ( VALUES (lo_create(0),
   ST_AsPNG( (SELECT rast FROM aerials.boston WHERE rid=1) )
  ) ) As v(oid,png);
-- &#xb2e4;&#xc74c;&#xacfc; &#xbe44;&#xc2b7;&#xd558;&#xac8c; &#xcd9c;&#xb825;&#xb420;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --
   oid   | num_bytes
---------+-----------
 2630819 |     74860

-- &#xadf8; &#xb2e4;&#xc74c; oid&#xb97c; &#xae30;&#xc5b5;&#xd558;&#xace0; c:/test.png ↩
    &#xb97c; &#xc0ac;&#xc6a9;&#xc790;&#xc758;
-- &#xb85c;&#xceec; &#xc2dc;&#xc2a4;&#xd15c; &#xd30c;&#xc77c; &#xacbd;&#xb85c;  ↩
    &#xc704;&#xce58;&#xb85c; &#xb300;&#xccb4;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
 \lo_export 2630819 'C:/temp/aerial_samp.png'

-- &#xc774; &#xad6c;&#xbb38;&#xc740; DB&#xc5d0; &#xc788;&#xb294; &#xb300;&#xc6a9;&#xb7c9;  ↩
    &#xac1d;&#xccb4; &#xc800;&#xc7a5;&#xc18c;&#xc5d0;&#xc11c; &#xd30c;&#xc77c;&#xc744;  ↩
    &#xc0ad;&#xc81c;&#xd569;&#xb2c8;&#xb2e4;.
SELECT lo_unlink(2630819);
```

Chapter 10

래스트 참조&#x

이 단원에서 주어진 함수들은 PostGIS 래스터 사용자가 필요로 하고, 현재 PostGIS 래스터에서 사용할 수 있&#x 함수들입니다. 일반 사용자에겐 쓸모없는, 래스터 객체에 필요한 다른 지원 함수들도 있습니다.

`raster` 는 래스터 데이터를 저장하고 분석하기 위한 새로운 PostGIS 유형입&#x

래스터 파일에서 래스터를 로드&#x Section 9.1 를 참조하십시오.

이 참조 문서에 있는 예시들의 경&# 다음 코드로 구성된 가짜 래스터&#x 담은 래스터 테이블을 이용할 것&#

```
CREATE TABLE dummy_rast(rid integer, rast raster);
INSERT INTO dummy_rast(rid, rast)
VALUES (1,
('01' -- little endian (uint8 ndr)
||
'0000' -- version (uint16 0)
||
'0000' -- nBands (uint16 0)
||
'0000000000000040' -- scaleX (float64 2)
||
'0000000000000840' -- scaleY (float64 3)
||
'000000000000E03F' -- ipX (float64 0.5)
||
'000000000000E03F' -- ipY (float64 0.5)
||
'0000000000000000' -- skewX (float64 0)
||
'0000000000000000' -- skewY (float64 0)
||
'00000000' -- SRID (int32 0)
||
'0A00' -- width (uint16 10)
||
'1400' -- height (uint16 20)
)::raster
),
```

```
-- &#xb798;&#xc2a4;&#xd130;: 5 x 5 &#xd53d;&#xc140;, &#xbc34;&#xb4dc; 3&#xac1c;, PT_8BUI  ↩
    &#xd53d;&#xc140; &#xc720;&#xd615;, NODATA = 0
(2,  ('01000003009A9999999999A93F9A9999999999A9BF000000E02B274A' ||
'41000000007719564100000000000000000000000000000000 ↩
    FFFFFFFF050005000400FDFEFDFEFEFDFEFEFDF9FAFEF' ||
' ↩
    EFCF9FBFDFEFEFDFCFAFEFEFE04004E627AADD16076B4F9FE6370A9F5FE59637AB0E54F5861708704004656648 7A1506
    ')::raster);
```

10.1 래스터 지원 데이터&#xd6

10.1.1 geomval

geomval — (도형 객체를 담고 있는) geom과 (래&#x 밴드의 이중 정밀도 픽셀값을 담&# 있는) val, 두 개의 필드를 가진 공간 데이터형입니다.

설명

geomval은 복합 데이터 유형으로, .geom 필&#xb4 참조하는 도형 객체와 래스터 밴&# 내부의 특정 기하 위치에 있는 픽&# 나타내는 이중 정밀도 값인 val로 구성됩니다. ST_DumpAsPolygon 및 래스터 교차 계열 함수들이 래스터 밴드를 도&# 폴리곤들로 분해하기 위한 출력&#x 유형으로 이 데이터형을 이용합&#

참고

Section 12.6

10.1.2 addbandarg

addbandarg — 새로운 밴드의 속성 및 초기&#xac12 정의하는 ST_AddBand 함수의 입력물로 이용되는 복합 데이터형입니다.

설명

새로운 밴드의 속성 및 초기값을 정의하는 ST_AddBand 함수의 입력물로 이용되는 복합 데이터형입니다.

index **integer** 래스터의 밴드들 사이 어떤 위치에 새 밴드를 추가할지 지&#xc2c 1-기반 값입니다. NULL일 경우, 래스&#xd1 밴드의 마지막에 새 밴드를 추&#xac0 것입니다.

pixeltype **text** ST_BandPixelType 에서 설명하고 있는 픽&#x 유형들 가운데 하나입니다.

initialvalue **double precision** 새 밴드의 모든 픽셀들&#xc7 설정하게 될 초기값입니다.

nodataval **double precision** 새 밴드의 NODATA 값입니다. NULL&# 경우, 새 밴드에 NODATA 값을 할당하&#xc9 않을 것입니다.

참고

ST_AddBand

10.1.3 rastbandarg

rastbandarg — 래스터 및 해당 래스터의 밴&#xb4d 인덱스를 표현해야 할 경우 쓰이&# 복합 데이터형입니다.

설명

래스터 및 해당 래스터의 밴드 인&# 표현해야 할 경우 쓰이는 복합 데&#

rast **raster** 해당 래스터를 지정합니다.

nband **integer** 래스터의 밴드를 지시하는 1-기반 값입니다.

참고

내장 맵 대수 콜백 함수

10.1.4 raster

raster — 래스터 공간 데이터형입니다.

설명

raster is a spatial data type used to represent raster data such as those imported from JPEGs, TIFFs, PNGs, digital elevation models. Each raster has 1 or more bands each having a set of pixel values. Rasters can be georeferenced.

Note

GDAL 지원과 함께 컴파일한 PostGIS가 필요합니다. 현재 래스터를 제약 없이 도형 유형으로 변환할 수 있지만, 이 변환 작업은 래스터의 ST_ConvexHull 을 반환합니다. 이 자동 형변환 기능은 가까운 시일 내에 제거될 수 있으므로 의존하지 않는 편이 좋습니다.

형변환 습성(Casting Behavior)

이 단원에서는 이 데이터형에 대&#
사용할 수 있는 자동적임은 물론
명시적인 형변환 목록을 제시합&#

형변환 결과	습성
도형	자동적

참고

Chapter 10

10.1.5 reclassarg

reclassarg — 재분류 작업의 습성을 정의하
ST_Reclass 함수의 입력물로 쓰이는 복합
데이터형입니다.

설명

재분류 작업의 습성을 정의하는
ST_Reclass 함수의 입력물로 쓰이는 복합
데이터형입니다.

nband **integer** 재분류할 밴드의 밴드 개수&#xc7

reclassexpr **text** 쉼표로 구분된 range:map_range 매핑으&#x
이루어진 범위 표현식입니다.
':'가 예전 밴드값을 새 밴드값으&#x
어떻게 매핑할 것인지를 정의&#xd5
매핑을 정의합니다. '('는 '>'를, ')'는
미만을, ']'는 '<' 또는 동일을, '['는 '>' 또&#
동일을 뜻합니다.

```
1. [a-b] = a <= x <= b

2. (a-b] = a < x <= b

3. [a-b) = a <= x < b

4. (a-b) = a < x < b
```

'(' 기호는 선택적이기 때문에 (a-b)&#xc640
a-b의 의미는 동일합니다.

pixeltype **text** ST_BandPixelType 에서 설명하고 있는 픽&#x
유형들 가운데 하나입니다.

nodataval **double precision** NODATA로 취급되는 값입니다.
투명도를 지원하는 이미지 출&#xb82
경우, 이 값이 투명이 될 것입니&#xb

예: 밴드 2를 255가 NODATA 값인 8BUI로 재분류&#

```
SELECT ROW(2, '0-100:1-10, 101-500:11-150,501 - 10000: 151-254', '8BUI', 255)::reclassarg;
```

예: 밴드 1을 NODATA 값이 정의되지 않은 1BB로 재분류하십시오.

```
SELECT ROW(1, '0-100]:0, (100-255:1', '1BB', NULL)::reclassarg;
```

참고

ST_Reclass

10.1.6 summarystats

summarystats — ST_SummaryStats 및 ST_SummaryStatsAgg 함수가 반환하&#x 복합 데이터형입니다.

설명

ST_SummaryStats 및 ST_SummaryStatsAgg 함수가 반환하는 복& 데이터형입니다.

count **integer** 요약 통계를 위해 집계된 픽&#xc 개수입니다.

sum **double precision** 집계된 모든 픽셀 값의 합&#xc78

mean **double precision** 집계된 모든 픽셀 값의 산&#xc2 평균입니다.

stddev **double precision** 집계된 모든 픽셀 값의 표&#x 편차입니다.

min **double precision** 집계된 픽셀 값 가운데 최&#xc18

max **double precision** 집계된 픽셀 값 가운데 최&#xb30

참고

ST_SummaryStats, ST_SummaryStatsAgg

10.1.7 unionarg

unionarg — 공간 처리할 밴드들 및 UNION 연산&#x 습성을 정의하는 ST_Union 함수의 입력&# 쓰이는 복합 데이터형입니다.

설명

공간 처리할 밴드들 및 UNION 연산의 습성을 정의하는 ST_Union 함수의 입력&# 쓰이는 복합 데이터형입니다.

nband **integer** 공간 처리할 각 입력 래스터&#xc 밴드를 지시하는 1-기반 값입니&#xb

uniontype **text** UNION 연산의 유형입니다. ST_Union 에&#x 설명하고 있는 유형들 가운데 하나입니다.

참고

ST_Union

10.2 래스터 관리

10.2.1 AddRasterConstraints

AddRasterConstraints — Adds raster constraints to a loaded raster table for a specific column that constrains spatial ref, scaling, blocksize, alignment, bands, band type and a flag to denote if raster column is regularly blocked. The table must be loaded with data for the constraints to be inferred. Returns true if the constraint setting was accomplished and issues a notice otherwise.

Synopsis

boolean **AddRasterConstraints**(name rasttable, name rastcolumn, boolean srid, boolean scale_x, boolean scale_y, boolean blocksize_x, boolean blocksize_y, boolean same_alignment, boolean regular_blocking, boolean num_bands=true , boolean pixel_types=true , boolean nodata_values=true , boolean out_db=true , boolean extent=true);
boolean **AddRasterConstraints**(name rasttable, name rastcolumn, text[] VARIADIC constraints);
boolean **AddRasterConstraints**(name rastschema, name rasttable, name rastcolumn, text[] VARIADIC constraints);
boolean **AddRasterConstraints**(name rastschema, name rasttable, name rastcolumn, boolean srid=true, boolean scale_x=true, boolean scale_y=true, boolean blocksize_x=true, boolean blocksize_y=true, boolean same_alignment=true, boolean regular_blocking=fa
boolean num_bands=true, boolean pixel_types=true, boolean nodata_values=true , boolean out_db=true , boolean extent=true);

설명

`raster_columns` 래스터 카탈로그에 정보를 표출하는 데 쓰이는, 래스터 열에 대한 제약조건들을 생성합니다. `rastschema` 는 해당 테이블이 속해 있는 테이블 스키마의 명칭입니다. `srid` 는 SPATIAL_REF_SYS 테이블에 있는 항목을 참&
정수형 값이어야만 합니다.

`raster2pgsql` 로더는 래스터 테이블을 등&#xb
데 이 함수를 이용합니다.

입력할 유효한 제약조건 명칭에
대한 자세한 내용은 Section 9.2.1 를 참조&#xd558

- `blocksize` 는 X 및 Y 블록 크기를 둘 다 설정&
- `blocksize_x` 는 X 타일(각 타일의 너비 픽셀
  개수)을 설정합니다.
- `blocksize_y` 는 Y 타일(각 타일의 높이 픽셀
  개수)을 설정합니다.
- `extent` 는 전체 테이블의 범위를 계산&
  제약조건을 적용합니다. 모든 래&
  해당 범위 내에 들어와야만 합니&
- `num_bands` 는 밴드의 개수입니다.
- `pixel_types` 각 밴드에 대해 픽셀 유형의
  배열을 읽어 들입니다. 모든 밴드
  N이 동일한 픽셀 유형을 가지도&#xb85d
  보장합니다.

- `regular_blocking` 은 공간적 유일성 제약조&#xac7
  두 래스터도 공간적으로 동일할
  수 없습니다) 및 커버리지 타일 제&
  커버리지에 맞춰 정렬됩니다)을
  설정합니다.
- `same_alignment` ensures they all have same alignment meaning any two tiles you compare will return true for. Refer to ST_SameAlignment.
- `srid` 는 모든 타일이 동일한 SRID를 가&#xc9c0
  보장합니다.
- 기타 -- 앞의 함수들이 입력받는
  제약조건은 무엇이든 추가해주&#

Note

이 함수는 테이블에 이미
존재하는 데이터에 제약조건을
적용합니다. 따라서 이 함수가
작동하려면, 먼저 래스터
열을 생성한 다음 데이터를
로드해야만 합니다.

Note

사용자가 제약조건을 적용한
다음 추가 데이터를 로드해야
할 경우, 사용자 데이터의
범위가 변경된다면 DropRasterCon-
straints 함수를 실행하는 편이
좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

**예시: 데이터에 기반한 열에 가능&#x
한 모든 제약조건을 적용하기**

```
CREATE TABLE myrasters(rid SERIAL primary key, rast raster);
INSERT INTO myrasters(rast)
SELECT ST_AddBand(ST_MakeEmptyRaster(1000, 1000, 0.3, -0.3, 2, 2, 0, 0,4326), 1, '8BSI':: ↩
    text, -129, NULL);

SELECT AddRasterConstraints('myrasters'::name, 'rast'::name);


-- raster_columns &#xbdf0;&#xc5d0; &#xc815;&#xd655;&#xd788;  ↩
    &#xb4f1;&#xb85d;&#xb410;&#xb294;&#xc9c0; &#xd655;&#xc778; --
SELECT srid, scale_x, scale_y, blocksize_x, blocksize_y, num_bands, pixel_types,  ↩
    nodata_values
        FROM raster_columns
        WHERE r_table_name = 'myrasters';

 srid | scale_x | scale_y | blocksize_x | blocksize_y | num_bands | pixel_types|  ↩
     nodata_values
------+---------+---------+-------------+-------------+-----------+-------------+-------------- ↩

 4326 |       2 |       2 |        1000 |        1000 |         1 | {8BSI}      | {0}
```

예시: 단일 제약조건을 적용하기

```
CREATE TABLE public.myrasters2(rid SERIAL primary key, rast raster);
INSERT INTO myrasters2(rast)
SELECT ST_AddBand(ST_MakeEmptyRaster(1000, 1000, 0.3, -0.3, 2, 2, 0, 0,4326), 1, '8BSI':: ↩
    text, -129, NULL);

SELECT AddRasterConstraints('public'::name, 'myrasters2'::name, 'rast'::name,' ↩
    regular_blocking', 'blocksize');
-- &#xc548;&#xb0b4;&#xbb38; &#xcd9c;&#xb825; --
NOTICE:  Adding regular blocking constraint
NOTICE:  Adding blocksize-X constraint
NOTICE:  Adding blocksize-Y constraint
```

참고

Section 9.2.1, ST_AddBand, ST_MakeEmptyRaster, DropRasterConstraints, ST_BandPixelType, ST_SRID

10.2.2 DropRasterConstraints

DropRasterConstraints — 래스터 테이블 열을 참조&#xd55
PostGIS 래스터 제약조건을 삭제합니&#xb
데이터를 다시 로드하거나 사용&#
래스터 열 데이터를 업데이트해&#
할 경우 유용합니다.

Synopsis

boolean **DropRasterConstraints**(name rasttable, name rastcolumn, boolean srid, boolean scale_x, boolean scale_y, boolean blocksize_x, boolean blocksize_y, boolean same_alignment, boolean regular_blocking, boolean num_bands=true, boolean pixel_types=t
boolean nodata_values=true, boolean out_db=true , boolean extent=true);
boolean **DropRasterConstraints**(name rastschema, name rasttable, name rastcolumn, boolean srid=true, boolean scale_x=true, boolean scale_y=true, boolean blocksize_x=true, boolean blocksize_y=true, boolean same_alignment=true, boolean regular_blocking=fa
boolean num_bands=true, boolean pixel_types=true, boolean nodata_values=true, boolean out_db=true , boolean extent=true);
boolean **DropRasterConstraints**(name rastschema, name rasttable, name rastcolumn, text[] constraints);

설명

AddRasterConstraints 가 추가한, 래스터 테이블 열&
참조하는 PostGIS 래스터 제약조건을
삭제합니다. 데이터를 다시 로드&
사용자 래스터 열 데이터를 업데&
할 경우 유용합니다. 래스터 테이&
또는 래스터 열을 제거하려고 이
함수를 쓸 필요는 없습니다.

래스터 테이블을 삭제하는 표준&
방법은 다음과 같습니다.

```
DROP TABLE mytable
```

래스터 열만 삭제하고 테이블의
나머지 부분은 남겨두려면, 표준
SQL을 이용하십시오.

```
ALTER TABLE mytable DROP COLUMN rast
```

열 또는 테이블을 삭제할 경우 raster_co
카탈로그에서 테이블이 사라질
것입니다. 하지만 제약조건들만
삭제할 경우, 래스터 열은 계속 raster_co
카탈로그 목록에 남아 있을 것입&#x
그러나 열 및 테이블 명칭을 제외&#x
정보는 남아 있지 않을 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT DropRasterConstraints ('myrasters','rast');
-- &#xacb0;&#xacfc; &#xcd9c;&#xb825; --
t

-- raster_columns&#xc758; &#xbcc0;&#xacbd; &#xc0ac;&#xd56d; &#xd655;&#xc778; --
SELECT srid, scale_x, scale_y, blocksize_x, blocksize_y, num_bands, pixel_types,  ↩
    nodata_values
        FROM raster_columns
        WHERE r_table_name = 'myrasters';

 srid | scale_x | scale_y | blocksize_x | blocksize_y | num_bands | pixel_types|  ↩
     nodata_values
------+---------+---------+-------------+-------------+-----------+-------------+--------------- ↩

    0 |         |         |             |             |           |             |
```

참고

AddRasterConstraints

10.2.3 AddOverviewConstraints

AddOverviewConstraints — 래스터 열을 또 다른 래스&#x
열의 미리보기(overview)로 태그합니다.

Synopsis

boolean **AddOverviewConstraints**(name ovschema, name ovtable, name ovcolumn, name refschema, name reftable, name refcolumn, int ovfactor);
boolean **AddOverviewConstraints**(name ovtable, name ovcolumn, name reftable, name refcolumn, int ovfactor);

설명

raster_overviews 래스터 카탈로그에 정보를
표출하는 데 쓰이는 래스터 열에
제약조건을 추가합니다.

ovfactor 파라미터는 미리보기 열에 대&#
축척 승수(乘數)를 나타냅니다. ovfacto
가 클수록 해상도가 낮아집니다.

ovschema 및 refschema 파라미터를 생략할 경&#xc6b
search_path 를 스캔하면서 처음 발견한
테이블을 이용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
CREATE TABLE res1 AS SELECT
ST_AddBand(
  ST_MakeEmptyRaster(1000, 1000, 0, 0, 2),
  1, '8BSI'::text, -129, NULL
) r1;

CREATE TABLE res2 AS SELECT
ST_AddBand(
  ST_MakeEmptyRaster(500, 500, 0, 0, 4),
  1, '8BSI'::text, -129, NULL
) r2;

SELECT AddOverviewConstraints('res2', 'r2', 'res1', 'r1', 2);

-- raster_overviews &#xbdf0;&#xc5d0; &#xc815;&#xd655;&#xd788;  ↩
    &#xb4f1;&#xb85d;&#xb410;&#xb294;&#xc9c0; &#xd655;&#xc778; --
SELECT o_table_name ot, o_raster_column oc,
       r_table_name rt, r_raster_column rc,
       overview_factor f
FROM raster_overviews WHERE o_table_name = 'res2';
  ot   | oc |  rt   | rc | f
------+----+------+----+---
 res2 | r2 | res1 | r1 | 2
(1 row)
```

참고

Section 9.2.2, DropOverviewConstraints, ST_CreateOverview, AddRasterConstraints

10.2.4 DropOverviewConstraints

DropOverviewConstraints — 또 다른 래스터 열의 미리&#x
래스터 열을 태그 해제합니다.

Synopsis

boolean **DropOverviewConstraints**(name ovschema, name ovtable, name ovcolumn);
boolean **DropOverviewConstraints**(name ovtable, name ovcolumn);

설명

raster_overviews 래스터 카탈로그에 또 다&#xb978
래스터 열의 미리보기를 표출하&#x
데 쓰이는 래스터 열의 제약조건&#x
제거합니다.

ovschema 파라미터를 생략할 경우, search_path 를 스캔하면서 처음 발견한 테이&#x 이용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

참고

Section 9.2.2, AddOverviewConstraints, DropRasterConstraints

10.2.5 PostGIS_GDAL_Version

PostGIS_GDAL_Version — PostGIS가 이용하고 있는 GDAL 라&#xc774 버전을 반환합니다.

Synopsis

text **PostGIS_GDAL_Version**();

설명

PostGIS가 이용하고 있는 GDAL 라이브러&#xb9a 버전을 반환합니다. 또 GDAL이 자체 데이터 파일을 찾을 수 있는지도 확인해서 보고할 것입니다.

예시

```
SELECT PostGIS_GDAL_Version();
       postgis_gdal_version
-----------------------------------
 GDAL 1.11dev, released 2013/04/13
```

참고

postgis.gdal_datapath

10.2.6 PostGIS_Raster_Lib_Build_Date

PostGIS_Raster_Lib_Build_Date — 전체 래스터 라이브러&#xb9a 빌드 날짜를 반환합니다.

Synopsis

text **PostGIS_Raster_Lib_Build_Date**();

설명

래스터의 빌드 날짜를 보고합니&#x

예시

```
SELECT PostGIS_Raster_Lib_Build_Date();
postgis_raster_lib_build_date
-----------------------------
2010-04-28 21:15:10
```

참고

PostGIS_Raster_Lib_Version

10.2.7 PostGIS_Raster_Lib_Version

PostGIS_Raster_Lib_Version — 전체 래스터 버전 및 설정 정보를 반환합니다.

Synopsis

text **PostGIS_Raster_Lib_Version**();

설명

전체 래스터 버전 및 설정 정보를 보고합니다.

예시

```
SELECT PostGIS_Raster_Lib_Version();
postgis_raster_lib_version
-----------------------------
 2.0.0
```

참고

PostGIS_Lib_Version

10.2.8 ST_GDALDrivers

ST_GDALDrivers — Returns a list of raster formats supported by PostGIS through GDAL. Only those formats with can_write=True can be used by ST_AsGDALRaster

Synopsis

setof record **ST_GDALDrivers**(integer OUT idx, text OUT short_name, text OUT long_name, text OUT can_read, text OUT can_write, text OUT create_options);

설명

Returns a list of raster formats short_name,long_name and creator options of each format supported by GDAL. Use the short_name as input in the `format` parameter of ST_AsGDALRaster. Options vary depending on what drivers your libgdal was compiled with. `create_options` returns an xml formatted set of CreationOptionList/Option consisting of name and optional `type`, `description` and set of `VALUE` for each creator option for the specific driver.

Changed: 2.5.0 - add can_read and can_write columns.

변경 사항: 2.0.6, 2.1.3 버전 - GUC 또는 환경 변&#gdal_enabled_drivers를 설정하지 않을 경우, 기본&어떤 드라이버도 활성화돼 있지 않습니다.

2.0.0 버전부터 사용할 수 있습니다. GDAL 1.6.0 이상 버전이 필요합니다.

예시: 드라이버 목록

```
SET postgis.gdal_enabled_drivers = 'ENABLE_ALL';
SELECT short_name, long_name, can_write
FROM st_gdaldrivers()
ORDER BY short_name;

   short_name    |                          long_name                          | can_write
-----------------+-----------------------------------------------------------------+-----------
 AAIGrid         | Arc/Info ASCII Grid                                             | t
 ACE2            | ACE2                                                            | f
 ADRG            | ARC Digitized Raster Graphics                                   | f
 AIG             | Arc/Info Binary Grid                                            | f
 AirSAR          | AirSAR Polarimetric Image                                       | f
 ARG             | Azavea Raster Grid format                                       | t
 BAG             | Bathymetry Attributed Grid                                      | f
 BIGGIF          | Graphics Interchange Format (.gif)                              | f
 BLX             | Magellan topo (.blx)                                            | t
 BMP             | MS Windows Device Independent Bitmap                            | f
 BSB             | Maptech BSB Nautical Charts                                     | f
 PAux            | PCI .aux Labelled                                               | f
 PCIDSK          | PCIDSK Database File                                            | f
 PCRaster        | PCRaster Raster File                                            | f
 PDF             | Geospatial PDF                                                  | f
 PDS             | NASA Planetary Data System                                      | f
 PDS4            | NASA Planetary Data System 4                                    | t
 PLMOSAIC        | Planet Labs Mosaics API                                         | f
 PLSCENES        | Planet Labs Scenes API                                          | f
 PNG             | Portable Network Graphics                                       | t
 PNM             | Portable Pixmap Format (netpbm)                                 | f
 PRF             | Racurs PHOTOMOD PRF                                             | f
 R               | R Object Data Store                                             | t
 Rasterlite      | Rasterlite                                                      | t
 RDA             | DigitalGlobe Raster Data Access driver                          | f
 RIK             | Swedish Grid RIK (.rik)                                         | f
 RMF             | Raster Matrix Format                                            | f
 ROI_PAC         | ROI_PAC raster                                                  | f
 RPFTOC          | Raster Product Format TOC format                                | f
 RRASTER         | R Raster                                                        | f
 RS2             | RadarSat 2 XML Product                                          | f
 RST             | Idrisi Raster A.1                                               | t
 SAFE            | Sentinel-1 SAR SAFE Product                                     | f
 SAGA            | SAGA GIS Binary Grid (.sdat, .sg-grd-z)                         | t
 SAR_CEOS        | CEOS SAR Image                                                  | f
```

```
 SDTS            | SDTS Raster                                                | f
 SENTINEL2       | Sentinel 2                                                 | f
 SGI             | SGI Image File Format 1.0                                  | f
 SNODAS          | Snow Data Assimilation System                              | f
 SRP             | Standard Raster Product (ASRP/USRP)                        | f
 SRTMHGT         | SRTMHGT File Format                                        | t
 Terragen        | Terragen heightfield                                       | f
 TIL             | EarthWatch .TIL                                            | f
 TSX             | TerraSAR-X Product                                         | f
 USGSDEM         | USGS Optional ASCII DEM (and CDED)                         | t
 VICAR           | MIPL VICAR file                                            | f
 VRT             | Virtual Raster                                             | t
 WCS             | OGC Web Coverage Service                                   | f
 WMS             | OGC Web Map Service                                        | t
 WMTS            | OGC Web Map Tile Service                                   | t
 XPM             | X11 PixMap Format                                          | t
 XYZ             | ASCII Gridded XYZ                                          | t
 ZMap            | ZMap Plus Grid                                             | t
```

예시: 각 드라이버에 대한 옵션 목&#

```
-- JPEG&#xc758; &#xc0dd;&#xc131; &#xc635;&#xc158; XML &#xc5f4;&#xc744; &#xd45c;&#xb85c;  ↩
    &#xcd9c;&#xb825; --
-- &#xc774; &#xc0dd;&#xc131; &#xc635;&#xc158;&#xb4e4;&#xc744; ST_AsGDALRaster&#xc758;  ↩
    &#xc778;&#xc218;&#xb85c; &#xc0ac;&#xc6a9;&#xd560; &#xc218; &#xc788;&#xb2e4;&#xb294;  ↩
    &#xc810;&#xc744; &#xae30;&#xc5b5;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
SELECT (xpath('@name', g.opt))[1]::text As oname,
       (xpath('@type', g.opt))[1]::text As otype,
       (xpath('@description', g.opt))[1]::text As descrip
FROM (SELECT unnest(xpath('/CreationOptionList/Option', create_options::xml)) As opt
FROM  st_gdaldrivers()
WHERE short_name = 'JPEG') As g;

       oname        |  otype  |      descrip
--------------------+---------+-------------------------------------------------
 PROGRESSIVE        | boolean | whether to generate a progressive JPEG
 QUALITY            | int     | good=100, bad=0, default=75
 WORLDFILE          | boolean | whether to geneate a worldfile
 INTERNAL_MASK      | boolean | whether to generate a validity mask
 COMMENT            | string  | Comment
 SOURCE_ICC_PROFILE | string  | ICC profile encoded in Base64
 EXIF_THUMBNAIL     | boolean | whether to generate an EXIF thumbnail(overview).
                                By default its max dimension will be 128
 THUMBNAIL_WIDTH    | int     | Forced thumbnail width
 THUMBNAIL_HEIGHT   | int     | Forced thumbnail height
(9 rows)
```

```
-- GeoFiff&#xc5d0; &#xb300;&#xd55c; &#xc0dd;&#xc131; &#xc635;&#xc158;&#xc758;  ↩
    &#xac00;&#xacf5;&#xb418;&#xc9c0; &#xc54a;&#xc740; XML &#xcd9c;&#xb825;&#xbb3c; --
SELECT create_options
FROM st_gdaldrivers()
WHERE short_name = 'GTiff';

<CreationOptionList>
    <Option name="COMPRESS" type="string-select">
        <Value
>NONE</Value>
        <Value
>LZW</Value>
        <Value
```

```
>PACKBITS</Value>
        <Value
>JPEG</Value>
        <Value
>CCITTRLE</Value>
        <Value
>CCITTFAX3</Value>
        <Value
>CCITTFAX4</Value>
        <Value
>DEFLATE</Value>
    </Option>
    <Option name="PREDICTOR" type="int" description="Predictor Type"/>
    <Option name="JPEG_QUALITY" type="int" description="JPEG quality 1-100" default="75"/>
    <Option name="ZLEVEL" type="int" description="DEFLATE compression level 1-9" default ↩
        ="6"/>
    <Option name="NBITS" type="int" description="BITS for sub-byte files (1-7), sub-uint16  ↩
        (9-15), sub-uint32 (17-31)"/>
    <Option name="INTERLEAVE" type="string-select" default="PIXEL">
        <Value
>BAND</Value>
        <Value
>PIXEL</Value>
    </Option>
    <Option name="TILED" type="boolean" description="Switch to tiled format"/>
    <Option name="TFW" type="boolean" description="Write out world file"/>
    <Option name="RPB" type="boolean" description="Write out .RPB (RPC) file"/>
    <Option name="BLOCKXSIZE" type="int" description="Tile Width"/>
    <Option name="BLOCKYSIZE" type="int" description="Tile/Strip Height"/>
    <Option name="PHOTOMETRIC" type="string-select">
        <Value
>MINISBLACK</Value>
        <Value
>MINISWHITE</Value>
        <Value
>PALETTE</Value>
        <Value
>RGB</Value>
        <Value
>CMYK</Value>
        <Value
>YCBCR</Value>
        <Value
>CIELAB</Value>
        <Value
>ICCLAB</Value>
        <Value
>ITULAB</Value>
    </Option>
    <Option name="SPARSE_OK" type="boolean" description="Can newly created files have  ↩
        missing blocks?" default="FALSE"/>
    <Option name="ALPHA" type="boolean" description="Mark first extrasample as being alpha ↩
        "/>
    <Option name="PROFILE" type="string-select" default="GDALGeoTIFF">
        <Value
>GDALGeoTIFF</Value>
        <Value
>GeoTIFF</Value>
        <Value
>BASELINE</Value>
    </Option>
    <Option name="PIXELTYPE" type="string-select">
```

```
        <Value
>DEFAULT</Value>
        <Value
>SIGNEDBYTE</Value>
    </Option>
    <Option name="BIGTIFF" type="string-select" description="Force creation of BigTIFF file ↩
        ">
        <Value
>YES</Value>
        <Value
>NO</Value>
        <Value
>IF_NEEDED</Value>
        <Value
>IF_SAFER</Value>
    </Option>
    <Option name="ENDIANNESS" type="string-select" default="NATIVE" description="Force  ↩
        endianness of created file. For DEBUG purpose mostly">
        <Value
>NATIVE</Value>
        <Value
>INVERTED</Value>
        <Value
>LITTLE</Value>
        <Value
>BIG</Value>
    </Option>
    <Option name="COPY_SRC_OVERVIEWS" type="boolean" default="NO" description="Force copy  ↩
        of overviews of source dataset (CreateCopy())"/>
</CreationOptionList
>

-- GeoFiff&#xc5d0; &#xb300;&#xd55c; &#xc0dd;&#xc131; &#xc635;&#xc158; XML &#xc5f4;&#xc744;  ↩
    &#xd45c;&#xb85c; &#xcd9c;&#xb825;  --
SELECT (xpath('@name', g.opt))[1]::text As oname,
       (xpath('@type', g.opt))[1]::text As otype,
       (xpath('@description', g.opt))[1]::text As descrip,
       array_to_string(xpath('Value/text()', g.opt),', ') As vals
FROM (SELECT unnest(xpath('/CreationOptionList/Option', create_options::xml)) As opt
FROM  st_gdaldrivers()
WHERE short_name = 'GTiff') As g;

       oname        |     otype     |                                descrip  ↩
                                    |                                          vals
--------------------+---------------+-------------------------------------------------------------------

 COMPRESS           | string-select |  ↩
                                                                              | NONE, LZW,  ↩
    PACKBITS, JPEG, CCITTRLE, CCITTFAX3, CCITTFAX4, DEFLATE
 PREDICTOR          | int           | Predictor Type  ↩
                                                          |
 JPEG_QUALITY       | int           | JPEG quality 1-100  ↩
                                                           |
 ZLEVEL             | int           | DEFLATE compression level 1-9  ↩
                                                    |
 NBITS              | int           | BITS for sub-byte files (1-7), sub-uint16 (9-15), sub ↩
    -uint32 (17-31) |
 INTERLEAVE         | string-select |  ↩
                                                                              | BAND, PIXEL
 TILED              | boolean       | Switch to tiled format  ↩
                                                            |
 TFW                | boolean       | Write out world file  ↩
```

```
                                                    |
 RPB                | boolean       | Write out .RPB (RPC) file  ↩
                                                  |
 BLOCKXSIZE         | int           | Tile Width  ↩
                                                          |
 BLOCKYSIZE         | int           | Tile/Strip Height  ↩
                                                        |
 PHOTOMETRIC        | string-select |  ↩
                                                                  | MINISBLACK,  ↩
    MINISWHITE, PALETTE, RGB, CMYK, YCBCR, CIELAB, ICCLAB, ITULAB
 SPARSE_OK          | boolean       | Can newly created files have missing blocks?  ↩
                            |
 ALPHA              | boolean       | Mark first extrasample as being alpha  ↩
                                  |
 PROFILE            | string-select |  ↩
                                                                  | GDALGeoTIFF,  ↩
    GeoTIFF, BASELINE
 PIXELTYPE          | string-select |  ↩
                                                                  | DEFAULT,  ↩
    SIGNEDBYTE
 BIGTIFF            | string-select | Force creation of BigTIFF file  ↩
                                        | YES, NO, IF_NEEDED, IF_SAFER
 ENDIANNESS         | string-select | Force endianness of created file. For DEBUG purpose  ↩
    mostly            | NATIVE, INVERTED, LITTLE, BIG
 COPY_SRC_OVERVIEWS | boolean       | Force copy of overviews of source dataset (CreateCopy ↩
    ())             |
(19 rows)
```

참고

ST_AsGDALRaster, ST_SRID, postgis.gdal_enabled_drivers

10.2.9 ST_Count

ST_Count — Generates a set of vector contours from the provided raster band, using the GDAL contouring algorithm.

Synopsis

raster **ST_TPI**(raster rast, integer nband, raster customextent, text pixeltype="32BF" , boolean interpolate_nodata=FALSE);

설명

Generates a set of vector contours from the provided raster band, using the GDAL contouring algorithm.

When the `fixed_levels` parameter is a non-empty array, the `level_interval` and `level_base` parameters are ignored.

Return values are a set of records with the following attributes:

geomval The geometry of the contour line.

id A unique identifier given to the contour line by GDAL.

ST_Value The raster value the line represents. For an elevation DEM input, this would be the elevation of the output contour.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
WITH c AS (
SELECT (ST_Contour(rast, 1, fixed_levels => ARRAY[100.0, 200.0, 300.0])).*
FROM dem_grid WHERE rid = 1
)
SELECT st_astext(geom), id, value
FROM c;
```

참고

ST_MakeEmptyRaster

10.2.10 ST_MakeEmptyRaster

ST_MakeEmptyRaster — Interpolates a gridded surface based on an input set of 3-d points, using the X- and Y-values to position the points on the grid and the Z-value of the points as the surface elevation.

Synopsis

bytea **ST_AsGDALRaster**(raster rast, text format, text[] options=NULL, integer srid=sameassource);

설명

Interpolates a gridded surface based on an input set of 3-d points, using the X- and Y-values to position the points on the grid and the Z-value of the points as the surface elevation. There are five interpolation algorithms available: inverse distance, inverse distance nearest-neighbor, moving average, nearest neighbor, and linear interpolation. See the gdal_grid documentation for more details on the algorithms and their parameters. For more information on how interpolations are calculated, see the GDAL grid tutorial.

Input parameters are:

input_points The points to drive the interpolation. Any geometry with Z-values is acceptable, all points in the input will be used.

algorithm_options A string defining the algorithm and algorithm options, in the format used by gdal_grid. For example, for an inverse-distance interpolation with a smoothing of 2, you would use "invdist:smoothing=2.0"

template A raster template to drive the geometry of the output raster. The width, height, pixel size, spatial extent and pixel type will be read from this template.

template_band_num By default the first band in the template raster is used to drive the output raster, but that can be adjusted with this parameter.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_InterpolateRaster(
    'MULTIPOINT(10.5 9.5 1000, 11.5 8.5 1000, 10.5 8.5 500, 11.5 9.5 500)'::geometry,
    'invdist:smoothing:2.0',
    ST_AddBand(ST_MakeEmptyRaster(200, 400, 10, 10, 0.01, -0.005, 0, 0), '16BSI')
)
```

참고

ST_Count

10.2.11 UpdateRasterSRID

UpdateRasterSRID — 사용자가 지정한 열 및 테이&
있는 모든 래스터의 SRID를 변경합&#xb2c

Synopsis

raster **UpdateRasterSRID**(name schema_name, name table_name, name column_name, integer new_srid);
raster **UpdateRasterSRID**(name table_name, name column_name, integer new_srid);

설명

사용자가 지정한 열 및 테이블에
있는 모든 래스터의 SRID를 변경합&#xb2c
이 함수는 지정한 열의 래스터의
SRID를 변경하기 전에 적절한 모든
열 제약조건들(범위, 정렬 방향 및
SRID)을 삭제할 것입니다.

Note
래스터의 데이터(밴드 픽셀
값)를 건드리지는 않습니다.
래스터의 메타데이터만
변경합니다.

2.1.0 버전부터 사용할 수 있습니다.

참고

UpdateGeometrySRID

10.2.12 ST_CreateOverview

ST_CreateOverview — 입력 래스터 커버리지의 저
버전을 생성합니다.

Synopsis

regclass **ST_CreateOverview**(regclass tab, name col, int factor, text algo='NearestNeighbor');

설명

소스 테이블로부터 리샘플링한 타일들을 담은 미리보기 테이블생성합니다. 출력 타일은 입력 타크기가 동일하고, 더 낮은 해상동일한 공간 범위를 커버합니다(크기는 양방향 모두 원본의 1/`factor` 이 될 것입니다).

`raster_overviews` 카탈로그에서 이 미리보기 테이블을 사용할 수 있게 되고, 래제약조건도 강제될 것입니다.

알고리즘 옵션에는 'NearestNeighbor', 'Bilinear', 'Cubic', 'Cubic-Spline', 그리고 'Lanczos'가 있습니다. 자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

2.2.0 버전부터 사용할 수 있습니다.

예시

Output to generally better quality but slower to product format

```
SELECT ST_CreateOverview('mydata.mytable'::regclass, 'rast', 2, 'Lanczos');
```

Output to faster to process default nearest neighbor

```
SELECT ST_CreateOverview('mydata.mytable'::regclass, 'rast', 2);
```

참고

ST_Retile, AddOverviewConstraints, AddRasterConstraints, Section 9.2.2

10.3 래스터 작성자(constructor)

10.3.1 ST_AddBand

ST_AddBand — 입력 인덱스 위치에 입력 초&#xac추가된 입력 유형의 새 밴드(들)을 가진 래스터를 반환합니다. 인덱&#x설정하지 않을 경우, 마지막 위치&#x밴드를 추가합니다.

Synopsis

(1) raster **ST_AddBand**(raster rast, addbandarg[] addbandargset);
(2) raster **ST_AddBand**(raster rast, integer index, text pixeltype, double precision initialvalue=0, double precision nodataval=NULL);
(3) raster **ST_AddBand**(raster rast, text pixeltype, double precision initialvalue=0, double precision nodataval=NULL);
(4) raster **ST_AddBand**(raster torast, raster fromrast, integer fromband=1, integer torastindex=at_end);
(5) raster **ST_AddBand**(raster torast, raster[] fromrasts, integer fromband=1, integer torastindex=at_end);
(6) raster **ST_AddBand**(raster rast, integer index, text outdbfile, integer[] outdbindex, double precision nodataval=NULL);
(7) raster **ST_AddBand**(raster rast, text outdbfile, integer[] outdbindex, integer index=at_end, double precision nodataval=NULL);

설명

입력 인덱스 위치에 입력 초기값, 입력 유형, 그리고 입력 NODATA 값의 새 밴드를 가진 래스터를 반환합니&#
인덱스를 설정하지 않을 경우, 마&#
위치에 밴드를 추가합니다. `fromband` 를
설정하지 않을 경우, 밴드 1로 가정&
픽셀 유형은 ST_BandPixelType 에서 지정한 픽&#
유형들 가운데 하나의 문자열 표&#
만약 기존 인덱스를 설정할 경우,
해당 인덱스보다 크거나 같은 그
이후의 모든 밴드들의 인덱스가
1씩 증가합니다. 픽셀 유형의 최대&
큰 초기값을 설정할 경우, 해당 픽&
유형이 가질 수 있는 가장 높은 값&
초기값을 설정합니다.

addbandarg 의 배열을 입력받는 변종 1의
경우, 특정 addbandarg의 인덱스 값은 addbandarg&#xac00
묘사하는 밴드가 래스터에 추가&#
당시의 해당 래스터에 상대적입&#
다음에 나오는 복수의 새로운 밴&#
예시를 참고하십시오.

래스터 배열을 입력받는 변종 5의
경우, `torast` 가 NULL이라면 배열 안에 있&#xb2
각 래스터의 `fromband` 밴드를 새 래스터&
누계(累計)합니다.

`outdbfile` 을 입력받는 변종 6 및 7의 경우,
`outdbfile` 값이 래스터 파일을 가리키는
전체 경로를 포함해야만 합니다.
PostgreSQL 서버 프로세스도 해당 파일에
접근할 수 있어야만 합니다.

개선 사항: 2.1.0 버전부터 addbandarg를 지원&#xd

개선 사항: 2.1.0 버전부터 새로운 DB 외&#
밴드를 지원합니다.

예시: 새로운 단일 밴드

```
-- &#xd53d;&#xc140; &#xcd08;&#xae30;&#xac12;&#xc744; 200&#xc73c;&#xb85c;  ↩
    &#xc124;&#xc815;&#xd55c;, &#xbd80;&#xd638;&#xac00; &#xc5c6;&#xb294;(unsigned) 8 ↩
    &#xbe44;&#xd2b8; &#xc815;&#xc218;&#xd615; &#xc720;&#xd615;&#xc758; &#xb610;  ↩
    &#xb2e4;&#xb978; &#xbc34;&#xb4dc;&#xb97c; &#xcd94;&#xac00;
UPDATE dummy_rast
    SET rast = ST_AddBand(rast,'8BUI'::text,200)
WHERE rid = 1;
```

```
-- &#xc88c;&#xc0c1;&#xb2e8;&#xc774; &#xb531; 0&#xc778; 100x100 &#xb2e8;&#xc704;&#xc758;  ↩
    &#xbe48; &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc0dd;&#xc131;&#xd558;&#xace0;, ( ↩
    &#xbc34;&#xb4dc; 1&#xc740; 0/1 &#xbd88; &#xac12; &#xbe44;&#xd2b8;  ↩
    &#xc2a4;&#xc704;&#xce58;, &#xbc34;&#xb4dc; 2&#xb294; 0&#xc5d0;&#xc11c; 15  ↩
    &#xc0ac;&#xc774;&#xc758; &#xac12;&#xc744; &#xac00;&#xc9c8; &#xc218; &#xc788;&#xb294;)  ↩
    &#xbc34;&#xb4dc; 2&#xac1c;&#xb97c; &#xcd94;&#xac00;
-- addbandargs&#xb97c; &#xc774;&#xc6a9;
INSERT INTO dummy_rast(rid,rast)
    VALUES(10, ST_AddBand(ST_MakeEmptyRaster(100, 100, 0, 0, 1, -1, 0, 0, 0),
```

```
        ARRAY[
                ROW(1, '1BB'::text, 0, NULL),
                ROW(2, '4BUI'::text, 0, NULL)
                        ]::addbandarg[]
     )
    );

-- &#xbaa8;&#xb4e0; &#xc791;&#xc5c5;&#xc774; &#xc815;&#xc0c1;&#xc778;&#xc9c0;  ↩
    &#xd655;&#xc778;&#xd558;&#xae30; &#xc704;&#xd574; &#xb798;&#xc2a4;&#xd130;  ↩
    &#xbc34;&#xb4dc;&#xb4e4;&#xc758; &#xba54;&#xd0c0;&#xb370;&#xc774;&#xd130;&#xb97c;  ↩
    &#xcd9c;&#xb825; --
SELECT  (bmd).*
FROM (SELECT ST_BandMetaData(rast,generate_series(1,2)) As bmd
    FROM dummy_rast WHERE rid = 10) AS foo;
 -- &#xacb0;&#xacfc; --
 pixeltype | nodatavalue | isoutdb | path
-----------+-------------+---------+------
 1BB       |             | f       |
 4BUI      |             | f       |


-- &#xb798;&#xc2a4;&#xd130;&#xc758; &#xba54;&#xd0c0;&#xb370;&#xc774;&#xd130;&#xb97c;  ↩
    &#xcd9c;&#xb825; --
SELECT  (rmd).width, (rmd).height, (rmd).numbands
FROM (SELECT ST_MetaData(rast) As rmd
    FROM dummy_rast WHERE rid = 10) AS foo;
-- &#xacb0;&#xacfc; --
 upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
     numbands
------------+------------+-------+--------+------------+------------+-------+-------+------+--------

          0 |          0 |   100 |    100 |      1 |     -1 |     0 |     0 |   0 |         ↩
            2
```

예시: 복수의 새로운 밴드

```
SELECT
        *
FROM ST_BandMetadata(
        ST_AddBand(
                ST_MakeEmptyRaster(10, 10, 0, 0, 1, -1, 0, 0, 0),
                ARRAY[
                        ROW(NULL, '8BUI', 255, 0),
                        ROW(NULL, '16BUI', 1, 2),
                        ROW(2, '32BUI', 100, 12),
                        ROW(2, '32BF', 3.14, -1)
                ]::addbandarg[]
        ),
        ARRAY[]::integer[]
);

 bandnum | pixeltype | nodatavalue | isoutdb | path
---------+-----------+-------------+---------+------
       1 | 8BUI      |           0 | f       |
       2 | 32BF      |          -1 | f       |
       3 | 32BUI     |          12 | f       |
       4 | 16BUI     |           2 | f       |
```

```
-- &#xb3d9;&#xc77c;&#xd55c; &#xc720;&#xd615;&#xc758;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb4e4;&#xc758; &#xd14c;&#xc774;&#xbe14;&#xc758; &#xccab;  ↩
```

```
    &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb97c; test_types&#xb9cc;&#xd07c; &#xb9ce;&#xc740;  ↩
    &#xbc34;&#xb4dc;&#xb4e4;&#xacfc;
-- mice&#xb9cc;&#xd07c; &#xb9ce;&#xc740; &#xd589;&#xb4e4;(&#xc0c8;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb4e4;)&#xacfc; &#xd568;&#xaed8; &#xb2e8;&#xc77c;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb85c; &#xc885;&#xd569;
-- &#xc8fc;&#xc758;: PostgreSQL 9.0 &#xc774;&#xc0c1; &#xbc84;&#xc804;&#xb9cc; ORDER BY  ↩
    test_type&#xc744; &#xc9c0;&#xc6d0;&#xd569;&#xb2c8;&#xb2e4;.
-- 8.4 &#xbc0f; &#xadf8; &#xc774;&#xc804; &#xbc84;&#xc804;&#xc5d0;&#xc11c;&#xb294;  ↩
    &#xc0ac;&#xc6a9;&#xc790; &#xb370;&#xc774;&#xd130;&#xb97c; &#xd558;&#xc704;  ↩
    &#xc9d1;&#xd569;&#xc73c;&#xb85c; &#xc815;&#xb82c;&#xd558;&#xb294;  ↩
    &#xc2dd;&#xc73c;&#xb85c; (&#xb300;&#xbd80;&#xbd84;&#xc758; &#xacbd;&#xc6b0;)  ↩
    &#xb3d9;&#xc791;&#xd569;&#xb2c8;&#xb2e4;.
-- test_type&#xc758; &#xc54c;&#xd30c;&#xbcb3; &#xc21c;&#xc11c;&#xb85c; &#xac01; test_type ↩
    &#xc5d0; &#xb300;&#xd55c; &#xbc34;&#xb4dc;&#xb97c; &#xac00;&#xc9c4;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xcd9c;&#xb825;&#xd560;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
-- &#xb3d9;&#xbb3c;&#xbcf4;&#xd638;&#xb860;&#xc790; &#xbd84;&#xb4e4;&#xaed8;: &#xc774;  ↩
    &#xc608;&#xc2dc;&#xc5d0;&#xc11c; &#xc5b4;&#xb5a4; &#xc950;(mice)&#xb3c4;  ↩
    &#xd76c;&#xc0dd;&#xb418;&#xc9c0; &#xc54a;&#xc558;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT
        mouse,
        ST_AddBand(NULL, array_agg(rast ORDER BY test_type), 1) As rast
FROM mice_studies
GROUP BY mouse;
```

예시: 새로운 DB 외부 밴드

```
SELECT
        *
FROM ST_BandMetadata(
        ST_AddBand(
                ST_MakeEmptyRaster(10, 10, 0, 0, 1, -1, 0, 0, 0),
                '/home/raster/mytestraster.tif'::text, NULL::int[]
        ),
        ARRAY[]::integer[]
);

 bandnum | pixeltype | nodatavalue | isoutdb | path
---------+-----------+-------------+---------+------
       1 | 8BUI      |             | t       | /home/raster/mytestraster.tif
       2 | 8BUI      |             | t       | /home/raster/mytestraster.tif
       3 | 8BUI      |             | t       | /home/raster/mytestraster.tif
```

참고

ST_BandMetaData, ST_BandPixelType, ST_MakeEmptyRaster, ST_MetaData, ST_NumBands, ST_Reclass

10.3.2 ST_AsRaster

ST_AsRaster — PostGIS 도형을 PostGIS 래스터로 변환&#xd569

Synopsis

raster **ST_AsRaster**(geometry geom, raster ref, text pixeltype, double precision value=1, double precision nodataval=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, raster ref, text[] pixeltype=ARRAY['8BUI'], double precision[] value=ARRAY[1], double

precision[] nodataval=ARRAY[0], boolean touched=false);
raster **ST_AsRaster**(geometry geom, double precision scalex, double precision scaley, double precision gridx, double precision gridy, text pixeltype, double precision value=1, double precision nodataval=0, double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, double precision scalex, double precision scaley, double precision gridx=NULL, double precision gridy=NULL, text[] pixeltype=ARRAY['8BUI'], double precision[] value=ARRAY[1], double precision[] nodataval=ARRAY[0], double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, double precision scalex, double precision scaley, text pixeltype, double precision value=1, double precision nodataval=0, double precision upperleftx=NULL, double precision upperlefty=NULL, double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, double precision scalex, double precision scaley, text[] pixeltype, double precision[] value=ARRAY[1], double precision[] nodataval=ARRAY[0], double precision upperleftx=NULL, double precision upperlefty=NULL, double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, integer width, integer height, double precision gridx, double precision gridy, text pixeltype, double precision value=1, double precision nodataval=0, double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, integer width, integer height, double precision gridx=NULL, double precision gridy=NULL, text[] pixeltype=ARRAY['8BUI'], double precision[] value=ARRAY[1], double precision[] nodataval=ARRAY[0], double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, integer width, integer height, text pixeltype, double precision value=1, double precision nodataval=0, double precision upperleftx=NULL, double precision upperlefty=NULL, double precision skewx=0, double precision skewy=0, boolean touched=false);
raster **ST_AsRaster**(geometry geom, integer width, integer height, text[] pixeltype, double precision[] value=ARRAY[1], double precision[] nodataval=ARRAY[0], double precision upperleftx=NULL, double precision upperlefty=NULL, double precision skewx=0, double precision skewy=0, boolean touched=false);

설명

PostGIS 도형을 PostGIS 래스터로 변환합니&#xb2
다양한 변종들을 통해 출력 래스&#
정렬 방향과 픽셀 크기를 크게 세
가지 방법으로 설정할 수 있습니&#

처음 두 변종으로 이루어진 첫 번&#
방법은 주어진 참조 래스터와 동&#x
정렬 방향(`scalex`, `scaley` 및 `gridx`, `gridy`), 픽셀 유형,
NODATA 값을 가진 래스터를 생성합니&#
일반적으로, 참조 래스터를 담고
있는 테이블과 도형을 담고 있는
테이블을 결합하는 방법으로 해&#
참조 래스터를 입력합니다.

네 변종으로 이루어진 두 번째 방&#
픽셀 크기(`scalex` & `scaley` 및 `skewx` & `skewy`)의 파라미&#
제공, 사용자가 래스터의 차원을
설정할 수 있도록 합니다. 결과 래&
`width` & `height` 가 도형의 범위에 맞도록 조&#
것입니다. 대부분의 경우, 정수형
`scalex` & `scaley` 인수들을 PostgreSQL이 올바른 변종
선택하도록 이중 정밀도 데이터&#
형변환해야만 합니다.

네 변종으로 이루어진 세 번째 방&#
래스터의 차원(`width` & `height`)을 제공, 사용&#
래스터의 차원을 수정할 수 있도&#
합니다. 결과 래스터의 픽셀 크기
파라미터(`scalex` & `scaley` 및 `skewx` & `skewy`)가 도형의
범위에 맞도록 조정될 것입니다.

뒤의 두 방법 가운데 각 방법의 처&#
두 변종들은 사용자가 정렬 그리&#x
임의의 모서리(`gridx` & `gridy`)를 설정할 수
있도록 합니다. 다른 두 변종들은
좌상단(`upperleftx` & `upperlefty`))을 입력받습니&#xb2e4

각 방법의 변종은 단일 밴드 래스&#
또는 복수 밴드 래스터를 생성할
수 있게 해줍니다. 복수 밴드 래스&#
생성하려면, 사용자가 픽셀 유형&#
배열(`pixeltype[]`), 초기값의 배열(`value`) 그리&#xace
NODTATA 값의 배열(`nodataval`)을 준비해야만
합니다. 이들을 입력하지 않으면,
기본적으로 픽셀 유형은 8BUI, 초기&#xac1
1, NODATA 값은 0이 됩니다.

출력 래스터는 소스 도형과 동일&#
공간 참조 시스템을 가지게 됩니&#x
유일한 예외는 참조 래스터를 받&#
변종들뿐입니다. 이런 경우 결과
래스터는 참조 래스터와 동일한
SRID를 가지게 됩니다.

선택적인 `touched` 파라미터의 기본값&#
거짓으로 GDAL ALL_TOUCHED 래스터화 옵션&#xc5d
매핑되는데, 이 옵션은 라인 또는
폴리곤에 닿은 픽셀을 없앨 것인&#x
말 것인지 결정합니다. 렌더링된
라인 경로 상에 있는 픽셀만이 아&#
그 중심점이 폴리곤 내부에 있는
픽셀 또한 말이죠.

이 함수는 ST_AsPNG 및 다른 ST_AsGDALRaster 계열
함수와 결합해서 사용할 때 데이&#
직접 가져온 도형의 JPEG 또는 PNG를 렌&
데 특히 유용합니다.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.0 이상 버전이 필요합니다.

Note

아직 만곡 도형, TIN, 다면체
표면 등의 복잡 도형 유형을
렌더링할 수는 없지만, GDAL이
관련 기능을 지원하게 되면 할
수 있게 될 것입니다.

예시: PNG 파일로 도형을 출력

검정색 원

```
-- this will output a black circle taking up 150 x 150 pixels --
SELECT ST_AsPNG(ST_AsRaster(ST_Buffer(ST_Point(1,5),10),150, 150));
```

PostGIS만을 이용해서 렌더링된 버퍼의 예시

```
-- RGB &#xbc34;&#xb4dc; - &#xc554;&#xb179;&#xc0c9; &#xac12; (118,154,118) - &#xc5d0;  ↩
    &#xb9e4;&#xd551;&#xb41c; &#xbc34;&#xb4dc;&#xb4e4; --
SELECT ST_AsPNG(
        ST_AsRaster(
                ST_Buffer(
                        ST_GeomFromText('LINESTRING(50 50,150 150,150 50)'), 10,'join=bevel ↩
                            '),
                        200,200,ARRAY['8BUI', '8BUI', '8BUI'], ARRAY[118,154,118], ARRAY ↩
                            [0,0,0]));
```

참고

ST_BandPixelType, ST_Buffer, ST_GDALDrivers, ST_AsGDALRaster, ST_AsPNG, ST_AsJPEG, ST_SRID

10.3.3 ST_Band

ST_Band — 기존 래스터의 하나 이상의 밴드를 새 래스터로 반환합니다. 기존 래스터로부터 새 래스터를 빌드하는 데 유용합니다.

Synopsis

raster **ST_Band**(raster rast, integer[] nbands = ARRAY[1]);
raster **ST_Band**(raster rast, integer nband);
raster **ST_Band**(raster rast, text nbands, character delimiter=,);

설명

Returns one or more bands of an existing raster as a new raster. Useful for building new rasters from existing rasters or export of only selected bands of a raster or rearranging the order of bands in a raster. If no band is specified or any of specified bands does not exist in the raster, then all bands are returned. Used as a helper function in various functions such as for deleting a band.

Warning

이 함수의 텍스트 변종으로 `nbands` 의 경우, 기본 구분자가 `,` 로 `'1,2,3'` 과 같은 서식으로 지정할 수 있다는 뜻입니다. 다른 구분자를 쓰고 싶은 경우 `ST_Band(rast, '1@2@3', '@')` 와 같은 서식을 이용하면 됩니다. 복수의 밴드를 지정하는 경우, 사용자가 이 함수의 `ST_Band(rast, '{1,2,3}'::int[])` 와 같은 배열 서식을 이용하도록 강력히 권고합니다. PostGIS 향후 버전에서 밴드들의 `text` 목록 서식이 제거될 수도 있기 때문입니다.

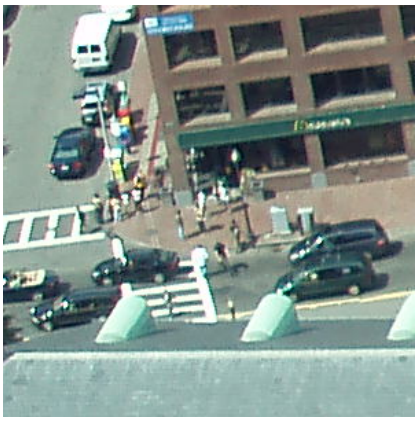
2.0.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc0c8; &#xb798;&#xc2a4;&#xd130;&#xb97c; 2&#xac1c;  ↩
    &#xc791;&#xc131;&#xd569;&#xb2c8;&#xb2e4;: &#xac00;&#xc9dc;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xc758; &#xbc34;&#xb4dc; 1&#xc744; &#xb2f4;&#xace0;  ↩
    &#xc788;&#xb294; &#xb798;&#xc2a4;&#xd130; &#xd558;&#xb098;, &#xac00;&#xc9dc;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xc758; &#xbc34;&#xb4dc; 2&#xb97c; &#xac00;&#xc838;&#xc640; 2 ↩
    BUI&#xb85c; &#xc7ac;&#xbd84;&#xb958;&#xd55c; &#xb798;&#xc2a4;&#xd130; &#xd558;&#xb098;
SELECT ST_NumBands(rast1) As numb1, ST_BandPixelType(rast1) As pix1,
 ST_NumBands(rast2) As numb2,  ST_BandPixelType(rast2) As pix2
FROM (
    SELECT ST_Band(rast) As rast1, ST_Reclass(ST_Band(rast,3), '100-200):1, [200-254:2', '2 ↩
        BUI') As rast2
        FROM dummy_rast
        WHERE rid = 2) As foo;

 numb1 | pix1 | numb2 | pix2
-------+------+-------+------
     1 | 8BUI |     1 | 2BUI
```

```
-- &#xbc30;&#xc5f4; &#xd615;&#xbcc0;&#xd658; &#xbb38;&#xbc95;&#xc744;  ↩
    &#xc774;&#xc6a9;&#xd574;&#xc11c; &#xbc34;&#xb4dc; 2 &#xbc0f; 3&#xc744;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_NumBands(ST_Band(rast, '{2,3}'::int[])) As num_bands
    FROM dummy_rast WHERE rid=2;
```

```
num_bands
----------
2

-- &#xbc34;&#xb4dc; 2 &#xbc0f; 3&#xc744; &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.  ↩
    &#xbc30;&#xc5f4;&#xc744; &#xc774;&#xc6a9;&#xd574; &#xbc34;&#xb4dc;&#xb97c;  ↩
    &#xc815;&#xc758;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_NumBands(ST_Band(rast, ARRAY[2,3])) As num_bands
    FROM dummy_rast
WHERE rid=2;
```

		
원본(rast 열)	*dupe_band*	*sing_band*

```
-- &#xc6d0;&#xbcf8;&#xc758; &#xb450; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb97c; &#xd55c;  ↩
    &#xbc88;, &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb97c; &#xb450; &#xbc88;  ↩
    &#xbc18;&#xbcf5;&#xd574;&#xc11c; &#xc0c8; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xc791;&#xc131;&#xd558;&#xace0;, &#xc138; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb85c;  ↩
    &#xb610; &#xb2e4;&#xb978; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xc791;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
SELECT rast, ST_Band(rast, ARRAY[2,1,1]) As dupe_band,
        ST_Band(rast, 3) As sing_band
FROM samples.than_chunked
WHERE rid=35;
```

참고

ST_AddBand, ST_NumBands, ST_Reclass, Chapter 10

10.3.4 ST_MakeEmptyCoverage

ST_MakeEmptyCoverage — Cover georeferenced area with a grid of empty raster tiles.

Synopsis

raster **ST_MakeEmptyCoverage**(integer tilewidth, integer tileheight, integer width, integer height, double precision upperleftx, double precision upperlefty, double precision scalex, double precision scaley, double precision skewx, double precision skewy, integer srid=unknown);

설명

Create a set of raster tiles with ST_MakeEmptyRaster. Grid dimension is `width` & `height`. Tile dimension is `tilewidth` & `tileheight`. The covered georeferenced area is from upper left corner (`upperleftx`, `upperlefty`) to lower right corner (`upperleftx` + `width` * `scalex`, `upperlefty` + `height` * `scaley`).

Note
Note that scaley is generally negative for rasters and scalex is generally positive. So lower right corner will have a lower y value and higher x value than the upper left corner.

Availability: 2.4.0

기본 예시

Create 16 tiles in a 4x4 grid to cover the WGS84 area from upper left corner (22, 77) to lower right corner (55, 33).

```
SELECT (ST_MetaData(tile)).* FROM ST_MakeEmptyCoverage(1, 1, 4, 4, 22, 33, (55 - 22)/(4):: ↩
    float, (33 - 77)/(4)::float, 0., 0., 4326) tile;

 upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
     numbands
------------------------------------------------------------------------------------------
         22 |         33 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      30.25 |         33 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
       38.5 |         33 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      46.75 |         33 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
         22 |         22 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      30.25 |         22 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
       38.5 |         22 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      46.75 |         22 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
         22 |         11 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      30.25 |         11 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
       38.5 |         11 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      46.75 |         11 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
         22 |          0 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      30.25 |          0 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
       38.5 |          0 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
      46.75 |          0 |     1 |      1 |   8.25 |    -11 |     0 |     0 | 4326 |  ↩
                  0
```

참고

ST_MakeEmptyRaster

10.3.5 ST_MakeEmptyRaster

ST_MakeEmptyRaster — 설정된 차원(너비 & 높이), 좌&#
X 및 Y, 픽셀 크기, 회전(scalex, scaley, skewx & skewy) 그리&#xac
공간 참조 시스템(SRID)를 가진 텅 빈
(밴드가 없는) 래스터를 반환합니&
래스터를 입력할 경우, 동일한 크&
정렬 방향 및 SRID를 가진 새 래스터&#xb9
반환합니다. SRID를 생략할 경우, 공&#xac
참조 시스템을 0(unknown)으로 설정합니&

Synopsis

raster **ST_MakeEmptyRaster**(raster rast);
raster **ST_MakeEmptyRaster**(integer width, integer height, float8 upperleftx, float8 upperlefty, float8 scalex, float8 scaley, float8 skewx, float8 skewy, integer srid=unknown);
raster **ST_MakeEmptyRaster**(integer width, integer height, float8 upperleftx, float8 upperlefty, float8 pixelsize);

설명

설정된 차원(너비 & 높이), 공간 (또&#xb29
월드) 좌표로 지리참조된 좌상단
X(upperleftx) 및 좌상단 Y(upperlefty), 픽셀 크기, 회전(sca
scaley, skewx & skewy) 그리고 공간 참조 시스템(SRID)&#x
가진 텅 빈 (밴드가 없는) 래스터를
반환합니다.

지난 버전은 픽셀 크기(pixelsize)를 설정&#
위한 단일 파라미터만 사용했습&#x
scalex는 이 인수로 설정됐고, scaley는 이
인수의 음의 값으로 설정됐습니&#x
skewx 및 skewy는 0으로 설정됐습니다.

기존 래스터를 입력할 경우, 동일&
메타데이터 설정을 가진 (밴드가
없는) 새 래스터를 반환합니다.

어떤 SRID도 설정하지 않을 경우 기&#xbcf
0입니다. 텅 빈 래스터를 생성한
다음 사용자가 밴드를 추가하거&#x
편집하려 할 수도 있습니다. 밴드&
정의하려면 ST_AddBand 를, 기본 픽셀 값&#xc74
설정하려면 ST_SetValue 를 참조하십시오.

예시

```
INSERT INTO dummy_rast(rid,rast)
VALUES(3, ST_MakeEmptyRaster( 100, 100, 0.0005, 0.0005, 1, 1, 0, 0, 4326) );

-- &#xae30;&#xc874; &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc0c8;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc704;&#xd55c;  ↩
    &#xd15c;&#xd50c;&#xb9bf;&#xc73c;&#xb85c; &#xc0ac;&#xc6a9;
INSERT INTO dummy_rast(rid,rast)
SELECT 4, ST_MakeEmptyRaster(rast)
FROM dummy_rast WHERE rid = 3;

-- &#xbc29;&#xae08; &#xcd94;&#xac00;&#xd55c; &#xb798;&#xc2a4;&#xd130;&#xc758;  ↩
    &#xba54;&#xd0c0;&#xb370;&#xc774;&#xd130;&#xb97c; &#xcd9c;&#xb825;
```

```
SELECT rid, (md).*
FROM (SELECT rid, ST_MetaData(rast) As md
        FROM dummy_rast
        WHERE rid IN(3,4)) As foo;

-- &#xcd9c;&#xb825; --
 rid | upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
     numbands
-----+------------+------------+-------+--------+--------+--------+-------+-------+------+--

   3 |     0.0005 |     0.0005 |   100 |    100 |      1 |      1 |     0 |     0 | ↩
       4326 |        0
   4 |     0.0005 |     0.0005 |   100 |    100 |      1 |      1 |     0 |     0 | ↩
       4326 |        0
```

참고

ST_AddBand, ST_MetaData, ST_ScaleX, ST_ScaleY, ST_SetValue, ST_SkewX, , ST_SkewY

10.3.6 ST_Tile

ST_Tile — 출력 래스터에 원하는 차원을 바탕으로 입력 래스터를 분할해&#x 나온 래스터들의 집합을 반환합&#x

Synopsis

setof raster **ST_Tile**(raster rast, int[] nband, integer width, integer height, boolean padwithnodata=FALSE, double precision nodataval=NULL);
setof raster **ST_Tile**(raster rast, integer nband, integer width, integer height, boolean padwithnodata=FALSE, double precision nodataval=NULL);
setof raster **ST_Tile**(raster rast, integer width, integer height, boolean padwithnodata=FALSE, double precision nodataval=NULL);

설명

출력 래스터에 원하는 차원을 바&#x 입력 래스터를 분할해서 나온 래&#x 집합을 반환합니다.

`padwithnodata` = FALSE일 경우, 래스터 우단 및 하&# 가장자리 타일들이 나머지 타일&#x 다른 차원을 가지고 있을지도 모&#x `padwithnodata` = TRUE일 경우, 모든 타일들이 동&#x 차원을 가지게 되지만 가장자리 타일들이 NODATA 값으로 패딩(padding)됐을 가능성이 있습니다. 래스터 밴드(& 지정된 NODATA 값(들)을 가지지 않은 경& `nodataval` 을 설정해서 NODATA 값을 지정할 수 있습니다.

Note

입력 래스터의 지정된 밴드가 DB 외부 밴드일 경우, 출력 래스터의 해당 밴드 또한 DB 외부 밴드일 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
WITH foo AS (
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 1, 0), 2, '8BUI', 10, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 2, 0), 2, '8BUI', 20, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 3, 0), 2, '8BUI', 30, 0) AS rast UNION ALL

        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 4, 0), 2, '8BUI', 40, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 5, 0), 2, '8BUI', 50, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 6, 0), 2, '8BUI', 60, 0) AS rast UNION ALL

        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 7, 0), 2, '8BUI', 70, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 8, 0), 2, '8BUI', 80, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 9, 0), 2, '8BUI', 90, 0) AS rast
), bar AS (
        SELECT ST_Union(rast) AS rast FROM foo
), baz AS (
        SELECT ST_Tile(rast, 3, 3, TRUE) AS rast FROM bar
)
SELECT
        ST_DumpValues(rast)
FROM baz;

              st_dumpvalues
----------------------------------------
 (1,"{{1,1,1},{1,1,1},{1,1,1}}")
 (2,"{{10,10,10},{10,10,10},{10,10,10}}")
 (1,"{{2,2,2},{2,2,2},{2,2,2}}")
 (2,"{{20,20,20},{20,20,20},{20,20,20}}")
 (1,"{{3,3,3},{3,3,3},{3,3,3}}")
 (2,"{{30,30,30},{30,30,30},{30,30,30}}")
 (1,"{{4,4,4},{4,4,4},{4,4,4}}")
 (2,"{{40,40,40},{40,40,40},{40,40,40}}")
 (1,"{{5,5,5},{5,5,5},{5,5,5}}")
 (2,"{{50,50,50},{50,50,50},{50,50,50}}")
 (1,"{{6,6,6},{6,6,6},{6,6,6}}")
 (2,"{{60,60,60},{60,60,60},{60,60,60}}")
 (1,"{{7,7,7},{7,7,7},{7,7,7}}")
 (2,"{{70,70,70},{70,70,70},{70,70,70}}")
 (1,"{{8,8,8},{8,8,8},{8,8,8}}")
 (2,"{{80,80,80},{80,80,80},{80,80,80}}")
 (1,"{{9,9,9},{9,9,9},{9,9,9}}")
 (2,"{{90,90,90},{90,90,90},{90,90,90}}")
(18 rows)
```

```
WITH foo AS (
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 1, 0), 2, '8BUI', 10, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 2, 0), 2, '8BUI', 20, 0) AS rast UNION ALL
```

```
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 3, 0), 2, '8BUI', 30, 0) AS rast UNION ALL

        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 4, 0), 2, '8BUI', 40, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 5, 0), 2, '8BUI', 50, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, -3, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 6, 0), 2, '8BUI', 60, 0) AS rast UNION ALL

        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 7, 0), 2, '8BUI', 70, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 3, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 8, 0), 2, '8BUI', 80, 0) AS rast UNION ALL
        SELECT ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 6, -6, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 9, 0), 2, '8BUI', 90, 0) AS rast
), bar AS (
        SELECT ST_Union(rast) AS rast FROM foo
), baz AS (
        SELECT ST_Tile(rast, 3, 3, 2) AS rast FROM bar
)
SELECT
        ST_DumpValues(rast)
FROM baz;

              st_dumpvalues
-----------------------------------------
 (1,"{{10,10,10},{10,10,10},{10,10,10}}")
 (1,"{{20,20,20},{20,20,20},{20,20,20}}")
 (1,"{{30,30,30},{30,30,30},{30,30,30}}")
 (1,"{{40,40,40},{40,40,40},{40,40,40}}")
 (1,"{{50,50,50},{50,50,50},{50,50,50}}")
 (1,"{{60,60,60},{60,60,60},{60,60,60}}")
 (1,"{{70,70,70},{70,70,70},{70,70,70}}")
 (1,"{{80,80,80},{80,80,80},{80,80,80}}")
 (1,"{{90,90,90},{90,90,90},{90,90,90}}")
(9 rows)
```

참고

ST_Union, ST_Retile

10.3.7 ST_Retile

ST_Retile — 임의로 타일화된 래스터 커버
설정된 타일들의 집합을 반환합&#

Synopsis

SETOF raster **ST_Retile**(regclass tab, name col, geometry ext, float8 sfx, float8 sfy, int tw, int th, text algo='NearestNeighbor');

설명

설정한 축척(`sfx`, `sfy`)과 최대 크기(`tw`, `th`)를
가지고, 설정한 래스터 커버리지(`ta`
`col`)에서 나온 데이터로 설정한 범&#xc7
커버하는 타일들의 집합을 반환&#

알고리즘 옵션에는 'NearestNeighbor', 'Bilinear', 'Cubic', 'Cubic-Spline', 그리고 'Lanczos'가 있습니다. 자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

2.2.0 버전부터 사용할 수 있습니다.

참고

ST_CreateOverview

10.3.8 ST_FromGDALRaster

ST_FromGDALRaster — 지원 GDAL 래스터 파일로부터 래스터를 반환합니다.

Synopsis

raster **ST_FromGDALRaster**(bytea gdaldata, integer srid=NULL);

설명

지원 GDAL 래스터 파일로부터 래스터반환합니다. `gdaldata` 는 bytea 유형으로 GDAL 래스터 파일의 내용을 담고 있어합니다.

`srid` 가 NULL일 경우, 이 함수는 GDAL 래스터자동적으로 SRID를 할당하려 할 것인 `srid` 를 설정한 경우, 해당 값이 자동할당된 어떤 SRID보다 우선할 것입&#xb2c

2.1.0 버전부터 사용할 수 있습니다.

예시

```
WITH foo AS (
        SELECT ST_AsPNG(ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0,  ↩
            0.1, -0.1, 0, 0, 4326), 1, '8BUI', 1, 0), 2, '8BUI', 2, 0), 3, '8BUI', 3, 0)) AS ↩
             png
),
bar AS (
        SELECT 1 AS rid, ST_FromGDALRaster(png) AS rast FROM foo
        UNION ALL
        SELECT 2 AS rid, ST_FromGDALRaster(png, 3310) AS rast FROM foo
)
SELECT
        rid,
        ST_Metadata(rast) AS metadata,
        ST_SummaryStats(rast, 1) AS stats1,
        ST_SummaryStats(rast, 2) AS stats2,
        ST_SummaryStats(rast, 3) AS stats3
FROM bar
ORDER BY rid;

 rid |         metadata          |    stats1     |    stats2     |     stats3
-----+---------------------------+---------------+---------------+----------------
   1 | (0,0,2,2,1,-1,0,0,0,3)    | (4,4,1,0,1,1) | (4,8,2,0,2,2) | (4,12,3,0,3,3)
```

```
   2 | (0,0,2,2,1,-1,0,0,3310,3) | (4,4,1,0,1,1) | (4,8,2,0,2,2) | (4,12,3,0,3,3)
(2 rows)
```

참고

ST_AsGDALRaster

10.4 래스터 접근자(accessor)

10.4.1 ST_GeoReference

ST_GeoReference — 월드(world) 파일에서 흔히 볼 수 있는 지리참조 메타데이터를 GDAL 또는 ESRI 형식으로 반환합니다. 기&#xbc GDAL입니다.

Synopsis

text **ST_GeoReference**(raster rast, text format=GDAL);

설명

월드 파일 에서 흔히 보이는, 캐리&# 포함한 지리참조 메타데이터를 GDAL 또는 ESRI 형식으로 반환합니다. 유형을 따로 설정하지 않을 경우 기본값은 GDAL입니다. 해당 유형값&#xc7 'GDAL' 또는 'ESRI' 문자열입니다.

형식 표현식 사이의 차이점은 다&# 같습니다:

GDAL:

```
scalex
skewy
skewx
scaley
upperleftx
upperlefty
```

ESRI:

```
scalex
skewy
skewx
scaley
upperleftx + scalex*0.5
upperlefty + scaley*0.5
```

예시

```
SELECT ST_GeoReference(rast, 'ESRI') As esri_ref, ST_GeoReference(rast, 'GDAL') As gdal_ref
 FROM dummy_rast WHERE rid=1;

   esri_ref    |   gdal_ref
---------------+--------------
 2.0000000000 | 2.0000000000
 0.0000000000 : 0.0000000000
 0.0000000000 : 0.0000000000
 3.0000000000 : 3.0000000000
 1.5000000000 : 0.5000000000
 2.0000000000 : 0.5000000000
```

참고

ST_SetGeoReference, ST_ScaleX, ST_ScaleY

10.4.2 ST_Height

ST_Height — 래스터의 높이를 픽셀 개수&#xb85c
반환합니다.

Synopsis

integer **ST_Height**(raster rast);

설명

래스터의 높이를 반환합니다.

예시

```
SELECT rid, ST_Height(rast) As rastheight
FROM dummy_rast;

 rid | rastheight
-----+------------
   1 |         20
   2 |          5
```

참고

ST_Width

10.4.3 ST_IsEmpty

ST_IsEmpty — 래스터가 비어 있을 경우 (width =
0, height = 0) 참을 반환합니다. 그렇지 않을
경우 거짓을 반환합니다.

Synopsis

boolean **ST_IsEmpty**(raster rast);

설명

래스터가 비어 있을 경우 (width = 0, height = 0) 참을 반환합니다. 그렇지 않을 경거짓을 반환합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_IsEmpty(ST_MakeEmptyRaster(100, 100, 0, 0, 0, 0, 0, 0))
st_isempty |
-----------+
f          |


SELECT ST_IsEmpty(ST_MakeEmptyRaster(0, 0, 0, 0, 0, 0, 0, 0))
st_isempty |
-----------+
t          |
```

참고

ST_HasNoBand

10.4.4 ST_MemSize

ST_MemSize — 래스터가 차지하는 공간의 용량을 (바이트 단위로) 반환합니&

Synopsis

integer **ST_MemSize**(raster rast);

설명

래스터가 차지하는 공간의 용량&#x (바이트 단위로) 반환합니다.

이 함수는 PostgreSQL 내장 함수들인 pg_column_size, pg_size_pretty, pg_relation_size, pg_total_relation_size를 멋지게 보완합&#xb2c8

Note

테이블의 바이트 용량을 출력하는 pg_relation_size가 ST_MemSize보다 적은 바이트 용량을 반환할 수도 있습니다. 왜냐하면 pg_relation_size 함수는 TOAST 테이블에 저장된 대용량 도형들 및 TOAST가 적용된 테이블이 분담하는 용량을 추가하지 않기 때문입니다. pg_column_size 함수는 압축된 용량을 반환하기 때문에 더 적은 용량을 반환할 수도 있습니다. pg_total_relation_size 함수는 테이블, TOAST가 적용된 테이블 및 인덱스를 포함합니다.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_MemSize(ST_AsRaster(ST_Buffer(ST_Point(1,5),10,1000),150, 150, '8BUI')) As ↩
    rast_mem;

                rast_mem
                --------
                22568
```

참고

10.4.5 ST_MetaData

ST_MetaData — 래스터 객체의 픽셀 크기, 회&#xc
좌상단, 좌하단 등과 같은 기본 메&#x
반환합니다.

Synopsis

record **ST_MetaData**(raster rast);

설명

래스터 객체의 픽셀 크기, 회전(skew), 좌상단, 좌하단 등과 같은 기본 메&#x 반환합니다. 반환되는 열들은 다&# 같습니다: upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid | numbands

예시

```
SELECT rid, (foo.md).*
 FROM (SELECT rid, ST_MetaData(rast) As md
FROM dummy_rast) As foo;
```

```
 rid | upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
     numbands
 ----+------------+------------+-------+--------+--------+----------+-------+-------+------+-------

   1 |        0.5 |        0.5 |    10 |     20 |      2 |        3 |                 0 |      ↩
       0 |     0 |          0
   2 | 3427927.75 |    5793244 |     5 |      5 |   0.05 |    -0.05 |                 0 |      ↩
       0 |     0 |          3
```

참고

ST_BandMetaData, ST_NumBands

10.4.6 ST_NumBands

ST_NumBands — 래스터 객체 내부에 있는 밴&#x
개수를 반환합니다.

Synopsis

integer **ST_NumBands**(raster rast);

설명

래스터 객체 내부에 있는 밴드들&#
개수를 반환합니다.

예시

```
SELECT rid, ST_NumBands(rast) As numbands
FROM dummy_rast;

rid | numbands
----+----------
  1 |        0
  2 |        3
```

참고

ST_Value

10.4.7 ST_PixelHeight

ST_PixelHeight — 픽셀 높이를 공간 참조 시스&#x
기하 단위로 반환합니다.

Synopsis

double precision **ST_PixelHeight**(raster rast);

설명

픽셀 높이를 공간 참조 시스템의 기하 단위로 반환합니다. 회전하&#x 않은 일반적인 경우, 픽셀 높이란 단순히 기하 좌표와 래스터 픽셀&# 축척 비율일 뿐입니다.

이 관계성을 그림으로 시각화한 예시를 보려면 ST_PixelWidth 를 참조하십&#xc2d

예시: 회전하지 않은 래스터

```
SELECT ST_Height(rast) As rastheight, ST_PixelHeight(rast) As pixheight,
 ST_ScaleX(rast) As scalex, ST_ScaleY(rast) As scaley, ST_SkewX(rast) As skewx,
        ST_SkewY(rast) As skewy
FROM dummy_rast;

 rastheight | pixheight | scalex | scaley | skewx | skewy
------------+-----------+--------+--------+-------+----------
         20 |         3 |      2 |      3 |     0 |        0
          5 |      0.05 |   0.05 |  -0.05 |     0 |        0
```

예시: 0값 이외의 값으로 회전한 래&

```
SELECT ST_Height(rast) As rastheight, ST_PixelHeight(rast) As pixheight,
 ST_ScaleX(rast) As scalex, ST_ScaleY(rast) As scaley, ST_SkewX(rast) As skewx,
        ST_SkewY(rast) As skewy
FROM (SELECT ST_SetSKew(rast,0.5,0.5) As rast
        FROM dummy_rast) As skewed;

rastheight |     pixheight     | scalex | scaley | skewx | skewy
-----------+-------------------+--------+--------+-------+----------
        20 |  3.04138126514911 |      2 |      3 |   0.5 |      0.5
         5 | 0.502493781056044 |   0.05 |  -0.05 |   0.5 |      0.5
```

참고

ST_PixelWidth, ST_ScaleX, ST_ScaleY, ST_SkewX, ST_SkewY

10.4.8 ST_PixelWidth

ST_PixelWidth — 픽셀 너비를 공간 참조 시스&#x 기하 단위로 반환합니다.

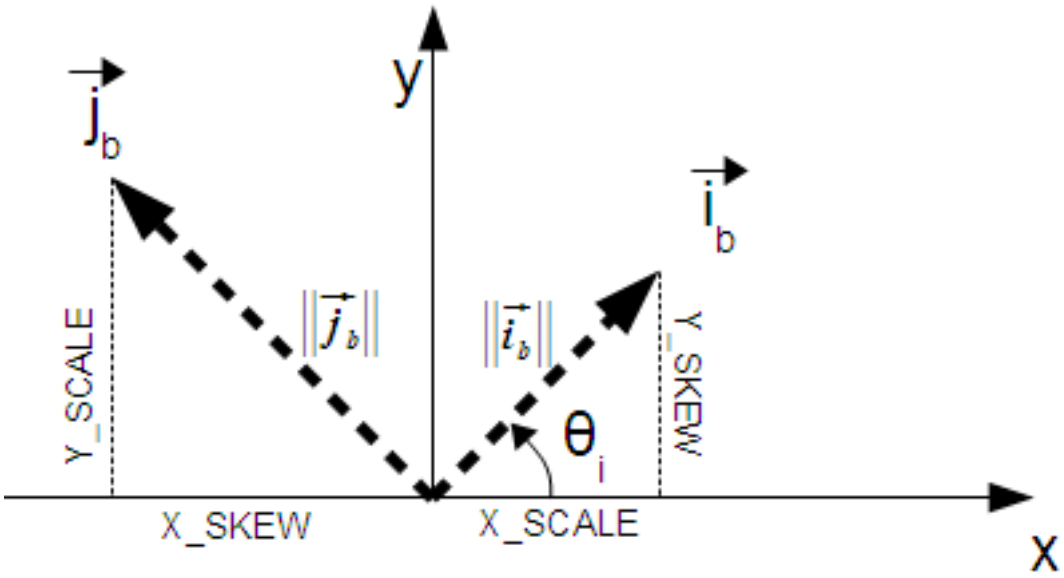
Synopsis

double precision **ST_PixelWidth**(raster rast);

설명

픽셀 너비를 공간 참조 시스템의 기하 단위로 반환합니다. 회전하않은 일반적인 경우, 픽셀 너비란 단순히 기하 좌표와 래스터 픽셀축척 비율일 뿐입니다.

다음은 해당 관계성을 보여주는 도표입니다:



픽셀 너비: i 방향의 픽셀 크기
픽셀 높이: j 방향의 픽셀 크기

예시: 회전하지 않은 래스터

```
SELECT ST_Width(rast) As rastwidth, ST_PixelWidth(rast) As pixwidth,
        ST_ScaleX(rast) As scalex, ST_ScaleY(rast) As scaley, ST_SkewX(rast) As skewx,
        ST_SkewY(rast) As skewy
        FROM dummy_rast;

        rastwidth | pixwidth | scalex | scaley | skewx | skewy
        ----------+----------+--------+--------+-------+----------
        10 |         2 |      2 |      3 |     0 |        0
         5 |      0.05 |   0.05 |  -0.05 |     0 |        0
```

예시: 0값 이외의 값으로 회전한 래&

```
SELECT ST_Width(rast) As rastwidth, ST_PixelWidth(rast) As pixwidth,
        ST_ScaleX(rast) As scalex, ST_ScaleY(rast) As scaley, ST_SkewX(rast) As skewx,
        ST_SkewY(rast) As skewy
        FROM (SELECT ST_SetSkew(rast,0.5,0.5) As rast
        FROM dummy_rast) As skewed;

        rastwidth |     pixwidth      | scalex | scaley | skewx | skewy
        ----------+-------------------+--------+--------+-------+----------
        10 |  2.06155281280883 |      2 |      3 |   0.5 |      0.5
         5 | 0.502493781056044 |   0.05 |  -0.05 |   0.5 |      0.5
```

참고

ST_PixelHeight, ST_ScaleX, ST_ScaleY, ST_SkewX, ST_SkewY

10.4.9 ST_ScaleX

ST_ScaleX — 픽셀 너비의 X 요소를 좌표 참&#xc8
시스템의 단위로 반환합니다.

Synopsis

float8 **ST_ScaleX**(raster rast);

설명

픽셀 너비의 X 요소를 좌표 참조
시스템의 단위로 반환합니다. 자&#
내용은 월드 파일 을 참조하십시&#

변경 사항: 2.0.0 미만 WKTRaster 버전에서는
ST_PixelSizeX라는 명칭이었습니다.

예시

```
SELECT rid, ST_ScaleX(rast) As rastpixwidth
FROM dummy_rast;

 rid | rastpixwidth
-----+--------------
   1 |            2
   2 |         0.05
```

참고

ST_Width

10.4.10 ST_ScaleY

ST_ScaleY — 픽셀 높이의 Y 요소를 좌표 참&#xc8
시스템의 단위로 반환합니다.

Synopsis

float8 **ST_ScaleY**(raster rast);

설명

픽셀 높이의 Y 요소를 좌표 참조
시스템의 단위로 반환합니다. 음&#
수도 있습니다. 자세한 내용은 월&#
파일 을 참조하십시오.

변경 사항: 2.0.0 미만 WKTRaster 버전에서는
ST_PixelSizeY라는 명칭이었습니다.

예시

```
SELECT rid, ST_ScaleY(rast) As rastpixheight
FROM dummy_rast;

 rid | rastpixheight
-----+---------------
   1 |             3
   2 |         -0.05
```

참고

ST_Height

10.4.11 ST_RasterToWorldCoord

ST_RasterToWorldCoord — 주어진 열과 행에 있는 래&#xc
좌상단의 기하학적 X, Y(경도, 위도)&#xb9
으로 반환합니다. 열과 행은 1부터
시작합니다.

Synopsis

record **ST_RasterToWorldCoord**(raster rast, integer xcolumn, integer yrow);

설명

주어진 열과 행에 있는 래스터의
좌상단의 기하학적 X, Y(경도, 위도)&#xb9
반환합니다. 반환된 X, Y의 좌표는
지리참조된 래스터의 기하 단위&#x
열과 행의 번호는 1부터 시작하지&#
두 파라미터 가운데 하나라도 0, 음&
또는 래스터의 각 차원보다 큰 숫&#
입력할 경우, 래스터의 그리드가
래스터의 경계선 바깥에도 적용&#x
가정하고 래스터 외부의 좌표를
반환할 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xd68c;&#xc804;&#xd558;&#xc9c0; &#xc54a;&#xc740; &#xb798;&#xc2a4;&#xd130;
SELECT
        rid,
        (ST_RasterToWorldCoord(rast,1, 1)).*,
        (ST_RasterToWorldCoord(rast,2, 2)).*
FROM dummy_rast

 rid | longitude  | latitude | longitude |  latitude
-----+------------+----------+-----------+------------
   1 |        0.5 |      0.5 |       2.5 |        3.5
   2 | 3427927.75 |  5793244 | 3427927.8 | 5793243.95
```

```
-- &#xd68c;&#xc804;&#xd55c; &#xb798;&#xc2a4;&#xd130;
SELECT
        rid,
        (ST_RasterToWorldCoord(rast, 1, 1)).*,
        (ST_RasterToWorldCoord(rast, 2, 3)).*
FROM (
        SELECT
                rid,
                ST_SetSkew(rast, 100.5, 0) As rast
        FROM dummy_rast
) As foo

 rid | longitude  | latitude | longitude | latitude
-----+------------+----------+-----------+-----------
   1 |        0.5 |      0.5 |     203.5 |       6.5
   2 | 3427927.75 |  5793244 | 3428128.8 | 5793243.9
```

참고

ST_RasterToWorldCoordX, ST_RasterToWorldCoordY, ST_SetSkew

10.4.12 ST_RasterToWorldCoordX

ST_RasterToWorldCoordX — 열과 행에 있는 래스터의 좌상단의 기하학적 X 좌표를 반환열과 행의 번호는 1부터 시작합니&#

Synopsis

float8 **ST_RasterToWorldCoordX**(raster rast, integer xcolumn);
float8 **ST_RasterToWorldCoordX**(raster rast, integer xcolumn, integer yrow);

설명

래스터 열과 행의 좌상단 X 좌표를 지리참조된 래스터의 기하 단위&#x 반환합니다. 열과 행의 번호는 1부& 시작하지만 두 파라미터 가운데 하나라도 음수 또는 래스터 열의 개수보다 큰 숫자를 입력할 경우, 회전 및 픽셀 크기가 선택된 래스&# 동일하다고 가정하고 래스터 파&#x 왼쪽 또는 오른쪽 바깥에 있는 좌&# 반환할 것입니다.

> **Note**
> 회전하지 않은 래스터의 경우, X열만 입력해도 충분합니다. 회전한 래스터의 경우, 지리참조된 좌표는 ST_ScaleX, ST_SkewX, 행 및 열의 함수입니다. 회전한 래스터에 대해 X열만 입력할 경우 오류가 발생할 것입니다.

변경 사항: 2.1.0 미만 버전에서는 ST_Raster2World
명칭이었습니다.

예시

```
-- &#xd68c;&#xc804;&#xd558;&#xc9c0; &#xc54a;&#xc740; &#xb798;&#xc2a4;&#xd130;&#xc77c;  ↩
    &#xacbd;&#xc6b0; &#xc5f4;&#xb9cc; &#xc785;&#xb825;&#xd574;&#xb3c4;  ↩
    &#xcda9;&#xbd84;&#xd569;&#xb2c8;&#xb2e4;.
SELECT rid, ST_RasterToWorldCoordX(rast,1) As x1coord,
        ST_RasterToWorldCoordX(rast,2) As x2coord,
        ST_ScaleX(rast) As pixelx
FROM dummy_rast;

 rid |  x1coord   |  x2coord  | pixelx
-----+------------+-----------+--------
   1 |        0.5 |       2.5 |      2
   2 | 3427927.75 | 3427927.8 |   0.05
```

```
-- &#xc7ac;&#xbbf8;&#xc0bc;&#xc544; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xd68c;&#xc804;&#xc2dc;&#xcf1c;&#xbd05;&#xc2dc;&#xb2e4;.
SELECT rid, ST_RasterToWorldCoordX(rast, 1, 1) As x1coord,
        ST_RasterToWorldCoordX(rast, 2, 3) As x2coord,
        ST_ScaleX(rast) As pixelx
FROM (SELECT rid, ST_SetSkew(rast, 100.5, 0) As rast FROM dummy_rast) As foo;

 rid |  x1coord   |  x2coord  | pixelx
-----+------------+-----------+--------
   1 |        0.5 |     203.5 |      2
   2 | 3427927.75 | 3428128.8 |   0.05
```

참고

ST_ScaleX, ST_RasterToWorldCoordY, ST_SetSkew, ST_SkewX

10.4.13 ST_RasterToWorldCoordY

ST_RasterToWorldCoordY — 열과 행에 있는 래스터의
좌상단의 기하학적 Y 좌표를 반환&
열과 행의 번호는 1부터 시작합니&

Synopsis

float8 **ST_RasterToWorldCoordY**(raster rast, integer yrow);
float8 **ST_RasterToWorldCoordY**(raster rast, integer xcolumn, integer yrow);

설명

래스터 열과 행의 좌상단 Y 좌표를
지리참조된 래스터의 기하 단위&#x
반환합니다. 열과 행의 번호는 1부&
시작하지만 두 파라미터 가운데
하나라도 음수 또는 래스터 열/행&
개수보다 큰 숫자를 입력할 경우,
회전 및 픽셀 크기가 선택된 래스&#

동일하다고 가정하고 래스터 타&#x
왼쪽 또는 오른쪽 바깥에 있는 좌&#
반환할 것입니다.

Note

회전하지 않은 래스터의 경우, Y열만 입력해도 충분합니다. 회전한 래스터의 경우, 지리참조된 좌표는 ST_ScaleY, ST_SkewY, 행 및 열의 함수입니다. 회전한 래스터에 대해 Y행만 입력할 경우 오류가 발생할 것입니다.

변경 사항: 2.1.0 미만 버전에서는 ST_Raster2World
명칭이었습니다.

예시

```
-- &#xd68c;&#xc804;&#xd558;&#xc9c0; &#xc54a;&#xc740; &#xb798;&#xc2a4;&#xd130;&#xc77c;  ↩
    &#xacbd;&#xc6b0; &#xd589;&#xb9cc; &#xc785;&#xb825;&#xd574;&#xb3c4;  ↩
    &#xcda9;&#xbd84;&#xd569;&#xb2c8;&#xb2e4;.
SELECT rid, ST_RasterToWorldCoordY(rast,1) As y1coord,
        ST_RasterToWorldCoordY(rast,3) As y2coord,
        ST_ScaleY(rast) As pixely
FROM dummy_rast;

 rid | y1coord |  y2coord  | pixely
-----+---------+-----------+--------
   1 |     0.5 |       6.5 |      3
   2 | 5793244 | 5793243.9 |  -0.05
```

```
-- &#xc7ac;&#xbbf8;&#xc0bc;&#xc544; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xd68c;&#xc804;&#xc2dc;&#xcf1c;&#xbd05;&#xc2dc;&#xb2e4;.
SELECT rid, ST_RasterToWorldCoordY(rast,1,1) As y1coord,
        ST_RasterToWorldCoordY(rast,2,3) As y2coord,
        ST_ScaleY(rast) As pixely
FROM (SELECT rid, ST_SetSkew(rast,0,100.5) As rast FROM dummy_rast) As foo;

 rid | y1coord |  y2coord  | pixely
-----+---------+-----------+--------
   1 |     0.5 |       107 |      3
   2 | 5793244 | 5793344.4 |  -0.05
```

참고

ST_ScaleY, ST_RasterToWorldCoordX, ST_SetSkew, ST_SkewY

10.4.14 ST_Rotation

ST_Rotation — 래스터의 회전각을 라디안&#xc73
반환합니다.

Synopsis

float8 **ST_Rotation**(raster rast);

설명

래스터의 균일한 회전각을 라디&#x
반환합니다. 래스터가 균일한 회&#
회전하지 않은 경우, NaN을 반환합&#xb2c
자세한 내용은 월드 파일 을 참조&#

예시

```
SELECT rid, ST_Rotation(ST_SetScale(ST_SetSkew(rast, sqrt(2)), sqrt(2))) as rot FROM  ↩
    dummy_rast;

 rid |        rot
-----+-------------------
   1 | 0.785398163397448
   2 | 0.785398163397448
```

참고

ST_SetRotation, ST_SetScale, ST_SetSkew

10.4.15 ST_SkewX

ST_SkewX — 지리참조 X 기울기(skew)(또는 회전
파라미터)를 반환합니다.

Synopsis

float8 **ST_SkewX**(raster rast);

설명

지리참조 X 기울기(또는 회전각 파&
반환합니다. 자세한 내용은 월드
파일 을 참조하십시오.

예시

```
SELECT rid, ST_SkewX(rast) As skewx, ST_SkewY(rast) As skewy,
    ST_GeoReference(rast) as georef
FROM dummy_rast;

 rid | skewx | skewy |       georef
-----+-------+-------+--------------------
   1 |     0 |     0 | 2.0000000000
                     : 0.0000000000
                     : 0.0000000000
                     : 3.0000000000
                     : 0.5000000000
                     : 0.5000000000
                     :
   2 |     0 |     0 | 0.0500000000
                     : 0.0000000000
                     : 0.0000000000
```

```
                      : -0.0500000000
                      : 3427927.7500000000
                      : 5793244.0000000000
```

참고

ST_GeoReference, ST_SkewY, ST_SetSkew

10.4.16 ST_SkewY

ST_SkewY — 지리참조 Y 기울기(또는 회전&#xac
파라미터)를 반환합니다.

Synopsis

float8 **ST_SkewY**(raster rast);

설명

지리참조 Y 기울기(또는 회전각 파&
반환합니다. 자세한 내용은 월드
파일 을 참조하십시오.

예시

```
SELECT rid, ST_SkewX(rast) As skewx, ST_SkewY(rast) As skewy,
    ST_GeoReference(rast) as georef
FROM dummy_rast;

 rid | skewx | skewy |       georef
-----+-------+-------+--------------------
   1 |     0 |     0 | 2.0000000000
                     : 0.0000000000
                     : 0.0000000000
                     : 3.0000000000
                     : 0.5000000000
                     : 0.5000000000
                     :
   2 |     0 |     0 | 0.0500000000
                     : 0.0000000000
                     : 0.0000000000
                     : -0.0500000000
                     : 3427927.7500000000
                     : 5793244.0000000000
```

참고

ST_GeoReference, ST_SkewX, ST_SetSkew

10.4.17 ST_SRID

ST_SRID — spatial_ref_sys 테이블에 정의되어 있는,
래스터의 공간 참조 식별자를 반&#x

Synopsis

integer **ST_SRID**(raster rast);

설명

spatial_ref_sys 테이블에 정의되어 있는, 래&#xc2a
객체의 공간 참조 식별자를 반환&#x

> **Note**
> PostGIS 2.0 버전부터, 지리참조되지 않은 래스터/도형의 SRID가 이전 버전의 -1 대신 0으로 바뀌었습니다.

예시

```
SELECT ST_SRID(rast) As srid
FROM dummy_rast WHERE rid=1;

srid
----------------
0
```

참고

Section 4.5, ST_SRID

10.4.18 ST_Summary

ST_Summary — 래스터의 내용을 요약한 텍&#xc
반환합니다.

