POSTGIS FAMILY OF EXTENSIONS

REGINA OBE

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LATEST BOOKS

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Books Coming

SQL in a Nutshell 4th Edition Out in hard-copy in 2 months, covers SQL:2016.

The Book of PostgreSQL (No Starch Press) In Progress
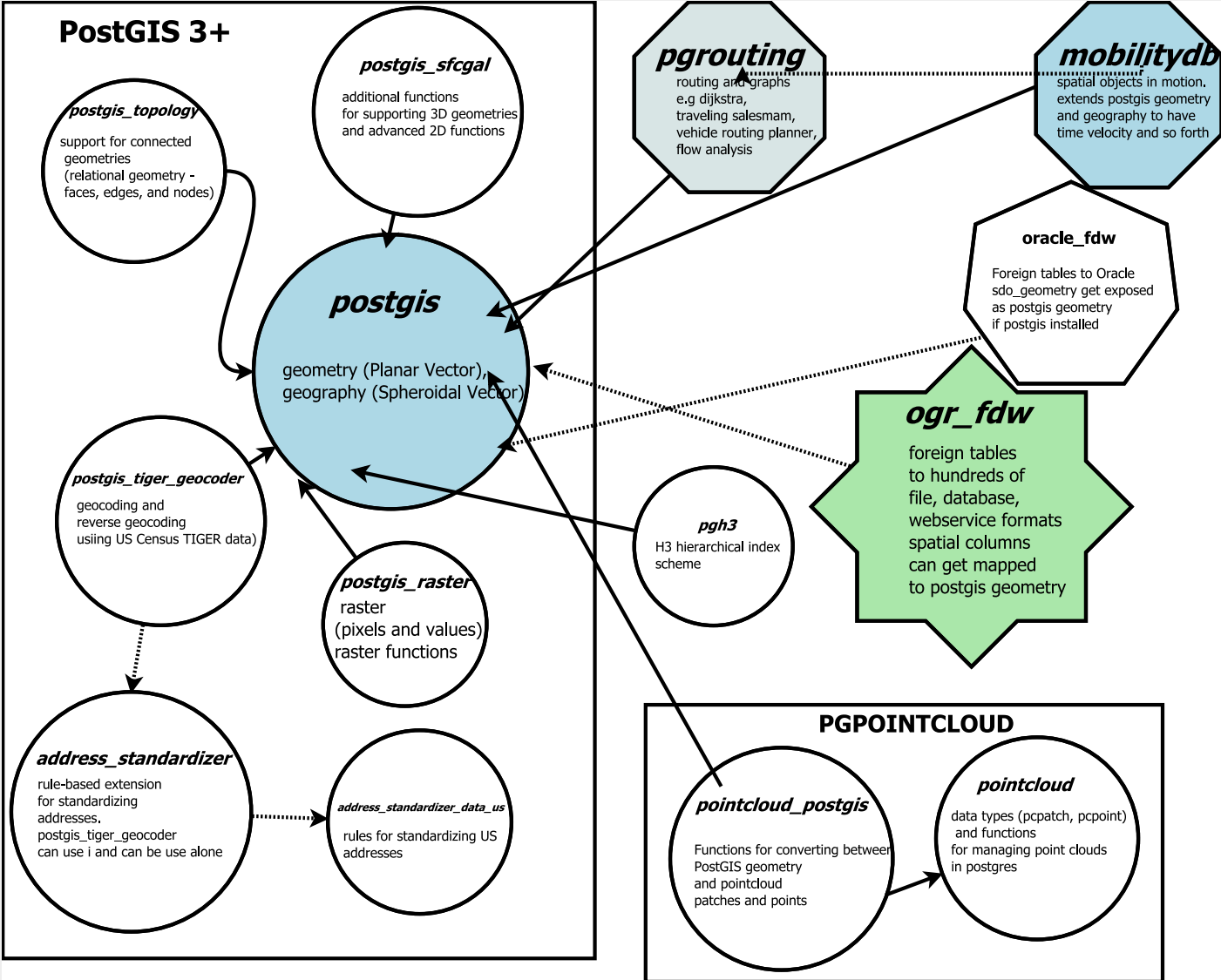
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pgRouting (a practical guide) 2nd Ed (Locate Press) in Progress.

POSTGIS SOLVES SPATIAL PROBLEMS

PostGIS helps you analyze, manage, mold, and visualize space.

POSTGIS RELATED EXTENSIONS

CREATE EXTENSION ...;

PostGIS 3+

postgis_sfcgal
additional functions
for supporting 3D geometries
and advanced 2D functions

postgis_topology
support for connected
geometries
(relational geometry -
faces, edges, and nodes)

postgis
geometry (Planar Vector),
geography (Spheroidal Vector)

postgis_tiger_geocoder
geocoding and
reverse geocoding
usiing US Census TIGER data)

postgis_raster
raster
(pixels and values)
raster functions

pgh3
H3 hierarchical index
scheme

address_standardizer
rule-based extension
for standardizing
addresses.
postgis_tiger_geocoder
can use i and can be use alone

address_standardizer_data_us
rules for standardizing US
addresses

pgrouting
routing and graphs
e.g dijkstra,
traveling salesmam,
vehicle routing planner,
flow analysis

mobilitydb
spatial objects in motion.
extends postgis geometry
and geography to have
time velocity and so forth

oracle_fdw
Foreign tables to Oracle
sdo_geometry get exposed
as postgis geometry
if postgis installed

ogr_fdw
foreign tables
to hundreds of
file, database,
webservice formats
spatial columns
can get mapped
to postgis geometry

PGPOINTCLOUD

pointcloud_postgis
Functions for converting between
PostGIS geometry
and pointcloud
patches and points

pointcloud
data types (pcpatch, pcpoint)
and functions
for managing point clouds
in postgres

POSTGIS MODELS SPACE IN MANY WAYS

Flat, Round, Matrix, Declarative

POSTGIS GEOMETRY TYPE (FLAT)

extension: postgis

The flat space model. Space is a cartesian grid. Supports drawing of linestrings, polygons, 3D polygons, points, 3d points, collections of polygons, points, linestrings, Polyhedral Surfaces, and