Synopsis

text **ST_Summary**(raster rast);

설명

래스터의 내용을 요약한 텍스트&#
반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_Summary(
        ST_AddBand(
                ST_AddBand(
                        ST_AddBand(
                                ST_MakeEmptyRaster(10, 10, 0, 0, 1, -1, 0, 0, 0)
```

```
                                , 1, '8BUI', 1, 0
                        )
                        , 2, '32BF', 0, -9999
                )
                , 3, '16BSI', 0, NULL
        )
);

                            st_summary
------------------------------------------------------------------
 Raster of 10x10 pixels has 3 bands and extent of BOX(0 -10,10 0)+
     band 1 of pixtype 8BUI is in-db with NODATA value of 0      +
     band 2 of pixtype 32BF is in-db with NODATA value of -9999  +
     band 3 of pixtype 16BSI is in-db with no NODATA value
(1 row)
```

참고

ST_MetaData, ST_BandMetaData, ST_Summary ST_Extent

10.4.19 ST_UpperLeftX

ST_UpperLeftX — 래스터의 좌상단 X 좌표를 투공간 참조 단위로 반환합니다.

Synopsis

float8 **ST_UpperLeftX**(raster rast);

설명

래스터의 좌상단 X 좌표를 투영된 공간 참조 단위로 반환합니다.

예시

```
SELECt rid, ST_UpperLeftX(rast) As ulx
FROM dummy_rast;

 rid |    ulx
-----+------------
   1 |        0.5
   2 | 3427927.75
```

참고

ST_UpperLeftY, ST_GeoReference, Box3D

10.4.20 ST_UpperLeftY

ST_UpperLeftY — 래스터의 좌상단 Y 좌표를 투공간 참조 단위로 반환합니다.

Synopsis

float8 **ST_UpperLeftY**(raster rast);

설명

래스터의 좌상단 Y 좌표를 투영된 공간 참조 단위로 반환합니다.

예시

```
SELECT rid, ST_UpperLeftY(rast) As uly
FROM dummy_rast;

 rid |   uly
-----+---------
   1 |     0.5
   2 | 5793244
```

참고

ST_UpperLeftX, ST_GeoReference, Box3D

10.4.21 ST_Width

ST_Width — 래스터의 너비를 픽셀 개수로
반환합니다.

Synopsis

integer **ST_Width**(raster rast);

설명

래스터의 너비를 픽셀 개수로 반&#

예시

```
SELECT ST_Width(rast) As rastwidth
FROM dummy_rast WHERE rid=1;

rastwidth
----------------
10
```

참고

ST_Height

10.4.22 ST_WorldToRasterCoord

ST_WorldToRasterCoord — 주어진 기하학적 X, Y(경도, 위도)의 좌상단을 열과 행으로 또&#x 래스터의 공간 참조 좌표 시스템 단위로 표현된 포인트 도형으로 반환합니다.

Synopsis

record **ST_WorldToRasterCoord**(raster rast, geometry pt);
record **ST_WorldToRasterCoord**(raster rast, double precision longitude, double precision latitude);

설명

주어진 기하학적 X, Y(경도, 위도)의 좌상단을 열과 행으로 또는 포인&#x 도형으로 반환합니다. 이 함수는 기하학적 X, Y 또는 포인트 도형이 래스터 범위 외부에 있건 말건 상&# 동작합니다. 기하학적 X, Y는 래스&#xd1 공간 참조 좌표 시스템 단위로 표&#x 합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT
        rid,
        (ST_WorldToRasterCoord(rast,3427927.8,20.5)).*,
        (ST_WorldToRasterCoord(rast,ST_GeomFromText('POINT(3427927.8 20.5)',ST_SRID(rast))) ↩
           ).*
FROM dummy_rast;

 rid | columnx |   rowy    | columnx |   rowy
-----+---------+-----------+---------+-----------
   1 | 1713964 |         7 | 1713964 |         7
   2 |       2 | 115864471 |       2 | 115864471
```

참고

ST_WorldToRasterCoordX, ST_WorldToRasterCoordY, ST_RasterToWorldCoordX, ST_RasterToWorldCoordY, ST_SRID

10.4.23 ST_WorldToRasterCoordX

ST_WorldToRasterCoordX — 포인트 도형(pt)의 래스터 안의 열 또는 래스터의 월드 공간 참조 시스템 단위로 표현된 X, Y 월&#xb4d 좌표(xw, yw)를 반환합니다.

Synopsis

integer **ST_WorldToRasterCoordX**(raster rast, geometry pt);
integer **ST_WorldToRasterCoordX**(raster rast, double precision xw);
integer **ST_WorldToRasterCoordX**(raster rast, double precision xw, double precision yw);

설명

포인트 도형(pt)의 래스터 안의 열 또는 X, Y 월드 좌표(xw, yw)를 반환합니&#xb2e4 포인트가 필요합니다(또는 래스&# 기울어진 경우 xw 및 yw 월드 좌표가 두 개 모두 필요합니다). 래스터가 기울어지지 않은 경우 xw 좌표만으& 충분합니다. 월드 좌표란 래스터&# 공간 참조 좌표 시스템의 좌표를 말합니다.

변경 사항: 2.1.0 미만 버전에서는 ST_World2Raster 명칭이었습니다.

예시

```
SELECT rid, ST_WorldToRasterCoordX(rast,3427927.8) As xcoord,
                ST_WorldToRasterCoordX(rast,3427927.8,20.5) As xcoord_xwyw,
                ST_WorldToRasterCoordX(rast,ST_GeomFromText('POINT(3427927.8 20.5)',ST_SRID ↩
                    (rast))) As ptxcoord
FROM dummy_rast;

 rid | xcoord  |  xcoord_xwyw   | ptxcoord
-----+---------+---------+----------
   1 | 1713964 | 1713964 |  1713964
   2 |       1 |       1 |        1
```

참고

ST_RasterToWorldCoordX, ST_RasterToWorldCoordY, ST_SRID

10.4.24 ST_WorldToRasterCoordY

ST_WorldToRasterCoordY — 포인트 도형(pt)의 래스터 안의 행 또는 래스터의 월드 공간 참조 시스템 단위로 표현된 X, Y 월&#xb4d 좌표(xw, yw)를 반환합니다.

Synopsis

integer **ST_WorldToRasterCoordY**(raster rast, geometry pt);
integer **ST_WorldToRasterCoordY**(raster rast, double precision xw);
integer **ST_WorldToRasterCoordY**(raster rast, double precision xw, double precision yw);

설명

포인트 도형(pt)의 래스터 안의 행 또는 X, Y 월드 좌표(xw, yw)를 반환합니&#xb2e4 포인트가 필요합니다(또는 래스&#x 기울어진 경우 xw 및 yw 월드 좌표가 두 개 모두 필요합니다). 래스터가 기울어지지 않은 경우 xw 좌표만으& 충분합니다. 월드 좌표란 래스터&# 공간 참조 좌표 시스템의 좌표를 말합니다.

변경 사항: 2.1.0 미만 버전에서는 ST_World2Raster 명칭이었습니다.

예시

```
SELECT rid, ST_WorldToRasterCoordY(rast,20.5) As ycoord,
                ST_WorldToRasterCoordY(rast,3427927.8,20.5) As ycoord_xwyw,
                ST_WorldToRasterCoordY(rast,ST_GeomFromText('POINT(3427927.8 20.5)',ST_SRID ↩
                    (rast))) As ptycoord
FROM dummy_rast;

 rid |  ycoord   | ycoord_xwyw | ptycoord
-----+-----------+-------------+-----------
   1 |         7 |           7 |         7
   2 | 115864471 |   115864471 | 115864471
```

참고

ST_RasterToWorldCoordX, ST_RasterToWorldCoordY, ST_SRID

10.5 래스터 밴드 접근자

10.5.1 ST_BandMetaData

ST_BandMetaData — 지정 래스터 밴드에 대한 기본 메타데이터를 반환합니다. 밴드를 지정하지 않을 경우 밴드 1번이라고 가정합니다.

Synopsis

(1) record **ST_BandMetaData**(raster rast, integer band=1);
(2) record **ST_BandMetaData**(raster rast, integer[] band);

설명

Returns basic meta data about a raster band. Columns returned: pixeltype, nodatavalue, isoutdb, path, outdbbandnum, filesize, filetimestamp.

Note
래스터가 어떤 밴드도 담고 있지 않을 경우 오류가 발생합니다.

Note
If band has no NODATA value, nodatavalue are NULL.

Note
If isoutdb is False, path, outdbbandnum, filesize and filetimestamp are NULL. If outdb access is disabled, filesize and filetimestamp will also be NULL.

Enhanced: 2.5.0 to include *outdbbandnum*, *filesize* and *filetimestamp* for outdb rasters.

예시: 변종 1

```
-- &#xd68c;&#xc804;&#xd55c; &#xb798;&#xc2a4;&#xd130;
SELECT
        rid,
        (ST_RasterToWorldCoord(rast, 1, 1)).*,
        (ST_RasterToWorldCoord(rast, 2, 3)).*
FROM (
        SELECT
                rid,
                ST_SetSkew(rast, 100.5, 0) As rast
        FROM dummy_rast
) As foo

 rid | longitude  | latitude | longitude | latitude
-----+------------+----------+-----------+----------
   1 |        0.5 |      0.5 |     203.5 |       6.5
   2 | 3427927.75 |  5793244 | 3428128.8 | 5793243.9
```

예시: 변종 2

```
WITH foo AS (
    SELECT
        ST_AddBand(NULL::raster, '/home/pele/devel/geo/postgis-git/raster/test/regress/ ↩
            loader/Projected.tif', NULL::int[]) AS rast
)
SELECT
    *
FROM ST_BandMetadata(
    (SELECT rast FROM foo),
    ARRAY[1,3,2]::int[]
);

 bandnum | pixeltype | nodatavalue | isoutdb |                                          path  ↩
                                          | outdbbandnum  | filesize | filetimestamp |
---------+-----------+-------------+---------+-----------------------------------------------------
```

```
      1 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/raster/test ↩
          /regress/loader/Projected.tif      |            1  |    12345 |    1521807257 |
      3 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/raster/test ↩
          /regress/loader/Projected.tif      |            3  |    12345 |    1521807257 |
      2 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/raster/test ↩
          /regress/loader/Projected.tif      |            2  |    12345 |    1521807257 |
```

참고

ST_MetaData, ST_BandPixelType

10.5.2 ST_BandNoDataValue

ST_BandNoDataValue — 입력 밴드에서 NODATA를 나타&#xb0
값을 반환합니다. 어떤 밴드도 지&#
않을 경우 밴드 1로 가정합니다.

Synopsis

double precision **ST_BandNoDataValue**(raster rast, integer bandnum=1);

설명

밴드에서 NODATA를 나타내는 값을 반&#

예시

```
SELECT ST_BandNoDataValue(rast,1) As bnval1,
    ST_BandNoDataValue(rast,2) As bnval2, ST_BandNoDataValue(rast,3) As bnval3
FROM dummy_rast
WHERE rid = 2;

 bnval1 | bnval2 | bnval3
--------+--------+--------
      0 |      0 |      0
```

참고

ST_NumBands

10.5.3 ST_BandIsNoData

ST_BandIsNoData — 밴드가 NODATA 값만으로 채워져
있을 경우 참을 반환합니다.

Synopsis

boolean **ST_BandIsNoData**(raster rast, integer band, boolean forceChecking=true);
boolean **ST_BandIsNoData**(raster rast, boolean forceChecking=true);

설명

밴드가 NODATA 값만으로 채워져 있을 경우 참을 반환합니다. 밴드를 지않으면 밴드 1로 가정합니다. 마지인수가 TRUE일 경우, 밴드의 픽셀 전하나하나 확인합니다. 그렇지 않경우, 이 함수는 밴드에 대한 isnodata 플값을 반환할 뿐입니다. 따로 설정않을 경우, 해당 파라미터의 기본&#xFALSE입니다.

2.0.0 버전부터 사용할 수 있습니다.

> **Note**
>
> 플래그가 지저분할 (즉, 마지막 파라미터에 TRUE를 설정하고 설정하지 않고에 따라 결과가 달라질) 경우, ST_SetBandNodataValue()의 마지막 인수로 TRUE를 입력하거나, 또는 ST_SetBandIsNodata()를 이용해서 해당 플래그를 참으로 설정하도록 래스터를 업데이트헤야 합니다. ST_SetBandIsNoData 를 참조하십시오.

예시

```
-- &#xb798;&#xc2a4;&#xd130; &#xc5f4; &#xd55c; &#xac1c;&#xb97c; &#xac00;&#xc9c4;  ↩
    &#xac00;&#xc9dc; &#xd14c;&#xc774;&#xbe14;&#xc744; &#xc0dd;&#xc131;
create table dummy_rast (rid integer, rast raster);

-- &#xbc34;&#xb4dc; &#xb450; &#xac1c;&#xc640; &#xd53d;&#xc140;/&#xbc34;&#xb4dc;  ↩
    &#xd558;&#xb098;&#xb97c; &#xac00;&#xc9c4; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xcd94;&#xac00;&#xd569;&#xb2c8;&#xb2e4;. &#xccab; &#xbc88;&#xc9f8;  ↩
    &#xbc34;&#xb4dc;&#xc758; nodatavalue = pixel value = 3&#xc785;&#xb2c8;&#xb2e4;.
-- &#xb450; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xc758; nodatavalue = 13, pixel value = 4 ↩
    &#xc785;&#xb2c8;&#xb2e4;.
insert into dummy_rast values(1,
(
'01' -- little endian (uint8 ndr)
||
'0000' -- version (uint16 0)
||
'0200' -- nBands (uint16 0)
||
'17263529ED684A3F' -- scaleX (float64 0.000805965234044584)
||
'F9253529ED684ABF' -- scaleY (float64 -0.00080596523404458)
||
'1C9F33CE69E352C0' -- ipX (float64 -75.5533328537098)
||
'718F0E9A27A44840' -- ipY (float64 49.2824585505576)
||
'ED50EB853EC32B3F' -- skewX (float64 0.000211812383858707)
||
'7550EB853EC32B3F' -- skewY (float64 0.000211812383858704)
||
```

```
'E6100000' -- SRID (int32 4326)
||
'0100' -- width (uint16 1)
||
'0100' -- height (uint16 1)
||
'6' -- hasnodatavalue and isnodata value set to true.
||
'2' -- first band type (4BUI)
||
'03' -- novalue==3
||
'03' -- pixel(0,0)==3 (same that nodata)
||
'0' -- hasnodatavalue set to false
||
'5' -- second band type (16BSI)
||
'0D00' -- novalue==13
||
'0400' -- pixel(0,0)==4
)::raster
);

select st_bandisnodata(rast, 1) from dummy_rast where rid = 1; -- Expected true
select st_bandisnodata(rast, 2) from dummy_rast where rid = 1; -- Expected false
```

참고

ST_BandNoDataValue, ST_NumBands, ST_SetBandNoDataValue, ST_SetBandIsNoData

10.5.4 ST_BandPath

ST_BandPath — 파일 시스템에 저장된 밴드&#xb9 가리키는 시스템 파일 경로를 반&#x bandnum을 설정하지 않을 경우 밴드 1로 가정합니다.

Synopsis

text **ST_BandPath**(raster rast, integer bandnum=1);

설명

밴드를 가리키는 시스템 파일 경&#x 반환합니다. DB 내부 밴드와 함께 호출할 경우 오류가 발생합니다.

예시

참고

10.5.5 ST_BandFileSize

ST_BandFileSize — Returns the file size of a band stored in file system. If no bandnum specified, 1 is assumed.

Synopsis

bigint **ST_BandFileSize**(raster rast, integer bandnum=1);

설명

Returns the file size of a band stored in file system. Throws an error if called with an in db band, or if outdb access is not enabled.

This function is typically used in conjunction with ST_BandPath() and ST_BandFileTimestamp() so a client can determine if the filename of a outdb raster as seen by it is the same as the one seen by the server.

Availability: 2.5.0

예시

```
SELECT ST_BandFileSize(rast,1) FROM dummy_rast WHERE rid = 1;

 st_bandfilesize
-----------------
          240574
```

10.5.6 ST_BandFileTimestamp

ST_BandFileTimestamp — Returns the file timestamp of a band stored in file system. If no bandnum specified, 1 is assumed.

Synopsis

bigint **ST_BandFileTimestamp**(raster rast, integer bandnum=1);

설명

Returns the file timestamp (number of seconds since Jan 1st 1970 00:00:00 UTC) of a band stored in file system. Throws an error if called with an in db band, or if outdb access is not enabled.

This function is typically used in conjunction with ST_BandPath() and ST_BandFileSize() so a client can determine if the filename of a outdb raster as seen by it is the same as the one seen by the server.

Availability: 2.5.0

예시

```
SELECT ST_BandFileTimestamp(rast,1) FROM dummy_rast WHERE rid = 1;

 st_bandfiletimestamp
----------------------
           1521807257
```

10.5.7 ST_BandPixelType

ST_BandPixelType — 입력 밴드의 픽셀 유형을 반환합니다. bandnum을 설정하지 않을 경우 밴드 1로 가정합니다.

Synopsis

text **ST_BandPixelType**(raster rast, integer bandnum=1);

설명

Returns name describing data type and size of values stored in each cell of given band.

11가지 픽셀 유형이 있습니다. 지원 픽셀 유형은 다음과 같습니다:

- 1BB - 1비트 불 값
- 2BUI - 부호 없는 2비트 정수형
- 4BUI - 부호 없는 4비트 정수형
- 8BSI - 부호 있는 8비트 정수형
- 8BUI - 부호 없는 8비트 정수형
- 16BSI - 부호 있는 16비트 정수형
- 16BUI - 부호 없는 16비트 정수형
- 32BSI - 부호 있는 32비트 정수형
- 32BUI - 부호 없는 32비트 정수형
- 32BF - 32비트 부동소수점 실수형
- 64BF - 64비트 부동소수점 실수형

예시

```
SELECT ST_BandPixelType(rast,1) As btype1,
    ST_BandPixelType(rast,2) As btype2, ST_BandPixelType(rast,3) As btype3
FROM dummy_rast
WHERE rid = 2;

 btype1 | btype2 | btype3
--------+--------+--------
 8BUI   | 8BUI   | 8BUI
```

참고

ST_NumBands

10.5.8 ST_PixelOfValue

ST_PixelOfValue — 래스터 객체 내부에 있는 밴개수를 반환합니다.

Synopsis

integer **ST_MemSize**(raster rast);

설명

래스터 객체 내부에 있는 밴드들&#
개수를 반환합니다.

예시

```
SELECT ST_MinPossibleValue('16BSI');

 st_minpossiblevalue
---------------------
              -32768


SELECT ST_MinPossibleValue('8BUI');

 st_minpossiblevalue
---------------------
                   0
```

참고

ST_BandPixelType

10.5.9 ST_HasNoBand

ST_HasNoBand — 입력된 밴드 번호에 밴드가
없을 경우 참을 반환합니다. 밴드
번호를 설정하지 않을 경우, 밴드
1로 가정합니다.

Synopsis

boolean **ST_HasNoBand**(raster rast, integer bandnum=1);

설명

입력된 밴드 번호에 밴드가 없을
경우 참을 반환합니다. 밴드 번호&#
설정하지 않을 경우, 밴드 1로 가정&

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT rid, ST_HasNoBand(rast) As hb1, ST_HasNoBand(rast,2) as hb2,
ST_HasNoBand(rast,4) as hb4, ST_NumBands(rast) As numbands
FROM dummy_rast;

rid | hb1 | hb2 | hb4 | numbands
-----+-----+-----+-----+----------
1 | t   | t   | t   |        0
2 | f   | f   | t   |        3
```

참고

ST_NumBands

10.6 래스터 픽셀 접근자 &#xbc 설정자(setter)

10.6.1 ST_PixelAsPolygon

ST_PixelAsPolygon — 특정 행 및 열에 대한 픽셀&#xc758 경계를 이루는 폴리곤 도형을 반&#x

Synopsis

geometry **ST_PixelAsPolygon**(raster rast, integer columnx, integer rowy);

설명

특정 행 및 열에 대한 픽셀의 경계&# 이루는 폴리곤 도형을 반환합니&#x

2.0.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xb798;&#xc2a4;&#xd130; &#xd53d;&#xc140; &#xd3f4;&#xb9ac;&#xace4; &#xd68d;&#xb4dd;
SELECT i,j, ST_AsText(ST_PixelAsPolygon(foo.rast, i,j)) As b1pgeom
FROM dummy_rast As foo
        CROSS JOIN generate_series(1,2) As i
        CROSS JOIN generate_series(1,1) As j
WHERE rid=2;

 i | j |                                                  b1pgeom
---+---+-------------------------------------------------------------------------------
 1 | 1 | POLYGON((3427927.75 5793244,3427927.8 5793244,3427927.8 5793243.95,...
 2 | 1 | POLYGON((3427927.8 5793244,3427927.85 5793244,3427927.85 5793243.95, ..
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygons, ST_PixelAsPoint, ST_PixelAsPoints, ST_PixelAsCentroid, ST_PixelAsCentroids, ST_Intersection, ST_AsText

10.6.2 ST_PixelAsPolygons

ST_PixelAsPolygons — 래스터 밴드의 모든 픽셀&#xc758
경계를 이루는 폴리곤 도형을 각
픽셀의 값과 X, Y 래스터 좌표와 함&#xaed8
반환합니다.

Synopsis

setof record **ST_PixelAsPolygons**(raster rast, integer band=1, boolean exclude_nodata_value=TRUE);

설명

래스터 밴드의 모든 픽셀의 경계&#
이루는 폴리곤 도형을 각 픽셀의
값(이중 정밀도 데이터형)과 X, Y 래&#xc2
좌표(정수형)와 함께 반환합니다.

Return record format: *geom* geometry, *val* double precision, *x* integer, *y* integers.

Note
When *exclude_nodata_value* = TRUE, only those pixels whose values are not NODATA are returned as points.

Note
ST_PixelAsPolygons 함수는 모든 픽셀을 아우르는 폴리곤 도형 한 개를 반환합니다. 각 도형이 동일한 픽셀 값을 가지는 한 개 이상의 픽셀을 나타내는 ST_DumpAsPolygons 함수와는 다릅니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 선택적인 exclude_nodata_value 인수를 추가했습니다.

변경 사항: 2.1.1 버전에서 exclude_nodata_value의 습&#xc
변경했습니다.

예시

```
-- &#xb798;&#xc2a4;&#xd130; &#xd53d;&#xc140; &#xd3f4;&#xb9ac;&#xace4; &#xd68d;&#xb4dd;
SELECT (gv).x, (gv).y, (gv).val, ST_AsText((gv).geom) geom
FROM (SELECT ST_PixelAsPolygons(
                ST_SetValue(ST_SetValue(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 0.001,  ↩
                    -0.001, 0.001, 0.001, 4269),
                                                    '8BUI'::text, 1, 0),
                                        2, 2, 10),
                            1, 1, NULL)
) gv
) foo;

 x | y | val |                geom
```

```
---+---+-----------------------------------------------------------------------------
 1 | 1 |      | POLYGON((0 0,0.001 0.001,0.002 0,0.001 -0.001,0 0))
 1 | 2 |    1 | POLYGON((0.001 -0.001,0.002 0,0.003 -0.001,0.002 -0.002,0.001 -0.001))
 2 | 1 |    1 | POLYGON((0.001 0.001,0.002 0.002,0.003 0.001,0.002 0,0.001 0.001))
 2 | 2 |   10 | POLYGON((0.002 0,0.003 0.001,0.004 0,0.003 -0.001,0.002 0))
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygon, ST_PixelAsPoint, ST_PixelAsPoints, ST_PixelAsCentroid, ST_PixelAsCentroids, ST_AsText

10.6.3 ST_PixelAsPoint

ST_PixelAsPoint — 픽셀의 좌상단에 위치하는 포인트 도형을 반환합니다.

Synopsis

geometry **ST_PixelAsPoint**(raster rast, integer columnx, integer rowy);

설명

픽셀의 좌상단에 위치하는 포인&#x
도형을 반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_PixelAsPoint(rast, 1, 1)) FROM dummy_rast WHERE rid = 1;

   st_astext
----------------
 POINT(0.5 0.5)
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygon, ST_PixelAsPolygons, ST_PixelAsPoints, ST_PixelAsCentroid, ST_PixelAsCentroids

10.6.4 ST_PixelAsPoints

ST_PixelAsPoints — 래스터 밴드의 각 픽셀에 대&
포인트 도형을 각 픽셀의 값 및 X, Y
래스터 좌표와 함께 반환합니다.
포인트 도형의 좌표는 픽셀의 좌&
좌표입니다.

Synopsis

setof record **ST_PixelAsPoints**(raster rast, integer band=1, boolean exclude_nodata_value=TRUE);

설명

래스터 밴드의 각 픽셀에 대한 포&#
도형을 각 픽셀의 값 및 X, Y 래스터
좌표와 함께 반환합니다. 포인트
도형의 좌표는 픽셀의 좌상단 좌&#

Return record format: *geom* geometry, *val* double precision, *x* integer, *y* integers.

Note

When *exclude_nodata_value* = TRUE, only those pixels whose values are not NODATA are returned as points.

2.1.0 버전부터 사용할 수 있습니다.

변경 사항: 2.1.1 버전에서 exclude_nodata_value의 습&#x
변경했습니다.

예시

```
SELECT x, y, val, ST_AsText(geom) FROM (SELECT (ST_PixelAsPoints(rast, 1)).* FROM  ↩
    dummy_rast WHERE rid = 2) foo;

 x | y | val |          st_astext
---+---+-----+----------------------------
 1 | 1 | 253 | POINT(3427927.75 5793244)
 2 | 1 | 254 | POINT(3427927.8 5793244)
 3 | 1 | 253 | POINT(3427927.85 5793244)
 4 | 1 | 254 | POINT(3427927.9 5793244)
 5 | 1 | 254 | POINT(3427927.95 5793244)
 1 | 2 | 253 | POINT(3427927.75 5793243.95)
 2 | 2 | 254 | POINT(3427927.8 5793243.95)
 3 | 2 | 254 | POINT(3427927.85 5793243.95)
 4 | 2 | 253 | POINT(3427927.9 5793243.95)
 5 | 2 | 249 | POINT(3427927.95 5793243.95)
 1 | 3 | 250 | POINT(3427927.75 5793243.9)
 2 | 3 | 254 | POINT(3427927.8 5793243.9)
 3 | 3 | 254 | POINT(3427927.85 5793243.9)
 4 | 3 | 252 | POINT(3427927.9 5793243.9)
 5 | 3 | 249 | POINT(3427927.95 5793243.9)
 1 | 4 | 251 | POINT(3427927.75 5793243.85)
 2 | 4 | 253 | POINT(3427927.8 5793243.85)
 3 | 4 | 254 | POINT(3427927.85 5793243.85)
 4 | 4 | 254 | POINT(3427927.9 5793243.85)
 5 | 4 | 253 | POINT(3427927.95 5793243.85)
 1 | 5 | 252 | POINT(3427927.75 5793243.8)
 2 | 5 | 250 | POINT(3427927.8 5793243.8)
 3 | 5 | 254 | POINT(3427927.85 5793243.8)
 4 | 5 | 254 | POINT(3427927.9 5793243.8)
 5 | 5 | 254 | POINT(3427927.95 5793243.8)
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygon, ST_PixelAsPolygons, ST_PixelAsPoint, ST_PixelAsCentroid, ST_PixelAsCentroids

10.6.5 ST_PixelAsCentroid

ST_PixelAsCentroid — 픽셀 하나가 차지하는 면&#xc758
중심점(포인트 도형)을 반환합니&#

Synopsis

geometry **ST_PixelAsCentroid**(raster rast, integer x, integer y);

설명

픽셀 하나가 차지하는 면의 중심&#
도형)을 반환합니다.

개선 사항: 2.1.0 버전에서 C 언어로 다&#xc
쓰였습니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT ST_AsText(ST_PixelAsCentroid(rast, 1, 1)) FROM dummy_rast WHERE rid = 1;

  st_astext
--------------
 POINT(1.5 2)
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygon, ST_PixelAsPolygons, ST_PixelAsPoint, ST_PixelAsPoints, ST_PixelAsCentroids

10.6.6 ST_PixelAsCentroids

ST_PixelAsCentroids — 래스터 밴드의 각 픽셀에
대한 중심점(포인트 도형)을 각 픽&
값 및 X, Y 래스터 좌표와 함께 반환&#xd56
포인트 도형은 픽셀이 차지하는
면의 중심점입니다.

Synopsis

setof record **ST_PixelAsCentroids**(raster rast, integer band=1, boolean exclude_nodata_value=TRUE);

설명

래스터 밴드의 각 픽셀에 대한 중&
도형)을 각 픽셀의 값 및 X, Y 래스터
좌표와 함께 반환합니다. 포인트
도형은 픽셀이 차지하는 면의 중&

Return record format: `geom` geometry, `val` double precision, `x` integer, `y` integers.

Note

When *exclude_nodata_value* = TRUE, only those pixels whose values are not NODATA are returned as points.

개선 사항: 2.1.0 버전에서 C 언어로 다&#xc
쓰였습니다.

변경 사항: 2.1.1 버전에서 exclude_nodata_value의 습&#xc
변경했습니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT x, y, val, ST_AsText(geom) FROM (SELECT (ST_PixelAsPoints(rast, 1)).* FROM  ↩
    dummy_rast WHERE rid = 2) foo;

 x | y | val |          st_astext
---+---+-----+-----------------------------
 1 | 1 | 253 | POINT(3427927.75 5793244)
 2 | 1 | 254 | POINT(3427927.8 5793244)
 3 | 1 | 253 | POINT(3427927.85 5793244)
 4 | 1 | 254 | POINT(3427927.9 5793244)
 5 | 1 | 254 | POINT(3427927.95 5793244)
 1 | 2 | 253 | POINT(3427927.75 5793243.95)
 2 | 2 | 254 | POINT(3427927.8 5793243.95)
 3 | 2 | 254 | POINT(3427927.85 5793243.95)
 4 | 2 | 253 | POINT(3427927.9 5793243.95)
 5 | 2 | 249 | POINT(3427927.95 5793243.95)
 1 | 3 | 250 | POINT(3427927.75 5793243.9)
 2 | 3 | 254 | POINT(3427927.8 5793243.9)
 3 | 3 | 254 | POINT(3427927.85 5793243.9)
 4 | 3 | 252 | POINT(3427927.9 5793243.9)
 5 | 3 | 249 | POINT(3427927.95 5793243.9)
 1 | 4 | 251 | POINT(3427927.75 5793243.85)
 2 | 4 | 253 | POINT(3427927.8 5793243.85)
 3 | 4 | 254 | POINT(3427927.85 5793243.85)
 4 | 4 | 254 | POINT(3427927.9 5793243.85)
 5 | 4 | 253 | POINT(3427927.95 5793243.85)
 1 | 5 | 252 | POINT(3427927.75 5793243.8)
 2 | 5 | 250 | POINT(3427927.8 5793243.8)
 3 | 5 | 254 | POINT(3427927.85 5793243.8)
 4 | 5 | 254 | POINT(3427927.9 5793243.8)
 5 | 5 | 254 | POINT(3427927.95 5793243.8)
```

참고

ST_DumpAsPolygons, ST_PixelAsPolygon, ST_PixelAsPolygons, ST_PixelAsPoint, ST_PixelAsPoints, ST_PixelAsCentroid

10.6.7 ST_Value

ST_Value — 입력 columnx, rowy 픽셀의 입력 밴드의
값, 또는 특정 기하학적 포인트의
밴드의 값을 반환합니다. 밴드 번&
1부터 시작하며, 따로 지정하지 않&
경우 1로 가정합니다. exclude_nodata_value 를 거&

설정할 경우, nodata 픽셀을 포함한 모&#
픽셀이 교차한다고 가정하고 값&#x
반환합니다. exclude_nodata_value 를 설정하지
않은 경우, 래스터의 메타데이터&#
값을 읽어 들입니다.

Synopsis

double precision **ST_Value**(raster rast, geometry pt, boolean exclude_nodata_value=true);
double precision **ST_Value**(raster rast, integer band, geometry pt, boolean exclude_nodata_value=true);
double precision **ST_Value**(raster rast, integer x, integer y, boolean exclude_nodata_value=true);
double precision **ST_Value**(raster rast, integer band, integer x, integer y, boolean exclude_nodata_value=true);

설명

입력한 columnx, rowy 픽셀 또는 특정 도형&#xac
교차하는 픽셀들의 위치의 밴드
값을 설정해서 나온 수정된 래스&#
반환합니다. 밴드 번호는 1부터 시
따로 설정하지 않을 경우 1로 가정&

exclude_nodata_value 를 참으로 설정할 경우, 래&
nodata 값이 아닌 픽셀의 개수만 반환&#x
것입니다. 모든 픽셀의 개수를 구&#
exclude_nodata_value 를 거짓으로 설정하십시&#x

The allowed values of the resample parameter are "nearest" which performs the default nearest-neighbor resampling, and "bilinear" which performs a bilinear interpolation to estimate the value between pixel centers.

개선 사항: 2.1.0 버전부터 선택적인 exclude_nodata_value 인수를 추가했습니다.

개선 사항: 2.0.0 버전부터 선택적인 exclude_nodata_value 인수를 추가했습니다.

예시

```
-- &#xd2b9;&#xc815; PostGIS &#xb3c4;&#xd615; &#xd3ec;&#xc778;&#xd2b8;  ↩
    &#xc704;&#xce58;&#xc758; &#xb798;&#xc2a4;&#xd130; &#xac12;&#xc744;  ↩
    &#xc5bb;&#xc2b5;&#xb2c8;&#xb2e4;.
-- &#xc0ac;&#xc6a9;&#xc790; &#xb3c4;&#xd615;&#xc758; SRID&#xac00; &#xc0ac;&#xc6a9;&#xc790;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xc640; &#xb3d9;&#xc77c;&#xd574;&#xc57c;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.
SELECT rid, ST_Value(rast, foo.pt_geom) As b1pval, ST_Value(rast, 2, foo.pt_geom) As b2pval
FROM dummy_rast CROSS JOIN (SELECT ST_SetSRID(ST_Point(3427927.77, 5793243.76), 0) As  ↩
    pt_geom) As foo
WHERE rid=2;

 rid | b1pval | b2pval
-----+--------+--------
   2 |    252 |     79


-- &#xc2e4;&#xc81c; &#xd14c;&#xc774;&#xbe14;&#xc744; &#xc774;&#xc6a9;&#xd55c;  ↩
    &#xc77c;&#xbc18;&#xc801;&#xc778; &#xd5c8;&#xad6c;&#xc758; &#xc608;&#xc2dc;
SELECT rid, ST_Value(rast, 3, sometable.geom) As b3pval
FROM sometable
WHERE ST_Intersects(rast,sometable.geom);
```

```
SELECT rid, ST_Value(rast, 1, 1, 1) As b1pval,
    ST_Value(rast, 2, 1, 1) As b2pval, ST_Value(rast, 3, 1, 1) As b3pval
FROM dummy_rast
WHERE rid=2;

 rid | b1pval | b2pval | b3pval
-----+--------+--------+--------
   2 |    253 |     78 |     70
```

```
-- &#xac01; &#xd53d;&#xc140;&#xc758; &#xbc34;&#xb4dc; 1, 2, 3&#xc758; &#xbaa8;&#xb4e0;  ↩
    &#xac12;&#xb4e4;&#xc744; &#xc5bb;&#xc2b5;&#xb2c8;&#xb2e4;. --
SELECT x, y, ST_Value(rast, 1, x, y) As b1val,
        ST_Value(rast, 2, x, y) As b2val, ST_Value(rast, 3, x, y) As b3val
FROM dummy_rast CROSS JOIN
generate_series(1, 1000) As x CROSS JOIN generate_series(1, 1000) As y
WHERE rid =  2 AND x <= ST_Width(rast) AND y <= ST_Height(rast);

 x | y | b1val | b2val | b3val
---+---+-------+-------+-------
 1 | 1 |   253 |    78 |    70
 1 | 2 |   253 |    96 |    80
 1 | 3 |   250 |    99 |    90
 1 | 4 |   251 |    89 |    77
 1 | 5 |   252 |    79 |    62
 2 | 1 |   254 |    98 |    86
 2 | 2 |   254 |   118 |   108
 :
 :
```

```
-- &#xc55e;&#xc758; &#xc608;&#xc2dc;&#xcc98;&#xb7fc; &#xac01; &#xd53d;&#xc140;&#xc758;  ↩
    &#xbc34;&#xb4dc; 1, 2, 3&#xc758; &#xbaa8;&#xb4e0; &#xac12;&#xb4e4;&#xc744;  ↩
    &#xc5bb;&#xc9c0;&#xb9cc; &#xac01; &#xd53d;&#xc140;&#xc758; &#xc88c;&#xc0c1;&#xb2e8;  ↩
    &#xd3ec;&#xc778;&#xd2b8;&#xb3c4; &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;. --
SELECT ST_AsText(ST_SetSRID(
        ST_Point(ST_UpperLeftX(rast) + ST_ScaleX(rast)*x,
                ST_UpperLeftY(rast) + ST_ScaleY(rast)*y),
                ST_SRID(rast))) As uplpt
    , ST_Value(rast, 1, x, y) As b1val,
        ST_Value(rast, 2, x, y) As b2val, ST_Value(rast, 3, x, y) As b3val
FROM dummy_rast CROSS JOIN
generate_series(1,1000) As x CROSS JOIN generate_series(1,1000) As y
WHERE rid =  2 AND x <= ST_Width(rast) AND y <= ST_Height(rast);

            uplpt            | b1val | b2val | b3val
-----------------------------+-------+-------+-------
 POINT(3427929.25 5793245.5) |   253 |    78 |    70
 POINT(3427929.25 5793247)   |   253 |    96 |    80
 POINT(3427929.25 5793248.5) |   250 |    99 |    90
:
```

```
-- &#xd2b9;&#xc815; &#xac12; &#xbc94;&#xc704;&#xc5d0; &#xb4e4;&#xc5b4;&#xc624;&#xba70;  ↩
    &#xd2b9;&#xc815; &#xd3f4;&#xb9ac;&#xace4;&#xacfc; &#xad50;&#xcc28;&#xd558;&#xb294;  ↩
    &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xb4e4;&#xc758;  ↩
    &#xd569;&#xc9d1;&#xd569;&#xc73c;&#xb85c; &#xc774;&#xb8e8;&#xc5b4;&#xc9c4;  ↩
    &#xd3f4;&#xb9ac;&#xace4;&#xc744; &#xc5bb;&#xc2b5;&#xb2c8;&#xb2e4;. --
SELECT ST_AsText(ST_Union(pixpolyg)) As shadow
FROM (SELECT ST_Translate(ST_MakeEnvelope(
                ST_UpperLeftX(rast), ST_UpperLeftY(rast),
                        ST_UpperLeftX(rast) + ST_ScaleX(rast),
                        ST_UpperLeftY(rast) + ST_ScaleY(rast), 0
```

```
                        ), ST_ScaleX(rast)*x, ST_ScaleY(rast)*y
                ) As pixpolyg, ST_Value(rast, 2, x, y) As b2val
        FROM dummy_rast CROSS JOIN
generate_series(1,1000) As x CROSS JOIN generate_series(1,1000) As y
WHERE rid =  2
        AND x <= ST_Width(rast) AND y <= ST_Height(rast)) As foo
WHERE
        ST_Intersects(
                pixpolyg,
                ST_GeomFromText('POLYGON((3427928 5793244,3427927.75 5793243.75,3427928  ↩
                    5793243.75,3427928 5793244))',0)
                ) AND b2val != 254;


                shadow
--------------------------------------------------------------------------------
 MULTIPOLYGON(((3427928 5793243.9,3427928 5793243.85,3427927.95 5793243.85,3427927.95  ↩
     5793243.9,
 3427927.95 5793243.95,3427928 5793243.95,3427928.05 5793243.95,3427928.05  ↩
     5793243.9,3427928 5793243.9)),((3427927.95 5793243.9,3427927.95 579324
3.85,3427927.9 5793243.85,3427927.85 5793243.85,3427927.85 5793243.9,3427927.9  ↩
    5793243.9,3427927.9 5793243.95,
3427927.95 5793243.95,3427927.95 5793243.9)),((3427927.85 5793243.75,3427927.85  ↩
    5793243.7,3427927.8 5793243.7,3427927.8 5793243.75
,3427927.8 5793243.8,3427927.8 5793243.85,3427927.85 5793243.85,3427927.85  ↩
    5793243.8,3427927.85 5793243.75)),
((3427928.05 5793243.75,3427928.05 5793243.7,3427928 5793243.7,3427927.95  ↩
    5793243.7,3427927.95 5793243.75,3427927.95 5793243.8,3427
927.95 5793243.85,3427928 5793243.85,3427928 5793243.8,3427928.05 5793243.8,
3427928.05 5793243.75)),((3427927.95 5793243.75,3427927.95 5793243.7,3427927.9  ↩
    5793243.7,3427927.85 5793243.7,
3427927.85 5793243.75,3427927.85 5793243.8,3427927.85 5793243.85,3427927.9 5793243.85,
3427927.95 5793243.85,3427927.95 5793243.8,3427927.95 5793243.75)))
```

```
-- &#xb300;&#xc6a9;&#xb7c9; &#xb798;&#xc2a4;&#xd130; &#xd0c0;&#xc77c;&#xc758;  ↩
    &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc744; &#xd655;&#xc778;&#xd558;&#xb294;  ↩
    &#xc791;&#xc5c5;&#xc740; &#xc624;&#xb798; &#xac78;&#xb9b4; &#xc218;  ↩
    &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
-- &#xb2e8;&#xacc4;&#xbcc4;&#xb85c; &#xc120;&#xd0dd;&#xd560; &#xc218; &#xc788;&#xb294;  ↩
    generate_series &#xd30c;&#xb77c;&#xbbf8;&#xd130;&#xb97c; &#xc774;&#xc6a9;&#xd574;&#xc11c;
-- &#xc790;&#xb9bf;&#xc218;&#xb97c; &#xd1b5;&#xd574; &#xc815;&#xd655;&#xb3c4;&#xb97c;  ↩
    &#xc870;&#xae08; &#xc904;&#xc774;&#xba74; &#xc18d;&#xb3c4;&#xb97c; &#xd06c;&#xac8c;  ↩
    &#xd5a5;&#xc0c1;&#xc2dc;&#xd0ac; &#xc218; &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
-- &#xb2e4;&#xc74c; &#xc608;&#xc2dc;&#xb294; &#xc774;&#xc804; &#xc608;&#xc2dc;&#xc640;  ↩
    &#xac19;&#xc740; &#xc791;&#xc5c5;&#xc744; &#xd558;&#xc9c0;&#xb9cc; &#xb9e4; 4(2x) ↩
    &#xd53d;&#xc140;&#xb9c8;&#xb2e4; &#xd53d;&#xc140; 1&#xac1c;&#xb97c;  ↩
    &#xd655;&#xc778;&#xd574;&#xc11c; &#xd655;&#xc778;&#xd55c; &#xac83;&#xc73c;&#xb85c;  ↩
    &#xcc98;&#xb9ac;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xd655;&#xc778;&#xb41c; &#xd53d;&#xc140;&#xc758; &#xac12;&#xc744; &#xadf8;  ↩
    &#xb2e4;&#xc74c; &#xd53d;&#xc140; 4&#xac1c;&#xc758; &#xac12;&#xc73c;&#xb85c;  ↩
    &#xc800;&#xc7a5;&#xd569;&#xb2c8;&#xb2e4;.

SELECT ST_AsText(ST_Union(pixpolyg)) As shadow
FROM (SELECT ST_Translate(ST_MakeEnvelope(
                ST_UpperLeftX(rast), ST_UpperLeftY(rast),
                        ST_UpperLeftX(rast) + ST_ScaleX(rast)*2,
                        ST_UpperLeftY(rast) + ST_ScaleY(rast)*2, 0
                        ), ST_ScaleX(rast)*x, ST_ScaleY(rast)*y
                ) As pixpolyg, ST_Value(rast, 2, x, y) As b2val
        FROM dummy_rast CROSS JOIN
generate_series(1,1000,2) As x CROSS JOIN generate_series(1,1000,2) As y
WHERE rid =  2
```

```
        AND x <= ST_Width(rast)  AND y <= ST_Height(rast)  ) As foo
WHERE
        ST_Intersects(
                pixpolyg,
                ST_GeomFromText('POLYGON((3427928 5793244,3427927.75 5793243.75,3427928  ↩
                    5793243.75,3427928 5793244))',0)
                ) AND b2val != 254;

                shadow
-------------------------------------------------------------------------------
 MULTIPOLYGON(((3427927.9 5793243.85,3427927.8 5793243.85,3427927.8 5793243.95,
 3427927.9 5793243.95,3427928 5793243.95,3427928.1 5793243.95,3427928.1 5793243.85,3427928  ↩
    5793243.85,3427927.9 5793243.85)),
 ((3427927.9 5793243.65,3427927.8 5793243.65,3427927.8 5793243.75,3427927.8  ↩
    5793243.85,3427927.9 5793243.85,
 3427928 5793243.85,3427928 5793243.75,3427928.1 5793243.75,3427928.1 5793243.65,3427928  ↩
    5793243.65,3427927.9 5793243.65)))
```

참고

ST_SetValue, ST_DumpAsPolygons, ST_NumBands, ST_PixelAsPolygon, ST_ScaleX, ST_ScaleY, ST_UpperLeftX, ST_UpperLeftY, ST_SRID, ST_AsText, ST_Point, ST_MakeEnvelope, ST_Intersects, ST_Intersection

10.6.8 ST_NearestValue

ST_NearestValue — columnx 및 rowy, 또는 래스터와 동일&#xd5 공간 참조 좌표 시스템 단위로 표&#x 기하학적 포인트로 지정된 입력 밴드의 픽셀에 가장 가까운 NODATA 가 아닌 값을 반환합니다.

Synopsis

double precision **ST_NearestValue**(raster rast, integer bandnum, geometry pt, boolean exclude_nodata_value=true);
double precision **ST_NearestValue**(raster rast, geometry pt, boolean exclude_nodata_value=true);
double precision **ST_NearestValue**(raster rast, integer bandnum, integer columnx, integer rowy, boolean exclude_nodata_value=true);
double precision **ST_NearestValue**(raster rast, integer columnx, integer rowy, boolean exclude_nodata_value=true);

설명

입력한 columnx, rowy 픽셀, 또는 특정 기하&#xd5 포인트 위치에 있는 입력 밴드에 가장 가까운 NODATA 가 아닌 값을 반환&#x columnx, rowy 픽셀 또는 특정 기하학적 포&#xc7 위치의 픽셀이 NODATA 일 경우, 이 함수&# columnx, rowy 픽셀 또는 특정 기하학적 포&#xc7 위치에 가장 가까우며 NODATA 가 아닌 픽셀을 찾을 것입니다.

밴드 번호는 1부터 시작하며, 따로 지정하지 않을 경우 bandnum 을 1로 가정& exclude_nodata_value 를 거짓으로 설정할 경우, nodata 픽셀을 포함한 모든 픽셀이 교&# 가정하고 값을 반환합니다. exclude_nodata_

를 설정하지 않은 경우, 래스터의 메타데이터에서 값을 읽어 들입&#x

2.1.0 버전부터 사용할 수 있습니다.

Note
ST_NearestValue 함수는 즉석에서 ST_Value를 대체할 수 있습니다.

예시

```
-- 2x2 &#xd53d;&#xc140;&#xc774; &#xac12;&#xc744; &#xac00;&#xc9c0;&#xace0;  ↩
    &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT
        ST_Value(rast, 2, 2) AS value,
        ST_NearestValue(rast, 2, 2) AS nearestvalue
FROM (
        SELECT
                ST_SetValue(
                        ST_SetValue(
                                ST_SetValue(
                                        ST_SetValue(
                                                ST_SetValue(
                                                        ST_AddBand(
                                                                ST_MakeEmptyRaster(5, 5,  ↩
                                                                    -2, 2, 1, -1, 0, 0, 0),
                                                                '8BUI'::text, 1, 0
                                                        ),
                                                        1, 1, 0.
                                                ),
                                                2, 3, 0.
                                        ),
                                        3, 5, 0.
                                ),
                                4, 2, 0.
                        ),
                        5, 4, 0.
                ) AS rast
) AS foo

 value | nearestvalue
-------+--------------
     1 |            1
```

```
-- 2x3 &#xd53d;&#xc140;&#xc774; NODATA&#xc785;&#xb2c8;&#xb2e4;.
SELECT
        ST_Value(rast, 2, 3) AS value,
        ST_NearestValue(rast, 2, 3) AS nearestvalue
FROM (
        SELECT
                ST_SetValue(
                        ST_SetValue(
                                ST_SetValue(
                                        ST_SetValue(
                                                ST_AddBand(
                                                        ST_MakeEmptyRaster(5, 5,  ↩
                                                            -2, 2, 1, -1, 0, 0, 0),
```

```
                                                                '8BUI'::text, 1, 0
                                                            ),
                                                            1, 1, 0.
                                                    ),
                                                    2, 3, 0.
                                            ),
                                            3, 5, 0.
                                    ),
                                    4, 2, 0.
                            ),
                            5, 4, 0.
                    ) AS rast
) AS foo

 value | nearestvalue
-------+--------------
       |            1
```

참고

ST_Neighborhood, ST_Value

10.6.9 ST_SetSkew

ST_SetSkew — Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the Z dimension using the requested resample algorithm.

Synopsis

bytea **ST_AsGDALRaster**(raster rast, text format, text[] options=NULL, integer srid=sameassource);

설명

Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the Z dimensions using the requested resample algorithm.

The `resample` parameter can be set to "nearest" to copy the values from the cell each vertex falls within, or "bilinear" to use bilinear interpolation to calculate a value that takes neighboring cells into account also.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
--
-- 2x2 test raster with values
--
-- 10 50
-- 40 20
--
WITH test_raster AS (
SELECT
ST_SetValues(
  ST_AddBand(
    ST_MakeEmptyRaster(width => 2, height => 2,
      upperleftx => 0, upperlefty => 2,
      scalex => 1.0, scaley => -1.0,
```

```
      skewx => 0, skewy => 0, srid => 4326),
    index => 1, pixeltype => '16BSI',
    initialvalue => 0,
    nodataval => -999),
  1,1,1,
  newvalueset =>ARRAY[ARRAY[10.0::float8, 50.0::float8], ARRAY[40.0::float8, 20.0::float8 ↩
     ]]) AS rast
)
SELECT
ST_AsText(
  ST_SetZ(
    rast,
    band => 1,
    geom => 'SRID=4326;LINESTRING(1.0 1.9, 1.0 0.2)'::geometry,
    resample => 'bilinear'
))
FROM test_raster

            st_astext
---------------------------------
 LINESTRING Z (1 1.9 38,1 0.2 27)
```

참고

ST_Value, ST_SetSRID

10.6.10 ST_SetSkew

ST_SetSkew — Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the M dimension using the requested resample algorithm.

Synopsis

bytea **ST_AsGDALRaster**(raster rast, text format, text[] options=NULL, integer srid=sameassource);

설명

Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the M dimensions using the requested resample algorithm.

The `resample` parameter can be set to "nearest" to copy the values from the cell each vertex falls within, or "bilinear" to use bilinear interpolation to calculate a value that takes neighboring cells into account also.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
--
-- 2x2 test raster with values
--
-- 10 50
-- 40 20
--
WITH test_raster AS (
SELECT
ST_SetValues(
```

```
  ST_AddBand(
    ST_MakeEmptyRaster(width => 2, height => 2,
      upperleftx => 0, upperlefty => 2,
      scalex => 1.0, scaley => -1.0,
      skewx => 0, skewy => 0, srid => 4326),
    index => 1, pixeltype => '16BSI',
    initialvalue => 0,
    nodataval => -999),
  1,1,1,
  newvalueset =>ARRAY[ARRAY[10.0::float8, 50.0::float8], ARRAY[40.0::float8, 20.0::float8 ↩
     ]]) AS rast
)
SELECT
ST_AsText(
  ST_SetM(
    rast,
    band => 1,
    geom => 'SRID=4326;LINESTRING(1.0 1.9, 1.0 0.2)'::geometry,
    resample => 'bilinear'
))
FROM test_raster

            st_astext
----------------------------------
 LINESTRING M (1 1.9 38,1 0.2 27)
```

참고

ST_Value, ST_SetSRID

10.6.11 ST_Neighborhood

ST_Neighborhood — columnx 및 rowy, 또는 래스터와 동일&#xd5
공간 참조 좌표 시스템 단위로 표&#x
기하학적 포인트로 지정된 입력
밴드의 픽셀 주위의 NODATA 가 아닌 값&#x
이중 정밀도 데이터형 2차원 배열&
반환합니다.

Synopsis

double precision[][] **ST_Neighborhood**(raster rast, integer bandnum, integer columnX, integer rowY, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, integer columnX, integer rowY, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, integer bandnum, geometry pt, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, geometry pt, integer distanceX, integer distanceY, boolean exclude_nodata_value=tru

설명

columnx 및 rowy, 또는 래스터와 동일한 공&#xac0
참조 좌표 시스템 단위로 표현된
기하학적 포인트로 지정된 입력
밴드의 픽셀 주위의 NODATA 가 아닌 값&#x

이중 정밀도 데이터형 2차원 배열&
반환합니다. `distanceX` 및 `distanceY` 파라미터&#xa
지정한 픽셀 주위의 픽셀 개수를
X 및 Y축으로 정의합니다. 예를 들&#xc5b4
사용자 설정 픽셀 주위로 X축을 따&
3픽셀 거리 안 그리고 Y축을 따라
2픽셀 거리 안의 모든 값을 원하는
경우 말입니다. 2차원 배열의 중심&
columnx 및 rowy 또는 기하학적 포인트로
지정된 픽셀의 값이 될 것입니다.

밴드 번호는 1부터 시작하며, 따로
지정하지 않을 경우 `bandnum` 을 1로 가정&
`exclude_nodata_value` 를 거짓으로 설정할 경우,
`nodata` 픽셀을 포함한 모든 픽셀이 교&#
가정하고 값을 반환합니다. `exclude_nodata_
를 설정하지 않은 경우, 래스터의
메타데이터에서 값을 읽어 들입&#

Note

반환되는 2차원 배열의 각 축의 구성 요소 개수는 2 * (`distanceX`|`distanceY`) + 1입니다. 따라서 `distanceX` 와 `distanceY` 가 각각 1인 경우, 반환되는 배열은 3x3이 될 것입니다.

Note

ST_Min4ma, ST_Sum4ma, ST_Mean4ma 같은 어떤 래스터 공간 처리 내장 함수도 이 2차원 배열 출력물을 입력받을 수있습니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- 2x2 &#xd53d;&#xc140;&#xc774; &#xac12;&#xc744; &#xac00;&#xc9c0;&#xace0;  ↩
    &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT
        ST_Neighborhood(rast, 2, 2, 1, 1)
FROM (
        SELECT
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(5, 5, -2, 2, 1, -1, 0, 0, 0),
                                '8BUI'::text, 1, 0
                        ),
                        1, 1, 1, ARRAY[
                                [0, 1, 1, 1, 1],
                                [1, 1, 1, 0, 1],
                                [1, 0, 1, 1, 1],
                                [1, 1, 1, 1, 0],
                                [1, 1, 0, 1, 1]
                        ]::double precision[],
                        1
```

```
                ) AS rast
) AS foo

         st_neighborhood
--------------------------------
 {{NULL,1,1},{1,1,NULL},{1,1,1}}
```

```
-- 2x3 &#xd53d;&#xc140;&#xc774; NODATA&#xc785;&#xb2c8;&#xb2e4;.
SELECT
        ST_Neighborhood(rast, 2, 3, 1, 1)
FROM (
        SELECT
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(5, 5, -2, 2, 1, -1, 0, 0, 0),
                                '8BUI'::text, 1, 0
                        ),
                        1, 1, 1, ARRAY[
                                [0, 1, 1, 1, 1],
                                [1, 1, 1, 0, 1],
                                [1, 0, 1, 1, 1],
                                [1, 1, 1, 1, 0],
                                [1, 1, 0, 1, 1]
                        ]::double precision[],
                        1
                ) AS rast
) AS foo

       st_neighborhood
-----------------------------
 {{1,1,1},{1,NULL,1},{1,1,1}}
```

```
-- 3x3 &#xd53d;&#xc140;&#xc774; &#xac12;&#xc744; &#xac00;&#xc9c0;&#xace0;  ↩
    &#xc788;&#xc2b5;&#xb2c8;&#xb2e4;.
-- exclude_nodata_value = FALSE
SELECT
        ST_Neighborhood(rast, 3, 3, 1, 1, false)
FROM (
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(5, 5, -2, 2, 1, -1, 0, 0, 0),
                                '8BUI'::text, 1, 0
                        ),
                        1, 1, 1, ARRAY[
                                [0, 1, 1, 1, 1],
                                [1, 1, 1, 0, 1],
                                [1, 0, 1, 1, 1],
                                [1, 1, 1, 1, 0],
                                [1, 1, 0, 1, 1]
                        ]::double precision[],
                        1
                ) AS rast
) AS foo

      st_neighborhood
---------------------------
 {{1,0,1},{1,1,1},{0,1,1}}
```

참고

ST_NearestValue, ST_Min4ma, ST_Max4ma, ST_Sum4ma, ST_Mean4ma, ST_Range4ma, ST_Distinct4ma, ST_StdDev4ma

10.6.12 ST_SetValue

ST_SetValue — 입력한 columnx, rowy 픽셀 또는 특정 도형과 교차하는 픽셀들의 위치&#x 밴드 값을 설정해서 나온 수정된 래스터를 반환합니다. 밴드 번호&# 1부터 시작하며, 따로 설정하지 않& 경우 1로 가정합니다.

Synopsis

raster **ST_SetValue**(raster rast, integer bandnum, geometry geom, double precision newvalue);
raster **ST_SetValue**(raster rast, geometry geom, double precision newvalue);
raster **ST_SetValue**(raster rast, integer bandnum, integer columnx, integer rowy, double precision newvalue);
raster **ST_SetValue**(raster rast, integer columnx, integer rowy, double precision newvalue);

설명

Returns modified raster resulting from setting the specified pixels' values to new value for the designated band given the raster's row and column or a geometry. If no band is specified, then band 1 is assumed.

개선 사항: 2.1.0 버전부터 ST_SetValue() 함수의 도형 변종이 포인트뿐만이 아니&#x 모든 도형 유형을 지원합니다. 이 도형 변종은 ST_SetValues()의 geomval[] 변종을 감&#xc2 래퍼(wrapper)입니다.

예시

```
-- &#xb3c4;&#xd615; &#xc608;&#xc2dc;
SELECT (foo.geomval).val, ST_AsText(ST_Union((foo.geomval).geom))
FROM (SELECT ST_DumpAsPolygons(
                ST_SetValue(rast,1,
                            ST_Point(3427927.75, 5793243.95),
                            50)
                        ) As geomval
FROM dummy_rast
where rid = 2) As foo
WHERE (foo.geomval).val < 250
GROUP BY (foo.geomval).val;

 val |                                                          st_astext
-----+-----------------------------------------------------------------------
  50 | POLYGON((3427927.75 5793244,3427927.75 5793243.95,3427927.8 579324 ...
 249 | POLYGON((3427927.95 5793243.95,3427927.95 5793243.85,3427928 57932 ...
```

```
-- &#xbcc0;&#xacbd;&#xb41c; &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc800;&#xc7a5; --
        UPDATE dummy_rast SET rast = ST_SetValue(rast,1, ST_Point(3427927.75, 5793243.95) ↩
            ,100)
                WHERE rid = 2   ;
```

참고

ST_Value, ST_DumpAsPolygons

10.6.13 ST_SetValues

ST_SetValues — 지정한 밴드의 값들을 설정&#xd5
나온 수정된 래스터를 반환합니&#

Synopsis

raster **ST_SetValues**(raster rast, integer nband, integer columnx, integer rowy, double precision[][] newvalueset, boolean[][] noset=NULL, boolean keepnodata=FALSE);
raster **ST_SetValues**(raster rast, integer nband, integer columnx, integer rowy, double precision[][] newvalueset, double precision nosetvalue, boolean keepnodata=FALSE);
raster **ST_SetValues**(raster rast, integer nband, integer columnx, integer rowy, integer width, integer height, double precision newvalue, boolean keepnodata=FALSE);
raster **ST_SetValues**(raster rast, integer columnx, integer rowy, integer width, integer height, double precision newvalue, boolean keepnodata=FALSE);
raster **ST_SetValues**(raster rast, integer nband, geomval[] geomvalset, boolean keepnodata=FALSE);

설명

지정한 밴드에 대해, 설정한 픽셀&#
새로운 값(들)로 설정해서 나온 수&
래스터를 반환합니다.

`keepnodata` 가 TRUE일 경우, NODATA 값인 픽셀들을
`newvalueset` 에 있는 상응하는 값으로 설&#xc8
않을 것입니다.

변종 1의 경우, `columnx`, `rowy` 픽셀 좌표 및 `newvalues
배열의 차원이 설정 대상 픽셀들&#
결정합니다. 이미 `newvalueset` 에 있는 값&#xb
가진 픽셀을 중복 설정하는 것을
막기 위해 `noset` 을 이용할 수 있습니&#x
이가 빠진 배열을 허용하지 않기
때문입니다). 변종 1 예시를 참조하

변종 2는 변종 1과 비슷하지만, 불
값인 `noset` 배열 대신 단순한 이중 정&#xb
데이터형인 `nosetvalue` 를 입력받습니&#xb2e
`newvalueset` 가운데 `nosetvalue` 값을 가진 구성 요&
무시할 것입니다. 변종 2 예시를 참&

변종 3의 경우, `columnx`, `rowy` 픽셀 좌표, `width` 및
`height` 가 설정 대상 픽셀들을 결정합&#
변종 3 예시를 참조하십시오.

변종 4는 `rast` 의 첫 번째 밴드의 픽셀&#xb
설정될 것이라고 가정하는 점만
제외하면 변종 3과 동일합니다.

변종 5의 경우, 설정 대상 픽셀들을
결정하는 데 geomval 의 배열을 이용합&#x
배열 안의 도형들이 모두 POINT 또는
MULTIPOINT일 경우, 이 함수는 각 포인트&#xc7
경도와 위도를 써서 직접 픽셀을

설정하는 지름길을 이용합니다.
그렇지 않을 경우, 도형을 래스터&#
변환한 다음 동일한 방식으로 반&#
변종 5 예시를 참조하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시: 변종 1

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 1 | 1 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 2, 2, ARRAY[[9, 9], [9, 9]]::double precision[][]
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   1
 1 | 2 |   1
 1 | 3 |   1
 2 | 1 |   1
 2 | 2 |   9
 2 | 3 |   9
 3 | 1 |   1
 3 | 2 |   9
 3 | 3 |   9
```

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 9 |   | 9 |
```

```
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 1, 1, ARRAY[[9, 9, 9], [9, NULL, 9], [9, 9, 9]]::double  ↩
                            precision[][]
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   9
 1 | 2 |   9
 1 | 3 |   9
 2 | 1 |   9
 2 | 2 |
 2 | 3 |   9
 3 | 1 |   9
 3 | 2 |   9
 3 | 3 |   9
```

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 |   | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 1, 1,
                                ARRAY[[9, 9, 9], [9, NULL, 9], [9, 9, 9]]::double precision ↩
```

```
                                    [][],
                                ARRAY[[false], [true]]::boolean[][]
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   9
 1 | 2 |   1
 1 | 3 |   9
 2 | 1 |   9
 2 | 2 |
 2 | 3 |   9
 3 | 1 |   9
 3 | 2 |   9
 3 | 3 |   9
```

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 |   | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 9 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 1, 1,
                                ARRAY[[9, 9, 9], [9, NULL, 9], [9, 9, 9]]::double precision ↩
                                    [][],
                                ARRAY[[false], [true]]::boolean[][]
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   9
 1 | 2 |   1
 1 | 3 |   9
 2 | 1 |   9
 2 | 2 |
 2 | 3 |   9
 3 | 1 |   9
```

```
 3 | 2 |   9
 3 | 3 |   9
```

예시: 변종 2

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 1 | 1 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 1, 1, ARRAY[[-1, -1, -1], [-1, 9, 9], [-1, 9, 9]]::double  ↩
                            precision[][], -1
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   1
 1 | 2 |   1
 1 | 3 |   1
 2 | 1 |   1
 2 | 2 |   9
 2 | 3 |   9
 3 | 1 |   1
 3 | 2 |   9
 3 | 3 |   9
```

```
/*
&#xc774; &#xc608;&#xc2dc;&#xb294; &#xc774;&#xc804; &#xc608;&#xc2dc;&#xc640;  ↩
    &#xbe44;&#xc2b7;&#xd558;&#xc9c0;&#xb9cc;, nosetvalue = -1 &#xb300;&#xc2e0; nosetvalue =  ↩
    NULL &#xc744; &#xc501;&#xb2c8;&#xb2e4;.

ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 1 | 1 |
+ - + - + - +          + - + - + - +
```

```
| 1 | 1 | 1 |    =
>    | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 1, 1, ARRAY[[NULL, NULL, NULL], [NULL, 9, 9], [NULL, 9, 9]]:: ↩
                            double precision[][], NULL::double precision
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   1
 1 | 2 |   1
 1 | 3 |   1
 2 | 1 |   1
 2 | 2 |   9
 2 | 3 |   9
 3 | 1 |   1
 3 | 2 |   9
 3 | 3 |   9
```

예시: 변종 3

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 1 | 1 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
```

```
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 2, 2, 2, 2, 9
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   1
 1 | 2 |   1
 1 | 3 |   1
 2 | 1 |   1
 2 | 2 |   9
 2 | 3 |   9
 3 | 1 |   1
 3 | 2 |   9
 3 | 3 |   9
```

```
/*
ST_SetValues() &#xd568;&#xc218;&#xac00; &#xb2e4;&#xc74c; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.

+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 1 | 1 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |    =
>    | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
| 1 | 1 | 1 |          | 1 | 9 | 9 |
+ - + - + - +          + - + - + - +
*/
SELECT
        (poly).x,
        (poly).y,
        (poly).val
FROM (
SELECT
        ST_PixelAsPolygons(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0),
                                1, '8BUI', 1, 0
                        ),
                        1, 2, 2, 2, 2, 9
                )
        ) AS poly
) foo
ORDER BY 1, 2;

 x | y | val
---+---+-----
 1 | 1 |   1
 1 | 2 |   1
 1 | 3 |   1
 2 | 1 |   1
 2 | 2 |   9
 2 | 3 |   9
 3 | 1 |   1
```

```
 3 | 2 |   9
 3 | 3 |   9
```

예시: 변종 5

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 0, 0) AS rast
), bar AS (
        SELECT 1 AS gid, 'SRID=0;POINT(2.5 -2.5)'::geometry geom UNION ALL
        SELECT 2 AS gid, 'SRID=0;POLYGON((1 -1, 4 -1, 4 -4, 1 -4, 1 -1))'::geometry geom  ↩
            UNION ALL
        SELECT 3 AS gid, 'SRID=0;POLYGON((0 0, 5 0, 5 -1, 1 -1, 1 -4, 0 -4, 0 0))':: ↩
            geometry geom UNION ALL
        SELECT 4 AS gid, 'SRID=0;MULTIPOINT(0 0, 4 4, 4 -4)'::geometry
)
SELECT
        rid, gid, ST_DumpValues(ST_SetValue(rast, 1, geom, gid))
FROM foo t1
CROSS JOIN bar t2
ORDER BY rid, gid;

 rid | gid |                                                                                                st_dumpvalues
-----+-----+-----------------------------------------------------------------------------------------------------------------------

   1 |   1 | (1,"{{NULL,NULL,NULL,NULL,NULL},{NULL,NULL,NULL,NULL,NULL},{NULL,NULL,1,NULL, ↩
       NULL},{NULL,NULL,NULL,NULL,NULL},{NULL,NULL,NULL,NULL,NULL}}")
   1 |   2 | (1,"{{NULL,NULL,NULL,NULL,NULL},{NULL,2,2,2,NULL},{NULL,2,2,2,NULL},{NULL ↩
       ,2,2,2,NULL},{NULL,NULL,NULL,NULL,NULL}}")
   1 |   3 | (1,"{{3,3,3,3,3},{3,NULL,NULL,NULL,NULL},{3,NULL,NULL,NULL,NULL},{3,NULL,NULL, ↩
       NULL,NULL},{NULL,NULL,NULL,NULL,NULL}}")
   1 |   4 | (1,"{{4,NULL,NULL,NULL,NULL},{NULL,NULL,NULL,NULL,NULL},{NULL,NULL,NULL,NULL, ↩
       NULL},{NULL,NULL,NULL,NULL,NULL},{NULL,NULL,NULL,NULL,4}}")
(4 rows)
```

다음은 배열 후반에 있는 geomvals가 전&#x
geomvals를 덮어 쓸 수 있다는 사실을 보&#x
예시입니다.

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 0, 0) AS rast
), bar AS (
        SELECT 1 AS gid, 'SRID=0;POINT(2.5 -2.5)'::geometry geom UNION ALL
        SELECT 2 AS gid, 'SRID=0;POLYGON((1 -1, 4 -1, 4 -4, 1 -4, 1 -1))'::geometry geom  ↩
            UNION ALL
        SELECT 3 AS gid, 'SRID=0;POLYGON((0 0, 5 0, 5 -1, 1 -1, 1 -4, 0 -4, 0 0))':: ↩
            geometry geom UNION ALL
        SELECT 4 AS gid, 'SRID=0;MULTIPOINT(0 0, 4 4, 4 -4)'::geometry
)
SELECT
        t1.rid, t2.gid, t3.gid, ST_DumpValues(ST_SetValues(rast, 1, ARRAY[ROW(t2.geom, t2. ↩
            gid), ROW(t3.geom, t3.gid)]::geomval[]))
FROM foo t1
CROSS JOIN bar t2
CROSS JOIN bar t3
WHERE t2.gid = 1
        AND t3.gid = 2
ORDER BY t1.rid, t2.gid, t3.gid;
```

```
 rid | gid | gid |                                                                                                st_dumpvalues
-----+-----+-----+-----------------------------------------------------------------------------------------------------------------------

   1 |   1 |   2 | (1,"{{NULL,NULL,NULL,NULL,NULL},{NULL,2,2,2,NULL},{NULL,2,2,2,NULL},{ ↩
      NULL,2,2,2,NULL},{NULL,NULL,NULL,NULL,NULL}}")
(1 row)
```

이전 예시와 반대되는 상황을 보&#
예시입니다.

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 0, 0) AS rast
), bar AS (
        SELECT 1 AS gid, 'SRID=0;POINT(2.5 -2.5)'::geometry geom UNION ALL
        SELECT 2 AS gid, 'SRID=0;POLYGON((1 -1, 4 -1, 4 -4, 1 -4, 1 -1))'::geometry geom  ↩
            UNION ALL
        SELECT 3 AS gid, 'SRID=0;POLYGON((0 0, 5 0, 5 -1, 1 -1, 1 -4, 0 -4, 0 0))':: ↩
            geometry geom UNION ALL
        SELECT 4 AS gid, 'SRID=0;MULTIPOINT(0 0, 4 4, 4 -4)'::geometry
)
SELECT
        t1.rid, t2.gid, t3.gid, ST_DumpValues(ST_SetValues(rast, 1, ARRAY[ROW(t2.geom, t2. ↩
            gid), ROW(t3.geom, t3.gid)]::geomval[]))
FROM foo t1
CROSS JOIN bar t2
CROSS JOIN bar t3
WHERE t2.gid = 2
        AND t3.gid = 1
ORDER BY t1.rid, t2.gid, t3.gid;

 rid | gid | gid |                                                                                                st_dumpvalues
-----+-----+-----+-----------------------------------------------------------------------------------------------------------------------

   1 |   2 |   1 | (1,"{{NULL,NULL,NULL,NULL,NULL},{NULL,2,2,2,NULL},{NULL,2,1,2,NULL},{ ↩
      NULL,2,2,2,NULL},{NULL,NULL,NULL,NULL,NULL}}")
(1 row)
```

참고

ST_Value, ST_SetValue, ST_PixelAsPolygons

10.6.14 ST_DumpValues

ST_DumpValues — 지정된 밴드의 값들을 2차원
배열로 반환합니다.

Synopsis

setof record **ST_DumpValues**(raster rast , integer[] nband=NULL , boolean exclude_nodata_value=true);
double precision[][] **ST_DumpValues**(raster rast , integer nband , boolean exclude_nodata_value=true);

설명

지정된 밴드의 값들을 2차원 배열&#
반환합니다(첫 번째 인덱스가 행,

두 번째 인덱스가 열입니다). nband 가 NULL이거나 설정되지 않은 경우, 래&#xc
모든 밴드를 처리합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
WITH foo AS (
    SELECT ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), ↩
        1, '8BUI'::text, 1, 0), 2, '32BF'::text, 3, -9999), 3, '16BSI', 0, 0) AS rast
)
SELECT
    (ST_DumpValues(rast)).*
FROM foo;

 nband |                        valarray
-------+-----------------------------------------------------
     1 | {{1,1,1},{1,1,1},{1,1,1}}
     2 | {{3,3,3},{3,3,3},{3,3,3}}
     3 | {{NULL,NULL,NULL},{NULL,NULL,NULL},{NULL,NULL,NULL}}
(3 rows)
```

```
WITH foo AS (
        SELECT ST_SetValue(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 1, 0), 1, 2, 5) AS rast
)
SELECT
        (ST_DumpValues(rast, 1))[2][1]
FROM foo;

 st_dumpvalues
---------------
             5
(1 row)
```

```
WITH foo AS (
        SELECT ST_SetValue(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 1, 0), 1, 2, 5) AS rast
)
SELECT
        (ST_DumpValues(rast, 1))[2][1]
FROM foo;

 st_dumpvalues
---------------
             5
(1 row)
```

참고

ST_Value, ST_SetValue, ST_SetValues

10.6.15 ST_PixelOfValue

ST_PixelOfValue — 검색 값과 일치하는 값을 가&#
픽셀의 columnx, rowy 좌표를 반환합니다.

Synopsis

setof record **ST_PixelOfValue**(raster rast , integer nband , double precision[] search , boolean exclude_nodata_value=true);
setof record **ST_PixelOfValue**(raster rast , double precision[] search , boolean exclude_nodata_value=true);
setof record **ST_PixelOfValue**(raster rast , integer nband , double precision search , boolean exclude_nodata_value=true);
setof record **ST_PixelOfValue**(raster rast , double precision search , boolean exclude_nodata_value=true);

설명

검색 값과 일치하는 값을 가진 픽&#x
columnx, rowy 좌표를 반환합니다. 밴드를
따로 설정하지 않을 경우, 밴드 1로
가정합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT
        (pixels).*
FROM (
        SELECT
                ST_PixelOfValue(
                        ST_SetValue(
                                ST_SetValue(
                                        ST_SetValue(
                                                ST_SetValue(
                                                        ST_SetValue(
                                                                ST_AddBand(
                                                                        ST_MakeEmptyRaster ↩
                                                                            (5, 5, -2, 2, 1, ↩
                                                                             -1, 0, 0, 0),
                                                                        '8BUI'::text, 1, 0
                                                                ),
                                                                1, 1, 0
                                                        ),
                                                        2, 3, 0
                                                ),
                                                3, 5, 0
                                        ),
                                        4, 2, 0
                                ),
                                5, 4, 255
                        )
                , 1, ARRAY[1, 255]) AS pixels
) AS foo

 val | x | y
-----+---+---
   1 | 1 | 2
   1 | 1 | 3
   1 | 1 | 4
   1 | 1 | 5
   1 | 2 | 1
   1 | 2 | 2
   1 | 2 | 4
   1 | 2 | 5
   1 | 3 | 1
   1 | 3 | 2
```

```
  1 | 3 | 3
  1 | 3 | 4
  1 | 4 | 1
  1 | 4 | 3
  1 | 4 | 4
  1 | 4 | 5
  1 | 5 | 1
  1 | 5 | 2
  1 | 5 | 3
255 | 5 | 4
  1 | 5 | 5
```

10.7 래스터 편집자

10.7.1 ST_SetGeoReference

ST_SetGeoReference — 단일 호출로 지리참조 파&#xb77c
6개를 설정합니다. 숫자를 공백으&#
구분해야 합니다. GDAL 또는 ESRI 서식&#xc758
입력물을 받아들입니다. 기본값&#x
GDAL입니다.

Synopsis

raster **ST_SetGeoReference**(raster rast, text georefcoords, text format=GDAL);
raster **ST_SetGeoReference**(raster rast, double precision upperleftx, double precision upperlefty, double precision scalex, double precision scaley, double precision skewx, double precision skewy);

설명

단일 호출로 지리참조 파라미터
6개를 설정합니다. 'GDAL' 또는 'ESRI' 서식&#xc
입력물을 받아들입니다. 기본값&#x
GDAL입니다. 6개의 좌표를 입력하지
않을 경우 NULL을 반환할 것입니다.

형식 표현식 사이의 차이점은 다&#
같습니다:

GDAL:

```
scalex skewy skewx scaley upperleftx upperlefty
```

ESRI:

```
scalex skewy skewx scaley upperleftx + scalex*0.5 upperlefty + scaley*0.5
```

Note

래스터가 DB 외부 밴드를 가지고 있을 경우, 지리참조 파라미터를 변경하면 밴드의 외부 저장 데이터에 접근하는 데 오류가 발생할 수도 있습니다.

개선 사항: 2.1.0버전에서 ST_SetGeoReference(raster, double precision, ...) 변종이 추가됐습니다.

예시

```
WITH foo AS (
        SELECT ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0) AS rast
)
SELECT
        0 AS rid, (ST_Metadata(rast)).*
FROM foo
UNION ALL
SELECT
        1, (ST_Metadata(ST_SetGeoReference(rast, '10 0 0 -10 0.1 0.1', 'GDAL'))).*
FROM foo
UNION ALL
SELECT
        2, (ST_Metadata(ST_SetGeoReference(rast, '10 0 0 -10 5.1 -4.9', 'ESRI'))).*
FROM foo
UNION ALL
SELECT
        3, (ST_Metadata(ST_SetGeoReference(rast, 1, 1, 10, -10, 0.001, 0.001))).*
FROM foo

 rid |     upperleftx     |     upperlefty     | width | height | scalex | scaley | skewx | ↩
     skewy | srid | numbands
-----+--------------------+--------------------+-------+--------+--------+--------+-------+-

   0 |                  0 |                  0 |     5 |      5 |      1 |     -1 |     0 | ↩
           0 |    0 |        0
   1 |                0.1 |                0.1 |     5 |      5 |     10 |    -10 |     0 | ↩
           0 |    0 |        0
   2 | 0.0999999999999996 | 0.0999999999999996 |     5 |      5 |     10 |    -10 |     0 | ↩
           0 |    0 |        0
   3 |                  1 |                  1 |     5 |      5 |     10 |    -10 | 0.001 | ↩
       0.001 |    0 |        0
```

참고

ST_GeoReference, ST_ScaleX, ST_ScaleY, ST_UpperLeftX, ST_UpperLeftY

10.7.2 ST_SetRotation

ST_SetRotation — 래스터의 회전각을 라디안&#x
설정합니다.

Synopsis

float8 **ST_SetRotation**(raster rast, float8 rotation);

설명

래스터를 균일하게 회전시킵니&#x
회전각은 라디안 단위입니다. 자&#
내용은 월드 파일 을 참조하십시&#

예시

```
SELECT
  ST_ScaleX(rast1), ST_ScaleY(rast1), ST_SkewX(rast1), ST_SkewY(rast1),
  ST_ScaleX(rast2), ST_ScaleY(rast2), ST_SkewX(rast2), ST_SkewY(rast2)
FROM (
  SELECT ST_SetRotation(rast, 15) AS rast1, rast as rast2 FROM dummy_rast
) AS foo;
      st_scalex       |      st_scaley      |      st_skewx       |      st_skewy       |  ↩
         st_scalex | st_scaley | st_skewx | st_skewy
--------------------+---------------------+---------------------+---------------------+-----------+--

   -1.51937582571764 |   -2.27906373857646 |   1.95086352047135 |   1.30057568031423 |  ↩
                2 |          3 |         0 |         0
 -0.0379843956429411 | -0.0379843956429411 | 0.0325143920078558 | 0.0325143920078558 |  ↩
          0.05 |      -0.05 |         0 |         0
```

참고

ST_Rotation, ST_ScaleX, ST_ScaleY, ST_SkewX, ST_SkewY

10.7.3 ST_SetScale

ST_SetScale — X 및 Y 픽셀 크기를 좌표 참조 시&#
단위로 설정합니다. 단위/픽셀 너&
높이 순서입니다.

Synopsis

raster **ST_SetScale**(raster rast, float8 xy);
raster **ST_SetScale**(raster rast, float8 x, float8 y);

설명

X 및 Y 픽셀 크기를 좌표 참조 시스&#xd15c
단위로 설정합니다. 단위/픽셀 너&
높이 순서로 숫자를 입력합니다.
단위 한 개만 입력될 경우, X와 Y가
동일한 숫자라고 가정합니다.

> **Note**
> ST_SetScale은 래스터 범위에 매칭시키&#xae
> 위해 래스터를 리샘플링하지
> 않는다는 점에서 ST_Rescale 과는
> 다릅니다. 원본에서 잘못
> 설정된 축척을 교정하기 위해
> 래스터의 메타데이터(또는
> 지리참조)를 변경할 뿐입니다.
> ST_Rescale 함수는 입력 데이터의
> 지리적 범위에 맞추기 위해
> 너비와 높이를 수정한
> 래스터를 출력합니다. ST_SetScale
> 함수는 래스터의 너비는 물론
> 높이도 수정하지 않습니다.

변경 사항: 2.0.0 미만 WKTRaster 버전에서는 ST_SetPixelSize라는 명칭이었습니다. 2.0.0 버전현재 명칭으로 변경됐습니다.

예시

```
UPDATE dummy_rast
        SET rast = ST_SetScale(rast, 1.5)
WHERE rid = 2;

SELECT ST_ScaleX(rast) As pixx, ST_ScaleY(rast) As pixy, Box3D(rast) As newbox
FROM dummy_rast
WHERE rid = 2;

 pixx | pixy |                    newbox
------+------+-------------------------------------------
  1.5 |  1.5 | BOX(3427927.75 5793244 0, 3427935.25 5793251.5 0)
```

```
UPDATE dummy_rast
        SET rast = ST_SetScale(rast, 1.5, 0.55)
WHERE rid = 2;

SELECT ST_ScaleX(rast) As pixx, ST_ScaleY(rast) As pixy, Box3D(rast) As newbox
FROM dummy_rast
WHERE rid = 2;

 pixx | pixy |                   newbox
------+------+--------------------------------------------
  1.5 | 0.55 | BOX(3427927.75 5793244 0,3427935.25 5793247 0)
```

참고

ST_ScaleX, ST_ScaleY, Box3D

10.7.4 ST_SetSkew

ST_SetSkew — 지리참조 X 및 Y 기울기(skew)(또는 회전각 파라미터)를 설정합니다. 값 하나만 입력할 경우, X와 Y를 동일값으로 설정합니다.

Synopsis

raster **ST_SetSkew**(raster rast, float8 skewxy);
raster **ST_SetSkew**(raster rast, float8 skewx, float8 skewy);

설명

지리참조 X 및 Y 기울기(또는 회전각 파라미터)를 설정합니다. 값 하나만 입력할 경우, X와 Y를 동일값으로 설정합니다. 자세한 내용은 월드 파일 을 참조하십시오.

예시

```
-- &#xc608;&#xc2dc; 1
UPDATE dummy_rast SET rast = ST_SetSkew(rast,1,2) WHERE rid = 1;
SELECT rid, ST_SkewX(rast) As skewx, ST_SkewY(rast) As skewy,
    ST_GeoReference(rast) as georef
FROM dummy_rast WHERE rid = 1;

rid | skewx | skewy |    georef
----+-------+-------+--------------
  1 |     1 |     2 | 2.0000000000
                    : 2.0000000000
                    : 1.0000000000
                    : 3.0000000000
                    : 0.5000000000
                    : 0.5000000000
```

```
-- &#xc608;&#xc2dc; 2: &#xb450; &#xae30;&#xc6b8;&#xae30;&#xb97c; &#xb3d9;&#xc77c;&#xd55c;  ↩
    &#xac12;&#xc73c;&#xb85c; &#xc124;&#xc815;
UPDATE dummy_rast SET rast = ST_SetSkew(rast,0) WHERE rid = 1;
SELECT rid, ST_SkewX(rast) As skewx, ST_SkewY(rast) As skewy,
    ST_GeoReference(rast) as georef
FROM dummy_rast WHERE rid = 1;

 rid | skewx | skewy |    georef
-----+-------+-------+--------------
   1 |     0 |     0 | 2.0000000000
                     : 0.0000000000
                     : 0.0000000000
                     : 3.0000000000
                     : 0.5000000000
                     : 0.5000000000
```

참고

ST_GeoReference, ST_SetGeoReference, ST_SkewX, ST_SkewY

10.7.5 ST_SetSRID

ST_SetSRID — 래스터의 SRID를 spatial_ref_sys 테이블에 정의된 특정 SRID의 정수값으로 설&#xc81

Synopsis

raster **ST_SetSRID**(raster rast, integer srid);

설명

래스터의 SRID를 특정 정수값으로 설정합니다.

Note

이 함수는 래스터를 어떤 식으로든 변환하지 않습니다. 현재 좌표 참조 시스템의 공간 참조를 정의하는 메타데이터를 설정할 뿐입니다. 향후 변환 작업을 준비하는 데 유용합니다.

참고

Section 4.5, ST_SRID

10.7.6 ST_SetUpperLeft

ST_SetUpperLeft — Sets the value of the upper left corner of the pixel of the raster to projected X and Y coordinates.

Synopsis

raster **ST_SetUpperLeft**(raster rast, double precision x, double precision y);

설명

Set the value of the upper left corner of raster to the projected X and Y coordinates

예시

```
SELECT ST_SetUpperLeft(rast,-71.01,42.37)
FROM dummy_rast
WHERE rid = 2;
```

참고

ST_UpperLeftX, ST_UpperLeftY

10.7.7 ST_Resample

ST_Resample — 특정 리샘플링 알고리즘, 새&#xb8 차원, 임의의 그리드 모서리, 그리&#x 또 다른 래스터에서 정의되거나 빌려온 래스터 지리참조 속성들&#x 집합을 이용해서 래스터를 리샘&#x

Synopsis

raster **ST_Resample**(raster rast, integer width, integer height, double precision gridx=NULL, double precision gridy=NULL, double precision skewx=0, double precision skewy=0, text algorithm=NearestNeighbour, double precision maxerr=0.125);
raster **ST_Resample**(raster rast, double precision scalex=0, double precision scaley=0, double precision gridx=NULL, double precision gridy=NULL, double precision skewx=0, double precision skewy=0, text algorithm=NearestNeighbor, double precision maxerr=0.125);
raster **ST_Resample**(raster rast, raster ref, text algorithm=NearestNeighbour, double precision maxerr=0.125, boolean usescale=true);
raster **ST_Resample**(raster rast, raster ref, boolean usescale, text algorithm=NearestNeighbour, double precision maxerr=0.125);

설명

특정 리샘플링 알고리즘, 새로운 차원(width & height), 그리드 모서리(gridx & gridy), 그리또 다른 래스터에서 정의되거나 빌려온 래스터 지리참조 속성들(scale, scaley, skewx & skewy)의 집합을 이용해서 래스터 리샘플링합니다. 참조 래스터를 이용할 경우, 두 래스터는 동일한 SRID를 지고 있어야만 합니다.

New pixel values are computed using one of the following resampling algorithms:

- NearestNeighbor (english or american spelling)
- Bilinear
- Cubic
- CubicSpline
- Lanczos
- Max
- Min

The default is NearestNeighbor which is the fastest but results in the worst interpolation.

`maxerr` 를 설정하지 않을 경우 최대 오백분율 0.125를 사용합니다.

Note
자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

2.0.0 버전부터 사용할 수 있습니다. GDAL 1.6.1 이상 버전이 필요합니다.

Enhanced: 3.4.0 max and min resampling options added

예시

```
SELECT
        ST_Width(orig) AS orig_width,
        ST_Width(reduce_100) AS new_width
FROM (
        SELECT
                rast AS orig,
                ST_Resample(rast,100,100) AS reduce_100
        FROM aerials.boston
        WHERE ST_Intersects(rast,
                ST_Transform(
                        ST_MakeEnvelope(-71.128, 42.2392,-71.1277, 42.2397, 4326),26986)
        )
        LIMIT 1
) AS foo;

 orig_width | new_width
------------+-------------
        200 |         100
```

참고

ST_Rescale, ST_Resize, ST_Transform

10.7.8 ST_Rescale

ST_Rescale — Resample a raster by adjusting only its scale (or pixel size). New pixel values are computed using the NearestNeighbor (english or american spelling), Bilinear, Cubic, CubicSpline, Lanczos, Max or Min resampling algorithm. Default is NearestNeighbor.

Synopsis

raster **ST_Rescale**(raster rast, double precision scalexy, text algorithm=NearestNeighbour, double precision maxerr=0.125);
raster **ST_Rescale**(raster rast, double precision scalex, double precision scaley, text algorithm=NearestNeighbour, double precision maxerr=0.125);

설명

Resample a raster by adjusting only its scale (or pixel size). New pixel values are computed using one of the following resampling algorithms:

- NearestNeighbor (english or american spelling)
- Bilinear
- Cubic
- CubicSpline
- Lanczos
- Max
- Min

The default is NearestNeighbor which is the fastest but results in the worst interpolation.

`scalex` and `scaley` define the new pixel size. scaley must often be negative to get well oriented raster.

새 scalex 또는 scaley가 래스터 너비 또는 높이의 나눗수가 아닌 경우, 결과 래스터의 범위가 입력 래스터의 범위를 포괄하도록 확장됩니다. 입력 범위를 정확히 유지하고자 할 경우, ST_Resize 를 참조하십시오.

`maxerr` is the threshold for transformation approximation by the resampling algorithm (in pixel units). A default of 0.125 is used if no `maxerr` is specified, which is the same value used in GDAL gdalwarp utility. If set to zero, no approximation takes place.

Note
자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

Note

ST_Rescale은 래스터 범위에 매칭시키&#xae3 위해 래스터를 리샘플링한다는 점에서 ST_SetScale 과는 다릅니다. ST_SetScale은 원본에서 잘못 설정된 축척을 교정하기 위해 래스터의 메타데이터(또는 지리참조)를 변경할 뿐입니다. ST_Rescale 함수는 입력 데이터의 지리적 범위에 맞추기 위해 너비와 높이를 수정한 래스터를 출력합니다. ST_SetScale 함수는 래스터의 너비는 물론 높이도 수정하지 않습니다.

2.0.0 버전부터 사용할 수 있습니다. GDAL 1.6.1 이상 버전이 필요합니다.

Enhanced: 3.4.0 max and min resampling options added

변경 사항: 2.1.0 버전부터 SRID가 없는 래&#x 입력받습니다.

예시

픽셀 크기 0.001도에서 픽셀 크기 0.0015도 래스터를 재축척하는 단순한 예&#x

```
-- &#xc6d0;&#xbcf8; &#xb798;&#xc2a4;&#xd130; &#xd53d;&#xc140; &#xd06c;&#xae30;
SELECT ST_PixelWidth(ST_AddBand(ST_MakeEmptyRaster(100, 100, 0, 0, 0.001, -0.001, 0, 0,  ↩
    4269), '8BUI'::text, 1, 0)) width

   width
----------
0.001

-- &#xc7ac;&#xcd95;&#xcc99;&#xb41c; &#xb798;&#xc2a4;&#xd130; &#xd53d;&#xc140; &#xd06c;&#xae30;
SELECT ST_PixelWidth(ST_Rescale(ST_AddBand(ST_MakeEmptyRaster(100, 100, 0, 0, 0.001,  ↩
    -0.001, 0, 0, 4269), '8BUI'::text, 1, 0), 0.0015)) width

   width
----------
0.0015
```

참고

ST_Resize, ST_Resample, ST_SetScale, ST_ScaleX, ST_ScaleY, ST_Transform

10.7.9 ST_Reskew

ST_Reskew — 기울기(또는 회전각 파라미&#xd13 조정해서 래스터를 리샘플링합&#x NearestNeighbor(영국 또는 미국 철자), Bilinear, Cubic, Cubic-Spline 또는 Lanczos 리샘플링 알고리즘을 이용해서 새 픽셀 값을 계산합니&#x 기본값은 NearestNeighbor입니다.

Synopsis

raster **ST_Reskew**(raster rast, double precision skewxy, text algorithm=NearestNeighbour, double precision maxerr=0.125);
raster **ST_Reskew**(raster rast, double precision skewx, double precision skewy, text algorithm=NearestNeighbour, double precision maxerr=0.125);

설명

기울기(또는 회전각 파라미터)만 조정해서 래스터를 리샘플링합&#x NearestNeighbor(영국 또는 미국 철자), Bilinear, Cubic, Cubic-Spline 또는 Lanczos 리샘플링 알고리즘을 이용해서 새 픽셀 값을 계산합니&# 기본값은 가장 빠르지만 보간의 질은 가장 낮은 NearestNeighbor입니다.

`skewx` 와 `skewy` 가 새 기울기를 정의합니&#xb2e

새 래스터의 범위가 입력 래스터&# 범위를 포괄할 것입니다.

`maxerr` 를 설정하지 않을 경우 최대 오&# 백분율 0.125를 사용합니다.

Note
자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

Note
ST_Reskew는 래스터 범위에 매칭시키&#xae3 위해 래스터를 리샘플링한다는 점에서 ST_SetSkew 와는 다릅니다. ST_SetSkew는 원본에서 잘못 설정된 기울기를 교정하기 위해 래스터의 메타데이터(또는 지리참조)를 변경할 뿐입니다. ST_Reskew 함수는 입력 데이터의 지리적 범위에 맞추기 위해 너비와 높이를 수정한 래스터를 출력합니다. ST_SetSkew 함수는 래스터의 너비는 물론 높이도 수정하지 않습니다.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.1 이상 버전이 필요합니다.

변경 사항: 2.1.0 버전부터 SRID가 없는 래&# 입력받습니다.

예시

기울기 0.0에서 기울기 0.0015로 래스터&# 다시 기울이는 단순한 예시입니&#x

```
-- the original raster non-rotated
SELECT ST_Rotation(ST_AddBand(ST_MakeEmptyRaster(100, 100, 0, 0, 0.001, -0.001, 0, 0, 4269) ↩
    , '8BUI'::text, 1, 0));

-- result
0

-- the reskewed raster raster rotation
SELECT ST_Rotation(ST_Reskew(ST_AddBand(ST_MakeEmptyRaster(100, 100, 0, 0, 0.001, -0.001,  ↩
    0, 0, 4269), '8BUI'::text, 1, 0), 0.0015));

-- result
-0.982793723247329
```

참고

ST_Resample, ST_Rescale, ST_SetSkew, ST_SetRotation, ST_SkewX, ST_SkewY, ST_Transform

10.7.10 ST_SnapToGrid

ST_SnapToGrid — 그리드에 래스터를 스냅시&#xc
래스터를 리샘플링합니다. NearestNeigh-
bor(영국 또는 미국 철자), Bilinear, Cubic, CubicSpline 또&#xb29
Lanczos 리샘플링 알고리즘을 이용해&#xc
새 픽셀 값을 계산합니다. 기본값&#
NearestNeighbor입니다.

Synopsis

raster **ST_SnapToGrid**(raster rast, double precision gridx, double precision gridy, text algorithm=NearestNeighbour, double precision maxerr=0.125, double precision scalex=DEFAULT 0, double precision scaley=DEFAULT 0);
raster **ST_SnapToGrid**(raster rast, double precision gridx, double precision gridy, double precision scalex, double precision scaley, text algorithm=NearestNeighbour, double precision maxerr=0.125);
raster **ST_SnapToGrid**(raster rast, double precision gridx, double precision gridy, double precision scalexy, text algorithm=NearestNeigh
double precision maxerr=0.125);

설명

임의의 픽셀 모서리(gridx & gridy)와 선택&#xc80
픽셀 크기(scalex & scaley)로 정의되는 그리&#xb4
래스터를 스냅시켜서 래스터를
리샘플링합니다. NearestNeighbor(영국 또는
미국 철자), Bilinear, Cubic, CubicSpline 또는 Lanczos 리샘플&#x
알고리즘을 이용해서 새 픽셀 값&#x
계산합니다. 기본값은 가장 빠르&#x
보간의 질은 가장 낮은 NearestNeighbor입니&#xb2

`gridx` 및 `gridy` 가 새 그리드의 어떤 임의&#xc75
픽셀 모서리라도 정의합니다. 이
픽셀 모서리가 새 래스터의 좌상&#x
필요도 없고, 새 래스터 범위의 경&#
또는 내부에 있어야 하지도 않습&#

You can optionally define the pixel size of the new grid with `scalex` and `scaley`.

새 래스터의 범위가 입력 래스터&#
범위를 포괄할 것입니다.

`maxerr` 를 설정하지 않을 경우 최대 오&#
백분율 0.125를 사용합니다.

Note

자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

Note

그리드 파라미터를 더 세밀하게 조정해야 할 경우 ST_Resample 함수를 이용하십시오.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.1 이상 버전이 필요합니다.

변경 사항: 2.1.0 버전부터 SRID가 없는 래&
입력받습니다.

예시

래스터를 약간 다른 그리드에 스&#
단순한 예시입니다.

```
-- the original raster upper left X
SELECT ST_UpperLeftX(ST_AddBand(ST_MakeEmptyRaster(10, 10, 0, 0, 0.001, -0.001, 0, 0, 4269) ↩
    , '8BUI'::text, 1, 0));
-- result
0

-- the upper left of raster after snapping
SELECT ST_UpperLeftX(ST_SnapToGrid(ST_AddBand(ST_MakeEmptyRaster(10, 10, 0, 0, 0.001,  ↩
    -0.001, 0, 0, 4269), '8BUI'::text, 1, 0), 0.0002, 0.0002));

--result
-0.0008
```

참고

ST_Resample, ST_Rescale, ST_UpperLeftX, ST_UpperLeftY

10.7.11 ST_Resize

ST_Resize — 래스터의 크기를 새 너비/높&#xc77
조정합니다.

Synopsis

raster **ST_Resize**(raster rast, integer width, integer height, text algorithm=NearestNeighbor, double precision maxerr=0.125);
raster **ST_Resize**(raster rast, double precision percentwidth, double precision percentheight, text algorithm=NearestNeighbor, double precision maxerr=0.125);
raster **ST_Resize**(raster rast, text width, text height, text algorithm=NearestNeighbor, double precision maxerr=0.125);

설명

래스터의 크기를 새 너비/높이로 조정합니다. 픽셀의 정확한 개수 또는 입력 래스터의 너비/높이의 백분율로 새 너비/높이를 설정할 수 있습니다. 새 래스터의 범위가 입력 래스터의 범위와 동일할 것&#

NearestNeighbor(영국 또는 미국 철자), Bilinear, Cubic, Cubic-Spline 또는 Lanczos 리샘플링 알고리즘을 이용해서 새 픽셀 값을 계산합니&#
기본값은 가장 빠르지만 보간의 질은 가장 낮은 NearestNeighbor입니다.

변종 1은 출력 레이어의 실제 너비/&
입력받습니다.

변종 2는 입력 래스터의 너비/높이&
백분율을 나타내는 0과 1 사이의 소&
입력받습니다.

변종 3은 출력 래스터의 실제 너비/&
또는 입력 래스터의 너비/높이의
백분율을 나타내는 문자열("20%")을
입력받습니다.

2.1.0 버전부터 사용할 수 있습니다.
GDAL 1.6.1 이상 버전이 필요합니다.

예시

```
WITH foo AS(
SELECT
        1 AS rid,
        ST_Resize(
                ST_AddBand(
                        ST_MakeEmptyRaster(1000, 1000, 0, 0, 1, -1, 0, 0, 0)
                        , 1, '8BUI', 255, 0
                )
        , '50%', '500') AS rast
UNION ALL
SELECT
        2 AS rid,
        ST_Resize(
                ST_AddBand(
                        ST_MakeEmptyRaster(1000, 1000, 0, 0, 1, -1, 0, 0, 0)
                        , 1, '8BUI', 255, 0
                )
        , 500, 100) AS rast
UNION ALL
SELECT
        3 AS rid,
        ST_Resize(
                ST_AddBand(
                        ST_MakeEmptyRaster(1000, 1000, 0, 0, 1, -1, 0, 0, 0)
                        , 1, '8BUI', 255, 0
                )
        , 0.25, 0.9) AS rast
), bar AS (
        SELECT rid, ST_Metadata(rast) AS meta, rast FROM foo
```

```
)
SELECT rid, (meta).* FROM bar

 rid | upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
     numbands
-----+------------+------------+-------+--------+--------+--------+-------+-------+------+----------

   1 |          0 |          0 |   500 |    500 |      1 |     -1 |     0 |     0 |    0 |  ↩
             1
   2 |          0 |          0 |   500 |    100 |      1 |     -1 |     0 |     0 |    0 |  ↩
             1
   3 |          0 |          0 |   250 |    900 |      1 |     -1 |     0 |     0 |    0 |  ↩
             1
(3 rows)
```

참고

ST_Resample, ST_Rescale, ST_Reskew, ST_SnapToGrid

10.7.12 ST_Transform

ST_Transform — 알려진 공간 참조 시스템의 래스터를 지정한 리샘플링 알고&#x 통해 또 다른 알려진 공간 참조 시&# 재투영합니다. NearestNeighbor, Bilinear, Cubic, CubicSpline, Lanczos 알&#xace 이용할 수 있습니다. 기본값은 Nearestneighbor입니다.

Synopsis

raster **ST_Transform**(raster rast, integer srid, text algorithm=NearestNeighbor, double precision maxerr=0.125, double precision scalex, double precision scaley);
raster **ST_Transform**(raster rast, integer srid, double precision scalex, double precision scaley, text algorithm=NearestNeighbor, double precision maxerr=0.125);
raster **ST_Transform**(raster rast, raster alignto, text algorithm=NearestNeighbor, double precision maxerr=0.125);

설명

알려진 공간 참조 시스템의 래스&#x 지정한 픽셀 왜곡(pixel warp) 알고리즘을 통해 또 다른 알려진 공간 참조 시&# 재투영합니다. 따로 알고리즘을 설정하지 않을 경우 기본값은 NearestNeighbor이며, maxerror를 설정하지 않을 경우 기본값은 백분율 0.125입니다.

알고리즘 옵션에는 'NearestNeighbor', 'Bilinear', 'Cubic', 'CubicSpline', 그리고 'Lanczos'가 있습니다. 자세한 내용은 GDAL Warp resampling methods 를 참조하십시오.

ST_Transform 함수는 종종 ST_SetSRID()와 착각당합&#x ST_Transform이 실제로 래스터의 좌표를 한 공간 참조 시스템에서 또다른 공간 참조 시스템으로 변환시키&#x (그리고 픽셀 값을 리샘플링하는)

반면, ST_SetSRID()는 래스터의 SRID 식별자를 변경할 뿐입니다.

다른 변종과 달리, 변종 3은 `alignto` 파라&
참조 래스터를 요구합니다. 결과
래스터는 참조 래스터의 공간 참&#
시스템(SRID)으로 변환될 것이며, (ST_SameAlign
= TRUE일 경우) 참조 래스터와 동일하&#x
정렬될 것입니다.

Note

사용자의 변환 지원이 제대로 동작하지 않는다면, PROJSO 환경 변수를 사용자 PostGIS가 이용하고 있는 .so 또는 .dll 투영 라이브러리로 설정해야 할 수도 있습니다. 파일명만 지정해주면 됩니다. 예를 들어 윈도우의 경우, 제어판 -> 시스템 -> 환경 변수로 가서 `PROJSO` 라는 시스템 변수를 추가한 다음 (사용자가 PROJ 4.6.1을 이용하고 있을 경우) 해당 변수를 `libproj.dll` 로 설정합니다. 이렇게 변경한 다음 사용자의 PostgreSQL 서비스/데몬을 재시작해야 할 것입니다.

Warning

When transforming a coverage of tiles, you almost always want to use a reference raster to insure same alignment and no gaps in your tiles as demonstrated in example: Variant 3.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.1 이상 버전이 필요합니다.

개선 사항: 2.1.0버전에서 ST_Transform(rast, alignto) 변종
추가됐습니다.

예시

```
SELECT ST_Width(mass_stm) As w_before, ST_Width(wgs_84) As w_after,
  ST_Height(mass_stm) As h_before, ST_Height(wgs_84) As h_after
        FROM
        ( SELECT rast As mass_stm, ST_Transform(rast,4326) As wgs_84
  ,  ST_Transform(rast,4326, 'Bilinear') AS wgs_84_bilin
                FROM aerials.o_2_boston
                        WHERE ST_Intersects(rast,
                                ST_Transform(ST_MakeEnvelope(-71.128, 42.2392,-71.1277,  ↩
                                    42.2397, 4326),26986) )
                LIMIT 1) As foo;

 w_before | w_after | h_before | h_after
----------+---------+----------+---------
      200 |     228 |      200 |     170
```

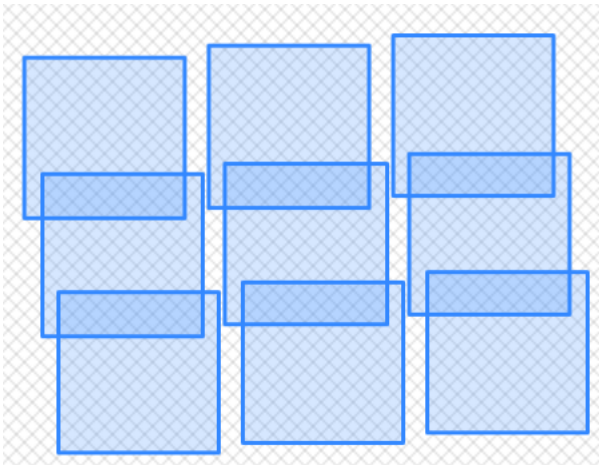
원본 매사추세츠 주 미터 단위 평면(mass_stm)	*WGS84 경위도(wgs_84) 변환한 후*	*기본값 NN 대신 Bilinear 알고리즘&#xc744 통해 WGS84 경위도(wgs_84_bilin) 변환한 후*

예시: 변종 3

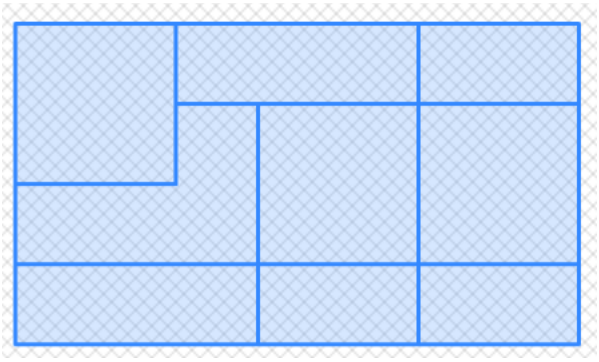
다음은 ST_Transform(raster, srid)과 ST_Transform(raster, alignto)의 차이&#xc81
보여주는 예시입니다.

```
WITH foo AS (
        SELECT 0 AS rid, ST_AddBand(ST_MakeEmptyRaster(2, 2, -500000, 600000, 100, -100, 0, ↩
             0, 2163), 1, '16BUI', 1, 0) AS rast UNION ALL
        SELECT 1, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499800, 600000, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 2, 0) AS rast UNION ALL
        SELECT 2, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499600, 600000, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 3, 0) AS rast UNION ALL

        SELECT 3, ST_AddBand(ST_MakeEmptyRaster(2, 2, -500000, 599800, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 10, 0) AS rast UNION ALL
        SELECT 4, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499800, 599800, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 20, 0) AS rast UNION ALL
        SELECT 5, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499600, 599800, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 30, 0) AS rast UNION ALL

        SELECT 6, ST_AddBand(ST_MakeEmptyRaster(2, 2, -500000, 599600, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 100, 0) AS rast UNION ALL
        SELECT 7, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499800, 599600, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 200, 0) AS rast UNION ALL
        SELECT 8, ST_AddBand(ST_MakeEmptyRaster(2, 2, -499600, 599600, 100, -100, 0, 0,  ↩
            2163), 1, '16BUI', 300, 0) AS rast
), bar AS (
        SELECT
                ST_Transform(rast, 4269) AS alignto
        FROM foo
        LIMIT 1
), baz AS (
        SELECT
                rid,
                rast,
                ST_Transform(rast, 4269) AS not_aligned,
                ST_Transform(rast, alignto) AS aligned
```

```
        FROM foo
        CROSS JOIN bar
)
SELECT
        ST_SameAlignment(rast) AS rast,
        ST_SameAlignment(not_aligned) AS not_aligned,
        ST_SameAlignment(aligned) AS aligned
FROM baz

 rast | not_aligned | aligned
------+-------------+---------
 t    | f           | t
```



not_aligned



aligned

참고

ST_Transform, ST_SetSRID

10.8 래스터 밴드 편집자

10.8.1 ST_SetBandNoDataValue

ST_SetBandNoDataValue — NODATA를 나타내는 입력 밴드&#x
값을 설정합니다. 밴드를 따로 설&
않을 경우 밴드 1로 가정합니다. 밴&
NODATA가 없다고 표시하려면, nodata value = NULL이&
설정하십시오.

Synopsis

raster **ST_SetBandNoDataValue**(raster rast, double precision nodatavalue);
raster **ST_SetBandNoDataValue**(raster rast, integer band, double precision nodatavalue, boolean forcechecking=false);

설명

밴드에서 NODATA를 나타내는 값을 설&#
밴드를 따로 설정하지 않을 경우
밴드 1로 가정합니다. 이 함수는
ST_Polygon, ST_DumpAsPolygons, 그리고 ST_PixelAs...() 함수의 결과&#
영향을 미칩니다.

예시

```
-- &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xc758; NODATA &#xac12;&#xb9cc; &#xbcc0;&#xacbd;
UPDATE dummy_rast
        SET rast = ST_SetBandNoDataValue(rast,1, 254)
WHERE rid = 2;

-- &#xbc34;&#xb4dc; 1, 2, 3&#xc758; NODATA &#xbc34;&#xb4dc; &#xac12;&#xc744; &#xbcc0;&#xacbd;
UPDATE dummy_rast
        SET rast =
                ST_SetBandNoDataValue(
                        ST_SetBandNoDataValue(
                                ST_SetBandNoDataValue(
                                        rast,1, 254)
                                ,2,99),
                                3,108)
                WHERE rid = 2;

-- NODATA &#xac12;&#xc744; &#xbaa8;&#xb450; &#xc81c;&#xac70;&#xd569;&#xb2c8;&#xb2e4;.  ↩
    &#xc774;&#xb807;&#xac8c; &#xd558;&#xba74; &#xbaa8;&#xb4e0; &#xacf5;&#xac04;  ↩
    &#xcc98;&#xb9ac; &#xd568;&#xc218;&#xac00; &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc744;  ↩
    &#xcc98;&#xb9ac;&#xd558;&#xac8c; &#xb420; &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
UPDATE dummy_rast
        SET rast = ST_SetBandNoDataValue(rast,1, NULL)
WHERE rid = 2;
```

참고

ST_BandNoDataValue, ST_NumBands

10.8.2 ST_SetBandIsNoData

ST_SetBandIsNoData — 밴드의 isnodata 플래그를 참으로
설정합니다.

Synopsis

raster **ST_SetBandIsNoData**(raster rast, integer band=1);

설명

밴드의 isnodata 플래그를 참으로 설정&#xd
밴드를 따로 설정하지 않을 경우
밴드 1로 가정합니다. 플래그가 지&
여겨지는 경우에만 이 함수를 호&#
합니다. 즉, 마지막 인수에 참을 설&

경우와 설정하지 않을 경우 ST_BandIsNoData 함수를 호출해서 나온 결과물이 달라질 때 말입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xb798;&#xc2a4;&#xd130; &#xc5f4; &#xd55c; &#xac1c;&#xb97c; &#xac00;&#xc9c4;  ↩
    &#xac00;&#xc9dc; &#xd14c;&#xc774;&#xbe14;&#xc744;  ↩
    &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
create table dummy_rast (rid integer, rast raster);

-- &#xbc34;&#xb4dc; &#xb450; &#xac1c;&#xc640; &#xd53d;&#xc140;/&#xbc34;&#xb4dc;  ↩
    &#xd558;&#xb098;&#xb97c; &#xac00;&#xc9c4; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xcd94;&#xac00;&#xd569;&#xb2c8;&#xb2e4;. &#xccab; &#xbc88;&#xc9f8;  ↩
    &#xbc34;&#xb4dc;&#xc758; nodatavalue = pixel value = 3&#xc785;&#xb2c8;&#xb2e4;.
-- &#xb450; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xc758; nodatavalue = 13, pixel value = 4 ↩
    &#xc785;&#xb2c8;&#xb2e4;.
insert into dummy_rast values(1,
(
'01' -- little endian (uint8 ndr)
||
'0000' -- version (uint16 0)
||
'0200' -- nBands (uint16 0)
||
'17263529ED684A3F' -- scaleX (float64 0.000805965234044584)
||
'F9253529ED684ABF' -- scaleY (float64 -0.00080596523404458)
||
'1C9F33CE69E352C0' -- ipX (float64 -75.5533328537098)
||
'718F0E9A27A44840' -- ipY (float64 49.2824585505576)
||
'ED50EB853EC32B3F' -- skewX (float64 0.000211812383858707)
||
'7550EB853EC32B3F' -- skewY (float64 0.000211812383858704)
||
'E6100000' -- SRID (int32 4326)
||
'0100' -- width (uint16 1)
||
'0100' -- height (uint16 1)
||
'4' -- hasnodatavalue &#xac12;&#xc774; &#xcc38;&#xc73c;&#xb85c;, isnodata &#xac12;&#xc774;  ↩
    (&#xcc38;&#xc774;&#xc5b4;&#xc57c; &#xd558;&#xb294;&#xb370;)  ↩
    &#xac70;&#xc9d3;&#xc73c;&#xb85c; &#xc124;&#xc815;&#xb410;&#xc2b5;&#xb2c8;&#xb2e4;.
||
'2' -- &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc; &#xc720;&#xd615;(4BUI)
||
'03' -- novalue==3
||
'03' -- pixel(0,0)==3 (same that nodata)
||
'0' -- hasnodatavalue &#xac12;&#xc774; &#xac70;&#xc9d3;&#xc73c;&#xb85c;  ↩
    &#xc124;&#xc815;&#xb410;&#xc2b5;&#xb2c8;&#xb2e4;.
||
'5' -- &#xb450; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc; &#xc720;&#xd615;(16BSI)
||
'0D00' -- novalue==13
```

```
||
'0400' -- pixel(0,0)==4
)::raster
);

select st_bandisnodata(rast, 1) from dummy_rast where rid = 1; -- Expected false
select st_bandisnodata(rast, 1, TRUE) from dummy_rast where rid = 1; -- Expected true

-- isnodata &#xd50c;&#xb798;&#xadf8;&#xac00;  ↩
    &#xc9c0;&#xc800;&#xbd84;&#xd569;&#xb2c8;&#xb2e4;. &#xc774;  ↩
    &#xd50c;&#xb798;&#xadf8;&#xb97c; &#xcc38;&#xc73c;&#xb85c;  ↩
    &#xc124;&#xc815;&#xd558;&#xaca0;&#xc2b5;&#xb2c8;&#xb2e4;.
update dummy_rast set rast = st_setbandisnodata(rast, 1) where rid = 1;


select st_bandisnodata(rast, 1) from dummy_rast where rid = 1; -- Expected true
```

참고

ST_BandNoDataValue, ST_NumBands, ST_SetBandNoDataValue, ST_BandIsNoData

10.8.3 ST_SetBandPath

ST_SetBandPath — Update the external path and band number of an out-db band

Synopsis

raster **ST_SetBandPath**(raster rast, integer band, text outdbpath, integer outdbindex, boolean force=false);

설명

Updates an out-db band's external raster file path and external band number.

Note
If `force` is set to true, no tests are done to ensure compatibility (e.g. alignment, pixel support) between the external raster file and the PostGIS raster. This mode is intended for file system changes where the external raster resides.

Note
Internally, this method replaces the PostGIS raster's band at index `band` with a new band instead of updating the existing path information.

Availability: 2.5.0

예시

```
WITH foo AS (
    SELECT
        ST_AddBand(NULL::raster, '/home/pele/devel/geo/postgis-git/raster/test/regress/ ↩
            loader/Projected.tif', NULL::int[]) AS rast
)
SELECT
    1 AS query,
    *
FROM ST_BandMetadata(
    (SELECT rast FROM foo),
    ARRAY[1,3,2]::int[]
)
UNION ALL
SELECT
    2,
    *
FROM ST_BandMetadata(
    (
        SELECT
            ST_SetBandPath(
                rast,
                2,
                '/home/pele/devel/geo/postgis-git/raster/test/regress/loader/Projected2.tif ↩
                    ',
                1
            ) AS rast
        FROM foo
    ),
    ARRAY[1,3,2]::int[]
)
ORDER BY 1, 2;

 query | bandnum | pixeltype | nodatavalue | isoutdb |  ↩
                                        path                                         |  ↩
     outdbbandnum
-------+---------+-----------+-------------+---------+--------------------------------------------
     1 |       1 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
         raster/test/regress/loader/Projected.tif       |            1
     1 |       2 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
         raster/test/regress/loader/Projected.tif       |            2
     1 |       3 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
         raster/test/regress/loader/Projected.tif       |            3
     2 |       1 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
         raster/test/regress/loader/Projected.tif       |            1
     2 |       2 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
    raster/test/regress/loader/Projected2.tif      |            1
     2 |       3 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
         raster/test/regress/loader/Projected.tif       |            3
```

참고

ST_BandMetaData, ST_SetBandIndex

10.8.4 ST_SetBandIndex

ST_SetBandIndex — Update the external band number of an out-db band

Synopsis

raster **ST_SetBandIndex**(raster rast, integer band, integer outdbindex, boolean force=false);

설명

Updates an out-db band's external band number. This does not touch the external raster file associated with the out-db band

---

Note
If `force` is set to true, no tests are done to ensure compatibility (e.g. alignment, pixel support) between the external raster file and the PostGIS raster. This mode is intended for where bands are moved around in the external raster file.

Note
Internally, this method replaces the PostGIS raster's band at index `band` with a new band instead of updating the existing path information.

Availability: 2.5.0

예시

```
WITH foo AS (
    SELECT
        ST_AddBand(NULL::raster, '/home/pele/devel/geo/postgis-git/raster/test/regress/ ↩
            loader/Projected.tif', NULL::int[]) AS rast
)
SELECT
    1 AS query,
    *
FROM ST_BandMetadata(
    (SELECT rast FROM foo),
    ARRAY[1,3,2]::int[]
)
UNION ALL
SELECT
    2,
    *
FROM ST_BandMetadata(
    (
        SELECT
            ST_SetBandIndex(
                rast,
                2,
                1
            ) AS rast
        FROM foo
    ),
    ARRAY[1,3,2]::int[]
)
ORDER BY 1, 2;

 query | bandnum | pixeltype | nodatavalue | isoutdb |  ↩
                                          path                                          |  ↩
     outdbbandnum
```

```
-------+---------+-----------+-------------+---------+-----------------------------------------

    1 |       1 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
        raster/test/regress/loader/Projected.tif       |             1
    1 |       2 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
        raster/test/regress/loader/Projected.tif       |             2
    1 |       3 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
        raster/test/regress/loader/Projected.tif       |             3
    2 |       1 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
        raster/test/regress/loader/Projected.tif       |             1
    2 |       2 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
   raster/test/regress/loader/Projected.tif       |             1
    2 |       3 | 8BUI      |             | t       | /home/pele/devel/geo/postgis-git/ ↩
        raster/test/regress/loader/Projected.tif       |             3
```

참고

ST_BandMetaData, ST_SetBandPath

10.9 래스터 밴드 통계 및 분석

10.9.1 ST_Count

ST_Count — 래스터 또는 래스터 커버리지 입력 밴드에 있는 픽셀 개수를 반&# 밴드를 따로 설정하지 않을 경우 기본값은 밴드 1입니다. exclude_nodata_value를 참으로 설정할 경우, NODATA 값이 아닌 픽셀의 개수만 반환할 것입니다.

Synopsis

boolean **ST_BandIsNoData**(raster rast, integer band, boolean forceChecking=true);
boolean **ST_BandIsNoData**(raster rast, boolean forceChecking=true);

설명

래스터 또는 래스터 커버리지의 입력 밴드에 있는 픽셀 개수를 반&# 밴드를 따로 설정하지 않을 경우 `nband` 의 기본값은 1입니다.

> **Note**
> `exclude_nodata_value` 를 참으로 설정할 경우, 래스터의 `nodata` 값이 아닌 픽셀의 개수만 반환할 것입니다. 모든 픽셀의 개수를 구하려면 `exclude_nodata_value` 를 거짓으로 설정하십시오.

2.2.0 버전부터 더 이상 ST_Count(rastertable, rastercolumn, ...) 변&#xc88
함수를 지원하지 않습니다. 대신
ST_CountAgg 함수를 이용하십시오.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xccab; &#xbc88;&#xc9f8; &#xd568;&#xc218;&#xb294; &#xac12;&#xc774; 249&#xac00;  ↩
    &#xc544;&#xb2cc; &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc758; &#xac1c;&#xc218;&#xb97c;  ↩
    &#xc9d1;&#xacc4;&#xd558;&#xace0;, &#xb450; &#xbc88;&#xc9f8; &#xd568;&#xc218;&#xb294;  ↩
    &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc758; &#xac1c;&#xc218;&#xb97c;  ↩
    &#xc9d1;&#xacc4;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --
SELECT rid, ST_Count(ST_SetBandNoDataValue(rast,249)) As exclude_nodata,
        ST_Count(ST_SetBandNoDataValue(rast,249),false) As include_nodata
    FROM dummy_rast WHERE rid=2;

rid | exclude_nodata | include_nodata
-----+----------------+----------------
   2 |             23 |             25
```

참고

ST_CountAgg, ST_SummaryStats, ST_SetBandNoDataValue

10.9.2 ST_CountAgg

ST_CountAgg — 종합 함수입니다. 래스터 집&#x
입력 밴드에 있는 픽셀 개수를 반&#
밴드를 따로 설정하지 않을 경우
기본값은 밴드 1입니다. exclude_nodata_value를
참으로 설정할 경우, NODATA 값이 아닌
픽셀의 개수만 반환할 것입니다.

Synopsis

bigint **ST_CountAgg**(raster rast, integer nband, boolean exclude_nodata_value, double precision sample_percent);
bigint **ST_CountAgg**(raster rast, integer nband, boolean exclude_nodata_value);
bigint **ST_CountAgg**(raster rast, boolean exclude_nodata_value);

설명

래스터 집합의 입력 밴드에 있는
픽셀 개수를 반환합니다. 밴드를
따로 설정하지 않을 경우 `nband` 의 기&#xb
1입니다.

`exclude_nodata_value` 를 참으로 설정할 경우, 래&
`nodata` 값이 아닌 픽셀의 개수만 반환&#x
것입니다. 모든 픽셀의 개수를 구&#
`exclude_nodata_value` 를 거짓으로 설정하십시&#x

기본적으로 모든 픽셀을 샘플링&#x
것입니다. 더 빠른 속도를 원한다&
`sample_percent` 를 0과 1 사이의 값으로 설정하

2.2.0 버전부터 사용할 수 있습니다.

예시

```
WITH foo AS (
        SELECT
                rast.rast
        FROM (
                SELECT ST_SetValue(
                        ST_SetValue(
                                ST_SetValue(
                                        ST_AddBand(
                                                ST_MakeEmptyRaster(10, 10, 10, 10, 2, 2, 0, ↩
                                                    0,0)
                                                , 1, '64BF', 0, 0
                                        )
                                        , 1, 1, 1, -10
                                )
                                , 1, 5, 4, 0
                        )
                        , 1, 5, 5, 3.14159
                ) AS rast
        ) AS rast
        FULL JOIN (
                SELECT generate_series(1, 10) AS id
        ) AS id
                ON 1 = 1
)
SELECT
        ST_CountAgg(rast, 1, TRUE)
FROM foo;

 st_countagg
-------------
          20
(1 row)
```

참고

ST_Count, ST_SummaryStats, ST_SetBandNoDataValue

10.9.3 ST_Histogram

ST_Histogram — 빈(bin; 히스토그램 표시에서 수&
막대로 나타나는 단위) 범위로 구&
래스터 또는 래스터 커버리지의
데이터 분포를 요약하는 레코드
집합을 반환합니다. 따로 설정하&
않을 경우 빈의 개수를 자동으로
계산합니다.

Synopsis

double precision[][] **ST_Neighborhood**(raster rast, integer bandnum, integer columnX, integer rowY, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, integer columnX, integer rowY, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, integer bandnum, geometry pt, integer distanceX, integer distanceY, boolean exclude_nodata_value=true);
double precision[][] **ST_Neighborhood**(raster rast, geometry pt, integer distanceX, integer distanceY, boolean exclude_nodata_value=tru

설명

각 빈에 대해 입력 래스터 밴드의 min, max, count, percent로 이루어진 레코드 집합&#xc744 반환합니다. 밴드를 따로 설정하&#x 않을 경우 `nband` 의 기본값은 1입니다.

> **Note**
> 기본적으로 `nodata` 값이 아닌 픽셀 값만 처리합니다. 모든 픽셀의 개수를 구하려면 `exclude_nodata_value` 를 거짓으로 설정하십시오.

`width` **double precision[]** width: 각 카테고리/빈의 너비&#xb97 나타내는 배열입니다. 빈 개수&#xac width 개수보다 큰 경우, width를 반복합&#xb

예시: 빈 9개, width [a, b, c]는 [a, b, c, a, b, c, a, b, c]로 출력&#xb420 것입니다.

`bins` **integer** 분류 단계(breakout)의 개수: 따로 설&#xc8 경우 함수가 반환하는 레코드&#xc75 개수입니다. 따로 설정하지 않&#xc7 경우 분류 단계의 개수를 자동&#xc7 계산합니다.

`right` **boolean** 히스토그램을 왼쪽부터보&#xb2e 오른쪽부터(기본값) 계산합니&#xb2e X값을 평가하는 기준을 [a, b) 에서 (a, b] 로 변경합니다.

Changed: 3.1.0 Removed ST_Histogram(table_name, column_name) variant.

2.0.0 버전부터 사용할 수 있습니다.

예시: 단일 래스터 타일 - 밴드 1, 2, 3에 대한 히스토그램을 계산하고 빈&#x 자동으로 계산합니다.

```
SELECT band, (stats).*
FROM (SELECT rid, band, ST_Histogram(rast, band) As stats
    FROM dummy_rast CROSS JOIN generate_series(1,3) As band
     WHERE rid=2) As foo;

 band |  min  |  max  | count | percent
------+-------+-------+-------+---------
    1 |   249 |   250 |     2 |    0.08
    1 |   250 |   251 |     2 |    0.08
    1 |   251 |   252 |     1 |    0.04
    1 |   252 |   253 |     2 |    0.08
    1 |   253 |   254 |    18 |    0.72
    2 |    78 | 113.2 |    11 |    0.44
    2 | 113.2 | 148.4 |     4 |    0.16
    2 | 148.4 | 183.6 |     4 |    0.16
    2 | 183.6 | 218.8 |     1 |    0.04
    2 | 218.8 |   254 |     5 |     0.2
    3 |    62 | 100.4 |    11 |    0.44
```

```
    3 | 100.4 | 138.8 |     5 |     0.2
    3 | 138.8 | 177.2 |     4 |    0.16
    3 | 177.2 | 215.6 |     1 |    0.04
    3 | 215.6 |   254 |     4 |    0.16
```

**예시: 밴드 2의 히스토그램만 계산&
빈 6개를 계산합니다.**

```
SELECT (stats).*
FROM (SELECT rid, ST_Histogram(rast, 2,6) As stats
    FROM dummy_rast
     WHERE rid=2) As foo;

    min     |    max     | count | percent
------------+------------+-------+---------
         78 | 107.333333 |     9 |    0.36
 107.333333 | 136.666667 |     6 |    0.24
 136.666667 |        166 |     0 |       0
        166 | 195.333333 |     4 |    0.16
 195.333333 | 224.666667 |     1 |    0.04
 224.666667 |        254 |     5 |     0.2
(6 rows)

-- &#xc774;&#xc804; &#xc608;&#xc2dc;&#xc640; &#xb3d9;&#xc77c;&#xd558;&#xc9c0;&#xb9cc;  ↩
    &#xac01; &#xbe48;&#xc758; &#xd53d;&#xc140; &#xac12; &#xbc94;&#xc704;&#xb97c;  ↩
    &#xba85;&#xd655;&#xd558;&#xac8c; &#xc870;&#xc815;&#xd569;&#xb2c8;&#xb2e4;.
SELECT (stats).*
FROM (SELECT rid, ST_Histogram(rast, 2,6,ARRAY[0.5,1,4,100,5]) As stats
    FROM dummy_rast
     WHERE rid=2) As foo;

  min   |  max   | count | percent
--------+--------+-------+----------
    78  |  78.5  |     1 |     0.08
  78.5  |  79.5  |     1 |     0.04
  79.5  |  83.5  |     0 |        0
  83.5  | 183.5  |    17 |   0.0068
 183.5  | 188.5  |     0 |        0
 188.5  |   254  |     6 | 0.003664
(6 rows)
```

참고

ST_Count, ST_SummaryStats, ST_SummaryStatsAgg

10.9.4 ST_Quantile

ST_Quantile — 샘플링 또는 채우기(population)라는
맥락에서 래스터 또는 래스터 테&#
커버리지의 사분위(quantile)를 계산합&#xb
따라서, 래스터의 25%, 50%, 75% 백분위(percentile)
단계로 값을 확인할 수 있습니다.

Synopsis

SETOF record **ST_Quantile**(raster rast, integer nband=1, boolean exclude_nodata_value=true, double precision[] quantiles=NULL);
SETOF record **ST_Quantile**(raster rast, double precision[] quantiles);

SETOF record **ST_Quantile**(raster rast, integer nband, double precision[] quantiles);
double precision **ST_Quantile**(raster rast, double precision quantile);
double precision **ST_Quantile**(raster rast, boolean exclude_nodata_value, double precision quantile=NULL);
double precision **ST_Quantile**(raster rast, integer nband, double precision quantile);
double precision **ST_Quantile**(raster rast, integer nband, boolean exclude_nodata_value, double precision quantile);
double precision **ST_Quantile**(raster rast, integer nband, double precision quantile);
SETOF record **ST_Quantile**(text rastertable, text rastercolumn, integer nband=1, boolean exclude_nodata_value=true, double precision[] quantiles=NULL);
SETOF record **ST_Quantile**(text rastertable, text rastercolumn, integer nband, double precision[] quantiles);

설명

샘플링 또는 채우기(population)라는 맥락&
래스터 또는 래스터 테이블 커버&#
사분위(quantile)를 계산합니다. 따라서,
래스터의 25%, 50%, 75% 백분위(percentile) 단계로
값을 확인할 수 있습니다.

Note
`exclude_nodata_value` 를 거짓으로 설정하면, NODATA 값의 픽셀도 집계할 것입니다.

Changed: 3.1.0 Removed ST_Quantile(table_name, column_name) variant.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
UPDATE dummy_rast SET rast = ST_SetBandNoDataValue(rast,249) WHERE rid=2;
-- &#xc774; &#xc608;&#xc2dc; &#xcffc;&#xb9ac;&#xb294; &#xc9c0;&#xc815;&#xd55c;  ↩
    &#xc0ac;&#xbd84;&#xc704; &#xc548;&#xc5d0; &#xc788;&#xb294; &#xbc34;&#xb4dc; 1&#xc758;  ↩
    &#xd53d;&#xc140; &#xac00;&#xc6b4;&#xb370; &#xac12;&#xc774; 249&#xac00; &#xc544;&#xb2cc;  ↩
    &#xd53d;&#xc140;&#xb4e4;&#xb9cc; &#xcc98;&#xb9ac;&#xd560;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --

SELECT (pvq).*
FROM (SELECT ST_Quantile(rast, ARRAY[0.25,0.75]) As pvq
    FROM dummy_rast WHERE rid=2) As foo
    ORDER BY (pvq).quantile;

 quantile | value
----------+-------
     0.25 |   253
     0.75 |   254

SELECT ST_Quantile(rast, 0.75) As value
    FROM dummy_rast WHERE rid=2;

value
------
  254
```

```
-- &#xc2e4;&#xc81c; &#xc608;&#xc2dc;&#xc785;&#xb2c8;&#xb2e4;. &#xbc34;&#xb4dc; 2&#xc758;  ↩
    &#xd53d;&#xc140; &#xac00;&#xc6b4;&#xb370; &#xb3c4;&#xd615;&#xacfc;  ↩
    &#xad50;&#xcc28;&#xd558;&#xb294; &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xb4e4;&#xc758;  ↩
    &#xc0ac;&#xbd84;&#xc704;&#xb97c; &#xad6c;&#xd569;&#xb2c8;&#xb2e4;.
```

```
SELECT rid, (ST_Quantile(rast,2)).* As pvc
    FROM o_4_boston
        WHERE ST_Intersects(rast,
            ST_GeomFromText('POLYGON((224486 892151,224486 892200,224706 892200,224706  ↩
                892151,224486 892151))',26986)
            )
ORDER BY value, quantile,rid
;


 rid | quantile | value
-----+----------+-------
   1 |        0 |     0
   2 |        0 |     0
  14 |        0 |     1
  15 |        0 |     2
  14 |     0.25 |    37
   1 |     0.25 |    42
  15 |     0.25 |    47
   2 |     0.25 |    50
  14 |      0.5 |    56
   1 |      0.5 |    64
  15 |      0.5 |    66
   2 |      0.5 |    77
  14 |     0.75 |    81
  15 |     0.75 |    87
   1 |     0.75 |    94
   2 |     0.75 |   106
  14 |        1 |   199
   1 |        1 |   244
   2 |        1 |   255
  15 |        1 |   255
```

참고

ST_Count, ST_SummaryStats, ST_SummaryStatsAgg, ST_SetBandNoDataValue

10.9.5 ST_SummaryStats

ST_SummaryStats — 입력한 래스터 밴드 또는 래
또는 래스터 커버리지의 count, sum, mean, stddev,
min, max로 이루어진 통계 요약을 반환&#x
밴드를 따로 설정하지 않을 경우
밴드 1로 가정합니다.

Synopsis

raster **ST_SetScale**(raster rast, float8 xy);
raster **ST_SetScale**(raster rast, float8 x, float8 y);

설명

입력한 래스터 밴드 또는 래스터
또는 래스터 커버리지의 count, sum, mean, stddev,
min, max로 이루어진 summarystats 을 반환합니다
밴드를 따로 설정하지 않을 경우
`nband` 의 기본값은 1입니다.

Note

기본적으로 `nodata` 값이 아닌 픽셀 값만 처리합니다. 모든 픽셀의 개수를 구하려면 `exclude_nodata_value` 를 거짓으로 설정하십시오.

Note

기본적으로 모든 픽셀을 샘플링할 것입니다. 더 빠른 속도를 원한다면, `sample_percent` 를 1보다 작은 값으로 설정하십시오.

2.2.0 버전부터 더 이상 ST_SummaryStats(rastertable, rastercolumn, ...) 변종 함수를 지원하지 않습니다. 대신 ST_SummaryStatsAgg 함수를 이용하십시오.

2.0.0 버전부터 사용할 수 있습니다.

예시: 단일 래스터 타일

```
SELECT rid, band, (stats).*
FROM (SELECT rid, band, ST_SummaryStats(rast, band) As stats
    FROM dummy_rast CROSS JOIN generate_series(1,3) As band
     WHERE rid=2) As foo;

 rid | band | count | sum  |    mean     |  stddev   | min | max
-----+------+-------+------+-------------+-----------+-----+-----
   2 |    1 |    23 | 5821 | 253.086957  |  1.248061 | 250 | 254
   2 |    2 |    25 | 3682 |     147.28  | 59.862188 |  78 | 254
   2 |    3 |    25 | 3290 |      131.6  | 61.647384 |  62 | 254
```

예시: 관심 건물과 교차하는 픽셀&#x 요약

PostGIS 윈도우 64비트 버전에서 모든 보&# 건물들과 항공사진 타일들(각각 건물 레코드 102,000개, 150x150 픽셀 크기의 타일 134,000개)을 처리하는 이 예시가 574밀리초 걸렸습니다.

```
WITH
-- &#xad00;&#xc2ec; &#xd53c;&#xcc98;
   feat AS (SELECT gid As building_id, geom_26986 As geom FROM buildings AS b
    WHERE gid IN(100, 103,150)
   ),
-- builds&#xc758; &#xacbd;&#xacc4;&#xc120;&#xc5d0; &#xb9de;&#xcdb0;  ↩
    &#xb798;&#xc2a4;&#xd130; &#xd0c0;&#xc77c;&#xc758; &#xbc34;&#xb4dc; 2&#xb97c;  ↩
    &#xc798;&#xb77c;&#xb0b8; &#xb2e4;&#xc74c;
-- &#xc774; &#xc798;&#xb77c;&#xb0b8; &#xc9c0;&#xc5ed;&#xc758; &#xd1b5;&#xacc4;&#xb97c;  ↩
    &#xc5bb;&#xc2b5;&#xb2c8;&#xb2e4;.
   b_stats AS
        (SELECT  building_id, (stats).*
FROM (SELECT building_id, ST_SummaryStats(ST_Clip(rast,2,geom)) As stats
    FROM aerials.boston
```

```
                INNER JOIN feat
        ON ST_Intersects(feat.geom,rast)
 ) As foo
 )
-- &#xb9c8;&#xc9c0;&#xb9c9;&#xc73c;&#xb85c; &#xd1b5;&#xacc4;&#xb97c;  ↩
    &#xc694;&#xc57d;&#xd569;&#xb2c8;&#xb2e4;.
SELECT building_id, SUM(count) As num_pixels
  , MIN(min) As min_pval
  ,  MAX(max) As max_pval
  , SUM(mean*count)/SUM(count) As avg_pval
        FROM b_stats
 WHERE count
> 0
        GROUP BY building_id
        ORDER BY building_id;
 building_id | num_pixels | min_pval | max_pval |     avg_pval
-------------+------------+----------+----------+------------------
         100 |       1090 |        1 |      255 | 61.0697247706422
         103 |        655 |        7 |      182 | 70.5038167938931
         150 |        895 |        2 |      252 | 185.642458100559
```

예시: 래스터 커버리지

```
-- &#xac01; &#xbc34;&#xb4dc;&#xc5d0; &#xb300;&#xd55c; &#xd1b5;&#xacc4; --
SELECT band, (stats).*
FROM (SELECT band, ST_SummaryStats('o_4_boston','rast', band) As stats
    FROM generate_series(1,3) As band) As foo;

 band |  count  |  sum   |       mean       |      stddev      | min | max
------+---------+--------+------------------+------------------+-----+-----
    1 | 8450000 | 725799 | 82.7064349112426 | 45.6800222638537 |   0 | 255
    2 | 8450000 | 700487 | 81.4197705325444 | 44.2161184161765 |   0 | 255
    3 | 8450000 | 575943 |  74.682739408284 | 44.2143885481407 |   0 | 255

-- &#xd14c;&#xc774;&#xbe14;&#xc758; &#xacbd;&#xc6b0;: &#xc0d8;&#xd50c;&#xb9c1;&#xc744; 100% ↩
     &#xbbf8;&#xb9cc;&#xc73c;&#xb85c; &#xc124;&#xc815;&#xd558;&#xba74;  ↩
    &#xc18d;&#xb3c4;&#xac00; &#xd5a5;&#xc0c1;&#xb429;&#xb2c8;&#xb2e4;.
-- &#xc774; &#xc608;&#xc2dc;&#xc5d0;&#xc11c;&#xb294; 25%&#xb85c;  ↩
    &#xc124;&#xc815;&#xd574;&#xc11c; &#xd6e8;&#xc52c; &#xbe68;&#xb9ac; &#xb2f5;&#xc744;  ↩
    &#xbc18;&#xd658;&#xbc1b;&#xc2b5;&#xb2c8;&#xb2e4;.
SELECT band, (stats).*
FROM (SELECT band, ST_SummaryStats('o_4_boston','rast', band,true,0.25) As stats
    FROM generate_series(1,3) As band) As foo;

 band |  count  |  sum   |       mean       |      stddev      | min | max
------+---------+--------+------------------+------------------+-----+-----
    1 | 2112500 | 180686 | 82.6890480473373 | 45.6961043857248 |   0 | 255
    2 | 2112500 | 174571 |  81.448503668639 | 44.2252623171821 |   0 | 255
    3 | 2112500 | 144364 | 74.6765884023669 | 44.2014869384578 |   0 | 255
```

참고

summarystats, ST_SummaryStatsAgg, ST_Count, ST_Clip

10.9.6 ST_SummaryStatsAgg

ST_SummaryStatsAgg — 종합 함수입니다. 래스터 집합의 입력 래스터 밴드의 count, sum, mean,

stddev, min, max로 이루어진 통계 요약을 반&#xd6
밴드를 따로 설정하지 않을 경우
밴드 1로 가정합니다.

Synopsis

summarystats **ST_SummaryStatsAgg**(raster rast, integer nband, boolean exclude_nodata_value, double precision sample_percent);
summarystats **ST_SummaryStatsAgg**(raster rast, boolean exclude_nodata_value, double precision sample_percent);
summarystats **ST_SummaryStatsAgg**(raster rast, integer nband, boolean exclude_nodata_value);

설명

입력한 래스터 밴드 또는 래스터
또는 래스터 커버리지의 count, sum, mean, stddev,
min, max로 이루어진 summarystats 을 반환합니다
밴드를 따로 설정하지 않을 경우
`nband` 의 기본값은 1입니다.

Note
기본적으로 `nodata` 값이 아닌 픽셀
값만 처리합니다. 모든 픽셀의
개수를 구하려면 `exclude_nodata_value` 를
거짓으로 설정하십시오.

Note
기본적으로 모든 픽셀을
샘플링할 것입니다. 더 빠른
ƍ도를 원한다면, `sample_percent` 를 0과 1
사이의 값으로 설정하십시오.

2.2.0 버전부터 사용할 수 있습니다.

예시

```
WITH foo AS (
        SELECT
                rast.rast
        FROM (
                SELECT ST_SetValue(
                        ST_SetValue(
                                ST_SetValue(
                                        ST_AddBand(
                                                ST_MakeEmptyRaster(10, 10, 10, 10, 2, 2, 0, ↩
                                                    0,0)
                                                , 1, '64BF', 0, 0
                                        )
                                        , 1, 1, 1, -10
                                )
                                , 1, 5, 4, 0
                        )
                        , 1, 5, 5, 3.14159
                ) AS rast
        ) AS rast
```

```
        FULL JOIN (
                SELECT generate_series(1, 10) AS id
        ) AS id
                ON 1 = 1
)
SELECT
        (stats).count,
        round((stats).sum::numeric, 3),
        round((stats).mean::numeric, 3),
        round((stats).stddev::numeric, 3),
        round((stats).min::numeric, 3),
        round((stats).max::numeric, 3)
FROM (
        SELECT
                ST_SummaryStatsAgg(rast, 1, TRUE, 1) AS stats
        FROM foo
) bar;

 count |  round   | round  | round |  round   | round
-------+----------+--------+-------+----------+-------
    20 | -68.584 | -3.429 | 6.571 | -10.000 | 3.142
(1 row)
```

참고

summarystats, ST_SummaryStats, ST_Count, ST_Clip

10.9.7 ST_ValueCount

ST_ValueCount — 설정한 값들의 집합을 가진 래스터(또는 래스터 커버리지)의 입력 밴드에 있는 픽셀 밴드 값 및 픽셀 개수의 집계를 담고 있는 레&#집합을 반환합니다. 밴드를 따로 설정하지 않을 경우 기본값은 밴&#x1입니다. 기본적으로 NODATA 값은 집계&#않습니다. 픽셀의 다른 모든 값들&#출력하는데, 픽셀 밴드 값은 가장 가까운 정수로 반올림됩니다.

Synopsis

SETOF record **ST_ValueCount**(raster rast, integer nband=1, boolean exclude_nodata_value=true, double precision[] searchvalues=NULL, double precision roundto=0, double precision OUT value, integer OUT count);
SETOF record **ST_ValueCount**(raster rast, integer nband, double precision[] searchvalues, double precision roundto=0, double precision OUT value, integer OUT count);
SETOF record **ST_ValueCount**(raster rast, double precision[] searchvalues, double precision roundto=0, double precision OUT value, integer OUT count);
bigint **ST_ValueCount**(raster rast, double precision searchvalue, double precision roundto=0);
bigint **ST_ValueCount**(raster rast, integer nband, boolean exclude_nodata_value, double precision searchvalue, double precision roundto=0);
bigint **ST_ValueCount**(raster rast, integer nband, double precision searchvalue, double precision roundto=0);
SETOF record **ST_ValueCount**(text rastertable, text rastercolumn, integer nband=1, boolean exclude_nodata_value=true, double precision[] searchvalues=NULL, double precision roundto=0, double precision OUT value, integer OUT count);
SETOF record **ST_ValueCount**(text rastertable, text rastercolumn, double precision[] searchvalues, double precision roundto=0, double precision OUT value, integer OUT count);

SETOF record **ST_ValueCount**(text rastertable, text rastercolumn, integer nband, double precision[] searchvalues, double precision roundto=0, double precision OUT value, integer OUT count);
bigint**ST_ValueCount**(text rastertable, text rastercolumn, integer nband, boolean exclude_nodata_value, double precision searchvalue, double precision roundto=0);
bigint **ST_ValueCount**(text rastertable, text rastercolumn, double precision searchvalue, double precision roundto=0);
bigint **ST_ValueCount**(text rastertable, text rastercolumn, integer nband, double precision searchvalue, double precision roundto=0);

설명

선택한 밴드의 래스터 타일 또는 래스터 커버리지에 있는 픽셀의 밴드 값 및 개수를 담고 있는 `value`, `count` 열을 가진 레코드 집합을 반환합&#x

밴드를 따로 설정하지 않을 경우 `nband` 의 기본값은 1입니다. `searchvalues` 를 설&#xc
않을 경우, 래스터 또는 래스터 커&
발견된 모든 픽셀 값을 반환할 것&#
`searchvalues` 를 하나만 설정하면, 레코드
대신 해당 픽셀 밴드 값을 가진 픽&
개수를 나타내는 정수를 반환할
것입니다.

> **Note**
> `exclude_nodata_value` 를 거짓으로 설정하면, NODATA 값의 픽셀도 집계할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
UPDATE dummy_rast SET rast = ST_SetBandNoDataValue(rast,249) WHERE rid=2;
-- &#xc774; &#xc608;&#xc2dc;&#xb294; &#xbc34;&#xb4dc; 1&#xc5d0;&#xc11c; &#xac12;&#xc774;  ↩
    249&#xac00; &#xc544;&#xb2cc; &#xd53d;&#xc140;&#xb4e4;&#xb9cc; &#xc9d1;&#xacc4;&#xd560;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --

SELECT (pvc).*
FROM (SELECT ST_ValueCount(rast) As pvc
    FROM dummy_rast WHERE rid=2) As foo
    ORDER BY (pvc).value;

 value | count
-------+-------
   250 |     2
   251 |     1
   252 |     2
   253 |     6
   254 |    12

-- &#xc774; &#xc608;&#xc2dc;&#xb294; &#xac12; 249&#xb97c; &#xd3ec;&#xd568;&#xd55c;  ↩
    &#xbc34;&#xb4dc; 1&#xc758; &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc744;  ↩
    &#xc9d1;&#xacc4;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --
SELECT (pvc).*
FROM (SELECT ST_ValueCount(rast,1,false) As pvc
    FROM dummy_rast WHERE rid=2) As foo
    ORDER BY (pvc).value;
```

```
 value | count
-------+-------
   249 |     2
   250 |     2
   251 |     1
   252 |     2
   253 |     6
   254 |    12

-- &#xc774; &#xc608;&#xc2dc;&#xb294; &#xbc34;&#xb4dc; 2 &#xac00;&#xc6b4;&#xb370; NODATA  ↩
    &#xac12;&#xc774; &#xc544;&#xb2cc; &#xd53d;&#xc140;&#xb4e4;&#xb9cc;  ↩
    &#xc9d1;&#xacc4;&#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --
SELECT (pvc).*
FROM (SELECT ST_ValueCount(rast,2) As pvc
    FROM dummy_rast WHERE rid=2) As foo
    ORDER BY (pvc).value;
 value | count
-------+-------
    78 |     1
    79 |     1
    88 |     1
    89 |     1
    96 |     1
    97 |     1
    98 |     1
    99 |     2
   112 |     2
:
```

```
-- &#xc2e4;&#xc81c; &#xc608;&#xc2dc;&#xc785;&#xb2c8;&#xb2e4;. &#xb3c4;&#xd615;&#xacfc;  ↩
    &#xad50;&#xcc28;&#xd558;&#xb294; &#xd56d;&#xacf5;&#xc0ac;&#xc9c4;  ↩
    &#xb798;&#xc2a4;&#xd130; &#xd0c0;&#xc77c;&#xc758; &#xbc34;&#xb4dc; 2&#xc5d0;  ↩
    &#xc788;&#xb294; &#xbaa8;&#xb4e0; &#xd53d;&#xc140;&#xc744; &#xc9d1;&#xacc4;&#xd55c;  ↩
    &#xb2e4;&#xc74c;
-- &#xac1c;&#xc218;&#xac00; 500&#xac1c;&#xb97c; &#xcd08;&#xacfc;&#xd558;&#xb294;  ↩
    &#xd53d;&#xc140; &#xbc34;&#xb4dc; &#xac12;&#xb9cc;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT (pvc).value, SUM((pvc).count) As total
FROM (SELECT ST_ValueCount(rast,2) As pvc
    FROM o_4_boston
        WHERE ST_Intersects(rast,
            ST_GeomFromText('POLYGON((224486 892151,224486 892200,224706 892200,224706  ↩
               892151,224486 892151))',26986)
             )
        ) As foo
    GROUP BY (pvc).value
    HAVING SUM((pvc).count)
> 500
    ORDER BY (pvc).value;

 value | total
-------+-----
    51 | 502
    54 | 521
```

```
-- &#xac01; &#xb798;&#xc2a4;&#xd130;&#xc5d0;&#xc11c; &#xd2b9;&#xc815;  ↩
    &#xb3c4;&#xd615;&#xacfc; &#xad50;&#xcc28;&#xd558;&#xb294; &#xd0c0;&#xc77c;  ↩
    &#xac00;&#xc6b4;&#xb370; &#xac12;&#xc774; 100&#xc778; &#xd53d;&#xc140;&#xc758;  ↩
    &#xac1c;&#xc218; &#xc9d1;&#xacc4;&#xb9cc; &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;. --
```

```
SELECT rid, ST_ValueCount(rast,2,100) As count
    FROM o_4_boston
        WHERE ST_Intersects(rast,
            ST_GeomFromText('POLYGON((224486 892151,224486 892200,224706 892200,224706  ↩
                892151,224486 892151))',26986)
             ) ;

 rid | count
-----+-------
   1 |    56
   2 |    95
  14 |    37
  15 |    64
```

참고

ST_Count, ST_SetBandNoDataValue

10.10 Raster Inputs

10.10.1 ST_RastFromWKB

ST_RastFromWKB — Return a raster value from a Well-Known Binary (WKB) raster.

Synopsis

raster **ST_RastFromWKB**(bytea wkb);

설명

Given a Well-Known Binary (WKB) raster, return a raster.

Availability: 2.5.0

예시

```
SELECT (ST_Metadata(
    ST_RastFromWKB(
        '\001\000\000\000\000\000\000\000\000\000\000@\000\000\000\000\000\000\010@ ↩
            \000\000\000\000\000\000\340?\000\000\000\000\000\000\340?\000\000\000\000\000\000\000\0
            bytea
    )
)).* AS metadata;

 upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
    numbands
------------+------------+-------+--------+--------+--------+-------+-------+------+---------- ↩

        0.5 |        0.5 |    10 |     20 |      2 |      3 |     0 |     0 |   10 |  ↩
                  0
```

참고

ST_MetaData, ST_RastFromHexWKB, ST_AsBinary/ST_AsWKB, ST_AsHexWKB

10.10.2 ST_RastFromHexWKB

ST_RastFromHexWKB — Return a raster value from a Hex representation of Well-Known Binary (WKB) raster.

Synopsis

raster **ST_RastFromHexWKB**(text wkb);

설명

Given a Well-Known Binary (WKB) raster in Hex representation, return a raster.

Availability: 2.5.0

예시

```
SELECT rid, (foo.md).*
 FROM (SELECT rid, ST_MetaData(rast) As md
FROM dummy_rast) As foo;

 rid | upperleftx | upperlefty | width | height | scalex | scaley | skewx | skewy | srid |  ↩
    numbands
 ----+------------+------------+-------+--------+--------+-----------+-------+-------+------+-------

   1 |        0.5 |        0.5 |    10 |     20 |      2 |       3 |                0 |      ↩
      0 |    0 |        0
   2 | 3427927.75 |    5793244 |     5 |      5 |   0.05 |  -0.05 |                0 |      ↩
      0 |    0 |        3
```

참고

ST_MetaData, ST_RastFromWKB, ST_AsBinary/ST_AsWKB, ST_AsHexWKB

10.11 래스터 출력

10.11.1 ST_AsBinary/ST_AsWKB

ST_AsBinary/ST_AsWKB — Return the Well-Known Binary (WKB) representation of the raster.

Synopsis

bytea **ST_AsBinary**(raster rast, boolean outasin=FALSE);
bytea **ST_AsWKB**(raster rast, boolean outasin=FALSE);

설명

Returns the Binary representation of the raster. If `outasin` is TRUE, out-db bands are treated as in-db. Refer to raster/doc/RFC2-WellKnownBinaryFormat located in the PostGIS source folder for details of the representation.

이 함수는 데이터베이스로부터 데이터를 문자열 표현식으로 변&#x 않고 추출하는 바이너리 커서에 유용합니다.

Note

기본적으로, WKB 출력물은 DB 외부 밴드를 가리키는 외부 파일 경로를 담고 있습니다. 클라이언트가 DB 외부 밴드의 기저 래스터 파일에 접근하지 못 하는 경우, `outasin` 을 참으로 설정하십시오.

개선 사항: 2.1.0버전에서 `outasin` 이 추가&#xb4

Enhanced: 2.5.0 Addition of `ST_AsWKB`

예시

```
SELECT ST_AsBinary(rast) As rastbin FROM dummy_rast WHERE rid=1;

                     rastbin
---------------------------------------------------------------------------
\001\000\000\000\000\000\000\000\000\000\000@\000\000\000\000\000\000\010@ ↩
    \000\000\000\000\000\000\340?\000\000\000\000\000\000\340?\000\000\000\000\000\000\000\000\000\0
```

참고

ST_RastFromWKB, ST_AsHexWKB

10.11.2 ST_AsHexWKB

ST_AsHexWKB — Return the Well-Known Binary (WKB) in Hex representation of the raster.

Synopsis

bytea **ST_AsHexWKB**(raster rast, boolean outasin=FALSE);

설명

Returns the Binary representation in Hex representation of the raster. If `outasin` is TRUE, out-db bands are treated as in-db. Refer to raster/doc/RFC2-WellKnownBinaryFormat located in the PostGIS source folder for details of the representation.

Note

By default, Hex WKB output contains the external file path for out-db bands. If the client does not have access to the raster file underlying an out-db band, set `outasin` to TRUE.

Availability: 2.5.0

예시

```
SELECT ST_AsHexWKB(rast) As rastbin FROM dummy_rast WHERE rid=1;

                                                        st_ashexwkb
------------------------------------------------------------------------------------------------------------------------

 01000000000000000000000040000000000000084000000000000000 ↩
    E03F000000000000E03F0000000000000000000000000000000000A0000000A001400
```

참고

ST_RastFromHexWKB, ST_AsBinary/ST_AsWKB

10.11.3 ST_AsGDALRaster

ST_AsGDALRaster — Return the raster tile in the designated GDAL Raster format. Raster formats are one of those supported by your compiled library. Use ST_GDALDrivers() to get a list of formats supported by your library.

Synopsis

bytea **ST_AsGDALRaster**(raster rast, text format, text[] options=NULL, integer srid=sameassource);

설명

래스터 타일을 지정한 형식으로
반환합니다. 인수들은 다음과 같&#

- `format` - 출력할 형식입니다. 사용자의
  LibGDAL 라이브러리에 컴파일된 드라&#
  따라 달라질 수 있습니다. 일반적&
  사용할 수 있는 형식은 'JPEG', 'GTiff', 'PNG'입&#xb2
  사용자 라이브러리가 지원하는
  형식들의 목록을 보려면 ST_GDALDrivers 함&#
  이용하십시오.
- `options` - GDAL 옵션들의 텍스트 배열입니&#
  형식에 따라 유효한 옵션들이 달&
  자세한 내용은 GDAL 래스터 형식 옵&#
  을 참조하십시오.
- `srs` - 이미지 파일에 임베딩할 proj4text 또&#xb2
  (spatial_ref_sys에서 가져온) srtext입니다.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.0 이상 버전이 필요합니다.

JPEG Output Example, multiple tiles as single raster

```
SELECT ST_AsGDALRaster(ST_Union(rast), 'JPEG', ARRAY['QUALITY=50']) As rastjpg
FROM dummy_rast
WHERE rast && ST_MakeEnvelope(10, 10, 11, 11);
```

Using PostgreSQL Large Object Support to export raster

One way to export raster into another format is using PostgreSQL large object export functions. We'lll repeat the prior example but also exporting. Note for this you'll need to have super user access to db since it uses server side lo functions. It will also export to path on server network. If you need export locally, use the psql equivalent lo_ functions which export to the local file system instead of the server file system.

```
DROP TABLE IF EXISTS tmp_out ;

CREATE TABLE tmp_out AS
SELECT lo_from_bytea(0,
       ST_AsGDALRaster(ST_Union(rast), 'JPEG', ARRAY['QUALITY=50'])
        ) AS loid
  FROM dummy_rast
WHERE rast && ST_MakeEnvelope(10, 10, 11, 11);

SELECT lo_export(loid, '/tmp/dummy.jpg')
   FROM tmp_out;

SELECT lo_unlink(loid)
  FROM tmp_out;
```

GeoTiff 출력 예시

```
SELECT ST_AsGDALRaster(rast, 'GTiff') As rastjpg
FROM dummy_rast WHERE rid=2;

-- JPEG &#xc555;&#xcd95;&#xd55c; GeoTiff&#xb97c; 90% &#xd488;&#xc9c8;&#xb85c; &#xcd9c;&#xb825;
SELECT ST_AsGDALRaster(rast, 'GTiff',
  ARRAY['COMPRESS=JPEG', 'JPEG_QUALITY=90'],
  4269) As rasttiff
FROM dummy_rast WHERE rid=2;
```

참고

Section 9.3, ST_GDALDrivers, ST_SRID

10.11.4 ST_AsJPEG

ST_AsJPEG — 래스터 타일에서 선택한 밴&#xb4
단일 JPEG(Joint Photographic Exports Group) 이미지(바이트 배&
반환합니다. 밴드를 따로 설정하&
않거나, 밴드가 1개거나 또는 3개를
초과할 경우 첫 번째 밴드를 씁니&#x
밴드가 3개뿐일 경우 밴드 3개를 모&
써서 RGB에 매핑시킵니다.

Synopsis

bytea **ST_AsJPEG**(raster rast, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer nband, integer quality);
bytea **ST_AsJPEG**(raster rast, integer nband, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer[] nbands, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer[] nbands, integer quality);

설명

래스터에서 선택한 밴드들을 단&#
JPEG(Joint Photographic Exports Group) 이미지로 반환합니다.
덜 흔한 래스터 유형으로 내보내&#
할 경우 ST_AsGDALRaster 함수를 이용하십시&#
밴드를 따로 설정하지 않거나, 밴&#
1개거나 또는 3개를 초과할 경우 &#xc-
cab; 번째 밴드만 씁니다. 밴드가 3개&#xc7
경우 밴드 3개를 모두 씁니다. 이
함수에는 다음과 같은 많은 옵션&#x
가진 많은 변종이 있습니다.

- `nband` - 단일 밴드 내보내기를 위한 옵&
- `nbands` - 내보낼 밴드들의 배열입니다(J
  경우 3이 최대값입니다). 밴드의
  순서는 RGB입니다. 예를 들어 ARRAY[3,2,1]은
  밴드 3을 빨간색, 밴드 2를 초록색,
  밴드 1을 파란색에 매핑한다는 &#xb73b
- `quality` - 1부터 100까지의 숫자입니다. 숫&#
  높을수록 이미지가 선명해집니&
- `options` - JPEG에 대해 정의된 GDAL 옵션들의
  텍스트 배열입니다(ST_GDALDrivers에서 JPEG&#xc5c
  대한 create_options를 살펴보십시오). JPEG의
  경우, 유효한 옵션은 `PROGRESSIVE` ON/OFF 및 기&#x
  75이고 0부터 100까지의 범위에서 설&#
  수 있는 `QUALITY` 입니다. 자세한 내용&#xc740
  GDAL 래스터 형식 옵션 을 참조하십&#

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.0 이상 버전이 필요합니다.

예시: 출력

```
-- &#xcc98;&#xc74c; &#xbc34;&#xb4dc; 3&#xac1c;&#xb97c; 75% &#xd488;&#xc9c8;&#xb85c;  ↩
    &#xcd9c;&#xb825;
SELECT ST_AsJPEG(rast) As rastjpg
    FROM dummy_rast WHERE rid=2;

-- &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb9cc; 90% &#xd488;&#xc9c8;&#xb85c;  ↩
    &#xcd9c;&#xb825;
SELECT ST_AsJPEG(rast,1,90) As rastjpg
    FROM dummy_rast WHERE rid=2;

-- &#xcc98;&#xc74c; &#xbc34;&#xb4dc; 3&#xac1c;&#xb97c; &#xcd9c;&#xb825;(&#xbc34;&#xb4dc; 2 ↩
    &#xb97c; &#xbe68;&#xac15;, &#xbc34;&#xb4dc; 1&#xc744; &#xb179;&#xc0c9;,  ↩
    &#xbc34;&#xb4dc; 3&#xc744; &#xd30c;&#xb791;&#xc73c;&#xb85c; &#xd558;&#xace0; PROGRESSIVE ↩
     = ON, &#xd488;&#xc9c8;&#xc740; 90%)
SELECT ST_AsJPEG(rast,ARRAY[2,1,3],ARRAY['QUALITY=90','PROGRESSIVE=ON']) As rastjpg
    FROM dummy_rast WHERE rid=2;
```

참고

Section 9.3, ST_GDALDrivers, ST_AsGDALRaster, ST_AsPNG, ST_AsTIFF

10.11.5 ST_AsPNG

ST_AsPNG — 래스터 타일에서 선택한 밴&#xb4d
단일 PNG(Portable Network Graphics) 이미지(바이트 배열
반환합니다. 래스터의 밴드가 1개,
3개, 또는 4개이거나 따로 설정하지
않을 경우 모든 밴드를 씁니다. 밴&
2개 또는 4개를 초과하며 따로 설정&
않을 경우, 밴드 1만 씁니다. 밴드를
RGB 또는 RGBA 스페이스에 매핑합니다.

Synopsis

bytea **ST_AsPNG**(raster rast, text[] options=NULL);
bytea **ST_AsPNG**(raster rast, integer nband, integer compression);
bytea **ST_AsPNG**(raster rast, integer nband, text[] options=NULL);
bytea **ST_AsPNG**(raster rast, integer[] nbands, integer compression);
bytea **ST_AsPNG**(raster rast, integer[] nbands, text[] options=NULL);

설명

래스터에서 선택한 밴드들을 단&#
PNG(Portable Network Graphics) 이미지로 반환합니다. &#xb35c
흔한 래스터 유형으로 내보내야
할 경우 ST_AsGDALRaster 함수를 이용하십시&#
밴드를 따로 설정하지 않을 경우,
처음 3개의 밴드를 내보냅니다. `srid`
를 따로 설정하지 않으면 래스터&#
SRID를 사용합니다. 이 함수에는 다&#xc7
같은 많은 옵션을 가진 많은 변종&#
있습니다:

- `nband` - 단일 밴드 내보내기를 위한 옵&
- `nbands` - 내보낼 밴드들의 배열입니다(P
  경우 4가 최대값입니다). 밴드의
  순서는 RGBA입니다. 예를 들어 ARRAY[3,2,1]&#xc74
  밴드 3을 빨간색, 밴드 2를 초록색,
  밴드 1을 파란색에 매핑한다는 &#xb73b
- `compression` - 1부터 9까지의 숫자입니다. 숫
  높을수록 압축률도 높아집니다.
- `options` - PNG에 대해 정의된 GDAL 옵션들의
  텍스트 배열입니다(ST_GDALDrivers에서 PNG&#xc5d
  대한 create_options를 살펴보십시오). PNG의 경
  유효한 옵션은 ZLEVEL(압축에 소비할
  시간 - 기본값은 6)뿐으로, 예를 들&#xc5b4
  ARRAY['ZLEVEL=9']처럼 쓰입니다. 이 함수는
  출력물 2개를 출력해야 하기 때문
  월드 파일을 사용할 수는 없습니&
  자세한 내용은 GDAL 래스터 형식 옵&#
  을 참조하십시오.

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.0 이상 버전이 필요합니다.

예시

```
SELECT ST_AsPNG(rast) As rastpng
FROM dummy_rast WHERE rid=2;

-- &#xcc98;&#xc74c; 3&#xac1c;&#xc758; &#xbc34;&#xb4dc;&#xb97c;  ↩
    &#xb0b4;&#xbcf4;&#xb0b4;&#xc11c; &#xbc34;&#xb4dc; 3&#xc744; &#xbe68;&#xac15;,  ↩
    &#xbc34;&#xb4dc; 1&#xc744; &#xb179;&#xc0c9;, &#xbc34;&#xb4dc; 2&#xb97c;  ↩
    &#xd30c;&#xb791;&#xc73c;&#xb85c; &#xb9e4;&#xd551;
SELECT ST_AsPNG(rast, ARRAY[3,1,2]) As rastpng
FROM dummy_rast WHERE rid=2;
```

참고

ST_AsGDALRaster, ST_ColorMap, ST_GDALDrivers, Section 9.3

10.11.6 ST_AsTIFF

ST_AsTIFF — Return the raster selected bands as a single TIFF image (byte array). If no band is specified or any of specified bands does not exist in the raster, then will try to use all bands.

Synopsis

bytea **ST_AsTIFF**(raster rast, text[] options='', integer srid=sameassource);
bytea **ST_AsTIFF**(raster rast, text compression='', integer srid=sameassource);
bytea **ST_AsTIFF**(raster rast, integer[] nbands, text compression='', integer srid=sameassource);
bytea **ST_AsTIFF**(raster rast, integer[] nbands, text[] options, integer srid=sameassource);

설명

래스터에서 선택한 밴드들을 단&#
TIFF(Tagged Image File Format) 이미지로 반환합니다. 밴
따로 설정하지 않을 경우, 모든 밴&
쓰려 할 것입니다. 이 함수는 ST_AsGDALRaster
를 둘러싼 래퍼입니다. 덜 흔한 래&
유형으로 내보내야 할 경우 ST_AsGDALRaster
함수를 이용하십시오. 어떤 공간
참조 SRS 텍스트도 없을 경우, 래스&#xd13
공간 참조를 사용합니다. 이 함수&#
다음과 같은 많은 옵션을 가진 많&#x
변종이 있습니다:

- `nbands` - 내보낼 밴드들의 배열입니다(P
  경우 3이 최대값입니다). 밴드의
  순서는 RGB입니다. 예를 들어 ARRAY[3,2,1]은
  밴드 3을 빨간색, 밴드 2를 초록색,
  밴드 1을 파란색에 매핑한다는 &#xb73b
- `compression` - 압축 표현식: JPEG90(또는 다른 퍼&
  LZW, JPEG, DEFLATE9
- `options` - GTiff에 대해 정의된 GDAL 생성 옵션&#xb
  텍스트 배열입니다(ST_GDALDrivers에서 GTiff&#xc5d
  대한 create_options를 살펴보십시오). 자세&#xd
  내용은 GDAL 래스터 형식 옵션 을 참&#

- `srid` - 래스터의 spatial_ref_sys의 SRID입니다. 이 옵&
  지리참조 정보를 채우는 데 쓰입&

2.0.0 버전부터 사용할 수 있습니다.
GDAL 1.6.0 이상 버전이 필요합니다.

예시: JPEG 압축 90%

```
SELECT ST_AsTIFF(rast, 'JPEG90') As rasttiff
FROM dummy_rast WHERE rid=2;
```

참고

ST_GDALDrivers, ST_AsGDALRaster, ST_SRID

10.12 래스터 공간 처리

10.12.1 ST_Clip

ST_Clip — 입력 도형으로 잘라낸 래스터&
반환합니다. 밴드 번호를 지정하&#
않은 경우, 모든 밴드를 처리합니&#
`crop` 을 설정하지 않거나 참으로 설&#xc8
경우, 잘라낸 래스터를 출력합니&#

Synopsis

raster **ST_Clip**(raster rast, integer[] nband, geometry geom, double precision[] nodataval=NULL, boolean crop=TRUE);
raster **ST_Clip**(raster rast, integer nband, geometry geom, double precision nodataval, boolean crop=TRUE);
raster **ST_Clip**(raster rast, integer nband, geometry geom, boolean crop);
raster **ST_Clip**(raster rast, geometry geom, double precision[] nodataval=NULL, boolean crop=TRUE);
raster **ST_Clip**(raster rast, geometry geom, double precision nodataval, boolean crop=TRUE);
raster **ST_Clip**(raster rast, geometry geom, boolean crop);

설명

입력 도형 `geom` 으로 잘라낸 래스터&#xb
반환합니다. 밴드 인덱스를 지정&
않을 경우, 모든 밴드를 처리합니&

ST_Clip이 출력한 래스터는 각 밴드에
대해 잘라낸 면에 할당된 NODATA 값을
가지고 있어야 합니다. NODATA 값을 설&
않고 입력 래스터에 정의된 NODATA 값&
없을 경우, 출력 래스터의 NODATA 값을
ST_MinPossibleValue(ST_BandPixelType(rast, band))로 설정합니다. 배&#xc5f4
내부의 NODATA 값의 개수가 밴드 개수&
작을 경우, 배열 안의 마지막 NODATA 값&
남은 밴드의 NODATA 값으로 씁니다. NO-
DATA 값의 개수가 밴드 개수보다 클
경우, 남는 NODATA 값을 무시합니다. NO-
DATA 값의 배열을 입력받는 모든 변&#xc8

함수는 각 밴드에 할당될 단일 값&#
입력받습니다.

`crop` 을 설정하지 않을 경우, 참으로
가정합니다. `geom` 범위와 `rast` 범위가
교차하는 부분을 잘라낸 래스터&#
출력한다는 의미입니다. `crop` 을 거&#xc9
설정할 경우, 새 래스터의 범위는
`rast` 의 범위와 동일합니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 C 언어로 다&#xc
쓰였습니다.

이 예시는 MassGIS 사이트의 MassGIS Aerial Orthos 에서
다운로드할 수 있는 매사추세츠
항공사진 데이터를 이용합니다.
매사추세츠 주 미터 단위 평면의
좌표로 돼 있습니다.

예시: 밴드 1개 잘라내기

```
-- &#xd56d;&#xacf5;&#xc0ac;&#xc9c4; &#xd0c0;&#xc77c;&#xc758; &#xccab; &#xbc88;&#xc9f8;  ↩
    &#xbc34;&#xb4dc;&#xb97c; 20&#xbbf8;&#xd130; &#xbc84;&#xd37c;&#xb85c;  ↩
    &#xc798;&#xb77c;&#xb0b4;&#xae30;
SELECT ST_Clip(rast, 1,
                ST_Buffer(ST_Centroid(ST_Envelope(rast)),20)
        ) from aerials.boston
WHERE rid = 4;
```

```
-- &#xb798;&#xc2a4;&#xd130;&#xc758; &#xb9c8;&#xc9c0;&#xb9c9; &#xcc28;&#xc6d0;&#xc5d0;  ↩
    &#xb300;&#xd55c; &#xc798;&#xb77c;&#xb0b4;&#xae30;&#xc758; &#xc601;&#xd5a5;&#xc744;  ↩
    &#xbcf4;&#xc5ec;&#xc90d;&#xb2c8;&#xb2e4;.
-- &#xb9c8;&#xc9c0;&#xb9c9; &#xbc94;&#xc704;&#xb97c; &#xc5b4;&#xb5bb;&#xac8c;  ↩
    &#xb3c4;&#xd615;&#xc758; &#xbc94;&#xc704;&#xb85c;  ↩
    &#xc798;&#xb77c;&#xb0b4;&#xb294;&#xc9c0; &#xb208;&#xc5ec;&#xaca8;  ↩
    &#xbcf4;&#xc2ed;&#xc2dc;&#xc624;.
-- crop = true &#xc77c; &#xacbd;&#xc6b0;
SELECT ST_XMax(ST_Envelope(ST_Clip(rast, 1, clipper, true))) As xmax_w_trim,
        ST_XMax(clipper) As xmax_clipper,
        ST_XMax(ST_Envelope(ST_Clip(rast, 1, clipper, false))) As xmax_wo_trim,
        ST_XMax(ST_Envelope(rast)) As xmax_rast_orig
FROM (SELECT rast, ST_Buffer(ST_Centroid(ST_Envelope(rast)),6) As clipper
        FROM aerials.boston
WHERE rid = 6) As foo;

   xmax_w_trim    |   xmax_clipper    |   xmax_wo_trim    |  xmax_rast_orig
------------------+------------------+------------------+------------------
 230657.436173996 | 230657.436173996 | 230666.436173996 | 230666.436173996
```

 잘라내기 전의 전체 래스터 타일	 *잘라낸 후*

**예시: crop 없이 밴드 1개를 잘라낸 다&#xc
다른 밴드들을 변경 없이 다시 추&#**

```
-- &#xc774;&#xc804;&#xacfc; &#xb3d9;&#xc77c;&#xd55c; &#xc608;&#xc2dc;&#xc9c0;&#xb9cc;,  ↩
    ST_AddBand&#xb97c; &#xc0ac;&#xc6a9;&#xd560; &#xc218; &#xc788;&#xc73c;&#xb824;&#xba74;  ↩
    crop&#xc744; &#xac70;&#xc9d3;&#xc73c;&#xb85c; &#xc124;&#xc815;&#xd574;&#xc57c;  ↩
    &#xd569;&#xb2c8;&#xb2e4;.
-- ST_AddBand &#xd568;&#xc218;&#xb97c; &#xc4f0;&#xb824;&#xba74; &#xbaa8;&#xb4e0;  ↩
    &#xbc34;&#xb4dc;&#xc758; &#xb108;&#xbe44; &#xbc0f; &#xb192;&#xc774;&#xac00;  ↩
    &#xb3d9;&#xc77c;&#xd574;&#xc57c; &#xd558;&#xae30;  ↩
    &#xb54c;&#xbb38;&#xc785;&#xb2c8;&#xb2e4;.
SELECT ST_AddBand(ST_Clip(rast, 1,
                ST_Buffer(ST_Centroid(ST_Envelope(rast)),20),false
        ), ARRAY[ST_Band(rast,2),ST_Band(rast,3)] ) from aerials.boston
WHERE rid = 6;
```

 잘라내기 전의 전체 래스터 타일	 *잘라낸 후 - 비현실적*

예시: 모든 밴드 잘라내기

```
-- &#xd56d;&#xacf5;&#xc0ac;&#xc9c4; &#xd0c0;&#xc77c;&#xc758; &#xbaa8;&#xb4e0;  ↩
    &#xbc34;&#xb4dc;&#xb97c; 20&#xbbf8;&#xd130; &#xbc84;&#xd37c;&#xb85c;  ↩
    &#xc798;&#xb77c;&#xb0b4;&#xae30;
-- &#xcc28;&#xc774;&#xc810;&#xc774;&#xb77c;&#xba74; &#xc798;&#xb77c;&#xb0bc;  ↩
    &#xd2b9;&#xc815; &#xbc34;&#xb4dc;&#xb97c; &#xc9c0;&#xc815;&#xd558;&#xc9c0;  ↩
    &#xc54a;&#xb294;&#xb2e4;&#xb294; &#xc810;&#xbfd0;&#xc785;&#xb2c8;&#xb2e4;.
-- &#xb530;&#xb77c;&#xc11c; &#xbaa8;&#xb4e0; &#xbc34;&#xb4dc;&#xb97c;  ↩
    &#xc798;&#xb77c;&#xb0c5;&#xb2c8;&#xb2e4;.
SELECT ST_Clip(rast,
          ST_Buffer(ST_Centroid(ST_Envelope(rast)), 20),
          false
        ) from aerials.boston
WHERE rid = 4;
```

잘라내기 전의 전체 래스터 타일	*잘라낸 후*

참고

ST_AddBand, 내장 맵 대수 콜백 함수, ST_Intersection

10.12.2 ST_ColorMap

ST_ColorMap — 소스 래스터 및 설정한 밴드&#xb
8BUI 밴드(grayscale, RGB, RGBA)를 4개까지 가지는 새
래스터를 생성합니다. 밴드를 따&
설정하지 않으면 밴드 1로 가정합&

Synopsis

raster **ST_ColorMap**(raster rast, integer nband=1, text colormap=grayscale, text method=INTERPOLATE);

raster **ST_ColorMap**(raster rast, text colormap, text method=INTERPOLATE);

설명

`rast` 의 `nband` 위치의 밴드에 `colormap` 을 적용&#xd5
8BUI 밴드 4개까지로 구성된 새 래스&#xd1
출력합니다. `colormap` 안에 정의된 색상
구성 요소의 개수가 새 래스터의
8BUI 밴드 개수를 결정합니다.

`nband` 를 설정하지 않을 경우, 밴드 1로
가정합니다.

미리 정의된 컬러맵의 키워드, 또&#
값 및 색상 구성 요소를 정의하는
라인 집합이 `colormap` 이 될 수 있습니다

유효한 미리 정의된 `colormap` 키워드:

- `grayscale` 또는 `greyscale` - 8BUI 밴드 래스터의 회&#xc
of gray)를 설정

- `pseudocolor` - 8BUI(RGBA) 밴드 4개의 래스터에 대&#xd5
파랑에서 녹색으로, 녹색에서 빨&
변하는 색상을 설정

- `fire` - 8BUI(RGBA) 밴드 4개의 래스터에 대해
검정에서 빨강으로, 빨강에서 연&
노랑으로 변하는 색상을 설정

- `bluered` - 8BUI(RGBA) 밴드 4개의 래스터에 대해
파랑에서 연한 하양으로, 연한 하&
빨강으로 변하는 색상을 설정

사용자 지정 컬러맵을 설정하려&#x
사용자가 `colormap` 에 (한 줄에 하나씩
작성한) 항목들의 집합을 입력할
수 있습니다. 각 항목은 일반적으&
다음 5개의 값으로 구성됩니다. 픽&
값과 해당 픽셀의 빨강, 녹색, 파랑,
알파 구성 요소(RGBA)입니다(색상 구&#x
요소는 0부터 255 사이의 값입니다).
픽셀 값 대신 해당 래스터 밴드의
최소/최대값이 0/100%인 백분율 값을
쓸 수도 있습니다. 각 값을 쉼표, 탭,
쌍점, 그리고/또는 공백으로 구분&#x
수 있습니다. 픽셀 값이 NODATA 값일 경&
nv, *null* 또는 *nodata* 로 설정할 수 있습니다.
다음은 그 예시입니다.

```
5 0 0 0 255
4 100:50 55 255
1 150,100 150 255
0% 255 255 255 255
nv 0 0 0 0
```

`colormap` 의 문법은 GDAL의 색상 강조(color-relief) 모&
gdaldem 의 문법과 유사합니다.

유효한 `method` 키워드:

- `INTERPOLATE` - 입력한 픽셀 값들 사이의 색&#
부드럽게 섞여들게 하기 위해 선&
보간법을 이용합니다.

- `EXACT` - 컬러맵에 존재하는 픽셀 값과&#x
엄격히 매칭시킵니다. 컬러맵 항&
일치하지 않는 값을 가진 픽셀은
0 0 0 0(RGBA)으로 설정할 것입니다.

- `NEAREST` - 픽셀 값과 가장 가까운 값을
가진 컬러맵 항목을 이용합니다.

Note

컬러맵에 대해서는 ColorBrewer 를
참조하면 좋습니다.

Warning

그 결과 새 래스터의 밴드들은 NODATA 값을 가지지 않을 것입니다. NODATA 값이 필요하다면 ST_SetBandNoDataValue 를 이용해서 NODATA 값을 설정하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

다음은 예시용 가짜 테이블입니&#x

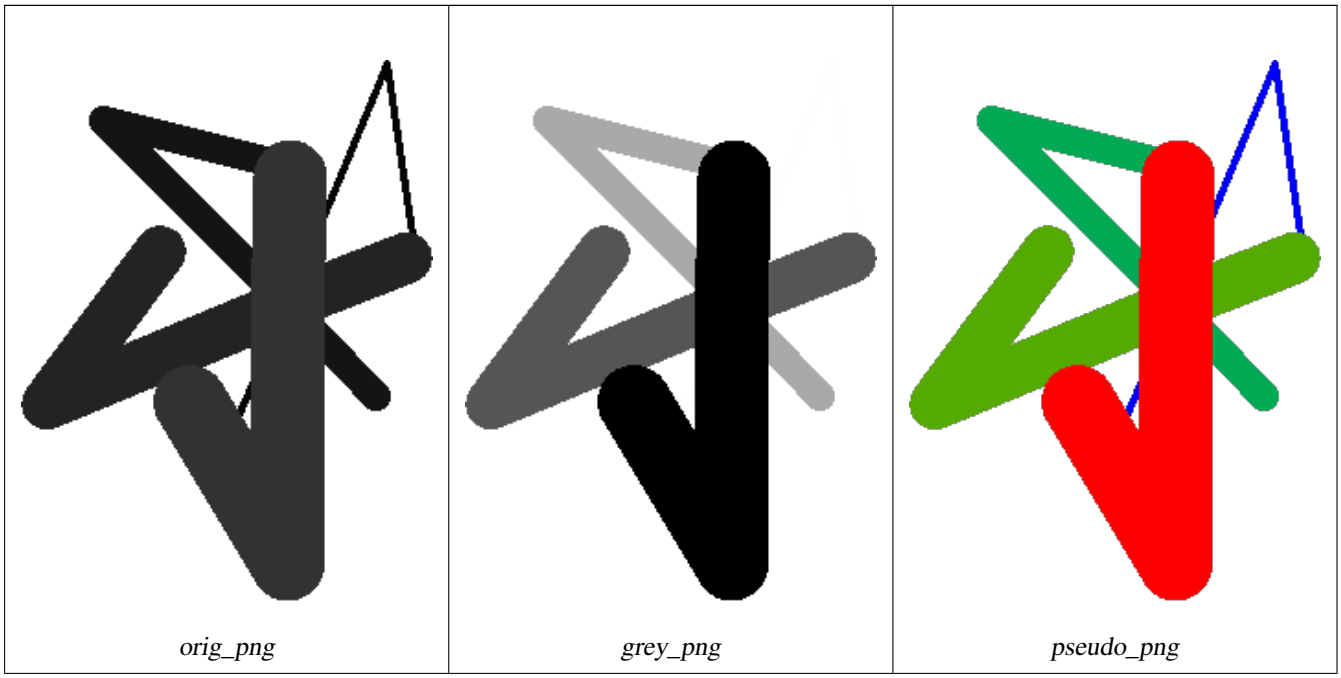
```
-- &#xd14c;&#xc2a4;&#xd2b8; &#xb798;&#xc2a4;&#xd130; &#xd14c;&#xc774;&#xbe14;  ↩
    &#xc791;&#xc131; --
DROP TABLE IF EXISTS funky_shapes;
CREATE TABLE funky_shapes(rast raster);

INSERT INTO funky_shapes(rast)
WITH ref AS (
        SELECT ST_MakeEmptyRaster( 200, 200, 0, 200, 1, -1, 0, 0) AS rast
)
SELECT
        ST_Union(rast)
FROM (
        SELECT
                ST_AsRaster(
                        ST_Rotate(
                                ST_Buffer(
                                        ST_GeomFromText('LINESTRING(0 2,50 50,150 150,125  ↩
                                            50)'),
                                        i*2
                                ),
                                pi() * i * 0.125, ST_Point(50,50)
                        ),
                        ref.rast, '8BUI'::text, i * 5
                ) AS rast
        FROM ref
        CROSS JOIN generate_series(1, 10, 3) AS i
) AS shapes;
```

```
SELECT
        ST_NumBands(rast) As n_orig,
        ST_NumBands(ST_ColorMap(rast,1, 'greyscale')) As ngrey,
        ST_NumBands(ST_ColorMap(rast,1, 'pseudocolor')) As npseudo,
        ST_NumBands(ST_ColorMap(rast,1, 'fire')) As nfire,
        ST_NumBands(ST_ColorMap(rast,1, 'bluered')) As nbluered,
        ST_NumBands(ST_ColorMap(rast,1, '
100% 255   0   0
 80% 160   0   0
 50% 130   0   0
 30%  30   0   0
 20%  60   0   0
  0%   0   0   0
  nv 255 255 255
        ')) As nred
FROM funky_shapes;
```

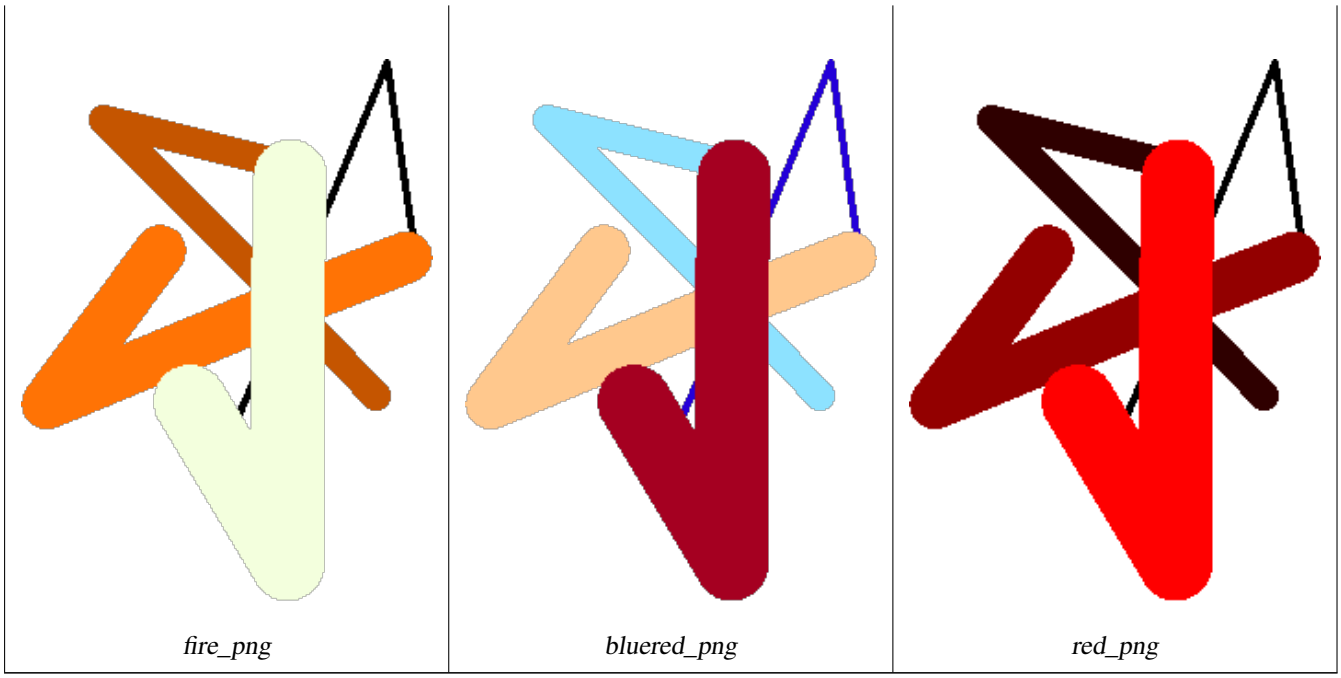
```
n_orig | ngrey | npseudo | nfire | nbluered | nred
--------+-------+---------+-------+----------+------
      1 |     1 |       4 |     4 |        4 |    3
```

예시: ST_AsPNG를 이용해서 서로 다른 컬외양을 비교하기

```
SELECT
        ST_AsPNG(rast) As orig_png,
        ST_AsPNG(ST_ColorMap(rast,1,'greyscale')) As grey_png,
        ST_AsPNG(ST_ColorMap(rast,1, 'pseudocolor')) As pseudo_png,
        ST_AsPNG(ST_ColorMap(rast,1, 'nfire')) As fire_png,
        ST_AsPNG(ST_ColorMap(rast,1, 'bluered')) As bluered_png,
        ST_AsPNG(ST_ColorMap(rast,1, '
100% 255   0   0
 80% 160   0   0
 50% 130   0   0
 30%  30   0   0
 20%  60   0   0
  0%   0   0   0
  nv 255 255 255
        ')) As red_png
FROM funky_shapes;
```



orig_png | *grey_png* | *pseudo_png*



fire_png | *bluered_png* | *red_png*

참고

ST_AsPNG, ST_AsRaster 내장 맵 대수 콜백 함수, ST_Grayscale ST_NumBands, ST_Reclass, ST_SetBandNoDataValue, ST_Union

10.12.3 ST_Grayscale

ST_Grayscale — Creates a new one-8BUI band raster from the source raster and specified bands representing Red, Green and Blue

Synopsis

(1) raster **ST_Grayscale**(raster rast, integer redband=1, integer greenband=2, integer blueband=3, text extenttype=INTERSECTION);

(2) raster **ST_Grayscale**(rastbandarg[] rastbandargset, text extenttype=INTERSECTION);

설명

Create a raster with one 8BUI band given three input bands (from one or more rasters). Any input band whose pixel type is not 8BUI will be reclassified using ST_Reclass.

Note
This function is not like ST_ColorMap with the `grayscale` keyword as ST_ColorMap operates on only one band while this function expects three bands for RGB. This function applies the following equation for converting RGB to Grayscale: 0.2989 * RED + 0.5870 * GREEN + 0.1140 * BLUE

Availability: 2.5.0

예시: 변종 1

```
SET postgis.gdal_enabled_drivers = 'ENABLE_ALL';
SET postgis.enable_outdb_rasters = True;

WITH apple AS (
    SELECT ST_AddBand(
        ST_MakeEmptyRaster(350, 246, 0, 0, 1, -1, 0, 0, 0),
        '/tmp/apple.png'::text,
        NULL::int[]
    ) AS rast
)
SELECT
    ST_AsPNG(rast) AS original_png,
    ST_AsPNG(ST_Grayscale(rast)) AS grayscale_png
FROM apple;
```

original_png

grayscale_png

예시: 변종 2

```
SET postgis.gdal_enabled_drivers = 'ENABLE_ALL';
SET postgis.enable_outdb_rasters = True;

WITH apple AS (
    SELECT ST_AddBand(
        ST_MakeEmptyRaster(350, 246, 0, 0, 1, -1, 0, 0, 0),
        '/tmp/apple.png'::text,
        NULL::int[]
    ) AS rast
)
SELECT
    ST_AsPNG(rast) AS original_png,
    ST_AsPNG(ST_Grayscale(
        ARRAY[
            ROW(rast, 1)::rastbandarg, -- red
            ROW(rast, 2)::rastbandarg, -- green
            ROW(rast, 3)::rastbandarg, -- blue
        ]::rastbandarg[]
    )) AS grayscale_png
FROM apple;
```

참고

ST_AsPNG, ST_Reclass, ST_ColorMap

10.12.4 ST_Intersection

ST_Intersection — 두 래스터의 공유 부분을 표&#x
또는 벡터화된 래스터와 도형의
기하학적 교차를 표현하는 래스&#
또는 도형-픽셀값 쌍의 집합을 반&

Synopsis

setof geomval **ST_Intersection**(geometry geom, raster rast, integer band_num=1);
setof geomval **ST_Intersection**(raster rast, geometry geom);
setof geomval **ST_Intersection**(raster rast, integer band, geometry geomin);
raster **ST_Intersection**(raster rast1, raster rast2, double precision[] nodataval);
raster **ST_Intersection**(raster rast1, raster rast2, text returnband, double precision[] nodataval);
raster **ST_Intersection**(raster rast1, integer band1, raster rast2, integer band2, double precision[] nodataval);
raster **ST_Intersection**(raster rast1, integer band1, raster rast2, integer band2, text returnband, double precision[] nodataval);

설명

두 래스터의 공유 부분을 표현하&#
또는 벡터화된 래스터와 도형의
기하학적 교차를 표현하는 래스&#
또는 도형-픽셀값 쌍의 집합을 반&

geomval 집합을 반환하는 처음 세 변종
함수는 벡터 스페이스에서 작동&#
먼저 (ST_DumpAsPolygon을 통해) 래스터를 geomval 행&
집합으로 벡터화한 다음, 해당 행&#
ST_Intersection(geometry, geometry) PostGIS 함수를 이용해서 도&#xd6
교차시킵니다. 도형이 래스터의
NODATA 값 부분과만 교차할 경우, 텅 빈
도형을 반환합니다. WHERE 절에 ST_Intersect
함수를 적절히 사용하면, 일반적&#
결과에서 이런 경우들을 제외시&#xc
수 있습니다.

출력되는 geomval 집합 앞뒤에 괄호를
치고 표현식 끝에 '.geom' 또는 '.val'을 붙&#xc774
도형 및 값 부분에 접근할 수 있습&#
예: (ST_Intersection(rast, geom)).geom

래스터를 반환하는 다른 변종들&#
래스터 스페이스에서 작동합니&#x
이 변종들은 교차를 수행하기 위&#
ST_MapAlgebraExpr 함수의 래스터 2개를 입력받
버전을 이용합니다.

출력 래스터의 범위는 두 래스터
범위의 기하학적 교차 부분과 일&#x
출력 래스터는 `returnband` 파라미터가
어떻게 설정됐는지에 따라 'BAND1', 'BAND2'
또는 'BOTH' 밴드를 포함합니다. 어느
한 밴드에서 NODATA 값을 가진 부분은

출력물의 모든 밴드에서 NODATA 값을 가지게 됩니다. 즉, NODATA 값을 가진 픽교차하는 픽셀을 모두 NODATA 값을 가픽셀로 출력합니다.

ST_Intersection 함수가 출력하는 래스터는 교차하지 않는 부분에 할당된 NODATA 값을 가지고 있어야 합니다. 사&#xc6 'BAND1', 'BAND2' 또는 'BOTH' 밴드 가운데 어떤 것&# 요청하느냐에 따라 1개 또는 2개의 NODATA 값을 가진 `nodataval[]` 배열을 입력해&#xc1 어떤 출력 밴드에 대해서도 NODATA 값&# 정의하거나 대체할 수 있습니다. 배열의 첫 번째 값은 첫 번째 밴드&#x NODATA 값을 대체하고, 두 번째 값은 두 번째 밴드의 NODATA 값을 대체합니다. 만약 입력 밴드 가운데 하나에 정&# NODATA 값이 없고 입력된 NODATA 값 배열도 없을 경우, ST_MinPossibleValue 함수를 통해 NODATA 값을 선택합니다. NODATA 값의 배열을 입력받는 모든 변종 함수는 요청&# 각 밴드에 할당될 단일 값도 입력&#

모든 변종 함수에서, 밴드 번호를 따로 지정하지 않을 경우 밴드 1로 가정합니다. 래스터와 도형 사이&# 교차 부분을 래스터로 반환받아&# 할 경우, ST_Clip 을 참조하십시오.

Note

출력 범위 또는 NODATA 값을 맞닥뜨렸을 때 무엇을 반환할지를 더 세밀히 조정하려면, ST_MapAlgebraExpr 함수의 두 래스터를 입력받는 버전을 이용하십시오.

Note

래스터 스페이스에서 래스터 밴드와 도형의 교차 부분을 계산하려면, ST_Clip 을 이용하십시오. ST_Clip 함수는 복수의 밴드를 가진 래스터를 입력받으며, 래스터화된 도형과 일치하는 밴드를 반환하지 않습니다.

Note

ST_Intersects 및 래스터에 대한 인덱스 그리고/또는 도형 열과 결합해서 ST_Intersection 함수를 사용해야 합니다.

개선 사항: 2.0.0부터 래스터 스페이&#xc2a 교차 부분을 구할 수 있습니다. 2.0.0

미만 버전에서는, 벡터 스페이스&#
교차 작업을 수행할 수 있었습니&#

**예시: 도형, 래스터 -- 도형-값 쌍으&#xb85c
출력**

```
SELECT
        foo.rid,
        foo.gid,
        ST_AsText((foo.geomval).geom) As geomwkt,
        (foo.geomval).val
FROM (
        SELECT
                A.rid,
                g.gid,
                ST_Intersection(A.rast, g.geom) As geomval
        FROM dummy_rast AS A
        CROSS JOIN (
                VALUES
                        (1, ST_Point(3427928, 5793243.85) ),
                        (2, ST_GeomFromText('LINESTRING(3427927.85 5793243.75,3427927.8  ↩
                            5793243.75,3427927.8 5793243.8)')),
                        (3, ST_GeomFromText('LINESTRING(1 2, 3 4)'))
        ) As g(gid,geom)
        WHERE A.rid = 2
) As foo;

 rid | gid |      geomwkt  ↩

     | val
-----+-----+-------------------------------------------------------------------------------------------

   2 |   1 | POINT(3427928 5793243.85)  ↩
                                                                                    | 249
   2 |   1 | POINT(3427928 5793243.85)  ↩
                                                                                    | 253
   2 |   2 | POINT(3427927.85 5793243.75)  ↩
                                                                          | 254
   2 |   2 | POINT(3427927.8 5793243.8)  ↩
                                                                                    | 251
   2 |   2 | POINT(3427927.8 5793243.8)  ↩
                                                                                    | 253
   2 |   2 | LINESTRING(3427927.8 5793243.75,3427927.8 5793243.8)         | 252
   2 |   2 | MULTILINESTRING((3427927.8 5793243.8,3427927.8 5793243.75),...) | 250
   2 |   3 | GEOMETRYCOLLECTION EMPTY
```

참고

geomval, ST_Intersects, ST_MapAlgebraExpr, ST_Clip, ST_AsText

10.12.5 내장 맵 대수 콜백 함수

내장 맵 대수 콜백 함수 — 콜백 함수
버전 - 래스터 1개 이상, 밴드 인덱스
그리고 사용자 지정 콜백 함수 1개&#
입력받아 밴드 1개를 가진 래스터&
반환합니다.

Synopsis

raster **ST_MapAlgebra**(rastbandarg[] rastbandargset, regprocedure callbackfunc, text pixeltype=NULL, text extenttype=INTERSECTIO
raster customextent=NULL, integer distancex=0, integer distancey=0, text[] VARIADIC userargs=NULL);
raster **ST_MapAlgebra**(raster rast, integer[] nband, regprocedure callbackfunc, text pixeltype=NULL, text extenttype=FIRST,
raster customextent=NULL, integer distancex=0, integer distancey=0, text[] VARIADIC userargs=NULL);
raster **ST_MapAlgebra**(raster rast, integer nband, regprocedure callbackfunc, text pixeltype=NULL, text extenttype=FIRST,
raster customextent=NULL, integer distancex=0, integer distancey=0, text[] VARIADIC userargs=NULL);
raster **ST_MapAlgebra**(raster rast1, integer nband1, raster rast2, integer nband2, regprocedure callbackfunc, text pixeltype=NULL,
text extenttype=INTERSECTION, raster customextent=NULL, integer distancex=0, integer distancey=0, text[] VARIADIC user-
args=NULL);
raster **ST_MapAlgebra**(nband integer, regprocedure callbackfunc, float8[] mask, boolean weighted, text pixeltype=NULL, text
extenttype=INTERSECTION, raster customextent=NULL, text[] VARIADIC userargs=NULL);

설명

래스터 1개 이상, 밴드 인덱스, 그리&
사용자 지정 콜백 함수 1개를 입력&#
밴드 1개를 가진 래스터를 반환합&

rast, rast1, rast2, rastbandargset 맵 대수(代數) 처리를 평&#xac
데 쓰이는 래스터

`rastbandargset` 은 많은 래스터 그리고/또&#xb
많은 밴드에 대해 맵 대수 연산&#xc7
이용할 수 있도록 해줍니다. 변&#xc8
1 예시를 참조하십시오.

nband, nband1, nband2 평가할 래스터의 밴드 개&#xc2
nband는 밴드를 나타내는 정수 또는
정수 배열이 될 수 있습니다. nband1&#xc74
rast1에 있는 밴드이며 nband2는 래스터
2개/밴드 2개일 경우 rast2에 있는 밴&#xb4dc

callbackfunc `callbackfunc` 파라미터는 regprocedure(회귀 처&#xb9
형변환된 SQL 또는 PL/pgSQL 함수의 명칭
및 서명(signature)이어야 합니다. 다음&#xc7
PL/pgSQL 함수의 예시입니다:

```
CREATE OR REPLACE FUNCTION sample_callbackfunc(value double precision[][][], position  ↩
    integer[][], VARIADIC userargs text[])
RETURNS double precision
AS $$
BEGIN
RETURN 0;
END;
$$ LANGUAGE 'plpgsql' IMMUTABLE;
```

`callbackfunc` 는 인수를 3개 가지고 있어&#xc57
합니다: 이중 정밀도 데이터형
3차원 배열, 정수형 2차원 배열, 그&#x
임의로 여러 인수를 입력받는
문자열 1차원 배열입니다. 첫 번&#xc9
인수 `value` 는 모든 입력 래스터에&#xc11c
나온 (이중 정밀도) 값들의 집합&#xc
(인덱스가 1-기반인) 3차원이란 래&#
번호, Y행, X열을 말합니다. 두 번째
인수 `position` 은 출력 래스터 및 입력

래스터의 픽셀 위치들의 집합&#xc7
(인덱스가 0-기반인) 외곽 차원은
래스터 번호입니다. 외곽 차원
인덱스 0에 있는 위치는 출력 래&#x
픽셀 위치입니다. 각 외곽 차원&#xc5
대해, 내곽 차원에 X 및 Y를 위한 두
요소가 있습니다. 세 번째 인수
`userargs` 는 어떤 사용자 지정 인수라&#x
넘겨주기 위한 것입니다.

regprocedure 인수를 SQL 함수에 입력하려&#xba74
입력하기 위한 전체 함수 서명&#xc7
필요하고, 그 다음 regprocedure 유형으로
형변환해야 합니다. 앞의 PL/pgSQL 함&#x
인수로서 넘겨주려면, 해당 인&#xc21
위한 SQL은 다음과 같습니다:

```
'sample_callbackfunc(double precision[], integer[], text[])'::regprocedure
```

해당 인수가 함수의 명칭, 함수
인수들의 유형, 명칭 및 인수 유&#xd
감싼 따옴표, 그리고 regprocedure 로의 형&#x
포함하고 있다는 점에 주의하&#xc2e

mask An n-dimensional array (matrix) of numbers used to filter what cells get passed to map algebra call-back function. 0 means a neighbor cell value should be treated as no-data and 1 means value should be treated as data. If weight is set to true, then the values, are used as multipliers to multiple the pixel value of that value in the neighborhood position.

weighted mask 값에 가중치를 적용해야 할&#xc9
값으로 곱해야 할지) 말지(mask를 입&
최초 버전에만 적용할지)를 표&#xc2
불 값(참/거짓)입니다.

pixeltype `pixeltype` 을 설정할 경우, 새 래스터&#xc75
밴드 하나가 해당 픽셀 유형이
될 것입니다. `pixeltype` 이 NULL이거나 생&#xb
경우, 새 래스터 밴드가 첫 번째
래스터의 지정된 밴드와(범위
유형의 경우: INTERSECTION, UNION, FIRST, CUSTOM), 또는
적절한 래스터의 지정된 밴드&#xc64
유형의 경우: SECOND, LAST) 동일한 픽셀
유형을 가지게 될 것입니다. 어&#xb5
유형인지 확신하지 못 한다면,
언제나 `pixeltype` 을 설정하십시오.

출력 래스터의 픽셀 유형은 ST_BandPixelTy
목록에 존재하는 유형 가운데
하나이거나, 생략되거나, NULL로 &#xc124
합니다.

extenttype 사용할 수 있는 값은 INTERSECTION(기본&#
UNION, FIRST(래스터 1개를 입력받는 변&#xc885
기본값), SECOND, LAST, CUSTOM입니다.

customextent `extentype` 이 CUSTOM일 경우, 래스터가 `customext`
를 입력받아야만 합니다. 변종
1의 4번째 예시를 참조하십시오.

distancex The distance in pixels from the reference cell in x direction. So width of resulting matrix would be `2*distancex + 1`.If not specified only the reference cell is considered (neighborhood of 0).

distancey 참조 셀에서 나온 Y 방향의 픽셀 단위 거리입니다. 결과 매트릭&#xc2a 높이는 `2*distancey + 1` 일 것입니다. 따로 설정하지 않으면 참조 셀만 (이&#xc6 셀의 개수가 0) 고려합니다.

userargs `callbackfunc` 에 들어가는 세 번째 인수&#x variadic text 배열입니다. 길고 긴 텍스트 인수들이 모두 지정된 `callbackfunc` 에 넘겨지며, `userargs` 인수에 담겨집니&#xb

---

Note

(다양한 개수의 인수를 입력받는) VARIADIC 키워드에 대한 더 자세한 정보를 알고 싶다면, PostgreSQL 문서 가운데 Query Language (SQL) Functions 의 "SQL Functions with Variable Numbers of Arguments" 단원을 참조하십시오.

Note

사용자가 처리하기 위해 콜백 함수에 어떤 인수를 넘겨주기로 하고 말고에 상관없이, `callbackfunc` 에 들어가는 text[] 인수는 필요합니다.

변종 1은 많은 래스터 그리고/또는 많은 밴드에 대해 맵 대수 연산을 이용할 수 있도록 해주는 `rastbandarg` 배&#xc5 입력받습니다. 변종 1 예시를 참조&

변종 2 및 3은 한 래스터의 1개 이상&#xc758 밴드에 대해 연산합니다. 변종 2및 3의 예시를 참조하십시오.

변종 4는 각 래스터가 밴드 1개씩 가지고 있는 래스터 2개에 대해 연&# 변종 4 예시를 참조하십시오.

2.2.0 버전부터 mask를 추가할 수 있습니&#

2.1.0 버전부터 사용할 수 있습니다.

예시: 변종 1

래스터 1개&#xc5, 밴드 1개

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, -1, 0, 0, 0), 1, '16 ↩
            BUI', 1, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                ARRAY[ROW(rast, 1)]::rastbandarg[],
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo
```

래스터 1개, 밴드 몇 개

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                ARRAY[ROW(rast, 3), ROW(rast, 1), ROW(rast, 3), ROW(rast, 2)]::rastbandarg ↩
                    [],
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo
```

래스터 몇 개, 밴드 몇 개

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast ↩
             UNION ALL
        SELECT 2 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 1, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 2, 0), 2, '8BUI', 20, 0), 3, '32BUI', 300, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                ARRAY[ROW(t1.rast, 3), ROW(t2.rast, 1), ROW(t2.rast, 3), ROW(t1.rast, 2)]:: ↩
                    rastbandarg[],
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo t1
CROSS JOIN foo t2
WHERE t1.rid = 1
        AND t2.rid = 2
```

이웃을 가진 커버리지의 타일들&#x
완전한 예시입니다. 이 쿼리는 PostgreSQL 9.1 이상 버전에서만 작동합니다.

```
WITH foo AS (
        SELECT 0 AS rid, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, -1, 0, 0, 0), 1, '16 ↩
            BUI', 1, 0) AS rast UNION ALL
        SELECT 1, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, 0, 1, -1, 0, 0, 0), 1, '16BUI', 2, ↩
             0) AS rast UNION ALL
        SELECT 2, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, 0, 1, -1, 0, 0, 0), 1, '16BUI', 3, ↩
             0) AS rast UNION ALL

        SELECT 3, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            10, 0) AS rast UNION ALL
        SELECT 4, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            20, 0) AS rast UNION ALL
        SELECT 5, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            30, 0) AS rast UNION ALL

        SELECT 6, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            100, 0) AS rast UNION ALL
        SELECT 7, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            200, 0) AS rast UNION ALL
        SELECT 8, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            300, 0) AS rast
)
SELECT
        t1.rid,
```

```
        ST_MapAlgebra(
                ARRAY[ROW(ST_Union(t2.rast), 1)]::rastbandarg[],
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure,
                '32BUI',
                'CUSTOM', t1.rast,
                1, 1
        ) AS rast
FROM foo t1
CROSS JOIN foo t2
WHERE t1.rid = 4
        AND t2.rid BETWEEN 0 AND 8
        AND ST_Intersects(t1.rast, t2.rast)
GROUP BY t1.rid, t1.rast
```

이웃을 가진 커버리지의 타일들&#x
예시와 유사하지만 PostgreSQL 9.0에서 작&#xb3d
쿼리입니다.

```
WITH src AS (
        SELECT 0 AS rid, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, -1, 0, 0, 0), 1, '16 ↩
            BUI', 1, 0) AS rast UNION ALL
        SELECT 1, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, 0, 1, -1, 0, 0, 0), 1, '16BUI', 2, ↩
             0) AS rast UNION ALL
        SELECT 2, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, 0, 1, -1, 0, 0, 0), 1, '16BUI', 3, ↩
             0) AS rast UNION ALL

        SELECT 3, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            10, 0) AS rast UNION ALL
        SELECT 4, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            20, 0) AS rast UNION ALL
        SELECT 5, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, -2, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            30, 0) AS rast UNION ALL

        SELECT 6, ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            100, 0) AS rast UNION ALL
        SELECT 7, ST_AddBand(ST_MakeEmptyRaster(2, 2, 2, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            200, 0) AS rast UNION ALL
        SELECT 8, ST_AddBand(ST_MakeEmptyRaster(2, 2, 4, -4, 1, -1, 0, 0, 0), 1, '16BUI',  ↩
            300, 0) AS rast
)
WITH foo AS (
        SELECT
                t1.rid,
                ST_Union(t2.rast) AS rast
        FROM src t1
        JOIN src t2
                ON ST_Intersects(t1.rast, t2.rast)
                AND t2.rid BETWEEN 0 AND 8
        WHERE t1.rid = 4
        GROUP BY t1.rid
), bar AS (
        SELECT
                t1.rid,
                ST_MapAlgebra(
                        ARRAY[ROW(t2.rast, 1)]::rastbandarg[],
                        'raster_nmapalgebra_test(double precision[], int[], text[])':: ↩
                            regprocedure,
                        '32BUI',
                        'CUSTOM', t1.rast,
                        1, 1
                ) AS rast
        FROM src t1
```

```
        JOIN foo t2
                ON t1.rid = t2.rid
)
SELECT
        rid,
        (ST_Metadata(rast)),
        (ST_BandMetadata(rast, 1)),
        ST_Value(rast, 1, 1, 1)
FROM bar;
```

예시: 변종 2 및 3

래스터 1개, 밴드 몇 개

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                rast, ARRAY[3, 1, 3, 2]::integer[],
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo
```

래스터 1개, 밴드 1개

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                rast, 2,
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo
```

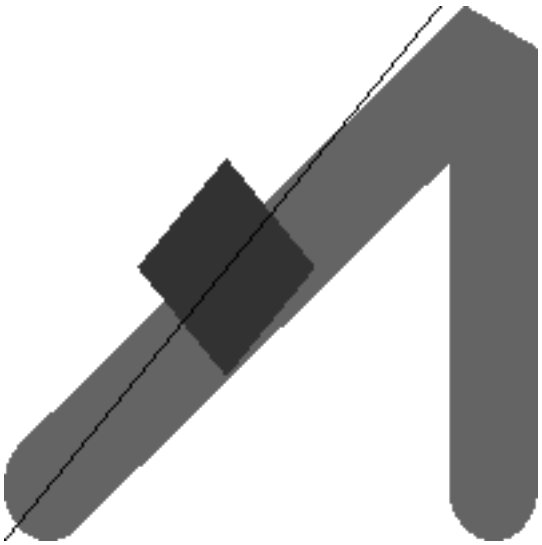
예시: 변종 4

래스터 2개, 밴드 2개

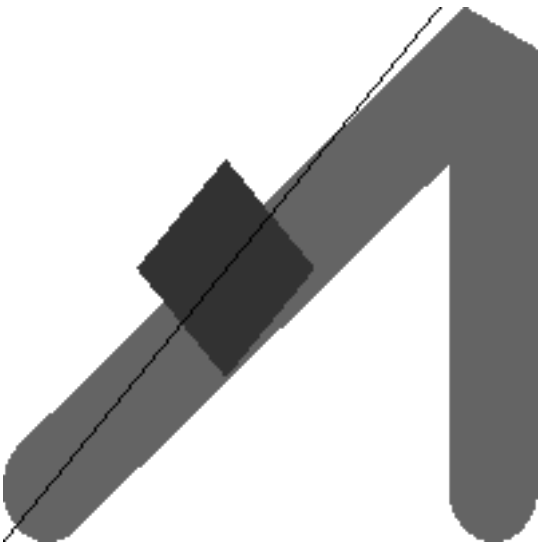
```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast ↩
             UNION ALL
        SELECT 2 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 1, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 2, 0), 2, '8BUI', 20, 0), 3, '32BUI', 300, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                t1.rast, 2,
                t2.rast, 1,
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo t1
CROSS JOIN foo t2
WHERE t1.rid = 1
        AND t2.rid = 2
```

예시: mask 사용하기

```
WITH foo AS (SELECT
   ST_SetBandNoDataValue(
ST_SetValue(ST_SetValue(ST_AsRaster(
                ST_Buffer(
                        ST_GeomFromText('LINESTRING(50 50,100 90,100 50)'), 5,'join=bevel') ↩
                            ,
                        200,200,ARRAY['8BUI'], ARRAY[100], ARRAY[0]), ST_Buffer('POINT(70  ↩
                            70)'::geometry,10,'quad_segs=1') ,50),
  'LINESTRING(20 20, 100 100, 150 98)'::geometry,1),0)  AS rast )
SELECT 'original' AS title, rast
FROM foo
UNION ALL
SELECT 'no mask mean value' AS title, ST_MapAlgebra(rast,1,'ST_mean4ma(double precision[],  ↩
    int[], text[])'::regprocedure) AS rast
FROM foo
UNION ALL
SELECT 'mask only consider neighbors, exclude center' AS title, ST_MapAlgebra(rast,1,' ↩
    ST_mean4ma(double precision[], int[], text[])'::regprocedure,
    '{{1,1,1}, {1,0,1}, {1,1,1}}'::double precision[], false) As rast
FROM foo

UNION ALL
SELECT 'mask weighted only consider neighbors, exclude center multi otehr pixel values by  ↩
    2' AS title, ST_MapAlgebra(rast,1,'ST_mean4ma(double precision[], int[], text[])':: ↩
    regprocedure,
    '{{2,2,2}, {2,0,2}, {2,2,2}}'::double precision[], true) As rast
FROM foo;
```

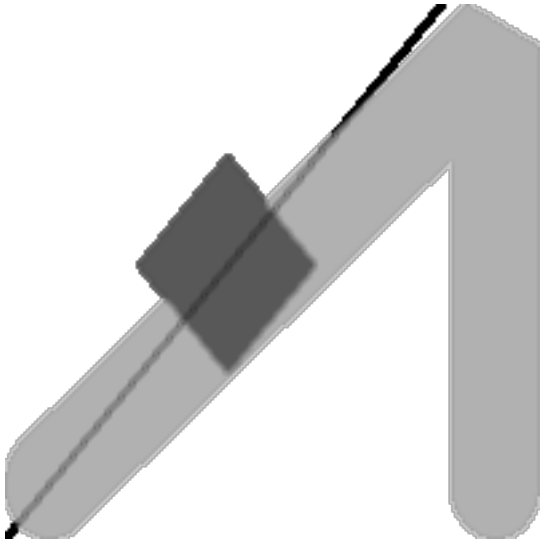


원본



mask 평균값 없음(mask 매트릭스의 숫자가 모두 1인 것과 동일)

mask가 중심을 제외한 이웃만 고려



mask가 중심을 제외한 다른 픽셀 값에 2를 곱해 이웃에만 가중치를 부여

참고

rastbandarg, ST_Union, ST_MapAlgebraExpr

10.12.6 ST_MapAlgebraExpr

ST_MapAlgebraExpr — 표현식 버전 - 입력 래스터 1개 또는 2개, 밴드 인덱스, 그리고 사용자 지정 SQL 표현식 1개 이상을 입력받아 밴드 1개를 가진 래스터반환합니다.

Synopsis

raster **ST_MapAlgebra**(raster rast, integer nband, text pixeltype, text expression, double precision nodataval=NULL);
raster **ST_MapAlgebra**(raster rast, text pixeltype, text expression, double precision nodataval=NULL);
raster **ST_MapAlgebra**(raster rast1, integer nband1, raster rast2, integer nband2, text expression, text pixeltype=NULL, text extenttype=INTERSECTION, text nodata1expr=NULL, text nodata2expr=NULL, double precision nodatanodataval=NULL);
raster **ST_MapAlgebra**(raster rast1, raster rast2, text expression, text pixeltype=NULL, text extenttype=INTERSECTION, text nodata1expr=NULL, text nodata2expr=NULL, double precision nodatanodataval=NULL);

설명

표현식 버전 - 입력 래스터 1개 또는 2개, 밴드 인덱스, 그리고 사용자 지정 SQL 표현식 1개 이상을 입력받아 밴드 1개를 가진 래스터반환합니다.

2.1.0 버전부터 사용할 수 있습니다.

설명: 변종 1, 2 (래스터 1개)

입력 래스터(`rast`)에 대해 `expression` 이 정의
유효한 PostgreSQL 대수 연산을 적용해서
형성된, 밴드 1개를 가진 새 래스터&
생성합니다. `nband` 를 설정하지 않을
경우, 밴드 1로 가정합니다. 이 새
래스터는 원본 래스터와 동일한
지리참조, 너비 및 높이이지만, 밴&#
1개만 가질 것입니다.

`pixeltype` 을 설정할 경우, 새 래스터의
밴드가 해당 픽셀 유형이 될 것입&#
`pixeltype` 이 NULL일 경우, 새 래스터의 밴드&
입력 `rast` 의 밴드와 동일한 픽셀 유&#xd
될 것입니다.

- `expression` 에 키워드를 쓸 수 있습니다.
  1. `[rast]` - 관심 픽셀의 픽셀 값
  2. `[rast.val]` - 관심 픽셀의 픽셀 값
  3. `[rast.x]` - 관심 픽셀의 1-기반 픽셀 열
  4. `[rast.y]` - 관심 픽셀의 1-기반 픽셀 행

설명: 변종 3, 4 (래스터 2개)

입력 래스터 밴드 `rast1`, (`rast2`)에 대한 `expressio
이 정의하는 밴드 2개에 대해, 유효&
PostgreSQL 대수 연산을 적용해서 형성된,
밴드 1개를 가진 새 래스터를 생성&
`band1`, `band2` 를 설정하지 않을 경우, 밴드
1로 가정합니다. 출력 래스터는 &#xc-
cab; 번째 래스터가 정의하는 그리&#xb4dc
상에 (축척, 기울기 및 픽셀 모서리&
정렬될 것입니다. `extenttype` 파라미터&#xac0
출력 래스터의 범위를 정의할 것&

표현식(expression) 래스터 2개가 관련된
PostgreSQL 대수 표현식 및 픽셀들이 교&#x
경우 픽셀 값을 정의할 PostgreSQL 정의
함수/연산자입니다. 예: (([rast1] + [rast2])/2.0)::integer

pixeltype 출력 래스터의 픽셀 유형입니&
이 유형은 ST_BandPixelType 목록에 존재하&#xb29
유형 가운데 하나이거나, 생략&#xb4
NULL로 설정돼야만 합니다. 따로 설
않거나 NULL로 설정하지 않으면, &#xc-
cab; 번째 래스터의 픽셀 유형을 기&
삼을 것입니다.

extenttype 출력 래스터의 범위 제어

1. `INTERSECTION` - 새 래스터의 범위는 두 래&
교차 부분입니다. 기본값입니&

2. UNION - 새 래스터의 범위는 두 래스&
통합한 범위입니다.
3. FIRST - 새 래스터의 범위는 첫 번째
래스터의 범위와 동일합니다.
4. SECOND - 새 래스터의 범위는 두 번째
래스터의 범위와 동일합니다.

nodata1expr rast1 의 픽셀들이 NODATA 값이고 공간&
상응하는 rast2 의 픽셀들이 값을
가지고 있을 때 어떤 것을 반환&#xd5
정의하는 상수만, 또는 rast2 와만
관련된 대수 표현식입니다.

nodata2expr rast2 의 픽셀들이 NODATA 값이고 공간&
상응하는 rast1 의 픽셀들이 값을
가지고 있을 때 어떤 것을 반환&#xd5
정의하는 상수만, 또는 rast1 과만
관련된 대수 표현식입니다.

nodatanodataval 공간적으로 상응하는 rast1 및
rast2 의 픽셀들이 모두 NODATA 값일 경&#xc6b0
반환하는 숫자 상수니다.

- expression, nodata1expr 및 nodata2expr 에 키워드를 쓸 수
있습니다.

1. [rast1] - rast1 에 있는 관심 픽셀의 픽셀
값
2. [rast1.val] - rast1 에 있는 관심 픽셀의 픽&#xc140
값
3. [rast1.x] - rast1 에 있는 관심 픽셀의 1-기반
픽셀 열
4. [rast1.y] - rast1 에 있는 관심 픽셀의 1-기반
픽셀 행
5. [rast2] - rast2 에 있는 관심 픽셀의 픽셀
값
6. [rast2.val] - rast2 에 있는 관심 픽셀의 픽&#xc140
값
7. [rast2.x] - rast2 에 있는 관심 픽셀의 1-기반
픽셀 열
8. [rast2.y] - rast2 에 있는 관심 픽셀의 1-기반
픽셀 행

예시: 변종 1 및 2

```
WITH foo AS (
        SELECT ST_SetValue(ST_AddBand(ST_MakeEmptyRaster(3, 3, 0, 0, 1, -1, 0, 0, 0), 1, '8 ↩
            BUI', 1, 0), 1, 2, 5) AS rast
)
SELECT
        (ST_DumpValues(rast, 1))[2][1]
FROM foo;

 st_dumpvalues
---------------
             5
(1 row)
```

예시: 변종 3 및 4

```
WITH foo AS (
        SELECT 1 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 0, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 1, 0), 2, '8BUI', 10, 0), 3, '32BUI', 100, 0) AS rast ↩
             UNION ALL
        SELECT 2 AS rid, ST_AddBand(ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(2, 2, 0, 1, 1, ↩
             -1, 0, 0, 0), 1, '16BUI', 2, 0), 2, '8BUI', 20, 0), 3, '32BUI', 300, 0) AS rast
)
SELECT
        ST_MapAlgebra(
                t1.rast, 2,
                t2.rast, 1,
                'sample_callbackfunc(double precision[], int[], text[])'::regprocedure
        ) AS rast
FROM foo t1
CROSS JOIN foo t2
WHERE t1.rid = 1
        AND t2.rid = 2
```

참고

rastbandarg, ST_Union, 내장 맵 대수 콜백 함수

10.12.7 ST_MapAlgebraExpr

ST_MapAlgebraExpr — 래스터 밴드 1개 버전: 입력 래스터에 대해 유효한 PostgreSQL 대수 연적용해서 형성되고, 설정한 픽셀 유형을 가진, 밴드 1개를 가진 새 래생성합니다. 따로 밴드를 설정하않을 경우, 밴드 1로 가정합니다.

Synopsis

raster **ST_MapAlgebraExpr**(raster rast, integer band, text pixeltype, text expression, double precision nodataval=NULL);
raster **ST_MapAlgebraExpr**(raster rast, text pixeltype, text expression, double precision nodataval=NULL);

설명

> **Warning**
> ST_MapAlgebraExpr 2.1.0 버전부터 더 이상 이 함수를 지원하지 않습니다. 대신 ST_MapAlgebraExpr 함수를 이용하십시&#xc62

입력 래스터(`rast`)에 대해 `expression` 이 정의 유효한 PostgreSQL 대수 연산을 적용해서 형성된, 밴드 1개를 가진 새 래스터생성합니다. `nband` 를 설정하지 않을 경우, 밴드 1로 가정합니다. 이 새 래스터는 원본 래스터와 동일한

지리참조, 너비 및 높이이지만, 밴&#
1개만 가질 것입니다.

`pixeltype` 을 설정할 경우, 새 래스터의 밴드가 해당 픽셀 유형이 될 것입&#
`pixeltype` 이 NULL일 경우, 새 래스터의 밴드&
입력 `rast` 의 밴드와 동일한 픽셀 유&#xd
될 것입니다.

표현식에서 원본 밴드의 픽셀 값&#
참조하는 데 `[rast]`, 1-기반 픽셀 열 인덱
참조하는 데 `[rast.x]`, 1-기반 픽셀 행 인&#xb3
참조하는 데 `[rast.y]` 용어를 사용할 수
있습니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

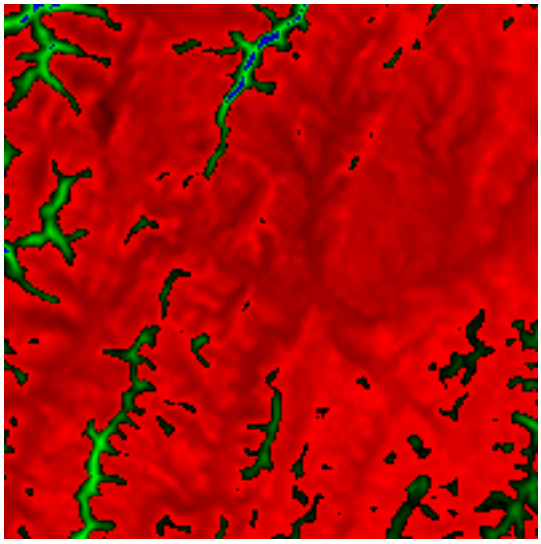
원본 래스터 2개를 입력받는 모듈&#
함수인 원본으로부터 밴드 1개를
가진 새 래스터를 생성합니다.

```
ALTER TABLE dummy_rast ADD COLUMN map_rast raster;
CREATE FUNCTION mod_fct(pixel float, pos integer[], variadic args text[])
RETURNS float
AS $$
BEGIN
    RETURN pixel::integer % 2;
END;
$$
LANGUAGE 'plpgsql' IMMUTABLE;

UPDATE dummy_rast SET map_rast = ST_MapAlgebraFct(rast,NULL,'mod_fct(float,integer[],text ↩
    [])'::regprocedure) WHERE rid = 2;

SELECT ST_Value(rast,1,i,j) As origval, ST_Value(map_rast, 1, i, j) As mapval
FROM dummy_rast CROSS JOIN generate_series(1, 3) AS i CROSS JOIN generate_series(1,3) AS j
WHERE rid = 2;

 origval | mapval
---------+--------
     253 |      1
     254 |      0
     253 |      1
     253 |      1
     254 |      0
     254 |      0
     250 |      0
     254 |      0
     254 |      0
```

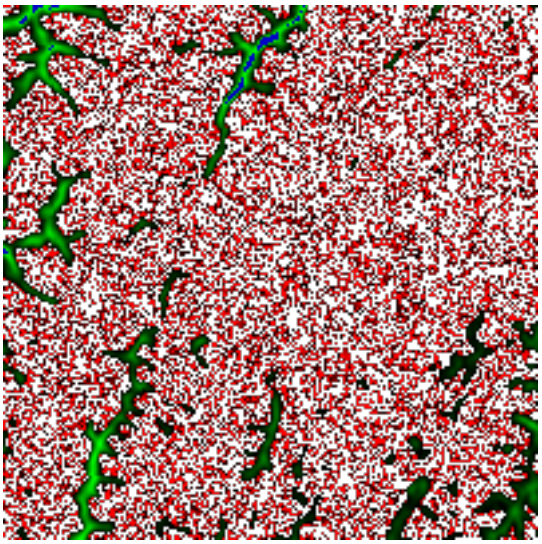
재분류를 거치고 NODATA 값을 0으로 설&
원본으로부터 픽셀 유형이 2BUI인,
밴드 1개를 가진 새 래스터를 생성&

```
ALTER TABLE dummy_rast ADD COLUMN map_rast2 raster;
CREATE FUNCTION classify_fct(pixel float, pos integer[], variadic args text[])
RETURNS float
AS
$$
```

```
DECLARE
    nodata float := 0;
BEGIN
    IF NOT args[1] IS NULL THEN
        nodata := args[1];
    END IF;
    IF pixel < 251 THEN
        RETURN 1;
    ELSIF pixel = 252 THEN
        RETURN 2;
    ELSIF pixel > 252 THEN
        RETURN 3;
    ELSE
        RETURN nodata;
    END IF;
END;
$$
LANGUAGE 'plpgsql';
UPDATE dummy_rast SET map_rast2 = ST_MapAlgebraFct(rast,'2BUI','classify_fct(float,integer ↩
    [],text[])'::regprocedure, '0') WHERE rid = 2;

SELECT DISTINCT ST_Value(rast,1,i,j) As origval, ST_Value(map_rast2, 1, i, j) As mapval
FROM dummy_rast CROSS JOIN generate_series(1, 5) AS i CROSS JOIN generate_series(1,5) AS j
WHERE rid = 2;

 origval | mapval
---------+--------
     249 |      1
     250 |      1
     251 |
     252 |      2
     253 |      3
     254 |      3

SELECT ST_BandPixelType(map_rast2) As b1pixtyp
FROM dummy_rast WHERE rid = 2;

 b1pixtyp
----------
 2BUI
```



original (column rast_view)



rast_view_ma

밴드 3개를 가진 원본 래스터에서 맵 대수로 첫 번째 밴드를 조정하나머지 두 밴드는 그대로 둔 상태동일한 픽셀 유형인 밴드 3개를 가새 래스터를 생성합니다.

```
CREATE FUNCTION rast_plus_tan(pixel float, pos integer[], variadic args text[])
RETURNS float
AS
$$
BEGIN
        RETURN tan(pixel) * pixel;
END;
$$
LANGUAGE 'plpgsql';

SELECT ST_AddBand(
        ST_AddBand(
                ST_AddBand(
                        ST_MakeEmptyRaster(rast_view),
                        ST_MapAlgebraFct(rast_view,1,NULL,'rast_plus_tan(float,integer[], ↩
                            text[])'::regprocedure)
                ),
                ST_Band(rast_view,2)
        ),
        ST_Band(rast_view, 3) As rast_view_ma
)
FROM wind
WHERE rid=167;
```

참고

ST_MapAlgebraExpr, ST_MapAlgebraFct, ST_BandPixelType, ST_GeoReference, ST_Value

10.12.8 ST_MapAlgebraExpr

ST_MapAlgebraExpr — 래스터 밴드 2개 버전: 입력 래스터 2개에 대해 유효한 PostgreSQL 대&#xc218 연산을 적용해서 형성되고, 설정&#x 픽셀 유형을 가진, 밴드 1개를 가진 새 래스터를 생성합니다. 따로 밴& 설정하지 않을 경우, 각 래스터의 밴드 1로 가정합니다. 출력 래스터& 첫 번째 래스터가 정의하는 그리&#x 상에 (축척, 기울기 및 픽셀 모서리&# 정렬될 것입니다. `extenttype` 파라미터&#xac0 출력 래스터의 범위를 정의할 것&# `extenttype` 의 값은 INTERSECTION, UNION, FIRST, SECOND가 될 수 있습니다.

Synopsis

raster **ST_MapAlgebraExpr**(raster rast1, raster rast2, text expression, text pixeltype=same_as_rast1_band, text extenttype=INTERSEC text nodata1expr=NULL, text nodata2expr=NULL, double precision nodatanodataval=NULL);
raster **ST_MapAlgebraExpr**(raster rast1, integer band1, raster rast2, integer band2, text expression, text pixeltype=same_as_rast1_band text extenttype=INTERSECTION, text nodata1expr=NULL, text nodata2expr=NULL, double precision nodatanodataval=NULL);

설명

> **Warning**
> ST_MapAlgebraExpr 2.1.0 버전부터 더 이상 이 함수를 지원하지 않습니다. 대신 ST_MapAlgebraExpr 함수를 이용하십시&#xc62

입력 래스터 밴드 `rast1`, (`rast2`)에 대한 `expressio` 이 정의하는 밴드 2개에 대해, 유효 PostgreSQL 대수 연산을 적용해서 형성된, 밴드 1개를 가진 새 래스터를 생성& `band1`, `band2` 를 설정하지 않을 경우, 밴드 1로 가정합니다. 출력 래스터는 &#xc- cab; 번째 래스터가 정의하는 그리&#xb4dc 상에 (축척, 기울기 및 픽셀 모서리&# 정렬될 것입니다. `extenttype` 파라미터&#xac0 출력 래스터의 범위를 정의할 것&#

표현식(expression) 래스터 2개가 관련된 PostgreSQL 대수 표현식 및 픽셀들이 교&#x 경우 픽셀 값을 정의할 PostgreSQL 정의 함수/연산자입니다. 예: (([rast1] + [rast2])/2.0)::integer

pixeltype 출력 래스터의 픽셀 유형입니& 이 유형은 ST_BandPixelType 목록에 존재하&#xb29 유형 가운데 하나이거나, 생략&#xb4 NULL로 설정돼야만 합니다. 따로 설 않거나 NULL로 설정하지 않으면, &#xc- cab; 번째 래스터의 픽셀 유형을 기& 삼을 것입니다.

extenttype 출력 래스터의 범위 제어

1. `INTERSECTION` - 새 래스터의 범위는 두 래&
   교차 부분입니다. 기본값입니&
2. `UNION` - 새 래스터의 범위는 두 래스&
   통합한 범위입니다.
3. `FIRST` - 새 래스터의 범위는 첫 번째
   래스터의 범위와 동일합니다.
4. `SECOND` - 새 래스터의 범위는 두 번째
   래스터의 범위와 동일합니다.

nodata1expr `rast1` 의 픽셀들이 NODATA 값이고 공간&
상응하는 `rast2` 의 픽셀들이 값을
가지고 있을 때 어떤 것을 반환&#xd5
정의하는 상수만, 또는 `rast2` 와만
관련된 대수 표현식입니다.

nodata2expr `rast2` 의 픽셀들이 NODATA 값이고 공간&
상응하는 `rast1` 의 픽셀들이 값을
가지고 있을 때 어떤 것을 반환&#xd5
정의하는 상수만, 또는 `rast1` 과만
관련된 대수 표현식입니다.

nodatanodataval 공간적으로 상응하는 `rast1` 및
`rast2` 의 픽셀들이 모두 NODATA 값일 경&#xc6b0
반환하는 숫자 상수입니다.

`pixeltype` 을 설정할 경우, 새 래스터의
밴드가 해당 픽셀 유형이 될 것입&#
`pixeltype` 이 NULL이거나 따로 설정하지 않&#
경우, 새 래스터의 밴드는 입력 `rast1`
의 밴드와 동일한 픽셀 유형이 될
것입니다.

원본 밴드의 픽셀 값을 참조하는
데 `[rast1.val]`, `[rast2.val]`, 픽셀의 열/행 위치를
참조하는 데 `[rast1.x]`, `[rast1.y]` 등의 용어를
사용하십시오.

2.0.0 버전부터 사용할 수 있습니다.

예시: 밴드 2개의 교차 및 통합

원본 래스터 2개를 입력받는 모듈&
함수인 원본으로부터 밴드 1개를
가진 새 래스터를 생성합니다.

```
-- &#xb798;&#xc2a4;&#xd130; &#xc9d1;&#xd569; &#xc0dd;&#xc131; --
DROP TABLE IF EXISTS fun_shapes;
CREATE TABLE fun_shapes(rid serial PRIMARY KEY, fun_name text, rast raster);

-- &#xb9e4;&#xc0ac;&#xcd94;&#xc138;&#xce20; &#xc8fc; &#xbbf8;&#xd130; &#xb2e8;&#xc704;  ↩
    &#xd3c9;&#xba74;&#xc758; &#xbcf4;&#xc2a4;&#xd134; &#xc8fc;&#xc704;&#xc5d0; &#xba87;  ↩
    &#xac1c;&#xc758; &#xd615;&#xc0c1;&#xc744; &#xc0bd;&#xc785; --
INSERT INTO fun_shapes(fun_name, rast)
VALUES ('ref', ST_AsRaster(ST_MakeEnvelope(235229, 899970, 237229, 901930,26986),200,200,'8 ↩
    BUI',0,0));

INSERT INTO fun_shapes(fun_name,rast)
```

```
WITH ref(rast) AS (SELECT rast FROM fun_shapes WHERE fun_name = 'ref' )
SELECT 'area' AS fun_name, ST_AsRaster(ST_Buffer(ST_SetSRID(ST_Point(236229, 900930),26986) ↩
    , 1000),
                        ref.rast,'8BUI', 10, 0) As rast
FROM ref
UNION ALL
SELECT 'rand bubbles',
                        ST_AsRaster(
                        (SELECT ST_Collect(geom)
        FROM (SELECT ST_Buffer(ST_SetSRID(ST_Point(236229 + i*random()*100, 900930 + j* ↩
            random()*100),26986), random()*20) As geom
                        FROM generate_series(1,10) As i, generate_series(1,10) As j
                        ) As foo ), ref.rast,'8BUI', 200, 0)
FROM ref;

-- &#xb9e4;&#xd551; --
SELECT  ST_MapAlgebraExpr(
                area.rast, bub.rast, '[rast2.val]', '8BUI', 'INTERSECTION', '[rast2.val]',  ↩
                    '[rast1.val]') As interrast,
                ST_MapAlgebraExpr(
                        area.rast, bub.rast, '[rast2.val]', '8BUI', 'UNION', '[rast2.val]', ↩
                             '[rast1.val]') As unionrast
FROM
  (SELECT rast FROM fun_shapes WHERE
 fun_name = 'area') As area
CROSS JOIN  (SELECT rast
FROM fun_shapes WHERE
 fun_name = 'rand bubbles') As bub
```

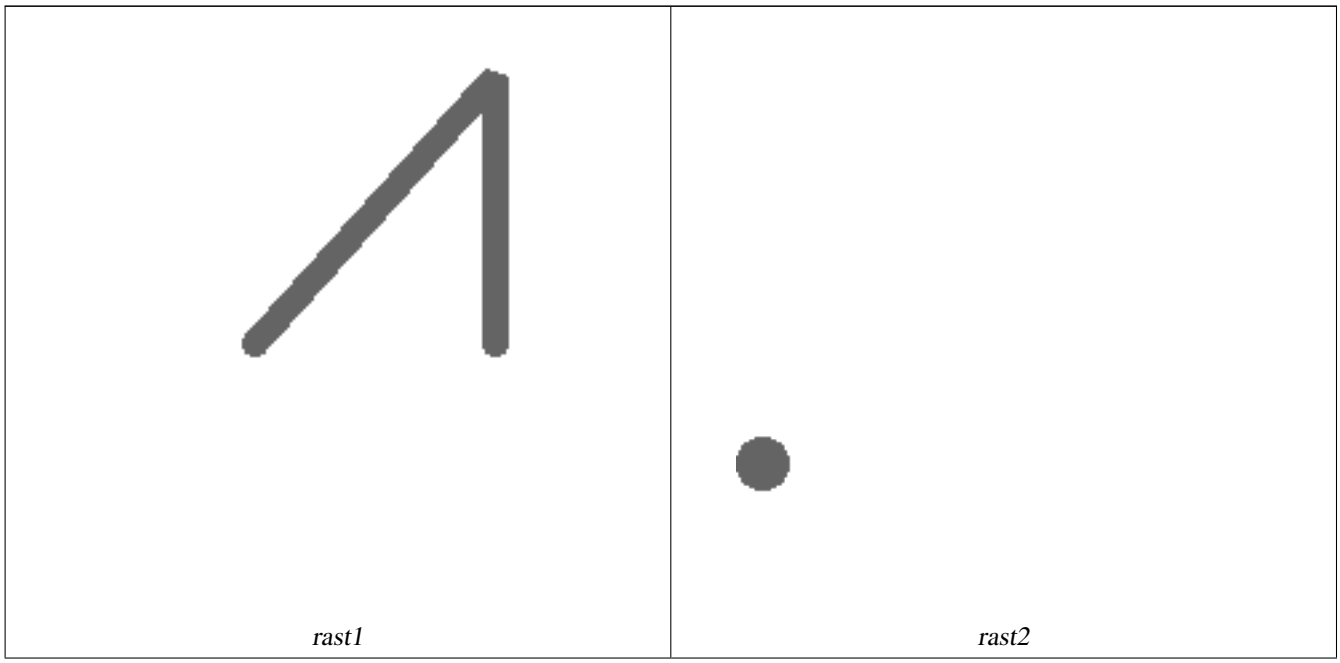
맵 대수 교차(intersection)

맵 대수 통합(union)

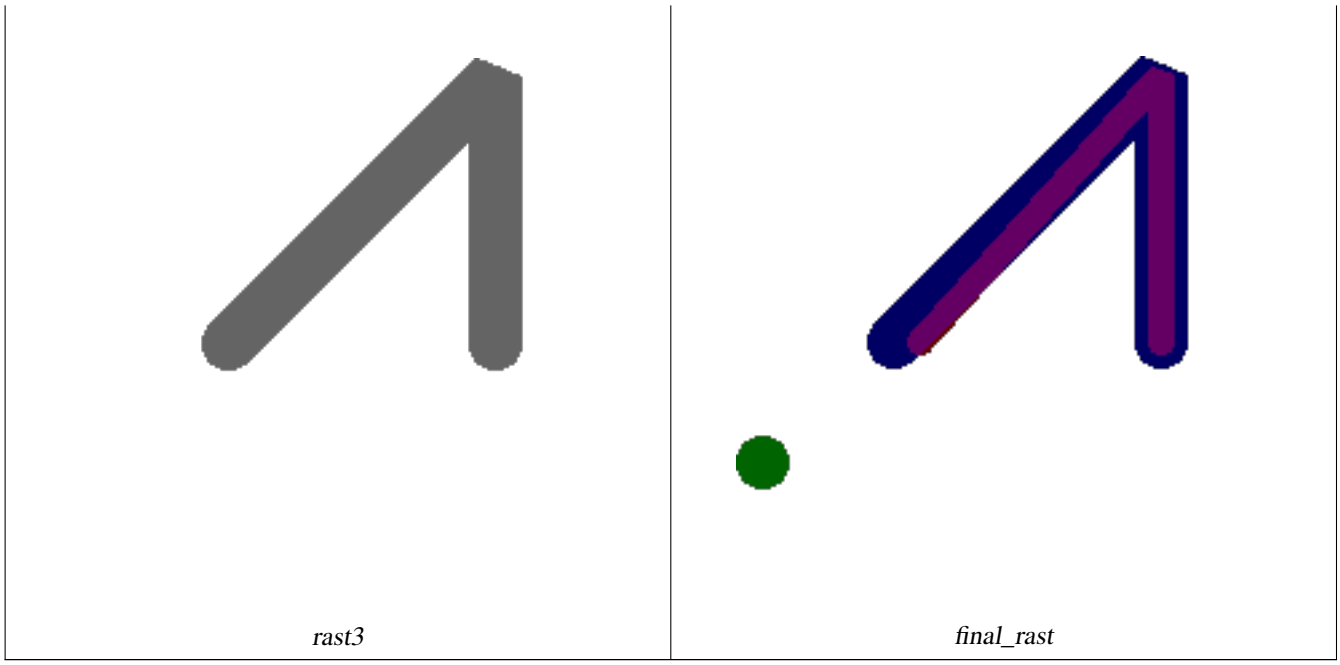
**예시: 캔버스 상에 래스터들을 개&#
밴드로서 오버레이**

```
-- &#xbaa8;&#xb4e0; &#xb2e8;&#xc77c; &#xbc34;&#xb4dc; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xd68c;&#xc0c9;&#xc870;&#xb85c; &#xb9cc;&#xb4e4;&#xae30; &#xc704;&#xd574; ST_AsPNG ↩
    &#xb97c; &#xd1b5;&#xd574; &#xc774;&#xbbf8;&#xc9c0;&#xb97c;  ↩
    &#xb80c;&#xb354;&#xb9c1;&#xd569;&#xb2c8;&#xb2e4;. --
```

```
WITH mygeoms
    AS ( SELECT 2 As bnum, ST_Buffer(ST_Point(1,5),10) As geom
            UNION ALL
            SELECT 3 AS bnum,
                ST_Buffer(ST_GeomFromText('LINESTRING(50 50,150 150,150 50)'), 10,'join= ↩
                    bevel') As geom
            UNION ALL
            SELECT 1 As bnum,
                ST_Buffer(ST_GeomFromText('LINESTRING(60 50,150 150,150 50)'), 5,'join= ↩
                    bevel') As geom
            ),
   -- &#xce94;&#xbc84;&#xc2a4;&#xac00; &#xb3c4;&#xd615;&#xc5d0; 1:1  ↩
       &#xd53d;&#xc140;&#xc774; &#xb418;&#xb3c4;&#xb85d; &#xc815;&#xc758;
   canvas
    AS (SELECT ST_AddBand(ST_MakeEmptyRaster(200,
        200,
        ST_XMin(e)::integer, ST_YMax(e)::integer, 1, -1, 0, 0) , '8BUI'::text,0) As rast
        FROM (SELECT ST_Extent(geom) As e,
                    Max(ST_SRID(geom)) As srid
                    from mygeoms
                    ) As foo
            ),
   rbands AS (SELECT ARRAY(SELECT ST_MapAlgebraExpr(canvas.rast, ST_AsRaster(m.geom, canvas ↩
       .rast, '8BUI', 100),
                 '[rast2.val]', '8BUI', 'FIRST', '[rast2.val]', '[rast1.val]') As rast
               FROM mygeoms AS m CROSS JOIN canvas
               ORDER BY m.bnum) As rasts
               )
          SELECT rasts[1] As rast1 , rasts[2] As rast2, rasts[3] As rast3, ST_AddBand(
                    ST_AddBand(rasts[1],rasts[2]), rasts[3]) As final_rast
            FROM rbands;
```



rast1 | *rast2*



rast3 | *final_rast*

**예시: 항공사진 상에 선택된 획지&#
두께 2미터의 경계선을 오버레이**

```
-- &#xcc98;&#xc74c; 2&#xac1c;&#xc758; &#xbc34;&#xb4dc;&#xb97c;  ↩
    &#xc798;&#xb77c;&#xb0b4;&#xace0; &#xc138; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb97c;  ↩
    &#xb3c4;&#xd615;&#xacfc; &#xacb9;&#xce5c;, &#xbc34;&#xb4dc; 3&#xac1c;&#xb97c;  ↩
    &#xac00;&#xc9c4; &#xc0c8; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
-- PostGIS &#xc708;&#xb3c4;&#xc6b0; 64&#xbe44;&#xd2b8;  ↩
    &#xc124;&#xce58;&#xbcf8;&#xc5d0;&#xc11c; &#xc774; &#xcffc;&#xb9ac;&#xac00; 3.6&#xcd08;  ↩
    &#xac78;&#xb838;&#xc2b5;&#xb2c8;&#xb2e4;.
WITH pr AS
-- &#xc5f0;&#xc0b0; &#xc21c;&#xc11c;&#xc5d0;  ↩
    &#xc8fc;&#xc758;&#xd558;&#xc2ed;&#xc2dc;&#xc624;: &#xbaa8;&#xb4e0;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xd574;&#xb2f9; &#xc9c0;&#xc5ed;&#xc758;  ↩
    &#xcc28;&#xc6d0;&#xc5d0; &#xb9de;&#xac8c; &#xc798;&#xb77c;&#xb0c5;&#xb2c8;&#xb2e4;.
(SELECT ST_Clip(rast,ST_Expand(geom,50) ) As rast, g.geom
        FROM aerials.o_2_boston AS r INNER JOIN
-- &#xad00;&#xc2ec; &#xd68d;&#xc9c0;&#xb97c; &#xd1b5;&#xd569;&#xd574;&#xc11c;  ↩
    &#xb098;&#xc911;&#xc5d0; &#xad50;&#xcc28;&#xc2dc;&#xd0ac; &#xc218; &#xc788;&#xb294;  ↩
    &#xb2e8;&#xc77c; &#xb3c4;&#xd615;&#xc73c;&#xb85c; &#xb9cc;&#xb4ed;&#xb2c8;&#xb2e4;.
                (SELECT ST_Union(ST_Transform(the_geom,26986)) AS geom
                  FROM landparcels WHERE pid IN('0303890000', '0303900000')) As g
                ON ST_Intersects(rast::geometry, ST_Expand(g.geom,50))
),
-- &#xadf8;&#xb9ac;&#xace0; &#xb798;&#xc2a4;&#xd130; &#xc870;&#xac01;&#xb4e4;&#xc744;  ↩
    &#xd1b5;&#xd569;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xb798;&#xc2a4;&#xd130;&#xb97c; ST_Union&#xc73c;&#xb85c;  ↩
    &#xd1b5;&#xd569;&#xd558;&#xb294; &#xc791;&#xc5c5;&#xc740; &#xc870;&#xae08;  ↩
    &#xb290;&#xb9b0; &#xd3b8;&#xc774;&#xc9c0;&#xb9cc;, &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xc798;&#xac8c; &#xcabc;&#xac24;&#xc218;&#xb85d; &#xc18d;&#xb3c4;&#xb294;  ↩
    &#xbe68;&#xb77c;&#xc9d1;&#xb2c8;&#xb2e4;.
-- &#xb530;&#xb77c;&#xc11c; &#xba3c;&#xc800; &#xc798;&#xb77c;&#xb0b8;  ↩
    &#xb2e4;&#xc74c;&#xc5d0; &#xd1b5;&#xd569;&#xd558;&#xb294; &#xd3b8;&#xc774;  ↩
    &#xc88b;&#xc2b5;&#xb2c8;&#xb2e4;.
prunion AS
(SELECT ST_AddBand(NULL, ARRAY[ST_Union(rast,1),ST_Union(rast,2),ST_Union(rast,3)] ) As  ↩
    clipped,geom
```

```
FROM pr
GROUP BY geom)
-- &#xb798;&#xc2a4;&#xd130; &#xc870;&#xac01;&#xb4e4;&#xc744;  ↩
    &#xd1b5;&#xd569;&#xd558;&#xace0; &#xd68d;&#xc9c0; &#xacbd;&#xacc4;&#xc120;&#xacfc;  ↩
    &#xacb9;&#xce5c;
-- &#xacb0;&#xacfc; &#xb798;&#xc2a4;&#xd130;&#xb97c;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xcc98;&#xc74c; 2&#xac1c;&#xc758; &#xbc34;&#xb4dc;&#xb97c; &#xcd94;&#xac00;&#xd55c;  ↩
    &#xb2e4;&#xc74c;, &#xc138; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xc640;  ↩
    &#xb3c4;&#xd615;&#xc5d0; &#xb9f5; &#xb300;&#xc218;&#xb97c;  ↩
    &#xc801;&#xc6a9;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AddBand(ST_Band(clipped,ARRAY[1,2])
        , ST_MapAlgebraExpr(ST_Band(clipped,3), ST_AsRaster(ST_Buffer(ST_Boundary(geom),2), ↩
            clipped, '8BUI',250),
         '[rast2.val]', '8BUI', 'FIRST', '[rast2.val]', '[rast1.val]') ) As rast
FROM prunion;
```

파란색 라인이 선택된 획지의 경계선입니다.

참고

ST_MapAlgebraExpr, ST_AddBand, ST_AsPNG, ST_AsRaster, ST_MapAlgebraFct, ST_BandPixelType, ST_GeoReference, ST_Value, ST_Union, ST_Union

10.12.9 ST_MapAlgebraFct

ST_MapAlgebraFct — 래스터 밴드 1개 버전: 입력 래스터에 대해 유효한 PostgreSQL 대수 연적용해서 형성되고, 설정한 픽셀 유형을 가진, 밴드 1개를 가진 새 래&

생성합니다. 따로 밴드를 설정하&#
않을 경우, 밴드 1로 가정합니다.

Synopsis

raster **ST_MapAlgebraFct**(raster rast, regprocedure onerasteruserfunc);
raster **ST_MapAlgebraFct**(raster rast, regprocedure onerasteruserfunc, text[] VARIADIC args);
raster **ST_MapAlgebraFct**(raster rast, text pixeltype, regprocedure onerasteruserfunc);
raster **ST_MapAlgebraFct**(raster rast, text pixeltype, regprocedure onerasteruserfunc, text[] VARIADIC args);
raster **ST_MapAlgebraFct**(raster rast, integer band, regprocedure onerasteruserfunc);
raster **ST_MapAlgebraFct**(raster rast, integer band, regprocedure onerasteruserfunc, text[] VARIADIC args);
raster **ST_MapAlgebraFct**(raster rast, integer band, text pixeltype, regprocedure onerasteruserfunc);
raster **ST_MapAlgebraFct**(raster rast, integer band, text pixeltype, regprocedure onerasteruserfunc, text[] VARIADIC args);

설명

Warning
ST_MapAlgebraFct 2.1.0 버전부터 더 이상 이 함수를 지원하지 않습니다. 대신 내장 맵 대수 콜백 함수 함수를 이용하십시오.

입력 래스터(`rast`)에 대해 `onerasteruserfunc` 가 정의하는 유효한 PostgreSQL 함수를 적용&
형성된, 밴드 1개를 가진 새 래스터&
생성합니다. `band` 를 설정하지 않을 경우, 밴드 1로 가정합니다. 이 새 래스터는 원본 래스터와 동일한 지리참조, 너비 및 높이이지만, 밴&#
1개만 가질 것입니다.

`pixeltype` 을 설정할 경우, 새 래스터의 밴드가 해당 픽셀 유형이 될 것입&#
`pixeltype` 이 NULL일 경우, 새 래스터의 밴드&
입력 `rast` 의 밴드와 동일한 픽셀 유&#xd
될 것입니다.

`onerasteruserfunc` 파라미터는 regprocedure(회귀 처리)&#
형변환된 SQL 또는 PL/pgSQL 함수의 명칭
및 서명(signature)이어야 합니다. 다음은
매우 간단하고 쓸모없는 PL/pgSQL 함수&#
예입니다:

```
CREATE OR REPLACE FUNCTION simple_function(pixel FLOAT, pos INTEGER[], VARIADIC args TEXT ↩
    [])
RETURNS FLOAT
AS $$ BEGIN
RETURN 0.0;
END; $$
LANGUAGE 'plpgsql' IMMUTABLE;
```

`userfunction` 은 인수를 2개 또는 3개 받을 수
있습니다: 부동소수점 값, 선택적&
정수 배열, 그리고 임의로 여러 인&#
입력받는 문자열 배열입니다. &#xc-
cab; 번째 인수는 (래스터의 데이터&#xd61

상관없이) 개별적인 래스터 셀의 값입니다. 두 번째 인수는 현재 처셀의 위치를 '{x,y}' 서식으로 표현한 것입니다. 세 번째 인수는 ST_MapAlgebraFct 의 모든 나머지 파라미터들을 `userfunction` 을 통해 설정해야 한다는 것을 의&

regprocedure 인수를 SQL 함수에 입력하려면 입력하기 위한 전체 함수 서명이 필요하고, 그 다음 regprocedure 유형으로 형변환해야 합니다. 앞의 PL/pgSQL 함수인수로서 넘겨주려면, 해당 인수위한 SQL은 다음과 같습니다:

```
'simple_function(float,integer[],text[])'::regprocedure
```

해당 인수가 함수의 명칭, 함수 인유형, 명칭 및 인수 유형을 감싼 따그리고 regprocedure 로의 형변환을 포함하있다는 점에 주의하십시오.

`userfunction` 에 들어가는 세 번째 인수는 variadic text 배열입니다. 어떤 ST_MapAlgebraFct 함수 호출에도 입력되는 길고 긴 텍스인수들이 모두 지정된 `userfunction` 에 넘겨주는 `args` 인수에 담겨집니다.

Note

(다양한 개수의 인수를 입력받는) VARIADIC 키워드에 대한 더 자세한 정보를 알고 싶다면, PostgreSQL 문서 가운데 Query Language (SQL) Functions 의 "SQL Functions with Variable Numbers of Arguments" 단원을 참조하십시오.

Note

공간 처리를 위해 사용자 함수에 어떤 인수를 넘겨주기로 하고 말고에 상관없이, `userfunction` 에 들어가는 text[] 인수는 필요합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

원본 래스터 2개를 입력받는 모듈함수인 원본으로부터 밴드 1개를 가진 새 래스터를 생성합니다.

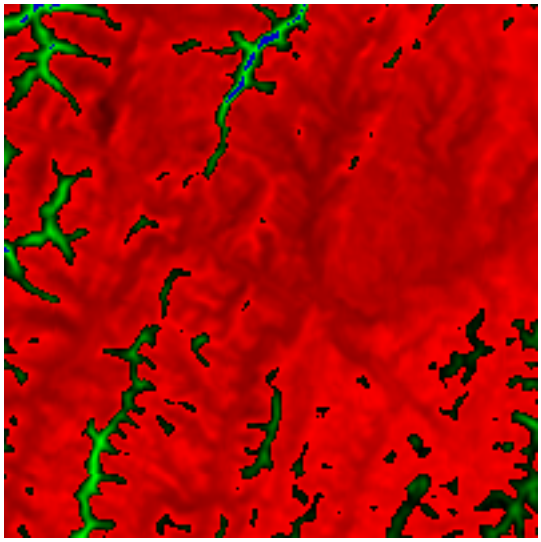
```
ALTER TABLE dummy_rast ADD COLUMN map_rast raster;
CREATE FUNCTION mod_fct(pixel float, pos integer[], variadic args text[])
RETURNS float
AS $$
BEGIN
    RETURN pixel::integer % 2;
```

```
END;
$$
LANGUAGE 'plpgsql' IMMUTABLE;

UPDATE dummy_rast SET map_rast = ST_MapAlgebraFct(rast,NULL,'mod_fct(float,integer[],text ↩
    [])'::regprocedure) WHERE rid = 2;

SELECT ST_Value(rast,1,i,j) As origval, ST_Value(map_rast, 1, i, j) As mapval
FROM dummy_rast CROSS JOIN generate_series(1, 3) AS i CROSS JOIN generate_series(1,3) AS j
WHERE rid = 2;

 origval | mapval
---------+--------
     253 |      1
     254 |      0
     253 |      1
     253 |      1
     254 |      0
     254 |      0
     250 |      0
     254 |      0
     254 |      0
```

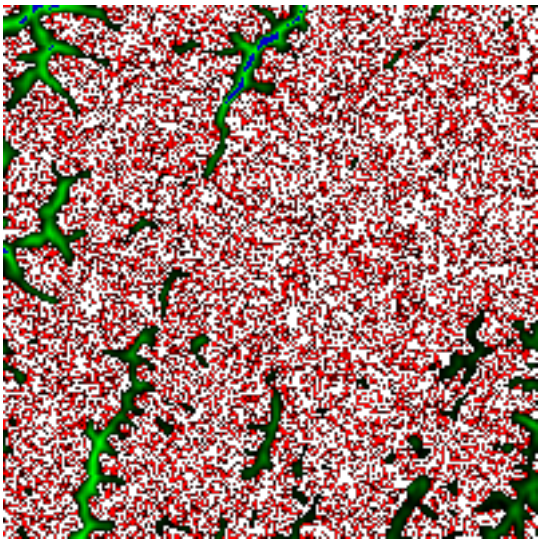
재분류를 거치고 NODATA 값을 사용자 함수(0)으로 넘겨진 파라미터로 설원본으로부터 픽셀 유형이 2BUI인, 밴드 1개를 가진 새 래스터를 생성&

```
ALTER TABLE dummy_rast ADD COLUMN map_rast2 raster;
CREATE FUNCTION classify_fct(pixel float, pos integer[], variadic args text[])
RETURNS float
AS
$$
DECLARE
    nodata float := 0;
BEGIN
    IF NOT args[1] IS NULL THEN
        nodata := args[1];
    END IF;
    IF pixel < 251 THEN
        RETURN 1;
    ELSIF pixel = 252 THEN
        RETURN 2;
    ELSIF pixel > 252 THEN
        RETURN 3;
    ELSE
        RETURN nodata;
    END IF;
END;
$$
LANGUAGE 'plpgsql';
UPDATE dummy_rast SET map_rast2 = ST_MapAlgebraFct(rast,'2BUI','classify_fct(float,integer ↩
    [],text[])'::regprocedure, '0') WHERE rid = 2;

SELECT DISTINCT ST_Value(rast,1,i,j) As origval, ST_Value(map_rast2, 1, i, j) As mapval
FROM dummy_rast CROSS JOIN generate_series(1, 5) AS i CROSS JOIN generate_series(1,5) AS j
WHERE rid = 2;

 origval | mapval
---------+--------
     249 |      1
     250 |      1
```

```
     251 |
     252 |       2
     253 |       3
     254 |       3

SELECT ST_BandPixelType(map_rast2) As b1pixtyp
FROM dummy_rast WHERE rid = 2;

 b1pixtyp
----------
 2BUI
```



원본(rast-view 열)



rast_view_ma

밴드 3개를 가진 원본 래스터에서 맵 대수로 첫 번째 밴드를 조정하나머지 두 밴드는 그대로 둔 상태동일한 픽셀 유형인 밴드 3개를 가새 래스터를 생성합니다.

```
CREATE FUNCTION rast_plus_tan(pixel float, pos integer[], variadic args text[])
RETURNS float
AS
$$
BEGIN
        RETURN tan(pixel) * pixel;
END;
$$
LANGUAGE 'plpgsql';

SELECT ST_AddBand(
        ST_AddBand(
                ST_AddBand(
                        ST_MakeEmptyRaster(rast_view),
                        ST_MapAlgebraFct(rast_view,1,NULL,'rast_plus_tan(float,integer[], ↩
                            text[])'::regprocedure)
                ),
                ST_Band(rast_view,2)
        ),
```

```
        ST_Band(rast_view, 3) As rast_view_ma
)
FROM wind
WHERE rid=167;
```

참고

ST_MapAlgebraExpr, ST_BandPixelType, ST_GeoReference, ST_SetValue

10.12.10 ST_MapAlgebraFct

ST_MapAlgebraFct — 래스터 밴드 2개 버전: 입력 래스터 2개에 대해 유효한 PostgreSQL 함&#xc218 적용해서 형성되고, 설정한 픽셀 유형을 가진, 밴드 1개를 가진 새 래& 생성합니다. 따로 밴드를 설정하& 않을 경우, 밴드 1로 가정합니다. 범 유형을 따로 설정하지 않을 경우 기본값은 INTERSECTION입니다.

Synopsis

raster **ST_MapAlgebraFct**(raster rast1, raster rast2, regprocedure tworastuserfunc, text pixeltype=same_as_rast1, text extenttype=INTERSECTION, text[] VARIADIC userargs);
raster **ST_MapAlgebraFct**(raster rast1, integer band1, raster rast2, integer band2, regprocedure tworastuserfunc, text pixeltype=same_as_rast1, text extenttype=INTERSECTION, text[] VARIADIC userargs);

설명

Warning
ST_MapAlgebraFct 2.1.0 버전부터 더 이상 이 함수를 지원하지 않습니다. 대신 내장 맵 대수 콜백 함수 함수를 이용하십시오.

입력 래스터 `rast1`, `rast2` 에 대해 `tworastuserfunc` 가 정의하는 PostgreSQL 함수를 적용해서 형 밴드 1개를 가진 새 래스터를 생성& `band1` 또는 `band2` 를 설정하지 않을 경우, 밴드 1로 가정합니다. 이 새 래스터 원본 래스터와 동일한 지리참조, 너비 및 높이이지만, 밴드는 1개만 가질 것입니다.

`pixeltype` 을 설정할 경우, 새 래스터의 밴드가 해당 픽셀 유형이 될 것입& `pixeltype` 이 NULL이거나 따로 설정하지 않& 경우, 새 래스터의 밴드는 입력 `rast1` 의 밴드와 동일한 픽셀 유형이 될 것입니다.

`tworastuserfunc` 파라미터는 regprocedure(회귀 처리)& 형변환된 SQL 또는 PL/pgSQL 함수의 명칭

및 서명(signature)이어야 합니다. 다음은 PL/pgSQL 함수의 예입니다:

```
CREATE OR REPLACE FUNCTION simple_function_for_two_rasters(pixel1 FLOAT, pixel2 FLOAT, pos  ↩
    INTEGER[], VARIADIC args TEXT[])
RETURNS FLOAT
AS $$ BEGIN
RETURN 0.0;
END; $$
LANGUAGE 'plpgsql' IMMUTABLE;
```

`tworastuserfunc` 은 인수를 3개 또는 4개 받을 수 있습니다: 이중 정밀도 값, 이중 정밀도 값, 선택적인 정수형 배열, 그리고 임의로 여러 인수를 입력&#x 문자열 배열입니다. 첫 번째 인수&#x (래스터의 데이터형과 상관없이) `rast1`에 있는 개별적인 래스터 셀의 값입니다. 두 번째 인수는 `rast2`에 있&#x 개별적인 래스터 셀의 값입니다. 세 번째 인수는 현재 처리중인 셀&# 위치를 '{x,y}' 서식으로 표현한 것입&#xb2 네 번째 인수는 ST_MapAlgebraFct 의 모든 나머&# 파라미터들을 `tworastuserfunc` 을 통해 설정& 한다는 것을 의미합니다.

regprocedure 인수를 SQL 함수에 입력하려면 입력하기 위한 전체 함수 서명이 필요하고, 그 다음 regprocedure 유형으로 형변환해야 합니다. 앞의 PL/pgSQL 함수& 인수로서 넘겨주려면, 해당 인수&#x 위한 SQL은 다음과 같습니다:

```
'simple_function(double precision, double precision, integer[], text[])'::regprocedure
```

해당 인수가 함수의 명칭, 함수 인& 유형, 명칭 및 인수 유형을 감싼 따& 그리고 regprocedure 로의 형변환을 포함하& 있다는 점에 주의하십시오.

The fourth argument to the `tworastuserfunc` is a variadic text array. All trailing text arguments to any ST_MapAlgebraFct call are passed through to the specified `tworastuserfunc`, and are contained in the `userargs` argument.

Note

(다양한 개수의 인수를 입력받는) VARIADIC 키워드에 대한 더 자세한 정보를 알고 싶다면, PostgreSQL 문서 가운데 Query Language (SQL) Functions 의 "SQL Functions with Variable Numbers of Arguments" 단원을 참조하십시오.

Note

공간 처리를 위해 사용자 함수에 어떤 인수를 넘겨주기로 하고 말고에 상관없이, `tworastuserfunc` 에 들어가는 text[] 인수는 필요합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시: 캔버스 상에 래스터들을 개밴드로서 오버레이

```
-- &#xc0ac;&#xc6a9;&#xc790; &#xc9c0;&#xc815; &#xd568;&#xc218;&#xb97c; &#xc815;&#xc758; --
CREATE OR REPLACE FUNCTION raster_mapalgebra_union(
        rast1 double precision,
        rast2 double precision,
    pos integer[],
        VARIADIC userargs text[]
)
        RETURNS double precision
        AS $$
        DECLARE
        BEGIN
                CASE
                        WHEN rast1 IS NOT NULL AND rast2 IS NOT NULL THEN
                                RETURN ((rast1 + rast2)/2.);
                        WHEN rast1 IS NULL AND rast2 IS NULL THEN
                                RETURN NULL;
                        WHEN rast1 IS NULL THEN
                                RETURN rast2;
                        ELSE
                                RETURN rast1;
                END CASE;

                RETURN NULL;
        END;
        $$ LANGUAGE 'plpgsql' IMMUTABLE COST 1000;

-- &#xb798;&#xc2a4;&#xd130; &#xd14c;&#xc2a4;&#xd2b8; &#xd14c;&#xc774;&#xbe14; &#xc900;&#xbe44;
DROP TABLE IF EXISTS map_shapes;
CREATE TABLE map_shapes(rid serial PRIMARY KEY, rast raster, bnum integer, descrip text);
INSERT INTO map_shapes(rast,bnum, descrip)
WITH mygeoms
    AS ( SELECT 2 As bnum, ST_Buffer(ST_Point(90,90),30) As geom, 'circle' As descrip
            UNION ALL
            SELECT 3 AS bnum,
                ST_Buffer(ST_GeomFromText('LINESTRING(50 50,150 150,150 50)'), 15) As geom, ↩
                     'big road' As descrip
            UNION ALL
            SELECT 1 As bnum,
                ST_Translate(ST_Buffer(ST_GeomFromText('LINESTRING(60 50,150 150,150 50)'), ↩
                     8,'join=bevel'), 10,-6) As geom, 'small road' As descrip
            ),
   -- &#xce94;&#xbc84;&#xc2a4;&#xac00; &#xb3c4;&#xd615;&#xc5d0; 1:1  ↩
       &#xd53d;&#xc140;&#xc774; &#xb418;&#xb3c4;&#xb85d; &#xc815;&#xc758;
   canvas
    AS ( SELECT ST_AddBand(ST_MakeEmptyRaster(250,
        250,
        ST_XMin(e)::integer, ST_YMax(e)::integer, 1, -1, 0, 0 ) , '8BUI'::text,0) As rast
        FROM (SELECT ST_Extent(geom) As e,
                    Max(ST_SRID(geom)) As srid
                    from mygeoms
                    ) As foo
            )
-- &#xce94;&#xbc84;&#xc2a4;&#xc5d0; &#xc815;&#xb82c;&#xb41c;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xbc18;&#xd658;
SELECT ST_AsRaster(m.geom, canvas.rast, '8BUI', 240) As rast, bnum, descrip
                FROM mygeoms AS m CROSS JOIN canvas
UNION ALL
SELECT canvas.rast, 4, 'canvas'
FROM canvas;
```

```
-- &#xb2e8;&#xc77c; &#xbc34;&#xb4dc; &#xb798;&#xc2a4;&#xd130;&#xc5d0; &#xb300;&#xd574;  ↩
    &#xb9f5; &#xb300;&#xc218;&#xb97c; &#xc5f0;&#xc0b0;&#xd55c; &#xb2e4;&#xc74c; ST_AddBand ↩
    &#xb85c; &#xbaa8;&#xc73c;&#xae30;
INSERT INTO map_shapes(rast,bnum,descrip)
SELECT ST_AddBand(ST_AddBand(rasts[1], rasts[2]),rasts[3]), 4, 'map bands overlay fct union ↩
     (canvas)'
        FROM (SELECT ARRAY(SELECT ST_MapAlgebraFct(m1.rast, m2.rast,
                        'raster_mapalgebra_union(double precision, double precision,  ↩
                            integer[], text[])'::regprocedure, '8BUI', 'FIRST')
                FROM map_shapes As m1 CROSS JOIN map_shapes As m2
        WHERE m1.descrip = 'canvas' AND m2.descrip <> 'canvas' ORDER BY m2.bnum) As rasts)  ↩
            As foo;
```

맵 밴드 오버레이(캔버스) (R: small road, G: circle, B: big road)

추가 인수를 입력받는 사용자 지&#x
함수

```
CREATE OR REPLACE FUNCTION raster_mapalgebra_userargs(
        rast1 double precision,
        rast2 double precision,
    pos integer[],
        VARIADIC userargs text[]
)
        RETURNS double precision
        AS $$
        DECLARE
        BEGIN
                CASE
                        WHEN rast1 IS NOT NULL AND rast2 IS NOT NULL THEN
                                RETURN least(userargs[1]::integer,(rast1 + rast2)/2.);
                        WHEN rast1 IS NULL AND rast2 IS NULL THEN
```

```
                                RETURN userargs[2]::integer;
                        WHEN rast1 IS NULL THEN
                                RETURN greatest(rast2,random()*userargs[3]::integer):: ↩
                                    integer;
                        ELSE
                                RETURN greatest(rast1, random()*userargs[4]::integer):: ↩
                                    integer;
                END CASE;

                RETURN NULL;
        END;
        $$ LANGUAGE 'plpgsql' VOLATILE COST 1000;

SELECT ST_MapAlgebraFct(m1.rast, 1, m1.rast, 3,
                        'raster_mapalgebra_userargs(double precision, double precision,  ↩
                           integer[], text[])'::regprocedure,
                                '8BUI', 'INTERSECT', '100','200','200','0')
                FROM map_shapes As m1
        WHERE m1.descrip = 'map bands overlay fct union (canvas)';
```

추가 인수 및 동일한 래스터에서 가져온 다른 밴드를 받는 사용자 지정 함수

참고

ST_MapAlgebraExpr, ST_BandPixelType, ST_GeoReference, ST_SetValue

10.12.11 ST_MapAlgebraFctNgb

ST_MapAlgebraFctNgb — 래스터 밴드 1개 버전: 사용&#x
지정 PostgreSQL 함수를 이용하는 맵 대수
최근접 이웃(Map Algebra Nearest Neighbor)입니다. 입력
래스터 밴드의 값의 이웃(neighborhood)이

관련된 PostgreSQL 사용자 함수가 출력하&
값을 가진 래스터를 반환합니다.

Synopsis

raster **ST_MapAlgebraFctNgb**(raster rast, integer band, text pixeltype, integer ngbwidth, integer ngbheight, regprocedure onerastngbuserfunc, text nodatamode, text[] VARIADIC args);

설명

Warning
ST_MapAlgebraFctNgb 2.1.0 버전부터 더 이상 이 함수를 지원하지 않습니다. 대신 내장 맵 대수 콜백 함수 함수를 이용하십시오.

래스터 1개 버전: 입력 래스터 밴드
값의 이웃(neighborhood)이 관련된 PostgreSQL 사용&#xc
함수가 출력하는 값을 가진 래스&#
반환합니다. 사용자 함수가 픽셀&#
이웃 값을 숫자의 배열로 입력받&#
각 픽셀에 대해 사용자 함수의 결&#
반환해서. 현재 처리중인 픽셀의
픽셀 값을 함수 결과값으로 대체&#

rast 사용자 함수를 평가하는 데 쓰&#xc77
래스터

band 평가할 래스터 밴드 번호(기본&#xac
1)

pixeltype 출력 래스터의 픽셀 유형입니&
이 유형은 ST_BandPixelType 목록에 존재하&#xb29
유형 가운데 하나이거나, 생략&#xb4
NULL로 설정돼야만 합니다. 따로 설
않거나 NULL로 설정하지 않으면, `rast`&#x
픽셀 유형을 기본값으로 삼을
것입니다. 결과값이 픽셀 유형&#xc75
허용치보다 클 경우 결과값의
길이를 허용치에 맞춰 줄입니&#xb2e

ngbwidth 이웃(neighborhood)의 셀 단위 너비

ngbheight 이웃(neighborhood)의 셀 단위 높이

onerastngbuserfunc 래스터의 단일 밴드의 근접
픽셀에 적용할 PL/pgSQL 또는 psql 사용자
함수입니다. 첫 번째 요소가 사&#xac
픽셀 이웃을 표현하는 2차원 숫&#xc
배열입니다.

nodatamode NODATA 또는 NULL인 이웃 픽셀의 경우
함수에 어떤 값을 넘겨줄지 정&#xc7

'ignore': 이웃에서 맞닥뜨린 어떤 NODATA
값도 계산을 통해 무시합니다.

사용자 콜백 함수에 이 플래그&#xb97
전송해야만 하며, 사용자 함수&#xb2
NODATA 값을 어떻게 무시할 것인지
결정합니다.

'NULL': 이웃에서 맞닥뜨린 모든 NODATA
값이 출력 픽셀을 NULL로 만들 것입
이 경우 사용자 콜백 함수를 건&#xb1

'value': 이웃에서 맞닥뜨린 어떤 NODATA
값도 참조 픽셀(이웃의 한가운&#xb3
있는 픽셀)로 대체합니다. 이 값&#x
NODATA일 경우, (영향을 받는 이웃에
대해) 'NULL'과 동일한 습성을 보인&#xb2e4
점에 주의하십시오.

args 사용자 함수로 넘겨줄 인수들

2.0.0 버전부터 사용할 수 있습니다.

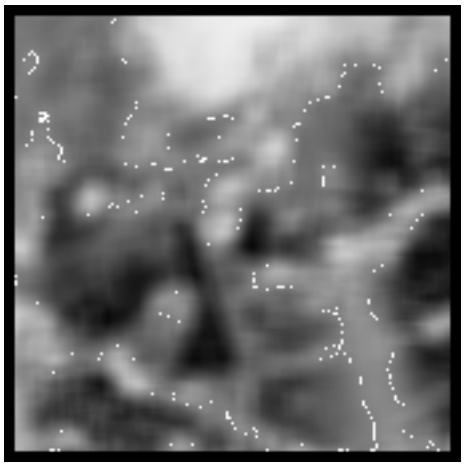
예시

다음 예시는 http://trac.osgeo.org/gdal/wiki/frmts_wtkraster.html 에서 설&
대로 단일 타일로 불러온 다음 ST_Rescale
예시 대로 준비한 카트리나 래스&#
활용합니다.

```
-- &#xc774;&#xc6c3;&#xc5d0; &#xc788;&#xb294; &#xbaa8;&#xb4e0; &#xac12;&#xc744;  ↩
    &#xd3c9;&#xade0;&#xd558;&#xb294; &#xb2e8;&#xc21c;&#xd55c; '&#xcf5c;&#xbc31;'  ↩
    &#xc0ac;&#xc6a9;&#xc790; &#xd568;&#xc218;&#xc785;&#xb2c8;&#xb2e4;. --
CREATE OR REPLACE FUNCTION rast_avg(matrix float[][], nodatamode text, variadic args text ↩
    [])
    RETURNS float AS
    $$
    DECLARE
                _matrix float[][];
        x1 integer;
        x2 integer;
        y1 integer;
        y2 integer;
        sum float;
    BEGIN
                _matrix := matrix;
        sum := 0;
        FOR x in array_lower(matrix, 1)..array_upper(matrix, 1) LOOP
            FOR y in array_lower(matrix, 2)..array_upper(matrix, 2) LOOP
                sum := sum + _matrix[x][y];
            END LOOP;
        END LOOP;
        RETURN (sum*1.0/(array_upper(matrix,1)*array_upper(matrix,2) ))::integer ;
    END;
    $$
LANGUAGE 'plpgsql' IMMUTABLE COST 1000;

-- &#xc774;&#xc81c; &#xac01;&#xac01; &#xc11c;&#xb85c;&#xc758; X &#xbc0f; Y  ↩
    &#xbc29;&#xd5a5;&#xc73c;&#xb85c; &#xd53d;&#xc140; 2&#xac1c; &#xb9cc;&#xd07c;&#xc758;  ↩
    &#xac70;&#xb9ac; &#xc548;&#xc5d0; &#xb798;&#xc2a4;&#xd130;&#xc758;  ↩
    &#xd3c9;&#xade0;&#xb0b8; &#xd53d;&#xc140;&#xb4e4;&#xc744;  ↩
    &#xc801;&#xc6a9;&#xd574;&#xbd05;&#xc2dc;&#xb2e4;. --
SELECT ST_MapAlgebraFctNgb(rast, 1,  '8BUI', 4,4,
                'rast_avg(float[][], text, text[])'::regprocedure, 'NULL', NULL) As  ↩
                    nn_with_border
```

```
        FROM katrinas_rescaled
        limit 1;
```

래스터의 첫 번째 밴드



각각 서로의 4x4 픽셀 거리 안에 있는 픽셀들을 평균낸 후의 새 래스터

참고

ST_MapAlgebraFct, ST_MapAlgebraExpr, ST_Rescale

10.12.12 ST_Reclass

ST_Reclass — 원본으로부터 재분류된 밴&#xb4dc
유형으로 이루어진 새 래스터를
생성합니다. `nband` 는 변경할 밴드를
가리킵니다. `nband` 를 따로 설정하지
않을 경우 밴드 1로 가정합니다. 다&
모든 밴드들은 변경 없이 반환됩&#
실제 사례: 보기 좋은 형식으로 더
간단하게 렌더링하기 위해 16BUI 밴&#xb4
8BUI 등등으로 변환하십시오.

Synopsis

raster **ST_Reclass**(raster rast, integer nband, text reclassexpr, text pixeltype, double precision nodataval=NULL);
raster **ST_Reclass**(raster rast, reclassarg[] VARIADIC reclassargset);
raster **ST_Reclass**(raster rast, text reclassexpr, text pixeltype);

설명

입력 래스터(`rast`)에 대해 `reclassexpr` 이 정&#xc75
유효한 PostgreSQL 대수 연산을 적용해서

형성된 새 래스터를 생성합니다. band 를 설정하지 않을 경우, 밴드 1로 가정합니다. 이 새 래스터는 원본 래스터와 동일한 지리참조, 너비 및 높이를 가질 것입니다. 지정하&#x 않은 밴드들은 변경 없이 반환될 것입니다. 유효한 재분류 표현식&# 대한 설명이 필요한 경우 reclassarg 를 참&

새 래스터의 밴드들은 pixeltype 픽셀 유형일 것입니다. reclassargset 를 넘겨받&# 경우, 각 reclassarg(재분류 인수)가 생성된 각 밴드의 습성을 정의합니다.

2.0.0 버전부터 사용할 수 있습니다.

기본 예시

원본의 밴드 2를 8BUI에서 4BUI로 변환하& 101에서 254까지의 모든 값을 NODATA 값으&#xb8 설정한 새 래스터를 생성합니다.

```
ALTER TABLE dummy_rast ADD COLUMN reclass_rast raster;
UPDATE dummy_rast SET reclass_rast = ST_Reclass(rast,2,'0-87:1-10, 88-100:11-15,  ↩
    101-254:0-0', '4BUI',0) WHERE rid = 2;

SELECT i as col, j as row, ST_Value(rast,2,i,j) As origval,
    ST_Value(reclass_rast, 2, i, j) As reclassval,
    ST_Value(reclass_rast, 2, i, j, false) As reclassval_include_nodata
FROM dummy_rast CROSS JOIN generate_series(1, 3) AS i CROSS JOIN generate_series(1,3) AS j
WHERE rid = 2;

 col | row | origval | reclassval | reclassval_include_nodata
-----+-----+---------+------------+---------------------------
   1 |   1 |      78 |          9 |                         9
   2 |   1 |      98 |         14 |                        14
   3 |   1 |     122 |            |                         0
   1 |   2 |      96 |         14 |                        14
   2 |   2 |     118 |            |                         0
   3 |   2 |     180 |            |                         0
   1 |   3 |      99 |         15 |                        15
   2 |   3 |     112 |            |                         0
   3 |   3 |     169 |            |                         0
```

재분류 인수를 여러 개 이용하는 고급 예시

원본 래스터의 밴드 1, 2, 3을 각각 1BB, 4BUI, 4BUI로 변환하고 재분류한 새 래스& 생성합니다. 이 예시가 (이론적으& 사용자가 가진 밴드의 개수만큼) 무한한 개수의 재분류 인수를 입&# 수 있는, 다양한 개수의 인수를 입& reclassarg 인수를 이용한다는 점에 주&#xc758

```
UPDATE dummy_rast SET reclass_rast =
    ST_Reclass(rast,
        ROW(2,'0-87]:1-10, (87-100]:11-15, (101-254]:0-0', '4BUI',NULL)::reclassarg,
        ROW(1,'0-253]:1, 254:0', '1BB', NULL)::reclassarg,
```

```
        ROW(3,'0-70]:1, (70-86:2, [86-150):3, [150-255:4', '4BUI', NULL)::reclassarg
        ) WHERE rid = 2;

SELECT i as col, j as row,ST_Value(rast,1,i,j) As ov1,  ST_Value(reclass_rast, 1, i, j) As ↩
    rv1,
    ST_Value(rast,2,i,j) As ov2, ST_Value(reclass_rast, 2, i, j) As rv2,
    ST_Value(rast,3,i,j) As ov3, ST_Value(reclass_rast, 3, i, j) As rv3
FROM dummy_rast CROSS JOIN generate_series(1, 3) AS i CROSS JOIN generate_series(1,3) AS j
WHERE rid = 2;

col | row | ov1 | rv1 | ov2 | rv2 | ov3 | rv3
----+-----+-----+-----+-----+-----+-----+-----
  1 |   1 | 253 |   1 |  78 |   9 |  70 |   1
  2 |   1 | 254 |   0 |  98 |  14 |  86 |   3
  3 |   1 | 253 |   1 | 122 |   0 | 100 |   3
  1 |   2 | 253 |   1 |  96 |  14 |  80 |   2
  2 |   2 | 254 |   0 | 118 |   0 | 108 |   3
  3 |   2 | 254 |   0 | 180 |   0 | 162 |   4
  1 |   3 | 250 |   1 |  99 |  15 |  90 |   3
  2 |   3 | 254 |   0 | 112 |   0 | 108 |   3
  3 |   3 | 254 |   0 | 169 |   0 | 175 |   4
```

단일 32BF 밴드를 가진 래스터를 보&#xae3 좋은 밴드 여러 개에 매핑하는 고&# 예시

32BF 밴드 하나만 가진 래스터로부&#xd1 새로운 밴드 3개((8BUI,8BUI,8BUI)를 가진 보기 좋은 새 래스터를 생성합니다.

```
ALTER TABLE wind ADD COLUMN rast_view raster;
UPDATE wind
        set rast_view = ST_AddBand( NULL,
        ARRAY[
        ST_Reclass(rast, 1,'0.1-10]:1-10,9-10]:11,(11-33:0'::text, '8BUI'::text,0),
        ST_Reclass(rast,1, '11-33):0-255,[0-32:0,(34-1000:0'::text, '8BUI'::text,0),
        ST_Reclass(rast,1,'0-32]:0,(32-100:100-255'::text, '8BUI'::text,0)
        ]
        );
```

참고

ST_AddBand, ST_Band, ST_BandPixelType, ST_MakeEmptyRaster, reclassarg, ST_Value

10.12.13 ST_Union

ST_Union — 래스터 타일 집합을 1개 이상&#xc75 밴드로 이루어진 단일 래스터로 통합합니다.

Synopsis

bytea **ST_AsJPEG**(raster rast, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer nband, integer quality);
bytea **ST_AsJPEG**(raster rast, integer nband, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer[] nbands, text[] options=NULL);
bytea **ST_AsJPEG**(raster rast, integer[] nbands, integer quality);

설명

래스터 타일 집합을 최소한 밴드 1개로 이루어진 단일 래스터로 통출력 래스터의 범위는 전체 집합범위입니다. 교차 부분의 경우, `uniontyp` 이 결과 값을 정의합니다. `uniontype` 의 값은 LAST(기본값), FIRST, MIN, MAX, COUNT, SUM, MEAN, RANGE 가운하나입니다.

Note
In order for rasters to be unioned, they must all have the same alignment. Use ST_SameAlignment and ST_NotSameAlignmentReason for more details and help. One way to fix alignment issues is to use ST_Resample and use the same reference raster for alignment.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 속도가 향&#xc0C언어 기반으로 변경했습니다).

2.1.0 버전부터 ST_Union(rast, unionarg) 변종을 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 ST_Union(rast) 변종 1 함수가 모든 입력 래스터의 모든 밴드를 통합합니다. PostGIS 이전 버전&#첫 번째 밴드로 가정했습니다.

개선 사항: 2.1.0 버전부터 ST_Union(rast, uniontype) 변종4 함수가 모든 입력 래스터의 모든 밴드를 통합합니다.

예시: 단일 밴드를 가진 래스터 타&#뭉치를 재구성

```
-- &#xc6d0;&#xbcf8; &#xd30c;&#xc77c; &#xc2dc;&#xc2a4;&#xd15c; &#xd0c0;&#xc77c;&#xc744;  ↩
    &#xd615;&#xc131;&#xd558;&#xb294; &#xb798;&#xc2a4;&#xd130; &#xd0c0;&#xc77c;&#xb4e4;&#xc758;
-- &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xb85c;&#xbd80;&#xd130; &#xb2e8;&#xc77c;  ↩
    &#xbc34;&#xb4dc;&#xb97c; &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
SELECT filename, ST_Union(rast,1) As file_rast
FROM sometable WHERE filename IN('dem01', 'dem02') GROUP BY filename;
```

예시: 타일이 도형과 교차하는 부&#통합한 다중 밴드 래스터를 반환

```
-- &#xb77c;&#xc778;&#xacfc; &#xad50;&#xcc28;&#xd558;&#xb294; &#xbaa8;&#xb4e0;  ↩
    &#xd0c0;&#xc77c;&#xb4e4;&#xc744; &#xbaa8;&#xc740; &#xb2e4;&#xc911; &#xbc34;&#xb4dc;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xc8fc;&#xc758;: 2.0 &#xbc84;&#xc804;&#xc5d0;&#xc11c; &#xc774;  ↩
    &#xcffc;&#xb9ac;&#xb294; &#xb2e8;&#xc77c; &#xbc34;&#xb4dc;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xbc18;&#xd658;&#xd588;&#xaca0;&#xc9c0;&#xb9cc;
-- &#xc0c8; &#xbc84;&#xc804;&#xc740; &#xae30;&#xbcf8;&#xc801;&#xc73c;&#xb85c;  ↩
    &#xbaa8;&#xb4e0; &#xbc34;&#xb4dc;&#xb97c; &#xcc98;&#xb9ac;&#xd569;&#xb2c8;&#xb2e4;.
-- &#xc774; &#xcffc;&#xb9ac;&#xb294; unionarg: ARRAY[ROW(1, 'LAST'), ROW(2, 'LAST'), ROW(3, ↩
     'LAST')]::unionarg[]&#xacfc; &#xb3d9;&#xc77c;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_Union(rast)
FROM aerials.boston
```

```
WHERE ST_Intersects(rast,  ST_GeomFromText('LINESTRING(230486 887771, 230500 88772)',26986) ↩
    );
```

**예시: 타일이 도형과 교차하는 부&#
통합한 다중 밴드 래스터를 반환**

다음은 밴드들의 하위 집합만을
원하거나, 또는 밴드들의 순서를
변경하고자 하는 경우 더 긴 문법&#
사용하는 예시입니다.

```
-- &#xb77c;&#xc778;&#xacfc; &#xad50;&#xcc28;&#xd558;&#xb294; &#xbaa8;&#xb4e0;  ↩
    &#xd0c0;&#xc77c;&#xb4e4;&#xc744; &#xbaa8;&#xc740; &#xb2e4;&#xc911; &#xbc34;&#xb4dc;  ↩
    &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xc0dd;&#xc131;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_Union(rast,ARRAY[ROW(2, 'LAST'), ROW(1, 'LAST'), ROW(3, 'LAST')]::unionarg[])
FROM aerials.boston
WHERE ST_Intersects(rast,  ST_GeomFromText('LINESTRING(230486 887771, 230500 88772)',26986) ↩
    );
```

참고

unionarg, ST_Envelope, ST_ConvexHull, ST_Clip, ST_Union

10.13 내장 맵 대수 콜백 함&#xc

10.13.1 ST_Distinct4ma

ST_Distinct4ma — 이웃에서 유일한 픽셀 값들&#x
개수를 계산하는 래스터 공간 처&#x
함수입니다.

Synopsis

float8 **ST_Distinct4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Distinct4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 유일한 픽셀
값들의 개수를 계산합니다.

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백
파라미터로 쓰이는 특화된
콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수
의 콜백 파라미터로 쓰이는
특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xa

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, NULL, 1, 1, 'st_distinct4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid | st_value
-----+----------
   2 |        3
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Max4ma, ST_Sum4ma, ST_Mean4ma, ST_Distinct4ma, ST_StdDev4ma

10.13.2 ST_InvDistWeight4ma

ST_InvDistWeight4ma — 픽셀의 이웃으로부터 픽&#xc14
값을 보간하는 래스터 공간 처리
함수입니다.

Synopsis

double precision **ST_InvDistWeight4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

거리 역산 가중법(Inverse Distance Weighted method)을 이&#xc6a
픽셀에 대한 보간값을 계산합니&#x

`userargs` 를 통해 넘길 수 있는 선택적&#xc778
파라미터가 2개 있습니다. 첫 번째
파라미터는 거리 역산 가중법 방&#x
쓰이는 0과 1 사이의 역률(力率)입니&
방정식의 k 변수). 따로 설정하지
않을 경우, 기본값은 1입니다. 두 번&
파라미터는 관심 픽셀의 값이 이&#
나온 보간값에 포함될 경우에만
적용되는 가중치 백분율입니다.

관심 픽셀이 값을 가지고 있고 따&#
설정하지 않을 경우, 해당 값을 반&#

거리 역산 가중법의 기본 방정식&#x
다음과 같습니다:

$$\hat{z}(x_o) = \frac{\sum_{j=1}^{m} z(x_j) d_{ij}^{-k}}{\sum_{j=1}^{m} d_{ij}^{-k}}$$

k = 역률(power factor), 0과 1 사이의 실수

Note
이 함수는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc608;&#xc2dc;&#xac00; &#xd544;&#xc694;&#xd568;
```

참고

내장 맵 대수 콜백 함수, ST_MinDist4ma

10.13.3 ST_Max4ma

ST_Max4ma — 이웃에서 최대 픽셀 값을 계&#xc0
래스터 공간 처리 함수입니다.

Synopsis

float8 **ST_Max4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Max4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 최대 픽셀 값&#
계산합니다.

변종 2의 경우, 해당 값을 `userargs` 에 넘&#xaca
NODATA 픽셀의 대체값을 지정할 수 있&#

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xac

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, NULL, 1, 1, 'st_max4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid | st_value
-----+----------
   2 |      254
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Sum4ma, ST_Mean4ma, ST_Range4ma, ST_Distinct4ma, ST_StdDev4ma

10.13.4 ST_Mean4ma

ST_Mean4ma — 이웃에서 평균 픽셀 값을 계&#xc0
래스터 공간 처리 함수입니다.

Synopsis

float8 **ST_Mean4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Mean4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 평균 픽셀 값&#
계산합니다.

변종 2의 경우, 해당 값을 `userargs` 에 넘&#xaca
NODATA 픽셀의 대체값을 지정할 수 있&#

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다. 개선 사항: 2.1.0 버전에서 변종 2가 추&#xa

예시: 변종 1

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, '32BF', 1, 1, 'st_mean4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid |     st_value
-----+------------------
   2 | 253.222229003906
(1 row)
```

예시: 변종 2

```
SELECT
    rid,
    st_value(
               ST_MapAlgebra(rast, 1, 'st_mean4ma(double precision[][][], integer[][], text ↩
                   [])'::regprocedure,'32BF', 'FIRST', NULL, 1, 1)
        ,  2, 2)
  FROM dummy_rast
   WHERE rid = 2;
 rid |     st_value
-----+------------------
   2 | 253.222229003906
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Max4ma, ST_Sum4ma, ST_Range4ma, ST_StdDev4ma

10.13.5 ST_Min4ma

ST_Min4ma — 이웃에서 최소 픽셀 값을 계&#xc0b
래스터 공간 처리 함수입니다.

Synopsis

float8 **ST_Min4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Min4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 최소 픽셀 값&#
계산합니다.

변종 2의 경우, 해당 값을 `userargs` 에 넘&#xaca
NODATA 픽셀의 대체값을 지정할 수 있&#

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xac

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, NULL, 1, 1, 'st_min4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid | st_value
-----+----------
   2 |      250
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Max4ma, ST_Sum4ma, ST_Mean4ma, ST_Range4ma, ST_Distinct4ma, ST_StdDev4ma

10.13.6 ST_MinDist4ma

ST_MinDist4ma — 관심 픽셀과 값을 가지고 있&#x 이웃 픽셀 사이의 최소 거리를 (픽&# 개수로) 반환하는 래스터 공간 처&# 함수입니다.

Synopsis

double precision **ST_MinDist4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

관심 픽셀과 이웃에서 값을 가지&# 있는 가장 가까운 픽셀 사이의 최&# 거리를 (픽셀 개수로) 반환합니다.

Note

이 함수의 목적은 ST_InvDistWeight4ma 함수가 반환하는 관심 픽셀의 보간값의 유용성을 추론하는 것을 도와주는 유익한 데이터 포인트를 제공하는 것입니다. 이웃의 밀도가 희박한 경우 이 함수가 특히 유용합니다.

Note

이 함수는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc608;&#xc2dc;&#xac00; &#xd544;&#xc694;&#xd568;
```

참고

내장 맵 대수 콜백 함수, ST_InvDistWeight4ma

10.13.7 ST_Range4ma

ST_Range4ma — 이웃에 있는 픽셀값들의 범&#xc 계산하는 래스터 공간 처리 함수&#x

Synopsis

float8 **ST_Range4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Range4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 픽셀 값들의 범위를 계산합니다.

변종 2의 경우, 해당 값을 `userargs` 에 넘&#xaca8 NODATA 픽셀의 대체값을 지정할 수 있&#

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xa

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, NULL, 1, 1, 'st_range4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid | st_value
-----+----------
   2 |        4
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Max4ma, ST_Sum4ma, ST_Mean4ma, ST_Distinct4ma, ST_StdDev4ma

10.13.8 ST_StdDev4ma

ST_StdDev4ma — 이웃에 있는 픽셀값들의 표&#x
편차를 계산하는 래스터 공간 처&#x
함수입니다.

Synopsis

float8 **ST_StdDev4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_StdDev4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 픽셀 값들의
표준 편차를 계산합니다.

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xa

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, '32BF', 1, 1, 'st_stddev4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
FROM dummy_rast
WHERE rid = 2;
 rid |     st_value
-----+------------------
   2 | 1.30170822143555
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Max4ma, ST_Sum4ma, ST_Mean4ma, ST_Distinct4ma, ST_StdDev4ma

10.13.9 ST_Sum4ma

ST_Sum4ma — 이웃에 있는 모든 픽셀값들&#xc7
합계를 계산하는 래스터 공간 처&#x
함수입니다.

Synopsis

float8 **ST_Sum4ma**(float8[][] matrix, text nodatamode, text[] VARIADIC args);
double precision **ST_Sum4ma**(double precision[][][] value, integer[][] pos, text[] VARIADIC userargs);

설명

픽셀의 이웃에 있는 모든 픽셀 값&#
합계를 계산합니다.

변종 2의 경우, 해당 값을 `userargs` 에 넘&#xaca
NODATA 픽셀의 대체값을 지정할 수 있&#

Note
변종 1은 ST_MapAlgebraFctNgb 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Note
변종 2는 내장 맵 대수 콜백 함수 의 콜백 파라미터로 쓰이는 특화된 콜백 함수입니다.

Warning
2.1.0 버전부터 ST_MapAlgebraFctNgb 를 지원하지 않기 때문에 변종 1 함수를 쓰지 않는 편이 좋습니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 변종 2가 추&#xa

예시

```
SELECT
    rid,
    st_value(
        st_mapalgebrafctngb(rast, 1, '32BF', 1, 1, 'st_sum4ma(float[][],text,text[])':: ↩
            regprocedure, 'ignore', NULL), 2, 2
    )
```

```
FROM dummy_rast
WHERE rid = 2;
 rid | st_value
-----+----------
   2 |     2279
(1 row)
```

참고

ST_MapAlgebraFctNgb, 내장 맵 대수 콜백 함수, ST_Min4ma, ST_Max4ma, ST_Mean4ma, ST_Range4ma, ST_Distinct4ma, ST_StdDev4ma

10.14 래스터 공간 처리

10.14.1 ST_Aspect

ST_Aspect — 표고 래스터 밴드의 향(기본 단위는 도)을 반환합니다. 지형을 분석하는 데 유용합니다.

Synopsis

raster **ST_Aspect**(raster rast, integer band=1, text pixeltype=32BF, text units=DEGREES, boolean interpolate_nodata=FALSE);
raster **ST_Aspect**(raster rast, integer band, raster customextent, text pixeltype=32BF, text units=DEGREES, boolean interpolate_nodata=FALSE);

설명

표고 래스터 밴드의 향(기본 단위는 도)을 반환합니다. 맵 대수를 활용이웃 픽셀들에 향 방정식을 적용&#

`units` 는 향의 단위를 의미합니다. RADIANS, DEGREES(기본값)를 쓸 수 있습니다.

`units` = RADIANS일 경우, 북쪽에서 시계방향측정한 0과 2π 라디안 사이의 값입니

`units` = DEGREES일 경우, 북쪽에서 시계방향측정한 0도와 360도 사이의 값입니&#xb2e4

픽셀의 경사가 0일 경우, 픽셀의 향&-1입니다.

> **Note**
> 경사(slope), 향(aspect), 음영기복(hillshade)에 대한 자세한 내용을 알고 싶다면, ESRI - How hillshade works 및 ERDAS Field Guide - Aspect Images 를 참조하십시오.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 ST_MapAlgebra()를 이용선택적인 `interpolate_nodata` 함수 파라미터&#xac추가됐습니다.

변경 사항: 2.1.0 미만 버전에서는 반&#xd65
값이 라디안 단위였습니다. 2.1.0 버&#xc80
반환되는 값의 기본 단위가 도로
바뀌었습니다.

예시: 변종 1

```
WITH foo AS (
        SELECT ST_SetValues(
                ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '32BF', 0,  ↩
                    -9999),
                1, 1, 1, ARRAY[
                        [1, 1, 1, 1, 1],
                        [1, 2, 2, 2, 1],
                        [1, 2, 3, 2, 1],
                        [1, 2, 2, 2, 1],
                        [1, 1, 1, 1, 1]
                ]::double precision[][]
        ) AS rast
)
SELECT
        ST_DumpValues(ST_Aspect(rast, 1, '32BF'))
FROM foo




----------------------------------------------------------------------------------------------------------------

-----------------------------------
 (1,"{{315,341.565063476562,0,18.4349479675293,45},{288.434936523438,315,0,45,71.5650482177734},{270

2227,180,161.565048217773,135}}")
(1 row)
```

예시: 변종 2

커버리지 타일의 완전한 예시입&#x
이 쿼리는 PostgreSQL 9.1 이상 버전에서만
작동합니다.

```
WITH foo AS (
        SELECT ST_Tile(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(6, 6, 0, 0, 1, -1, 0, 0, 0),
                                1, '32BF', 0, -9999
                        ),
                        1, 1, 1, ARRAY[
                                [1, 1, 1, 1, 1, 1],
                                [1, 1, 1, 1, 2, 1],
                                [1, 2, 2, 3, 3, 1],
                                [1, 1, 3, 2, 1, 1],
                                [1, 2, 2, 1, 2, 1],
                                [1, 1, 1, 1, 1, 1]
                        ]::double precision[]
                ),
                2, 2
        ) AS rast
```

```
)
SELECT
        t1.rast,
        ST_Aspect(ST_Union(t2.rast), 1, t1.rast)
FROM foo t1
CROSS JOIN foo t2
WHERE ST_Intersects(t1.rast, t2.rast)
GROUP BY t1.rast;
```

참고

내장 맵 대수 콜백 함수, ST_TRI, ST_TPI, ST_Roughness, ST_HillShade, ST_Slope

10.14.2 ST_HillShade

ST_HillShade — 입력한 방위각, 고도각, 밝기 및 축척을 이용해서 표고 래스터 밴드의 가상적인 음영기복을 반&#x

Synopsis

raster **ST_HillShade**(raster rast, integer band=1, text pixeltype=32BF, double precision azimuth=315, double precision altitude=45, double precision max_bright=255, double precision scale=1.0, boolean interpolate_nodata=FALSE);
raster **ST_HillShade**(raster rast, integer band, raster customextent, text pixeltype=32BF, double precision azimuth=315, double precision altitude=45, double precision max_bright=255, double precision scale=1.0, boolean interpolate_nodata=FALSE);

설명

입력한 방위각, 고도각, 밝기 및 축&#
이용해서 표고 래스터 밴드의 가&#
음영기복을 반환합니다. 맵 대수&#
활용해서 이웃 픽셀들에 음영기&#
방정식을 적용합니다. 반환되는
픽셀 값은 0과 255 사이입니다.

`azimuth` 는 북쪽에서 시계방향으로 측&#
0도와 360도 사이의 값입니다.

`altitude` 는 0도가 지평선, 90도가 천정(天&#x9
0도와 90도 사이의 값입니다.

`max_bright` 는 0이 밝기가 없고, 255가 최대 밝&
0과 255 사이의 값입니다.

`scale` 은 수평 단위에 대한 수직 단위&#x
비율입니다. 피트:경위도의 경우
scale=370400, 미터:경위도의 경우 scale=111120을 사&#x

`interpolate_nodata` 가 참일 경우, 음영기복을
계산하기 전에 ST_InvDistWeight4ma 함수를 통해
입력 래스터에서 나온 NODATA 픽셀들&#
값을 보간할 것입니다.

Note

음영기복에 대해 더 자세히 알고 싶다면, How hillshade works 를 참조하십시오.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 ST_MapAlgebra()를 이&#xc6a9
선택적인 `interpolate_nodata` 함수 파라미터&#xac
추가됐습니다.

변경 사항: 2.1.0 미만 버전에서는 방&#xc70
및 고도각이 라디안 단위였습니&#x
2.1.0 버전부터 방위각과 고도각이 &#xb3c4
단위로 바뀌었습니다.

예시: 변종 1

```
WITH foo AS (
        SELECT ST_SetValues(
                ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '32BF', 0,  ↩
                    -9999),
                1, 1, 1, ARRAY[
                        [1, 1, 1, 1, 1],
                        [1, 2, 2, 2, 1],
                        [1, 2, 3, 2, 1],
                        [1, 2, 2, 2, 1],
                        [1, 1, 1, 1, 1]
                ]::double precision[][]
        ) AS rast
)
SELECT
        ST_DumpValues(ST_Hillshade(rast, 1, '32BF'))
FROM foo




----------------------------------------------------------------------------------------------------------------

-------------------------------------------------------------------------
 (1,"{{NULL,NULL,NULL,NULL,NULL},{NULL,251.32763671875,220.749786376953,147.224319458008, ↩
    NULL},{NULL,220.749786376953,180.312225341797,67.7497863769531,NULL},{NULL ↩
    ,147.224319458008
,67.7497863769531,43.1210060119629,NULL},{NULL,NULL,NULL,NULL,NULL}}")
(1 row)
```

예시: 변종 2

커버리지 타일의 완전한 예시입&#x
이 쿼리는 PostgreSQL 9.1 이상 버전에서만
작동합니다.

```
WITH foo AS (
        SELECT ST_Tile(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(6, 6, 0, 0, 1, -1, 0, 0, 0),
```

```
                                1, '32BF', 0, -9999
                        ),
                        1, 1, 1, ARRAY[
                                [1, 1, 1, 1, 1, 1],
                                [1, 1, 1, 1, 2, 1],
                                [1, 2, 2, 3, 3, 1],
                                [1, 1, 3, 2, 1, 1],
                                [1, 2, 2, 1, 2, 1],
                                [1, 1, 1, 1, 1, 1]
                        ]::double precision[]
                ),
                2, 2
        ) AS rast
)
SELECT
        t1.rast,
        ST_Hillshade(ST_Union(t2.rast), 1, t1.rast)
FROM foo t1
CROSS JOIN foo t2
WHERE ST_Intersects(t1.rast, t2.rast)
GROUP BY t1.rast;
```

참고

내장 맵 대수 콜백 함수, ST_TRI, ST_TPI, ST_Roughness, ST_Aspect, ST_Slope

10.14.3 ST_Roughness

ST_Roughness — DEM의 계산된 "거칠기(roughness)"와 함&#xae
래스터를 반환합니다.

Synopsis

raster **ST_Roughness**(raster rast, integer nband, raster customextent, text pixeltype="32BF" , boolean interpolate_nodata=FALSE);

설명

관심 지역에 대해 최소값에서 최&#x
뺀 DEM의 "거칠기"를 계산합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc608;&#xc2dc;&#xac00; &#xd544;&#xc694;&#xd568;
```

참고

내장 맵 대수 콜백 함수, ST_TRI, ST_TPI, ST_Slope, ST_HillShad
ST_Aspect

10.14.4 ST_Slope

ST_Slope — 표고 래스터 밴드의 경사(기본
단위는 도)를 반환합니다. 지형을
분석하는 데 유용합니다.

Synopsis

raster **ST_Slope**(raster rast, integer nband=1, text pixeltype=32BF, text units=DEGREES, double precision scale=1.0, boolean interpolate_nodata=FALSE);
raster **ST_Slope**(raster rast, integer nband, raster customextent, text pixeltype=32BF, text units=DEGREES, double precision scale=1.0, boolean interpolate_nodata=FALSE);

설명

표고 래스터 밴드의 경사(기본 단&#
도)를 반환합니다. 맵 대수를 활용&
이웃 픽셀들에 경사 방정식을 적&#

`units` 는 경사의 단위를 의미합니다.
RADIANS, DEGREES(기본값), PERCENT를 쓸 수 있습니&#xb2e

`scale` 은 수평 단위에 대한 수직 단위&#x
비율입니다. 피트:경위도의 경우
scale=370400, 미터:경위도의 경우 scale=111120을 사&#x

`interpolate_nodata` 가 참일 경우, 지표면 경사&#xb9
계산하기 전에 ST_InvDistWeight4ma 함수를 통해
입력 래스터에서 나온 NODATA 픽셀들&#
값을 보간할 것입니다.

Note
경사(slope), 향(aspect), 음영기복(hillshade)에
대한 자세한 내용을 알고
싶다면, ESRI - How hillshade works 및 ERDAS Field Guide - Slope Images 를
참조하십시오.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전부터 ST_MapAlgebra()를 이&#xc6a9
선택적인 `units`, `scale`, `interpolate_nodata` 함수 파라&#xbbf8
추가됐습니다.

변경 사항: 2.1.0 미만 버전에서는 반&#xd65
값이 라디안 단위였습니다. 2.1.0 버&#xc80
반환되는 값의 기본 단위가 도로
바뀌었습니다.

예시: 변종 1

```
WITH foo AS (
        SELECT ST_SetValues(
                ST_AddBand(ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 0), 1, '32BF', 0,  ↩
                    -9999),
                1, 1, 1, ARRAY[
                        [1, 1, 1, 1, 1],
```

```
                        [1, 2, 2, 2, 1],
                        [1, 2, 3, 2, 1],
                        [1, 2, 2, 2, 1],
                        [1, 1, 1, 1, 1]
                ]::double precision[][]
        ) AS rast
)
SELECT
        ST_DumpValues(ST_Slope(rast, 1, '32BF'))
FROM foo

                            st_dumpvalues

------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------

-----------------------------------------------------------------
 (1,"{{10.0249881744385,21.5681285858154,26.5650520324707,21.5681285858154,10.0249881744385},{21.568

{26.5650520324707,36.8698959350586,0,36.8698959350586,26.5650520324707},{21.5681285858154,35.2643890

5681285858154,26.5650520324707,21.5681285858154,10.0249881744385}}")
(1 row)
```

예시: 변종 2

커버리지 타일의 완전한 예시입&#x
이 쿼리는 PostgreSQL 9.1 이상 버전에서만
작동합니다.

```
WITH foo AS (
        SELECT ST_Tile(
                ST_SetValues(
                        ST_AddBand(
                                ST_MakeEmptyRaster(6, 6, 0, 0, 1, -1, 0, 0, 0),
                                1, '32BF', 0, -9999
                        ),
                        1, 1, 1, ARRAY[
                                [1, 1, 1, 1, 1, 1],
                                [1, 1, 1, 1, 2, 1],
                                [1, 2, 2, 3, 3, 1],
                                [1, 1, 3, 2, 1, 1],
                                [1, 2, 2, 1, 2, 1],
                                [1, 1, 1, 1, 1, 1]
                        ]::double precision[]
                ),
                2, 2
        ) AS rast
)
SELECT
        t1.rast,
        ST_Slope(ST_Union(t2.rast), 1, t1.rast)
FROM foo t1
CROSS JOIN foo t2
WHERE ST_Intersects(t1.rast, t2.rast)
GROUP BY t1.rast;
```

참고

내장 맵 대수 콜백 함수, ST_TRI, ST_TPI, ST_Roughness, ST_HillShade, ST_Aspect

10.14.5 ST_TPI

ST_TPI — 계산된 지형위치지수(Topographic Position Index)와 함께 래스터를 반환합니다.

Synopsis

raster **ST_TPI**(raster rast, integer nband, raster customextent, text pixeltype="32BF" , boolean interpolate_nodata=FALSE);

설명

Calculates the Topographic Position Index, which is defined as the focal mean with radius of one minus the center cell.

Note
이 함수는 1 반경 중심 평균(focalmean radius of one)만을 지원합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc608;&#xc2dc;&#xac00; &#xd544;&#xc694;&#xd568;
```

참고

내장 맵 대수 콜백 함수, ST_TRI, ST_Roughness, ST_Slope, ST_HillShade, ST_Aspect

10.14.6 ST_TRI

ST_TRI — 계산된 지형험준도지수(Terrain Ruggedness Index)와 함께 래스터를 반환합니다.

Synopsis

raster **ST_TRI**(raster rast, integer nband, raster customextent, text pixeltype="32BF" , boolean interpolate_nodata=FALSE);

설명

중심 픽셀과 그 이웃을 비교해서 그 차의 절대값의 평균으로 지형&#x Ruggedness Index)를 계산합니다.

Note
이 함수는 1 반경 중심 평균(focalmean radius of one)만을 지원합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xc608;&#xc2dc;&#xac00; &#xd544;&#xc694;&#xd568;
```

참고

내장 맵 대수 콜백 함수, ST_Roughness, ST_TPI, ST_Slope, ST_HillShade, ST_Aspect

10.15 래스터를 도형으로

10.15.1 Box3D

Box3D — 래스터를 둘러싼 상자의 BOX3D 표&#x 반환합니다.

Synopsis

box3d **Box3D**(raster rast);

설명

래스터의 범위를 표현하는 상자&# 반환합니다.

경계 상자의 꼭짓점 포인트들((MINX, MINY), (MAXX, MAXY))이 폴리곤을 정의합니다.

변경 사항: 2.0.0 미만 버전에서는 BOX3D 대신 BOX2D를 이용했습니다. BOX2D가 지&#xc 끝난 유형이기 때문에, 2.0.0 버전에&#xc1 BOX3D로 바뀌었습니다.

예시

```
SELECT
        rid,
        Box3D(rast) AS rastbox
FROM dummy_rast;

rid |        rastbox
----+------------------------------------------------
1   | BOX3D(0.5 0.5 0,20.5 60.5 0)
2   | BOX3D(3427927.75 5793243.5 0,3427928 5793244 0)
```

참고

ST_Envelope

10.15.2 ST_ConvexHull

ST_ConvexHull — BandNoDataValue와 일치하는 픽셀 값을 포함한, 래스터의 볼록 껍질 도형반환합니다. 정규 형상 및 기울어않은 래스터의 경우, ST_Envelope와 동일한 결과물을 출력하므로 비정규 형또는 기울어진 래스터에 대해서쓸모가 있습니다.

Synopsis

geometry **ST_ConvexHull**(raster rast);

설명

NoDataBandValue 밴드 픽셀을 포함한, 래스터볼록 껍질 도형을 반환합니다. 정형상 및 기울어지지 않은 래스터경우, ST_Envelope와 거의 동일한 결과물을 출력하므로 비정규 형상 또는 기래스터에 대해서만 쓸모가 있습&#x

> **Note**
> ST_Envelope 함수는 좌표를 버림(floor)하기때문에 래스터 주위에 버퍼를 약간 주게 됩니다. 따라서 버림을 하지 않는 ST_ConvexHull 함수와는 약간 다른 결과를 냅니다.

예시

이 차이에 대한 도표를 보고 싶다&#x
PostGIS Raster Specification 을 참조하십시오.

```
-- &#xc5d4;&#xbca8;&#xb85c;&#xd504;&#xc640; &#xbcfc;&#xb85d; &#xaecd;&#xc9c8;&#xc774;  ↩
    &#xac70;&#xc758; &#xb3d9;&#xc77c;&#xd558;&#xb2e4;&#xb294; &#xc810;&#xc5d0;  ↩
    &#xc8fc;&#xc758;&#xd558;&#xc2ed;&#xc2dc;&#xc624;.
SELECT ST_AsText(ST_ConvexHull(rast)) As convhull,
        ST_AsText(ST_Envelope(rast)) As env
FROM dummy_rast WHERE rid=1;

                        convhull                         |                env
---------------------------------------------------------+---------------------------------- ↩

 POLYGON((0.5 0.5,20.5 0.5,20.5 60.5,0.5 60.5,0.5 0.5)) | POLYGON((0 0,20 0,20 60,0 60,0 0) ↩
    )
```

```
-- &#xb798;&#xc2a4;&#xd130;&#xb97c; &#xae30;&#xc6b8;&#xc785;&#xb2c8;&#xb2e4;.
-- &#xc774;&#xc81c; &#xbcfc;&#xb85d; &#xaecd;&#xc9c8;&#xacfc;  ↩
    &#xc5d4;&#xbca8;&#xb85c;&#xd504;&#xac00; &#xc5b4;&#xb5bb;&#xac8c;  ↩
    &#xb2ec;&#xb77c;&#xc9c0;&#xb294;&#xc9c0; &#xb208;&#xc5ec;&#xaca8;  ↩
    &#xbcf4;&#xc2ed;&#xc2dc;&#xc624;.
SELECT ST_AsText(ST_ConvexHull(rast)) As convhull,
        ST_AsText(ST_Envelope(rast)) As env
FROM (SELECT ST_SetRotation(rast, 0.1, 0.1) As rast
        FROM dummy_rast WHERE rid=1) As foo;

                        convhull                         |                env
---------------------------------------------------------+---------------------------------- ↩

 POLYGON((0.5 0.5,20.5 1.5,22.5 61.5,2.5 60.5,0.5 0.5)) | POLYGON((0 0,22 0,22 61,0 61,0 0) ↩
    )
```

참고

ST_Envelope, ST_MinConvexHull, ST_ConvexHull, ST_AsText

10.15.3 ST_DumpAsPolygons

ST_DumpAsPolygons — 입력 래스터 밴드로부터 geomval(geom, val) 행들의 집합을 반환합니다. 밴드 번호를 설정하지 않을 경우 기본적으로 밴드 1로 가정합니다.

Synopsis

setof geomval **ST_DumpAsPolygons**(raster rast, integer band_num=1, boolean exclude_nodata_value=TRUE);

설명

이 함수는 집합 반환 함수(SRF; Set-Returning Function)입니다. 도형(geom)과 픽셀 밴드 값(val)&#xc7 이루어진 geomval 행들의 집합을 반환&#x 각 폴리곤은 해당 밴드에서 val이 표& 값과 동일한 픽셀 값을 가진 모든 픽셀들을 통합한 것입니다.

ST_DumpAsPolygon은 래스터를 폴리곤화하는 데 유용합니다. 새 행들을 생성한&

점에서 GROUP BY의 역함수라고 할 수 있
예를 들어 단일 래스터를 복수의
폴리곤/멀티폴리곤으로 확장하&#xb
데 이 함수를 쓸 수 있습니다.

Changed 3.3.0, validation and fixing is disabled to improve performance. May result invalid geometries.

GDAL 1.7 이상 버전이 필요합니다.

Note

If there is a no data value set for a band, pixels with that value will not be returned except in the case of exclude_nodata_value=false.

Note

래스터 안에 있는 해당 값을 가진 픽셀들의 개수에만 관심이 있다면, ST_ValueCount 함수가 더 빠릅니다.

Note

이 함수는 픽셀 값과 상관없이 각 픽셀에 대해 도형 하나를 반환하는 ST_PixelAsPolygons 함수와 다릅니다.

예시

```
-- this syntax requires PostgreSQL 9.3+
SELECT val, ST_AsText(geom) As geomwkt
FROM (
SELECT dp.*
FROM dummy_rast, LATERAL ST_DumpAsPolygons(rast) AS dp
WHERE rid = 2
) As foo
WHERE val BETWEEN 249 and 251
ORDER BY val;

 val |                                                                        geomwkt
-----+---------------------------------------------------------------------------------
 249 | POLYGON((3427927.95 5793243.95,3427927.95 5793243.85,3427928 5793243.85,
       3427928 5793243.95,3427927.95 5793243.95))
 250 | POLYGON((3427927.75 5793243.9,3427927.75 5793243.85,3427927.8 5793243.85,
       3427927.8 5793243.9,3427927.75 5793243.9))
 250 | POLYGON((3427927.8 5793243.8,3427927.8 5793243.75,3427927.85 5793243.75,
       3427927.85 5793243.8, 3427927.8 5793243.8))
 251 | POLYGON((3427927.75 5793243.85,3427927.75 5793243.8,3427927.8 5793243.8,
       3427927.8 5793243.85,3427927.75 5793243.85))
```

참고

geomval, ST_Value, ST_Polygon, ST_ValueCount

10.15.4 ST_Envelope

ST_Envelope — 래스터 범위의 폴리곤 표현&#xc2
반환합니다.

Synopsis

geometry **ST_Envelope**(raster rast);

설명

래스터 범위의 폴리곤 표현식을
SRID가 정의하는 공간 좌표 단위로
반환합니다. 여기에서 폴리곤 표&#x
폴리곤으로 표현된 float8 형 최소치
경계 상자입니다.

해당 폴리곤은 경계 상자의 꼭짓&#x
포인트들로 정의됩니다((MINX, MINY), (MINX, MAXY),
(MAXX, MAXY), (MAXX, MINY), (MINX, MINY)).

예시

```
SELECT rid, ST_AsText(ST_Envelope(rast)) As envgeomwkt
FROM dummy_rast;

 rid |                                          envgeomwkt
-----+---------------------------------------------------------------------
   1 | POLYGON((0 0,20 0,20 60,0 60,0 0))
   2 | POLYGON((3427927 5793243,3427928 5793243,
                3427928 5793244,3427927 5793244, 3427927 5793243))
```

참고

ST_Envelope, ST_AsText, ST_SRID

10.15.5 ST_MinConvexHull

ST_MinConvexHull — 래스터의 NODATA 픽셀을 제외한
볼록 껍질 도형을 반환합니다.

Synopsis

geometry **ST_MinConvexHull**(raster rast, integer nband=NULL);

설명

래스터의 NODATA 픽셀을 제외한 볼록
껍질 도형을 반환합니다. nband 가 NULL&#xc77
경우, 래스터의 모든 밴드를 처리&#

2.1.0 버전부터 사용할 수있습니다.

예시

```
WITH foo AS (
        SELECT
                ST_SetValues(
                        ST_SetValues(
                                ST_AddBand(ST_AddBand(ST_MakeEmptyRaster(9, 9, 0, 0, 1, -1, ↩
                                     0, 0, 0), 1, '8BUI', 0, 0), 2, '8BUI', 1, 0),
                                1, 1, 1,
                                ARRAY[
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 1, 0, 0, 0, 0, 1],
                                        [0, 0, 0, 1, 1, 0, 0, 0, 0],
                                        [0, 0, 0, 1, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                        [0, 0, 0, 0, 0, 0, 0, 0, 0]
                                ]::double precision[][]
                        ),
                        2, 1, 1,
                        ARRAY[
                                [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                [1, 0, 0, 0, 0, 1, 0, 0, 0],
                                [0, 0, 0, 0, 1, 1, 0, 0, 0],
                                [0, 0, 0, 0, 0, 1, 0, 0, 0],
                                [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                [0, 0, 0, 0, 0, 0, 0, 0, 0],
                                [0, 0, 1, 0, 0, 0, 0, 0, 0]
                        ]::double precision[][]
                ) AS rast
)
SELECT
        ST_AsText(ST_ConvexHull(rast)) AS hull,
        ST_AsText(ST_MinConvexHull(rast)) AS mhull,
        ST_AsText(ST_MinConvexHull(rast, 1)) AS mhull_1,
        ST_AsText(ST_MinConvexHull(rast, 2)) AS mhull_2
FROM foo

               hull                |                mhull                |                ↩
                   mhull_1                |                mhull_2
-----------------------------------+---------------------------------------+---------------------------

 POLYGON((0 0,9 0,9 -9,0 -9,0 0)) | POLYGON((0 -3,9 -3,9 -9,0 -9,0 -3)) | POLYGON((3 -3,9  ↩
    -3,9 -6,3 -6,3 -3)) | POLYGON((0 -3,6 -3,6 -9,0 -9,0 -3))
```

참고

ST_Envelope, ST_ConvexHull, ST_ConvexHull, ST_AsText

10.15.6 ST_Polygon

ST_Polygon — NODATA 값이 아닌 픽셀 값을 가진 픽셀들을 통합해서 형성된 멀티&#도형을 반환합니다.

Synopsis

geometry **ST_Polygon**(raster rast, integer band_num=1);

설명

Changed 3.3.0, validation and fixing is disabled to improve performance. May result invalid geometries.

0.1.6 버전부터 사용할 수 있습니다.
GDAL 1.7 이상 버전이 필요합니다.

개선 사항: 2.1.0 버전부터 속도가 향&#xc0
C언어 기반으로 변경했습니다). 반&
멀티폴리곤이 유효한 도형인지
확인합니다.

변경 사항: 2.1.0 미만 버전에서 종종
폴리곤을 반환하곤 했던 것을, 언&#
멀티폴리곤을 반환하도록 바꿨&#xc

예시

```
-- &#xae30;&#xbcf8;&#xc801;&#xc73c;&#xb85c; NODATA &#xbc34;&#xb4dc; &#xac12;&#xc774; 0  ↩
    &#xb610;&#xb294; &#xc124;&#xc815;&#xb418;&#xc9c0; &#xc54a;&#xc740;  ↩
    &#xc0c1;&#xd0dc;&#xb85c;, &#xb530;&#xb77c;&#xc11c; &#xc0ac;&#xac01;&#xd615;  ↩
    &#xd3f4;&#xb9ac;&#xace4;&#xc744; &#xbc18;&#xd658;&#xd560;  ↩
    &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(ST_Polygon(rast)) As geomwkt
FROM dummy_rast
WHERE rid = 2;

geomwkt
---------------------------------------------
MULTIPOLYGON(((3427927.75 5793244,3427928 5793244,3427928 5793243.75,3427927.75  ↩
    5793243.75,3427927.75 5793244)))


-- &#xc774;&#xc81c; &#xccab; &#xbc88;&#xc9f8; &#xbc34;&#xb4dc;&#xc758; NODATA  ↩
    &#xac12;&#xc744; &#xbcc0;&#xacbd;&#xd569;&#xb2c8;&#xb2e4;.
UPDATE dummy_rast SET rast = ST_SetBandNoDataValue(rast,1,254)
WHERE rid = 2;
SELECt rid, ST_BandNoDataValue(rast)
from dummy_rast where rid = 2;

-- ST_Polygon&#xc774; &#xd544;&#xc140; &#xac12; 254&#xb97c;  ↩
    &#xc81c;&#xc678;&#xd558;&#xace0; &#xba40;&#xd2f0;&#xd3f4;&#xb9ac;&#xace4;&#xc744;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT ST_AsText(ST_Polygon(rast)) As geomwkt
FROM dummy_rast
WHERE rid = 2;

geomwkt
-----------------------------------------------------------
MULTIPOLYGON(((3427927.9 5793243.95,3427927.85 5793243.95,3427927.85 5793244,3427927.9  ↩
    5793244,3427927.9 5793243.95)),((3427928 5793243.85,3427928 5793243.8,3427927.95  ↩
    5793243.8,3427927.95 5793243.85,3427927.9 5793243.85,3427927.9 5793243.9,3427927.9  ↩
    5793243.95,3427927.95 5793243.95,3427928 5793243.95,3427928 5793243.85)),((3427927.8  ↩
    5793243.75,3427927.75 5793243.75,3427927.75 5793243.8,3427927.75 5793243.85,3427927.75  ↩
    5793243.9,3427927.75 5793244,3427927.8 5793244,3427927.8 5793243.9,3427927.8  ↩
    5793243.85,3427927.85 5793243.85,3427927.85 5793243.8,3427927.85 5793243.75,3427927.8  ↩
    5793243.75)))
```

```
-- &#xb610;&#xb294; NODATA &#xac12;&#xc744; &#xd55c;&#xbc88;&#xb9cc;  ↩
    &#xb2e4;&#xb974;&#xac8c; &#xd558;&#xace0; &#xc2f6;&#xc744; &#xacbd;&#xc6b0;

SELECT ST_AsText(
        ST_Polygon(
                ST_SetBandNoDataValue(rast,1,252)
                )
        ) As geomwkt
FROM dummy_rast
WHERE rid =2;

geomwkt
---------------------------------
MULTIPOLYGON(((3427928 5793243.85,3427928 5793243.8,3427928 5793243.75,3427927.85  ↩
    5793243.75,3427927.8 5793243.75,3427927.8 5793243.8,3427927.75 5793243.8,3427927.75  ↩
    5793243.85,3427927.75 5793243.9,3427927.75 5793244,3427927.8 5793244,3427927.85  ↩
    5793244,3427927.9 5793244,3427928 5793244,3427928 5793243.95,3427928 5793243.85) ↩
    ,(3427927.9 5793243.9,3427927.9 5793243.85,3427927.95 5793243.85,3427927.95  ↩
    5793243.9,3427927.9 5793243.9)))
```

참고

ST_Value, ST_DumpAsPolygons

10.16 래스터 연산자

10.16.1 &&

&& — A의 경계 상자와 B의 경계 상자가 교차하는 경우 TRUE 를 반환합니다.

Synopsis

boolean **&&**(raster A , raster B);
boolean **&&**(raster A , geometry B);
boolean **&&**(geometry B , raster A);

설명

&& 연산자는 래스터/도형 A의 경계 상자와 래스터/도형 B의 경계 상자교차하는 경우 TRUE 를 반환합니다.

Note
이 피연산자(operand)는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT A.rid As a_rid, B.rid As b_rid, A.rast && B.rast As intersect
 FROM dummy_rast AS A CROSS JOIN dummy_rast AS B LIMIT 3;

 a_rid | b_rid | intersect
-------+-------+---------
     2 |     2 | t
     2 |     3 | f
     2 |     1 | f
```

10.16.2 &<

&< — A의 경계 상자가 B의 경계 상자 왼&#
있을 경우 TRUE 를 반환합니다.

Synopsis

boolean **&<**(raster A , raster B);

설명

&< 연산자는 래스터 A의 경계 상자&#xac0
래스터 B의 경계 상자와 겹치거나
그 왼쪽에 있을 경우, 또는 더 정확&
말하자면 래스터 B의 경계 상자와
겹치거나 그 오른쪽에 있지 않을
경우, TRUE 를 반환합니다.

> **Note**
> 이 피연산자(operand)는 래스터에서
> 이용할 수도 있는 모든
> 인덱스를 활용할 것입니다.

예시

```
SELECT A.rid As a_rid, B.rid As b_rid, A.rast &< B.rast As overleft
 FROM dummy_rast AS A CROSS JOIN dummy_rast AS B;

a_rid | b_rid | overleft
------+-------+----------
    2 |     2 | t
    2 |     3 | f
    2 |     1 | f
    3 |     2 | t
    3 |     3 | t
    3 |     1 | f
    1 |     2 | t
    1 |     3 | t
    1 |     1 | t
```

10.16.3 &>

&> — A의 경계 상자가 B의 경계 상자 오&#
있을 경우 TRUE 를 반환합니다.

Synopsis

boolean **&>**(raster A , raster B);

설명

&> 연산자는 래스터 A의 경계 상자&#xac0
래스터 B의 경계 상자와 겹치거나
그 오른쪽에 있을 경우, 또는 더 정&
말하자면 래스터 B의 경계 상자와
겹치거나 그 왼쪽에 있지 않을 경&#x
TRUE 를 반환합니다.

> **Note**
> 이 피연산자(operand)는 래스터에서
> 이용할 수도 있는 모든
> 인덱스를 활용할 것입니다.

예시

```
SELECT A.rid As a_rid, B.rid As b_rid, A.rast &> B.rast As overright
 FROM dummy_rast AS A CROSS JOIN dummy_rast AS B;

 a_rid | b_rid | overright
-------+-------+-----------
     2 |     2 | t
     2 |     3 | t
     2 |     1 | t
     3 |     2 | f
     3 |     3 | t
     3 |     1 | f
     1 |     2 | f
     1 |     3 | t
     1 |     1 | t
```

10.16.4 =

= — A의 경계 상자와 B의 경계 상자가
동일할 경우 TRUE 를 반환합니다. 이&#xc
정밀도 경계 상자를 이용합니다.

Synopsis

boolean **=**(raster A , raster B);

설명

= 연산자는 래스터 A의 경계 상자와 래스터 B의 경계 상자가 동일할 경우 TRUE 를 반환합니다. PostgreSQL은 래스터를 내부 정렬하고 비교하기 위해 도대해 정의된 =, <, 및 > 연산자를 이용한 GROUP BY 또는 ORDER BY 절에서).

Caution

이 피연산자(operand)는 래스터에 대해 이용할 수 있을지도 모르는 어떤 인덱스도 활용하지 않을 것입니다. 대신 ~= 함수를 이용하십시오. 이 연산자의 목적은 대부분 래스터 열로 그룹화(group by)하는 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

참고

~=

10.16.5 @

@ — B의 경계 상자가 A의 경계 상자를 담고 있을 경우 TRUE 를 반환합니다. 이중 정밀도 경계 상자를 이용합&#x

Synopsis

boolean @(raster A , raster B);
boolean @(geometry A , raster B);
boolean @(raster B , geometry A);

설명

@ 연산자는 래스터/도형 B의 경계 상자가 래스터/도형 A의 경계 상자담고 있을 경우 TRUE 를 반환합니다.

Note

이 피연산자(operand)는 래스터에 있는 공간 인덱스를 활용할 것입니다.

2.0.0 버전부터 raster @ raster, raster @ geometry 를 사용할 수 있습니다.

2.0.5 버전부터 geometry @ raster 를 지원합니다.

참고

~

10.16.6 ~=

~= — A의 경계 상자와 B의 경계 상자가 동일할 경우 TRUE 를 반환합니다.

Synopsis

boolean **~=**(raster A , raster B);

설명

~= 연산자는 래스터 A의 경계 상자와 래스터 B의 경계 상자가 동일할 경우 TRUE 를 반환합니다.

> **Note**
> 이 피연산자(operand)는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

동일한 뭉치이지만 서로 다른 주&#x표현하는 단일 밴드 래스터의 집&#x2개를 입력받아 다중 밴드 래스터&#x생성하는 데 매우 유용합니다.

```
SELECT ST_AddBand(prec.rast, alt.rast) As new_rast
    FROM prec INNER JOIN alt ON (prec.rast ~= alt.rast);
```

참고

ST_AddBand, =

10.16.7 ~

~ — A의 경계 상자가 B의 경계 상자를 담고 있을 경우 TRUE 를 반환합니다. 이중 정밀도 경계 상자를 이용합&#x

Synopsis

boolean ~(raster A , raster B);
boolean ~(geometry A , raster B);
boolean ~(raster B , geometry A);

설명

~ 연산자는 래스터/도형 A의 경계 상자가 래스터/도형 B의 경계 상자담고 있을 경우 TRUE 를 반환합니다.

> **Note**
> 이 피연산자(operand)는 래스터에 있는 공간 인덱스를 활용할 것입니다.

2.0.0 버전부터 사용할 수 있습니다.

참고

@

10.17 래스터 및 래스터 밴&#xb 공간 관계성

10.17.1 ST_Contains

ST_Contains — 래스터 rastA 외부에 놓인 래스터 rastB의 포인트가 하나도 없고, 적어&#xb3 rastB 내부의 포인트 하나가 rastA의 내부&#x 있는 경우 참을 반환합니다.

Synopsis

boolean **ST_Contains**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Contains**(raster rastA , raster rastB);

설명

래스터 rastA 외부에 놓인 래스터 rastB의 포인트가 하나도 없고, 적어도 rastB 내부의 포인트 하나가 rastA의 내부&#xc5 있을 경우에만 rastA가 rastB를 담고 있다&# 합니다. 밴드 번호를 설정하지 않&# 또는 NULL로 설정할 경우, 확인 작업&#xc 래스터의 볼록 껍질만 고려합니&#x 밴드 번호를 설정할 경우, 확인 작& 값을 가진 (NODATA가 아닌) 픽셀들만 고&

> **Note**
> 이 함수는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note

래스터와 도형의 공간 관계성을 확인하려면, ST_Contains(ST_Polygon(raster), geometry) 또는 ST_Contains(geometry, ST_Polygon(raster))처럼 래스터에 ST_Polygon 함수를 이용하십시오.

Note

ST_Contains()는 ST_Within()의 역함수입니다. 따라서, ST_Contains(rastA, rastB)의 결과와 ST_Within(rastB, rastA)의 결과는 동일할 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xbc34;&#xb4dc; &#xbc88;&#xd638; &#xc124;&#xc815;
SELECT r1.rid, r2.rid, ST_Contains(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 1;

NOTICE:  The first raster provided has no bands
 rid | rid | st_contains
-----+-----+-------------
   1 |   1 |
   1 |   2 | f
```

```
-- &#xbc34;&#xb4dc; &#xbc88;&#xd638; &#xc124;&#xc815;&#xd558;&#xc9c0; &#xc54a;&#xc74c;
SELECT r1.rid, r2.rid, ST_Contains(r1.rast, r2.rast) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 1;
 rid | rid | st_contains
-----+-----+-------------
   1 |   1 | t
   1 |   2 | f
```

참고

ST_Intersects, ST_Within

10.17.2 ST_ContainsProperly

ST_ContainsProperly — rastB가 rastA의 내부와 교차하지&#xb9c
rastA의 경계선 또는 외부와 교차하&#xc9c
않을 경우 참을 반환합니다.

Synopsis

boolean **ST_ContainsProperly**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_ContainsProperly**(raster rastA , raster rastB);

설명

래스터 rastB가 래스터 rastA의 내부와 교&
rastA의 경계선 또는 외부와 교차하&#xc9c
않을 경우 rastA가 rastB를 제대로 담고 있&
합니다. 밴드 번호를 설정하지 않&
또는 NULL로 설정할 경우, 확인 작업&#x
래스터의 볼록 껍질만 고려합니&#x
밴드 번호를 설정할 경우, 확인 작&
값을 가진 (NODATA가 아닌) 픽셀들만 고&

래스터 rastA는 자기 자신을 제대로
담고 있지는 않지만, 자기 자신을
담고 있긴 합니다.

Note
이 함수는 래스터에서 이용할
수도 있는 모든 인덱스를
활용할 것입니다.

Note
래스터와 도형의 공간
관계성을 확인하려면,
ST_ContainsProperly(ST_Polygon(raster), geometry) 또는 ST_ContainsProperly(geometry,
ST_Polygon(raster))처럼 래스터에 ST_Polygon
함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_ContainsProperly(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS ↩
     JOIN dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_containsproperly
-----+-----+---------------------
   2 |   1 | f
   2 |   2 | f
```

참고

ST_Intersects, ST_Contains

10.17.3 ST_Covers

ST_Covers — 래스터 rastB의 어떤 포인트도 래&#
rastA 외부에 없을 경우 참을 반환합&#xb2

Synopsis

boolean **ST_Covers**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Covers**(raster rastA , raster rastB);

설명

래스터 rastB의 어떤 포인트도 래스&#xd13
rastA 외부에 없을 경우 rastA가 rastB를 커버&#xd5
합니다. 밴드 번호를 설정하지 않&
또는 NULL로 설정할 경우, 확인 작업&#xc
래스터의 볼록 껍질만 고려합니&#x
밴드 번호를 설정할 경우, 확인 작&
값을 가진 (NODATA가 아닌) 픽셀들만 고&

Note

이 함수는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note

래스터와 도형의 공간 관계성을 확인하려면, ST_Covers(ST_Polygon(raster), geometry) 또는 ST_Covers(geometry, ST_Polygon(raster))처럼 래스터에 ST_Polygon 함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_Covers(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_covers
-----+-----+-----------
   2 |   1 | f
   2 |   2 | t
```

참고

ST_Intersects, ST_CoveredBy

10.17.4 ST_CoveredBy

ST_CoveredBy — 래스터 rastA의 어떤 포인트도 래스터 rastB 외부에 없을 경우 참을 반환합니다.

Synopsis

boolean **ST_CoveredBy**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_CoveredBy**(raster rastA , raster rastB);

설명

래스터 rastA의 어떤 포인트도 래스&#xd13
rastB 외부에 없을 경우 rastA가 rastB에 의해
커버된다고 합니다. 밴드 번호를
설정하지 않거나 또는 NULL로 설정&#xd5
경우, 확인 작업중 래스터의 볼록
껍질만 고려합니다. 밴드 번호를
설정할 경우, 확인 작업중 값을 가&
(NODATA가 아닌) 픽셀들만 고려합니다.

Note
이 함수는 래스터에서 이용할
수도 있는 모든 인덱스를
활용할 것입니다.

Note
래스터와 도형의 공간
관계성을 확인하려면,
ST_CoveredBy(ST_Polygon(raster), geometry) 또는 ST_CoveredBy(geometry,
ST_Polygon(raster))처럼 래스터에 ST_Polygon
함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_CoveredBy(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_coveredby
-----+-----+--------------
   2 |   1 | f
   2 |   2 | t
```

참고

ST_Intersects, ST_Covers

10.17.5 ST_Disjoint

ST_Disjoint — 래스터 rastA와 래스터 rastB가 공간&#xc8
교차하지 않을 경우 참을 반환합&#

Synopsis

boolean **ST_Disjoint**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Disjoint**(raster rastA , raster rastB);

설명

래스터 rastA와 래스터 rastB가 어떤 공간&#
함께 공유하지 않을 경우 rastA와 rastB가
분리됐다고 합니다. 밴드 번호를
설정하지 않거나 또는 NULL로 설정&#xd5
경우, 확인 작업중 래스터의 볼록
껍질만 고려합니다. 밴드 번호를
설정할 경우, 확인 작업중 값을 가&
(NODATA가 아닌) 픽셀들만 고려합니다.

Note
이 함수는 어떤 인덱스도 활용하지 않습니다.

Note
래스터와 도형의 공간관계성을 확인하려면, ST_Disjoint(ST_Polygon(raster), geometry)처럼 래스터에 ST_Polygon 함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- rid = 1 &#xc774; &#xbc34;&#xb4dc;&#xb97c; &#xac00;&#xc9c0;&#xace0; &#xc788;&#xc9c0;  ↩
    &#xc54a;&#xae30; &#xb54c;&#xbb38;&#xc5d0;, &#xc548;&#xb0b4;&#xbb38;(NOTICE)&#xc774;  ↩
    &#xcd9c;&#xb825;&#xb418;&#xace0; st_disjoint&#xac00; NULL&#xac12;&#xc744;  ↩
    &#xac00;&#xc9c0;&#xac8c; &#xb429;&#xb2c8;&#xb2e4;.
SELECT r1.rid, r2.rid, ST_Disjoint(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

NOTICE:  The second raster provided has no bands
 rid | rid | st_disjoint
-----+-----+-------------
   2 |   1 |
   2 |   2 | f
```

```
-- &#xc774;&#xbc88;&#xc5d0;&#xb294; &#xbc34;&#xb4dc; &#xbc88;&#xd638;&#xb97c;  ↩
    &#xc124;&#xc815;&#xd558;&#xc9c0; &#xc54a;&#xc74c;
SELECT r1.rid, r2.rid, ST_Disjoint(r1.rast, r2.rast) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_disjoint
-----+-----+-------------
   2 |   1 | t
   2 |   2 | f
```

참고

ST_Intersects

10.17.6 ST_Intersects

ST_Intersects — 래스터 rastA와 래스터 rastB가 공간&#xc
교차할 경우 참을 반환합니다.

Synopsis

boolean **ST_Intersects**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Intersects**(raster rastA , raster rastB);
boolean **ST_Intersects**(raster rast , integer nband , geometry geommin);
boolean **ST_Intersects**(raster rast , geometry geommin , integer nband=NULL);
boolean **ST_Intersects**(geometry geommin , raster rast , integer nband=NULL);

설명

래스터 rastA와 래스터 rastB가 공간적으&#
교차할 경우 참을 반환합니다. 밴&#
번호를 설정하지 않거나 또는 NULL&#xb
설정할 경우, 확인 작업중 래스터&#
볼록 껍질만 고려합니다. 밴드 번&#
설정할 경우, 확인 작업중 값을 가&#
(NODATA가 아닌) 픽셀들만 고려합니다.

> **Note**
> 이 함수는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

개선 사항: 2.0.0 버전부터 래스터/래&#xc2
교차를 지원합니다.

> **Warning**
> 변경 사항: 2.1.0 버전부터 ST_Intersects(geometry, raster)의 습성과 일치시키기 위해 ST_Intersects(raster, geometry) 변종의 습성을 바꿨습니다.

예시

```
-- &#xb3d9;&#xc77c; &#xb798;&#xc2a4;&#xd130;&#xc758; &#xc11c;&#xb85c; &#xb2e4;&#xb978;  ↩
    &#xbc34;&#xb4dc;&#xb4e4;
SELECT ST_Intersects(rast, 2, rast, 3) FROM dummy_rast WHERE rid = 2;

 st_intersects
---------------
 t
```

참고

ST_Intersection, ST_Disjoint

10.17.7 ST_Overlaps

ST_Overlaps — 래스터 rastA와 래스터 rastB가 교차&#xd
어느 한 쪽이 다른 한 쪽을 완전히
담고 있지는 않을 경우 참을 반환&#

Synopsis

boolean **ST_Overlaps**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Overlaps**(raster rastA , raster rastB);

설명

래스터 rastA와 래스터 rastB가 공간적으&#
중첩할 경우 참을 반환합니다. 다&#
말해 rastA와 rastB가 교차하지만 어느 한
쪽이 다른 한 쪽을 완전히 담고 있&#
않다는 뜻입니다. 밴드 번호를 설&
않거나 또는 NULL로 설정할 경우, 확&#xc
작업중 래스터의 볼록 껍질만 고&#x
밴드 번호를 설정할 경우, 확인 작&
값을 가진 (NODATA가 아닌) 픽셀들만 고&

Note
이 함수는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note
래스터와 도형의 공간관계성을 확인하려면, ST_Overlaps(ST_Polygon(raster), geometry)처럼 래스터에 ST_Polygon 함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
-- &#xb3d9;&#xc77c; &#xb798;&#xc2a4;&#xd130;&#xc758; &#xc11c;&#xb85c; &#xb2e4;&#xb978;  ↩
    &#xbc34;&#xb4dc;&#xb4e4;&#xc744; &#xbe44;&#xad50;
SELECT ST_Overlaps(rast, 1, rast, 2) FROM dummy_rast WHERE rid = 2;

 st_overlaps
-------------
 f
```

참고

ST_Intersects

10.17.8 ST_Touches

ST_Touches — 래스터 rastA와 래스터 rastB가 최소&#xd5
포인트 한 개를 공유하지만, 내부&#
교차하지는 않을 경우 TRUE 를 반환&#xd5

Synopsis

boolean **ST_Touches**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Touches**(raster rastA , raster rastB);

설명

래스터 rastA와 래스터 rastB가 공간적으&#
접촉할 경우 참을 반환합니다. 다&#
말해 rastA와 래스터 rastB가 최소한 포인&
한 개를 공유하지만, 내부가 교차&#
않는다는 뜻입니다. 밴드 번호를
설정하지 않거나 또는 NULL로 설정&#xd5
경우, 확인 작업중 래스터의 볼록
껍질만 고려합니다. 밴드 번호를
설정할 경우, 확인 작업중 값을 가&
(NODATA가 아닌) 픽셀들만 고려합니다.

Note
이 함수는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note
래스터와 도형의 공간적 관계성을 확인하려면, ST_Touches(ST_Polygon(raster), geometry)처럼 래스터에 ST_Polygon 함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_Touches(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_touches
-----+-----+------------
   2 |   1 | f
   2 |   2 | f
```

참고

ST_Intersects

10.17.9 ST_SameAlignment

ST_SameAlignment — 래스터들이 동일한 기울기,
축척, 공간 참조 시스템, 그리고 오&#
가지고 있을 경우 (픽셀이 다른 픽&
침범하지 않고 동일한 그리드에
놓일 수 있을 경우) 참을 반환하고,
그렇지 않을 경우 문제점을 설명&#
안내문과 함께 거짓을 반환합니&#

Synopsis

boolean **ST_SameAlignment**(raster rastA , raster rastB);
boolean **ST_SameAlignment**(double precision ulx1 , double precision uly1 , double precision scalex1 , double precision scaley1 , double precision skewx1 , double precision skewy1 , double precision ulx2 , double precision uly2 , double precision scalex2 , double precision scaley2 , double precision skewx2 , double precision skewy2);
boolean **ST_SameAlignment**(raster set rastfield);

설명

종합 함수가 아닌 버전(변종 1, 2): (직&#xc
입력하거나 또는 좌상단, 축척, 기&
SRID 값을 이용해서) 두 래스터가 동&#xc7
축척, 기울기, SRID를 가지며 한 래스&#xd1
어떤 픽셀의 꼭짓점 4개 가운데 적&
어느 한 꼭짓점이 다른 래스터의
그리드의 어느 모서리에 놓일 경&#x
참을 반환합니다. 그렇지 않을 경&#
정렬 문제를 설명하는 안내문(NOTICE)&#
함께 거짓을 반환합니다.

종합 함수 버전(변종 3): 래스터 집&#xd56
집합 내부의 모든 래스터가 정렬&#
있을 경우 참을 반환합니다. ST_SameAlignment()
함수는 PostgreSQL 전문 용어로 "종합(aggregate)"
함수입니다. 즉 SUM() 및 AVG() 함수와 마&#xcc2
데이터 행들을 대상으로 연산한&#
뜻입니다.

2.0.0 버전부터 사용할 수 있습니다.

개선 사항: 2.1.0 버전에서 종합 함수
변종이 추가됐습니다.

예시: 래스터

```
SELECT ST_SameAlignment(
        ST_MakeEmptyRaster(1, 1, 0, 0, 1, 1, 0, 0),
        ST_MakeEmptyRaster(1, 1, 0, 0, 1, 1, 0, 0)
) as sm;

sm
----
t
```

```
SELECT ST_SameAlignment(A.rast,b.rast)
 FROM dummy_rast AS A CROSS JOIN dummy_rast AS B;

 NOTICE:  The two rasters provided have different SRIDs
NOTICE:  The two rasters provided have different SRIDs
 st_samealignment
------------------
 t
 f
 f
 f
```

참고

Section 9.1, ST_NotSameAlignmentReason, ST_MakeEmptyRaster

10.17.10 ST_NotSameAlignmentReason

ST_NotSameAlignmentReason — 래스터들이 정렬돼 있&#xb294
아닌지, 그리고 정렬되지 않았다&#x
그 이유를 설명하는 텍스트를 반&#

Synopsis

text **ST_NotSameAlignmentReason**(raster rastA, raster rastB);

설명

래스터들이 정렬돼 있는지 아닌&#x
그리고 정렬되지 않았다면 그 이&#x
설명하는 텍스트를 반환합니다.

Note

래스터들이 정렬되지 않은 이유가 여러 개 있을 경우, 한 가지 이유(실패한 첫 번째 확인 작업)만 반환할 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT
        ST_SameAlignment(
                ST_MakeEmptyRaster(1, 1, 0, 0, 1, 1, 0, 0),
                ST_MakeEmptyRaster(1, 1, 0, 0, 1.1, 1.1, 0, 0)
        ),
        ST_NotSameAlignmentReason(
                ST_MakeEmptyRaster(1, 1, 0, 0, 1, 1, 0, 0),
                ST_MakeEmptyRaster(1, 1, 0, 0, 1.1, 1.1, 0, 0)
        )
;
```

```
 st_samealignment |            st_notsamealignmentreason
------------------+-----------------------------------------------------
 f                | The rasters have different scales on the X axis
(1 row)
```

참고

Section 9.1, ST_SameAlignment

10.17.11 ST_Within

ST_Within — 래스터 rastB 외부에 놓인 래스터 rastA의 포인트가 하나도 없고, 적어&#xb3c rastA 내부의 포인트 하나가 rastB의 내부& 있는 경우 참을 반환합니다.

Synopsis

boolean **ST_Within**(raster rastA , integer nbandA , raster rastB , integer nbandB);
boolean **ST_Within**(raster rastA , raster rastB);

설명

래스터 rastB 외부에 놓인 래스터 rastA의 포인트가 하나도 없고, 적어도 rastA 내부의 포인트 하나가 rastB의 내부&#xc5 있을 경우에만 rastA가 rastB 내부에 있다& 합니다. 밴드 번호를 설정하지 않& 또는 NULL로 설정할 경우, 확인 작업&#x 래스터의 볼록 껍질만 고려합니&#x 밴드 번호를 설정할 경우, 확인 작& 값을 가진 (NODATA가 아닌) 픽셀들만 고&

Note
이 피연산자(operand)는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note
래스터와 도형의 공간 관계성을 확인하려면, ST_Within(ST_Polygon(raster), geometry) 또는 ST_Within(geometry, ST_Polygon(raster))처럼 래스터에 ST_Polygon 함수를 이용하십시오.

Note
ST_Within()는 ST_Contains()의 역함수입니다. 따라서, ST_Within(rastA, rastB)의 결과와 ST_Contains(rastB, rastA)의 결과는 동일할 것입니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_Within(r1.rast, 1, r2.rast, 1) FROM dummy_rast r1 CROSS JOIN  ↩
    dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_within
-----+-----+-----------
   2 |   1 | f
   2 |   2 | t
```

참고

ST_Intersects, ST_Contains, ST_DWithin, ST_DFullyWithin

10.17.12 ST_DWithin

ST_DWithin — 래스터 rastA와 래스터 rastB가 서로 설정된 거리 안에 있을 경우 참을 반환합니다.

Synopsis

boolean **ST_DWithin**(raster rastA , integer nbandA , raster rastB , integer nbandB , double precision distance_of_srid);
boolean **ST_DWithin**(raster rastA , raster rastB , double precision distance_of_srid);

설명

래스터 rastA와 래스터 rastB가 서로 설정&
거리 안에 있을 경우 참을 반환합&#
밴드 번호를 설정하지 않거나 또&#
NULL로 설정할 경우, 확인 작업중 래&#xc
볼록 껍질만 고려합니다. 밴드 번&#
설정할 경우, 확인 작업중 값을 가&
(NODATA가 아닌) 픽셀들만 고려합니다.

거리는 래스터들의 공간 참조 시&#x
정의한 단위로 설정됩니다. 이 함&
제대로 동작하려면, 소스 래스터&#
둘 다 동일한 SRID를 가진, 동일한 좌&#xd
투영체여야 합니다.

Note
이 피연산자(operand)는 래스터에서 이용할 수도 있는 모든 인덱스를 활용할 것입니다.

Note
래스터와 도형의 공간 관계성을 확인하려면, ST_DWithin(ST_Polygon(raster), geometry)처럼 래스터에 ST_Polygon 함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_DWithin(r1.rast, 1, r2.rast, 1, 3.14) FROM dummy_rast r1 CROSS  ↩
    JOIN dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_dwithin
-----+-----+------------
   2 |   1 | f
   2 |   2 | t
```

참고

ST_Within, ST_DFullyWithin

10.17.13 ST_DFullyWithin

ST_DFullyWithin — 래스터 rastA와 래스터 rastB가 완전&
서로 설정된 거리 안에 있을 경우
참을 반환합니다.

Synopsis

boolean **ST_DFullyWithin**(raster rastA , integer nbandA , raster rastB , integer nbandB , double precision distance_of_srid);
boolean **ST_DFullyWithin**(raster rastA , raster rastB , double precision distance_of_srid);

설명

래스터 rastA와 래스터 rastB가 완전히 서&
설정된 거리 안에 있을 경우 참을
반환합니다. 밴드 번호를 설정하&
않거나 또는 NULL로 설정할 경우, 확&#xc
작업중 래스터의 볼록 껍질만 고&#x
밴드 번호를 설정할 경우, 확인 작&
값을 가진 (NODATA가 아닌) 픽셀들만 고&

거리는 래스터들의 공간 참조 시&#x
정의한 단위로 설정됩니다. 이 함&
제대로 동작하려면, 소스 래스터&#
둘 다 동일한 SRID를 가진, 동일한 좌&#xd
투영체여야 합니다.

Note
이 피연산자(operand)는 래스터에서
이용할 수도 있는 모든
인덱스를 활용할 것입니다.

Note
래스터와 도형의 공간
관계성을 확인하려면,
ST_DFullyWithin(ST_Polygon(raster), geometry)처럼 래스터에 ST_Polygon
함수를 이용하십시오.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT r1.rid, r2.rid, ST_DFullyWithin(r1.rast, 1, r2.rast, 1, 3.14) FROM dummy_rast r1  ↩
    CROSS JOIN dummy_rast r2 WHERE r1.rid = 2;

 rid | rid | st_dfullywithin
-----+-----+-----------------
   2 |   1 | f
   2 |   2 | t
```

참고

ST_Within, ST_DWithin

10.18 Raster Tips

10.18.1 Out-DB Rasters

10.18.1.1 Directory containing many files

When GDAL opens a file, GDAL eagerly scans the directory of that file to build a catalog of other files. If this directory contains many files (e.g. thousands, millions), opening that file becomes extremely slow (especially if that file happens to be on a network drive such as NFS).

To control this behavior, GDAL provides the following environment variable: GDAL_DISABLE_READDIR_ON_OPEN. Set `GDAL_DISABLE_READDIR_ON_OPEN` to `TRUE` to disable directory scanning.

In Ubuntu (and assuming you are using PostgreSQL's packages for Ubuntu), `GDAL_DISABLE_READDIR_ON_OPEN` can be set in */etc/postgresql/POSTGRESQL_VERSION/CLUSTER_NAME/environment* (where POSTGRESQL_VERSION is the version of PostgreSQL, e.g. 9.6 and CLUSTER_NAME is the name of the cluster, e.g. maindb). You can also set PostGIS environment variables here as well.

```
# environment variables for postmaster process
# This file has the same syntax as postgresql.conf:
#  VARIABLE = simple_value
#  VARIABLE2 = 'any value!'
# I. e. you need to enclose any value which does not only consist of letters,
# numbers, and '-', '_', '.' in single quotes. Shell commands are not
# evaluated.
POSTGIS_GDAL_ENABLED_DRIVERS = 'ENABLE_ALL'

POSTGIS_ENABLE_OUTDB_RASTERS = 1

GDAL_DISABLE_READDIR_ON_OPEN = 'TRUE'
```

10.18.1.2 Maximum Number of Open Files

The maximum number of open files permitted by Linux and PostgreSQL are typically conservative (typically 1024 open files per process) given the assumption that the system is consumed by human users. For Out-DB Rasters, a single valid query can easily exceed this limit (e.g. a dataset of 10 year's worth of rasters with one raster for each day containing minimum and maximum temperatures and we want to know the absolute min and max value for a pixel in that dataset).

The easiest change to make is the following PostgreSQL setting: max_files_per_process. The default is set to 1000, which is far too low for Out-DB Rasters. A safe starting value could be 65536 but this really depends on your datasets and the queries run against those datasets. This setting can only be made on server start and probably only in the PostgreSQL configuration file (e.g. */etc/postgresql/POSTGRESQL_VERSION/CLUSTER_NAME/postgresql.conf* in Ubuntu environments).

```
...
# - Kernel Resource Usage -

max_files_per_process = 65536           # min 25
                                        # (change requires restart)
...
```

The major change to make is the Linux kernel's open files limits. There are two parts to this:

- Maximum number of open files for the entire system
- Maximum number of open files per process

10.18.1.2.1 Maximum number of open files for the entire system

You can inspect the current maximum number of open files for the entire system with the following example:

```
$ sysctl -a | grep fs.file-max
fs.file-max = 131072
```

If the value returned is not large enough, add a file to */etc/sysctl.d/* as per the following example:

```
$ echo "fs.file-max = 6145324" >> /etc/sysctl.d/fs.conf

$ cat /etc/sysctl.d/fs.conf
fs.file-max = 6145324

$ sysctl -p --system
* Applying /etc/sysctl.d/fs.conf ...
fs.file-max = 2097152
* Applying /etc/sysctl.conf ...

$ sysctl -a | grep fs.file-max
fs.file-max = 6145324
```

10.18.1.2.2 Maximum number of open files per process

We need to increase the maximum number of open files per process for the PostgreSQL server processes.

To see what the current PostgreSQL service processes are using for maximum number of open files, do as per the following example (make sure to have PostgreSQL running):

```
$ ps aux | grep postgres
postgres 31713  0.0  0.4 179012 17564 pts/0    S    Dec26   0:03 /home/dustymugs/devel/ ↩
    postgresql/sandbox/10/usr/local/bin/postgres -D /home/dustymugs/devel/postgresql/sandbox ↩
    /10/pgdata
postgres 31716  0.0  0.8 179776 33632 ?        Ss   Dec26   0:01 postgres: checkpointer  ↩
    process
postgres 31717  0.0  0.2 179144  9416 ?        Ss   Dec26   0:05 postgres: writer process
postgres 31718  0.0  0.2 179012  8708 ?        Ss   Dec26   0:06 postgres: wal writer  ↩
    process
postgres 31719  0.0  0.1 179568  7252 ?        Ss   Dec26   0:03 postgres: autovacuum  ↩
    launcher process
postgres 31720  0.0  0.1  34228  4124 ?        Ss   Dec26   0:09 postgres: stats collector  ↩
    process
postgres 31721  0.0  0.1 179308  6052 ?        Ss   Dec26   0:00 postgres: bgworker:  ↩
    logical replication launcher

$ cat /proc/31718/limits
```

```
Limit                     Soft Limit           Hard Limit           Units
Max cpu time              unlimited            unlimited            seconds
Max file size             unlimited            unlimited            bytes
Max data size             unlimited            unlimited            bytes
Max stack size            8388608              unlimited            bytes
Max core file size        0                    unlimited            bytes
Max resident set          unlimited            unlimited            bytes
Max processes             15738                15738                processes
Max open files            1024                 4096                 files
Max locked memory         65536                65536                bytes
Max address space         unlimited            unlimited            bytes
Max file locks            unlimited            unlimited            locks
Max pending signals       15738                15738                signals
Max msgqueue size         819200               819200               bytes
Max nice priority         0                    0
Max realtime priority     0                    0
Max realtime timeout      unlimited            unlimited            us
```

In the example above, we inspected the open files limit for Process 31718. It doesn't matter which PostgreSQL process, any of them will do. The response we are interested in is *Max open files*.

We want to increase *Soft Limit* and *Hard Limit* of *Max open files* to be greater than the value we specified for the PostgreSQL setting `max_files_per_process`. In our example, we set `max_files_per_process` to 65536.

In Ubuntu (and assuming you are using PostgreSQL's packages for Ubuntu), the easiest way to change the *Soft Limit* and *Hard Limit* is to edit **/etc/init.d/postgresql** (SysV) or **/lib/systemd/system/postgresql*.service** (systemd).

Let's first address the SysV Ubuntu case where we add **ulimit -H -n 262144** and **ulimit -n 131072** to **/etc/init.d/postgresql**.

```
...
case "$1" in
    start|stop|restart|reload)
        if [ "$1" = "start" ]; then
            create_socket_directory
        fi
    if [ -z "`pg_lsclusters -h`" ]; then
        log_warning_msg 'No PostgreSQL clusters exist; see "man pg_createcluster"'
        exit 0
    fi

    ulimit -H -n 262144
    ulimit -n 131072

    for v in $versions; do
        $1 $v || EXIT=$?
    done
    exit ${EXIT:-0}
        ;;
    status)
...
```

Now to address the systemd Ubuntu case. We will add **LimitNOFILE=131072** to every **/lib/systemd/system/postgresql*.service** file in the **[Service]** section.

```
...
[Service]

LimitNOFILE=131072

...

[Install]
WantedBy=multi-user.target
```

```
...
```

After making the necessary systemd changes, make sure to reload the daemon

```
systemctl daemon-reload
```

Chapter 11

PostGIS Extras

This chapter documents features found in the extras folder of the PostGIS source tarballs and source repository. These are not always packaged with PostGIS binary releases, but are usually PL/pgSQL based or standard shell scripts that can be run as is.

11.1 주소 표준화 도구

이 도구는 PAGC standardizer 의 한 갈래(fork)입니&#xb2e
갈래의 원본 코드는 PAGC PostgreSQL 주소 표&#xc
도구 였습니다).

주소 표준화 도구는 단일 라인 주&#x
파싱 도구로, 주소를 입력받아 테&#x
저장된 일련의 규칙 및 도우미 어&#x
목록(lexicon; lex) 테이블 과 지명 색인(gazetteer;
gaz) 테이블 에 기반해서 정규화합&#xb2c8

`CREATE EXTENSION address_standardizer;` 명령으로 설치할
수 있는 `address_standardizer` 라는 단일 PostgreSQL 확장
프로그램 라이브러리로 코드를
빌드합니다. `address_standardizer` 확장 프로그&#
더해, `address_standardizer_data_us` 라는 샘플 데이터
확장 프로그램도 빌드하는데, 미&#
데이터에 대한 지명 색인, 어휘 목&
규칙 테이블을 담고 있습니다. `CREATE
EXTENSION address_standardizer_data_us;` 명령으로 이 확장
프로그램을 설치할 수 있습니다.

PostGIS `extensions/address_standardizer` 에서 이 확장 프로&#xadf
위한 코드를 찾을 수 있으며, 현재
독립적으로 돼 있습니다.

설치에 대한 지침을 보고 싶다면
Section 2.3 를 참조하십시오.

11.1.1 파싱 도구의 작동 방식

파싱 도구는 오른쪽에서 왼쪽 방&#x
먼저 우편번호, 주/도, 시군구에 해&
거시적(macro) 요소를 탐색한 다음, 가&#xa
번지수 또는 교차점 또는 랜드마&#
가운데 어떤 것을 처리하고 있는&#

결정하기 위한 미시적(micro) 요소를 탐색합니다. 현재 국가 코드 또는 국가명을 탐색하지는 않지만, 향&#
추가될 수도 있습니다.

국가 코드 미국 또는 캐나다의 주/
미국 또는 캐나다의 우편번호&#xb9
바탕으로 미국 또는 캐나다로
가정합니다.

우편번호/집코드(zip code) 펄(Perl) 호환 정&#
표현식을 이용해서 우편번호&#xb97
인식합니다. 이 정규 표현식은
현재 parseaddress-api.c 파일에 담겨 있고, 필&#xc69
경우 상대적으로 쉽게 변경할
수 있습니다.

주/도 펄(Perl) 호환 정규 표현식을 이&#x
우편번호를 인식합니다. 이 정&#xac
표현식은 현재 parseaddress-api.c 파일에 담&#xaca8
있는데, 향후 유지보수를 더 쉽&#xac
하기 위해 "includes"로 이동할 수도 있&#xc

11.1.2 주소 표준화 도구 유형

11.1.2.1 stdaddr

stdaddr — 주소의 요소들로 이루어진 합&#x
유형입니다. `standardize_address` 함수가 이 유&#x
반환합니다.

설명

주소의 요소들로 이루어진 합성
유형입니다. standardize_address 함수가 이 유형&
반환합니다. PAGC Postal Attributes 에서 요소들&#xc5d0
대한 몇몇 설명을 빌려왔습니다.

규칙 테이블 에서 출력 참조 번호&#
표시하는 토큰 번호를 찾아볼 수
있습니다.

This method needs address_standardizer extension.

building 문자형(토큰 번호 `0`)입니다: 건&#xbb3c
번호 또는 건물명을 참조합니&#xb2
파싱되지 않은 건물 식별자 및
유형입니다. 주소 대부분의 경&#xc6
일반적으로 비어 있습니다.

house_num 문자형(토큰 번호 `1`)입니다: 도&#xb
번지수입니다. 예: `75 State Street` 의 *75* 번지

predir 문자형(토큰 번호 `2`)입니다: North, South,
East, West 등과 같이 방향을 나타내는
도로명 접두사(STREET NAME PRE-DIRECTIONAL)입니&#xb2e

qual 문자형(토큰 번호 3)입니다: 도로&#
전치수식어(STREET NAME PRE-MODIFIER)입니다. 예:
`3715 OLD HIGHWAY 99` 에서 *OLD*

pretype 문자형(토큰 번호 4)입니다: 도로
접두사 유형(STREET PREFIX TYPE)입니다.

name 문자형(토큰 번호 5)입니다: 도로&
NAME)입니다.

suftype 문자형(토큰 번호 6)입니다: St, Ave, Cir&#xc640
같은 도로 접미사 유형(STREET POST TYPE)입&#x
도로명의 몸통 뒤에 붙는 도로
유형을 뜻합니다. 예: `75 State Street` 에서
STREET

sufdir 문자형(토큰 번호 7)입니다: 방향&
나타내는 도로 접미사(STREET POST-DIRECTIONAL)&#
도로명 뒤에 붙어 방향을 나타&#xb0
수식어입니다. 예: `3715 TENTH AVENUE WEST` 에서
WEST

ruralroute is text (token number `8`): RURAL ROUTE . Example *7* in `RR 7`.

extra 문자형입니다: 층수 같은 추가
정보입니다.

city 문자형(토큰 번호 10)입니다: 예: 보&
시

state 문자형(토큰 번호 11)입니다: 예: 매
주

country 문자형(토큰 번호 12)입니다: 예:
`USA`

postcode 문자형(토큰 번호 13) 우편번호(postal
code, zip code)입니다: 예: `02109`

box 문자형(토큰 번호 14, 15) 사서함 번&#xd638
BOX NUMBER)입니다: 예: `02109`

unit 문자형(토큰 번호 17) 아파트 동수
또는 호수입니다: 예: `APT 3B` 에서 *3B*

11.1.3 주소 표준화 도구 테이블

11.1.3.1 규칙 테이블

규칙 테이블 — 규칙 테이블은 주소
입력 배열 토큰을 표준화된 출력
배열 토큰에 매핑하는 일련의 규&#
담고 있습니다. 입력 토큰들의 집&#
그 뒤에 -1(종결자; terminator), 그 뒤에 출력
토큰들의 집합, 그 뒤에 -1, 그 뒤에
규칙의 종류를 표시하는 번호, 그
뒤에 규칙의 순위를 나열해서 하&#
규칙을 정의합니다.

설명

규칙 테이블은 최소한 다음 열들&#x
가지고 있어야만 하지만, 사용자&#x
용처에 따라 더 많은 열을 추가할
수도 있습니다.

id 테이블의 기본 키

rule 규칙을 표시하는 텍스트 항목&#xc78
PAGC Address Standardizer Rule records 에서 자세히 설명하&#xac
있습니다.

하나의 규칙은 입력 토큰을 나&#xd0
음수가 아닌 정수들의 집합, 해&#xb2
집합을 종결하는 -1, 그 다음에 우&#x
속성을 나타내는 동일한 개수&#xc7
음수가 아닌 정수들의 집합, 해&#xb2
집합을 종결하는 -1, 그 다음에 규&#x
유형을 나타내는 정수, 그 다음&#xc5
규칙 순위를 나타내는 정수로
이루어집니다. 규칙의 순위는
(최저) 0부터 (최고) 17까지입니다.

따라서, 예를 들어 규칙 `2 0 2 22 3 -1 5 5 6 7 3 -1 2 6` 은 출력 토큰 배열 *TYPE NUMBER TYPE DIRECT QUALIF* 에, 해당 출력 토큰 배열은 출&#xb8
배열 *STREET STREET SUFTYP SUFDIR QUALIF* 에 매핑됩니다.
규칙은 6순위의 ARC_C 규칙입니다.

stdaddr에서 해당 출력 토큰에 대한
번호 목록을 소개하고 있습니&#xb2e

입력 토큰

각 규칙은 입력 토큰 집합과 그 다&#
종결자 `-1` 로 시작합니다. PAGC Input Tokens 에&#xc11c
발췌한 유효한 입력 토큰들은 다&#
같습니다:

서식 기반 입력 토큰

AMPERS (13). 앰퍼샌드(&)는 단어 "and"를 축약&#xd5
데 자주 쓰입니다.

DASH (9). 구두법(句讀法; punctuation) 문자입니&#xb2e

DOUBLE (21). 문자 2개의 배열입니다. 식별&#x
종종 쓰입니다.

FRACT (25). 분수는 가끔 가구 번호 또는
동호수에 쓰입니다.

MIXED (23). 문자와 숫자 모두를 담고 있&#xb29
영숫자 스트링입니다. 식별자&#xb8
쓰입니다.

NUMBER (0). 숫자 스트링입니다.

ORD (15). "First" 또는 "1st" 같은 표현입니다. 도&#xb85
자주 쓰입니다.

ORD (18). 단일 문자입니다.

WORD (1). 임의의 길이의 문자열입니다. 단일 문자는 SINGLE도, WORD도 될 수 있&#xc2b

기능 기반 입력 토큰

BOXH (14). 우편사서함을 표시하는 데 쓰이는 단어입니다. 예를 들어 *Box* 또는 *PO Box* 처럼 말이죠.

BUILDH (19). 일반적으로 접두사의 형태&#xc77 건물 또는 건물군을 표시하는 데 쓰이는 단어입니다. 예: *Tower 7A* 에&#xc *Tower*

BUILDT 일반적으로 접미사의 형태인, 건물 또는 건물군을 표시하는 데 쓰이는 단어 및 약어입니다. 예: *Shopping Centre*

DIRECT (22). 방향을 표시하는 데 쓰이는 단어입니다. 예: *North*

MILE (20). 거리표(어떤 지점까지의 거리나타내는 도로가의 푯말; milepost) 주&#xc1 표시하는 데 쓰이는 단어입니&#xb2e

ROAD (6). 고속도로와 도로를 표시하는 데 쓰이는 단어 및 약어입니다. 예: *Interstate 5* 에서 *Interstate*

RR (8). 지방 우편물 배달 노선(rural route)을 표데 쓰이는 단어 및 약어입니다. *RR*.

TYPE (2). 도로 유형을 표시하는 데 쓰이 단어 및 약어입니다. 예: *ST* 또는 *AVE*

UNITH (16). 내부 하위주소를 표시하는 데 쓰이는 단어 및 약어입니다. 예: *APT* 또는 *UNIT*

우편 유형 입력 토큰

QUINT (28). 다섯 자리 숫자입니다. 집코&#xb4dc Code)를 식별합니다.

QUAD (29). 네 자리 숫자입니다. ZIP4를 식별&#

PCH (27). 문자, 숫자, 문자 순서로 이루어 문자 3개의 배열입니다. 캐나다 우편 번호의 처음 세 문자인 FSA를 식별합니다.

PCT (26). 숫자, 문자, 숫자 순서로 이루는 문자 3개의 배열입니다. 캐나다 우편 번호의 마지막 세 문자인 LDU를 식별합니다.

불용어(不用語; stopword)

STOPWORD는 WORD와 결합합니다. 규칙 상 복&
WORD 및 STOPWORD 스트링을 단일 WORD 토큰으&#x
표현할 것입니다.

STOPWORD (7). 어휘 상 중요도가 낮아 파싱
작업시 생략할 수 있는 단어입&#xb2
예: *THE*

출력 토큰

첫 번째 -1(종결자) 다음에 출력 토큰
및 그 순서가 오고, 그 다음에 종결&#x
`-1` 이 따라옵니다. stdaddr 에서 많은 해당
출력 토큰들의 목록을 소개하고
있습니다. 규칙의 유형에 따라 사&#
수 있는 출력 토큰들도 달라집니&#
the section called “규칙 유형 및 순위” 에서 각 규&#
유형에 대해 유효한 출력 토큰 목&#
볼 수 있습니다.

규칙 유형 및 순위

규칙을 구성하는 마지막 부분은
다음 가운데 하나로 표시되는 규&#
유형과 그 다음에 오는 규칙 순위&#x
규칙의 순위는 (최저) 0부터 (최고)
17까지입니다.

MACRO_C

(토큰 번호 = "**0**"). *PLACE STATE ZIP* 같은 MACRO 절을 파&#xc
위한 규칙 클래스입니다.

MACRO_C 출력 토큰 (http://www.pagcgeo.org/docs/html/pagc-12.html#--r-typ-- 에서
발췌)

CITY (토큰 번호 "10"). 예: "Albany"

STATE (토큰 번호 "11"). 예: "NY"

NATION (토큰 번호 "12"). 이 속성은 대부분&#x
참조 파일에서 쓰이지 않습니&#xb2e
예: "USA"

POSTAL (토큰 번호 "13"). (SADS 요소 "ZIP CODE", "PLUS 4"). 미국
집코드 및 캐나다 우편 번호 모&#xb4
이 속성을 이용합니다.

MICRO_C

(토큰 번호 = "**1**"). (가구, 도로, sufdir, predir, pretyp, suftype,
qualif와 같은) 완전한 MICRO 절을 파싱하&#xae3
위한 규칙 클래스입니다(예: ARC_C 및
CIVIC_C). 빌드 시기에는 이 규칙들을 이&
않습니다.

MICRO_C 출력 토큰 (http://www.pagcgeo.org/docs/html/pagc-12.html#--r-typ-- 에서
발췌).

HOUSE 문자형(토큰 번호 1)입니다: 도&#xb85c 번지수입니다. 예: `75 State Street` 의 *75* 번지

predir 문자형(토큰 번호 2)입니다: North, South, East, West 등과 같이 방향을 나타내는 도로명 접두사(STREET NAME PRE-DIRECTIONAL)입니&#xb2e

qual 문자형(토큰 번호 3)입니다: 도로&# 전치수식어(STREET NAME PRE-MODIFIER)입니다. 예: `3715 OLD HIGHWAY 99` 에서 *OLD*

pretype 문자형(토큰 번호 4)입니다: 도&#xb85c 접두사 유형(STREET PREFIX TYPE)입니다.

street 문자형(토큰 번호 5)입니다: 도로& NAME)입니다.

suftype 문자형(토큰 번호 6)입니다: St, Ave, Cir&#xc640 같은 도로 접미사 유형(STREET POST TYPE)입&#x 도로명의 몸통 뒤에 붙는 도로 유형을 뜻합니다. 예: `75 State Street` 에서 *STREET*

sufdir 문자형(토큰 번호 7)입니다: 방향& 나타내는 도로 접미사(STREET POST-DIRECTIONAL)&# 도로명 뒤에 붙어 방향을 나타&#xb0 수식어입니다. 예: `3715 TENTH AVENUE WEST` 에서 *WEST*

ARC_C

(토큰 번호 = "**2**"). HOUSE 속성을 제외하고 MICRO 절을 파싱하기 위한 규칙 클래&#xc 따라서 HOUSE 토큰을 뺀 MICRO_C 출력 토큰 집합을 이용합니다.

CIVIC_C

(토큰 번호 = "**3**"). HOUSE 속성을 파싱하기 위한 규칙 클래스입니다.

EXTRA_C

(토큰 번호 = "**4**"). EXTRA 속성 - 지오코딩에&#xc 제외된 속성 - 을 파싱하기 위한 규& 클래스입니다. 빌드 시기에는 이 규칙들을 이용하지 않습니다.

EXTRA_C 출력 토큰 (http://www.pagcgeo.org/docs/html/pagc-12.html#--r-typ-- 에서 발췌).

BLDNG (토큰 번호 0): 파싱되지 않은 건&#xbb3c 식별자 및 유형입니다.

BOXH (token number 14): The **BOX** in `BOX 3B`

BOXT (토큰 번호 15): `BOX 3B` 에서 **3B**

RR (토큰 번호 8): `RR 7` 에서 **RR**

UNITH (토큰 번호 16): `APT 3B` 에서 **APT**

UNITT (토큰 번호 17): `APT 3B` 에서 **3B**

UNKNWN (토큰 번호 9): 따로 분류되지 않&#xc 출력물입니다.

11.1.3.2 어휘 목록 테이블

어휘 목록 테이블 — 어휘 목록(lex) 테&#x
영숫자 입력을 분류하고, 해당 입&#
(1) 입력 토큰(the section called "입력 토큰" 참조)
및 (2) 표준화된 표현식과 연관짓는
데 쓰입니다.

설명

어휘 목록(lexicon) 테이블은 영숫자 입&#x
분류하고, 해당 입력을 (1) 입력 토&#xd070
section called "입력 토큰" 참조) 및 (2) 표준화된
표현식과 연관짓는 데 쓰입니다.
이 테이블에서, 예를 들어, 영단어
ONE 이 stdword 1 로 매핑된 것을 찾아볼 수
있습니다.

어휘 목록 테이블은 최소한 다음
열을 가지고 있어야 합니다. 사용&#x
지정 열을 추가할 수도 있습니다.

id 테이블의 기본 키

seq 정수형: 정의 번호?

word 문자형: 입력 단어

stdword 문자형: 표준화된 대체 단어

token 정수형: 단어의 유형을 나타냅&#xb
단어가 해당 맥락에서 쓰였을
경우에만 대체될 것입니다. PAGC To-
kens 를 참조하십시오.

11.1.3.3 지명 색인 테이블

지명 색인 테이블 — 지명 색인(gaz) 테&#xc
지명을 표준화하고, 해당 입력을
(1) 입력 토큰(the section called "입력 토큰" 참조)
및 (2) 표준화된 표현식과 연관짓는
데 쓰입니다.

설명

A gaz (short for gazeteer) table is used to standardize place names and associate that input with the section called "입력 토큰" and (b) standardized representations. For example if you are in US, you may load these with State Names and associated abbreviations.

지명 색인 테이블은 최소한 다음
열을 가지고 있어야 합니다. 사용&#x
용처에 따라 더 많은 열을 추가할
수도 있습니다.

id 테이블의 기본 키

seq 정수형: 정의 번호? - 단어의 해당
인스턴스에 쓰이는 식별자

word 문자형: 입력 단어

stdword 문자형: 표준화된 대체 단어

token 정수형: 단어의 유형을 나타냅&#xb
단어가 해당 맥락에서 쓰였을
경우에만 대체될 것입니다. PAGC To-
kens 를 참조하십시오.

11.1.4 주소 표준화 도구 함수

11.1.4.1 debug_standardize_address

debug_standardize_address — Returns a json formatted text listing the parse tokens and standardizations

Synopsis

text **debug_standardize_address**(text lextab, text gaztab, text rultab, text micro, text macro=NULL);

설명

This is a function for debugging address standardizer rules and lex/gaz mappings. It returns a json formatted text that includes the matching rules, mapping of tokens, and best standardized address stdaddr form of an input address utilizing 어휘
목록 테이블 table name, 지명 색인 테이블,
and 규칙 테이블 table names and an address.

For single line addresses use just `micro`

For two line address A `micro` consisting of standard first line of postal address e.g. `house_num street`, and a macro consisting of standard postal second line of an address e.g `city, state postal_code country`.

Elements returned in the json document are

input_tokens For each word in the input address, returns the position of the word, token categorization of the word, and the standard word it is mapped to. Note that for some input words, you might get back multiple records because some inputs can be categorized as more than one thing.

rules The set of rules matching the input and the corresponding score for each. The first rule (highest scoring) is what is used for standardization

stdaddr The standardized address elements stdaddr that would be returned when running standardize_address

Availability: 3.4.0

This method needs address_standardizer extension.

예시

address_standardizer_data_us 확장 프로그램 이용

```
CREATE EXTENSION address_standardizer_data_us; -- &#xd55c; &#xbc88;&#xb9cc;  ↩
    &#xc2e4;&#xd589;&#xd558;&#xba74; &#xb429;&#xb2c8;&#xb2e4;.
```

Variant 1: Single line address and returning the input tokens

```
SELECT it->>'pos' AS position, it->>'word' AS word, it->>'stdword' AS standardized_word,
            it->>'token' AS token, it->>'token-code' AS token_code
    FROM jsonb(
            debug_standardize_address('us_lex',
                'us_gaz', 'us_rules', 'One Devonshire Place, PH 301, Boston, MA 02109')
                 ) AS s, jsonb_array_elements(s->'input_tokens') AS it;
```

```
position |    word    | standardized_word | token  | token_code
---------+------------+-------------------+--------+------------
 0       | ONE        | 1                 | NUMBER | 0
 0       | ONE        | 1                 | WORD   | 1
 1       | DEVONSHIRE | DEVONSHIRE        | WORD   | 1
 2       | PLACE      | PLACE             | TYPE   | 2
 3       | PH         | PATH              | TYPE   | 2
 3       | PH         | PENTHOUSE         | UNITT  | 17
 4       | 301        | 301               | NUMBER | 0
(7 rows)
```

Variant 2: Multi line address and returning first rule input mappings and score

```
SELECT (s->'rules'->0->>'score')::numeric AS score, it->>'pos' AS position,
        it->>'input-word' AS word, it->>'input-token' AS input_token, it->>'mapped-word' AS ↩
             standardized_word,
            it->>'output-token' AS output_token
    FROM jsonb(
            debug_standardize_address('us_lex',
                'us_gaz', 'us_rules', 'One Devonshire Place, PH 301', 'Boston, MA 02109')
                 ) AS s, jsonb_array_elements(s->'rules'->0->'rule_tokens') AS it;
```

```
score    | position |    word    | input_token | standardized_word | output_token
---------+----------+------------+-------------+-------------------+--------------
 0.876250 | 0        | ONE        | NUMBER      | 1                 | HOUSE
 0.876250 | 1        | DEVONSHIRE | WORD        | DEVONSHIRE        | STREET
 0.876250 | 2        | PLACE      | TYPE        | PLACE             | SUFTYP
 0.876250 | 3        | PH         | UNITT       | PENTHOUSE         | UNITT
 0.876250 | 4        | 301        | NUMBER      | 301               | UNITT
(5 rows)
```

참고

stdaddr, 규칙 테이블, 어휘 목록 테이블, 지명 색인 테이블, Pagc_Normalize_Address

11.1.4.2 parse_address

parse_address — 한 줄로 된 주소를 입력받아 부분들로 분해합니다.

Synopsis

record **parse_address**(text address);

설명

Returns takes an address as input, and returns a record output consisting of fields *num*, *street*, *street2*, *address1*, *city*, *state*, *zip*, *zipplus*, *country*.

2.2.0 버전부터 사용할 수 있습니다.

This method needs address_standardizer extension.

예시

단일 주소

```
SELECT num, street, city, zip, zipplus
        FROM parse_address('1 Devonshire Place, Boston, MA 02109-1234') AS a;
```

```
num |      street      |  city  |  zip  | zipplus
-----+------------------+--------+-------+---------
 1   | Devonshire Place | Boston | 02109 | 1234
```

주소 테이블

```
-- &#xae30;&#xbcf8; &#xd14c;&#xc774;&#xbe14;
CREATE TABLE places(addid serial PRIMARY KEY, address text);

INSERT INTO places(address)
VALUES ('529 Main Street, Boston MA, 02129'),
 ('77 Massachusetts Avenue, Cambridge, MA 02139'),
 ('25 Wizard of Oz, Walaford, KS 99912323'),
 ('26 Capen Street, Medford, MA'),
 ('124 Mount Auburn St, Cambridge, Massachusetts 02138'),
 ('950 Main Street, Worcester, MA 01610');

 -- &#xc8fc;&#xc18c; &#xd30c;&#xc2f1;&#xd558;&#xae30;
 -- &#xbaa8;&#xb4e0; &#xd56d;&#xbaa9;&#xc744; &#xc6d0;&#xd55c;&#xb2e4;&#xba74; (a).* ↩
    &#xb97c; &#xc4f0;&#xba74; &#xb429;&#xb2c8;&#xb2e4;.
SELECT addid, (a).num, (a).street, (a).city, (a).state, (a).zip, (a).zipplus
FROM (SELECT addid, parse_address(address) As a
 FROM places) AS p;
```

```
addid | num |        street        |   city    | state |  zip  | zipplus
-------+-----+----------------------+-----------+-------+-------+---------
     1 | 529 | Main Street          | Boston    | MA    | 02129 |
     2 | 77  | Massachusetts Avenue | Cambridge | MA    | 02139 |
     3 | 25  | Wizard of Oz         | Walaford  | KS    | 99912 | 323
     4 | 26  | Capen Street         | Medford   | MA    |       |
     5 | 124 | Mount Auburn St      | Cambridge | MA    | 02138 |
     6 | 950 | Main Street          | Worcester | MA    | 01610 |
(6 rows)
```

참고

11.1.4.3 standardize_address

standardize_address — 어휘 목록, 지명 색인, 규칙 테이블을 활용해서 입력 주소의 stdaddr 형식을 반환합니다.

Synopsis

stdaddr **standardize_address**(text lextab, text gaztab, text rultab, text address);
stdaddr **standardize_address**(text lextab, text gaztab, text rultab, text micro, text macro);

설명

어휘 목록 테이블, 지명 색인 테이블규칙 테이블 테이블명 및 주소를 활용해서 입력 주소의 stdaddr 형식을 반환합니다.

변종 1: 주소를 단일 행으로 입력받&

변종 2: 주소를 두 부분으로 입력받&`house_num street` 같은 우편 주소의 표준 첫 번째 행으로 이루어진 `micro` 절과, `city, state postal_code country` 같은 우편 주소의 표준 두 번째 행으로 이루어진 `macro` 절입&#xb

2.2.0 버전부터 사용할 수 있습니다.

This method needs address_standardizer extension.

예시

address_standardizer_data_us 확장 프로그램 이용

```
CREATE EXTENSION address_standardizer_data_us; -- &#xd55c; &#xbc88;&#xb9cc;  ↩
    &#xc2e4;&#xd589;&#xd558;&#xba74; &#xb429;&#xb2c8;&#xb2e4;.
```

변종 1: 단일 행 주소를 입력 받습니미국 주소가 아닌 경우 제대로 동않습니다.

```
SELECT house_num, name, suftype, city, country, state, unit  FROM standardize_address(' ↩
    us_lex',
                            'us_gaz', 'us_rules', 'One Devonshire Place, PH 301, Boston, MA  ↩
                               02109');
```

```
house_num |    name    | suftype |  city  | country |     state      |      unit
----------+------------+---------+--------+---------+----------------+-----------------
1         | DEVONSHIRE | PLACE   | BOSTON | USA     | MASSACHUSETTS | # PENTHOUSE 301
```

TIGER 지오코딩 도구로 패키징된 테이용 (이 예시는 사용자가 `postgis_tiger_geocoder` 를 설치했을 경우에만 동작합니&#x

```
SELECT *  FROM standardize_address('tiger.pagc_lex',
         'tiger.pagc_gaz', 'tiger.pagc_rules', 'One Devonshire Place, PH 301, Boston, MA  ↩
            02109-1234');
```

더 알아보기 쉽게 하기 위해 hstore 확&#xc7프로그램을 이용해서 출력물을 덤프할 것입니다. 사용자가 `CREATE EXTENSION hstore;` 명령으로 설치해야 합니다.

```
SELECT (each(hstore(p))).*
 FROM standardize_address('tiger.pagc_lex', 'tiger.pagc_gaz',
   'tiger.pagc_rules', 'One Devonshire Place, PH 301, Boston, MA 02109') As p;
```

```
key     |      value
------------+-----------------
 box        |
 city       | BOSTON
 name       | DEVONSHIRE
 qual       |
 unit       | # PENTHOUSE 301
 extra      |
 state      | MA
 predir     |
 sufdir     |
 country    | USA
 pretype    |
 suftype    | PL
 building   |
 postcode   | 02109
 house_num  | 1
 ruralroute |
(16 rows)
```

변종 2: 주소를 두 부분으로 입력받&

```
SELECT (each(hstore(p))).*
 FROM standardize_address('tiger.pagc_lex', 'tiger.pagc_gaz',
   'tiger.pagc_rules', 'One Devonshire Place, PH 301', 'Boston, MA 02109, US') As p;
```

```
key     |      value
------------+-----------------
 box        |
 city       | BOSTON
 name       | DEVONSHIRE
 qual       |
 unit       | # PENTHOUSE 301
 extra      |
 state      | MA
 predir     |
 sufdir     |
 country    | USA
 pretype    |
 suftype    | PL
 building   |
 postcode   | 02109
 house_num  | 1
 ruralroute |
(16 rows)
```

참고

stdaddr, 규칙 테이블, 어휘 목록 테이블, 지명 색인 테이블, Pagc_Normalize_Address

11.2 TIGER 지오코딩 도구

TIGER 지오코딩 도구와 달리 여러 국&#xac
지오코딩을 지원한다는 장점을
가진, PostGIS를 지원하는 몇몇 오픈소&#x
지오코딩 도구들이 있습니다.

- Nominatim 은 OpenStreetMap 지명 색인 데이터 형식&#
  이용합니다. 데이터를 로드하기
  위해 osm2pgsql이, 제대로 동작하기 위&#xd574
  PostgreSQL 8.4 이상 버전 및 PostGIS 1.5 이상 버전이
  필요합니다. 웹서비스 인터페이&
  패키징됐으며, 웹서비스로 호출&
  위해 설계된 것으로 보입니다. TIGER
  지오코딩 도구와 마찬가지로, 지&
  도구 및 역 지오코딩 도구 구성 요&
  모두 가지고 있습니다. 문서상에&
  보면, Nominatim이 TIGER 지오코딩 도구처럼
  순수한 SQL 인터페이스를 가지고
  있는지, 또는 웹 인터페이스에 충&
  로직을 구현했는지 불확실합니&
- GIS Graphy 또한 PostGIS를 활용하며 Nominatim처럼
  OSM(OpenStreetMap) 데이터를 이용합니다. OSM 데&
  로드하기 위한 로더를 갖추고 있&
  Nominatim와 유사하게 미국 이외의 국가&
  지오코딩도 할 수 있습니다. Nominatim೼
  마찬가지로, 웹서비스로 실행되&#
  Java 1.5, Servlet apps, Solr에 의존합니다. GIS Graphy는 여러
  플랫폼 상에서 실행되며, 몇몇 멋&
  기능과 함께 역 지오코딩 도구도
  가지고 있습니다.

11.2.1 Drop_Indexes_Generate_Script

Drop_Indexes_Generate_Script — TIGER 스키마 및 사용자 지정
스키마에 있는 기본 키가 아닌 그&#
유일하지 않은 인덱스들을 모두
삭제하는 스크립트를 생성합니&#
스키마를 따로 지정하지 않을 경&#
기본값인 `tiger_data` 스키마를 대상으로
합니다.

Synopsis

text **Drop_Indexes_Generate_Script**(text param_schema=tiger_data);

설명

TIGER 스키마 및 사용자 지정 스키마&#xc5
있는 기본 키가 아닌 그리고 유일&#x
않은 인덱스들을 모두 삭제하는
스크립트를 생성합니다. 스키마&#
따로 지정하지 않을 경우 기본값&#x
`tiger_data` 스키마를 대상으로 합니다.

이 함수는 쿼리 설계자를 혼란스&#x
할 수도 있는 인덱스의 쓸데없는
팽창(bloat) 또는 불필요한 용량을 차&#xc9
일을 최소화합니다. Install_Missing_Indexes 함수&#xc64
결합해서 지오코딩 도구가 이용&#x
인덱스들만 추가하는 데 쓰입니&#x

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT drop_indexes_generate_script() As actionsql;
actionsql
-----------------------------------------------------------
DROP INDEX tiger.idx_tiger_countysub_lookup_lower_name;
DROP INDEX tiger.idx_tiger_edges_countyfp;
DROP INDEX tiger.idx_tiger_faces_countyfp;
DROP INDEX tiger.tiger_place_the_geom_gist;
DROP INDEX tiger.tiger_edges_the_geom_gist;
DROP INDEX tiger.tiger_state_the_geom_gist;
DROP INDEX tiger.idx_tiger_addr_least_address;
DROP INDEX tiger.idx_tiger_addr_tlid;
DROP INDEX tiger.idx_tiger_addr_zip;
DROP INDEX tiger.idx_tiger_county_countyfp;
DROP INDEX tiger.idx_tiger_county_lookup_lower_name;
DROP INDEX tiger.idx_tiger_county_lookup_snd_name;
DROP INDEX tiger.idx_tiger_county_lower_name;
DROP INDEX tiger.idx_tiger_county_snd_name;
DROP INDEX tiger.idx_tiger_county_the_geom_gist;
DROP INDEX tiger.idx_tiger_countysub_lookup_snd_name;
DROP INDEX tiger.idx_tiger_cousub_countyfp;
DROP INDEX tiger.idx_tiger_cousub_cousubfp;
DROP INDEX tiger.idx_tiger_cousub_lower_name;
DROP INDEX tiger.idx_tiger_cousub_snd_name;
DROP INDEX tiger.idx_tiger_cousub_the_geom_gist;
DROP INDEX tiger_data.idx_tiger_data_ma_addr_least_address;
DROP INDEX tiger_data.idx_tiger_data_ma_addr_tlid;
DROP INDEX tiger_data.idx_tiger_data_ma_addr_zip;
DROP INDEX tiger_data.idx_tiger_data_ma_county_countyfp;
DROP INDEX tiger_data.idx_tiger_data_ma_county_lookup_lower_name;
DROP INDEX tiger_data.idx_tiger_data_ma_county_lookup_snd_name;
DROP INDEX tiger_data.idx_tiger_data_ma_county_lower_name;
DROP INDEX tiger_data.idx_tiger_data_ma_county_snd_name;
:
:
```

참고

Install_Missing_Indexes, Missing_Indexes_Generate_Script

11.2.2 Drop_Nation_Tables_Generate_Script

Drop_Nation_Tables_Generate_Script — 지정한 스키마에서 `county_al` `state_all` 로 시작하는 테이블, 또는 뒤&#xc5d `county`, `state` 가 붙는 주(州) 코드를 모두 삭&#x 스크립트를 생성합니다.

Synopsis

text **Drop_Nation_Tables_Generate_Script**(text param_schema=tiger_data);

설명

지정한 스키마에서 `county_all`, `state_all` 로 시&#x 테이블, 또는 뒤에 `county`, `state` 가 붙는 주(&#

코드를 모두 삭제하는 스크립트&#x
생성합니다. tiger_2010 데이터를 tiger_2011 데&
업그레이드하는 경우 이 함수가
필요합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시

```
SELECT drop_nation_tables_generate_script();
DROP TABLE tiger_data.county_all;
DROP TABLE tiger_data.county_all_lookup;
DROP TABLE tiger_data.state_all;
DROP TABLE tiger_data.ma_county;
DROP TABLE tiger_data.ma_state;
```

참고

Loader_Generate_Nation_Script

11.2.3 Drop_State_Tables_Generate_Script

Drop_State_Tables_Generate_Script — 지정한 스키마에서 주(&#x
명칭의 약어가 접두사로 붙는 테&#
모두 삭제하는 스크립트를 생성&#
스키마를 따로 지정하지 않을 경&#
기본값인 tiger_data 스키마를 대상으로
합니다.

Synopsis

text **Drop_State_Tables_Generate_Script**(text param_state, text param_schema=tiger_data);

설명

지정한 스키마에서 주(州) 명칭의
약어가 접두사로 붙는 테이블을
모두 삭제하는 스크립트를 생성&#
스키마를 따로 지정하지 않을 경&#
기본값인 tiger_data 스키마를 대상으로
합니다. 이전 데이터 로드 과정에
어떤 문제가 생겼을 경우 주(州) 데&
다시 로드하기 전에 주(州) 테이블&
삭제하는 데 유용합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT drop_state_tables_generate_script('PA');
DROP TABLE tiger_data.pa_addr;
DROP TABLE tiger_data.pa_county;
DROP TABLE tiger_data.pa_county_lookup;
DROP TABLE tiger_data.pa_cousub;
```

```
DROP TABLE tiger_data.pa_edges;
DROP TABLE tiger_data.pa_faces;
DROP TABLE tiger_data.pa_featnames;
DROP TABLE tiger_data.pa_place;
DROP TABLE tiger_data.pa_state;
DROP TABLE tiger_data.pa_zip_lookup_base;
DROP TABLE tiger_data.pa_zip_state;
DROP TABLE tiger_data.pa_zip_state_loc;
```

참고

Loader_Generate_Script

11.2.4 Geocode

Geocode — 주소를 스트링(또는 다른 정규&
주소)으로 입력받아 NAD83 경위도로
투영된 포인트 도형, 각 주소에 대&#
정규화된 주소 및 순위를 포함하&#x
가능성 있는 위치들의 집합을 출&#
순위가 낮을수록 주소와 위치가
일치할 가능성이 커집니다. 결과&#x
순위가 낮은 순서로 정렬합니다.
결과의 최대 개수(기본값 10) 및 restrict_region(&#xa
NULL) 옵션 파라미터를 넘겨줄 수 있&#xc

Synopsis

setof record **geocode**(varchar address, integer max_results=10, geometry restrict_region=NULL, norm_addy OUT addy, geometry OUT geomout, integer OUT rating);
setof record **geocode**(norm_addy in_addy, integer max_results=10, geometry restrict_region=NULL, norm_addy OUT addy, geometry OUT geomout, integer OUT rating);

설명

주소를 스트링(또는 다른 정규화&#
주소)으로 입력받아 NAD83 경위도로
투영된 포인트 도형, 각 주소에 대&#
`normalized_address` (addy) 및 순위를 포함하는 가&#xb2a5
있는 위치들의 집합을 출력합니&#
순위가 낮을수록 주소와 위치가
일치할 가능성이 커집니다. 결과&#x
순위가 낮은 순서로 정렬합니다.
TIGER 데이터(edge, face, addr), PostgreSQL 퍼지 문자열 매&#xc
levenshtein), 그리고 PostGIS 라인 보간 함수를 이&
TIGER 경계선을 따라 주소를 보간합&#xb2
순위가 높을수록 지오코딩 작업&#x
올바를 가능성이 떨어집니다. 지&#
포인트는 기본적으로 중심선에&#xc
도로 주소가 위치한 쪽(왼쪽/오른&#
10미터 오프셋됩니다.

개선 사항: 2.0.0 버전에서 TIGER 2010 데이터
구조를 지원하고, 속도와 지오코&#x

작업의 정확도를 향상시키기 위&#x
몇몇 로직을 수정하고, 포인트를
중심선에서 도로 주소가 위치한
쪽으로 오프셋시키기 시작했습&#x
새로 도입된 `max_results` 파라미터는 결&#xac
개수를 설정하거나 최선의 결과&#x
반환하도록 하는 데 유용합니다.

기본 예시

매사추세츠(MA), 미네소타(MN), 캘리포&#
로드아일랜드(RI) 주의 TIGER 데이터를
로드한 PostgreSQL 9.1rc1/PostGIS 2.0이 실행되고 있는
3.0 GHZ 단일 프로세서 및 2GB 램 윈도우7
컴퓨터에서 다음 예시를 실행시&#x
데 걸리는 시간을 측정했습니다.

완전 일치를 계산하는 것이 더 빠&#

```
SELECT g.rating, ST_X(g.geomout) As lon, ST_Y(g.geomout) As lat,
    (addy).address As stno, (addy).streetname As street,
    (addy).streettypeabbrev As styp, (addy).location As city, (addy).stateabbrev As st,( ↩
       addy).zip
    FROM geocode('75 State Street, Boston MA 02109') As g;
 rating |        lon        |       lat        | stno | street | styp |  city  | st |  zip
--------+-------------------+------------------+------+--------+------+--------+----+------- ↩

      0 | -71.0556722990239 | 42.3589914927049 |   75 | State  | St   | Boston | MA | 02109
```

지오코딩 도구에 집코드를 넘겨&#x
않더라도 추측할 수 있습니다(122 ~
150밀리초 걸립니다).

```
SELECT g.rating, ST_AsText(ST_SnapToGrid(g.geomout,0.00001)) As wktlonlat,
    (addy).address As stno, (addy).streetname As street,
    (addy).streettypeabbrev As styp, (addy).location As city, (addy).stateabbrev As st,( ↩
       addy).zip
    FROM geocode('226 Hanover Street, Boston, MA',1) As g;
 rating |         wktlonlat          | stno | street  | styp |  city  | st |  zip
--------+----------------------------+------+---------+------+--------+----+-------
      1 | POINT(-71.05528 42.36316) |  226 | Hanover | St   | Boston | MA | 02113
```

철자 오류도 처리할 수 있는데, 하&
이상의 가능성 있는 답을 순위와
함께 생성하기 때문에 시간이 더
걸립니다(500밀리초).

```
SELECT g.rating, ST_AsText(ST_SnapToGrid(g.geomout,0.00001)) As wktlonlat,
    (addy).address As stno, (addy).streetname As street,
    (addy).streettypeabbrev As styp, (addy).location As city, (addy).stateabbrev As st,( ↩
       addy).zip
    FROM geocode('31 - 37 Stewart Street, Boston, MA 02116') As g;
 rating |         wktlonlat          | stno | street | styp |  city  | st |  zip
--------+----------------------------+------+--------+------+--------+----+-------
     70 | POINT(-71.06459 42.35113) |   31 | Stuart | St   | Boston | MA | 02116
```

주소들을 지오코딩하는 데 배치(bat
작업을 이용합니다. `max_results = 1` 로 설정
편이 가장 쉽습니다. 아직 지오코&#x
않은 (순위가 없는) 주소들만 󌲘리&#

```
CREATE TABLE addresses_to_geocode(addid serial PRIMARY KEY, address text,
        lon numeric, lat numeric, new_address text, rating integer);

INSERT INTO addresses_to_geocode(address)
VALUES ('529 Main Street, Boston MA, 02129'),
 ('77 Massachusetts Avenue, Cambridge, MA 02139'),
 ('25 Wizard of Oz, Walaford, KS 99912323'),
 ('26 Capen Street, Medford, MA'),
 ('124 Mount Auburn St, Cambridge, Massachusetts 02138'),
 ('950 Main Street, Worcester, MA 01610');

-- &#xcc98;&#xc74c; &#xc138; &#xc8fc;&#xc18c;&#xb9cc;  ↩
    &#xc5c5;&#xb370;&#xc774;&#xd2b8;&#xd569;&#xb2c8;&#xb2e4;(323 ~ 704 ↩
    &#xbc00;&#xb9ac;&#xcd08; - &#xce90;&#xc2f1; &#xbc0f; &#xacf5;&#xc720;  ↩
    &#xba54;&#xbaa8;&#xb9ac; &#xc601;&#xd5a5; &#xb54c;&#xbb38;&#xc5d0; &#xccab;  ↩
    &#xc9c0;&#xc624;&#xcf54;&#xb529; &#xc791;&#xc5c5;&#xc740; &#xd56d;&#xc0c1;  ↩
    &#xb290;&#xb9bd;&#xb2c8;&#xb2e4;). --
-- &#xc8fc;&#xc18c;&#xac00; &#xb300;&#xb7c9;&#xc77c; &#xacbd;&#xc6b0;  ↩
    &#xd55c;&#xbc88;&#xc5d0; &#xc5c5;&#xb370;&#xc774;&#xd2b8;&#xd558;&#xc9c0;  ↩
    &#xc54a;&#xb294; &#xd3b8;&#xc774; &#xc88b;&#xc2b5;&#xb2c8;&#xb2e4;.
-- &#xc804;&#xccb4; &#xc9c0;&#xc624;&#xcf54;&#xb529; &#xc791;&#xc5c5;&#xc744;  ↩
    &#xd55c;&#xbc88;&#xc5d0; &#xcee4;&#xbc0b;&#xd574;&#xc57c;&#xb9cc; &#xd558;&#xae30;  ↩
    &#xb54c;&#xbb38;&#xc785;&#xb2c8;&#xb2e4;.
-- &#xc774; &#xc608;&#xc2dc;&#xc758; &#xacbd;&#xc6b0; LEFT JOIN&#xc73c;&#xb85c;  ↩
    &#xc7ac;&#xacb0;&#xd569;&#xc2dc;&#xd0a4;&#xace0;
-- &#xb098;&#xc05c; &#xc8fc;&#xc18c;&#xb97c; &#xb2e4;&#xc2dc;  ↩
    &#xc9c0;&#xc624;&#xcf54;&#xb529; &#xc791;&#xc5c5;&#xd558;&#xc9c0; &#xc54a;&#xae30;  ↩
    &#xc704;&#xd574;
-- &#xc77c;&#xce58;&#xd558;&#xc9c0; &#xc54a;&#xc744; &#xacbd;&#xc6b0;  ↩
    &#xc21c;&#xc704;&#xb97c; -1&#xb85c; &#xc124;&#xc815;&#xd569;&#xb2c8;&#xb2e4;.
UPDATE addresses_to_geocode
  SET  (rating, new_address, lon, lat)
    = ( COALESCE((g.geo).rating,-1), pprint_addy((g.geo).addy),
       ST_X((g.geo).geomout)::numeric(8,5), ST_Y((g.geo).geomout)::numeric(8,5) )
FROM (SELECT addid
    FROM addresses_to_geocode
    WHERE rating IS NULL ORDER BY addid LIMIT 3) As a
    LEFT JOIN (SELECT addid, (geocode(address,1)) As geo
    FROM addresses_to_geocode As ag
    WHERE ag.rating IS NULL ORDER BY addid LIMIT 3) As g ON a.addid = g.addid
WHERE a.addid = addresses_to_geocode.addid;

result
-----
Query returned successfully: 3 rows affected, 480 ms execution time.

SELECT * FROM addresses_to_geocode WHERE rating is not null;

 addid |                   address                    |    lon    |   lat    |  ↩
                   new_address                | rating
-------+----------------------------------------------+-----------+----------+----------------------

     1 | 529 Main Street, Boston MA, 02129            | -71.07181 | 42.38359 | 529 Main St, ↩
         Boston, MA 02129             |      0
     2 | 77 Massachusetts Avenue, Cambridge, MA 02139 | -71.09428 | 42.35988 | 77  ↩
        Massachusetts Ave, Cambridge, MA 02139 |      0
     3 | 25 Wizard of Oz, Walaford, KS 99912323       |           |          |  ↩
                                                |     -1
```

예시: 도형 필터 이용

```
SELECT g.rating, ST_AsText(ST_SnapToGrid(g.geomout,0.00001)) As wktlonlat,
    (addy).address As stno, (addy).streetname As street,
    (addy).streettypeabbrev As styp,
    (addy).location As city, (addy).stateabbrev As st,(addy).zip
  FROM geocode('100 Federal Street, MA',
        3,
        (SELECT ST_Union(the_geom)
            FROM place WHERE statefp = '25' AND name = 'Lynn')::geometry
        ) As g;

 rating |        wktlonlat         | stno | street   | styp | city | st |  zip
--------+--------------------------+------+----------+------+------+----+-------
      8 | POINT(-70.96796 42.4659) |  100 | Federal | St   | Lynn | MA | 01905
Total query runtime: 245 ms.
```

참고

Normalize_Address, Pprint_Addy, ST_AsText, ST_SnapToGrid, ST_X, ST_Y

11.2.5 Geocode_Intersection

Geocode_Intersection — 교차하는 도로 2개와 주, 시, 집코드를 입력받아 NAD83 경위도로 투영된 포인트 위치인 `geomout`, 각 위치대한 `normalized_address` (addy) 및 순위도 포함하는 교차점에서 처음 가로지르는 도&#x 있는 가능성 있는 위치들의 집합&# 출력합니다. 순위가 낮을수록 주&# 위치가 일치할 가능성이 커집니&# 결과를 순위가 낮은 순서로 정렬&# 결과의 최대 개수(기본값 10) 옵션 파 넘겨줄 수 있습니다. TIGER 데이터(edge, face, addr) 및 PostgreSQL 퍼지 문자열 매칭(soundex, levenshtein)&#xc74 이용합니다.

Synopsis

setof record **geocode_intersection**(text roadway1, text roadway2, text in_state, text in_city, text in_zip, integer max_results=10, norm_addy OUT addy, geometry OUT geomout, integer OUT rating);

설명

교차하는 도로 2개와 주, 시, 집코드를 입력받아 각 위치에 대한 `normalized_address` (addy), NAD83 경위도로 투영된 포인트 위&#xce5 geomout, 그리고 순위(rating)도 포함하는, 교&#xcc 처음 가로지르는 도로에 있는 가&# 있는 위치들의 집합을 출력합니&# 순위가 낮을수록 주소와 위치가 일치할 가능성이 커집니다. 결과&#x 순위가 낮은 순서로 정렬합니다. 결과의 최대 개수(기본값 10) 옵션 파

넘겨줄 수 있습니다. TIGER 데이터(edge, face, addr) 및 PostgreSQL 퍼지 문자열 매칭(soundex, levenshtein)&#xc744 이용합니다.

2.0.0 버전부터 사용할 수 있습니다.

기본 예시

매사추세츠(MA) 주의 모든 TIGER 데이터& 로드한 PostgreSQL 9.0/PostGIS 1.5가 실행되고 있는 3.0 GHZ 단일 프로세서 및 2GB 램 윈도우7 컴퓨터에서 다음 예시를 실행시&#x 데 걸리는 시간을 측정했습니다. 현재 조금 느린 편입니다(3,000밀리&#xcd0

TIGER 2011 데이터를 로드한 PostGIS 2.0과 PostgreSQL 64비&#x 버전을 실행중인 8GB 램 윈도우 2003 64비 컴퓨터에서 테스트한 결과는 더 빠릅니다(41밀리초).

```
SELECT pprint_addy(addy), st_astext(geomout),rating
            FROM geocode_intersection( 'Haverford St','Germania St', 'MA', 'Boston',  ↩
                '02130',1);
           pprint_addy             |          st_astext           | rating
-----------------------------------+------------------------------+--------
98 Haverford St, Boston, MA 02130 | POINT(-71.101375 42.31376) |      0
```

지오코딩 도구에 집코드를 넘겨&#x 않더라도 추측할 수 있습니다. 윈&# 7 컴퓨터에서는 3,500밀리초, 윈도우 2003 64비트 컴퓨터에서는 741밀리초 걸&#

```
SELECT pprint_addy(addy), st_astext(geomout),rating
               FROM geocode_intersection('Weld', 'School', 'MA', 'Boston');
          pprint_addy          |         st_astext          | rating
-------------------------------+----------------------------+--------
 98 Weld Ave, Boston, MA 02119 | POINT(-71.099 42.314234) |      3
 99 Weld Ave, Boston, MA 02119 | POINT(-71.099 42.314234) |      3
```

참고

Geocode, Pprint_Addy, ST_AsText

11.2.6 Get_Geocode_Setting

Get_Geocode_Setting — tiger.geocode_settings 테이블에 저장된 특&#xc 설정값을 반환합니다.

Synopsis

text **Get_Geocode_Setting**(text setting_name);

설명

tiger.geocode_settings 테이블에 저장된 특정 설정&
반환합니다. 사용자가 함수의 디&#
켜고 끌 수 있게 해주는 설정값입&#x
향후 설정값으로 순위를 제어할
수 있도록 할 계획입니다. 현재 설&
목록은 다음과 같습니다:

```
&#xba85;&#xce6d;              | &#xc124;&#xc815;&#xac12; |  ↩
     &#xb370;&#xc774;&#xd130;&#xd615;   | &#xce74;&#xd14c;&#xace0;&#xb9ac;  |  ↩
                                                          &#xac04;&#xb2e8;&#xd55c;  ↩
    &#xc124;&#xba85;
-------------------------------+---------+---------+-----------+-----------------------------------

 debug_geocode_address          | false   | boolean | debug     | &#xcc38;&#xc77c;  ↩
     &#xacbd;&#xc6b0; geocode_address&#xb97c; &#xd638;&#xcd9c;&#xd560; &#xb54c; NOTICE  ↩
     &#xb85c;&#xadf8;&#xc5d0; &#xcffc;&#xb9ac;&#xc640; &#xac19;&#xc740;  ↩
     &#xb514;&#xbc84;&#xadf8; &#xc815;&#xbcf4;&#xb97c;  ↩
     &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;.
 debug_geocode_intersection     | false   | boolean | debug     | &#xcc38;&#xc77c;  ↩
     &#xacbd;&#xc6b0; geocode_intersection&#xc744; &#xd638;&#xcd9c;&#xd560; &#xb54c; NOTICE  ↩
     &#xb85c;&#xadf8;&#xc5d0; &#xcffc;&#xb9ac;&#xc640; &#xac19;&#xc740;  ↩
     &#xb514;&#xbc84;&#xadf8; &#xc815;&#xbcf4;&#xb97c;  ↩
     &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;.
 debug_normalize_address        | false   | boolean | debug     | &#xcc38;&#xc77c;  ↩
     &#xacbd;&#xc6b0; normalize_address&#xb97c; &#xd638;&#xcd9c;&#xd560; &#xb54c; NOTICE  ↩
     &#xb85c;&#xadf8;&#xc5d0; &#xcffc;&#xb9ac; &#xbc0f; &#xc911;&#xac04;  ↩
     &#xd45c;&#xd604;&#xc2dd;&#xacfc; &#xac19;&#xc740; &#xb514;&#xbc84;&#xadf8;  ↩
     &#xc815;&#xbcf4;&#xb97c; &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;.
 debug_reverse_geocode          | false   | boolean | debug     | &#xcc38;&#xc77c;  ↩
     &#xacbd;&#xc6b0; reverse_geocode&#xb97c; &#xd638;&#xcd9c;&#xd560; &#xb54c; NOTICE  ↩
     &#xb85c;&#xadf8;&#xc5d0; &#xcffc;&#xb9ac; &#xbc0f; &#xc911;&#xac04;  ↩
     &#xd45c;&#xd604;&#xc2dd;&#xacfc; &#xac19;&#xc740; &#xb514;&#xbc84;&#xadf8;  ↩
     &#xc815;&#xbcf4;&#xb97c; &#xcd9c;&#xb825;&#xd569;&#xb2c8;&#xb2e4;.
 reverse_geocode_numbered_roads | 0       | integer | rating    | &#xc8fc; &#xbc0f;  ↩
     &#xad70; &#xace0;&#xc18d;&#xb3c4;&#xb85c;&#xc5d0; &#xb300;&#xd574;, 0 -  ↩
     &#xc5b4;&#xb5a4; &#xba85;&#xce6d;&#xb3c4; &#xc6b0;&#xc120;&#xd558;&#xc9c0;  ↩
     &#xc54a;&#xace0;, 1 - &#xbc88;&#xd638;&#xb85c; &#xb41c;  ↩
     &#xace0;&#xc18d;&#xb3c4;&#xb85c; &#xba85;&#xce6d;&#xc744;  ↩
     &#xc6b0;&#xc120;&#xd558;&#xba70;, 2 - &#xc9c0;&#xbc29;&#xc758; &#xc8fc;/&#xad70;  ↩
     &#xba85;&#xce6d;&#xc744; &#xc6b0;&#xc120;&#xd569;&#xb2c8;&#xb2e4;.
 use_pagc_address_parser        | false   | boolean | normalize | &#xcc38;&#xc73c;&#xb85c;  ↩
     &#xc124;&#xc815;&#xd560; &#xacbd;&#xc6b0;, &#xbe4c;&#xb4dc;&#xb41c; TIGER  ↩
     normalize_address &#xb300;&#xc2e0; (pagc_normalize_address&#xb97c; &#xd1b5;&#xd574;)  ↩
     address_standardizer &#xd655;&#xc7a5; &#xd504;&#xb85c;&#xadf8;&#xb7a8;&#xc744;  ↩
     &#xc774;&#xc6a9;&#xd558;&#xb824; &#xd560; &#xac83;&#xc785;&#xb2c8;&#xb2e4;.
```

변경 사항: 2.2.0 버전부터 geocode_settings_default 테이&
기본 설정값을 저장합니다. 사용&#x
지정 설정값은 geocode_settings 테이블에 있&#xc7
이 geocode_settings 테이블에는 사용자가 설&#xc8
설정값만 저장합니다.

2.1.0 버전부터 사용할 수 있습니다.

예시: 디버깅 설정값 반환

```
SELECT get_geocode_setting('debug_geocode_address) As result;
result
```

```
---------
false
```

참고

Set_Geocode_Setting

11.2.7 Get_Tract

Get_Tract — 도형이 위치해 있는 구역(tract) 테&#x
인구조사 구역 또는 현장(field)을 반&#xd6
기본적으로 구역의 축약된 명칭&#x
반환합니다.

Synopsis

text **get_tract**(geometry loc_geom, text output_field=name);

설명

도형을 입력받아 해당 도형이 위&#
인구조사 구역을 반환합니다. 공&#x
참조 시스템을 따로 설정하지 않&#
경우 NAD83 경위도라고 가정합니다.

Note
This function uses the census `tract` which is not loaded by default. If you have already loaded your state table, you can load tract as well as bg, and tabblock using the Loader_Generate_Census_Script script.
If you have not loaded your state data yet and want these additional tables loaded, do the following

```
UPDATE tiger.loader_lookuptables SET load = true WHERE load = false AND lookup_name  ↩
    IN('tract', 'bg', 'tabblock');
```

then they will be included by the Loader_Generate_Script.

2.0.0 버전부터 사용할 수 있습니다.

기본 예시

```
SELECT get_tract(ST_Point(-71.101375, 42.31376) ) As tract_name;
tract_name
---------
1203.01
```

```
-- &#xc774; &#xcffc;&#xb9ac;&#xb294; TIGER &#xb3c4;&#xd615; ID(geoid)&#xb97c;  ↩
    &#xbc18;&#xd658;&#xd569;&#xb2c8;&#xb2e4;.
SELECT get_tract(ST_Point(-71.101375, 42.31376), 'tract_id' ) As tract_id;
tract_id
---------
25025120301
```

참고

Geocode >

11.2.8 Install_Missing_Indexes

Install_Missing_Indexes — 지오코딩 도구의 결합(join)에 이용되는 키(key) 열을 가진 테이블을 모두 찾아서 해당 열에 쓰인 인덱&#x 가운데 없어진 것들에 대한 조건&#x 필터링해서 없어진 인덱스들을 추가합니다.

Synopsis

boolean **Install_Missing_Indexes**();

설명

`tiger` 및 `tiger_data` 스키마에서 지오코딩 도& 결합에 이용되는 키 열을 가진 테&# 모두 찾은 다음, 해당 열에서 없어&# 인덱스들을 필터링해서, 해당 테&# 위한 인덱스를 정의하기 위한 SQL DDL을 출력하고, 생성된 스크립트&#xb97 실행합니다. 이 함수는 로드 과정&# 없어졌을 수도 있는, 쿼리를 더 빨&# 하기 위해 필요한 새 인덱스들을 추가하는 도우미 함수입니다. 이 함수는 인덱스 생성 스크립트를 작성하는 Missing_Indexes_Generate_Script 함수와 동일&#xd55 계열로, 작성된 스크립트를 실행&# 합니다. `update_geocode.sql` 업그레이드 스크&#xb9 일부로 이 함수를 호출합니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT install_missing_indexes();
         install_missing_indexes
-------------------------
 t
```

참고

Loader_Generate_Script, Missing_Indexes_Generate_Script

11.2.9 Loader_Generate_Census_Script

Loader_Generate_Census_Script — 설정한 플랫폼에 대해 설정한 주(州)를 위한, TIGER 인구조사

주(州) 구역(tract), 블록 그룹(bg), 블록(tabblock) 데&
테이블을 다운로드해서 `tiger_data` 스&#xd0a4
단계별로 로드하는 셸 스크립트&#x
생성합니다. 각 주(州)의 스크립트&
개별 레코드로 반환합니다.

Synopsis

setof text **loader_generate_census_script**(text[] param_states, text os);

설명

설정한 플랫폼에 대해 설정한 주(&#
위한, TIGER 인구조사 주(州) `tract`, `bg`, `tabblocks` 데&#xc77
테이블을 다운로드해서 `tiger_data` 스&#xd0a4
단계별로 로드하는 셸 스크립트&#x
생성합니다. 각 주(州)의 스크립트&
개별 레코드로 반환합니다.

리눅스 상에서 unzip을 (윈도우 상에&#xc1
기본적으로 7-zip을) 사용하고, 다운&#xb85
위해 wget을 씁니다. 데이터를 로드&#xd5
데 Section 4.7.2 를 이용합니다. 이 함수가
작업에 이용하는 가장 작은 단위&#
주(州) 전체라는 점에 주의하십시&#
이 함수는 "staging" 및 "temp" 폴더에 있는 파&#xc
처리할 것입니다.

처리 과정 및 서로 다른 OS 셸 문법
변수들을 제어하기 위해 다음 제&#
테이블들을 이용합니다.

1. `loader_variables` - 인구조사 현장, 연도, 데이&
   및 단계별(staging) 스키마들과 같은 여
   변수들을 추적합니다.

2. `loader_platform` - 여러 플랫폼 및 여러 실행
   파일들의 위치에 대한 개요를
   작성합니다. 기본적으로 윈도&#xc6b
   리눅스를 가지고 있습니다. 더
   많은 플랫폼을 추가할 수 있습&#xb2c

3. `loader_lookuptables` - 각 레코드가 테이블 유&#xd61
   군), 테이블에서 레코드를 처리&#xd5
   여부, 테이블에 레코드를 로드&#xd5
   방법을 정의합니다. 각 단계별&#xb8
   데이터를 임포트하고 준비하&#xba7
   각 단계에 대해 열, 인덱스, 제약&#xc
   추가하고 제거하는 단계들을
   정의합니다. 각 테이블의 접두&#xc0
   주명(州名)이며, TIGER 스키마 안의
   테이블을 승계합니다. 예: `tiger.faces`
   를 승계하는 `tiger_data.ma_faces` 테이블을
   생성하십시오.

2.0.0 버전부터 사용할 수 있습니다.

Note

Loader_Generate_Script 는 이 로직을 포함하지만, PostGIS 2.0.0 alpha5 이전 버전에 TIGER 지오코딩 도구를 설치한 경우, 이런 추가적인 테이블을 얻으려면 사용자가 이미 처리한 주(州)에 대해 이 함수를 실행해야 할 것입니다.

예시

선택한 주들을 위한 데이터를 윈&#셸 스크립트 형식으로 로드하는 스크립트를 생성합니다.

```
SELECT loader_generate_census_script(ARRAY['MA'], 'windows');
-- &#xacb0;&#xacfc; --
set STATEDIR="\gisdata\www2.census.gov\geo\pvs\tiger2010st\25_Massachusetts"
set TMPDIR=\gisdata\temp\
set UNZIPTOOL="C:\Program Files\7-Zip\7z.exe"
set WGETTOOL="C:\wget\wget.exe"
set PGBIN=C:\projects\pg\pg91win\bin\
set PGPORT=5432
set PGHOST=localhost
set PGUSER=postgres
set PGPASSWORD=yourpasswordhere
set PGDATABASE=tiger_postgis20
set PSQL="%PGBIN%psql"
set SHP2PGSQL="%PGBIN%shp2pgsql"
cd \gisdata

%WGETTOOL% http://www2.census.gov/geo/pvs/tiger2010st/25_Massachusetts/25/ --no-parent -- ↩
    relative --accept=*bg10.zip,*tract10.zip,*tabblock10.zip --mirror --reject=html
del %TMPDIR%\*.* /Q
%PSQL% -c "DROP SCHEMA tiger_staging CASCADE;"
%PSQL% -c "CREATE SCHEMA tiger_staging;"
cd %STATEDIR%
for /r %%z in (*.zip) do %UNZIPTOOL% e %%z  -o%TMPDIR%
cd %TMPDIR%
%PSQL% -c "CREATE TABLE tiger_data.MA_tract(CONSTRAINT pk_MA_tract PRIMARY KEY (tract_id) ) ↩
     INHERITS(tiger.tract); "
%SHP2PGSQL% -c -s 4269 -g the_geom   -W "latin1" tl_2010_25_tract10.dbf tiger_staging. ↩
    ma_tract10 | %PSQL%
%PSQL% -c "ALTER TABLE tiger_staging.MA_tract10 RENAME geoid10 TO tract_id;  SELECT  ↩
    loader_load_staged_data(lower('MA_tract10'), lower('MA_tract')); "
%PSQL% -c "CREATE INDEX tiger_data_MA_tract_the_geom_gist ON tiger_data.MA_tract USING gist ↩
    (the_geom);"
%PSQL% -c "VACUUM ANALYZE tiger_data.MA_tract;"
%PSQL% -c "ALTER TABLE tiger_data.MA_tract ADD CONSTRAINT chk_statefp CHECK (statefp =  ↩
    '25');"
:
```

.sh 스크립트를 생성합니다.

```
STATEDIR="/gisdata/www2.census.gov/geo/pvs/tiger2010st/25_Massachusetts"
TMPDIR="/gisdata/temp/"
UNZIPTOOL=unzip
WGETTOOL="/usr/bin/wget"
export PGBIN=/usr/pgsql-9.0/bin
```

```
export PGPORT=5432
export PGHOST=localhost
export PGUSER=postgres
export PGPASSWORD=yourpasswordhere
export PGDATABASE=geocoder
PSQL=${PGBIN}/psql
SHP2PGSQL=${PGBIN}/shp2pgsql
cd /gisdata

wget http://www2.census.gov/geo/pvs/tiger2010st/25_Massachusetts/25/ --no-parent --relative ↩
     --accept=*bg10.zip,*tract10.zip,*tabblock10.zip --mirror --reject=html
rm -f ${TMPDIR}/*.*
${PSQL} -c "DROP SCHEMA tiger_staging CASCADE;"
${PSQL} -c "CREATE SCHEMA tiger_staging;"
cd $STATEDIR
for z in *.zip; do $UNZIPTOOL -o -d $TMPDIR $z; done
:
:
```

참고

Loader_Generate_Script

11.2.10 Loader_Generate_Script

Loader_Generate_Script — 설정한 플랫폼에 대해 설&#xc
주(州)를 위한, TIGER 데이터를 다운로&#x
`tiger_data` 스키마에 단계별로 로드하&#xb294
셸 스크립트를 생성합니다. 각 주(&
스크립트를 개별 레코드로 반환&#x
최신 버전은 TIGER 2010 구조 변경 사항을
지원하며, 인구조사 구역, 블록 그&#
블록 테이블도 로드합니다.

Synopsis

setof text **loader_generate_script**(text[] param_states, text os);

설명

설정한 플랫폼에 대해 설정한 주(&#
위한, TIGER 데이터를 다운로드해서
`tiger_data` 스키마에 단계별로 로드하&#xb294
셸 스크립트를 생성합니다. 각 주(&
스크립트를 개별 레코드로 반환&#x

리눅스 상에서 unzip을 (윈도우 상에&#xc1
기본적으로 7-zip을) 사용하고, 다운&#xb85
위해 wget을 씁니다. 데이터를 로드&#xd5
데 Section 4.7.2 를 이용합니다. 이 함수가
작업에 이용하는 가장 작은 단위&#
주(州) 전체라는 점에 주의하십시&#
다만 사용자가 직접 파일들을 다&#x
이 단위를 덮어 쓸 수 있습니다. 이

함수는 "staging" 및 "temp" 폴더에 있는 파일&#xb4
처리할 것입니다.

처리 과정 및 서로 다른 OS 셸 문법
변수들을 제어하기 위해 다음 제&#
테이블들을 이용합니다.

1. `loader_variables` - 인구조사 현장, 연도, 데이&
   및 단계별(staging) 스키마들과 같은 여
   변수들을 추적합니다.
2. `loader_platform` - 여러 플랫폼 및 여러 실행
   파일들의 위치에 대한 개요를
   작성합니다. 기본적으로 윈도&#xc6b
   리눅스를 가지고 있습니다. 더
   많은 플랫폼을 추가할 수 있습&#xb2c
3. `loader_lookuptables` - 각 레코드가 테이블 유&#xd61
   군), 테이블에서 레코드를 처리&#xd5
   여부, 테이블에 레코드를 로드&#xd5
   방법을 정의합니다. 각 단계별&#xb8
   데이터를 임포트하고 준비하&#xba7
   각 단계에 대해 열, 인덱스, 제약&#xc8
   추가하고 제거하는 단계들을
   정의합니다. 각 테이블의 접두&#xc0
   주명(州名)이며, TIGER 스키마 안의
   테이블을 승계합니다. 예: `tiger.faces`
   를 승계하는 `tiger_data.ma_faces` 테이블을
   생성하십시오.

2.0.0 버전부터 사용할 수 있습니다.
TIGER 2010 데이터 구조를 지원하며 인구
구역(tract), 블록 그룹(bg), 블록(tabblock) 테이블&
로드합니다.

Note

If you are using pgAdmin 3, be warned that by default pgAdmin 3 truncates long text. To fix, change *File -> Options -> Query Tool -> Query Editor - > Max. characters per column* to larger than 50000 characters.

예시

Using psql where gistest is your database and `/gisdata/data_load.sh` is the file to create with the shell commands to run.

```
psql -U postgres -h localhost -d gistest -A -t \
 -c "SELECT Loader_Generate_Script(ARRAY['MA'], 'gistest')" > /gisdata/data_load.sh;
```

주(州) 2곳을 위한 데이터를 윈도우
셸 스크립트 형식으로 로드하는
스크립트를 생성합니다.

```
SELECT loader_generate_script(ARRAY['MA','RI'], 'windows') AS result;
-- result --
set TMPDIR=\gisdata\temp\
set UNZIPTOOL="C:\Program Files\7-Zip\7z.exe"
set WGETTOOL="C:\wget\wget.exe"
set PGBIN=C:\Program Files\PostgreSQL\9.4\bin\
set PGPORT=5432
```

```
set PGHOST=localhost
set PGUSER=postgres
set PGPASSWORD=yourpasswordhere
set PGDATABASE=geocoder
set PSQL="%PGBIN%psql"
set SHP2PGSQL="%PGBIN%shp2pgsql"
cd \gisdata

cd \gisdata
%WGETTOOL% ftp://ftp2.census.gov/geo/tiger/TIGER2015/PLACE/tl_*_25_* --no-parent --relative ↩
     --recursive --level=2 --accept=zip --mirror --reject=html
cd \gisdata/ftp2.census.gov/geo/tiger/TIGER2015/PLACE
:
:
```

.sh 스크립트를 생성합니다.

```
STATEDIR="/gisdata/www2.census.gov/geo/pvs/tiger2010st/25_Massachusetts"
TMPDIR="/gisdata/temp/"
UNZIPTOOL=unzip
WGETTOOL="/usr/bin/wget"
export PGBIN=/usr/pgsql-9.0/bin
export PGPORT=5432
export PGHOST=localhost
export PGUSER=postgres
export PGPASSWORD=yourpasswordhere
export PGDATABASE=geocoder
PSQL=${PGBIN}/psql
SHP2PGSQL=${PGBIN}/shp2pgsql
cd /gisdata

wget http://www2.census.gov/geo/pvs/tiger2010st/25_Massachusetts/25/ --no-parent --relative ↩
     --accept=*bg10.zip,*tract10.zip,*tabblock10.zip --mirror --reject=html
rm -f ${TMPDIR}/*.*
${PSQL} -c "DROP SCHEMA tiger_staging CASCADE;"
${PSQL} -c "CREATE SCHEMA tiger_staging;"
cd $STATEDIR
for z in *.zip; do $UNZIPTOOL -o -d $TMPDIR $z; done
:
:
```

참고

Section 2.4.1, Pprint_Addy, ST_AsText

11.2.11 Loader_Generate_Nation_Script

Loader_Generate_Nation_Script — 설정한 플랫폼에 대해, 군 및 주 색인 테이블을 로드하는 셸 스크립트를 생성합니다.

Synopsis

text **loader_generate_nation_script**(text os);

설명

설정한 플랫폼에 대해, `tiger_data` 스키&#xb9c
`county_all`, `county_all_lookup`, `state_all` 테이블을 로드하&#xb29
셸 스크립트를 생성합니다. 이 테&
각각 `tiger` 스키마의 `county`, `county_lookup`, `state` 테이&#xbe1
승계합니다.

리눅스 상에서 unzip을 (윈도우 상에&#xc1
기본적으로 7-zip을) 사용하고, 다운&#xb85
위해 wget을 씁니다. 데이터를 로드&#xd5
데 Section 4.7.2 를 이용합니다.

처리 과정 및 서로 다른 OS 셸 문법
변수들을 제어하기 위해 다음 제&#
테이블 `tiger.loader_platform`, `tiger.loader_variables`, 그리고
`tiger.loader_lookuptables` 를 이용합니다.

1. `loader_variables` - 인구조사 현장, 연도, 데이&
   및 단계별(staging) 스키마들과 같은 여
   변수들을 추적합니다.
2. `loader_platform` - 여러 플랫폼 및 여러 실행
   파일들의 위치에 대한 개요를
   작성합니다. 기본적으로 윈도&#xc6b
   리눅스/유닉스를 가지고 있습&#xb2c
   더 많은 플랫폼을 추가할 수 있&#xc2
3. `loader_lookuptables` - 각 레코드가 테이블 유&#xd61
   군), 테이블에서 레코드를 처리&#xd5
   여부, 테이블에 레코드를 로드&#xd5
   방법을 정의합니다. 각 단계별&#xb8
   데이터를 임포트하고 준비하&#xba7
   각 단계에 대해 열, 인덱스, 제약&#xc
   추가하고 제거하는 단계들을
   정의합니다. 각 테이블의 접두&#xc0
   주명(州名)이며, TIGER 스키마 안의
   테이블을 승계합니다. 예: `tiger.faces`
   를 승계하는 `tiger_data.ma_faces` 테이블을
   생성하십시오.

Enhanced: 2.4.1 zip code 5 tabulation area (zcta5) load step was fixed and when enabled, zcta5 data is loaded as a single table called zcta5_all as part of the nation script load.

2.1.0 버전부터 사용할 수 있습니다.

Note

If you want zip code 5 tabulation area (zcta5) to be included in your nation script load, do the following:

```
UPDATE tiger.loader_lookuptables SET load = true WHERE table_name = 'zcta510';
```

Note

사용자가 `tiger_2010` 버전을 사용중이&#xc
주(州)를 `tiger_2011` 버전으로 다시
로드하려 할 경우, 이 스크립트&#xb97c
실행하기 전에 제일 먼저 삭제
선언문 Drop_Nation_Tables_Generate_Script 를 생성하고
실행해야 할 것입니다.

예시

윈도우 상에서 국가 데이터를 로&#
위한 스크립트를 생성합니다.

```
SELECT loader_generate_nation_script('windows');
```

리눅스/유닉스 시스템 상에서 데&#
로드하기 위한 스크립트를 생성&#

```
SELECT loader_generate_nation_script('sh');
```

참고

Loader_Generate_Script, Missing_Indexes_Generate_Script

11.2.12 Missing_Indexes_Generate_Script

Missing_Indexes_Generate_Script — 지오코딩 도구의 결합(join)&
이용되는 키(key) 열을 가진 테이블
가운데 해당 열에서 없어진 인덱&#
모두 찾아서 해당 테이블에 대한
인덱스를 정의하는 SQL DDL을 출력합&#

Synopsis

text **Missing_Indexes_Generate_Script**();

설명

`tiger` 및 `tiger_data` 스키마에서 지오코딩 도&
결합(join)에 이용되는 키(key) 열을 가진
테이블 가운데 해당 열에서 없어&#x
인덱스를 모두 찾아서 해당 테이&#x
대한 인덱스를 정의하는 SQL DDL을 출&#
이 함수는 로드 과정에서 없어졌&#x
수도 있는, 쿼리를 더 빨리 하기 위&#
필요한 새 인덱스들을 추가하는
도우미 함수입니다. 지오코딩 도&#
향상되면, 사용되는 새 인덱스를
수용하기 위해 이 함수도 업데이&#
것입니다. 이 함수가 아무것도 출&#
않을 경우, 모든 테이블이 이미 키
인덱스로 간주되는 것을 가지고
있다는 뜻입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시

```
SELECT missing_indexes_generate_script();
-- &#xcd9c;&#xb825;&#xbb3c;: &#xb85c;&#xb4dc; &#xc791;&#xc5c5;  ↩
    &#xc2a4;&#xd06c;&#xb9bd;&#xd2b8;&#xc5d0; &#xb9ce;&#xc740; &#xc218;&#xc815;&#xc774;  ↩
    &#xac00;&#xd574;&#xc9c0;&#xae30; &#xc804;&#xc5d0; &#xc0dd;&#xc131;&#xb41c;  ↩
    &#xb370;&#xc774;&#xd130;&#xbca0;&#xc774;&#xc2a4; &#xc0c1;&#xc5d0;&#xc11c;  ↩
    &#xc2e4;&#xd589;&#xd55c; &#xac83;&#xc785;&#xb2c8;&#xb2e4;. --
CREATE INDEX idx_tiger_county_countyfp ON tiger.county USING btree(countyfp);
CREATE INDEX idx_tiger_cousub_countyfp ON tiger.cousub USING btree(countyfp);
CREATE INDEX idx_tiger_edges_tfidr ON tiger.edges USING btree(tfidr);
CREATE INDEX idx_tiger_edges_tfidl ON tiger.edges USING btree(tfidl);
CREATE INDEX idx_tiger_zip_lookup_all_zip ON tiger.zip_lookup_all USING btree(zip);
CREATE INDEX idx_tiger_data_ma_county_countyfp ON tiger_data.ma_county USING btree(countyfp ↩
    );
CREATE INDEX idx_tiger_data_ma_cousub_countyfp ON tiger_data.ma_cousub USING btree(countyfp ↩
    );
CREATE INDEX idx_tiger_data_ma_edges_countyfp ON tiger_data.ma_edges USING btree(countyfp);
CREATE INDEX idx_tiger_data_ma_faces_countyfp ON tiger_data.ma_faces USING btree(countyfp);
```

참고

Loader_Generate_Script, Install_Missing_Indexes

11.2.13 Normalize_Address

Normalize_Address — 문자형 도로 주소를 입력받&
도로 접미사, 접두사 및 유형을 표&#
도로, 도로명 등을 개별 필드로 분&#
`norm_addy` 합성 유형을 반환합니다. 이
함수는 tiger_geocoder와 함께 패키징된 색&#xc77
데이터만 이용해서 (TIGER 인구조사
데이터는 필요없이) 작동할 것입&#

Synopsis

norm_addy **normalize_address**(varchar in_address);

설명

문자형 도로 주소를 입력받아, 도&#
접미사, 접두사 및 유형을 표준화&#
도로, 도로명 등을 개별 필드로 분&#
`norm_addy` 합성 유형을 반환합니다. 모&#xb4e
주소를 정규화된 우편 형식ܼ로
변환하기 위한 지오코딩 과정의
첫 번째 단계입니다. 지오코딩 도&#
함께 패키징된 데이터 외에 다른
데이터는 필요하지 않습니다.

이 함수는 `tiger` 스키마에 있고 tiger_geocoder와
함께 미리 로드돼 있는 여러 방향/&#
색인 테이블만 이용합니다. 따라&#
이 함수를 이용하기 위해 TIGER 인구&#xc
데이터 또는 다른 추가적인 데이&#
다운로드할 필요가 없습니다. `tiger`

스키마에 있는 여러 색인 테이블&#x
더 많은 약어 또는 대체 명칭들을
추가해야 할 필요가 있을 수도 있&#

이 함수는 입력 주소를 정규화하&#
위해 `tiger` 스키마에 있는 여러 제어
색인 테이블을 이용합니다.

이 함수는 `norm_addy` 유형 객체 안의 필&#xb4d
다음과 같은 순서로 반환합니다.
이때 ()가 지오코딩 도구가 요구하&
필드를 나타내고, []는 선택적인 필
나타냅니다:

(address) [predirAbbrev] (streetName) [streetTypeAbbrev] [postdirAbbrev] [internal] [location] [stateAbbrev] [zip] [parsed] [zip4] [address_alphanumeric]

Enhanced: 2.4.0 norm_addy object includes additional fields zip4 and address_alphanumeric.

1. `address` 는 정수형입니다: 도로 번지&#xc
2. `predirAbbrev` 는 varchar형입니다: N, S, E, W 등과 같은
   도로의 방향을 의미하는 접두&#xc0
   `direction_lookup` 테이블을 이용해서 이 필&#
   제어합니다.
3. `streetName` 은 varchar형입니다.
4. `streetTypeAbbrev` 는 varchar형으로, St, Ave, Cir처럼 도로
   유형의 축약 버전입니다. `street_type_lookup`
   테이블을 이용해서 이 필드를
   제어합니다.
5. `postdirAbbrev` 는 varchar형으로, N, S, E, W 등과 같은
   도로의 방향을 의미하는 접미&#xc0a
   축약 버전입니다. `direction_lookup` 테이블&#
   이용해서 이 필드를 제어합니&#xb2e
6. `internal` 은 varchar형입니다. 아파트 또는
   빌라의 동호수와 같은 내부 주&#xc1
7. `location` 은 varchar형으로, 일반적으로 도&#xc2
   또는 지자체를 나타냅니다.
8. `stateAbbrev` 는 varchar형으로, MA, NY, MI처럼 두 글&#xc790
   표현한 미국의 주명(州名)입니&#xb2
   `state_lookup` 테이블을 이용해서 이 필&#xb4dc
   제어합니다.
9. `zip` 은 varchar형입니다. 02109 같은 다섯 자&#xb9
   집코드입니다.
10. `parsed` 는 불(boolean)형입니다. 정규화 처&#xb9
    주소를 형성했는지 여부를 표&#xc2d
    normalize_address 함수는 주소를 반환하기
    전에 이 필드를 참으로 설정합&#xb2
11. `zip4` last 4 digits of a 9 digit zip code. Availability: PostGIS 2.4.0.
12. `address_alphanumeric` Full street number even if it has alpha characters like 17R. Parsing of this is better using Pagc_Normalize_Address function. Availability: PostGIS 2.4.0.

예시

선택한 필드를 출력합니다. 보기
좋은 문자형 출력물을 원한다면
Pprint_Addy 함수를 이용하십시오.

```
SELECT address As orig, (g.na).streetname, (g.na).streettypeabbrev
 FROM (SELECT address, normalize_address(address) As na
        FROM addresses_to_geocode) As g;

                        orig                          |  streetname   | streettypeabbrev
------------------------------------------------------+---------------+------------------
 28 Capen Street, Medford, MA                         | Capen         | St
 124 Mount Auburn St, Cambridge, Massachusetts 02138  | Mount Auburn  | St
 950 Main Street, Worcester, MA 01610                 | Main          | St
 529 Main Street, Boston MA, 02129                    | Main          | St
 77 Massachusetts Avenue, Cambridge, MA 02139         | Massachusetts | Ave
 25 Wizard of Oz, Walaford, KS 99912323               | Wizard of Oz  |
```

참고

Geocode, Pprint_Addy

11.2.14 Pagc_Normalize_Address

Pagc_Normalize_Address — 문자형 도로 주소를 입력&#x
도로 접미사, 접두사 및 유형을 표&#
도로, 도로명 등을 개별 필드로 분&#
`norm_addy` 합성 유형을 반환합니다. 이
함수는 tiger_geocoder와 함께 패키징된 색&#xc77
데이터만 이용해서 (TIGER 인구조사
데이터는 필요없이) 작동할 것입&#
address_standardizer 확장 프로그램이 필요합니&#

Synopsis

norm_addy **pagc_normalize_address**(varchar in_address);

설명

문자형 도로 주소를 입력받아, 도&#
접미사, 접두사 및 유형을 표준화&#
도로, 도로명 등을 개별 필드로 분&#
`norm_addy` 합성 유형을 반환합니다. 모&#xb4e
주소를 정규화된 우편 형식으로
변환하기 위한 지오코딩 과정의
첫 번째 단계입니다. 지오코딩 도&#
함께 패키징된 데이터 외에 다른
데이터는 필요하지 않습니다.

이 함수는 `tiger` 스키마에 있고 tiger_geocoder와
함께 미리 로드돼 있는 여러 pagc_* 색&#xc7
테이블만 이용합니다. 따라서 이
함수를 이용하기 위해 TIGER 인구조&#xc
데이터 또는 다른 추가적인 데이&#

다운로드할 필요가 없습니다. `tiger` 스키마에 있는 여러 색인 테이블&#x 더 많은 약어 또는 대체 명칭들을 추가해야 할 필요가 있을 수도 있&#

이 함수는 입력 주소를 정규화하&# 위해 `tiger` 스키마에 있는 여러 제어 색인 테이블을 이용합니다.

이 함수는 `norm_addy` 유형 객체 안의 필&#xb4d 다음과 같은 순서로 반환합니다. 이때 ()가 지오코딩 도구가 요구하&# 필드를 나타내고, []는 선택적인 필 나타냅니다:

Normalize_Address 에 대해 대소문자 규칙 및 서&# 살짝 다른 변종들이 있습니다.

2.1.0 버전부터 사용할 수 있습니다.

This method needs address_standardizer extension.

(address) [predirAbbrev] (streetName) [streetTypeAbbrev] [postdirAbbrev] [internal] [location] [stateAbbrev] [zip]

이 시점에서 address_standardizer 확장 프로그램&# 원형 standardaddr는 norm_addy보다 약간 다채롭&#xc2b5 (국가를 포함한) 국제 주소를 지원&# 설계됐기 때문입니다. standardaddr의 상응 필드들은 다음과 같습니다:

house_num, predir, name, suftype, sufdir, unit, city, state, postcode

Enhanced: 2.4.0 norm_addy object includes additional fields zip4 and address_alphanumeric.

1. `address` 는 정수형입니다: 도로 번지&#xc
2. `predirAbbrev` 는 varchar형입니다: N, S, E, W 등과 같은 도로의 방향을 의미하는 접두&#xc0 `direction_lookup` 테이블을 이용해서 이 필&# 제어합니다.
3. `streetName` 은 varchar형입니다.
4. `streetTypeAbbrev` 는 varchar형으로, St, Ave, Cir처럼 도로 유형의 축약 버전입니다. `street_type_lookup` 테이블을 이용해서 이 필드를 제어합니다.
5. `postdirAbbrev` 는 varchar형으로, N, S, E, W 등과 같은 도로의 방향을 의미하는 접미&#xc0 축약 버전입니다. `direction_lookup` 테이블&# 이용해서 이 필드를 제어합니&#xb2e
6. `internal` 은 varchar형입니다. 아파트 또는 빌라의 동호수와 같은 내부 주&#xc1
7. `location` 은 varchar형으로, 일반적으로 도&#xc2 또는 지자체를 나타냅니다.
8. `stateAbbrev` 는 varchar형으로, MA, NY, MI처럼 두 글&#xc790 표현한 미국의 주명(州名)입니&#xb2 `state_lookup` 테이블을 이용해서 이 필&#xb4d 제어합니다.

9. `zip` 은 varchar형입니다. 02109 같은 다섯 자&#xb9
집코드입니다.

10. `parsed` 는 불(boolean)형입니다. 정규화 처&#xb9
주소를 형성했는지 여부를 표&#xc2d
normalize_address 함수는 주소를 반환하기
전에 이 필드를 참으로 설정합&#xb2

11. `zip4` last 4 digits of a 9 digit zip code. Availability: PostGIS 2.4.0.

12. `address_alphanumeric` Full street number even if it has alpha characters like 17R. Parsing of this is better using Pagc_Normalize_Address function. Availability: PostGIS 2.4.0.

예시

단일 호출 예시

```
SELECT addy.*
FROM pagc_normalize_address('9000 E ROO ST STE 999, Springfield, CO') AS addy;


 address | predirabbrev | streetname | streettypeabbrev | postdirabbrev | internal  |   ↩
    location    | stateabbrev | zip | parsed
---------+--------------+------------+------------------+---------------+-----------+-------------+-

    9000 | E            | ROO        | ST               |               | SUITE 999 |  ↩
       SPRINGFIELD | CO          |     | t
```

배치 호출 예시. 현재 postgis_tiger_geocoder가 address_standardiz
감싸는 방식에 대한 속도 관련 문&#
있습니다. 바라건대 향후 버전에&#
이 문제점들을 해결할 수 있을 것&#
이 문제점들을 피하려면, 배치 지&#
작업이 배치 모드에서 normaddy를 생성&#
호출하는 데 속도를 높힐 필요가
있을 경우, Geocode 에서 생성한 데이터&#
이용하는 Normalize_Address 의 예시와 유사한
다음 예시에서처럼 address_standardizer 및 standardize_address
함수를 직접 호출하도록 권장합&#

```
WITH g AS (SELECT address, ROW((sa).house_num, (sa).predir, (sa).name
  , (sa).suftype, (sa).sufdir, (sa).unit , (sa).city, (sa).state, (sa).postcode, true):: ↩
      norm_addy As na
 FROM (SELECT address, standardize_address('tiger.pagc_lex'
       , 'tiger.pagc_gaz'
       , 'tiger.pagc_rules', address) As sa
        FROM addresses_to_geocode) As g)
SELECT address As orig, (g.na).streetname, (g.na).streettypeabbrev
 FROM  g;

 orig                                                 |  streetname   | streettypeabbrev
------------------------------------------------------+---------------+------------------
 529 Main Street, Boston MA, 02129                    | MAIN          | ST
 77 Massachusetts Avenue, Cambridge, MA 02139         | MASSACHUSETTS | AVE
 25 Wizard of Oz, Walaford, KS 99912323               | WIZARD OF     |
 26 Capen Street, Medford, MA                         | CAPEN         | ST
 124 Mount Auburn St, Cambridge, Massachusetts 02138  | MOUNT AUBURN  | ST
 950 Main Street, Worcester, MA 01610                 | MAIN          | ST
```

참고

Normalize_Address, Geocode

11.2.15 Pprint_Addy

Pprint_Addy — `norm_addy` 복합 유형 객체를 입력받&#
해당 객체의 보기 좋은 인쇄용 표&#
반환합니다. 일반적으로 normalize_address 함&#
결합해서 쓰입니다.

Synopsis

varchar **pprint_addy**(norm_addy in_addy);

설명

`norm_addy` 복합 유형 객체를 입력받아,
해당 객체의 보기 좋은 인쇄용 표&#
반환합니다. 지오코딩 도구와 함&#
패키징된 데이터 이외에 다른 데&#
불필요합니다.

일반적으로 Normalize_Address 함수와 결합해&#
쓰입니다.

예시

단일 주소의 보기 좋은 인쇄용 출&#

```
SELECT pprint_addy(normalize_address('202 East Fremont Street, Las Vegas, Nevada 89101'))  ↩
    As pretty_address;
           pretty_address
----------------------------------------
 202 E Fremont St, Las Vegas, NV 89101
```

주소 테이블의 보기 좋은 인쇄용
출력

```
SELECT address As orig, pprint_addy(normalize_address(address)) As pretty_address
        FROM addresses_to_geocode;

                        orig                         |              pretty_address
-----------------------------------------------------+------------------------------------------- ↩

 529 Main Street, Boston MA, 02129                   | 529 Main St, Boston MA, 02129
 77 Massachusetts Avenue, Cambridge, MA 02139        | 77 Massachusetts Ave, Cambridge, MA  ↩
     02139
 28 Capen Street, Medford, MA                        | 28 Capen St, Medford, MA
 124 Mount Auburn St, Cambridge, Massachusetts 02138 | 124 Mount Auburn St, Cambridge, MA  ↩
     02138
 950 Main Street, Worcester, MA 01610                | 950 Main St, Worcester, MA 01610
```

참고

Normalize_Address

11.2.16 Reverse_Geocode

Reverse_Geocode — 알려진 공간 참조 시스템으&#
투영된 도형 포인트를 입력받아
이론적으로 가능한 주소들의 배&#x
교차로의 배열을 담고 있는 레코&#x
반환합니다. include_strnum_range = true일 경우, 교차&#x
있는 도로 범위를 포함합니다.

Synopsis

record **Reverse_Geocode**(geometry pt, boolean include_strnum_range=false, geometry[] OUT intpt, norm_addy[] OUT addy, varchar[] OUT street);

설명

알려진 공간 참조 시스템으로 투&#x
도형 포인트를 입력받아 이론적&#
가능한 주소들의 배열과 교차로&#xc
배열을 담고 있는 레코드를 반환&#x
include_strnum_range = true일 경우, 교차로에 있는 도&#x
범위를 포함합니다. 따로 설정하&#
않을 경우 include_strnum_range의 기본값은 거짓&
포인트가 어떤 도로에 가장 가까&#x
따라 주소를 정렬하기 때문에 &#xc-
cab; 번째 주소가 대부분 맞는 편입&#xb2c8

실제 주소라고 하는 대신 이론적&#x
하는 이유가 뭘까요. TIGER 데이터는
실제 주소를 가지고 있지 않고, 다&#x
도로 범위만 가지고 있습니다. 그&#
이론적 주소란 도로 범위에 기반&#x
보간된 주소입니다. 예를 들어 어&#
실제 주소를 보간하면 26 Court Sq. 라는
주소가 실재하지 않는데도 불구&#x
26 Court St. 와 26 Court Sq. 를 반환합니다. 왜냐하&#xba
포인트가 두 도로의 교차점에 위&#
수도 있으므로 로직이 두 도로 모&#
따라 보간하기 때문입니다. 이 로&#
또 주소들이 도로를 따라 균등한
간격으로 위치한다고 가정하는&#xb
물론 지자체 건물이 도로 범위의
큰 부분을 차지하고 나머지 건물&#
도로 끝 부분에 몰려 있을 수도 있&
때문에 이 가정은 틀렸습니다.

주의: 이 함수는 TIGER 데이터에 의존&#x
해당 포인트의 지역을 커버하는
데이터를 로드하지 않았을 경우,
NULL로 채워진 레코드를 반환할 것&#xc7

반환된 레코드를 구성하는 요소&#x
다음과 같습니다:

1. `intpt` 은 포인트 배열입니다: 입력
   포인트에 가장 가까운 도로 상&#xc75
   중심선 포인트들입니다. 주소&#xc75
   개수 만큼 많은 포인트들이 있&#xc2b

2. addy 는 norm_addy(정규화된 주소) 배열입&#xb2c8
입력 포인트에 적합한, 가능한
주소들의 배열입니다. 배열의
첫 번째 주소가 가장 올바를 가&#xb2a
큽니다. 일반적으로, 포인트가
도로 2개 또는 3개의 교차점에 위&#x
경우 또는 포인트가 도로의 어&#xb2
한 편이 아니라 도로 상에 위치&#xd5
경우를 제외하면, 주소 1개만 있&#xc5
합니다.

3. street 는 varchar형 배열입니다: 교차로의
도로들(또는 도로 1개)입니다(교&#x
도로들 또는 포인트가 그 위에
투영된 도로입니다).

Enhanced: 2.4.1 if optional zcta5 dataset is loaded, the reverse_geocode function can resolve to state and zip even if the specific state data is not loaded. Refer to Loader_Generate_Nation_Script for details on loading zcta5 data.

2.0.0 버전부터 사용할 수 있습니다.

예시

포인트가 두 도로의 교차점에 있&#
어느 한 도로에 더 가까운 경우의
예시입니다. 이 포인트는 MIT - 77 Massachusetts
Ave, Cambridge, MA 02139 - 에 매우 가까운 위치에 있&#
도로 3개의 경우는 아니지만, PostgreSQL&#xc774
상한(上限; upper bound)을 넘어서는 항목&#xc5d0
대해 NULL을 반환할 것이기 때문에
안전하게 이용할 수 있다는 점에
주의하십시오. 도로 범위도 포함&#

```
SELECT pprint_addy(r.addy[1]) As st1, pprint_addy(r.addy[2]) As st2, pprint_addy(r.addy[3]) ↩
    As st3,
            array_to_string(r.street, ',') As cross_streets
       FROM reverse_geocode(ST_GeomFromText('POINT(-71.093902 42.359446)',4269),true) As r ↩
           ;

 result
 ------
      st1                                      | st2 | st3 |                cross_streets
-----------------------------------------------+-----+-----+-----------------------------------------------

 67 Massachusetts Ave, Cambridge, MA 02139 |     |     | 67 - 127 Massachusetts Ave,32 - 88 ↩
     Vassar St
```

다음 예시는 교차로에 대해 주소
범위를 포함하지 않도록 선택하&#
두 도로의 교차점에 정말로 가까&#
위치를 골라서 서로 다른 두 주소&#
반환할 수 있도록 합니다.

```
SELECT pprint_addy(r.addy[1]) As st1, pprint_addy(r.addy[2]) As st2,
pprint_addy(r.addy[3]) As st3, array_to_string(r.street, ',') As cross_str
FROM reverse_geocode(ST_GeomFromText('POINT(-71.06941 42.34225)',4269)) As r;

result
--------
```

```
               st1                |               st2                | st3 | cross_str
----------------------------------+----------------------------------+-----+------------------------ ↩

 5 Bradford St, Boston, MA 02118 | 49 Waltham St, Boston, MA 02118 |     | Waltham St
```

다음 예시는 Geocode 의 지오코딩된 예&#x
다시 이용해서 도로가 최대한 2개&#
교차하는 교차로에 있는 최선의
주소만을 반환하도록 합니다.

```
SELECT actual_addr, lon, lat, pprint_addy((rg).addy[1]) As int_addr1,
    (rg).street[1] As cross1, (rg).street[2] As cross2
FROM (SELECT address As actual_addr, lon, lat,
    reverse_geocode( ST_SetSRID(ST_Point(lon,lat),4326) ) As rg
    FROM addresses_to_geocode WHERE rating
> -1) As foo;

                    actual_addr                     |    lon    |   lat    | ↩
                            int_addr1                 |     cross1      |    ↩
                        cross2
----------------------------------------------------+-----------+----------+-----------------------

 529 Main Street, Boston MA, 02129                  | -71.07181 | 42.38359 | 527 Main St,  ↩
    Boston, MA 02129             | Medford St      |
 77 Massachusetts Avenue, Cambridge, MA 02139       | -71.09428 | 42.35988 | 77  ↩
    Massachusetts Ave, Cambridge, MA 02139 | Vassar St       |
 26 Capen Street, Medford, MA                       | -71.12377 | 42.41101 | 9 Edison Ave, ↩
     Medford, MA 02155           | Capen St        | Tesla Ave
 124 Mount Auburn St, Cambridge, Massachusetts 02138 | -71.12304 | 42.37328 | 3 University  ↩
    Rd, Cambridge, MA 02138      | Mount Auburn St |
 950 Main Street, Worcester, MA 01610               | -71.82368 | 42.24956 | 3 Maywood St, ↩
     Worcester, MA 01603         | Main St         | Maywood Pl
```

참고

Pprint_Addy, Pprint_Addy, ST_AsText

11.2.17 Topology_Load_Tiger

Topology_Load_Tiger — PostGIS 지형에 TIGER 데이터의 정의&
지역을 로드하면서 TIGER 데이터를
지형의 공간 참조 시스템으로 변&#x
지형의 정확도 허용 오차에 스냅&#

Synopsis

text **Topology_Load_Tiger**(varchar topo_name, varchar region_type, varchar region_id);

설명

PostGIS 지형에 TIGER 데이터의 정의된 지&#xc5
로드합니다. 면, 노드 및 경계선을
대상 지형의 공간 참조 시스템으&#x
변환하고 대상 지형의 허용 오차&#
포인트들을 스냅시킵니다. 이렇&#

생성된 면, 노드, 경계선이 원본 TIGER 데이터의 면, 노드, 경계선과 동일&# ID를 유지하기 때문에, 이 데이터&#xc14b 향후 TIGER 데이터와 더 쉽게 함께 쓰&#xc 수 있습니다. 처리 과정에 대한 요&# 설명문을 반환합니다.

이 함수는, 예를 들어, 도로의 중심&# 따라 새로 형성된 폴리곤이 필요&# 이 폴리곤들이 서로 중첩해서는 안 될 경우, 데이터를 제약하는 데 유용합니다.

Note

이 함수는 TIGER 데이터는 물론 PostGIS 지형의 설치에 의존적입니다. 더 자세한 정보를 원한다면 Chapter 8 및 Section 2.2.3 을 참조하십시오. 관심지역을 커버하는 데이터를 로드하지 않았을 경우, 어떤 지형 레코드도 생성하지 않을 것입니다. 또한 지형 함수를 이용해서 지형을 생성하지 않았을 경우에도 오류를 발생시킬 것입니다.

Note

지형 확인 오류 대부분은 변환 작업 후 경계선 및 포인트가 제대로 정렬되지 않거나 중첩되지 않는 허용 오차 문제입니다. 지형 확인 오류가 발생한 경우, 이런 상황을 해결하려면 정확도를 높이거나 낮추는 편이 좋을 수도 있습니다.

필수 인수::

1. `topo_name` - 데이터를 로드할 기존 PostGIS 지&# 명칭입니다.

2. `region_type` - 경계를 이루는 지역의 유&#xd615 현재 `place` 와 `county` 만 지원합니다. 몇&#xba87 유형을 더 지원할 예정입니다. 이 인수는 `tiger.place`, `tiger.county` 첸럼 지역 경&# 정의하려면 살펴봐야 할 테이&#xbe

3. `region_id` - TIGER가 지리 ID(geoid)라고 부르는 식&# 테이블에 있는 지역의 유일한 식별자입니다. `place` 의 경우 `tiger.place` 테&# 있는 `plcidfp` 열입니다. `county` 의 경우 `tiger.count` 테이블에 있는 `cntyidfp` 열입니다.

2.0.0 버전부터 사용할 수 있습니다.

예시: 매사추세츠 주 보스턴 시의 지형

매사추세츠 주 피트 단위 평면(2249)&#xc5
매사추세츠 주 보스턴 시에 대해
허용 오차 0.25 피트를 가진 지형을
생성한 다음, 보스턴 시의 TIGER 면, 경&#x
노드를 로드합니다.

```
SELECT topology.CreateTopology('topo_boston', 2249, 0.25);
createtopology
--------------
   15
-- &#xc708;&#xb3c4;&#xc6b0;7 &#xb370;&#xc2a4;&#xd06c;&#xd0d1;&#xc5d0;&#xc11c; 9.1  ↩
    &#xbc84;&#xc804;&#xc744; (5&#xac1c; &#xc8fc;&#xc758; TIGER  ↩
    &#xb370;&#xc774;&#xd130;&#xb97c; &#xb85c;&#xb4dc;&#xd55c; &#xc0c1;&#xd0dc;&#xb85c;)  ↩
    &#xc2e4;&#xd589;&#xd588;&#xc744; &#xb54c; 60,902&#xbc00;&#xb9ac;&#xcd08; ~ 1&#xbd84;  ↩
    &#xc18c;&#xc694;
SELECT tiger.topology_load_tiger('topo_boston', 'place', '2507000');
-- topology_loader_tiger --
29722 edges holding in temporary. 11108 faces added. 1875 edges of faces added.  20576  ↩
    nodes added.
19962 nodes contained in a face.  0 edge start end corrected.  31597 edges added.

-- 41&#xbc00;&#xb9ac;&#xcd08; &#xc18c;&#xc694; --
SELECT topology.TopologySummary('topo_boston');
 -- topologysummary--
Topology topo_boston (15), SRID 2249, precision 0.25
20576 nodes, 31597 edges, 11109 faces, 0 topogeoms in 0 layers

-- &#xd655;&#xc778; &#xc791;&#xc5c5;&#xc5d0; 28,797&#xbc00;&#xb9ac;&#xcd08;  ↩
    &#xc18c;&#xc694;, &#xbc1c;&#xc0dd;&#xd55c; &#xc624;&#xb958; &#xc5c6;&#xc74c; --
SELECT * FROM
    topology.ValidateTopology('topo_boston');

       error       |   id1    |    id2
-------------------+----------+-----------
```

예시: 매사추세츠 주 서퍽 군의 지&#

매사추세츠 주 미터 단위 평면(26986)&#xc5
매사추세츠 주 서퍽 군에 대해 허&#
오차 0.25 미터를 가진 지형을 생성&#xd55c
다음, 서퍽 군의 TIGER 면, 경계선, 노드&#
로드합니다.

```
SELECT topology.CreateTopology('topo_suffolk', 26986, 0.25);
-- &#xc708;&#xb3c4;&#xc6b0;7 32&#xbe44;&#xd2b8; &#xc0c1;&#xc5d0;&#xc11c; 5&#xac1c;  ↩
    &#xc8fc;&#xc758; TIGER &#xb370;&#xc774;&#xd130;&#xb97c; &#xb85c;&#xb4dc;&#xd55c;  ↩
    &#xc0c1;&#xd0dc;&#xb85c; &#xc2e4;&#xd589;&#xd588;&#xc744; &#xb54c; 56,275 ↩
    &#xbc00;&#xb9ac;&#xcd08; ~ 1&#xbd84; &#xc18c;&#xc694;
-- &#xbcf4;&#xc2a4;&#xd134; &#xb370;&#xc774;&#xd130;&#xb97c; &#xb85c;&#xb4dc;&#xd55c;  ↩
    &#xb2e4;&#xc74c; &#xc608;&#xc5f4;&#xb410;&#xc74c;&#xc774; &#xbd84;&#xba85;&#xd568;
SELECT tiger.topology_load_tiger('topo_suffolk', 'county', '25025');
-- topology_loader_tiger --
 36003 edges holding in temporary. 13518 faces added. 2172 edges of faces added.
 24761 nodes added.  24075 nodes contained in a face.  0 edge start end corrected.  38175  ↩
     edges added.
-- 31&#xbc00;&#xb9ac;&#xcd08; &#xc18c;&#xc694; --
SELECT topology.TopologySummary('topo_suffolk');
```

```
 -- topologysummary--
 Topology topo_suffolk (14), SRID 26986, precision 0.25
24761 nodes, 38175 edges, 13519 faces, 0 topogeoms in 0 layers

-- &#xd655;&#xc778; &#xc791;&#xc5c5;&#xc5d0; 33,606&#xbc00;&#xb9ac;&#xcd08;  ↩
    &#xc18c;&#xc694; --
SELECT * FROM
    topology.ValidateTopology('topo_suffolk');

       error       |   id1    |    id2
-------------------+----------+-----------
 coincident nodes  | 81045651 |  81064553
 edge crosses node | 81045651 |  85737793
 edge crosses node | 81045651 |  85742215
 edge crosses node | 81045651 | 620628939
 edge crosses node | 81064553 |  85697815
 edge crosses node | 81064553 |  85728168
 edge crosses node | 81064553 |  85733413
```

참고

CreateTopology, CreateTopoGeom, TopologySummary, ValidateTopology

11.2.18 Set_Geocode_Setting

Set_Geocode_Setting — 지오코딩 도구 함수들의 습성에 영향을 미치는 설정값을 설정합니다.

Synopsis

text **Set_Geocode_Setting**(text setting_name, text setting_value);

설명

`tiger.geocode_settings` 테이블에 저장된 특정 설값을 설정합니다. 사용자가 함수디버깅을 켜고 끌 수 있게 해주는 설정값입니다. 향후 설정값으로 순위를 제어할 수 있도록 할 계획&#x Get_Geocode_Setting 에서 현재 설정값 목록을 볼 수 있습니다.

2.1.0 버전부터 사용할 수 있습니다.

예시: 디버깅 설정값 반환

이 함수가 참일 때 Geocode 를 실행할 경&# NOTICE 로그가 소요 시간 및 쿼리를 출&#xb 것입니다.

```
SELECT set_geocode_setting('debug_geocode_address', 'true') As result;
result
---------
true
```

참고

Get_Geocode_Setting

Chapter 12

PostGIS Special Functions Index

12.1 PostGIS Aggregate Functions

The functions below are spatial aggregate functions that are used in the same way as SQL aggregate function such as `sum` and `average`.

- ST_3DExtent - Aggregate function that returns the 3D bounding box of geometries.
- ST_3DUnion - Perform 3D union.
- ST_AsFlatGeobuf - Return a FlatGeobuf representation of a set of rows.
- ST_AsGeobuf - Return a Geobuf representation of a set of rows.
- ST_AsMVT - Aggregate function returning a MVT representation of a set of rows.
- ST_ClusterIntersecting - Aggregate function that clusters input geometries into connected sets.
- ST_ClusterWithin - Aggregate function that clusters input geometries by separation distance.
- ST_CoverageUnion - Computes the union of a set of polygons forming a coverage by removing shared edges.
- ST_Extent - Aggregate function that returns the bounding box of geometries.
- ST_GeomCollFromText - Creates a GeometryCollection or Multi* geometry from a set of geometries.
- ST_MakeLine - 포인트, 멀티포인트 또는 라&#x
  도형으로부터 라인스트링을 생&
- ST_MemUnion - Aggregate function which unions geometries in a memory-efficent but slower way
- ST_Polygonize - Computes a collection of polygons formed from the linework of a set of geometries.
- ST_SameAlignment - 래스터들이 동일한 기울기
  축척, 공간 참조 시스템, 그리고 오&
  가지고 있을 경우 (픽셀이 다른 픽
  침범하지 않고 동일한 그리드에
  놓일 수 있을 경우) 참을 반환하고
  그렇지 않을 경우 문제점을 설명&
  안내문과 함께 거짓을 반환합니&
- ST_Union - Computes a geometry representing the point-set union of the input geometries.
- TopoElementArray_Agg - Returns a topoelementarray for a set of element_id, type arrays (topoelements).

12.2 PostGIS Window Functions

The functions below are spatial window functions that are used in the same way as SQL window functions such as `row_number()`, `lead()`, and `lag()`. They must be followed by an `OVER()` clause.

- ST_ClusterDBSCAN - Window function that returns a cluster id for each input geometry using the DBSCAN algorithm.
- ST_ClusterIntersectingWin - Window function that returns a cluster id for each input geometry, clustering input geometries into connected sets.
- ST_ClusterKMeans - Window function that returns a cluster id for each input geometry using the K-means algorithm.
- ST_ClusterWithinWin - Window function that returns a cluster id for each input geometry, clustering using separation distance.
- ST_CoverageInvalidEdges - Window function that finds locations where polygons fail to form a valid coverage.
- ST_CoverageSimplify - Window function that simplifies the edges of a polygonal coverage.

12.3 PostGIS SQL-MM Compliant Functions

The functions given below are PostGIS functions that conform to the SQL/MM 3 standard

- ST_3DArea - 3차원 표면 도형의 면적을 계&#xc0 입체일 경우 0을 반환할 것입니다 설명 2.1.0 버전부터 사용할 수 있습&#xb This method needs SFCGAL backend. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 8.1, 10.5 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).
- ST_3DDWithin - Tests if two 3D geometries are within a given 3D distance Description Returns true if the 3D distance between two geometry values is no larger than distance distance_of_srid. The distance is specified in units defined by the spatial reference system of the geometries. For this function to make sense the source geometries must be in the same coordinate system (have the same SRID). This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This method implements the SQL/MM specification. SQL-MM ? Availability: 2.0.0
- ST_3DDifference - 3차원 차이를 수행합니다. 설 geom2의 일부분이 아닌 geom1의 부분을 반환합니다. 2.2.0 버전부터 사용할 수 있습니다. This method needs SFCGAL backend. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).
- ST_3DDistance - 도형 유형에 대해, 두 도형 사& (SRS에 기반한) 3차원 데카르트 최단 거리를 투영 단위로 반환합니다. 설명 도형 유형에 대해, 두 도형 사이의 3차원 데카르트 최단 거리 두 도형의 투영 단위(SRS 단위)로 반&#x This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3 2.0.0 버전부터 사용할 수 있습니다. 변경 사항: 2.2.0 버전부&#x 2D 및 3D의 경우 더 이상 Z가 없을 때 Z를 0으로 가정하지 않습니다. Changed: 3.0.0 - SFCGAL version removed

- ST_3DIntersection - 3차원 교차를 수행합니다. 설명 geom1과 geom2가 공유하는 부분을 도형으로 반환합니다. 2.1.0 버전부&#xd
사용할 수 있습니다. This method needs SFCGAL backend. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_3DIntersects - Tests if two geometries spatially intersect in 3D - only for points, linestrings, polygons, polyhedral surface (area) Description Overlaps, Touches, Within all imply spatial intersection. If any of the aforementioned returns true, then the geometries also spatially intersect. Disjoint implies false for spatial intersection. This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. Changed: 3.0.0 SFCGAL backend removed, GEOS backend supports TINs. Availability: 2.0.0 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN). This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

- ST_3DLength - 도형의 기하학적 중심을 반&#xd
설명 도형이 라인스트링 또는 멀&
경우 도형의 3차원 또는 2차원 길&#xc77
반환합니다. 2차원 라인의 경우
2차원 길이만 반환할 것입니다(ST_Lengt
및 ST_Length2D와 동일합니다). This function supports 3d and will not drop the z-index. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 7.1, 10.3 변경
사항: 2.0.0 미만 버전에서는 ST_Length3D라는
명칭이었습니다.

- ST_3DPerimeter - 도형의 기하학적 중심을 반&#
설명 도형이 폴리곤 또는 멀티폴&
경우 도형의 3차원 둘레를 반환&#xd569
2차원 도형의 경우 2차원 둘레를
반환할 것입니다. This function supports 3d and will not drop the z-index. This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.1, 10.5 변경
사항: 2.0.0 미만 버전에서는 ST_Perimeter3D라&#xb294
명칭이었습니다.

- ST_3DUnion - Perform 3D union. 설명 2.2.0 버전부터 사용할
수 있습니다. Availability: 3.3.0 aggregate variant was added This method needs SFCGAL backend. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN). Aggregate variant: returns a geometry that is the 3D union of a rowset of geometries. The ST_3DUnion() function is an "aggregate" function in the terminology of PostgreSQL. That means that it operates on rows of data, in the same way the SUM() and AVG() functions do and like most aggregates, it also ignores NULL geometries.

- ST_AddEdgeModFace - 새 경계선을 추가하고, 그
과정에서 경계선이 표면을 분할&#
경우, 원본 표면을 수정하고 새 표&
추가합니다. 설명 새 경계선을 추&
그 과정에서 경계선이 표면을 분&
경우, 원본 표면을 수정하고 새 표&
추가합니다. 가능한 경우, 새 경계
왼쪽에 새 표면을 생성할 것입니&
왼쪽의 표면이 (무한한) 세계 표면
face)이어야 할 경우 이는 불가능할
것입니다. 새로 추가된 경계선의
ID를 반환합니다. 모든 기존의 결&#xd56
경계선 및 관계성을 결과에 맞춰
업데이트합니다. 어떤 인수가 NULL&#x
경우, 주어진 노드들이 알려지지
않은 경우(노드가 이미 지형 스키&

node 테이블에 존재해야 합니다), acurve 가 LINESTRING 이 아닐 경우, anode 와 anothernode 가 acurve 의 시작점 및 종단점이 아닐 경우 오류가 발생합니다. acurve 도형과 지&#x 공간 참조 시스템(SRID)이 다를 경우 예외가 발생합니다. 2.0 버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.13

- ST_AddEdgeNewFaces - 새 경계선을 추가하고, 그 과정에서 경계선이 표면을 분할&# 경우, 원본 표면을 삭제하고 새 표& 2개로 교체합니다. 설명 새 경계선 추가하고, 그 과정에서 경계선이 표면을 분할할 경우, 원본 표면을 삭제하고 새 표면 2개로 교체합니&# 새로 추가된 경계선의 ID를 반환&#xd569 모든 기존의 결합된 경계선 및 관& 결과에 맞춰 업데이트합니다. 어& 인수가 NULL일 경우, 주어진 노드들&#x 알려지지 않은 경우(노드가 이미 지형 스키마의 node 테이블에 존재&#xd5 합니다), acurve 가 LINESTRING 이 아닐 경우, anode 와 anothernode 가 acurve 의 시작점 및 종단점이 아닐 경우 오류가 발생합니다. acurve 도형과 지형의 공간 참조 시스템(Sl 다를 경우 예외가 발생합니다. 2.0 버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.12

- ST_AddIsoEdge - 지형에 두 개의 고립된 기존 노드 anode 와 anothernode 를 연결하는 alinestring 도형& 정의하는 고립된 경계선을 추가& 새 경계선의 ID를 반환합니다. 설&#xba8 지형에 두 개의 고립된 기존 노드 anode 와 anothernode 를 연결하는 alinestring 도형이 정의하는 고립된 경계선을 추가& 새 경계선의 ID(edgeid)를 반환합니다. alinestrin 도형과 지형의 공간 참조 시스템(Sl 다를 경우, 입력 인수 가운데 하&#xb098 NULL일 경우, 하나 이상의 표면이 노&# 담고 있을 경우, 또는 노드가 기존 경계선의 시작 또는 종단 노드일 경우, 예외가 발생합니다. alinestring 이 anode 와 anothernode 가 속해 있는 표면 내부에 없을 경우, 예외가 발생합니다. an- ode 와 anothernode 가 alinestring 의 시작점 및 종단점&# 아닐 경우 예외가 발생합니다. Avail- ability: 1.1 This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.4

- ST_AddIsoNode - 지형 안의 표면에 고립된(isolated) 노드를 추가하고 새 노드의 ID를 반환합니다. 표면이 NULL일 경우, 그&# 노드를 생성합니다. 설명 atopology 지형 aface ID(faceid)를 가진 기존 표면에 포인트 위치가 apoint 인 고립된 노드를 추가&#x 새 노드의 ID(nodeid)를 반환합니다. 포&#xc778 도형과 지형의 공간 참조 시스템(Sl

다를 경우, apoint 가 포인트 도형이 아&#
경우, 포인트가 NULL일 경우, 또는 포&#
기존 경계선과 (또는 외곽선일지&#
교차하는 경우 예외가 발생합니&
해당 포인트의 위치에 이미 노드&
존재할 경우에도 예외가 발생합&
aface 가 NULL이 아닌데 apoint 가 표면 내부에
있지 않을 경우, 예외가 발생합니&
Availability: 1.1 This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X+1.3.1

- ST_Area - 도형의 기하학적 중심을 반환&
설명 도형이 폴리곤이나 멀티폴&#
경우 표면의 면적을 - ST_Surface 또는 ST_MultiSurface
함수의 면적 측정값을 - 반환합니
도형 유형의 경우, SRID가 지정한 단&#x
2차원 데카르트 면적을 구합니다
지리형 유형의 경우, 평방미터 단&
곡면(curved surface)의 면적을 구합니다. 구&#x
면적에 대해 덜 정확하지만 더 빠
측정하려면, ST_Area(geog,false) 함수를 이용하
개선 사항: 2.0.0 버전부터 2차원 다면&#x
표면(polyhedral surface)을 지원합니다. 개선 사&
2.2.0 버전부터 회전타원체 측정시
정확도와 강력함을 향상시키기
위해 GeographicLib을 이용합니다. 이 새 기&#x
장점을 취하려면 Proj 4.9.0 이상 버전이
필요합니다. Changed: 3.0.0 - does not depend on SFCGAL anymore. This method im-
plements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specifi-
cation. SQL-MM 3: 8.1.2, 9.5.3 This function supports Polyhedral surfaces. 다면체 표면&#xc7
경우, (2.5차원이 아니라) 2차원 다면&#x
표면만 지원합니다. 2.5차원일 경&#xc6b
0이 아닌(non-zero) 답을 내놓을 수도 있&#xc9c0
XY 평면상에 완벽하게 놓이는 면&#xb4
면적만 반환하는 것입니다.

- ST_AsBinary - Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data. 설명 Returns the OGC/ISO Well-Known Binary (WKB) representation of the geometry. The first function variant defaults to encoding using server machine endian. The second function variant takes a text argument specifying the endian encoding, either little-endian ('NDR') or big-endian ('XDR'). WKB format is useful to read geometry data from the database and maintaining full numeric precision. This avoids the precision rounding that can happen with text formats such as WKT. To perform the inverse conversion of WKB to PostGIS geometry use . The OGC/ISO WKB format does not include the SRID. To get the EWKB format which does include the SRID use The default behavior in PostgreSQL 9.0 has been changed to output bytea in hex encoding. If your GUI tools require the old behavior, then SET bytea_output='escape' in your database. 개선 사항: 2.0.0 버전부터 다면체 표&#xb
삼각형 및 TIN을 지원하기 시작했&#xc2b
개선 사항: 2.0.0 버전부터 더 높은 좌&#x
차원을 지원합니다. 개선 사항: 2.0.0
버전부터 지리형과 함께 엔디안&
설정하는 방식을 지원합니다. 1.5.0
버전부터 지리형을 지원합니다.
변경 사항: 2.0.0버전부터 이 함수에
알려지지 않은 유형을 입력할 수
없게 됐습니다. 반드시 도형을 입
합니다. ST_AsBinary('POINT(1 2)') 같은 구조는 더
이상 유효하지 않아, n st_asbinary(unknown) is not unique error
오류가 발생합니다. 이런 코드는
ST_AsBinary('POINT(1 2)'::geometry); 로 변경돼야 합니다. 이
변경할 수 없는 경우, legacy.sql 을 설치하

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.37 This method supports Circular Strings and Curves. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN). This function supports 3d and will not drop the z-index.

- ST_AsGML - 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다. 설명 Return the geometry as a Geography Markup Language (GML) element. The version parameter, if specified, may be either 2 or 3. If no version parameter is specified then the default is assumed to be 2. The maxdecimaldigits argument may be used to reduce the maximum number of decimal places used in output (defaults to 15). Using the maxdecimaldigits parameter can cause output geometry to become invalid. To avoid this use with a suitable gridsize first. GML 2는 2.1.2 버전을, GML 3은 3.1.1 버전을 가리킵니다. '옵션' 인수&#xb294 비트필드(bitfield) 구조체입니다. CRS 출&#xb8 유형을 GML 출력으로 정의하고, 데&#x 위도/경도로 선언하는 데 쓸 수 있 0: GML Short CRS (예: EPSG:4326), 기본값 1: GML Long CRS (예: urn:ogc:def:crs:EPSG::43 2: GML 3에 한해, 출력물에서 srsDimension 속성&#xc7 제거합니다. 4: GML 3에 한해, 라인을 위해 <Curve> 보다 <LineString> 태그를 사용합&#xb2c8 16: 데이터가 위도/경도(예: srid=4326)라고 선언합니다. 기본적으로는 데이&# 평면 좌표라고 가정합니다. 이 옵& 축의 순서(axis order)와 관련돼 있어, GML 3.1.1 출력물에 대해서만 쓸모가 있습&# 따라서 이 옵션을 설정하면, 데이 경도 위도 대신 위도 경도로 좌표& 순서를 바꿀 것입니다. 32: 도형을 둘러싼 상자(envelope)를 출력합니다. 사& 지정 네임스페이스 접두사를 설& 접두사를 사용하지 않도록 설정(& 있는 경우)하는 데 '네임스페이&#xc2a4 접두사' 인수를 사용할 수도 있습& 이 인수가 NULL이거나 생략된 경우 'gml' 접두사를 씁니다. 1.3.2 버전부터 사용할 수 있습니다. 1.5.0 버전부터 지리형을 지원합니다. 개선 사항: 2.0.0 버전부터 접두사를 지원합니&#xb 라인에 대해 커브 대신 라인스트& 태그를 이용할 수 있도록 GML 3용 옵&#x '4'가 등장했습니다. GML 3가 다면체 표& 및 TIN을 지원하기 시작했습니다. 상자를 출력하는 옵션 '32'도 새롭&#xac 등장했습니다. 변경 사항: 2.0.0 버전&#x 명명된 독립변수(named arg)를 기본값으& 씁니다. 개선 사항: 2.1.0 버전부터 GML 3를 위해 ID를 지원하기 시작했습&#xb2 ST_AsGML 함수의 3 이상 버전만이 다면&#xccb 표면 및 TIN을 지원합니다. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 17.2 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_AsText - 도형/지리형의 WKT(Well-Known Text) 표현식&# SRID 메타데이터 없이 반환합니다. 설명 Returns the OGC Well-Known Text (WKT) representation of the geometry/geography. The optional maxdecimaldigits argument may be used to limit the number of digits after the decimal point in output ordinates (defaults to 15). To perform the inverse conversion of WKT representation to PostGIS geometry use . The standard OGC WKT representation does not include the SRID. To include the SRID as part of the output representation, use the non-standard PostGIS

function The textual representation of numbers in WKT may not maintain full floating-point precision. To ensure full accuracy for data storage or transport it is best to use Well-Known Binary (WKB) format (see and maxdecimaldigits). Using the maxdecimaldigits parameter can cause output geometry to become invalid. To avoid this use with a suitable gridsize first. 1.5.0 버전부터 지리형을 지원합니다. Enhanced: 2.5 - optional parameter precision introduced. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.25 This method supports Circular Strings and Curves.

- ST_Boundary - 해당 도형의 결합된 범위의 닫힘 여부를 반환합니다. 설명 해 도형의 결합된 범위의 닫힘(closure) 여반환합니다. 결합 범위(combinatorial boundary)는 OGC 사양서의 3.12.3.2 단원이 설명하는&#xb30 정의됩니다. 이 함수의 결과가 닫때문에, 즉 위상적(位相的)으로 폐때문에, OGC 사양서 3.12.2 단원에서 설명표현적인 도형 원형(primitive)을 이용해결과 범위를 표현할 수 있습니다. GEOS 모듈로 실행 2.0.0 미만 버전에서 이 함수를 GEOMETRYCOLLECTION과 함께 사용하예외가 발생했습니다. 2.0.0 이후 버&#xc 대신 (입력을 지원하지 않는다는 의미의) NULL을 반환합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. OGC SPEC s2.1.1.1 This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.17 This function supports 3d and will not drop the z-index. 개선 사항: 2.1.0 버전부터 삼각형을 지원&#xd 시작했습니다. Changed: 3.2.0 support for TIN, does not use geos, does not linearize curves
- ST_Buffer - Computes a geometry covering all points within a given distance from a geometry. 설명 Computes a POLYGON or MULTIPOLYGON that represents all points whose distance from a geometry/geography is less than or equal to a given distance. A negative distance shrinks the geometry rather than expanding it. A negative distance may shrink a polygon completely, in which case POLYGON EMPTY is returned. For points and lines negative distances always return empty results. For geometry, the distance is specified in the units of the Spatial Reference System of the geometry. For geography, the distance is specified in meters. The optional third parameter controls the buffer accuracy and style. The accuracy of circular arcs in the buffer is specified as the number of line segments used to approximate a quarter circle (default is 8). The buffer style can be specifed by providing a list of blank-separated key=value pairs as follows: 'quad_segs=#' : number of line segments used to approximate a quarter circle (default is 8). 'endcap=round|flat|square' : endcap style (defaults to "round"). 'butt' is accepted as a synonym for 'flat'. 'join=round|mitre|bevel' : join style (defaults to "round"). 'miter' is accepted as a synonym for 'mitre'. 'mitre_limit=#.#' : mitre ratio limit (only affects mitered join style). 'miter_limit' is accepted as a synonym for 'mitre_limit'. 'side=both|left|right' : 'left' or 'right' performs a single-sided buffer on the geometry, with the buffered side relative to the direction of the line. This is only applicable to LINESTRING geometry and does not affect POINT or POLYGON geometries. By default end caps are square. For geography this is a thin wrapper around the geometry implementation. It determines a planar spatial reference system that best fits the bounding box of the geography object (trying UTM, Lambert Azimuthal Equal Area (LAEA) North/South pole, and finally Mercator). The buffer is computed in the planar space, and then transformed back to WGS84. This may not produce the desired behavior if the input object is much larger than a UTM zone or crosses the dateline Buffer output is always a valid polygonal geometry. Buffer can handle invalid inputs, so buffering by distance 0 is sometimes used as a way of repairing invalid polygons. can also be used for this purpose. Buffering is sometimes used to perform a within-distance search. For this use case it is more efficient to use . This function ignores the Z dimension. It always gives a 2D result even when used on a 3D geometry. Enhanced: 2.5.0 - ST_Buffer geometry support was enhanced to allow for side buffering specification side=both|left|right. Availability: 1.5 - ST_Buffer was enhanced to support different endcaps and join types. These are useful for example to convert road linestrings into polygon roads with flat or square edges instead of rounded edges. Thin wrapper for geography was added. GEOS 모듈로 실행 This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.30
- ST_Centroid - 도형의 기하학적 중심을 반&#xd6 설명 Computes a point which is the geometric center of mass of a geometry. For [MULTI]POINTs, the cen-

troid is the arithmetic mean of the input coordinates. For [MULTI]LINESTRINGs, the centroid is computed using the weighted length of each line segment. For [MULTI]POLYGONs, the centroid is computed in terms of area. If an empty geometry is supplied, an empty GEOMETRYCOLLECTION is returned. If NULL is supplied, NULL is returned. If CIRCULARSTRING or COMPOUNDCURVE are supplied, they are converted to linestring with CurveToLine first, then same than for LINESTRING For mixed-dimension input, the result is equal to the centroid of the component Geometries of highest dimension (since the lower-dimension geometries contribute zero "weight" to the centroid). Note that for polygonal geometries the centroid does not necessarily lie in the interior of the polygon. For example, see the diagram below of the centroid of a C-shaped polygon. To construct a point guaranteed to lie in the interior of a polygon use . New in 2.3.0 : supports CIRCULARSTRING and COMPOUNDCURVE (using CurveToLine) Availability: 2.4.0 support for geography was introduced. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 8.1.4, 9.5.5

- ST_ChangeEdgeGeom - 지형 구조를 건드리는 일
없이 경계선의 형상을 변경합니&#
설명 지형 구조를 건드리는 일 없&
경계선의 형상을 변경합니다. If any arguments are null, the given edge does not exist in the edge table of the topology schema, the acurve is not a LINESTRING, or the modification would change the underlying topology then an error is thrown. acurve 도형과
지형의 공간 참조 시스템(SRID)이 다&#x
경우 예외가 발생합니다. 새 acurve 가
단순 도형이 아닐 경우, 오류가 발
예전 위치에서 새 위치로 경계선&
이동시킬 때 장애물에 부딪히는
경우 오류가 발생합니다. 1.1.0 버전&#xb
사용할 수 있습니다. 개선 사항:
2.0.0버전부터 지형의 일관성을 강&#xc8
This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details X.3.6

- ST_Contains - Tests if every point of B lies in A, and their interiors have a point in common Description Returns TRUE if geometry A contains geometry B. A contains B if and only if all points of B lie inside (i.e. in the interior or boundary of) A (or equivalently, no points of B lie in the exterior of A), and the interiors of A and B have at least one point in common. In mathematical terms: ST_Contains(A, B) $\Leftrightarrow$ (A $\bigcap$ B = B) $\wedge$ (Int(A) $\bigcap$ Int(B) $\neq \varnothing$) The contains relationship is reflexive: every geometry contains itself. (In contrast, in the predicate a geometry does not properly contain itself.) The relationship is antisymmetric: if ST_Contains(A,B) = true and ST_Contains(B,A) = true, then the two geometries must be topologically equal (ST_Equals(A,B) = true). ST_Contains is the converse of . So, ST_Contains(A,B) = ST_Within(B,A). Because the interiors must have a common point, a subtlety of the definition is that polygons and lines do not contain lines and points lying fully in their boundary. For further details see Subtleties of OGC Covers, Contains, Within. The predicate provides a more inclusive relationship. This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function _ST_Contains. Performed by the GEOS module Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon. Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Do not use this function with invalid geometries. You will get unexpected results. NOTE: this is the "allowable" version that returns a boolean, not an integer. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 - same as within(geometry B, geometry A) This method implements the SQL/MM specification. SQL-MM 3: 5.1.31

- ST_ConvexHull - Computes the convex hull of a geometry. 설명 Computes the convex hull of a geometry. The convex hull is the smallest convex geometry that encloses all geometries in the input. One can think of the convex hull as the geometry obtained by wrapping an rubber band around a set of geometries. This is different from a concave hull which is analogous to "shrink-wrapping" the geometries. A convex hull is often used to determine an affected area based on a set of point observations. In the general case the convex hull is a Polygon. The convex hull of two or more collinear points is a two-point LineString. The convex hull of one or more identical points is a Point. This is not an aggregate function. To compute the convex hull of a set of geometries, use to aggregate them into a geometry collection (e.g. ST_ConvexHull(ST_Collect(geom)). GEOS 모듈로 실행 This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.16 This function supports 3d and will not drop the z-index.

- ST_CoordDim - ST_Geometry 값의 좌표 차원을 반환합
설명 ST_Geometry 값의 좌표 차원을 반환&#xd5

이 함수는 MM을 준수하는, 와 동일&#x
함수합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 5.1.3 This method supports Circular Strings and Curves. This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_CreateTopoGeo - 텅 빈 입력 지형에 도형들&#xc758
집합을 추가한 다음 작업 성공 여&
상세하게 설명하는 메시지를 반&
설명 텅 빈 입력 지형에 도형들의
집합을 추가한 다음 작업 성공 여&
상세하게 설명하는 메시지를 반&
텅 빈 지형을 채우는 데 유용합니
2.0 버전부터 사용할 수 있습니다.
This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details -- X.3.18

- ST_Crosses - Tests if two geometries have some, but not all, interior points in common Description Compares two geometry objects and returns true if their intersection "spatially crosses"; that is, the geometries have some, but not all interior points in common. The intersection of the interiors of the geometries must be non-empty and must have dimension less than the maximum dimension of the two input geometries, and the intersection of the two geometries must not equal either geometry. Otherwise, it returns false. The crosses relation is symmetric and irreflexive. In mathematical terms: ST_Crosses(A, B) $\Leftrightarrow$ (dim(Int(A) $\bigcap$ Int(B)) < max(dim(Int(A)), dim(Int(B)))) $\wedge$ (A $\bigcap$ B $\neq$ A) $\wedge$ (A $\bigcap$ B $\neq$ B) Geometries cross if their DE-9IM Intersection Matrix matches: T*T****** for Point/Line, Point/Area, and Line/Area situations T*****T** for Line/Point, Area/Point, and Area/Line situations 0******** for Line/Line situations the result is false for Point/Point and Area/Area situations The OpenGIS Simple Features Specification defines this predicate only for Point/Line, Point/Area, Line/Line, and Line/Area situations. JTS / GEOS extends the definition to apply to Line/Point, Area/Point and Area/Line situations as well. This makes the relation symmetric. This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.13.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.29

- ST_CurveToLine - Converts a geometry containing curves to a linear geometry. 설명 Converts a CIRCULAR STRING to regular LINESTRING or CURVEPOLYGON to POLYGON or MULTISURFACE to MULTIPOLYGON. Useful for outputting to devices that can't support CIRCULARSTRING geometry types Converts a given geometry to a linear geometry. Each curved geometry or segment is converted into a linear approximation using the given `tolerance` and options (32 segments per quadrant and no options by default). The 'tolerance_type' argument determines interpretation of the `tolerance` argument. It can take the following values: 0 (default): Tolerance is max segments per quadrant. 1: Tolerance is max-deviation of line from curve, in source units. 2: Tolerance is max-angle, in radians, between generating radii. The 'flags' argument is a bitfield. 0 by default. Supported bits are: 1: Symmetric (orientation idependent) output. 2: Retain angle, avoids reducing angles (segment lengths) when producing symmetric output. Has no effect when Symmetric flag is off. Availability: 1.3.0 Enhanced: 2.4.0 added support for max-deviation and max-angle tolerance, and for symmetric output. Enhanced: 3.0.0 implemented a minimum number of segments per linearized arc to prevent topological collapse. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 7.1.7 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves.

- ST_Difference - Computes a geometry representing the part of geometry A that does not intersect geometry B. Description Returns a geometry representing the part of geometry A that does not intersect geometry B. This is equivalent to A - ST_Intersection(A,B). If A is completely contained in B then an empty atomic geometry of appropriate type is returned. This is the only overlay function where input order matters. ST_Difference(A, B) always returns a portion of A. If the optional gridSize argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher) Performed by the GEOS module Enhanced: 3.1.0 accept a gridSize parameter. Requires GEOS >= 3.9.0 to use the gridSize parameter. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.20 This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

- ST_Dimension - ST_Geometry 값의 좌표 차원을 반환합
설명 좌표 차원과 동등하거나 낮&
하는, 해당 도형 객체의 내재된 차

반환합니다. OGC 사양서 s2.1.1.1 단원을 보면 POINT 는 0, LINESTRING 은 1, POLYGON 은 2, 그리고 GEOMETRYCOLLECTION 의 경우 구성 요소 가운데 가장 높은 차원입니다. 알려지지 않은 (텅 빈) 도형인 경우 null을 반환&#x This method implements the SQL/MM specification. SQL-MM 3: 5.1.2 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface) 및 TIN&#xc7 지원합니다. 빈 도형이 주어져도 더 이상 예외가 발생하지 않습니& 2.0.0 미만 버전에서는 빈 도형에 대&#xd 예외를 발생시켰습니다. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_Disjoint - Tests if two geometries have no points in common Description Returns true if two geometries are disjoint. Geometries are disjoint if they have no point in common. If any other spatial relationship is true for a pair of geometries, they are not disjoint. Disjoint implies that is false. In mathematical terms: ST_Disjoint(A, B) $\Leftrightarrow$ A $\bigcap$ B = $\varnothing$ Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Performed by the GEOS module This function call does not use indexes. A negated predicate can be used as a more performant alternative that uses indexes: ST_Disjoint(A,B) = NOT ST_Intersects(A,B) NOTE: this is the "allowable" version that returns a boolean, not an integer. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 //s2.1.13.3 - a.Relate(b, 'FF*FF****') This method implements the SQL/MM specification. SQL-MM 3: 5.1.26

- ST_Distance - 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다. 설명 도형 유 대해, 두 도형 사이의 3차원 데카&#xb974 최단 거리를 두 도형의 투영 단위(단위)로 반환합니다. For types defaults to return the minimum geodesic distance between two geographies in meters, compute on the spheroid determined by the SRID. If use_spheroid is false, a faster spherical calculation is used. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 5.1.23 This method supports Circular Strings and Curves. 1.5.0 버전부터 지리형을 지원합&#x 대용량 또는 수많은 꼭짓점을 가&# 도형을 더 잘 처리하기 위해 평면 대한 속도를 향상시켰습니다. 개& 사항: 2.1.0 버전부터 지리형에 대한 속도가 향상됐습니다. 자세한 내& Making Geography faster 를 참조하십시오. 개선 사&#xd 2.1.0 버전부터 만곡 도형을 지원하&#xae 시작했습니다. 개선 사항: 2.2.0 버전&#x 회전타원체 측정시 정확도와 강& 향상시키기 위해 GeographicLib을 이용합&#xb2 이 새 기능의 장점을 취하려면 Proj 4.9.0 이상 버전이 필요합니다. Changed: 3.0.0 - does not depend on SFCGAL anymore.

- ST_EndPoint - ST_LineString 또는 ST_CircularString 값에 있는 포인& 개수를 반환합니다. 설명 LINESTRING 또&#xb CIRCULARLINESTRING 도형의 첫 번째 포인트를 POINT로 반환합니다. 입력 파라미터&# LINESTRING 또는 CIRCULARLINESTRING 이 아닐 경우 NULL 을 반환합니다. This method implements the SQL/MM specification. SQL-MM 3: 7.1.4 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves. 변경 사항: 2.0.0 버전부터 단일 도형 멀티라인스트링을 지원하지 않&# PostGIS 예전 버전이라면 단일 라인 멀&# 입력받는 경우 시작점을 반환했& 겁니다. 2.0.0 버전은 다른 모든 멀티&#xb NULL을 반환할 뿐입니다. 구식 습성&#x

문서화되지 않은 기능이지만, 사&
데이터를 라인스트링으로 저장&
가정한 사용자의 경우 현재 2.0 버&#xc80
NULL이 반환될 수도 있습니다.

- ST_Envelope - 주어진 도형의 이중 정밀도(doubl
precision; float8) 경계 상자를 표현하는 도형&#x
반환합니다. 설명 주어진 도형에
대해 float8 형 최소치 경계 상자를 도&#x
반환합니다. 해당 폴리곤은 경계
상자의 꼭짓점 포인트들로 정의&
MINY), (MINX, MAXY), (MAXX, MAXY), (MAXX, MINY), (MINX, MINY)). (PostGIS는 ZMIN/ZMAX 좌&#xd4
추가할 것입니다.) 차원이 낮은 (&#xc218
라인, 포인트) 경우 POLYGON 보다 낮은
차원의, 예를 들어 POINT 또는 LINESTRING 도&#xd6
반환할 것입니다. 1.5.0 버전부터 사&#xc
수 있으며, float4 형 대신 이중 정밀도
형으로 출력하도록 변경되었습&
This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.19

- ST_Equals - Tests if two geometries include the same set of points Description Returns true if the given geometries are "topologically equal". Use this for a 'better' answer than '='. Topological equality means that the geometries have the same dimension, and their point-sets occupy the same space. This means that the order of vertices may be different in topologically equal geometries. To verify the order of points is consistent use (it must be noted ST_OrderingEquals is a little more stringent than simply verifying order of points are the same). In mathematical terms: ST_Equals(A, B) ⇔ A = B The following relation holds: ST_Equals(A, B) ⇔ ST_Within(A,B) ∧ ST_Within(B,A) Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 This method implements the SQL/MM specification. SQL-MM 3: 5.1.24 Changed: 2.2.0 Returns true even for invalid geometries if they are binary equal

- ST_ExteriorRing - 폴리곤 도형의 내곽 고리의
개수를 반환합니다. 설명 POLYGON 도&#xd61
외곽 고리(exterior ring)를 표현하는 라인&#xc2a
반환합니다. 도형이 폴리곤이 아&
경우 NULL을 반환합니다. 이 함수는
멀티폴리곤을 입력받지 못 합니&
멀티폴리곤의 경우 ST_Dump 함수와 결&
이용하십시오. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 2.1.5.1 This method implements the SQL/MM specification. SQL-MM 3: 8.2.3, 8.3.3 This function supports 3d and will not drop the z-index.

- ST_GMLToSQL - GML로부터 지정된 ST_Geometry 값을 반&
이 함수는 ST_GeomFromGML 함수와 동일합&#xb2c8
설명 This method implements the SQL/MM specification. SQL-MM 3: 5.1.50 (만곡 도&#xd615
지원 제외) 1.5 버전부터 사용할 수
있습니다. LibXML2 1.6 이상 버전이 필요&#xd5
개선 사항: 2.0.0 버전부터 다면체 표&#x
surface) 및 TIN을 지원합니다. 개선 사항:
2.0.0 버전에서 선택적인 기본 SRID 파라
추가됐습니다.

- ST_GeomCollFromText - Makes a collection Geometry from collection WKT with the given SRID. If SRID is not given, it defaults to 0. 설명 Makes a collection Geometry from the Well-Known-Text (WKT) representation with the given SRID. If SRID is not given, it defaults to 0. OGC 사양 3.2.6.2 - 선택적인
SRID를 적합성 스위트(conformance suite)로부터
가져오십시오. WKT가 도형 집합(GEOMETRY
아닌 경우 null을 반환합니다. 사용&#xc7
WKT 도형이 모두 집합이라고 확신&#xd

이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단거치므로 ST_GeomFromText보다 느립니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification.

- ST_GeomFromText - WKT 표현식으로부터 지정된 ST_Geometry 값을 반환합니다. 설명 OGC WKT(Well-Known Text) 표현식으로부터 PostGIS ST_Geometry 객체&#xb 작성합니다. ST_GeomFromText 함수의 변종이 2개 있는데, 첫 번째는 SRID를 입력받&# 않고 공간 참조 시스템이 정의되&# 않은(SRID=0) 도형을 반환합니다. 두 번 SRID를 두 번째 인수로 입력받아 해&#x SRID를 자체 메타데이터의 일부로 포함하는 도형을 반환합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오. This method implements the SQL/MM specification. SQL-MM 3: 5.1.40 This method supports Circular Strings and Curves. While not OGC-compliant, is faster than ST_GeomFromText and ST_PointFromText. It is also easier to use for numeric coordinate values. is another option similar in speed to and is OGC-compliant, but doesn't support anything but 2D points. 변경 사항: PostGIS 2.0.0 미만 버전에서는 ST_GeomFromText('GEOMETRYCOLLECTI 를 사용할 수 있었습니다. PostGIS 2.0.0 버&#xc8 SQL/MM 표준을 더 잘 준수하기 위해 이런 사용법은 금지됐습니다. 이& ST_GeomFromText('GEOMETRYCOLLECTION EMPTY') 라고 작성해야 합
- ST_GeomFromWKB - WKB(Well-Known Binary) 도형 표현식과 선택& SRID로부터 도형 인스턴스를 생성&#xd 설명 ST_GeogFromWKB 함수는 도형의 WKB 표현&# SRID(공간 참조 시스템 ID)를 받아 적절& 도형 유형의 인스턴스를 생성합& 이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다. 이 함수는 ST_WKBToSQL 함수를 대체할 수 있습니다. SRID를 설정하지 않은 경우, 기본값으로 0(unkown)을 씁니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.7.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시&# This method implements the SQL/MM specification. SQL-MM 3: 5.1.41 This method supports Circular Strings and Curves.
- ST_GeometryFromText - WKT(Well-Known Text)로부터 지정된 ST_Geometry 값을 반환합니다. 이 함수는 ST_GeomFromText 함수와 동일합니다. 설명 This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 5.1.40
- ST_GeometryN - ST_Geometry 값의 도형 유형을 반환&#xd569 설명 입력 도형이 도형 집합, (멀&#xd2f0 (멀티)라인스트링, 멀티커브(multicurve) &#xb61 (멀티)폴리곤이나 다면체 표면일 경우 1-기반 N번째 도형을 반환하&#xba7 그 외의 경우 NULL을 반환합니다. 0.8.0 버전부터 인덱스는 OGC 사양을 따&#xb 1-기반입니다. 예전 버전은 대신 0-기반 인덱스를 시행했습니다. &#xbaa8 도형들을 추출하고자 한다면 ST_Dump

함수가 더 효율적이며, 단일 도형
대해서도 작동할 것입니다. 개선
사항: 2.0.0 버전부터 다면체 표면, 삼&#x
및 TIN을 지원하기 시작했습니다.
변경 사항: 2.0.0 미만 버전은 단일 도&#xc
대해 NULL을 반환했을 겁니다. 2.0.0 버&#xc80
ST_GeometryN(..,1) 경우에 대한 도형을 반환하
변경됐습니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 9.1.5 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_GeometryType - ST_Geometry 값의 도형 유형을 반환&#xd
설명 도형의 유형을 'ST_LineString', 'ST_Polygon', 'ST_MultiPolygon
등과 같은 스트링으로 반환합니&#
이 함수는 도형의 단위가 설정돼
있는지 알려주지 않는 것은 물론,
반환된 결과물이 스트링이며 접&#
ST가 달린다는 점에서도 GeometryType(geometry) 함&
다릅니다. 개선 사항: 2.0.0 버전부터
다면체 표면(polyhedral surface)을 지원합니다.
This method implements the SQL/MM specification. SQL-MM 3: 5.1.4 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces.

- ST_GetFaceEdges - aface 의 경계를 이루는 정렬된
경계선들의 집합을 반환합니다.
설명 aface 의 경계를 이루는 정렬된
경계선들의 집합을 반환합니다.
각 출력물은 순차(sequence) 및 경계선 ID(edgeid)
이루어집니다. 순차 번호는 1부&#xd130
시작합니다. 각 고리의 경계선을
가장 작은 식별자를 가진 경계선&
열거합니다. 경계선의 순서는 왼&
법칙을 따릅니다(각 경계선의 왼&
방향으로 표면의 경계선을 구성&
됩니다). 2.0 버전부터 사용할 수 있&#xc
This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.5

- ST_GetFaceGeometry - 입력 지형으로부터 설정&#xb41
표면 ID를 가진 폴리곤을 반환합&#xb2c8
설명 입력 지형으로부터 설정된
표면 ID를 가진 폴리곤을 반환합&#xb2c8
표면을 구성하는 경계선들로부&
폴리곤을 빌드합니다. Availability: 1.1 This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.16

- ST_InitTopoGeo - Creates a new topology schema and registers it in the topology.topology table. 설명 This is the SQL-MM equivalent of . It lacks options for spatial reference system and tolerance. it returns a text description of the topology creation, instead of the topology id. Availability: 1.1 This method implements the SQL/MM specification. SQL-MM 3 Topo-Geo and Topo-Net 3: Routine Details: X.3.17

- ST_InteriorRingN - 폴리곤 도형의 내곽 고리의
개수를 반환합니다. 설명 폴리곤
도형의 N번째 내곽 라인스트링 고
반환합니다. 도형이 폴리곤이 아&
주어진 N이 범위(range)를 벗어난 경우
NULL을 반환합니다. 이 함수는 멀티&#
입력받지 못 합니다. 멀티폴리곤&
경우 ST_Dump 함수와 결합해서 이용하&

This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 8.2.6, 8.3.5 This function supports 3d and will not drop the z-index.

- ST_Intersection - Computes a geometry representing the shared portion of geometries A and B. Description Returns a geometry representing the point-set intersection of two geometries. In other words, that portion of geometry A and geometry B that is shared between the two geometries. If the geometries have no points in common (i.e. are disjoint) then an empty atomic geometry of appropriate type is returned. If the optional gridSize argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher) ST_Intersection in conjunction with is useful for clipping geometries such as in bounding box, buffer, or region queries where you only require the portion of a geometry that is inside a country or region of interest. For geography this is a thin wrapper around the geometry implementation. It first determines the best SRID that fits the bounding box of the 2 geography objects (if geography objects are within one half zone UTM but not same UTM will pick one of those) (favoring UTM or Lambert Azimuthal Equal Area (LAEA) north/south pole, and falling back on mercator in worst case scenario) and then intersection in that best fit planar spatial ref and retransforms back to WGS84 geography. This function will drop the M coordinate values if present. If working with 3D geometries, you may want to use SFGCAL based which does a proper 3D intersection for 3D geometries. Although this function works with Z-coordinate, it does an averaging of Z-Coordinate. Performed by the GEOS module Enhanced: 3.1.0 accept a gridSize parameter Requires GEOS >= 3.9.0 to use the gridSize parameter Changed: 3.0.0 does not depend on SFCGAL. Availability: 1.5 support for geography data type was introduced. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.18 This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

- ST_Intersects - Tests if two geometries intersect (they have at least one point in common) Description Returns true if two geometries intersect. Geometries intersect if they have any point in common. For geography, a distance tolerance of 0.00001 meters is used (so points that are very close are considered to intersect). In mathematical terms: ST_Intersects(A, B) $\Leftrightarrow$ A $\bigcap$ B $\neq \varnothing$ Geometries intersect if their DE-9IM Intersection Matrix matches one of: T******** *T******* ***T***** ****T**** Spatial intersection is implied by all the other spatial relationship tests, except , which tests that geometries do NOT intersect. This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. Changed: 3.0.0 SFCGAL version removed and native support for 2D TINS added. Enhanced: 2.5.0 Supports GEOMETRYCOLLECTION. Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon. Performed by the GEOS module (for geometry), geography is native Availability: 1.5 support for geography was introduced. For geography, this function has a distance tolerance of about 0.00001 meters and uses the sphere rather than spheroid calculation. NOTE: this is the "allowable" version that returns a boolean, not an integer. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 //s2.1.13.3 - ST_Intersects(g1, g2) --> Not (ST_Disjoint(g1, g2)) This method implements the SQL/MM specification. SQL-MM 3: 5.1.27 This method supports Circular Strings and Curves. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_IsClosed - LINESTRING 의 시작점과 종단점이 일&#
경우 TRUE 를 반환합니다. 다면체 표&#
닫혀 (부피를 가지고) 있는 경우
TRUE 를 반환합니다. 설명 LINESTRING 의 시&#xc79
종단점이 일치하는 경우 TRUE 를 반&#x
다면체 표면의 경우, 다면체 표면&
면적(열림)을 가지고 있는지 부피(
가지고 있는지 알려줍니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 7.1.5, 9.3.3 SQL-MM은 ST_IsClosed(NULL) 의 결과를 0으로 정의하지만, PostGIS는 NULL 을 반환&#x
This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves. 개선
사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. This function supports Polyhedral surfaces.

- ST_IsEmpty - Tests if a geometry is empty. 설명 해당 도형이 텅
빈 도형인 경우 TRUE 를 반환합니다.
TRUE 인 경우, 해당 도형이 텅 빈 도형
집합, 폴리곤, 포인트 등을 표현한
뜻입니다. SQL-MM은 ST_IsEmpty(NULL) 의 결과를

0으로 정의하지만, PostGIS는 NULL 을 반환&#x This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.7 This method supports Circular Strings and Curves. 변경 사항: PostGIS 2.0.0 미만 버전에서는 ST_GeomFromText('GEO 를 사용할 수 있었습니다. PostGIS 2.0.0 버&#xc8 SQL/MM 표준을 더 잘 준수하기 위해 이런 사용법은 금지됐습니다.

- ST_IsRing - Tests if a LineString is closed and simple. 설명 해당 LINESTRING 이 (ST_StartPoint(g) ~= ST_Endpoint(g)) 인 동시에 인 (자체 교차하않는) 경우 TRUE 를 반환합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 2.1.5.1 This method implements the SQL/MM specification. SQL-MM 3: 7.1.6 SQL-MM은 ST_IsRing(NULL) 의 결과를 0으&#xb85c 정의하지만, PostGIS는 NULL 을 반환합니&#x

- ST_IsSimple - 해당 도형이 자체 교차하거&#xb0 자체 접촉하는 이례적인 도형 포 가지고 있지 않을 경우 TRUE 를 반환&#x 설명 해당 도형이 자체 교차하거& 자체 접촉하는 이례적인 도형 포 가지고 있지 않을 경우 TRUE 를 반환&#x 도형 단순성 및 유효성에 대한 OGC&#xc 정의를 더 자세히 알고 싶다면, "OpenGIS 도형 준수성 확인(Ensuring OpenGIS compliancy of geometries)" 을 참조하십시오. SQL-MM은 ST_IsSimple(NULL) 의 결과 0으로 정의하지만, PostGIS는 NULL 을 반환&#x This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.8 This function supports 3d and will not drop the z-index.

- ST_IsValid - Tests if a geometry is well-formed in 2D. Description Tests if an ST_Geometry value is well-formed and valid in 2D according to the OGC rules. For geometries with 3 and 4 dimensions, the validity is still only tested in 2 dimensions. For geometries that are invalid, a PostgreSQL NOTICE is emitted providing details of why it is not valid. For the version with the flags parameter, supported values are documented in This version does not print a NOTICE explaining invalidity. For more information on the definition of geometry validity, refer to SQL-MM defines the result of ST_IsValid(NULL) to be 0, while PostGIS returns NULL. Performed by the GEOS module. The version accepting flags is available starting with 2.0.0. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 5.1.9 Neither OGC-SFS nor SQL-MM specifications include a flag argument for ST_IsValid. The flag is a PostGIS extension.

- ST_Length - 도형의 기하학적 중심을 반&#xd65 설명 도형의 경우: 도형이 라인스 멀티라인스트링, ST_Curve, ST_MultiCurve일 경우 도형의 2차원 데카르트 길이를 &#xbc18 면 도형의 경우 0을 반환합니다. 면 도형에 대해서는 를 이용하십 도형 유형의 경우, 도형의 공간 참 시스템이 해당 길이의 측정 단위& 설정합니다. For geography types: computation is performed using the inverse geodesic calculation. Units of length are in meters. If PostGIS is compiled with PROJ version 4.8.0 or later, the spheroid is specified by the SRID, otherwise it is exclusive to WGS84. If use_spheroid = false, then the calculation is based on a sphere instead of a spheroid. 도형의 경우 이 함수는 현재 ST_Length2D와 동일하지만, 향후 더 높은 차원을 지원하기 위해 변경될 수& 있습니다. 변경 사항: 2.0.0 버전에서 중요한 변경이 이루어졌습니다. 2.0.0 이전 버전에서 이 함수에 폴리&#xa 유형의 지리형을 입력하면 폴리& 둘레를 반환했을 겁니다. 2.0.0 버전&#x

도형 습성과 맞추기 위해 0을 반환
변경됐습니다. 폴리곤의 둘레를
원한다면 ST_Perimeter 함수를 이용하십&#xc2d
지리형 측정시 기본값은 회전타&#
상의 측정입니다. 더 빠르지만 덜
정확한 구체를 이용하려면 ST_Length(gg,false);
를 쓰십시오. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.5.1 This method implements the SQL/MM specification. SQL-MM 3: 7.1.2, 9.3.4 1.5.0 버전&
지리형을 지원합니다.

- ST_LineFromText - 주어진 SRID와 함께 WKT 표현식으
도형을 만듭니다. SRID가 주어지지
않은 경우, 기본값인 0을 씁니다.
설명 Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. If WKT passed in is not a LINESTRING, then null is returned. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터
가져오십시오. 사용자 도형이 모&
라인스트링이란 걸 알고 있다면,
그냥 ST_GeomFromText 함수를 쓰는 편이 더
효율적입니다. 이 함수는 ST_GeomFromText만
호출하고, 라인스트링을 반환한&
유효성 검사를 추가합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 7.2.8

- ST_LineFromWKB - 주어진 SRID와 함께 WKB로부터
LINESTRING 을 만듭니다. 설명 ST_LineFromWKB 함수&#x
도형의 WKB 표현식과 SRID(공간 참조
시스템 ID)를 받아 적절한 도형 유&#xd6
인스턴스 - 이 경우, LINESTRING 도형 - 를 생&
이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다. SRID를 설정하지
않은 경우, 기본값인 0을 씁니다.
입력된 bytea가 라인스트링이 아닌
경우, NULL을 반환합니다. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오. 사용자 도형이 모두 LINESTRING이란 걸 알고 있&#xb
그냥 함수를 쓰는 편이 더 효율적&
이 함수는 만 호출하고, 라인스트&
반환한다는 유효성 검사를 추가&
This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 7.2.9

- ST_LinestringFromWKB - 주어진 SRID와 함께 WKB로부터
도형을 만듭니다. 설명 ST_LinestringFromWKB 함&#x
도형의 WKB 표현식과 SRID(공간 참조
시스템 ID)를 받아 적절한 도형 유&#xd6
인스턴스 - 이 경우, LINESTRING 도형 - 를 생&
이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다. SRID를 설정하지
않은 경우, 기본값인 0을 씁니다.
입력된 bytea가 LINESTRING 도형이 아닌 경우,
NULL을 반환합니다. OGC 사양 3.2.6.2 - 선택&#xc801
SRID를 적합성 스위트(conformance suite)로부터
가져오십시오. 사용자 도형이 모&
LINESTRING이란 걸 알고 있다면, 그냥 함&#xc
쓰는 편이 더 효율적입니다. 이

함수는 만 호출하고, LINESTRING을 반환&#xd
유효성 검사를 추가합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 7.2.9

- ST_LocateAlong - Returns the point(s) on a geometry that match a measure value. 설명 Returns the location(s) along a measured geometry that have the given measure values. The result is a Point or MultiPoint. Polygonal inputs are not supported. If offset is provided, the result is offset to the left or right of the input line by the specified distance. A positive offset will be to the left, and a negative one to the right. Use this function only for linear geometries with an M component The semantic is specified by the ISO/IEC 13249-3 SQL/MM Spatial standard. 1.1.0 버전부터 예전 명칭인 ST_Locate_Along_Measure로 사용할 수 있습니다. 변경 사항: 2.0.0 미만 버전&#x ST_Locate_Along_Measure라는 명칭이었습니다. 예&# 명칭은 더 지원되지 않고 곧 삭제& 예정이지만, 아직은 사용할 수 있& This function supports M coordinates. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1.13

- ST_LocateBetween - Returns the portions of a geometry that match a measure range. 설명 설정&#xd55 척도와 일치하는 요소들을 가진 파생 도형 집합의 값을 반환합니& 폴리곤 구성 요소는 지원되지 않& 오프셋을 설정할 경우, 그 결과 입& 라인에서 설정한 단위 개수만큼 왼쪽 또는 오른쪽에 오프셋 도형 집합을 출력할 것입니다. 양의 오 왼쪽, 음의 오프셋은 오른쪽으로 출력할 것입니다. Clipping a non-convex POLYGON may produce invalid geometry. The semantic is specified by the ISO/IEC 13249-3 SQL/MM Spatial standard. 1.1.0 버전부&#x 예전 명칭인 ST_Locate_Between_Measures로 사용할 &#xc218 있습니다. 변경 사항: 2.0.0 미만 버전&#x ST_Locate_Along_Measure라는 명칭이었습니다. 예&# 명칭은 더 지원되지 않고 곧 삭제& 예정이지만, 아직은 사용할 수 있& Enhanced: 3.0.0 - added support for POLYGON, TIN, TRIANGLE. This function supports M coordinates. This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 5.1

- ST_M - Returns the M coordinate of a Point. 설명 포인트의 M 좌표&#xb 반환합니다. M 좌표가 없는 경우 NULL을 반환합니다. 포인트만 입력&#x 수 있습니다. 이 함수는 (아직) OGC 사& 들어가지 않지만, 포인트 좌표 추& 함수 목록을 완성하기 위해 이 문 작성됐습니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. This function supports 3d and will not drop the z-index.

- ST_MLineFromText - WKT 표현식으로부터 지정된 ST_MultiLineString 값을 반환합니다. 설명 Makes a Geometry from Well-Known-Text (WKT) with the given SRID. If SRID is not given, it defaults to 0. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(confo suite)로부터 가져오십시오. WKT가 멀티 아닌 경우 null을 반환합니다. 사용&#xc7 WKT 도형이 모두 포인트라고 확신&#xd 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단 거치므로 ST_GeomFromText보다 느립니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 9.4.4

- ST_MPointFromText - Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. 설명 Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시오. WKT가 멀티아닌 경우 null을 반환합니다. 사용&#xc7 WKT 도형이 모두 포인트라고 확신&#xd 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단& 거치므로 ST_GeomFromText보다 느립니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 9.2.4
- ST_MPolyFromText - Makes a MultiPolygon Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. 설명 Makes a MultiPolygon from WKT with the given SRID. If SRID is not given, it defaults to 0. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시&# WKT가 멀티폴리곤이 아닌 경우 오&#xb9 발생합니다. 사용자 WKT 도형이 모&#xb 멀티폴리곤이라고 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유효성 검사 단& 거치므로 ST_GeomFromText보다 느립니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 9.6.4
- ST_ModEdgeHeal - Heals two edges by deleting the node connecting them, modifying the first edge and deleting the second edge. Returns the id of the deleted node. 설명 Heals two edges by deleting the node connecting them, modifying the first edge and deleting the second edge. Returns the id of the deleted node. Updates all existing joined edges and relationships accordingly. 2.0 버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9
- ST_ModEdgeSplit - 기존 경계선을 따라 새 노드& 추가한 다음, 원본 경계선을 수정& 새 경계선을 추가해서 경계선을 분할합니다. 설명 기존 경계선을 따라 새 노드를 추가한 다음, 원본 경계선을 수정하고 새 경계선을 추가해서 경계선을 분할합니다. 기존의 모든 결합된 경계선들 및 관계성을 새로이 분할된 경계선& 맞춰 업데이트합니다. 새로 추가& 노드의 식별자를 반환합니다. Availability: 1.1 변경 사항: 2.0 미만 버전에서, 이 함수는 ST_ModEdgesSplit이라는 잘못된 명칭& This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9
- ST_MoveIsoNode - Moves an isolated node in a topology from one point to another. If new apoint geometry exists as a node an error is thrown. Returns description of move. 설명 지형 안에 있는 고립된 노드를 어떤 위치에서 다& 위치로 이동합니다. 새 apoint 도형의 위치에 노드가 존재할 경우 오류& 발생합니다. If any arguments are null, the apoint is not a point, the existing node is not isolated (is a start or end point of an existing edge), new node location intersects an existing edge (even at the end points) or the new location is in a different face (since 3.2.0) then an exception is thrown. 포인트 도형과 지형의 공간 참조 시스템(Sl 다를 경우 예외가 발생합니다. 2.0.0 버전부터 사용할 수 있습니다. En-

hanced: 3.2.0 ensures the nod cannot be moved in a different face This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X.3.2

- ST_NewEdgeHeal - Heals two edges by deleting the node connecting them, deleting both edges, and replacing them with an edge whose direction is the same as the first edge provided. 설명 Heals two edges by deleting the node connecting them, deleting both edges, and replacing them with an edge whose direction is the same as the first edge provided. Returns the id of the new edge replacing the healed ones. Updates all existing joined edges and relationships accordingly. 2.0 버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.9

- ST_NewEdgesSplit - 기존 경계선을 따라 새 노드
추가한 다음, 원본 경계선을 삭제&
새 경계선 2개로 교체해서 경계선&
분할합니다. 새 경계선들을 결합&
새로 생성된 노드의 ID를 반환합&#xb2c
설명 기존 경계선을 따라 apoint 포인&#x
위치에 새 노드를 생성한 다음, 다
원본 경계선을 삭제하고 새 경계&#
2개로 교체해서 경계선 ID anedge 인 경계
분할합니다. 새 경계선들을 결합&
새로 생성된 노드의 ID를 반환합&#xb2c
기존의 모든 결합된 경계선들 및
관계성을 분할된 경계선에 맞춰
업데이트합니다. 포인트 도형과
지형의 공간 참조 시스템(SRID)이 다&#x
경우, apoint 가 포인트 도형이 아닐 경&#
포인트가 NULL일 경우, 해당 포인트&#x
위치에 이미 노드가 존재할 경우,
경계선이 기존 경계선과 일치하&#
않을 경우, 또는 포인트가 경계선
안에 있지 않을 경우 예외가 발생&
Availability: 1.1 This method implements the SQL/MM specification. SQL-MM: Topo-Net Routines: X.3.8

- ST_NumGeometries - 도형이 가지고 있는 포인&#xd2b8
개수를 반환합니다. 모든 도형을
입력받을 수 있습니다. 설명 도형
개수를 반환합니다. 도형 집합 또
멀티 도형인 경우 도형의 개수를,
단일 도형인 경우 1을 반환하고,
도형 집합도 멀티 도형도 단일 도
아닌 경우 NULL을 반환합니다. 개선
사항: 2.0.0 버전부터 다면체 표면, 삼&#x
및 TIN을 지원하기 시작했습니다.
변경 사항: 2.0.0 미만 버전에서 도형&#xc
집합이나 멀티 유형이 아닐 경우
NULL을 반환했습니다. 2.0.0 버전부터
폴리곤, 라인스트링, 포인트 같은
단일 도형에 대해 1을 반환합니&#xb2e4
This method implements the SQL/MM specification. SQL-MM 3: 9.1.4 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN).

- ST_NumInteriorRings - 폴리곤 도형의 내곽 고리&#xc758
개수를 반환합니다. 설명 폴리곤
도형의 내곽 고리의 개수를 반환&
도형이 폴리곤이 아닐 경우 NULL을
반환합니다. This method implements the SQL/MM specification. SQL-MM 3: 8.2.5
변경 사항: 2.0.0 미만 버전에서는 멀&#xd

입력하면 첫 번째 폴리곤의 내곽 고리의 개수를 반환받을 수 있었&

- ST_NumPatches - 다면체 표면 상에 있는 면의 개수를 반환합니다. 다면체 도형& 아닌 경우 NULL을 반환할 것입니다. 설명 다면체 표면 상에 있는 면의 개수를 반환합니다. 다면체 도형& 아닌 경우 NULL을 반환할 것입니다. 이 함수는 ST_NumGeometries와 동일하지만 MM 명명법을 지원합니다. MM 규약을 신경 쓰지 않는다면 ST_NumGeometries가 더 빠& 2.0.0 버전부터 사용할 수 있습니다. This function supports 3d and will not drop the z-index. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.5 This function supports Polyhedral surfaces.

- ST_NumPoints - ST_LineString 또는 ST_CircularString 값에 있는 포인 개수를 반환합니다. 설명 ST_LineString 또&#xb ST_CircularString 값에 있는 포인트의 개수를 반환합니다. 1.4 미만 버전에서는 사양서대로 라인스트링만 입력&# 1.4 버전부터 이 함수는 단순히 라&#xc7 아닌, 도형의 꼭짓점의 개수를 반& ST_NPoints 함수와 비슷해졌습니다. 쿼&#xb9ac 목적이 다양하고 많은 도형 유형& 사용할 수 있는 ST_NPoints 함수를 대신 사용하는 편이 좋습니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 7.2.4

- ST_OrderingEquals - Tests if two geometries represent the same geometry and have points in the same directional order Description ST_OrderingEquals compares two geometries and returns t (TRUE) if the geometries are equal and the coordinates are in the same order; otherwise it returns f (FALSE). This function is implemented as per the ArcSDE SQL specification rather than SQL-MM. http://edndoc.esri.com/arcsde/9.1/sql_api/sqlapi3.htm#ST_OrderingEquals This method implements the SQL/MM specification. SQL-MM 3: 5.1.43

- ST_Overlaps - Tests if two geometries have the same dimension and intersect, but each has at least one point not in the other Description Returns TRUE if geometry A and B "spatially overlap". Two geometries overlap if they have the same dimension, their interiors intersect in that dimension. and each has at least one point inside the other (or equivalently, neither one covers the other). The overlaps relation is symmetric and irreflexive. In mathematical terms: ST_Overlaps(A, B) $\Leftrightarrow$ (dim(A) = dim(B) = dim(Int(A) $\bigcap$ Int(B))) $\wedge$ (A $\bigcap$ B $\neq$ A) $\wedge$ (A $\bigcap$ B $\neq$ B) This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function _ST_Overlaps. Performed by the GEOS module Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION NOTE: this is the "allowable" version that returns a boolean, not an integer. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.32

- ST_PatchN - ST_Geometry 값의 도형 유형을 반환합&# 설명 도형이 POLYHEDRALSURFACE, POLYHEDRALSURFACEM 인 경&# 1-기반 N번째 도형 (면)을 반환합니&#xb 그 외의 경우 NULL을 반환합니다. 이 함수는 다면체 표면에 대해 ST_GeometryN&#x 동일한 답을 반환합니다. ST_GeometryN을 이용하는 편이 더 빠릅니다. 인&#xb371 1-기반입니다. 모든 도형들을 추&#xcd9 한다면 ST_Dump 함수가 더 효율적입니 2.0.0 버전부터 사용할 수 있습니다.

This method implements the SQL/MM specification. SQL-MM ISO/IEC 13249-3: 8.5 This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces.

- ST_Perimeter - Returns the length of the boundary of a polygonal geometry or geography. 설명 도형/&#
ST_Surface, ST_MultiSurface(폴리곤, 멀티폴리곤)일 경&
도형/지리형의 2차원 둘레를 반&#xd658
면이 없는 도형의 경우 0을 반환&#xd569
선형 도형의 경우 를 이용하십시&
도형 유형의 경우, 도형의 공간 참
시스템이 해당 둘레의 측정 단위&
설정합니다. For geography types, the calculations are performed using the inverse geodesic problem, where perimeter units are in meters. If PostGIS is compiled with PROJ version 4.8.0 or later, the spheroid is specified by the SRID, otherwise it is exclusive to WGS84. If use_spheroid = false, then calculations will approximate a sphere instead of a spheroid. 이 함수는 현재 ST_Perimeter2D와
동일하지만, 향후 더 높은 차원을
지원하기 위해 변경될 수도 있습&
This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.5.1 This method implements the SQL/MM specification. SQL-MM 3: 8.1.3, 9.5.4 개선 사항: 2.0.0 버전&#xbd
지리형을 지원합니다.

- ST_Point - Creates a Point with X, Y and SRID values. 설명 Returns a Point with the given X and Y coordinate values. This is the SQL-MM equivalent for that takes just X and Y. For geodetic coordinates, X is longitude and Y is latitude Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry. This method implements the SQL/MM specification. SQL-MM 3: 6.1.2

- ST_PointFromText - 주어진 SRID와 함께 WKT 표현식&#xc73c
포인트 도형을 만듭니다. SRID가 주&#xc
않은 경우, 기본값인 0을 씁니다.
설명 Constructs a PostGIS ST_Geometry point object from the OGC Well-Known text representation. If SRID is not given, it defaults to unknown (currently 0). If geometry is not a WKT point representation, returns null. If completely invalid WKT, then throws an error. ST_PointFromText 함수의 변종이 2개
있는데, 첫 번째는 SRID를 입력받지
않고 공간 참조 시스템이 정의되&#
않은 도형을 반환합니다. 두 번째
SRID를 두 번째 인수로 입력받아 자&#x
메타데이터의 일부로 해당 SRID를
포함하는 ST_Geometry를 반환합니다. spatial_ref_sys
테이블에 정의되어 있는 SRID여야
합니다. 사용자 WKT 도형이 모두 포&#x
확신한다면, 이 함수를 사용하지
마십시오. 이 함수는 추가적인 유
검사 단계를 거치므로 ST_GeomFromText보다
느립니다. 사용자가 경위도 좌표&
포인트를 빌드하고 OGC 준수 여부&#xb
성능 및 정확도에 더 관심이 있다&
또는 OGC를 준수하는 동일한 함수&#x
이용하십시오. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. 사양 3.2.6.2 - 선택적인 SRID를 적&#xd5
스위트(conformance suite)로부터 가져오십시&#
This method implements the SQL/MM specification. SQL-MM 3: 6.1.8

- ST_PointFromWKB - 주어진 SRID와 함께 WKB로부터
도형을 만듭니다. 설명 ST_PointFromWKB 함&#xc218
도형의 WKB 표현식과 SRID(공간 참조
시스템 ID)를 받아 적절한 도형 유&#xd6
인스턴스 - 이 경우, POINT 도형 - 를 생&#xc131
이 함수는 SQL에서 도형 공장(Geometry Factory) 역할을 합니다. SRID를 설정하지

않은 경우, 기본값인 0을 씁니다. 입력된 bytea가 포인트가 아닌 경우, NULL을 반환합니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.7.2 This method implements the SQL/MM specification. SQL-MM 3: 6.1.9 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves.

- ST_PointN - ST_LineString 또는 ST_CircularString 값에 있는 포인&#x 개수를 반환합니다. 설명 도형 안 있는 단일 라인스트링 또는 원형 라인스트링의 N번째 포인트를 반 음수 값은 라인스트링의 종단점&# 반대로 집계되므로, -1이 마지막 포인트입니다. 도형 안에 라인스& 없는 경우 NULL을 반환합니다. 0.8.0 버&#xc80 인덱스는 OGC 사양을 따라 1-기반입&#x OGC는 반대 방향 인덱스(음수 인덱&#x 지원하지 않습니다. 예전 버전은 대신 0-기반 인덱스를 도입했습&#xb2c8 멀티라인스트링 안에 있는 각 라& N번째 포인트를 얻고자 할 경우, 이 함수를 ST_Dump 함수와 연결해서 이& This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 7.2.5, 7.3.5 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves. 변경 사항: 2.0.0 버전부터 단일 도형 멀티라인스트링을 지&# 않습니다. PostGIS 예전 버전이라면 단&# 라인 멀티라인스트링을 입력받&# 경우 시작점을 반환했을 겁니다. 2.0.0 버전은 다른 모든 멀티라인스&#xd2 NULL을 반환할 뿐입니다. 변경 사항: 2.3.0 버전부터 음수 인덱스(-1이 마지&# 포인트)를 이용할 수 있습니다.
- ST_PointOnSurface - Computes a point guaranteed to lie in a polygon, or on a geometry. 설명 Returns a POINT which is guaranteed to lie in the interior of a surface (POLYGON, MULTIPOLYGON, and CURVED POLYGON). In PostGIS this function also works on line and point geometries. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.14.2 // s3.2.18.2 This method implements the SQL/MM specification. SQL-MM 3: 8.1.5, 9.5.6. The specifications define ST_PointOnSurface for surface geometries only. PostGIS extends the function to support all common geometry types. Other databases (Oracle, DB2, ArcSDE) seem to support this function only for surfaces. SQL Server 2008 supports all common geometry types. This function supports 3d and will not drop the z-index.
- ST_Polygon - Creates a Polygon from a LineString with a specified SRID. 설명 Returns a polygon built from the given LineString and sets the spatial reference system from the srid. ST_Polygon is similar to Variant 1 with the addition of setting the SRID. , , 이 함수에 멀티라인스트링&#xc 입력할 수는 없습니다. 라인스트 생성하려면 또는 를 이용하십시& This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 8.3.2 This function supports 3d and will not drop the z-index.
- ST_PolygonFromText - Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. 설명 Makes a Geometry from WKT with the given SRID. If SRID is not given, it defaults to 0. Returns null if WKT is not a polygon. OGC 사양 3.2.6.2 - 선택적인 SRID를 적합성 스위트(conformance suite)로부터 가져오십시&# 사용자 WKT 도형이 모두 폴리곤이&#xb7 확신한다면, 이 함수를 사용하지 마십시오. 이 함수는 추가적인 유 검사 단계를 거치므로 ST_GeomFromText보다 느립니다. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s3.2.6.2 This method implements the SQL/MM specification. SQL-MM 3: 8.3.6

- ST_Relate - Tests if two geometries have a topological relationship matching an Intersection Matrix pattern, or computes their Intersection Matrix Description These functions allow testing and evaluating the spatial (topological) relationship between two geometries, as defined by the Dimensionally Extended 9-Intersection Model (DE-9IM). The DE-9IM is specified as a 9-element matrix indicating the dimension of the intersections between the Interior, Boundary and Exterior of two geometries. It is represented by a 9-character text string using the symbols 'F', '0', '1', '2' (e.g. 'FF1FF0102'). A specific kind of spatial relationship can be tested by matching the intersection matrix to an intersection matrix pattern. Patterns can include the additional symbols 'T' (meaning "intersection is non-empty") and '*' (meaning "any value"). Common spatial relationships are provided by the named functions , , , , , , , , , and . Using an explicit pattern allows testing multiple conditions of intersects, crosses, etc in one step. It also allows testing spatial relationships which do not have a named spatial relationship function. For example, the relationship "Interior-Intersects" has the DE-9IM pattern T********, which is not evaluated by any named predicate. For more information refer to . Variant 1: Tests if two geometries are spatially related according to the given intersectionMatrixPattern. Unlike most of the named spatial relationship predicates, this does NOT automatically include an index call. The reason is that some relationships are true for geometries which do NOT intersect (e.g. Disjoint). If you are using a relationship pattern that requires intersection, then include the && index call. It is better to use a named relationship function if available, since they automatically use a spatial index where one exists. Also, they may implement performance optimizations which are not available with full relate evalation. Variant 2: Returns the DE-9IM matrix string for the spatial relationship between the two input geometries. The matrix string can be tested for matching a DE-9IM pattern using . Variant 3: Like variant 2, but allows specifying a Boundary Node Rule. A boundary node rule allows finer control over whether the endpoints of MultiLineStrings are considered to lie in the DE-9IM Interior or Boundary. The boundaryNodeRule values are: 1: OGC-Mod2 - line endpoints are in the Boundary if they occur an odd number of times. This is the rule defined by the OGC SFS standard, and is the default for ST_Relate. 2: Endpoint - all endpoints are in the Boundary. 3: MultivalentEndpoint - endpoints are in the Boundary if they occur more than once. In other words, the boundary is all the "attached" or "inner" endpoints (but not the "unattached/outer" ones). 4: MonovalentEndpoint - endpoints are in the Boundary if they occur only once. In other words, the boundary is all the "unattached" or "outer" endpoints. This function is not in the OGC spec, but is implied. see s2.1.13.2 This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.25 Performed by the GEOS module Enhanced: 2.0.0 - added support for specifying boundary node rule. Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION
- ST_RemEdgeModFace - Removes an edge, and if the edge separates two faces deletes one face and modifies the other face to cover the space of both. 설명 Removes an edge, and if the removed edge separates two faces deletes one face and modifies the other face to cover the space of both. Preferentially keeps the face on the right, to be consistent with . Returns the id of the face which is preserved. 모든 기존의 결합된 경계선 및 관계성을 결과에 맞춰 업데이트합니다. Refuses to remove an edge participating in the definition of an existing TopoGeometry. Refuses to heal two faces if any TopoGeometry is defined by only one of them (and not the other). 어떤 인수가 NULL일 경우, 주어진 경계선이 알려지지 않은 경우(경&
이미 지형 스키마의 edge 테이블에
존재해야 합니다), 지형 명칭이 유
않은 경우 오류가 발생합니다. 2.0
버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.15
- ST_RemEdgeNewFace - 경계선을 제거하고, 제거&#xd5
경계선이 두 표면을 분할하고 있&
경우, 원본 표면들을 삭제하고 새
표면 하나로 대체합니다. 설명 경
제거하고, 제거한 경계선이 두 표&
분할하고 있을 경우, 원본 표면들&
삭제하고 새 표면 하나로 대체합&
새로 생성된 표면의 ID를 반환하&#xac7
또는 새 표면이 생성되지 않은 경&
NULL을 반환합니다. 제거한 경계선&#x
세계 표면에 매달려 있거나, 고립&
있거나, 또는 (세계 표면이 다른
쪽의 표면을 침범하게 할 수 있게)
갇혀 있을 경우 새 표면을 생성할
수 없습니다. 모든 기존의 결합된

경계선 및 관계성을 결과에 맞춰 업데이트합니다. Refuses to remove an edge participating in the definition of an existing TopoGeometry. Refuses to heal two faces if any TopoGeometry is defined by only one of them (and not the other). 어떤 인수가 NULL일 경우, 주어진 경계선이 알려지지 않은 경우(경&
이미 지형 스키마의 edge 테이블에 존재해야 합니다), 지형 명칭이 유
않은 경우 오류가 발생합니다. 2.0 버전부터 사용할 수 있습니다. This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X.3.14

- ST_RemoveIsoEdge - Removes an isolated edge and returns description of action. If the edge is not isolated, then an exception is thrown. 설명 Removes an isolated edge and returns description of action. If the edge is not isolated, then an exception is thrown. Availability: 1.1 This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X+1.3.3

- ST_RemoveIsoNode - 고립된 노드를 제거하고 작업 내용을 설명하는 메시지를 반환합니다. 노드가 고립되지 않&
(경계선의 시작점이나 종단점인)
경우, 예외가 발생합니다. 설명 고
노드를 제거하고 작업 내용을 설&
메시지를 반환합니다. 노드가 고&
않은 (경계선의 시작점이나 종단&
경우, 예외가 발생합니다. Availability: 1.1 This method implements the SQL/MM specification. SQL-MM: Topo-Geo and Topo-Net 3: Routine Details: X+1.3.3

- ST_SRID - Returns the spatial reference identifier for a geometry. Description Returns the spatial reference identifier for the ST_Geometry as defined in spatial_ref_sys table. spatial_ref_sys table is a table that catalogs all spatial reference systems known to PostGIS and is used for transformations from one spatial reference system to another. So verifying you have the right spatial reference system identifier is important if you plan to ever transform your geometries. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.1 This method implements the SQL/MM specification. SQL-MM 3: 5.1.5 This method supports Circular Strings and Curves.

- ST_StartPoint - Returns the first point of a LineString. 설명 LINESTRING 또는 CIRCULARLINESTRING 도형의 첫 번째 포인트를 POINT&#xb85c
반환합니다. 입력 파라미터가 LINESTR
또는 CIRCULARLINESTRING 이 아닐 경우 NULL 을 반&#xc
This method implements the SQL/MM specification. SQL-MM 3: 7.1.3 This function supports 3d and will not drop the z-index. This method supports Circular Strings and Curves. Enhanced: 3.2.0 returns a point for all geometries. Prior behavior returns NULLs if input was not a LineString. 변경 사항: 2.0.0 버전부터
단일 도형 멀티라인스트링을 지&
않습니다. PostGIS 예전 버전이라면 단&
라인 멀티라인스트링을 입력받&
경우 시작점을 반환했을 겁니다.
2.0.0 버전은 다른 모든 멀티라인스&#xd2
NULL을 반환할 뿐입니다. 구식 습성&#x
문서화되지 않은 기능이지만, 사&
데이터를 라인스트링으로 저장&
가정한 사용자의 경우 현재 2.0 버&#xc80
NULL이 반환될 수도 있습니다.

- ST_SymDifference - Computes a geometry representing the portions of geometries A and B that do not intersect. Description Returns a geometry representing the portions of geonetries A and B that do not intersect. This is equivalent to ST_Union(A,B) - ST_Intersection(A,B). It is called a symmetric difference because ST_SymDifference(A,B) = ST_SymDifference(B,A). If the optional gridSize argument is provided, the inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher) Performed by the GEOS module Enhanced: 3.1.0 accept a gridSize parameter. Requires GEOS >= 3.9.0 to use the gridSize parameter This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.21

This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

- ST_Touches - Tests if two geometries have at least one point in common, but their interiors do not intersect Description Returns TRUE if A and B intersect, but their interiors do not intersect. Equivalently, A and B have at least one point in common, and the common points lie in at least one boundary. For Point/Point inputs the relationship is always FALSE, since points do not have a boundary. In mathematical terms: ST_Touches(A, B) $\Leftrightarrow$ (Int(A) $\bigcap$ Int(B) $\neq \varnothing$) $\wedge$ (A $\bigcap$ B $\neq \varnothing$) This relationship holds if the DE-9IM Intersection Matrix for the two geometries matches one of: FT******* F**T***** F***T**** This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid using an index, use _ST_Touches instead. Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 This method implements the SQL/MM specification. SQL-MM 3: 5.1.28

- ST_Transform - Return a new geometry with coordinates transformed to a different spatial reference system. Description Returns a new geometry with its coordinates transformed to a different spatial reference system. The destination spatial reference to_srid may be identified by a valid SRID integer parameter (i.e. it must exist in the spatial_ref_sys table). Alternatively, a spatial reference defined as a PROJ.4 string can be used for to_proj and/or from_proj, however these methods are not optimized. If the destination spatial reference system is expressed with a PROJ.4 string instead of an SRID, the SRID of the output geometry will be set to zero. With the exception of functions with from_proj, input geometries must have a defined SRID. ST_Transform is often confused with . ST_Transform actually changes the coordinates of a geometry from one spatial reference system to another, while ST_SetSRID() simply changes the SRID identifier of the geometry. ST_Transform automatically selects a suitable conversion pipeline given the source and target spatial reference systems. To use a specific conversion method, use . Requires PostGIS be compiled with PROJ support. Use to confirm you have PROJ support compiled in. If using more than one transformation, it is useful to have a functional index on the commonly used transformations to take advantage of index usage. Prior to 1.3.4, this function crashes if used with geometries that contain CURVES. This is fixed in 1.3.4+ Enhanced: 2.0.0 support for Polyhedral surfaces was introduced. Enhanced: 2.3.0 support for direct PROJ.4 text was introduced. This method implements the SQL/MM specification. SQL-MM 3: 5.1.6 This method supports Circular Strings and Curves. This function supports Polyhedral surfaces.

- ST_Union - Computes a geometry representing the point-set union of the input geometries. Description Unions the input geometries, merging geometry to produce a result geometry with no overlaps. The output may be an atomic geometry, a MultiGeometry, or a Geometry Collection. Comes in several variants: Two-input variant: returns a geometry that is the union of two input geometries. If either input is NULL, then NULL is returned. Array variant: returns a geometry that is the union of an array of geometries. Aggregate variant: returns a geometry that is the union of a rowset of geometries. The ST_Union() function is an "aggregate" function in the terminology of PostgreSQL. That means that it operates on rows of data, in the same way the SUM() and AVG() functions do and like most aggregates, it also ignores NULL geometries. See for a non-aggregate, single-input variant. The ST_Union array and set variants use the fast Cascaded Union algorithm described in http://blog.cleverelephant.ca/2009/01/must-faster-unions-in-postgis-14.html A gridSize can be specified to work in fixed-precision space. The inputs are snapped to a grid of the given size, and the result vertices are computed on that same grid. (Requires GEOS-3.9.0 or higher) may sometimes be used in place of ST_Union, if the result is not required to be non-overlapping. ST_Collect is usually faster than ST_Union because it performs no processing on the collected geometries. Performed by the GEOS module. ST_Union creates MultiLineString and does not sew LineStrings into a single LineString. Use to sew LineStrings. NOTE: this function was formerly called GeomUnion(), which was renamed from "Union" because UNION is an SQL reserved word. Enhanced: 3.1.0 accept a gridSize parameter. Requires GEOS >= 3.9.0 to use the gridSize parameter Changed: 3.0.0 does not depend on SFCGAL. Availability: 1.4.0 - ST_Union was enhanced. ST_Union(geomarray) was introduced and also faster aggregate collection in PostgreSQL. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.3 Aggregate version is not explicitly defined in OGC SPEC. This method implements the SQL/MM specification. SQL-MM 3: 5.1.19 the z-index (elevation) when polygons are involved. This function supports 3d and will not drop the z-index. However, the result is computed using XY only. The result Z values are copied, averaged or interpolated.

- ST_Volume - 3차원 입체의 부피를 계산합&#xb2
표면 도형을 입력하면 (닫힌 도&#xd615
0을 반환할 것입니다. 설명 2.2.0 버전&#
사용할 수 있습니다. This method needs SFCGAL backend. This function supports 3d and will not drop the z-index. This function supports Polyhedral surfaces. This function supports Triangles and Triangulated Irregular Network Surfaces (TIN). This method implements the SQL/MM specification. SQL-MM IEC 13249-3: 9.1 (same as ST_3DVolume)

- ST_WKBToSQL - WKB(Well-Known Binary) 표현식으로부터 지&#xc
  ST_Geometry 값을 반환합니다. 이 함수는
  SRID를 입력받지 않는 ST_GeomFromWKB 함수와
  동일합니다. 설명 This method implements the SQL/MM specification.
  SQL-MM 3: 5.1.36

- ST_WKTToSQL - WKT(Well-Known Text)로부터 지정된 ST_Geometry 값&#
  반환합니다. 이 함수는 ST_GeomFromText 함&#xc218
  동일합니다. 설명 This method implements the SQL/MM specification.
  SQL-MM 3: 5.1.34

- ST_Within - Tests if every point of A lies in B, and their interiors have a point in common Description Returns TRUE if geometry A is within geometry B. A is within B if and only if all points of A lie inside (i.e. in the interior or boundary of) B (or equivalently, no points of A lie in the exterior of B), and the interiors of A and B have at least one point in common. For this function to make sense, the source geometries must both be of the same coordinate projection, having the same SRID. In mathematical terms: ST_Within(A, B) $\Leftrightarrow$ (A $\bigcap$ B = A) $\wedge$ (Int(A) $\bigcap$ Int(B) $\neq \varnothing$) The within relation is reflexive: every geometry is within itself. The relation is antisymmetric: if ST_Within(A,B) = true and ST_Within(B,A) = true, then the two geometries must be topologically equal (ST_Equals(A,B) = true). ST_Within is the converse of . So, ST_Within(A,B) = ST_Contains(B,A). Because the interiors must have a common point, a subtlety of the definition is that lines and points lying fully in the boundary of polygons or lines are not within the geometry. For further details see Subtleties of OGC Covers, Contains, Within. The predicate provides a more inclusive relationship. This function automatically includes a bounding box comparison that makes use of any spatial indexes that are available on the geometries. To avoid index use, use the function _ST_Within. Performed by the GEOS module Enhanced: 2.3.0 Enhancement to PIP short-circuit for geometry extended to support MultiPoints with few points. Prior versions only supported point in polygon. Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Do not use this function with invalid geometries. You will get unexpected results. NOTE: this is the "allowable" version that returns a boolean, not an integer. This method implements the OGC Simple Features Implementation Specification for SQL 1.1. s2.1.1.2 // s2.1.13.3 - a.Relate(b, 'T*F**F***') This method implements the SQL/MM specification. SQL-MM 3: 5.1.30

- ST_X - Returns the X coordinate of a Point. 설명 포인트의 X 좌표&#xb9
  반환합니다. X 좌표가 없는 경우
  NULL을 반환합니다. 포인트만 입력&#x
  수 있습니다. To get the minimum and maximum X value of geometry coordinates use the functions and . This method implements the SQL/MM specification. SQL-MM 3: 6.1.3 This function supports 3d and will not drop the z-index.

- ST_Y - Returns the Y coordinate of a Point. 설명 포인트의 Y 좌표&#xb9
  반환합니다. Y 좌표가 없는 경우
  NULL을 반환합니다. 포인트만 입력&#x
  수 있습니다. To get the minimum and maximum Y value of geometry coordinates use the functions and . This method implements the OGC Simple Features Implementation Specification for SQL 1.1. This method implements the SQL/MM specification. SQL-MM 3: 6.1.4 This function supports 3d and will not drop the z-index.

- ST_Z - Returns the Z coordinate of a Point. 설명 포인트의 Z 좌표&#xb9
  반환합니다. Z 좌표가 없는 경우
  NULL을 반환합니다. 포인트만 입력&#x
  수 있습니다. To get the minimum and maximum Z value of geometry coordinates use the functions and . This method implements the SQL/MM specification. This function supports 3d and will not drop the z-index.

- TG_ST_SRID - Returns the spatial reference identifier for a topogeometry. 설명 Returns the spatial reference identifier for the ST_Geometry as defined in spatial_ref_sys table. spatial_ref_sys table is a table that catalogs all spatial reference systems known to PostGIS and is used for transformations from one spatial reference system to another. So verifying you have the right spatial reference system identifier is important if you plan to ever transform your geometries. Availability: 3.2.0 This method implements the SQL/MM specification. SQL-MM 3: 14.1.5

12.4 PostGIS Geography Support Functions

The functions and operators given below are PostGIS functions/operators that take as input or return as output a geography data type object.

Note

Functions with a (T) are not native geodetic functions, and use a ST_Transform call to and from geometry to do the operation. As a result, they may not behave as expected when going over dateline, poles, and for large geometries or geometry pairs that cover more than one UTM zone. Basic transform - (favoring UTM, Lambert Azimuthal (North/South), and falling back on mercator in worst case scenario)

- ST_Area - 도형의 기하학적 중심을 반환&
- ST_AsBinary - Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsEWKT - 도형의 WKT(Well-Known Text) 표현식을 SRID 메&#x 함께 반환합니다.
- ST_AsGML - 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.
- ST_AsGeoJSON - Return a geometry as a GeoJSON element.
- ST_AsKML - 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.
- ST_AsSVG - Returns SVG path data for a geometry.
- ST_AsText - 도형/지리형의 WKT(Well-Known Text) 표현식&# SRID 메타데이터 없이 반환합니다.
- ST_Azimuth - 두 도형 사이의 2차원 최단 라&#x 반환합니다.
- ST_Buffer - Computes a geometry covering all points within a given distance from a geometry.
- ST_Centroid - 도형의 기하학적 중심을 반&#xd6
- ST_ClosestPoint - Returns the 2D point on g1 that is closest to g2. This is the first point of the shortest line from one geometry to the other.
- ST_CoveredBy - Tests if every point of A lies in B
- ST_Covers - Tests if every point of B lies in A
- ST_DWithin - Tests if two geometries are within a given distance
- ST_Distance - 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.
- ST_GeogFromText - WKT (확장) 표현식으로부터 지&# 지리형 값을 반환합니다.
- ST_GeogFromWKB - WKB 도형 표현식 또는 EWKB(확장 WKB)로부터 지리형 인스턴스를 생&#x
- ST_GeographyFromText - WKT (확장) 표현식으로부터 지정된 지리형 값을 반환합니다.

- = - Returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B.
- ST_Intersection - Computes a geometry representing the shared portion of geometries A and B.
- ST_Intersects - Tests if two geometries intersect (they have at least one point in common)
- ST_Length - 도형의 기하학적 중심을 반&#xd65
- ST_LineInterpolatePoint - Returns a point interpolated along a line at a fractional location.
- ST_LineInterpolatePoints - Returns points interpolated along a line at a fractional interval.
- ST_LineLocatePoint - Returns the fractional location of the closest point on a line to a point.
- ST_LineSubstring - Returns the part of a line between two fractional locations.
- ST_Perimeter - Returns the length of the boundary of a polygonal geometry or geography.
- ST_Project - Returns a point projected from a start point by a distance and bearing (azimuth).
- ST_Segmentize - Returns a modified geometry/geography having no segment longer than a given distance.
- ST_ShortestLine - 두 도형 사이의 2차원 최단 라인을 반환합니다.
- ST_Summary - 도형의 내용을 요약한 텍스&#xd
반환합니다.
- <-> - A와 B 사이의 2차원 거리를 반환합&
- && - A의 2D 경계 상자와 B의 2D 경계 상자&#xa
교차하는 경우 TRUE 를 반환합니다.

12.5 PostGIS Raster Support Functions

The functions and operators given below are PostGIS functions/operators that take as input or return as output a raster data type object. Listed in alphabetical order.

- Box3D - 래스터를 둘러싼 상자의 BOX3D 표&#x
반환합니다.
- @ - B의 경계 상자가 A의 경계 상자를
담고 있을 경우 TRUE 를 반환합니다.
이중 정밀도 경계 상자를 이용합&
- ~ - A의 경계 상자가 B의 경계 상자를
담고 있을 경우 TRUE 를 반환합니다.
이중 정밀도 경계 상자를 이용합&
- = - A의 경계 상자와 B의 경계 상자가
동일할 경우 TRUE 를 반환합니다. 이&#
정밀도 경계 상자를 이용합니다.
- && - A의 경계 상자와 B의 경계 상자가
교차하는 경우 TRUE 를 반환합니다.
- &< - A의 경계 상자가 B의 경계 상자 왼&#
있을 경우 TRUE 를 반환합니다.
- &> - A의 경계 상자가 B의 경계 상자 오&#
있을 경우 TRUE 를 반환합니다.

- ~= - A의 경계 상자와 B의 경계 상자가 동일할 경우 TRUE 를 반환합니다.
- ST_Retile - 임의로 타일화된 래스터 커버
설정된 타일들의 집합을 반환합&
- ST_AddBand - 입력 인덱스 위치에 입력 초&#xa
추가된 입력 유형의 새 밴드(들)&#xc744
가진 래스터를 반환합니다. 인덱
설정하지 않을 경우, 마지막 위치
밴드를 추가합니다.
- ST_AsBinary/ST_AsWKB - Return the Well-Known Binary (WKB) representation of the raster.
- ST_AsGDALRaster - Return the raster tile in the designated GDAL Raster format. Raster formats are one of those supported by your compiled library. Use ST_GDALDrivers() to get a list of formats supported by your library.
- ST_AsHexWKB - Return the Well-Known Binary (WKB) in Hex representation of the raster.
- ST_AsJPEG - 래스터 타일에서 선택한 밴&#xb4
단일 JPEG(Joint Photographic Exports Group) 이미지(바이트 배
반환합니다. 밴드를 따로 설정하
않거나, 밴드가 1개거나 또는 3개&#xb97
초과할 경우 첫 번째 밴드를 씁니&
밴드가 3개뿐일 경우 밴드 3개를
모두 써서 RGB에 매핑시킵니다.
- ST_AsPNG - 래스터 타일에서 선택한 밴&#xb4c
단일 PNG(Portable Network Graphics) 이미지(바이트 배&#xc5f
반환합니다. 래스터의 밴드가 1&#xac1c
3개, 또는 4개이거나 따로 설정하&#xc9c
않을 경우 모든 밴드를 씁니다. 밴
2개 또는 4개를 초과하며 따로 설&#xc815
않을 경우, 밴드 1만 씁니다. 밴드&#xb97
RGB 또는 RGBA 스페이스에 매핑합니&#xb2e
- ST_AsRaster - PostGIS 도형을 PostGIS 래스터로 변환&#xd569
- ST_AsTIFF - Return the raster selected bands as a single TIFF image (byte array). If no band is specified or any of specified bands does not exist in the raster, then will try to use all bands.
- ST_Aspect - 표고 래스터 밴드의 향(기본
단위는 도)을 반환합니다. 지형&#xc744
분석하는 데 유용합니다.
- ST_Band - 기존 래스터의 하나 이상의
밴드를 새 래스터로 반환합니다.
기존 래스터로부터 새 래스터를
빌드하는 데 유용합니다.
- ST_BandFileSize - Returns the file size of a band stored in file system. If no bandnum specified, 1 is assumed.
- ST_BandFileTimestamp - Returns the file timestamp of a band stored in file system. If no bandnum specified, 1 is assumed.
- ST_BandIsNoData - 밴드가 NODATA 값만으로 채워져
있을 경우 참을 반환합니다.
- ST_BandMetaData - 지정 래스터 밴드에 대한
기본 메타데이터를 반환합니다.
밴드를 지정하지 않을 경우 밴드
1번이라고 가정합니다.

- ST_BandNoDataValue - 입력 밴드에서 NODATA를 나타&#xb0
  값을 반환합니다. 어떤 밴드도 지
  않을 경우 밴드 1로 가정합니다.
- ST_BandPath - 파일 시스템에 저장된 밴드&#xb9
  가리키는 시스템 파일 경로를 반&
  bandnum을 설정하지 않을 경우 밴드 1로
  가정합니다.
- ST_BandPixelType - 입력 밴드의 픽셀 유형을
  반환합니다. bandnum을 설정하지 않을
  경우 밴드 1로 가정합니다.
- ST_Clip - 입력 도형으로 잘라낸 래스터&
  반환합니다. 밴드 번호를 지정하
  않은 경우, 모든 밴드를 처리합니&
  crop 을 설정하지 않거나 참으로 설&#xc8
  경우, 잘라낸 래스터를 출력합니&
- ST_ColorMap - 소스 래스터 및 설정한 밴드&#xb
  8BUI 밴드(grayscale, RGB, RGBA)를 4개까지 가지는
  새 래스터를 생성합니다. 밴드를
  따로 설정하지 않으면 밴드 1로
  가정합니다.
- ST_Contains - 래스터 rastA 외부에 놓인 래스터
  rastB의 포인트가 하나도 없고, 적어&#xb
  rastB 내부의 포인트 하나가 rastA의 내&#xbd80
  있는 경우 참을 반환합니다.
- ST_ContainsProperly - rastB가 rastA의 내부와 교차하지&#xb9
  rastA의 경계선 또는 외부와 교차하&#xc
  않을 경우 참을 반환합니다.
- ST_Count - Generates a set of vector contours from the provided raster band, using the GDAL contouring algorithm.
- ST_ConvexHull - BandNoDataValue와 일치하는 픽셀 값을
  포함한, 래스터의 볼록 껍질 도형&
  반환합니다. 정규 형상 및 기울어&
  않은 래스터의 경우, ST_Envelope와 동일&#xd5
  결과물을 출력하므로 비정규 형&
  또는 기울어진 래스터에 대해서&
  쓸모가 있습니다.
- ST_Count - 래스터 또는 래스터 커버리&#xc9c0
  입력 밴드에 있는 픽셀 개수를 반
  밴드를 따로 설정하지 않을 경우
  기본값은 밴드 1입니다. exclude_nodata_value를
  참으로 설정할 경우, NODATA 값이 아닌
  픽셀의 개수만 반환할 것입니다.
- ST_CountAgg - 종합 함수입니다. 래스터 집&
  입력 밴드에 있는 픽셀 개수를 반
  밴드를 따로 설정하지 않을 경우
  기본값은 밴드 1입니다. exclude_nodata_value를
  참으로 설정할 경우, NODATA 값이 아닌
  픽셀의 개수만 반환할 것입니다.
- ST_CoveredBy - 래스터 rastA의 어떤 포인트도
  래스터 rastB 외부에 없을 경우 참을
  반환합니다.

- ST_Covers - 래스터 rastB의 어떤 포인트도 래&#
rastA 외부에 없을 경우 참을 반환합&#xb
- ST_DFullyWithin - 래스터 rastA와 래스터 rastB가 완전
서로 설정된 거리 안에 있을 경우
참을 반환합니다.
- ST_DWithin - 래스터 rastA와 래스터 rastB가 서로
설정된 거리 안에 있을 경우 참을
반환합니다.
- ST_Disjoint - 래스터 rastA와 래스터 rastB가 공간&#xc8
교차하지 않을 경우 참을 반환합&
- ST_DumpAsPolygons - 입력 래스터 밴드로부터
geomval(geom, val) 행들의 집합을 반환합니다.
밴드 번호를 설정하지 않을 경우
기본적으로 밴드 1로 가정합니다.
- ST_DumpValues - 지정된 밴드의 값들을 2차원
배열로 반환합니다.
- ST_Envelope - 래스터 범위의 폴리곤 표현&#xc2
반환합니다.
- ST_FromGDALRaster - 지원 GDAL 래스터 파일로부터
래스터를 반환합니다.
- ST_GeoReference - 월드(world) 파일에서 흔히 볼 수
있는 지리참조 메타데이터를 GDAL
또는 ESRI 형식으로 반환합니다. 기&#x
GDAL입니다.
- ST_Grayscale - Creates a new one-8BUI band raster from the source raster and specified bands representing Red, Green and Blue
- ST_HasNoBand - 입력된 밴드 번호에 밴드가
없을 경우 참을 반환합니다. 밴드
번호를 설정하지 않을 경우, 밴드
1로 가정합니다.
- ST_Height - 래스터의 높이를 픽셀 개수&#xb85
반환합니다.
- ST_HillShade - 입력한 방위각, 고도각, 밝기
및 축척을 이용해서 표고 래스터
밴드의 가상적인 음영기복을 반&#
- ST_Histogram - 빈(bin; 히스토그램 표시에서 수&
막대로 나타나는 단위) 범위로 구
래스터 또는 래스터 커버리지의
데이터 분포를 요약하는 레코드
집합을 반환합니다. 따로 설정하
않을 경우 빈의 개수를 자동으로
계산합니다.
- ST_MakeEmptyRaster - Interpolates a gridded surface based on an input set of 3-d points, using the X- and Y-values to position the points on the grid and the Z-value of the points as the surface elevation.
- ST_Intersection - 두 래스터의 공유 부분을 표&#
또는 벡터화된 래스터와 도형의
기하학적 교차를 표현하는 래스&
또는 도형-픽셀값 쌍의 집합을 &#xbc18

- ST_Intersects - 래스터 rastA와 래스터 rastB가 공간&#xc
  교차할 경우 참을 반환합니다.
- ST_IsEmpty - 래스터가 비어 있을 경우 (width =
  0, height = 0) 참을 반환합니다. 그렇지 않&#xc74
  경우 거짓을 반환합니다.
- ST_MakeEmptyCoverage - Cover georeferenced area with a grid of empty raster tiles.
- ST_MakeEmptyRaster - 설정된 차원(너비 & 높이), 좌&
  X 및 Y, 픽셀 크기, 회전(scalex, scaley, skewx & skewy) 그리&#x
  공간 참조 시스템(SRID)를 가진 텅 빈
  (밴드가 없는) 래스터를 반환합&#xb2c8
  래스터를 입력할 경우, 동일한 크
  정렬 방향 및 SRID를 가진 새 래스터&#x
  반환합니다. SRID를 생략할 경우, 공&#x
  참조 시스템을 0(unknown)으로 설정합니
- 내장 맵 대수 콜백 함수 - 콜백 함&#xc218
  버전 - 래스터 1개 이상, 밴드 인덱&#xc2a
  그리고 사용자 지정 콜백 함수 1개&
  입력받아 밴드 1개를 가진 래스터
  반환합니다.
- ST_MapAlgebraExpr - 래스터 밴드 1개 버전: 입력
  래스터에 대해 유효한 PostgreSQL 대수
  연산을 적용해서 형성되고, 설정&
  픽셀 유형을 가진, 밴드 1개를 가&#xc9c4
  새 래스터를 생성합니다. 따로 밴
  설정하지 않을 경우, 밴드 1로 가&#xc815
- ST_MapAlgebraExpr - 래스터 밴드 2개 버전: 입력
  래스터 2개에 대해 유효한 PostgreSQL 대&#xc2
  연산을 적용해서 형성되고, 설정&
  픽셀 유형을 가진, 밴드 1개를 가&#xc9c4
  새 래스터를 생성합니다. 따로 밴
  설정하지 않을 경우, 각 래스터의
  밴드 1로 가정합니다. 출력 래스&#xd130
  첫 번째 래스터가 정의하는 그리&
  상에 (축척, 기울기 및 픽셀 모서리
  정렬될 것입니다. extenttype 파라미터가
  출력 래스터의 범위를 정의할 것&
  extenttype 의 값은 INTERSECTION, UNION, FIRST, SECOND가 될 수 있&#x
- ST_MapAlgebraFct - 래스터 밴드 1개 버전: 입력
  래스터에 대해 유효한 PostgreSQL 대수
  연산을 적용해서 형성되고, 설정&
  픽셀 유형을 가진, 밴드 1개를 가&#xc9c4
  새 래스터를 생성합니다. 따로 밴
  설정하지 않을 경우, 밴드 1로 가&#xc815
- ST_MapAlgebraFct - 래스터 밴드 2개 버전: 입력
  래스터 2개에 대해 유효한 PostgreSQL 함&#xc2
  적용해서 형성되고, 설정한 픽셀
  유형을 가진, 밴드 1개를 가진 새
  래스터를 생성합니다. 따로 밴드
  설정하지 않을 경우, 밴드 1로 가&#xc815
  범위 유형을 따로 설정하지 않을
  경우 기본값은 INTERSECTION입니다.

- ST_MapAlgebraFctNgb - 래스터 밴드 1개 버전: 사용&#
지정 PostgreSQL 함수를 이용하는 맵 대&#xc21
최근접 이웃(Map Algebra Nearest Neighbor)입니다. 입&#xb825
래스터 밴드의 값의 이웃(neighborhood)이
관련된 PostgreSQL 사용자 함수가 출력&#xd558
값을 가진 래스터를 반환합니다.

- ST_MapAlgebraExpr - 표현식 버전 - 입력 래스터
1개 또는 2개, 밴드 인덱스, 그리고
사용자 지정 SQL 표현식 1개 이상을
입력받아 밴드 1개를 가진 래스터
반환합니다.

- ST_MemSize - 래스터가 차지하는 공간의
용량을 (바이트 단위로) 반환합&#xb2c8

- ST_MetaData - 래스터 객체의 픽셀 크기, 회&#x
좌상단, 좌하단 등과 같은 기본 메&
반환합니다.

- ST_MinConvexHull - 래스터의 NODATA 픽셀을 제외&#xd55c
볼록 껍질 도형을 반환합니다.

- ST_NearestValue - columnx 및 rowy, 또는 래스터와 동일&#xd5
공간 참조 좌표 시스템 단위로 표&
기하학적 포인트로 지정된 입력
밴드의 픽셀에 가장 가까운 NODATA 가
아닌 값을 반환합니다.

- ST_Neighborhood - columnx 및 rowy, 또는 래스터와 동일&#xd
공간 참조 좌표 시스템 단위로 표&
기하학적 포인트로 지정된 입력
밴드의 픽셀 주위의 NODATA 가 아닌 값&
이중 정밀도 데이터형 2차원 배열
반환합니다.

- ST_NotSameAlignmentReason - 래스터들이 정렬돼 있&#xb294
아닌지, 그리고 정렬되지 않았다&
그 이유를 설명하는 텍스트를 반&

- ST_NumBands - 래스터 객체 내부에 있는 밴&#
개수를 반환합니다.

- ST_Overlaps - 래스터 rastA와 래스터 rastB가 교차&#xd
어느 한 쪽이 다른 한 쪽을 완전히
담고 있지는 않을 경우 참을 반환&

- ST_PixelAsCentroid - 픽셀 하나가 차지하는 면&#xc758
중심점(포인트 도형)을 반환합니

- ST_PixelAsCentroids - 래스터 밴드의 각 픽셀에
대한 중심점(포인트 도형)을 각 &#xd53d
값 및 X, Y 래스터 좌표와 함께 반환&#xd
포인트 도형은 픽셀이 차지하는
면의 중심점입니다.

- ST_PixelAsPoint - 픽셀의 좌상단에 위치하는
포인트 도형을 반환합니다.

- ST_PixelAsPoints - 래스터 밴드의 각 픽셀에 대&
  포인트 도형을 각 픽셀의 값 및 X,
  Y 래스터 좌표와 함께 반환합니&#xb2e4
  포인트 도형의 좌표는 픽셀의 좌&
  좌표입니다.
- ST_PixelAsPolygon - 특정 행 및 열에 대한 픽셀&#xc758
  경계를 이루는 폴리곤 도형을 반&
- ST_PixelAsPolygons - 래스터 밴드의 모든 픽셀&#xc75
  경계를 이루는 폴리곤 도형을 각
  픽셀의 값과 X, Y 래스터 좌표와 함&#xae
  반환합니다.
- ST_PixelHeight - 픽셀 높이를 공간 참조 시스&#x
  기하 단위로 반환합니다.
- ST_PixelOfValue - 검색 값과 일치하는 값을 가&#
  픽셀의 columnx, rowy 좌표를 반환합니다.
- ST_PixelWidth - 픽셀 너비를 공간 참조 시스&#x
  기하 단위로 반환합니다.
- ST_Polygon - NODATA 값이 아닌 픽셀 값을 가진
  픽셀들을 통합해서 형성된 멀티&
  도형을 반환합니다.
- ST_Quantile - 샘플링 또는 채우기(population)라는
  맥락에서 래스터 또는 래스터 테
  커버리지의 사분위(quantile)를 계산합&#
  따라서, 래스터의 25%, 50%, 75% 백분위(percentile)
  단계로 값을 확인할 수 있습니다.
- ST_RastFromHexWKB - Return a raster value from a Hex representation of Well-Known Binary (WKB) raster.
- ST_RastFromWKB - Return a raster value from a Well-Known Binary (WKB) raster.
- ST_RasterToWorldCoord - 주어진 열과 행에 있는 래&#x
  좌상단의 기하학적 X, Y(경도, 위도)&#x
  으로 반환합니다. 열과 행은 1부&#xd130
  시작합니다.
- ST_RasterToWorldCoordX - 열과 행에 있는 래스터의
  좌상단의 기하학적 X 좌표를 반&#xd658
  열과 행의 번호는 1부터 시작합니
- ST_RasterToWorldCoordY - 열과 행에 있는 래스터의
  좌상단의 기하학적 Y 좌표를 반&#xd658
  열과 행의 번호는 1부터 시작합니
- ST_Reclass - 원본으로부터 재분류된 밴&#xb4dc
  유형으로 이루어진 새 래스터를
  생성합니다. nband 는 변경할 밴드를
  가리킵니다. nband 를 따로 설정하지
  않을 경우 밴드 1로 가정합니다.
  다른 모든 밴드들은 변경 없이 반&
  실제 사례: 보기 좋은 형식으로 더
  간단하게 렌더링하기 위해 16BUI 밴&#x
  8BUI 등등으로 변환하십시오.

- ST_Resample - 특정 리샘플링 알고리즘, 새&#xb
차원, 임의의 그리드 모서리, 그리&
또 다른 래스터에서 정의되거나
빌려온 래스터 지리참조 속성들&
집합을 이용해서 래스터를 리샘&

- ST_Rescale - Resample a raster by adjusting only its scale (or pixel size). New pixel values are computed using the Nearest-Neighbor (english or american spelling), Bilinear, Cubic, CubicSpline, Lanczos, Max or Min resampling algorithm. Default is NearestNeighbor.

- ST_Resize - 래스터의 크기를 새 너비/높&#xc77
조정합니다.

- ST_Reskew - 기울기(또는 회전각 파라미&#xd13
조정해서 래스터를 리샘플링합&
NearestNeighbor(영국 또는 미국 철자), Bilinear, Cubic, Cubic-Spline 또는 Lanczos 리샘플링 알고리즘을
이용해서 새 픽셀 값을 계산합니&
기본값은 NearestNeighbor입니다.

- ST_Rotation - 래스터의 회전각을 라디안&#xc7
반환합니다.

- ST_Roughness - DEM의 계산된 "거칠기(roughness)"와 함&#xa
래스터를 반환합니다.

- ST_SRID - spatial_ref_sys 테이블에 정의되어 있는,
래스터의 공간 참조 식별자를 반&

- ST_SameAlignment - 래스터들이 동일한 기울기
축척, 공간 참조 시스템, 그리고 오&
가지고 있을 경우 (픽셀이 다른 픽
침범하지 않고 동일한 그리드에
놓일 수 있을 경우) 참을 반환하고
그렇지 않을 경우 문제점을 설명&
안내문과 함께 거짓을 반환합니&

- ST_ScaleX - 픽셀 너비의 X 요소를 좌표 참&#xc
시스템의 단위로 반환합니다.

- ST_ScaleY - 픽셀 높이의 Y 요소를 좌표 참&#xc
시스템의 단위로 반환합니다.

- ST_SetBandIndex - Update the external band number of an out-db band

- ST_SetBandIsNoData - 밴드의 isnodata 플래그를 참으로
설정합니다.

- ST_SetBandNoDataValue - NODATA를 나타내는 입력 밴드&#
값을 설정합니다. 밴드를 따로 설
않을 경우 밴드 1로 가정합니다.
밴드에 NODATA가 없다고 표시하려면,
nodata value = NULL이라고 설정하십시오.

- ST_SetBandPath - Update the external path and band number of an out-db band

- ST_SetGeoReference - 단일 호출로 지리참조 파&#xb77
6개를 설정합니다. 숫자를 공백으
구분해야 합니다. GDAL 또는 ESRI 서식&#xc7
입력물을 받아들입니다. 기본값&
GDAL입니다.

- ST_SetSkew - Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the M dimension using the requested resample algorithm.
- ST_SetRotation - 래스터의 회전각을 라디안&#x 설정합니다.
- ST_SetSRID - 래스터의 SRID를 spatial_ref_sys 테이블에 정의된 특정 SRID의 정수값으로 설&#xc
- ST_SetScale - X 및 Y 픽셀 크기를 좌표 참조 시스템의 단위로 설정합니다. 단너비/픽셀 높이 순서입니다.
- ST_SetSkew - 지리참조 X 및 Y 기울기(skew)(또는 회전각 파라미터)를 설정합니다. 값 하나만 입력할 경우, X와 Y를 동&#xc 값으로 설정합니다.
- ST_SetUpperLeft - Sets the value of the upper left corner of the pixel of the raster to projected X and Y coordinates.
- ST_SetValue - 입력한 columnx, rowy 픽셀 또는 특정 도형과 교차하는 픽셀들의 위치&# 밴드 값을 설정해서 나온 수정된 래스터를 반환합니다. 밴드 번호 1부터 시작하며, 따로 설정하지 않을 경우 1로 가정합니다.
- ST_SetValues - 지정한 밴드의 값들을 설정&#xd 나온 수정된 래스터를 반환합니&
- ST_SetSkew - Returns a geometry with the same X/Y coordinates as the input geometry, and values from the raster copied into the Z dimension using the requested resample algorithm.
- ST_SkewX - 지리참조 X 기울기(skew)(또는 회&#xc804 파라미터)를 반환합니다.
- ST_SkewY - 지리참조 Y 기울기(또는 회전&#xac 파라미터)를 반환합니다.
- ST_Slope - 표고 래스터 밴드의 경사(기본 단위는 도)를 반환합니다. 지형&#xc744 분석하는 데 유용합니다.
- ST_SnapToGrid - 그리드에 래스터를 스냅시&#x 래스터를 리샘플링합니다. NearestNeighbor(영국 또는 미국 철자), Bilinear, Cubic, CubicSpline 또&#xb2 Lanczos 리샘플링 알고리즘을 이용해&#x 새 픽셀 값을 계산합니다. 기본값& NearestNeighbor입니다.
- ST_Summary - 래스터의 내용을 요약한 텍&#xc 반환합니다.
- ST_SummaryStats - 입력한 래스터 밴드 또는 래스터 또는 래스터 커버리지의 count, sum, mean, stddev, min, max로 이루어진 통계 요약&#xc7 반환합니다. 밴드를 따로 설정하 않을 경우 밴드 1로 가정합니다.
- ST_SummaryStatsAgg - 종합 함수입니다. 래스터 집합의 입력 래스터 밴드의 count, sum, mean, stddev, min, max로 이루어진 통계 요약을 반환합니다. 밴드를 따로 설정하 않을 경우 밴드 1로 가정합니다.

- ST_TPI - 계산된 지형위치지수(Topographic Position Index)와 함께 래스터를 반환합니다.
- ST_TRI - 계산된 지형험준도지수(Terrain Ruggedness Index)와 함께 래스터를 반환합니다
- ST_Tile - 출력 래스터에 원하는 차원을 바탕으로 입력 래스터를 분할해나온 래스터들의 집합을 반환합&
- ST_Touches - 래스터 rastA와 래스터 rastB가 최소포인트 한 개를 공유하지만, 내부교차하지는 않을 경우 TRUE 를 반환&#x
- ST_Transform - 알려진 공간 참조 시스템의 래스터를 지정한 리샘플링 알고통해 또 다른 알려진 공간 참조 시스템으로 재투영합니다. NearestNeighbor, Bilinear, Cubic, CubicSpline, Lanczos 알고리즘을 이용할 수 있습니다. 기본값은 NearestNeighbor입니&#x
- ST_Union - 래스터 타일 집합을 1개 이상&#xc75밴드로 이루어진 단일 래스터로 통합합니다.
- ST_UpperLeftX - 래스터의 좌상단 X 좌표를 투공간 참조 단위로 반환합니다.
- ST_UpperLeftY - 래스터의 좌상단 Y 좌표를 투공간 참조 단위로 반환합니다.
- ST_Value - 입력 columnx, rowy 픽셀의 입력 밴드의 값, 또는 특정 기하학적 포인트의 밴드의 값을 반환합니다. 밴드 번 1부터 시작하며, 따로 지정하지 않을 경우 1로 가정합니다. exclude_nodata_value 를 거짓으로 설정할 경우, nodata 픽셀포함한 모든 픽셀이 교차한다고 가정하고 값을 반환합니다. exclude_nodata_valu 를 설정하지 않은 경우, 래스터의 메타데이터에서 값을 읽어 들입&
- ST_ValueCount - 설정한 값들의 집합을 가진 래스터(또는 래스터 커버리지)의 입력 밴드에 있는 픽셀 밴드 값 및 픽셀 개수의 집계를 담고 있는 레코드 집합을 반환합니다. 밴드 따로 설정하지 않을 경우 기본값 밴드 1입니다. 기본각으로 NODATA 값은 집계되지 않습니다. 픽셀의 다른 모든 값들을 출력하는데, 픽셀 밴값은 가장 가까운 정수로 반올림&
- ST_Width - 래스터의 너비를 픽셀 개수로반환합니다.
- ST_Within - 래스터 rastB 외부에 놓인 래스터 rastA의 포인트가 하나도 없고, 적어&#xb3 rastA 내부의 포인트 하나가 rastB의 내&#xbd80 있는 경우 참을 반환합니다.

- ST_WorldToRasterCoord - 주어진 기하학적 X, Y(경도, 위도)의 좌상단을 열과 행으로 또래스터의 공간 참조 좌표 시스템 단위로 표현된 포인트 도형으로 반환합니다.
- ST_WorldToRasterCoordX - 포인트 도형(pt)의 래스터 안의 열 또는 래스터의 월드 공간 참조 시스템 단위로 표현된 X, Y 월&#xb4 좌표(xw, yw)를 반환합니다.
- ST_WorldToRasterCoordY - 포인트 도형(pt)의 래스터 안의 행 또는 래스터의 월드 공간 참조 시스템 단위로 표현된 X, Y 월&#xb4 좌표(xw, yw)를 반환합니다.
- UpdateRasterSRID - 사용자가 지정한 열 및 테이랈는 모든 래스터의 SRID를 변경합&#xb
- ST_PixelOfValue - 래스터 객체 내부에 있는 밴개수를 반환합니다.

12.6 PostGIS Geometry / Geography / Raster Dump Functions

The functions given below are PostGIS functions that take as input or return as output a set of or single geometry_dump or geomval data type object.

- ST_DumpAsPolygons - 입력 래스터 밴드로부터 geomval(geom, val) 행들의 집합을 반환합니다. 밴드 번호를 설정하지 않을 경우 기본적으로 밴드 1로 가정합니다.
- ST_Intersection - 두 래스터의 공유 부분을 표또는 벡터화된 래스터와 도형의 기하학적 교차를 표현하는 래스또는 도형-픽셀값 쌍의 집합을 &#xbc18

12.7 PostGIS Box Functions

The functions given below are PostGIS functions that take as input or return as output the box* family of PostGIS spatial types. The box family of types consists of box2d, and box3d

- Box2D - Returns a BOX2D representing the 2D extent of a geometry.
- Box3D - Returns a BOX3D representing the 3D extent of a geometry.
- Box3D - 래스터를 둘러싼 상자의 BOX3D 표&#x 반환합니다.
- ST_3DExtent - Aggregate function that returns the 3D bounding box of geometries.
- ST_3DMakeBox - Creates a BOX3D defined by two 3D point geometries.
- ST_AsMVTGeom - Transforms a geometry into the coordinate space of a MVT tile.
- ST_AsTWKB - 도형을 TWKB(Tiny Well-Known Binary)로 반환합니&

- ST_Box2dFromGeoHash - GeoHash 스트링으로부터 BOX2D를 반환합니다.
- ST_ClipByBox2D - Computes the portion of a geometry falling within a rectangle.
- ST_EstimatedExtent - Returns the estimated extent of a spatial table.
- ST_Expand - Returns a bounding box expanded from another bounding box or a geometry.
- ST_Extent - Aggregate function that returns the bounding box of geometries.
- ST_MakeBox2D - Creates a BOX2D defined by two 2D point geometries.
- ST_XMax - Returns the X maxima of a 2D or 3D bounding box or a geometry.
- ST_XMin - Returns the X minima of a 2D or 3D bounding box or a geometry.
- ST_YMax - Returns the Y maxima of a 2D or 3D bounding box or a geometry.
- ST_YMin - Returns the Y minima of a 2D or 3D bounding box or a geometry.
- ST_ZMax - Returns the Z maxima of a 2D or 3D bounding box or a geometry.
- ST_ZMin - Returns the Z minima of a 2D or 3D bounding box or a geometry.
- RemoveUnusedPrimitives - Removes topology primitives which not needed to define existing TopoGeometry objects.
- ValidateTopology - Returns a set of validatetopology_returntype objects detailing issues with topology.
- ~(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains another 2D float precision bounding box (BOX2DF).
- ~(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains a geometry's 2D bonding box.
- ~(geometry,box2df) - Returns TRUE if a geometry's 2D bonding box contains a 2D float precision bounding box (GIDX).
- @(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into another 2D float precision bounding box.
- @(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into a geometry's 2D bounding box.
- @(geometry,box2df) - Returns TRUE if a geometry's 2D bounding box is contained into a 2D float precision bounding box (BOX2DF).
- &&(box2df,box2df) - Returns TRUE if two 2D float precision bounding boxes (BOX2DF) intersect each other.
- &&(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) intersects a geometry's (cached) 2D bounding box.
- &&(geometry,box2df) - Returns TRUE if a geometry's (cached) 2D bounding box intersects a 2D float precision bounding box (BOX2DF).

12.8 PostGIS Functions that support 3D

The functions given below are PostGIS functions that do not throw away the Z-Index.

- AddGeometryColumn - 공간 테이블에서 지오메&#xd2b8 컬럼을 제거합니다.
- Box3D - Returns a BOX3D representing the 3D extent of a geometry.
- DropGeometryColumn - 공간 테이블에서 지오메&#xd2b 컬럼을 제거합니다.

- GeometryType - ST_Geometry 값의 도형 유형을 반환합
- ST_3DArea - 3차원 표면 도형의 면적을 계&#xc0 입체일 경우 0을 반환할 것입니다
- ST_3DClosestPoint - g2에 가장 가까운 g1 상에 있는 3차원 포인트를 반환합니다. 해&#xb2f9 포인트는 3D 최단 라인의 첫 번째 포인트입니다.
- ST_3DConvexHull - 면 도형의 근사 중심축을 계&
- ST_3DDFullyWithin - Tests if two 3D geometries are entirely within a given 3D distance
- ST_3DDWithin - Tests if two 3D geometries are within a given 3D distance
- ST_3DDifference - 3차원 차이를 수행합니다.
- ST_3DDistance - 도형 유형에 대해, 두 도형 사& (SRS에 기반한) 3차원 데카르트 최단 거리를 투영 단위로 반환합니다.
- ST_3DExtent - Aggregate function that returns the 3D bounding box of geometries.
- ST_3DIntersection - 3차원 교차를 수행합니다.
- ST_3DIntersects - Tests if two geometries spatially intersect in 3D - only for points, linestrings, polygons, polyhedral surface (area)
- ST_3DLength - 도형의 기하학적 중심을 반&#xd
- ST_3DLineInterpolatePoint - Returns a point interpolated along a 3D line at a fractional location.
- ST_3DLongestLine - 두 도형 사이의 3차원 최장(longest 라인을 반환합니다.
- ST_3DMaxDistance - 도형 유형에 대해, 두 도형 사이의 (SRS에 기반한) 3차원 데카르&#x 최장 거리를 투영 단위로 반환합&
- ST_3DPerimeter - 도형의 기하학적 중심을 반&#
- ST_3DShortestLine - 두 도형 사이의 3차원 최단(shortest 라인을 반환합니다.
- ST_3DUnion - Perform 3D union.
- ST_AddMeasure - Interpolates measures along a linear geometry.
- ST_AddPoint - 라인스트링에 포인트를 추&#xac
- ST_Affine - Apply a 3D affine transformation to a geometry.
- ST_ApproximateMedialAxis - 면 도형의 근사 중심축을 계산합니다.
- ST_AsBinary - Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsEWKB - Return the Extended Well-Known Binary (EWKB) representation of the geometry with SRID meta data.
- ST_AsEWKT - 도형의 WKT(Well-Known Text) 표현식을 SRID 메&#x 함께 반환합니다.
- ST_AsGML - 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.

- ST_AsGeoJSON - Return a geometry as a GeoJSON element.
- ST_AsHEXEWKB - 도형을 소 엔디안(NDR) 또는 대엔디안(XDR) 인코딩을 통해 HEXEWKB (텍스형식으로 반환합니다.
- ST_AsKML - 도형을 GML 2 또는 GML 3 버전 요소로반환합니다.
- ST_AsX3D - 도형을 X3D XML 노드 요소 형식: ISO-IEC-19776-1.2-X3DEncodings-XML로 반환합니다.
- ST_Boundary - 해당 도형의 결합된 범위의닫힘 여부를 반환합니다.
- ST_BoundingDiagonal - 주어진 도형의 경계 상자&#xc75대각선을 반환합니다.
- ST_CPAWithin - Tests if the closest point of approach of two trajectories is within the specified distance.
- ST_ChaikinSmoothing - Returns a smoothed version of a geometry, using the Chaikin algorithm
- ST_ClosestPointOfApproach - Returns a measure at the closest point of approach of two trajectories.
- ST_Collect - Creates a GeometryCollection or Multi* geometry from a set of geometries.
- ST_ConstrainedDelaunayTriangles - Return a constrained Delaunay triangulation around the given input geometry.
- ST_ConvexHull - Computes the convex hull of a geometry.
- ST_CoordDim - ST_Geometry 값의 좌표 차원을 반환합
- ST_CurveToLine - Converts a geometry containing curves to a linear geometry.
- ST_DelaunayTriangles - Returns the Delaunay triangulation of the vertices of a geometry.
- ST_Difference - Computes a geometry representing the part of geometry A that does not intersect geometry B.
- ST_DistanceCPA - Returns the distance between the closest point of approach of two trajectories.
- ST_Dump - Returns a set of geometry_dump rows for the components of a geometry.
- ST_DumpPoints - 도형의 내용을 요약한 텍스&#반환합니다.
- ST_DumpRings - Returns a set of geometry_dump rows for the exterior and interior rings of a Polygon.
- ST_DumpSegments - 도형의 내용을 요약한 텍&#xc2a4반환합니다.
- ST_EndPoint - ST_LineString 또는 ST_CircularString 값에 있는 포인&#개수를 반환합니다.
- ST_ExteriorRing - 폴리곤 도형의 내곽 고리의개수를 반환합니다.
- ST_Extrude - 표면을 관련 입체로 돌출시&#xd0b
- ST_FlipCoordinates - Returns a version of a geometry with X and Y axis flipped.
- ST_Force2D - 도형을 "2차원 모드"로 강제합&#
- ST_ForceCurve - 적용이 가능한 경우, 도형을 해당 도형의 만곡 유형으로 상위형변환(upcast)합니다.

- ST_ForceLHR - LHR(Left Hand Reverse; 시계 방향) 방향을 강&#xc81c
- ST_ForcePolygonCCW - Orients all exterior rings counter-clockwise and all interior rings clockwise.
- ST_ForcePolygonCW - Orients all exterior rings clockwise and all interior rings counter-clockwise.
- ST_ForceRHR - 폴리곤 안에 있는 꼭짓점들&#xc
  방향(orientation)이 오른손 법칙(Right-Hand Rule)을 따
  강제합니다.
- ST_ForceSFS - 도형이 SFS 1.1 도형 유형만을 쓰&#xb3c
  강제합니다.
- ST_Force_3D - 도형을 XYZ 모드로 강제합니다.
  ST_Force3DZ라고도 합니다.
- ST_Force_3DZ - 도형을 XYZ 모드로 강제합니&#xb2e4
- ST_Force_4D - 도형을 XYZM 모드로 강제합니&#xb2e
- ST_Force_Collection - 도형을 도형 집합으로 변&#xd65
- ST_GeomFromEWKB - EWKB(Extended Well-Known Binary)로부터 지정된
  ST_Geometry 값을 반환합니다.
- ST_GeomFromEWKT - EWKT(Extended Well-Known Text)로부터 지정된 ST_Geome
  값을 반환합니다.
- ST_GeomFromGML - 도형의 GML 표현식을 입력받&#
  PostGIS 도형 객체를 출력합니다.
- ST_GeomFromGeoJSON - GeoJSON 표현식을 입력받아 Post-
  GIS 도형 객체를 출력합니다.
- ST_GeomFromKML - 도형의 KML 표현식을 입력받&#
  PostGIS 도형 객체를 출력합니다.
- ST_GeometricMedian - 멀티 포인트의 기하학적
  중심값(median)을 반환합니다.
- ST_GeometryN - ST_Geometry 값의 도형 유형을 반환&#xd569
- ST_GeometryType - ST_Geometry 값의 도형 유형을 반환&#xd
- ST_HasArc - Tests if a geometry contains a circular arc
- ST_InteriorRingN - 폴리곤 도형의 내곽 고리의
  개수를 반환합니다.
- ST_InterpolatePoint - 입력 포인트에 가까운 포인
  도형의 척도 차원(M 차원)의 값을
  반환합니다.
- ST_Intersection - Computes a geometry representing the shared portion of geometries A and B.
- ST_IsClosed - LINESTRING 의 시작점과 종단점이 일&#
  경우 TRUE 를 반환합니다. 다면체 표&#
  닫혀 (부피를 가지고) 있는 경우
  TRUE 를 반환합니다.
- ST_IsCollection - 해당 도형이 텅 빈 도형 집합,
  폴리곤, 포인트 등인 경우 TRUE 를 반&#
- ST_IsPlanar - 표면이 평면인지 아닌지 확&#xc7

- ST_IsPolygonCCW - Tests if Polygons have exterior rings oriented counter-clockwise and interior rings oriented clockwise.
- ST_IsPolygonCW - Tests if Polygons have exterior rings oriented clockwise and interior rings oriented counter-clockwise.
- ST_IsSimple - 해당 도형이 자체 교차하거&#xb0 자체 접촉하는 이례적인 도형 포& 가지고 있지 않을 경우 TRUE 를 반환&#x
- ST_IsSolid - 도형이 입체인지 테스트합&#xb2c8 어떤 유효성 검사도 수행하지 않&
- ST_IsValidTrajectory - Tests if the geometry is a valid trajectory.
- ST_Length_Spheroid - 도형의 기하학적 중심을 반환합니다.
- ST_LineFromMultiPoint - 멀티포인트 도형으로부&#xd 라인스트링을 생성합니다.
- ST_LineInterpolatePoint - Returns a point interpolated along a line at a fractional location.
- ST_LineInterpolatePoints - Returns points interpolated along a line at a fractional interval.
- ST_LineSubstring - Returns the part of a line between two fractional locations.
- ST_LineToCurve - Converts a linear geometry to a curved geometry.
- ST_LocateBetweenElevations - Returns the portions of a geometry that lie in an elevation (Z) range.
- ST_M - Returns the M coordinate of a Point.
- ST_MakeLine - 포인트, 멀티포인트 또는 라&#x 도형으로부터 라인스트링을 생&
- ST_MakePoint - Creates a 2D, 3DZ or 4D Point.
- ST_MakePolygon - Creates a Polygon from a shell and optional list of holes.
- ST_MakeSolid - 도형을 입체로 지정합니다. 어떤 확인 작업도 수행하지 않습& 유효한 입체를 얻으려면, 입력 도& 닫힌 다면체 표면 또는 닫힌 TIN이&#xc5 합니다.
- ST_MakeValid - Attempts to make an invalid geometry valid without losing vertices.
- ST_MemSize - ST_Geometry 값의 도형 유형을 반환합&
- ST_MemUnion - Aggregate function which unions geometries in a memory-efficent but slower way
- ST_NDims - ST_Geometry 값의 좌표 차원을 반환합&#x
- ST_NPoints - 도형이 가지고 있는 포인트(&#xaf 개수를 반환합니다.
- ST_NRings - 폴리곤 도형의 내곽 고리의 개수를 반환합니다.
- ST_Node - Nodes a collection of lines.
- ST_NumGeometries - 도형이 가지고 있는 포인&#xd2b8 개수를 반환합니다. 모든 도형을 입력받을 수 있습니다.

- ST_NumPatches - 다면체 표면 상에 있는 면의 개수를 반환합니다. 다면체 도형아닌 경우 NULL을 반환할 것입니다.
- ST_Orientation - 표면의 방향(orientation)을 결정합니&#
- ST_PatchN - ST_Geometry 값의 도형 유형을 반환합&#
- ST_PointFromWKB - 주어진 SRID와 함께 WKB로부터 도형을 만듭니다.
- ST_PointN - ST_LineString 또는 ST_CircularString 값에 있는 포인&#x 개수를 반환합니다.
- ST_PointOnSurface - Computes a point guaranteed to lie in a polygon, or on a geometry.
- ST_Points - 도형의 모든 좌표들을 담고 있는 멀티포인트를 반환합니다.
- ST_Polygon - Creates a Polygon from a LineString with a specified SRID.
- ST_RemovePoint - Remove a point from a linestring.
- ST_RemoveRepeatedPoints - Returns a version of a geometry with duplicate points removed.
- ST_Reverse - 꼭짓점들의 순서가 반대인 도형을 반환합니다.
- ST_Rotate - Rotates a geometry about an origin point.
- ST_RotateX - Rotates a geometry about the X axis.
- ST_RotateY - Rotates a geometry about the Y axis.
- ST_RotateZ - Rotates a geometry about the Z axis.
- ST_Scale - Scales a geometry by given factors.
- ST_Scroll - Change start point of a closed LineString.
- ST_SetPoint - 라인스트링의 포인트를 주&#xc5b 포인트로 대체합니다.
- ST_ShiftLongitude - Shifts the longitude coordinates of a geometry between -180..180 and 0..360.
- ST_SnapToGrid - 입력 도형의 모든 포인트를 정규 그리드로 스냅(snap)시킵니다.
- ST_StartPoint - Returns the first point of a LineString.
- ST_StraightSkeleton - 도형으로부터 직선 골격(straight skeleton)을 계산합니다.
- ST_SwapOrdinates - 입력 도형을 좌표값을 뒤바 상태로 반환합니다.
- ST_SymDifference - Computes a geometry representing the portions of geometries A and B that do not intersect.
- ST_Tesselate - 폴리곤 또는 다면체 표면의 표면 다듬기(tesselation) 작업을 수행한 &#xb2e4 TIN 또는 TIN 집합으로 반환합니다.
- ST_TransScale - Translates and scales a geometry by given offsets and factors.
- ST_Translate - Translates a geometry by given offsets.

- ST_UnaryUnion - Computes the union of the components of a single geometry.
- ST_Union - Computes a geometry representing the point-set union of the input geometries.
- ST_Volume - 3차원 입체의 부피를 계산합&#xb2 표면 도형을 입력하면 (닫힌 도&#xd615 0을 반환할 것입니다.
- ST_WrapX - X값 근처에서 도형을 래핑합&#xb2
- ST_X - Returns the X coordinate of a Point.
- ST_XMax - Returns the X maxima of a 2D or 3D bounding box or a geometry.
- ST_XMin - Returns the X minima of a 2D or 3D bounding box or a geometry.
- ST_Y - Returns the Y coordinate of a Point.
- ST_YMax - Returns the Y maxima of a 2D or 3D bounding box or a geometry.
- ST_YMin - Returns the Y minima of a 2D or 3D bounding box or a geometry.
- ST_Z - Returns the Z coordinate of a Point.
- ST_ZMax - Returns the Z maxima of a 2D or 3D bounding box or a geometry.
- ST_ZMin - Returns the Z minima of a 2D or 3D bounding box or a geometry.
- ST_Zmflag - ST_Geometry 값의 좌표 차원을 반환합&#x
- TG_Equals - 두 TopoGeometry가 동일한 지형 원시형&# 이루어졌을 경우 참을 반환합니&
- TG_Intersects - 두 TopoGeometry에서 나온 원시형의 쌍 가운데 하나라도 교차할 경우 참을 반환합니다.
- UpdateGeometrySRID - Updates the SRID of all features in a geometry column, and the table metadata.
- geometry_overlaps_nd - A의 n차원 경계 상자와 B의 n차& 경계 상자가 교차하는 경우 TRUE 를 반환합니다.
- overlaps_nd_geometry_gidx - Returns TRUE if a geometry's (cached) n-D bounding box intersects a n-D float precision bounding box (GIDX).
- overlaps_nd_gidx_geometry - Returns TRUE if a n-D float precision bounding box (GIDX) intersects a geometry's (cached) n-D bounding box.
- overlaps_nd_gidx_gidx - Returns TRUE if two n-D float precision bounding boxes (GIDX) intersect each other.
- postgis_sfcgal_full_version - Returns the full version of SFCGAL in use including CGAL and Boost versions
- postgis_sfcgal_version - 실행중인 SFCGAL의 버전을 반&#xd6

12.9 PostGIS Curved Geometry Support Functions

The functions given below are PostGIS functions that can use CIRCULARSTRING, CURVEPOLYGON, and other curved geometry types

- AddGeometryColumn - 공간 테이블에서 지오메&#xd2b8 컬럼을 제거합니다.

- Box2D - Returns a BOX2D representing the 2D extent of a geometry.
- Box3D - Returns a BOX3D representing the 3D extent of a geometry.
- DropGeometryColumn - 공간 테이블에서 지오메&#xd2b 컬럼을 제거합니다.
- 도형 유형 - ST_Geometry 값의 도형 유형을 반환합니다.
- PostGIS_AddBBox - Add bounding box to the geometry.
- PostGIS_DropBBox - Drop the bounding box cache from the geometry.
- PostGIS_HasBBox - Returns TRUE if the bbox of this geometry is cached, FALSE otherwise.
- ST_3DExtent - Aggregate function that returns the 3D bounding box of geometries.
- ST_Affine - Apply a 3D affine transformation to a geometry.
- ST_AsBinary - Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsEWKB - Return the Extended Well-Known Binary (EWKB) representation of the geometry with SRID meta data.
- ST_AsEWKT - 도형의 WKT(Well-Known Text) 표현식을 SRID 메&#x 함께 반환합니다.
- ST_AsHEXEWKB - 도형을 소 엔디안(NDR) 또는 대 엔디안(XDR) 인코딩을 통해 HEXEWKB (텍스& 형식으로 반환합니다.
- ST_AsSVG - Returns SVG path data for a geometry.
- ST_AsText - 도형/지리형의 WKT(Well-Known Text) 표현식&# SRID 메타데이터 없이 반환합니다.
- ST_ClusterDBSCAN - Window function that returns a cluster id for each input geometry using the DBSCAN algorithm.
- ST_ClusterWithin - Aggregate function that clusters input geometries by separation distance.
- ST_ClusterWithinWin - Window function that returns a cluster id for each input geometry, clustering using separation distance.
- ST_GeomCollFromText - Creates a GeometryCollection or Multi* geometry from a set of geometries.
- ST_CoordDim - ST_Geometry 값의 좌표 차원을 반환합&
- ST_CurveToLine - Converts a geometry containing curves to a linear geometry.
- ST_Distance - 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.
- ST_Dump - Returns a set of geometry_dump rows for the components of a geometry.
- ST_NumPoints - 도형의 내용을 요약한 텍스&#x 반환합니다.
- ST_EndPoint - ST_LineString 또는 ST_CircularString 값에 있는 포인& 개수를 반환합니다.
- ST_EstimatedExtent - Returns the estimated extent of a spatial table.
- ST_FlipCoordinates - Returns a version of a geometry with X and Y axis flipped.
- ST_Force2D - 도형을 "2차원 모드"로 강제합&#x

- ST_ForceCurve - 적용이 가능한 경우, 도형을 해당 도형의 만곡 유형으로 상위 형변환(upcast)합니다.
- ST_ForceSFS - 도형이 SFS 1.1 도형 유형만을 쓰&#xb3c 강제합니다.
- ST_Force3D - 도형을 XYZ 모드로 강제합니다. ST_Force3DZ라고도 합니다.
- ST_Force3DM - 도형을 XYM 모드로 강제합니&#xb2e4
- ST_Force3DZ - 도형을 XYZ 모드로 강제합니다.
- ST_Force4D - 도형을 XYZM 모드로 강제합니&#xb2e4
- ST_ForceCollection - 도형을 도형 집합으로 변&#xd658
- ST_GeoHash - 도형의 GeoHash 표현식을 반환합&#xb2
- ST_GeogFromWKB - WKB 도형 표현식 또는 EWKB(확장 WKB)로부터 지리형 인스턴스를 생&#xc
- ST_GeomFromEWKB - EWKB(Extended Well-Known Binary)로부터 지정된 ST_Geometry 값을 반환합니다.
- ST_GeomFromEWKT - EWKT(Extended Well-Known Text)로부터 지정된 ST_Geome 값을 반환합니다.
- ST_GeomFromText - WKT 표현식으로부터 지정된 ST_Geometry 값을 반환합니다.
- ST_GeomFromWKB - WKB(Well-Known Binary) 도형 표현식과 선택& SRID로부터 도형 인스턴스를 생성&#xd
- ST_GeometryN - ST_Geometry 값의 도형 유형을 반환&#xd569
- = - Returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B.
- &<| - A의 경계 상자가 B의 경계 상자와 겹치거나 그 아래에 있을 경우 TRUE 를 반환합니다.
- ST_HasArc - Tests if a geometry contains a circular arc
- ST_Intersects - Tests if two geometries intersect (they have at least one point in common)
- ST_IsClosed - LINESTRING 의 시작점과 종단점이 일&# 경우 TRUE 를 반환합니다. 다면체 표&# 닫혀 (부피를 가지고) 있는 경우 TRUE 를 반환합니다.
- ST_IsCollection - 해당 도형이 텅 빈 도형 집합, 폴리곤, 포인트 등인 경우 TRUE 를 반&#x
- ST_IsEmpty - Tests if a geometry is empty.
- ST_LineToCurve - Converts a linear geometry to a curved geometry.
- ST_MemSize - ST_Geometry 값의 도형 유형을 반환합&
- ST_NPoints - 도형이 가지고 있는 포인트(&#xaf 개수를 반환합니다.

- ST_NRings - 폴리곤 도형의 내곽 고리의 개수를 반환합니다.
- ST_PointFromWKB - 주어진 SRID와 함께 WKB로부터 도형을 만듭니다.
- ST_PointN - ST_LineString 또는 ST_CircularString 값에 있는 포인&#x 개수를 반환합니다.
- ST_Points - 도형의 모든 좌표들을 담고 있는 멀티포인트를 반환합니다.
- ST_Rotate - Rotates a geometry about an origin point.
- ST_RotateZ - Rotates a geometry about the Z axis.
- ST_SRID - Returns the spatial reference identifier for a geometry.
- ST_Scale - Scales a geometry by given factors.
- ST_SetSRID - Set the SRID on a geometry.
- ST_StartPoint - Returns the first point of a LineString.
- ST_Summary - 도형의 내용을 요약한 텍스&#xd 반환합니다.
- ST_SwapOrdinates - 입력 도형을 좌표값을 뒤바 상태로 반환합니다.
- ST_TransScale - Translates and scales a geometry by given offsets and factors.
- ST_Transform - Return a new geometry with coordinates transformed to a different spatial reference system.
- ST_Translate - Translates a geometry by given offsets.
- ST_XMax - Returns the X maxima of a 2D or 3D bounding box or a geometry.
- ST_XMin - Returns the X minima of a 2D or 3D bounding box or a geometry.
- ST_YMax - Returns the Y maxima of a 2D or 3D bounding box or a geometry.
- ST_YMin - Returns the Y minima of a 2D or 3D bounding box or a geometry.
- ST_ZMax - Returns the Z maxima of a 2D or 3D bounding box or a geometry.
- ST_ZMin - Returns the Z minima of a 2D or 3D bounding box or a geometry.
- ST_Zmflag - ST_Geometry 값의 좌표 차원을 반환합&#x
- UpdateGeometrySRID - Updates the SRID of all features in a geometry column, and the table metadata.
- ~(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains another 2D float precision bounding box (BOX2DF).
- ~(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains a geometry's 2D bonding box.
- ~(geometry,box2df) - Returns TRUE if a geometry's 2D bonding box contains a 2D float precision bounding box (GIDX).
- && - A의 2D 경계 상자와 B의 2D 경계 상자&#xa 교차하는 경우 TRUE 를 반환합니다.
- &&& - A의 n차원 경계 상자와 B의 n차원 경계 상자가 교차하는 경우 TRUE 를 반환합니다.

- @(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into another 2D float precision bounding box.
- @(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into a geometry's 2D bounding box.
- @(geometry,box2df) - Returns TRUE if a geometry's 2D bounding box is contained into a 2D float precision bounding box (BOX2DF).
- &&(box2df,box2df) - Returns TRUE if two 2D float precision bounding boxes (BOX2DF) intersect each other.
- &&(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) intersects a geometry's (cached) 2D bounding box.
- &&(geometry,box2df) - Returns TRUE if a geometry's (cached) 2D bounding box intersects a 2D float precision bounding box (BOX2DF).
- &&&(geometry,gidx) - Returns TRUE if a geometry's (cached) n-D bounding box intersects a n-D float precision bounding box (GIDX).
- &&&(gidx,geometry) - Returns TRUE if a n-D float precision bounding box (GIDX) intersects a geometry's (cached) n-D bounding box.
- &&&(gidx,gidx) - Returns TRUE if two n-D float precision bounding boxes (GIDX) intersect each other.

12.10 PostGIS Polyhedral Surface Support Functions

The functions given below are PostGIS functions that can use POLYHEDRALSURFACE, POLYHEDRALSURFACEM geometries

- AddGeometryColumn - 공간 테이블에서 지오메&#xd2b8
  컬럼을 제거합니다.
- Box2D - Returns a BOX2D representing the 2D extent of a geometry.
- Box3D - Returns a BOX3D representing the 3D extent of a geometry.
- DropGeometryColumn - 공간 테이블에서 지오메&#xd2b
  컬럼을 제거합니다.
- 도형 유형 - ST_Geometry 값의 도형 유형을
  반환합니다.
- PostGIS_AddBBox - Add bounding box to the geometry.
- PostGIS_DropBBox - Drop the bounding box cache from the geometry.
- PostGIS_HasBBox - Returns TRUE if the bbox of this geometry is cached, FALSE otherwise.
- ST_3DExtent - Aggregate function that returns the 3D bounding box of geometries.
- ST_Affine - Apply a 3D affine transformation to a geometry.
- ST_AsBinary - Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsEWKB - Return the Extended Well-Known Binary (EWKB) representation of the geometry with SRID meta data.
- ST_AsEWKT - 도형의 WKT(Well-Known Text) 표현식을 SRID 메&#x
  함께 반환합니다.

- ST_AsHEXEWKB - 도형을 소 엔디안(NDR) 또는 대 엔디안(XDR) 인코딩을 통해 HEXEWKB (텍스&
  형식으로 반환합니다.
- ST_AsSVG - Returns SVG path data for a geometry.
- ST_AsText - 도형/지리형의 WKT(Well-Known Text) 표현식&#
  SRID 메타데이터 없이 반환합니다.
- ST_ClusterDBSCAN - Window function that returns a cluster id for each input geometry using the DBSCAN algorithm.
- ST_ClusterWithin - Aggregate function that clusters input geometries by separation distance.
- ST_ClusterWithinWin - Window function that returns a cluster id for each input geometry, clustering using separation distance.
- ST_GeomCollFromText - Creates a GeometryCollection or Multi* geometry from a set of geometries.
- ST_CoordDim - ST_Geometry 값의 좌표 차원을 반환합
- ST_CurveToLine - Converts a geometry containing curves to a linear geometry.
- ST_Distance - 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.
- ST_Dump - Returns a set of geometry_dump rows for the components of a geometry.
- ST_NumPoints - 도형의 내용을 요약한 텍스&#x
  반환합니다.
- ST_EndPoint - ST_LineString 또는 ST_CircularString 값에 있는 포인&
  개수를 반환합니다.
- ST_EstimatedExtent - Returns the estimated extent of a spatial table.
- ST_FlipCoordinates - Returns a version of a geometry with X and Y axis flipped.
- ST_Force2D - 도형을 "2차원 모드"로 강제합&#x
- ST_ForceCurve - 적용이 가능한 경우, 도형을
  해당 도형의 만곡 유형으로 상위
  형변환(upcast)합니다.
- ST_ForceSFS - 도형이 SFS 1.1 도형 유형만을 쓰&#xb3c
  강제합니다.
- ST_Force3D - 도형을 XYZ 모드로 강제합니다.
  ST_Force3DZ라고도 합니다.
- ST_Force3DM - 도형을 XYM 모드로 강제합니&#xb2e4
- ST_Force3DZ - 도형을 XYZ 모드로 강제합니다
- ST_Force4D - 도형을 XYZM 모드로 강제합니&#xb2e4
- ST_ForceCollection - 도형을 도형 집합으로 변&#xd658
- ST_GeoHash - 도형의 GeoHash 표현식을 반환합&#xb2
- ST_GeogFromWKB - WKB 도형 표현식 또는 EWKB(확장
  WKB)로부터 지리형 인스턴스를 생&#x
- ST_GeomFromEWKB - EWKB(Extended Well-Known Binary)로부터 지정된
  ST_Geometry 값을 반환합니다.
- ST_GeomFromEWKT - EWKT(Extended Well-Known Text)로부터 지정된 ST_Geome
  값을 반환합니다.

- ST_GeomFromText - WKT 표현식으로부터 지정된 ST_Geometry 값을 반환합니다.
- ST_GeomFromWKB - WKB(Well-Known Binary) 도형 표현식과 선택&
SRID로부터 도형 인스턴스를 생성&#xd
- ST_GeometryN - ST_Geometry 값의 도형 유형을 반환&#xd569
- = - Returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B.
- &<| - A의 경계 상자가 B의 경계 상자와 겹치거나 그 아래에 있을 경우 TRUE 를 반환합니다.
- ST_HasArc - Tests if a geometry contains a circular arc
- ST_Intersects - Tests if two geometries intersect (they have at least one point in common)
- ST_IsClosed - LINESTRING 의 시작점과 종단점이 일&
경우 TRUE 를 반환합니다. 다면체 표&
닫혀 (부피를 가지고) 있는 경우
TRUE 를 반환합니다.
- ST_IsCollection - 해당 도형이 텅 빈 도형 집합,
폴리곤, 포인트 등인 경우 TRUE 를 반&#x
- ST_IsEmpty - Tests if a geometry is empty.
- ST_LineToCurve - Converts a linear geometry to a curved geometry.
- ST_MemSize - ST_Geometry 값의 도형 유형을 반환합&
- ST_NPoints - 도형이 가지고 있는 포인트(&#xaf
개수를 반환합니다.
- ST_NRings - 폴리곤 도형의 내곽 고리의
개수를 반환합니다.
- ST_PointFromWKB - 주어진 SRID와 함께 WKB로부터
도형을 만듭니다.
- ST_PointN - ST_LineString 또는 ST_CircularString 값에 있는 포인&#x
개수를 반환합니다.
- ST_Points - 도형의 모든 좌표들을 담고
있는 멀티포인트를 반환합니다.
- ST_Rotate - Rotates a geometry about an origin point.
- ST_RotateZ - Rotates a geometry about the Z axis.
- ST_SRID - Returns the spatial reference identifier for a geometry.
- ST_Scale - Scales a geometry by given factors.
- ST_SetSRID - Set the SRID on a geometry.
- ST_StartPoint - Returns the first point of a LineString.
- ST_Summary - 도형의 내용을 요약한 텍스&#xd
반환합니다.
- ST_SwapOrdinates - 입력 도형을 좌표값을 뒤바
상태로 반환합니다.

- ST_TransScale - Translates and scales a geometry by given offsets and factors.
- ST_Transform - Return a new geometry with coordinates transformed to a different spatial reference system.
- ST_Translate - Translates a geometry by given offsets.
- ST_XMax - Returns the X maxima of a 2D or 3D bounding box or a geometry.
- ST_XMin - Returns the X minima of a 2D or 3D bounding box or a geometry.
- ST_YMax - Returns the Y maxima of a 2D or 3D bounding box or a geometry.
- ST_YMin - Returns the Y minima of a 2D or 3D bounding box or a geometry.
- ST_ZMax - Returns the Z maxima of a 2D or 3D bounding box or a geometry.
- ST_ZMin - Returns the Z minima of a 2D or 3D bounding box or a geometry.
- ST_Zmflag - ST_Geometry 값의 좌표 차원을 반환합&#x
- UpdateGeometrySRID - Updates the SRID of all features in a geometry column, and the table metadata.
- ~(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains another 2D float precision bounding box (BOX2DF).
- ~(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) contains a geometry's 2D bonding box.
- ~(geometry,box2df) - Returns TRUE if a geometry's 2D bonding box contains a 2D float precision bounding box (GIDX).
- && - A의 2D 경계 상자와 B의 2D 경계 상자&#xa 교차하는 경우 TRUE 를 반환합니다.
- &&& - A의 n차원 경계 상자와 B의 n차원 경계 상자가 교차하는 경우 TRUE 를 반환합니다.
- @(box2df,box2df) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into another 2D float precision bounding box.
- @(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into a geometry's 2D bounding box.
- @(geometry,box2df) - Returns TRUE if a geometry's 2D bounding box is contained into a 2D float precision bounding box (BOX2DF).
- &&(box2df,box2df) - Returns TRUE if two 2D float precision bounding boxes (BOX2DF) intersect each other.
- &&(box2df,geometry) - Returns TRUE if a 2D float precision bounding box (BOX2DF) intersects a geometry's (cached) 2D bounding box.
- &&(geometry,box2df) - Returns TRUE if a geometry's (cached) 2D bounding box intersects a 2D float precision bounding box (BOX2DF).
- &&&(geometry,gidx) - Returns TRUE if a geometry's (cached) n-D bounding box intersects a n-D float precision bounding box (GIDX).
- &&&(gidx,geometry) - Returns TRUE if a n-D float precision bounding box (GIDX) intersects a geometry's (cached) n-D bounding box.
- &&&(gidx,gidx) - Returns TRUE if two n-D float precision bounding boxes (GIDX) intersect each other.

12.11 PostGIS Function Support Matrix

Below is an alphabetical listing of spatial specific functions in PostGIS and the kinds of spatial types they work with or OGC/SQL compliance they try to conform to.

- A ✓ means the function works with the type or subtype natively.
- A means it works but with a transform cast built-in using cast to geometry, transform to a "best srid" spatial ref and then cast back. Results may not be as expected for large areas or areas at poles and may accumulate floating point junk.
- A means the function works with the type because of a auto-cast to another such as to box3d rather than direct type support.
- A means the function only available if PostGIS compiled with SFCGAL support.
- A means the function support is provided by SFCGAL if PostGIS compiled with SFCGAL support, otherwise GEOS/built-in support.
- geom - Basic 2D geometry support (x,y).
- geog - Basic 2D geography support (x,y).
- 2.5D - basic 2D geometries in 3 D/4D space (has Z or M coord).
- PS - Polyhedral surfaces
- T - Triangles and Triangulated Irregular Network surfaces (TIN)

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
Box2D	✓			✓		✓	✓
Box3D	✓		✓	✓		✓	✓
도형유형	✓		✓	✓		✓	✓
PostGIS_AddBBox	✓			✓			
PostGIS_DropBBox	✓			✓			
PostGIS_HasBBox	✓			✓			
ST_3DArea							
ST_3DClosestPoint	✓		✓			✓	
ST_3DConvexHull							
ST_3DDFullyWithi	✓		✓			✓	
ST_3DDWithin	✓		✓		✓	✓	
ST_3DDifference							
ST_3DDistance	✓		✓		✓	✓	
ST_3DExtent	✓		✓	✓		✓	✓

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_3DIntersection							
ST_3DIntersects	✓		✓		✓	✓	✓
ST_3DLength	✓		✓		✓		
ST_LineInterpolatePoint	✓		✓				
ST_3DLongestLine	✓		✓			✓	
ST_3DMakeBox	✓						
ST_3DMaxDistance	✓		✓			✓	
ST_3DPerimeter	✓		✓		✓		
ST_3DShortestLine	✓		✓			✓	
ST_3DUnion							
ST_AddMeasure	✓		✓				
ST_AddPoint	✓		✓				
ST_Affine	✓		✓	✓		✓	✓
ST_AlphaShape							
ST_Angle	✓						
ST_ApproximateMedialAxis							
ST_Area	✓	✓			✓	✓	
ST_AsBinary	✓	✓	✓	✓	✓	✓	✓
ST_AsEWKB	✓		✓	✓		✓	✓
ST_AsEWKT	✓	✓	✓	✓		✓	✓
ST_AsEncodedPolyline	✓						
ST_AsFlatGeobuf							
ST_AsGML	✓	✓	✓		✓	✓	✓
ST_AsGeoJSON	✓	✓	✓				
ST_AsGeobuf							
ST_AsHEXEWKB	✓		✓	✓			
ST_AsKML	✓	✓	✓				
ST_AsLatLonText	✓						
ST_AsMARC21	✓						
ST_AsMVT							
ST_AsMVTGeom	✓						
ST_AsSVG	✓	✓		✓			

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_AsTWKB	✓						
ST_AsText	✓	✓		✓	✓		
ST_AsX3D	✓		✓			✓	✓
ST_Azimuth	✓	✓					
ST_BdMPolyFromT	✓						
ST_BdPolyFromTe	✓						
ST_Boundary	✓		✓		✓		
ST_BoundingDiago	✓		✓				
ST_Box2dFromGe h							
ST_Buffer	✓				✓		
ST_BuildArea	✓						
ST_CPAWithin	✓		✓				
ST_Centroid	✓	✓			✓		
ST_ChaikinSmooth	✓		✓				
ST_ClipByBox2D	✓						
ST_ClosestPoint	✓	✓					
ST_ClosestPointOf oach	✓		✓				
ST_ClusterDBSCA	✓			✓			
ST_ClusterIntersect	✓						
ST_ClusterIntersect Vin	✓						
ST_ClusterKMeans	✓						
ST_ClusterWithin	✓			✓			
ST_ClusterWithinW	✓			✓			
ST_GeomCollFrom	✓		✓	✓			
ST_CollectionExtra	✓						
ST_CollectionHom ize	✓						
ST_ConcaveHull	✓						
ST_ConstrainedDe yTriangles							
ST_Contains	✓				✓		
ST_ContainsProper	✓						
ST_ConvexHull	✓		✓		✓		
ST_CoordDim	✓		✓	✓	✓	✓	✓
ST_CoverageInvalic es	✓						

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_CoverageSimpli	✓						
ST_CoverageUnion	✓						
ST_CoveredBy	✓	✓					
ST_Covers	✓	✓					
ST_Crosses	✓				✓		
ST_CurveToLine	✓		✓	✓	✓		
ST_DFullyWithin	✓						
ST_DWithin	✓	✓					
ST_DelaunayTriang	✓		✓				✓
ST_Difference	✓		✓		✓		
ST_Dimension	✓				✓	✓	✓
ST_Disjoint	✓				✓		
ST_Distance	✓	✓		✓	✓		
ST_DistanceCPA	✓		✓				
ST_DistanceSphere	✓						
ST_DistanceSphero	✓						
ST_Dump	✓		✓	✓		✓	✓
ST_NumPoints	✓		✓	✓		✓	✓
ST_NRings	✓		✓				
ST_NumPoints	✓		✓				✓
ST_EndPoint	✓		✓	✓	✓		
ST_Envelope	✓				✓		
ST_Equals	✓				✓		
ST_EstimatedExten	✓			✓			
ST_Expand	✓					✓	✓
ST_Extent	✓					✓	✓
ST_ExteriorRing	✓		✓		✓		
ST_Extrude							
ST_FilterByM	✓						
ST_FlipCoordinates	✓		✓	✓		✓	✓
ST_Force2D	✓		✓	✓		✓	
ST_ForceCurve	✓		✓	✓			
ST_ForceLHR							

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_ForcePolygonC	✓		✓				
ST_ForcePolygonC	✓		✓				
ST_ForceRHR	✓		✓			✓	
ST_ForceSFS	✓		✓	✓		✓	✓
ST_Force3D	✓		✓	✓		✓	
ST_Force3DM	✓			✓			
ST_Force3DZ	✓		✓	✓		✓	
ST_Force4D	✓		✓	✓			
ST_ForceCollection	✓		✓	✓		✓	
ST_FrechetDistance	✓						
ST_FromFlatGeobuf							
ST_FromFlatGeobu	✓	Table					
ST_GMLToSQL	✓				✓		
ST_GeneratePoints	✓						
ST_GeoHash	✓			✓			
ST_GeogFromText		✓					
ST_GeogFromWKB		✓		✓			
ST_GeographyFromText		✓					
ST_GeomCollFrom	✓	:			✓		
ST_GeomFromEWI	✓		✓	✓		✓	✓
ST_GeomFromEWI	✓		✓	✓		✓	✓
ST_GeomFromGM	✓		✓			✓	✓
ST_GeomFromGeo	✓	n					
ST_GeomFromGeo	✓	N	✓				
ST_GeomFromKM	✓		✓				
ST_GeomFromMA	✓	l					
ST_GeomFromTWI	✓						
ST_GeomFromText	✓			✓	✓		
ST_GeomFromWK	✓			✓	✓		
ST_GeometricMedi	✓		✓				
ST_GeometryFrom	✓				✓		
ST_GeometryN	✓		✓	✓	✓	✓	✓
ST_GeometryType	✓		✓		✓	✓	
I>>	✓						

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
<<|	✓						
~	✓						
@	✓						
=	✓	✓		✓		✓	
<<	✓						
|&>	✓						
&<|	✓			✓		✓	
&<	✓						
&>	✓						
>>	✓						
~=	✓					✓	
ST_HasArc	✓		✓	✓			
ST_HausdorffDistar	✓						
ST_Hexagon	✓						
ST_HexagonGrid	✓						
ST_InteriorRingN	✓		✓		✓		
ST_InterpolatePoint	✓		✓				
ST_Intersection	✓	😁	✓		✓		
ST_Intersects	✓	✓		✓	✓		✓
ST_InverseTransfor	✓ peline						
ST_IsClosed	✓		✓	✓	✓	✓	
ST_IsCollection	✓		✓	✓			
ST_IsEmpty	✓			✓	✓		
ST_IsPlanar	🧊		🧊			🧊	🧊
ST_IsPolygonCCW	✓		✓				
ST_IsPolygonCW	✓		✓				
ST_IsRing	✓				✓		
ST_IsSimple	✓		✓		✓		
ST_IsSolid	🧊		🧊			🧊	🧊
ST_IsValid	✓				✓		
ST_IsValidDetail	✓						
ST_IsValidReason	✓						
ST_IsValidTrajector	✓		✓				

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_LargestEmptyC	✓						
ST_Length	✓	✓			✓		
ST_Length2D	✓						
ST_LengthSpheroid	✓		✓				
ST_Letters	✓						
ST_LineCrossingDi	✓ ion						
ST_LineExtend	✓						
ST_LineFromEncoc	✓ olyline						
ST_LineFromMulti	✓ t		✓				
ST_LineFromText	✓				✓		
ST_LineFromWKB	✓				✓		
ST_LineInterpolatel	✓ t	✓	✓				
ST_LineInterpolatel	✓ ts	✓	✓				
ST_LineLocatePoin	✓	✓					
ST_LineMerge	✓						
ST_LineSubstring	✓	✓	✓				
ST_LineToCurve	✓		✓	✓			
ST_LinestringFrom	✓ B				✓		
ST_LocateAlong	✓				✓		
ST_LocateBetween	✓				✓		
ST_LocateBetweenI	✓ ations		✓				
ST_LongestLine	✓						
ST_M	✓		✓		✓		
ST_MLineFromTex	✓				✓		
ST_MPointFromTe	✓				✓		
ST_MPolyFromTex	✓				✓		
ST_MakeBox2D	✓						
ST_MakeEnvelope	✓						
ST_MakeLine	✓		✓				
ST_MakePoint	✓		✓				
ST_MakePointM	✓						
ST_MakePolygon	✓		✓				
ST_MakeSolid							

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_MakeValid	✓		✓				
ST_MaxDistance	✓						
ST_MaximumInscri	✓ Circle						
ST_MemSize	✓		✓	✓		✓	✓
ST_MemUnion	✓		✓				
ST_MinimumBoun	✓ Circle						
ST_MinimumBoun	✓ Radius						
ST_MinimumClear	✓						
ST_MinimumClear	✓ Line						
ST_MinkowskiSun							
ST_Multi	✓						
ST_NDims	✓		✓				
ST_NPoints	✓		✓	✓		✓	
ST_NRings	✓		✓	✓			
ST_Node	✓		✓				
ST_Normalize	✓						
ST_NumGeometrie	✓		✓		✓	✓	✓
ST_NumInteriorRin	✓						
ST_NumInteriorRin	✓				✓		
ST_NumPatches	✓		✓		✓	✓	
ST_NumPoints	✓				✓		
ST_OffsetCurve	✓						
ST_OptimalAlphaS							
ST_OrderingEquals	✓				✓		
ST_Orientation							
ST_OrientedEnvelo	✓						
ST_Overlaps	✓				✓		
ST_PatchN	✓		✓		✓	✓	
ST_Perimeter	✓	✓			✓		
ST_Perimeter2D	✓						
ST_Point	✓				✓		
ST_PointFromGeoHash							
ST_PointFromText	✓				✓		

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_PointFromWKB	✓		✓	✓	✓		
ST_PointInsideCirc	✓						
ST_Point	✓						
ST_PointN	✓		✓	✓	✓		
ST_PointOnSurface	✓		✓		✓		
ST_Point	✓						
ST_Point	✓						
ST_Points	✓		✓	✓			
ST_Polygon	✓		✓		✓		
ST_PolygonFromTe	✓				✓		
ST_Polygonize	✓						
ST_Project	✓	✓					
ST_QuantizeCoordi	✓ s						
ST_ReducePrecisio	✓						
ST_Relate	✓				✓		
ST_RelateMatch							
ST_RemovePoint	✓		✓				
ST_RemoveRepeate	✓ ints		✓			✓	
ST_Reverse	✓		✓			✓	
ST_Rotate	✓		✓	✓		✓	✓
ST_RotateX	✓		✓			✓	✓
ST_RotateY	✓		✓			✓	✓
ST_RotateZ	✓		✓	✓		✓	✓
ST_SRID	✓			✓	✓		
ST_Scale	✓		✓	✓		✓	✓
ST_Scroll	✓		✓				
ST_Segmentize	✓	✓					
ST_SetEffectiveAre	✓						
ST_SetPoint	✓		✓				
ST_SetSRID	✓			✓			
ST_SharedPaths	✓						
ST_ShiftLongitude	✓		✓			✓	✓
ST_ShortestLine	✓	✓					
ST_Simplify	✓						

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_SimplifyPolygo	✓ ll						
ST_SimplifyPreserv	✓ pology						
ST_SimplifyVW	✓						
ST_Snap	✓						
ST_SnapToGrid	✓		✓				
ST_Split	✓						
ST_Square	✓						
ST_SquareGrid	✓						
ST_StartPoint	✓		✓	✓	✓		
ST_StraightSkeleto							
ST_Subdivide	✓						
ST_Summary	✓	✓		✓		✓	✓
ST_SwapOrdinates	✓		✓	✓		✓	✓
ST_SymDifference	✓		✓		✓		
ST_Tesselate							
ST_MakeEnvelope	✓						
ST_Touches	✓				✓		
ST_TransScale	✓		✓	✓			
ST_Transform	✓			✓	✓	✓	
ST_TransformPipel	✓						
ST_Translate	✓		✓	✓			
ST_TriangulatePoly	✓						
ST_UnaryUnion	✓		✓				
ST_Union	✓		✓		✓		
ST_Volume							
ST_VoronoiLines	✓						
ST_VoronoiPolygor	✓						
ST_WKBToSQL	✓				✓		
ST_WKTToSQL	✓				✓		
ST_Within	✓				✓		
ST_WrapX	✓		✓				
ST_X	✓		✓		✓		
ST_XMax			✓	✓			

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
ST_XMin	✓		✓	✓			
ST_Y	✓		✓		✓		
ST_YMax	✓		✓	✓			
ST_YMin	✓		✓	✓			
ST_Z	✓		✓		✓		
ST_ZMax	✓		✓	✓			
ST_ZMin	✓		✓	✓			
ST_Zmflag	✓		✓	✓			
~(box2df,box2df)	✓			✓		✓	
~(box2df,geometry)	✓			✓		✓	
~(geometry,box2df)	✓			✓		✓	
<#>	✓						
<<#>>	✓						
<<->>	✓						
|=|	✓						
<->	✓	✓					
&&	✓	✓		✓		✓	
&&&	✓		✓	✓		✓	✓
@(box2df,box2df)	✓			✓		✓	
@(box2df,geometry	✓			✓		✓	
@(geometry,box2df	✓			✓		✓	
&&(box2df,box2df)	✓			✓		✓	
&&(box2df,geomet	✓			✓		✓	
&&(geometry,box2	✓			✓		✓	
&&&(geometry,gid	✓		✓	✓		✓	✓
&&&(gidx,geometr	✓		✓	✓		✓	✓
&&&(gidx,gidx)			✓	✓		✓	✓
postgis.backend							
postgis.enable_outdb_rasters							
postgis.gdal_datapath							
postgis.gdal_enabled_drivers							
postgis.gdal_datapath							
postgis_sfcgal_version							
postgis_sfcgal_version							
postgis_srs							
postgis_srs_all							

Function	geom	geog	2.5D	Curves	SQL MM	PS	T
postgis_srs_codes							
postgis_srs_search	✓						

12.12 New, Enhanced or changed PostGIS Functions

12.12.1 PostGIS Functions new or enhanced in 3.4

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 3.4

- PostGIS_GEOS_Compiled_Version - Availability: 3.4.0 Returns the version number of the GEOS library against which PostGIS was built.
- ST_ClusterIntersectingWin - Availability: 3.4.0 Window function that returns a cluster id for each input geometry, clustering input geometries into connected sets.
- ST_ClusterWithinWin - Availability: 3.4.0 Window function that returns a cluster id for each input geometry, clustering using separation distance.
- ST_CoverageInvalidEdges - Availability: 3.4.0 - requires GEOS >= 3.12.0 Window function that finds locations where polygons fail to form a valid coverage.
- ST_CoverageSimplify - Availability: 3.4.0 - requires GEOS >= 3.12.0 Window function that simplifies the edges of a polygonal coverage.
- ST_CoverageUnion - Availability: 3.4.0 - requires GEOS >= 3.8.0 Computes the union of a set of polygons forming a coverage by removing shared edges.
- ST_InverseTransformPipeline - Availability: 3.4.0 Return a new geometry with coordinates transformed to a different spatial reference system using the inverse of a defined coordinate transformation pipeline.
- ST_LargestEmptyCircle - Availability: 3.4.0. Computes the largest circle not overlapping a geometry.
- ST_LineExtend - Availability: 3.4.0 Returns a line with the last and first segments extended the specified distance(s).
- ST_TransformPipeline - Availability: 3.4.0 Return a new geometry with coordinates transformed to a different spatial reference system using a defined coordinate transformation pipeline.
- postgis_srs - Availability: 3.4.0 Return a metadata record for the requested authority and srid.
- postgis_srs_all - Availability: 3.4.0 Return metadata records for every spatial reference system in the underlying Proj database.
- postgis_srs_codes - Availability: 3.4.0 Return the list of SRS codes associated with the given authority.
- postgis_srs_search - Availability: 3.4.0 Return metadata records for projected coordinate systems that have areas of useage that fully contain the bounds parameter.

Functions enhanced in PostGIS 3.4

- PostGIS_Full_Version - Enhanced: 3.4.0 now includes extra PROJ configurations NETWORK_ENABLED, URL_ENDPOINT and DATABASE_PATH of proj.db location Reports full PostGIS version and build configuration infos.
- PostGIS_PROJ_Version - Enhanced: 3.4.0 now includes NETWORK_ENABLED, URL_ENDPOINT and DATABASE_PATH of proj.db location Returns the version number of the PROJ4 library.
- ST_AsSVG - Enhanced: 3.4.0 to support all curve types Returns SVG path data for a geometry.

- ST_Project - Enhanced: 3.4.0 Allow geometry arguments and two-point form omitting azimuth. Returns a point projected from a start point by a distance and bearing (azimuth).

Functions changed in PostGIS 3.4

- PostGIS_Extensions_Upgrade - Changed: 3.4.0 to add target_version argument. Packages and upgrades PostGIS extensions (e.g. postgis_raster, postgis_topology, postgis_sfcgal) to given or latest version.

12.12.2 PostGIS Functions new or enhanced in 3.3

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 3.3

- ST_3DConvexHull - 2.1.0 버전부터 사용할 수 있습&#xb
면 도형의 근사 중심축을 계산합&
- ST_3DUnion - Availability: 3.3.0 aggregate variant was added Perform 3D union.
- ST_AlphaShape - Availability: 3.3.0 - requires SFCGAL >= 1.4.1. Computes an Alpha-shape enclosing a geometry
- ST_AsMARC21 - Availability: 3.3.0 Returns geometry as a MARC21/XML record with a geographic datafield (034).
- ST_GeomFromMARC21 - Availability: 3.3.0, requires libxml2 2.6+ Takes MARC21/XML geographic data as input and returns a PostGIS geometry object.
- ST_Letters - 2.1.0 버전부터 사용할 수 있습니&
Returns the input letters rendered as geometry with a default start position at the origin and default text height of 100.
- ST_OptimalAlphaShape - Availability: 3.3.0 - requires SFCGAL >= 1.4.1. Computes an Alpha-shape enclosing a geometry using an "optimal" alpha value.
- ST_SimplifyPolygonHull - Availability: 3.3.0. Computes a simplifed topology-preserving outer or inner hull of a polygonal geometry.
- ST_TriangulatePolygon - Availability: 3.3.0. Computes the constrained Delaunay triangulation of polygons
- postgis_sfcgal_version - 2.1.0 버전부터 사용할 수 있습&
Returns the full version of SFCGAL in use including CGAL and Boost versions

Functions enhanced in PostGIS 3.3

- ST_ConcaveHull - Enhanced: 3.3.0, GEOS native implementation enabled for GEOS 3.11+ Computes a possibly concave geometry that contains all input geometry vertices
- ST_LineMerge - Enhanced: 3.3.0 accept a directed parameter. Return the lines formed by sewing together a MultiLineString.

Functions changed in PostGIS 3.3

- PostGIS_Extensions_Upgrade - Changed: 3.3.0 support for upgrades from any PostGIS version. Does not work on all systems. Packages and upgrades PostGIS extensions (e.g. postgis_raster, postgis_topology, postgis_sfcgal) to given or latest version.

12.12.3 PostGIS Functions new or enhanced in 3.2

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 3.2

- ST_AsFlatGeobuf - Availability: 3.2.0 Return a FlatGeobuf representation of a set of rows.
- ST_FromFlatGeobuf - Availability: 3.2.0 Reads FlatGeobuf data.
- ST_FromFlatGeobufToTable - Availability: 3.2.0 Creates a table based on the structure of FlatGeobuf data.
- ST_NumPoints - 2.2.0 버전부터 사용할 수 있습&#xb2c8 도형의 내용을 요약한 텍스트를 반환합니다.
- ST_Scroll - Availability: 3.2.0 Change start point of a closed LineString.
- postgis.gdal_datapath - 2.2.0 버전부터 사용할 수 있습&# DB 외부 래스터 밴드에 접근할 수 있게 해주는 불 설정 옵션입니다.

Functions enhanced in PostGIS 3.2

- ST_ClusterKMeans - Enhanced: 3.2.0 Support for max_radius Window function that returns a cluster id for each input geometry using the K-means algorithm.
- ST_MakeValid - Enhanced: 3.2.0, added algorithm options, 'linework' and 'structure' which requires GEOS >= 3.10.0. Attempts to make an invalid geometry valid without losing vertices.
- ST_Point - Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry. Creates a Point with X, Y and SRID values.
- ST_Point - Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry. Creates a Point with X, Y, Z and SRID values.
- ST_Point - Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry. Creates a Point with X, Y, M and SRID values.
- ST_Point - Enhanced: 3.2.0 srid as an extra optional argument was added. Older installs require combining with ST_SetSRID to mark the srid on the geometry. Creates a Point with X, Y, Z, M and SRID values.
- ST_RemovePoint - Enhanced: 3.2.0 Remove a point from a linestring.
- ST_RemoveRepeatedPoints - Enhanced: 3.2.0 Returns a version of a geometry with duplicate points removed.
- ST_StartPoint - Enhanced: 3.2.0 returns a point for all geometries. Prior behavior returns NULLs if input was not a LineString. Returns the first point of a LineString.

Functions changed in PostGIS 3.2

- ST_Boundary - Changed: 3.2.0 support for TIN, does not use geos, does not linearize curves 해당 도형& 결합된 범위의 닫힘 여부를 반환&

12.12.4 PostGIS Functions new or enhanced in 3.1

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 3.1

- ST_Hexagon - 2.1.0 버전부터 사용할 수 있습니&
  Returns a single hexagon, using the provided edge size and cell coordinate within the hexagon grid space.
- ST_HexagonGrid - 2.1.0 버전부터 사용할 수 있습&#xb2
  Returns a set of hexagons and cell indices that completely cover the bounds of the geometry argument.
- ST_MaximumInscribedCircle - Availability: 3.1.0. 도형의 기하학적 중심을 반환합니다.
- ST_ReducePrecision - Availability: 3.1.0. Returns a valid geometry with points rounded to a grid tolerance.
- ST_Square - 2.1.0 버전부터 사용할 수 있습니&#
  Returns a single square, using the provided edge size and cell coordinate within the square grid space.
- ST_SquareGrid - 2.1.0 버전부터 사용할 수 있습&#xb2c8
  Returns a set of grid squares and cell indices that completely cover the bounds of the geometry argument.

Functions enhanced in PostGIS 3.1

- ST_AsEWKT - Enhanced: 3.1.0 support for optional precision parameter. 도형의 WKT(Well-Known Text) 표현식을 SRID 메타데이터와 함께
  반환합니다.
- ST_ClusterKMeans - Enhanced: 3.1.0 Support for 3D geometries and weights Window function that returns a cluster id for each input geometry using the K-means algorithm.
- ST_Difference - Enhanced: 3.1.0 accept a gridSize parameter. Computes a geometry representing the part of geometry A that does not intersect geometry B.
- ST_Intersection - Enhanced: 3.1.0 accept a gridSize parameter Computes a geometry representing the shared portion of geometries A and B.
- ST_MakeEnvelope - 개선 사항: 2.0.0 버전에서 선택&#x
  기본 SRID 파라미터가 추가됐습니&#xb2
  Creates a rectangular Polygon in Web Mercator (SRID:3857) using the XYZ tile system.
- ST_MakeValid - Enhanced: 3.1.0, added removal of Coordinates with NaN values. Attempts to make an invalid geometry valid without losing vertices.
- ST_Subdivide - Enhanced: 3.1.0 accept a gridSize parameter. Computes a rectilinear subdivision of a geometry.
- ST_SymDifference - Enhanced: 3.1.0 accept a gridSize parameter. Computes a geometry representing the portions of geometries A and B that do not intersect.
- ST_UnaryUnion - Enhanced: 3.1.0 accept a gridSize parameter. Computes the union of the components of a single geometry.
- ST_Union - Enhanced: 3.1.0 accept a gridSize parameter. Computes a geometry representing the point-set union of the input geometries.

Functions changed in PostGIS 3.1

- ST_Force3D - Changed: 3.1.0. Added support for supplying a non-zero Z value. 도형을 XYZ 모드로 강제합니다. ST_Force3DZ라고도 합니다.
- ST_Force3DM - Changed: 3.1.0. Added support for supplying a non-zero M value. 도형을 XYM 모드로 강제합니다.

- ST_Force3DZ - Changed: 3.1.0. Added support for supplying a non-zero Z value. 도형을 XYZ 모드로 강제합니다.
- ST_Force4D - Changed: 3.1.0. Added support for supplying non-zero Z and M values. 도형을 XYZM 모드로 강제합니다.

12.12.5 PostGIS Functions new or enhanced in 3.0

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 3.0

- ST_ConstrainedDelaunayTriangles - 2.1.0 버전부터 사용할 수 있습니다. Return a constrained Delaunay triangulation around the given input geometry.
- ST_LineInterpolatePoint - 2.0.0 버전부터 사용할 수 있&#xc2b5
  Returns a point interpolated along a 3D line at a fractional location.
- ST_MakeEnvelope - 2.1.0 버전부터 사용할 수 있습&#xb
  Creates a rectangular Polygon in Web Mercator (SRID:3857) using the XYZ tile system.

Functions enhanced in PostGIS 3.0

- ST_AsMVT - Enhanced: 3.0 - added support for Feature ID. Aggregate function returning a MVT representation of a set of rows.
- ST_Contains - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if every point of B lies in A, and their interiors have a point in common
- ST_ContainsProperly - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if every point of B lies in the interior of A
- ST_CoveredBy - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if every point of A lies in B
- ST_Covers - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if every point of B lies in A
- ST_Crosses - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries have some, but not all, interior points in common
- ST_CurveToLine - Enhanced: 3.0.0 implemented a minimum number of segments per linearized arc to prevent topological collapse. Converts a geometry containing curves to a linear geometry.
- ST_Disjoint - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries have no points in common
- ST_Equals - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries include the same set of points
- ST_GeneratePoints - Enhanced: 3.0.0, added seed parameter Generates random points contained in a Polygon or MultiPolygon.
- ST_GeomFromGeoJSON - Enhanced: 3.0.0 parsed geometry defaults to SRID=4326 if not specified otherwise. GeoJSON 표현식을 입력받아 PostGIS 도형 객체&#
  출력합니다.
- ST_LocateBetween - Enhanced: 3.0.0 - added support for POLYGON, TIN, TRIANGLE. Returns the portions of a geometry that match a measure range.
- ST_LocateBetweenElevations - Enhanced: 3.0.0 - added support for POLYGON, TIN, TRIANGLE. Returns the portions of a geometry that lie in an elevation (Z) range.
- ST_Overlaps - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries have the same dimension and intersect, but each has at least one point not in the other

- ST_Relate - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries have a topological relationship matching an Intersection Matrix pattern, or computes their Intersection Matrix
- ST_Segmentize - Enhanced: 3.0.0 Segmentize geometry now produces equal-length subsegments Returns a modified geometry/geography having no segment longer than a given distance.
- ST_Touches - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if two geometries have at least one point in common, but their interiors do not intersect
- ST_Within - Enhanced: 3.0.0 enabled support for GEOMETRYCOLLECTION Tests if every point of A lies in B, and their interiors have a point in common

Functions changed in PostGIS 3.0

- PostGIS_Extensions_Upgrade - Changed: 3.0.0 to repackage loose extensions and support postgis_raster. Packages and upgrades PostGIS extensions (e.g. postgis_raster, postgis_topology, postgis_sfcgal) to given or latest version.
- ST_3DDistance - Changed: 3.0.0 - SFCGAL version removed 도형 유형에 대해 두 도형 사이의 (SRS에 기반한) 3차원 데카르트 최단 거리를 투영 단위&#x 반환합니다.
- ST_3DIntersects - Changed: 3.0.0 SFCGAL backend removed, GEOS backend supports TINs. Tests if two geometries spatially intersect in 3D - only for points, linestrings, polygons, polyhedral surface (area)
- ST_Area - Changed: 3.0.0 - does not depend on SFCGAL anymore. 도형의 기하학&#x 중심을 반환합니다.
- ST_AsGeoJSON - Changed: 3.0.0 support records as input Return a geometry as a GeoJSON element.
- ST_AsGeoJSON - Changed: 3.0.0 output SRID if not EPSG:4326. Return a geometry as a GeoJSON element.
- ST_AsKML - Changed: 3.0.0 - Removed the "versioned" variant signature 도형을 GML 2 또는 GML 3 버전 요소로 반환합니다.
- ST_Distance - Changed: 3.0.0 - does not depend on SFCGAL anymore. 두 도형 사이의 3차원 최장(longest) 라인을 반환합니다.
- ST_Intersection - Changed: 3.0.0 does not depend on SFCGAL. Computes a geometry representing the shared portion of geometries A and B.
- ST_Intersects - Changed: 3.0.0 SFCGAL version removed and native support for 2D TINS added. Tests if two geometries intersect (they have at least one point in common)
- ST_Union - Changed: 3.0.0 does not depend on SFCGAL. Computes a geometry representing the point-set union of the input geometries.

12.12.6 PostGIS Functions new or enhanced in 2.5

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.5

- PostGIS_Extensions_Upgrade - Availability: 2.5.0 Packages and upgrades PostGIS extensions (e.g. postgis_raster, postgis_topology, postgis_sfcgal) to given or latest version.
- ST_Angle - Availability: 2.5.0 두 도형 사이의 3차원 최&#xc7a5 라인을 반환합니다.
- ST_ChaikinSmoothing - Availability: 2.5.0 Returns a smoothed version of a geometry, using the Chaikin algorithm
- ST_FilterByM - Availability: 2.5.0 Removes vertices based on their M value

- ST_LineInterpolatePoints - Availability: 2.5.0 Returns points interpolated along a line at a fractional interval.
- ST_OrientedEnvelope - Availability: 2.5.0. Returns a minimum-area rectangle containing a geometry.
- ST_QuantizeCoordinates - Availability: 2.5.0 Sets least significant bits of coordinates to zero

Functions enhanced in PostGIS 2.5

- ST_AsMVT - Enhanced: 2.5.0 - added support parallel query. Aggregate function returning a MVT representation of a set of rows.
- ST_AsText - Enhanced: 2.5 - optional parameter precision introduced. 도형/지리형의 WKT(Well-Known Text) 표현식을 SRID 메타데이터 없 반환합니다.
- ST_Buffer - Enhanced: 2.5.0 - ST_Buffer geometry support was enhanced to allow for side buffering specification side=both|left|right. Computes a geometry covering all points within a given distance from a geometry.
- ST_GeomFromGeoJSON - Enhanced: 2.5.0 can now accept json and jsonb as inputs. GeoJSON 표현식&#xc74 입력받아 PostGIS 도형 객체를 출력합&#
- ST_GeometricMedian - Enhanced: 2.5.0 Added support for M as weight of points. 멀티 포인트& 기하학적 중심값(median)을 반환합니&#
- ST_Intersects - Enhanced: 2.5.0 Supports GEOMETRYCOLLECTION. Tests if two geometries intersect (they have at least one point in common)
- ST_OffsetCurve - Enhanced: 2.5 - added support for GEOMETRYCOLLECTION and MULTILINESTRING Returns an offset line at a given distance and side from an input line.
- ST_Scale - Enhanced: 2.5.0 support for scaling relative to a local origin (origin parameter) was introduced. Scales a geometry by given factors.
- ST_Split - Enhanced: 2.5.0 support for splitting a polygon by a multiline was introduced. Returns a collection of geometries created by splitting a geometry by another geometry.
- ST_Subdivide - Enhanced: 2.5.0 reuses existing points on polygon split, vertex count is lowered from 8 to 5. Computes a rectilinear subdivision of a geometry.

12.12.7 PostGIS Functions new or enhanced in 2.4

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.4

- ST_AsGeobuf - Availability: 2.4.0 Return a Geobuf representation of a set of rows.
- ST_AsMVT - Availability: 2.4.0 Aggregate function returning a MVT representation of a set of rows.
- ST_AsMVTGeom - Availability: 2.4.0 Transforms a geometry into the coordinate space of a MVT tile.
- ST_Centroid - Availability: 2.4.0 support for geography was introduced. 도형의 기하학 중심을 반환합니다.
- ST_ForcePolygonCCW - Availability: 2.4.0 Orients all exterior rings counter-clockwise and all interior rings clockwise.
- ST_ForcePolygonCW - Availability: 2.4.0 Orients all exterior rings clockwise and all interior rings counter-clockwise.
- ST_FrechetDistance - Availability: 2.4.0 - requires GEOS >= 3.7.0 두 도형 사이의 3차원 최단(shortest) 라인을 반환합니다.
- ST_IsPolygonCCW - 2.2.0 버전부터 사용할 수 있습&#x Tests if Polygons have exterior rings oriented counter-clockwise and interior rings oriented clockwise.

- ST_IsPolygonCW - 2.2.0 버전부터 사용할 수 있습&#xb
  Tests if Polygons have exterior rings oriented clockwise and interior rings oriented counter-clockwise.

Functions enhanced in PostGIS 2.4

- ST_AsTWKB - Enhanced: 2.4.0 memory and speed improvements. 도형을 TWKB(Tiny Well-Known Binary)로 반환합니다.
- ST_Covers - Enhanced: 2.4.0 Support for polygon in polygon and line in polygon added for geography type Tests if every point of B lies in A
- ST_CurveToLine - Enhanced: 2.4.0 added support for max-deviation and max-angle tolerance, and for symmetric output. Converts a geometry containing curves to a linear geometry.
- ST_Project - Enhanced: 2.4.0 Allow negative distance and non-normalized azimuth. Returns a point projected from a start point by a distance and bearing (azimuth).
- ST_Reverse - Enhanced: 2.4.0 support for curves was introduced. 꼭짓점들의 순&#xc11
  반대인 도형을 반환합니다.

Functions changed in PostGIS 2.4

- = - Changed: 2.4.0, in prior versions this was bounding box equality not a geometric equality. If you need bounding box equality, use instead. Returns TRUE if the coordinates and coordinate order geometry/geography A are the same as the coordinates and coordinate order of geometry/geography B.
- ST_Node - Changed: 2.4.0 this function uses GEOSNode internally instead of GEOSUnaryUnion. This may cause the resulting linestrings to have a different order and direction compared to PostGIS < 2.4. Nodes a collection of lines.

12.12.8 PostGIS Functions new or enhanced in 2.3

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.3

- &&&(geometry,gidx) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a geometry's (cached) n-D bounding box intersects a n-D float precision bounding box (GIDX).
- &&&(gidx,geometry) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a n-D float precision bounding box (GIDX) intersects a geometry's (cached) n-D bounding box.
- &&&(gidx,gidx) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if two n-D float precision bounding boxes (GIDX) intersect each other.
- &&(box2df,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if two 2D float precision bounding boxes (BOX2DF) intersect each other.
- &&(box2df,geometry) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a 2D float precision bounding box (BOX2DF) intersects a geometry's (cached) 2D bounding box.
- &&(geometry,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a geometry's (cached) 2D bounding box intersects a 2D float precision bounding box (BOX2DF).
- @(box2df,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into another 2D float precision bounding box.
- @(box2df,geometry) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a 2D float precision bounding box (BOX2DF) is contained into a geometry's 2D bounding box.
- @(geometry,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a geometry's 2D bounding box is contained into a 2D float precision bounding box (BOX2DF).

- ST_ClusterDBSCAN - Availability: 2.3.0 Window function that returns a cluster id for each input geometry using the DBSCAN algorithm.
- ST_ClusterKMeans - Availability: 2.3.0 Window function that returns a cluster id for each input geometry using the K-means algorithm.
- ST_GeneratePoints - 2.3.0 버전부터 사용할 수 있습&#x
  Generates random points contained in a Polygon or MultiPolygon.
- ST_GeometricMedian - 2.3.0 버전부터 사용할 수 있습&
  멀티 포인트의 기하학적 중심값(m
  반환합니다.
- ST_MakeLine - 2.0.0 버전부터 라인스트링 구성
  요소 입력을 지원하기 시작했습&
  포인트, 멀티포인트 또는 라인 도
  라인스트링을 생성합니다.
- ST_MinimumBoundingRadius - 2.3.0 버전부터 사용할 수 있&#
  Returns the center point and radius of the smallest circle that contains a geometry.
- ST_MinimumClearance - 2.3.0 버전부터 사용할 수 있습
  도형의 튼튼함(robustness)의 척도인 도&#xd615
  최소 여유(clearance)를 반환합니다.
- ST_MinimumClearanceLine - 2.3.0 버전부터 사용할 수 있&#xc
  GEOS 3.6.0 이상 버전이 필요합니다. 포&#xc77
  2개로 이루어진, 도형의 최소 여유
  나타내는 라인스트링을 반환합&
- ST_Normalize - 2.3.0 버전부터 사용할 수 있습&#xb2c8
  도형을 해당 도형의 기본형으로
  반환합니다.
- ST_Points - 2.3.0 버전부터 사용할 수 있습니&#x
  도형의 모든 좌표들을 담고 있는
  멀티포인트를 반환합니다.
- ST_VoronoiLines - 2.3.0 버전부터 사용할 수 있습&#xb2
  Returns the boundaries of the Voronoi diagram of the vertices of a geometry.
- ST_VoronoiPolygons - 2.3.0 버전부터 사용할 수 있습&#
  Returns the cells of the Voronoi diagram of the vertices of a geometry.
- ST_WrapX - Availability: 2.3.0 requires GEOS X값 근처에서 도형을
  래핑합니다.
- ~(box2df,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a 2D float precision bounding box (BOX2DF) contains another 2D float precision bounding box (BOX2DF).
- ~(box2df,geometry) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a 2D float precision bounding box (BOX2DF) contains a geometry's 2D bonding box.
- ~(geometry,box2df) - Availability: 2.3.0 support for Block Range INdexes (BRIN) was introduced. Requires PostgreSQL 9.5+. Returns TRUE if a geometry's 2D bonding box contains a 2D float precision bounding box (GIDX).

Functions enhanced in PostGIS 2.3

- ST_Contains - Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon. Tests if every point of B lies in A, and their interiors have a point in common
- ST_Covers - Enhanced: 2.3.0 Enhancement to PIP short-circuit for geometry extended to support MultiPoints with few points. Prior versions only supported point in polygon. Tests if every point of B lies in A

- ST_Expand - Enhanced: 2.3.0 support was added to expand a box by different amounts in different dimensions. Returns a bounding box expanded from another bounding box or a geometry.
- ST_Intersects - Enhanced: 2.3.0 Enhancement to PIP short-circuit extended to support MultiPoints with few points. Prior versions only supported point in polygon. Tests if two geometries intersect (they have at least one point in common)
- ST_Segmentize - Enhanced: 2.3.0 Segmentize geography now produces equal-length subsegments Returns a modified geometry/geography having no segment longer than a given distance.
- ST_Transform - Enhanced: 2.3.0 support for direct PROJ.4 text was introduced. Return a new geometry with coordinates transformed to a different spatial reference system.
- ST_Within - Enhanced: 2.3.0 Enhancement to PIP short-circuit for geometry extended to support MultiPoints with few points. Prior versions only supported point in polygon. Tests if every point of A lies in B, and their interiors have a point in common

Functions changed in PostGIS 2.3

- ST_PointN - 변경 사항: 2.3.0 버전부터 음수 인&
  1이 마지막 포인트)를 이용할 수
  있습니다. ST_LineString 또는 ST_CircularString 값에 있&#xb2
  포인트의 개수를 반환합니다.

12.12.9 PostGIS Functions new or enhanced in 2.2

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.2

- <<#>> - 2.2.0 버전부터 사용할 수 있습니&#xb2
  PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수
  있습니다. A와 B의 경계 상자 사이&#xc7
  N차원 거리를 반환합니다.
- <<->> - 2.2.0 버전부터 사용할 수 있습니&#xb2
  PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수
  있습니다. A 경계 상자와 B의 경계
  상자의 중심점 사이의 N차원 거리
  반환합니다.
- ST_3DDifference - 2.2.0 버전부터 사용할 수 있습&#xb2
  3차원 차이를 수행합니다.
- ST_3DUnion - 2.2.0 버전부터 사용할 수 있습니&
  Perform 3D union.
- ST_ApproximateMedialAxis - 2.2.0 버전부터 사용할 수 있&#xc
  면 도형의 근사 중심축을 계산합&
- ST_AsEncodedPolyline - 2.2.0 버전부터 사용할 수 있습
  라인스트링 도형으로부터 인코&
  폴리라인을 반환합니다.
- ST_AsTWKB - 2.2.0 버전부터 사용할 수 있습니
  도형을 TWKB(Tiny Well-Known Binary)로 반환합니다.
- ST_BoundingDiagonal - 2.2.0 버전부터 사용할 수 있습&
  주어진 도형의 경계 상자의 대각&
  반환합니다.
- ST_CPAWithin - Availability: 2.2.0 Tests if the closest point of approach of two trajectories is within the specified distance.

- ST_ClipByBox2D - Availability: 2.2.0 Computes the portion of a geometry falling within a rectangle.
- ST_ClosestPointOfApproach - Availability: 2.2.0 Returns a measure at the closest point of approach of two trajectories.
- ST_ClusterIntersecting - Availability: 2.2.0 Aggregate function that clusters input geometries into connected sets.
- ST_ClusterWithin - Availability: 2.2.0 Aggregate function that clusters input geometries by separation distance.
- ST_DistanceCPA - Availability: 2.2.0 Returns the distance between the closest point of approach of two trajectories.
- ST_ForceCurve - 2.2.0 버전부터 사용할 수 있습니 적용이 가능한 경우, 도형을 해당 도형의 만곡 유형으로 상위 형변&
- ST_IsPlanar - 2.2.0 버전부터 사용할 수 있습니원래 2.1.0 버전에 문서화됐지만 2.1 배실수로 빠졌습니다. 표면이 평면아닌지 확인합니다.
- ST_IsSolid - 2.2.0 버전부터 사용할 수 있습니도형이 입체인지 테스트합니다. 어떤 유효성 검사도 수행하지 않&
- ST_IsValidTrajectory - Availability: 2.2.0 Tests if the geometry is a valid trajectory.
- ST_LineFromEncodedPolyline - 2.2.0 버전부터 사용할 수 있인코딩된 폴리라인(polyline)으로부터 라인스트링을 생성합니다.
- ST_MakeSolid - 2.2.0 버전부터 사용할 수 있습니도형을 입체로 지정합니다. 어떤 확인 작업도 수행하지 않습니다. 유효한 입체를 얻으려면, 입력 도닫힌 다면체 표면 또는 닫힌 TIN이&#xc5 합니다.
- ST_RemoveRepeatedPoints - 2.2.0 버전부터 사용할 수 있&#xc2 Returns a version of a geometry with duplicate points removed.
- ST_SetEffectiveArea - 2.2.0 버전부터 사용할 수 있습&# Sets the effective area for each vertex, using the Visvalingam-Whyatt algorithm.
- ST_SimplifyVW - 2.2.0 버전부터 사용할 수 있습&#xb2 Returns a simplified version of a geometry, using the Visvalingam-Whyatt algorithm
- ST_Subdivide - Availability: 2.2.0 Computes a rectilinear subdivision of a geometry.
- ST_SwapOrdinates - 2.2.0 버전부터 사용할 수 있습&#x 입력 도형을 좌표값을 뒤바꾼 상& 반환합니다.
- ST_Volume - 2.2.0 버전부터 사용할 수 있습니&# 3차원 입체의 부피를 계산합니다. 표면 도형을 입력하면 (닫힌 도&#xd615 0을 반환할 것입니다.
- postgis.enable_outdb_rasters - 2.2.0 버전부터 사용할 수 있&#x DB 외부 래스터 밴드에 접근할 수 있게 해주는 불 설정 옵션입니다.
- postgis.gdal_datapath - 2.2.0 버전부터 사용할 수 있습&# GDAL의 GDAL_DATA 옵션의 값을 할당하는 설정 옵션입니다. 설정하지 않을 경우, 환경적으로 설정된 GDAL_DATA 변&#xc2 사용합니다.

- postgis.gdal_enabled_drivers - 2.2.0 버전부터 사용할 수 있&#xc PostGIS 환경에서 사용할 수 있는 GDAL 드&#xb 설정하는 설정 옵션입니다. GDAL 설&# 변수 GDAL_SKIP에 영향을 미칩니다.

- |=| - 2.2.0 버전부터 사용할 수 있습니다. PostgreSQL 9.5 이상 버전에서만 인덱스 지&#xc supported)을 사용할 수 있습니다. A와 B 사&#xc 최근접점(closest point of approach)을 잇는 궤도(trajectory)&#xc 거리를 반환합니다.

Functions enhanced in PostGIS 2.2

- <-> - 개선 사항: 2.2.0 버전 -- PostgreSQL 9.5 이상 버전& 도형 및 지리형에 대해 진정한 KNN("K nearest neighbor") 습성을 도입했습니다. 지리&# KNN이 타원체가 아니라 구체를 기&#xb 한다는 점에 주의하십시오. PostgreSQL 9.4 이하 버전에서 지리형을 쓸 수 있긴 하지만, 중심점 상자만 지원& A와 B 사이의 2차원 거리를 반환합&#xb2

- ST_Area - 개선 사항: 2.2.0 버전부터 회전타&#x 측정시 정확도와 강력함을 향상& 위해 GeographicLib을 이용합니다. 이 새 기&#x 장점을 취하려면 Proj 4.9.0 이상 버전이 필요합니다. 도형의 기하학적 중 반환합니다.

- ST_AsX3D - 개선 사항: 2.2.0 버전부터 지리좌& 및 축(x/y, 경도/위도) 뒤집기를 지원&#xd 자세한 내용은 옵션을 살펴보십& 도형을 X3D XML 노드 요소 형식: ISO-IEC-19776-1.2-X3DEncodings-XML로 반환합니다.

- ST_Azimuth - 개선 사항: 2.2.0 버전부터 회전타 측정시 정확도와 강력함을 향상& 위해 GeographicLib을 이용합니다. 이 새 기&#x 장점을 취하려면 Proj 4.9.0 이상 버전이 필요합니다. 두 도형 사이의 2차&#xc6d0 최단 라인을 반환합니다.

- ST_Distance - 개선 사항: 2.2.0 버전부터 회전타 측정시 정확도와 강력함을 향상& 위해 GeographicLib을 이용합니다. 이 새 기&#x 장점을 취하려면 Proj 4.9.0 이상 버전이 필요합니다. 두 도형 사이의 3차&#xc6d0 최장(longest) 라인을 반환합니다.

- ST_Scale - Enhanced: 2.2.0 support for scaling all dimension (factor parameter) was introduced. Scales a geometry by given factors.

- ST_Split - Enhanced: 2.2.0 support for splitting a line by a multiline, a multipoint or (multi)polygon boundary was introduced. Returns a collection of geometries created by splitting a geometry by another geometry.

- ST_Summary - 개선 사항: 2.2.0 버전부터 TIN 및 만&#xa 도형(curve)을 지원하기 시작했습니&#x 도형의 내용을 요약한 텍스트를 반환합니다.

Functions changed in PostGIS 2.2

- <-> - 변경 사항: 2.2.0 버전 -- PostgreSQL 9.5 버전 사용경우, 예전의 하이브리드 문법(Hybrid syntax)이 느릴 수도 있기 때문에 PostGIS 2.2 이상, PostgreSQL 9.5 이상 버전에서만 사용코드를 실행하는 경우 이 꼼수를 제거하는 편이 좋을 수도 있습니다음 예시를 참조하세요. A와 B 사౲차원 거리를 반환합니다.

- ST_3DClosestPoint - 변경 사항: 2.2.0 버전부터 2D 도형두 개를 입력할 경우, (존재하지 않는 Z을 0으로 가정하는 예전 습대신) 2D 포인트를 반환합니다. 2D 및 3D의 경우, 더 이상 Z가 없을 때 Z를 0으가정하지 않습니다. g2에 가장 가까g1 상에 있는 3차원 포인트를 반환해당 포인트는 3D 최단 라인의 첫 번째 포인트입니다.

- ST_3DDistance - 변경 사항: 2.2.0 버전부터, 2D 및 3D의 경우 더 이상 Z가 없을 때 Z를 0으가정하지 않습니다. 도형 유형에대해, 두 도형 사이의 (SRS에 기반한) 3차원 데카르트 최단 거리를 투영단위로 반환합니다.

- ST_3DLongestLine - 변경 사항: 2.2.0 버전부터 2D 도형두 개를 입력할 경우, (존재하지 않는 Z을 0으가정하는 예전 습대신) 2D 포인트를 반환합니다. 2D 및 3D의 경우, 더 이상 Z가 없을 때 Z를 0으가정하지 않습니다. 두 도형 사이&#3차원 최장(longest) 라인을 반환합니다.

- ST_3DMaxDistance - 변경 사항: 2.2.0 버전부터, 2D 및 3D의 경우 더 이상 Z가 없을 때 Z를 0으가정하지 않습니다. 도형 유형에대해, 두 도형 사이의 (SRS에 기반한) 3차원 데카르트 최장 거리를 투영단위로 반환합니다.

- ST_3DShortestLine - 변경 사항: 2.2.0 버전부터 2D 도형두 개를 입력할 경우, (존재하지 않는 Z을 0으가정하는 예전 습대신) 2D 포인트를 반환합니다. 2D 및 3D의 경우, 더 이상 Z가 없을 때 Z를 0으가정하지 않습니다. 두 도형 사이&#3차원 최단(shortest) 라인을 반환합니다.

- ST_DistanceSphere - 변경 사항: 2.2.0 미만 버전에서&#xST_Distance_Sphere라는 명칭이었습니다. 특정회전타원체가 주어진 두 경위도도형 사이의 최단 거리를 반환합&#xPostGIS 1.5 미만 버전은 포인트만 지원했

- ST_DistanceSpheroid - 변경 사항: 2.2.0 미만 버전에서&#xST_Distance_Spheroid라는 명칭이었습니다. 특&#xc81

회전타원체가 주어진 두 경위도 도형 사이의 최단 거리를 반환합&
PostGIS 1.5 미만 버전은 포인트만 지원&#xd588

- ST_Equals - Changed: 2.2.0 Returns true even for invalid geometries if they are binary equal Tests if two geometries include the same set of points
- ST_LengthSpheroid - 변경 사항: 2.2.0 미만 버전에서&#x ST_Length_Spheroid라는 명칭이었으며, ST_3DLength_Spheroid&#xb 동일 함수가 있었습니다. 도형의 기하학적 중심을 반환합니다.
- ST_MemSize - Changed: 2.2.0 name changed to ST_MemSize to follow naming convention. ST_Geometry 값의 도형 유형을 반환합니다.
- ST_PointInsideCircle - Changed: 2.2.0 In prior versions this was called ST_Point_Inside_Circle Tests if a point geometry is inside a circle defined by a center and radius

12.12.10 PostGIS Functions new or enhanced in 2.1

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.1

- ST_3DArea - 2.1.0 버전부터 사용할 수 있습니&# 3차원 표면 도형의 면적을 계산합 입체일 경우 0을 반환할 것입니다
- ST_3DIntersection - 2.1.0 버전부터 사용할 수 있습&#xb 3차원 교차를 수행합니다.
- ST_Box2dFromGeoHash - 2.1.0 버전부터 사용할 수 있&#xc2b GeoHash 스트링으로부터 BOX2D를 반환합&#
- ST_DelaunayTriangles - 2.1.0 버전부터 사용할 수 있습& Returns the Delaunay triangulation of the vertices of a geometry.
- ST_Extrude - 2.1.0 버전부터 사용할 수 있습니&# 표면을 관련 입체로 돌출시킵니&
- ST_ForceLHR - 2.1.0 버전부터 사용할 수 있습&#xb2c8 LHR(Left Hand Reverse; 시계 방향) 방향을 강제합&#xb
- ST_GeomFromGeoHash - 2.1.0 버전부터 사용할 수 있&#xc2b5 GeoHash 스트링으로부터 도형을 반환&
- ST_MinkowskiSum - 2.1.0 버전부터 사용할 수 있습&#x 민코프스키 합계를 수행합니다.
- ST_Orientation - 2.1.0 버전부터 사용할 수 있습&#xb2c8 표면의 방향(orientation)을 결정합니다.
- ST_PointFromGeoHash - 2.1.0 버전부터 사용할 수 있습 GeoHash 스트링으로부터 포인트를 반&#
- ST_StraightSkeleton - 2.1.0 버전부터 사용할 수 있습&# 도형으로부터 직선 골격(straight skeleton)을 계산합니다.
- ST_Tesselate - 2.1.0 버전부터 사용할 수 있습니& 폴리곤 또는 다면체 표면의 표면 다듬기(tesselation) 작업을 수행한 다음 TIN 또는 TIN 집합으로 반환합니다.

- postgis.backend - 2.1.0 버전부터 사용할 수 있습&#xb2c
GEOS와 SFCGAL 양쪽의 겹치는 함수를 서&#x
백엔드입니다. geos 또는 sfcgal을 선택&#xd560
수 있는데, 기본값은 geos입니다.

- postgis_sfcgal_version - 2.1.0 버전부터 사용할 수 있습&
실행중인 SFCGAL의 버전을 반환합니&

Functions enhanced in PostGIS 2.1

- ST_AsGML - 개선 사항: 2.1.0 버전부터 GML 3를 위&#
ID를 지원하기 시작했습니다. 도&#xd61
GML 2 또는 GML 3 버전 요소로 반환합니&#xb

- ST_Boundary - 개선 사항: 2.1.0 버전부터 삼각&#xd615
지원하기 시작했습니다. 해당 도&
결합된 범위의 닫힘 여부를 반환&

- ST_DWithin - Enhanced: 2.1.0 improved speed for geography. See Making Geography faster for details. Tests if two geometries are within a given distance

- ST_DWithin - Enhanced: 2.1.0 support for curved geometries was introduced. Tests if two geometries are within a given distance

- ST_Distance - 개선 사항: 2.1.0 버전부터 지리형&
대한 속도가 향상됐습니다. 자세&
내용은 Making Geography faster 를 참조하십시오.
두 도형 사이의 3차원 최장(longest) 라인&
반환합니다.

- ST_Distance - 개선 사항: 2.1.0 버전부터 만곡
도형을 지원하기 시작했습니다.
두 도형 사이의 3차원 최장(longest) 라인&
반환합니다.

- ST_MakeValid - Enhanced: 2.1.0, added support for GEOMETRYCOLLECTION and MULTIPOINT. Attempts to make an invalid geometry valid without losing vertices.

- ST_NumPoints - Enhanced: 2.1.0 Faster speed. Reimplemented as native-C. 도형의 내용&#xc7
요약한 텍스트를 반환합니다.

- ST_Segmentize - 개선 사항: 2.1.0 버전부터 지리&#xd61
지원하기 시작했습니다. Returns a modified geometry/geography having no segment longer than a given distance.

- ST_Summary - 개선 사항: 2.1.0 버전. 알려진 공&#xac04
참조 시스템을 가진 경우를 나타&
S 플래그가 추가됐습니다. 도형&#xc758
내용을 요약한 텍스트를 반환합&

Functions changed in PostGIS 2.1

- ST_EstimatedExtent - Changed: 2.1.0. Up to 2.0.x this was called ST_Estimated_Extent. Returns the estimated extent of a spatial table.

- ST_Force2D - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버&#x
이 함수의 명칭은 ST_Force_2D였습니다.
도형을 "2차원 모드"로 강제합니&#xb2e

- ST_Force3D - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버&#x 이 함수의 명칭은 ST_Force_3D였습니다. 도형을 XYZ 모드로 강제합니다. ST_Force3DZ& 합니다.
- ST_Force3DM - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Force_3DM&#xc 도형을 XYM 모드로 강제합니다.
- ST_Force3DZ - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Force_3DZ&#xc 도형을 XYZ 모드로 강제합니다.
- ST_Force4D - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버&#x 이 함수의 명칭은 ST_Force_4D였습니다. 도형을 XYZM 모드로 강제합니다.
- ST_ForceCollection - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Force_Collection 도형을 도형 집합으로 변환합니&
- ST_LineInterpolatePoint - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Line_Interp Returns a point interpolated along a line at a fractional location.
- ST_LineLocatePoint - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Line_Locat Returns the fractional location of the closest point on a line to a point.
- ST_LineSubstring - 변경 사항: 2.1.0 미만 버전, 즉 2.0.x 버전까지 이 함수의 명칭은 ST_Line_Substring& Returns the part of a line between two fractional locations.
- ST_Segmentize - Changed: 2.1.0 As a result of the introduction of geography support, the usage ST_Segmentize('LINESTRING(1 2, 3 4)', 0.5) causes an ambiguous function error. The input needs to be properly typed as a geometry or geography. Use ST_GeomFromText, ST_GeogFromText or a cast to the required type (e.g. ST_Segmentize('LINESTRING(1 2, 3 4)'::geometry, 0.5)) Returns a modified geometry/geography having no segment longer than a given distance.

12.12.11 PostGIS Functions new or enhanced in 2.0

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 2.0

- &&& - 2.0.0 버전부터 사용할 수 있습니&#xb2e A의 n차원 경계 상자와 B의 n차원 경&#xa 상자가 교차하는 경우 TRUE 를 반환&#x
- <#> - 2.0.0 버전부터 사용할 수 있습니다 PostgreSQL 9.1 이상 버전에서만 KNN을 쓸 수 있습니다. A와 B의 경계 상자 사이&#xc7 2차원 거리를 반환합니다.
- <-> - 2.0.0 버전부터 사용할 수 있습니다. 약한 KNN이 실제 거리 대신 도형 중&#xc 거리에 기반한 최근접 탐색을 제&#x 포인트의 경우 정확한 결과를 출&# 다른 모든 유형에 대해서는 부정& 결과를 냅니다. PostgreSQL 9.1 이상 버전에&#xc 이용할 수 있습니다. A와 B 사이의 2차원 거리를 반환합니다.

- ST_3DClosestPoint - 2.0.0 버전부터 사용할 수 있습&#x g2에 가장 가까운 g1 상에 있는 3차원 포인트를 반환합니다. 해당 포인& 3D 최단 라인의 첫 번째 포인트입&#xb2c
- ST_3DDFullyWithin - Availability: 2.0.0 Tests if two 3D geometries are entirely within a given 3D distance
- ST_3DDWithin - Availability: 2.0.0 Tests if two 3D geometries are within a given 3D distance
- ST_3DDistance - 2.0.0 버전부터 사용할 수 있습&#xb2c 도형 유형에 대해, 두 도형 사이&#xc758 (SRS에 기반한) 3차원 데카르트 최단 거리를 투영 단위로 반환합니다.
- ST_3DIntersects - Availability: 2.0.0 Tests if two geometries spatially intersect in 3D - only for points, linestrings, polygons, polyhedral surface (area)
- ST_3DLongestLine - 2.0.0 버전부터 사용할 수 있습&#x 두 도형 사이의 3차원 최장(longest) 라인& 반환합니다.
- ST_3DMaxDistance - 2.0.0 버전부터 사용할 수 있습&#x 도형 유형에 대해, 두 도형 사이&#xc758 (SRS에 기반한) 3차원 데카르트 최장 거리를 투영 단위로 반환합니다.
- ST_3DShortestLine - 2.0.0 버전부터 사용할 수 있습&#x 두 도형 사이의 3차원 최단(shortest) 라인 반환합니다.
- ST_AsLatLonText - 2.0 버전부터 사용할 수 있습&#xb2c 주어진 포인트의 도, 분, 초 표현&#xc2dd 반환합니다.
- ST_AsX3D - 2.0.0 버전부터 ISO-IEC-19776-1.2-X3DEncodings-XML을 이용 수 있습니다. 도형을 X3D XML 노드 요&#xc18 형식: ISO-IEC-19776-1.2-X3DEncodings-XML로 반환합니다.
- ST_CollectionHomogenize - 2.0.0 버전부터 사용할 수 있&#xc2 Returns the simplest representation of a geometry collection.
- ST_ConcaveHull - 2.0.0 버전부터 사용할 수 있습&#xb2 Computes a possibly concave geometry that contains all input geometry vertices
- ST_FlipCoordinates - 2.0.0 버전부터 사용할 수 있습&#x Returns a version of a geometry with X and Y axis flipped.
- ST_GeomFromGeoJSON - 2.0.0 버전부터 사용할 수 있&#xc2b JSON-C 0.9 이상 버전이 필요합니다. GeoJSON 표현식을 입력받아 PostGIS 도형 객체&# 출력합니다.
- ST_InterpolatePoint - 2.0.0 버전부터 사용할 수 있습&#x 입력 포인트에 가까운 포인트에& 도형의 척도 차원(M 차원)의 값을 반환합니다.
- ST_IsValidDetail - Availability: 2.0.0 Returns a valid_detail row stating if a geometry is valid or if not a reason and a location.
- ST_IsValidReason - Availability: 2.0 version taking flags. Returns text stating if a geometry is valid, or a reason for invalidity.

- ST_MakeLine - 2.0.0 버전부터 라인스트링 구성 요소 입력을 지원하기 시작했습포인트, 멀티포인트 또는 라인 도라인스트링을 생성합니다.
- ST_MakeValid - Availability: 2.0.0 Attempts to make an invalid geometry valid without losing vertices.
- ST_Node - Availability: 2.0.0 Nodes a collection of lines.
- ST_NumPatches - 2.0.0 버전부터 사용할 수 있습다면체 표면 상에 있는 면의 개수반환합니다. 다면체 도형이 아닌 경우 NULL을 반환할 것입니다.
- ST_OffsetCurve - 2.0 버전부터 사용할 수 있습니 Returns an offset line at a given distance and side from an input line.
- ST_PatchN - 2.0.0 버전부터 사용할 수 있습니&# ST_Geometry 값의 도형 유형을 반환합니&#xb2
- ST_Perimeter - 개선 사항: 2.0.0 버전부터 지리형지원합니다. Returns the length of the boundary of a polygonal geometry or geography.
- ST_Project - 2.0.0 버전부터 사용할 수 있습니&# Returns a point projected from a start point by a distance and bearing (azimuth).
- ST_RelateMatch - Availability: 2.0.0 Tests if a DE-9IM Intersection Matrix matches an Intersection Matrix pattern
- ST_SharedPaths - 2.0.0 버전부터 사용할 수 있습두 입력 라인스트링/멀티라인스공유하는 경로를 담고 있는 집합반환합니다.
- ST_Snap - 2.0.0 버전부터 사용할 수 있습니입력 도형의 분절 구간과 꼭짓점참조 도형의 꼭짓점으로 스냅시&
- ST_Split - Availability: 2.0.0 requires GEOS Returns a collection of geometries created by splitting a geometry by another geometry.
- ST_UnaryUnion - Availability: 2.0.0 Computes the union of the components of a single geometry.

Functions enhanced in PostGIS 2.0

- && - 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. A의 2D 경상자와 B의 2D 경계 상자가 교차하는 경우 TRUE 를 반환합니다.
- AddGeometryColumn - 개선 사항: 2.0.0 버전. use_typmod 인자가추가됐습니다. 제약조건 기반 도열 대신 기본적으로 typmod 도형 열을 생성합니다. 공간 테이블에서 지컬럼을 제거합니다.
- Box2D - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Returns a BOX2D representing the 2D extent of a geometry.
- Box3D - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Returns a BOX3D representing the 3D extent of a geometry.

- Populate_Geometry_Columns - 개선 사항: 2.0.0 버전. 열 생성&#
유형 변경자와 함께, 또는 확인
제약조건과 함께 생성할지 통제&#
수 있는 use_typmod 의 선택적 인자가 추&#xac0
Ensures geometry columns are defined with type modifiers or have appropriate spatial constraints.

- ST_3DExtent - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Aggregate function that returns the 3D bounding box of geometries.

- ST_Affine - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Apply a 3D affine transformation to a geometry.

- ST_Area - 개선 사항: 2.0.0 버전부터 2차원 다&#
표면(polyhedral surface)을 지원합니다. 도형의
기하학적 중심을 반환합니다.

- ST_AsBinary - 개선 사항: 2.0.0 버전부터 다면체
표면, 삼각형 및 TIN을 지원하기 시&#xc7
Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.

- ST_AsBinary - 개선 사항: 2.0.0 버전부터 더 높&#xc740
좌표 차원을 지원합니다. Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.

- ST_AsBinary - 개선 사항: 2.0.0 버전부터 지리형
함께 엔디안을 설정하는 방식을
지원합니다. Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.

- ST_AsEWKB - 개선 사항: 2.0.0 버전부터 다면&#xccb4
표면, 삼각형 및 TIN을 지원하기 시&#xc7
Return the Extended Well-Known Binary (EWKB) representation of the geometry with SRID meta data.

- ST_AsEWKT - 개선 사항: 2.0.0 버전부터 지리&#xd615
다면체 표면, 삼각형 및 TIN을 지원&#xd5
시작했습니다. 도형의 WKT(Well-Known Text) 표&#xd
SRID 메타데이터와 함께 반환합니&#xb

- ST_AsGML - 개선 사항: 2.0.0 버전부터 접두사&
지원합니다. 라인에 대해 커브 대
라인스트링 태그를 이용할 수 있&
GML 3용 옵션 '4' 가 등장했습니다. GML 3가
다면체 표면 및 TIN을 지원하기 시&#xc7
상자를 출력하는 옵션 '32' 도 새롭&#xac
등장했습니다. 도형을 GML 2 또는 GML
3 버전 요소로 반환합니다.

- ST_AsKML - 개선 사항: 2.0.0 버전부터 네임스&
접두사를 추가할 수 있습니다. 기
접두사를 쓰지 않는 것입니다. 도&
GML 2 또는 GML 3 버전 요소로 반환합니&#xb

- ST_Azimuth - 개선 사항: 2.0.0 버전부터 지리형&
지원합니다. 두 도형 사이의 2차&#xc6d0
최단 라인을 반환합니다.

- ST_Dimension - 개선 사항: 2.0.0 버전부터 다면&#xccb4
표면(polyhedral surface) 및 TIN을 지원합니다. 빈
도형이 주어져도 더 이상 예외가
발생하지 않습니다. ST_Geometry 값의 좌&#xd4
차원을 반환합니다.

- ST_Dump - 개선 사항: 2.0.0 버전부터 다면체 표면, 삼각형 및 TIN을 지원하기 시&#xc7 Returns a set of geometry_dump rows for the components of a geometry.
- ST_Expand - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Returns a bounding box expanded from another bounding box or a geometry.
- ST_Extent - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Aggregate function that returns the bounding box of geometries.
- ST_Force2D - 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. 도형을 "2차원 모드"로 강제합니다.
- ST_Force3D - 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. 도형을 XYZ 모드로 강제합니다. ST_Force3DZ라고도 합니다.
- ST_Force3DZ - 개선 사항: 2.0.0 버전부터 다면&#xccb4 표면(polyhedral surface)을 지원합니다. 도형을 XYZ 모드로 강제합니다.
- ST_ForceCollection - 개선 사항: 2.0.0 버전부터 다면&# 표면(polyhedral surface)을 지원합니다. 도형을 도형 집합으로 변환합니다.
- ST_ForceRHR - 개선 사항: 2.0.0 버전부터 다면&#xccb4 표면(polyhedral surface)을 지원합니다. 폴리곤 안에 있는 꼭짓점들의 방향(orientation)&#xc774 오른손 법칙(Right-Hand Rule)을 따르도록 강&#
- ST_GMLToSQL - 개선 사항: 2.0.0 버전부터 다면&#xcc 표면(polyhedral surface) 및 TIN을 지원합니다. GML로& 지정된 ST_Geometry 값을 반환합니다. 이 함수는 ST_GeomFromGML 함수와 동일합니&#xb2e4
- ST_GMLToSQL - 개선 사항: 2.0.0 버전에서 선택&#xc8 기본 SRID 파라미터가 추가됐습니&#xb2 GML로부터 지정된 ST_Geometry 값을 반환합& 이 함수는 ST_GeomFromGML 함수와 동일합&#xb2c8
- ST_GeomFromEWKB - 개선 사항: 2.0.0 버전부터 다면 표면(polyhedral surface) 및 TIN을 지원합니다. EWKB(Extende Well-Known Binary)로부터 지정된 ST_Geometry 값을 반&#xd
- ST_GeomFromEWKT - 개선 사항: 2.0.0 버전부터 다면& 표면(polyhedral surface) 및 TIN을 지원합니다. EWKT(Extende Well-Known Text)로부터 지정된 ST_Geometry 값을 반&#xd65
- ST_GeomFromGML - 개선 사항: 2.0.0 버전부터 다면&# 표면(polyhedral surface) 및 TIN을 지원합니다. 도&#xd6 GML 표현식을 입력받아 PostGIS 도형 객&#xcc 출력합니다.
- ST_GeomFromGML - 개선 사항: 2.0.0 버전에서 선택&# 기본 SRID 파라미터가 추가됐습니&#xb2 도형의 GML 표현식을 입력받아 Post- GIS 도형 객체를 출력합니다.
- ST_GeometryN - 개선 사항: 2.0.0 버전부터 다면&#xccb 표면, 삼각형 및 TIN을 지원하기 시&#xc7 ST_Geometry 값의 도형 유형을 반환합니&#xb2

- ST_GeometryType - 개선 사항: 2.0.0 버전부터 다면&#x 표면(polyhedral surface)을 지원합니다. ST_Geometry 값&#xc7 도형 유형을 반환합니다.
- ST_IsClosed - 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. LINESTRING 의 시작점과 종단점이 일치하는 경&# TRUE 를 반환합니다. 다면체 표면이 닫혀 (부피를 가지고) 있는 경우 TRUE 를 반환합니다.
- ST_MakeEnvelope - 개선 사항: 2.0 버전부터 SRID를 지정하지 않고도 직사각형(envelope)을 설정할 수 있는 기능이 추가됐습& 주어진 최소값과 최대값으로 형&#x 직사각형 폴리곤을 생성합니다. 입력값이 SRID로 지정된 SRS를 가지고 있어야 합니다.
- ST_MakeValid - Enhanced: 2.0.1, speed improvements Attempts to make an invalid geometry valid without losing vertices.
- ST_NPoints - 개선 사항: 2.0.0 버전부터 다면체 표면(polyhedral surface)을 지원합니다. 도형이 가지고 있는 포인트(꼭짓점)의 개& 반환합니다.
- ST_NumGeometries - 개선 사항: 2.0.0 버전부터 다면&# 표면, 삼각형 및 TIN을 지원하기 시&#xc7 도형이 가지고 있는 포인트의 개& 반환합니다. 모든 도형을 입력받 수 있습니다.
- ST_NumPoints - 개선 사항: 2.0.0 버전부터 다면&#xccb 표면, 삼각형 및 TIN을 지원하기 시&#xc7 도형의 내용을 요약한 텍스트를 반환합니다.
- ST_Relate - Enhanced: 2.0.0 - added support for specifying boundary node rule. Tests if two geometries have a topological relationship matching an Intersection Matrix pattern, or computes their Intersection Matrix
- ST_Rotate - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Rotates a geometry about an origin point.
- ST_Rotate - Enhanced: 2.0.0 additional parameters for specifying the origin of rotation were added. Rotates a geometry about an origin point.
- ST_RotateX - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Rotates a geometry about the X axis.
- ST_RotateY - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Rotates a geometry about the Y axis.
- ST_RotateZ - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Rotates a geometry about the Z axis.
- ST_Scale - Enhanced: 2.0.0 support for Polyhedral surfaces, Triangles and TIN was introduced. Scales a geometry by given factors.
- ST_ShiftLongitude - 개선 사항: 2.0.0 버전부터 다면&#x 표면(polyhedral surface) 및 TIN을 지원합니다. Shifts the longitude coordinates of a geometry between -180..180 and 0..360.

- ST_Summary - 개선 사항: 2.0.0 버전부터 지리형 지원하기 시작했습니다. 도형의 내용을 요약한 텍스트를 반환합&
- ST_Transform - Enhanced: 2.0.0 support for Polyhedral surfaces was introduced. Return a new geometry with coordinates transformed to a different spatial reference system.
- 도형 유형 - 개선 사항: 2.0.0 버전부터 다면체 표면, 삼각형 및 TIN을 지원&#xd5 시작했습니다. ST_Geometry 값의 도형 유&#xd 반환합니다.

Functions changed in PostGIS 2.0

- AddGeometryColumn - 변경사항: 2.0.0 이 함수는 geometry_columns& 시스템 카테고리에서 읽히는 뷰&# 동안 더 이상 geometry_columns을 업데이트 하& 않습니다. 이것은 기본적으로 컨& 만들지 않지만, 대신에 PostgreSQL의 내&#xc7a5 타입 변경 동작이 대신합니다. 그& 예를 들어 WGS84 POINT 컬럼을 이 함수로 만든다면 이 함수는 다음과 동등& ALTER TABLE some_table ADD COLUMN geom geometry(Point,4326); 공간 테이블&#xc5d 지오메트리 컬럼을 제거합니다.
- AddGeometryColumn - 변경 사항: 2.0.0 버전. 제약조건& 구식 습성이 필요할 경우, 기본값& use_typmod 를 이용하되, 거짓으로 설정&#xd55 공간 테이블에서 지오메트리 컬&# 제거합니다.
- AddGeometryColumn - 변경 사항: 2.0.0 버전. 더 이상 뷰를 직접 geometry_columns에 등록시킬 수는 없지만, 도형 typmod 테이블 도형을 기&# 빌드된 , 그리고 래퍼 함수 없이 사용되는 뷰는 자신의 페어런트 테이블 열의 typmod 습성을 상속하기 때문에 스스로를 정확히 등록시& 이런 뷰 도형 열을 geometry_columns에 정확히 등록시키려면, 다른 도형을 출력& 도형 함수를 이용하는 뷰를 typmod 도& 형변환시켜야 할 것입니다. 을 참& 공간 테이블에서 지오메트리 컬&# 제거합니다.
- DropGeometryColumn - 변경 사항: 2.0.0 버전. 하위 호&#xd658 위해 이 함수를 제공합니다. 이제& geometry_columns이 시스템 카탈로그를 기반&# 하는 뷰이기 때문에, 다른 어떤 테이블 열과도 마찬가지로 도형 열도 ALTER TABLE 을 이용해서 삭제할 수 있습니다. 공간 테이블에서 지오& 컬럼을 제거합니다.
- DropGeometryTable - 변경 사항: 2.0.0 버전. 하위 호환& 위해 이 함수를 제공합니다. 이제& geometry_columns이 시스템 카탈로그를 기반&# 하는 뷰이기 때문에, 다른 어떤 테이블과도 마찬가지로 도형 열&#&#

가진 테이블도 DROP TABLE 을 이용해서 삭제할 수 있습니다. 테이블 및 geometry_columns의 모든 참조를 삭제합니다.

- Populate_Geometry_Columns - 변경 사항: 2.0.0 버전. 이제 도&#
유형을 제한하기 위해 확인 제약&
대신 유형 변경자를 이용합니다.
새 use_typmod 를 거짓으로 설정하면, 확&#xc77
제약조건 습성을 계속 쓸 수 있습&
Ensures geometry columns are defined with type modifiers or have appropriate spatial constraints.
- ST_3DExtent - Changed: 2.0.0 In prior versions this used to be called ST_Extent3D Aggregate function that returns the 3D bounding box of geometries.
- ST_3DLength - 변경 사항: 2.0.0 미만 버전에서는
ST_Length3D라는 명칭이었습니다. 도형&#xc7
기하학적 중심을 반환합니다.
- ST_3DMakeBox - Changed: 2.0.0 In prior versions this used to be called ST_MakeBox3D Creates a BOX3D defined by two 3D point geometries.
- ST_3DPerimeter - 변경 사항: 2.0.0 미만 버전에서&#xb29
ST_Perimeter3D라는 명칭이었습니다. 도형&#x
기하학적 중심을 반환합니다.
- ST_AsBinary - 변경 사항: 2.0.0버전부터 이 함&#xc218
알려지지 않은 유형을 입력할 수
없게 됐습니다. 반드시 도형을 입
합니다. ST_AsBinary('POINT(1 2)') 같은 구조는 더
이상 유효하지 않아, n st_asbinary(unknown) is not unique error
오류가 발생합니다. 이런 코드는
ST_AsBinary('POINT(1 2)'::geometry); 로 변경돼야 합니다. 이
변경할 수 없는 경우, legacy.sql 을 설치하
Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsGML - 변경 사항: 2.0.0 버전부터 명명된
독립변수(named arg)를 기본값으로 씁니
도형을 GML 2 또는 GML 3 버전 요소로 반&#xc
- ST_AsGeoJSON - 변경 사항: 2.0.0 버전부터 기본
독립 변수(default arg) 및 명명된 독립 변&#xc218
arg)를 지원합니다. Return a geometry as a GeoJSON element.
- ST_AsSVG - 변경 사항: 2.0.0 버전부터 기본 독&
변수(default arg)를 사용하고 명명된 독립
변수(named arg)를 지원합니다. Returns SVG path data for a geometry.
- ST_EndPoint - 변경 사항: 2.0.0 버전부터 단일
도형 멀티라인스트링을 지원하&
않습니다. PostGIS 예전 버전이라면 단&
라인 멀티라인스트링을 입력받&
경우 시작점을 반환했을 겁니다.
2.0.0 버전은 다른 모든 멀티라인스&#xd2
NULL을 반환할 뿐입니다. 구식 습성&
문서화되지 않은 기능이지만, 사&
데이터를 라인스트링으로 저장&
가정한 사용자의 경우 현재 2.0 버&#xc80
NULL이 반환될 수도 있습니다. ST_LineString
또는 ST_CircularString 값에 있는 포인트의 개&
반환합니다.

- ST_GeomFromText - 변경 사항: PostGIS 2.0.0 미만 버전에&#xc
ST_GeomFromText('GEOMETRYCOLLECTION(EMPTY)') 를 사용할 수 있&#xc5c8
PostGIS 2.0.0 버전부터, SQL/MM 표준을 더 잘 준&#xc
위해 이런 사용법은 금지됐습니&
이제는 ST_GeomFromText('GEOMETRYCOLLECTION EMPTY') 라고 작성
합니다. WKT 표현식으로부터 지정&#x
ST_Geometry 값을 반환합니다.

- ST_GeometryN - 변경 사항: 2.0.0 미만 버전은 단&#xc77
도형에 대해 NULL을 반환했을 겁니&#
2.0.0 버전부터 ST_GeometryN(..,1) 경우에 대한 도&#x
반환하도록 변경됐습니다. ST_Geometry
값의 도형 유형을 반환합니다.

- ST_IsEmpty - 변경 사항: PostGIS 2.0.0 미만 버전에서&#
ST_GeomFromText('GEOMETRYCOLLECTION(EMPTY)') 를 사용할 수 있&#xc5c8
PostGIS 2.0.0 버전부터, SQL/MM 표준을 더 잘 준&#xc
위해 이런 사용법은 금지됐습니&
Tests if a geometry is empty.

- ST_Length - 변경 사항: 2.0.0 버전에서 중요한
변경이 이루어졌습니다. 2.0.0 이전
버전에서 이 함수에 폴리곤/멀티&
유형의 지리형을 입력하면 폴리&
둘레를 반환했을 겁니다. 2.0.0 버전&#x
도형 습성과 맞추기 위해 0을 반&#xd658
변경됐습니다. 폴리곤의 둘레를
원한다면 ST_Perimeter 함수를 이용하십&#xc2c
도형의 기하학적 중심을 반환합&

- ST_LocateAlong - 변경 사항: 2.0.0 미만 버전에서&#xb2
ST_Locate_Along_Measure라는 명칭이었습니다. 예&#
명칭은 더 지원되지 않고 곧 삭제&
예정이지만, 아직은 사용할 수 있&
Returns the point(s) on a geometry that match a measure value.

- ST_LocateBetween - 변경 사항: 2.0.0 미만 버전에서&#x
ST_Locate_Along_Measure라는 명칭이었습니다. 예&#
명칭은 더 지원되지 않고 곧 삭제&
예정이지만, 아직은 사용할 수 있&
Returns the portions of a geometry that match a measure range.

- ST_NumGeometries - 변경 사항: 2.0.0 미만 버전에서
도형이 집합이나 멀티 유형이 아&
경우 NULL을 반환했습니다. 2.0.0 버전&#xbd8
폴리곤, 라인스트링, 포인트 같은
단일 도형에 대해 1을 반환합니&#xb2e4
도형이 가지고 있는 포인트의 개&
반환합니다. 모든 도형을 입력받
수 있습니다.

- ST_NumInteriorRings - 변경 사항: 2.0.0 미만 버전에서&
멀티폴리곤을 입력하면 첫 번째
폴리곤의 내곽 고리의 개수를 반&#
수 있었습니다. 폴리곤 도형의 내&
고리의 개수를 반환합니다.

- ST_PointN - 변경 사항: 2.0.0 버전부터 단일 도&
멀티라인스트링을 지원하지 않&
PostGIS 예전 버전이라면 단일 라인 멀&

입력받는 경우 시작점을 반환했&
겁니다. 2.0.0 버전은 다른 모든 멀티&#xb
NULL을 반환할 뿐입니다. ST_LineString 또는
ST_CircularString 값에 있는 포인트의 개수를
반환합니다.

- ST_StartPoint - 변경 사항: 2.0.0 버전부터 단일
도형 멀티라인스트링을 지원하&
않습니다. PostGIS 예전 버전이라면 단&
라인 멀티라인스트링을 입력받&
경우 시작점을 반환했을 겁니다.
2.0.0 버전은 다른 모든 멀티라인스&#xd2
NULL을 반환할 뿐입니다. 구식 습성&#
문서화되지 않은 기능이지만, 사&
데이터를 라인스트링으로 저장&
가정한 사용자의 경우 현재 2.0 버&#xc80
NULL이 반환될 수도 있습니다. Returns the first
point of a LineString.

12.12.12 PostGIS Functions new or enhanced in 1.5

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 1.5

- && - 1.5.0 버전부터 지리형을 지원합니&
A의 2D 경계 상자와 B의 2D 경계 상자가
교차하는 경우 TRUE 를 반환합니다.
- PostGIS_LibXML_Version - Availability: 1.5 Returns the version number of the libxml2 library.
- ST_AddMeasure - 1.5.0 버전부터 사용할 수 있습&#xb2
Interpolates measures along a linear geometry.
- ST_AsBinary - 1.5.0 버전부터 지리형을 지원합&
Return the OGC/ISO Well-Known Binary (WKB) representation of the geometry/geography without SRID meta data.
- ST_AsGML - 1.5.0 버전부터 지리형을 지원합&
도형을 GML 2 또는 GML 3 버전 요소로 반&#xc
- ST_AsGeoJSON - 1.5.0 버전부터 지리형을 지원&#xd56
Return a geometry as a GeoJSON element.
- ST_AsText - 1.5.0 버전부터 지리형을 지원합&#
도형/지리형의 WKT(Well-Known Text) 표현식을
SRID 메타데이터 없이 반환합니다.
- ST_Buffer - Availability: 1.5 - ST_Buffer was enhanced to support different endcaps and join types. These are useful for example to convert road linestrings into polygon roads with flat or square edges instead of rounded edges. Thin wrapper for geography was added. Computes a geometry covering all points within a given distance from a geometry.
- ST_ClosestPoint - 1.5.0 버전부터 사용할 수 있습&#xb2c
Returns the 2D point on g1 that is closest to g2. This is the first point of the shortest line from one geometry to the other.
- ST_CollectionExtract - 1.5.0 버전부터 사용할 수 있습&#
Given a geometry collection, returns a multi-geometry containing only elements of a specified type.
- ST_Covers - Availability: 1.5 - support for geography was introduced. Tests if every point of B lies in A
- ST_DFullyWithin - Availability: 1.5.0 Tests if two geometries are entirely within a given distance

- ST_DWithin - Availability: 1.5.0 support for geography was introduced Tests if two geometries are within a given distance
- ST_Distance - 1.5.0 버전부터 지리형을 지원합&
  대용량 또는 수많은 꼭짓점을 가&
  도형을 더 잘 처리하기 위해 평면
  대한 속도를 향상시켰습니다. 두
  도형 사이의 3󌰨원 최장(longest) 라인을
  반환합니다.
- ST_DistanceSphere - 1.5 버전부터 포인트가 아닌
  다른 도형 유형을 지원하기 시작&
  1.5 미만 버전에서는 포인트에 대&#xd57
  구현돼 있었습니다. 특정 회전타&
  주어진 두 경위도 도형 사이의 최&
  거리를 반환합니다. PostGIS 1.5 미만 버&#xc804
  포인트만 지원했습니다.
- ST_DistanceSpheroid - 1.5 버전부터 포인트가 아닌
  다른 도형 유형을 지원하기 시작&
  1.5 미만 버전에서는 포인트에 대&#xd57
  구현돼 있었습니다. 특정 회전타&
  주어진 두 경위도 도형 사이의 최&
  거리를 반환합니다. PostGIS 1.5 미만 버&#xc804
  포인트만 지원했습니다.
- ST_Envelope - 1.5.0 버전부터 사용할 수 있으며,
  float4 형 대신 이중 정밀도 형으로 출&#x
  변경되었습니다. 주어진 도형의
  이중 정밀도(double precision; float8) 경계 상자를
  표현하는 도형을 반환합니다.
- ST_Expand - Availability: 1.5.0 behavior changed to output double precision instead of float4 coordinates. Returns a bounding box expanded from another bounding box or a geometry.
- ST_GMLToSQL - 1.5 버전부터 사용할 수 있습&#xb2c8
  LibXML2 1.6 이상 버전이 필요합니다. GML로&
  지정된 ST_Geometry 값을 반환합니다. 이
  함수는 ST_GeomFromGML 함수와 동일합니&#xb2e4
- ST_GeomFromGML - 1.5 버전부터 사용할 수 있습&#x
  LibXML2 1.6 이상 버전이 필요합니다. 도&#xd
  GML 표현식을 입력받아 PostGIS 도형 객&#xcc
  출력합니다.
- ST_GeomFromKML - Availability: 1.5, requires libxml2 2.6+ 도형의 KML 표현식&#x
  입력받아 PostGIS 도형 객체를 출력합&#
- ST_HausdorffDistance - 1.5.0 버전부터 사용할 수 있습&
  두 도형 사이의 3󌰨원 최단(shortest) 라인
  반환합니다.
- ST_Intersection - Availability: 1.5 support for geography data type was introduced. Computes a geometry representing the shared portion of geometries A and B.
- ST_Intersects - Availability: 1.5 support for geography was introduced. Tests if two geometries intersect (they have at least one point in common)
- ST_Length - 1.5.0 버전부터 지리형을 지원합&#
  도형의 기하학적 중심을 반환합&

- ST_LongestLine - 1.5.0 버전부터 사용할 수 있습&#xb2c
  두 도형 사이의 3차원 최장(longest) 라인&
  반환합니다.
- ST_MakeEnvelope - 1.5 버전부터 사용할 수 있습&#xb2
  주어진 최소값과 최대값으로 형&#
  직사각형 폴리곤을 생성합니다.
  입력값이 SRID로 지정된 SRS를 가지고
  있어야 합니다.
- ST_MaxDistance - 1.5.0 버전부터 사용할 수 있습&#xb2
  두 도형 사이의 2차원 최장 거리를
  투영 단위로 반환합니다.
- ST_NumPoints - 1.2.2 버전부터 사용할 수 있습&#xb2c8
  도형의 내용을 요약한 텍스트를
  반환합니다.
- ST_ShortestLine - 1.5.0 버전부터 사용할 수 있습&#xb2c
  두 도형 사이의 2차원 최단 라인&#xc744
  반환합니다.
- ~= - 1.5.0 버전에서 습성이 변경됐습니&#
  A의 경계 상자와 B의 경계 상자가
  동일할 경우 TRUE 를 반환합니다.

12.12.13 PostGIS Functions new or enhanced in 1.4

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 1.4

- Populate_Geometry_Columns - 유효버전: 1.4.0 Ensures geometry columns are defined with type modifiers or have appropriate spatial constraints.
- ST_ContainsProperly - Availability: 1.4.0 Tests if every point of B lies in the interior of A
- ST_GeoHash - 1.4.0 버전부터 사용할 수 있습니&
  도형의 GeoHash 표현식을 반환합니다.
- ST_GeomCollFromText - 1.4.0 버전부터 사용할 수 있습
  이 버전부터 ST_MakeLine가 도형 배열을
  입력받을 수 있습니다. 더 많은
  포인트를 더 빨리 처리하기 위해
  ST_MakeLine 합산 함수를 개선했습니다.
  Creates a GeometryCollection or Multi* geometry from a set of geometries.
- ST_IsValidReason - Availability: 1.4 Returns text stating if a geometry is valid, or a reason for invalidity.
- ST_LineCrossingDirection - Availability: 1.4 Returns a number indicating the crossing behavior of two LineStrings
- ST_LocateBetweenElevations - 1.4.0 버전부터 사용할 수 있&#x
  Returns the portions of a geometry that lie in an elevation (Z) range.
- ST_MakeLine - 1.4.0 버전부터 사용할 수 있습니
  이 버전부터 ST_MakeLine가 도형 배열을
  입력받을 수 있습니다. 더 많은
  포인트를 더 빨리 처리하기 위해
  ST_MakeLine 합산 함수를 개선했습니다.
  포인트, 멀티포인트 또는 라인 도
  라인스트링을 생성합니다.

- ST_MinimumBoundingCircle - 유효버전: 1.4.0 Returns the smallest circle polygon that contains a geometry.
- ST_Union - Availability: 1.4.0 - ST_Union was enhanced. ST_Union(geomarray) was introduced and also faster aggregate collection in PostgreSQL. Computes a geometry representing the point-set union of the input geometries.

12.12.14 PostGIS Functions new or enhanced in 1.3

The functions given below are PostGIS functions that were added or enhanced.

Functions new in PostGIS 1.3

- ST_AsGML - 1.3.2 버전부터 사용할 수 있습니&
도형을 GML 2 또는 GML 3 버전 요소로 반&#xc
- ST_AsGeoJSON - 1.3.4 버전부터 사용할 수 있습&#xb2
Return a geometry as a GeoJSON element.
- ST_CurveToLine - Availability: 1.3.0 Converts a geometry containing curves to a linear geometry.
- ST_LineToCurve - Availability: 1.3.0 Converts a linear geometry to a curved geometry.
- ST_SimplifyPreserveTopology - 1.3.3 버전부터 사용할 수 있&#
Returns a simplified and valid version of a geometry, using the Douglas-Peucker algorithm.

Chapter 13

Reporting Problems

13.1 Reporting Software Bugs

Reporting bugs effectively is a fundamental way to help PostGIS development. The most effective bug report is that enabling PostGIS developers to reproduce it, so it would ideally contain a script triggering it and every information regarding the environment in which it was detected. Good enough info can be extracted running `SELECT postgis_full_version()` [for PostGIS] and `SELECT version()` [for postgresql].

If you aren't using the latest release, it's worth taking a look at its release changelog first, to find out if your bug has already been fixed.

Using the PostGIS bug tracker will ensure your reports are not discarded, and will keep you informed on its handling process. Before reporting a new bug please query the database to see if it is a known one, and if it is please add any new information you have about it.

You might want to read Simon Tatham's paper about How to Report Bugs Effectively before filing a new report.

13.2 Reporting Documentation Issues

The documentation should accurately reflect the features and behavior of the software. If it doesn't, it could be because of a software bug or because the documentation is in error or deficient.

Documentation issues can also be reported to the PostGIS bug tracker.

If your revision is trivial, just describe it in a new bug tracker issue, being specific about its location in the documentation.

If your changes are more extensive, a patch is definitely preferred. This is a four step process on Unix (assuming you already have git installed):

1. Clone the PostGIS' git repository. On Unix, type:

   git clone https://git.osgeo.org/gitea/postgis/postgis.git

   This will be stored in the directory postgis

2. Make your changes to the documentation with your favorite text editor. On Unix, type (for example):

   vim doc/postgis.xml

   Note that the documentation is written in DocBook XML rather than HTML, so if you are not familiar with it please follow the example of the rest of the documentation.

3. Make a patch file containing the differences from the master copy of the documentation. On Unix, type:

   git diff doc/postgis.xml > doc.patch

4. Attach the patch to a new issue in bug tracker.

Appendix A

Appendix

A.1 PostGIS 3.4.0beta1

2023/07/15

This version requires PostgreSQL 12 or higher, GEOS 3.6 or higher, and Proj 6.1+. To take advantage of all features, GEOS 3.12+ is needed. To take advantage of all SFCGAL featurs, SFCGAL 1.4.1+ is needed.

NOTE: GEOS 3.12.0 details at GEOS 3.12.0 release notes

A.1.1 New features

5055, complete manual internationalization (Sandro Santilli)

5052, target version support in postgis_extensions_upgrade (Sandro Santilli)

5306, expose version of GEOS at compile time (Sandro Santilli)

New install-extension-upgrades command in postgis script (Sandro Santilli)

5257, 5261, 5277, Support changes for PostgreSQL 16 (Regina Obe)

5006, 705, ST_Transform: Support PROJ pipelines (Robert Coup, Koordinates)

5283, [postgis_topology] RenameTopology (Sandro Santilli)

5286, [postgis_topology] RenameTopoGeometryColumn (Sandro Santilli)

703, [postgis_raster] Add min/max resampling as options (Christian Schroeder)

5336, [postgis_topology] topogeometry cast to topoelement support (Regina Obe)

Allow singleton geometry to be inserted into Geometry(Multi*) columns (Paul Ramsey)

721, New window-based ST_ClusterWithinWin and ST_ClusterIntersectingWin (Paul Ramsey)

5397, [address_standardizer] debug_standardize_address function (Regina Obe)

ST_LargestEmptyCircle, exposes extra semantics on circle finding. Geos 3.9+ required(Martin Davis)

ST_Project signature for geometry, and two-point signature (Paul Ramsey)

A.1.2 Enhancements

5194, do not update system catalogs from postgis_extensions_upgrade (Sandro Santilli)

5092, reduce number of upgrade paths installed on system (Sandro Santilli)

635, honour --bindir (and --prefix) configure switch for executables (Sandro Santilli)

Honour --mandir (and --prefix) configure switch for man pages install path (Sandro Santilli)

Honour --htmldir (and --docdir and --prefix) configure switch for html pages install path (Sandro Santilli)

[postgis_topology] Speed up check of topology faces without edges (Sandro Santilli)

[postgis_topology] Speed up coincident nodes check in topology validation (Sandro Santilli)

718, ST_QuantizeCoordinates(): speed-up implementation (Even Rouault)

Repair spatial planner stats to use computed selectivity for contains/within queries (Paul Ramsey)

734, Additional metadata on Proj installation in postgis_proj_version (Paul Ramsey)

5177, allow building tools without PostgreSQL server headers (Sandro Santilli)

ST_Project signature for geometry, and two-point signature (Paul Ramsey)

4913, ST_AsSVG support for curve types CircularString, CompoundCurve, MultiCurve, and MultiSurface (Regina Obe)

A.1.3 Breaking Changes

5229, Drop support for Proj < 6.1 and PG 11 (Regina Obe)

5306, 734, postgis_full_version() and postgis_proj_version() now output more information about proj network configuration and data paths. GEOS compile-time version also shown if different from run-time (Paul Ramsey, Sandro Santilli)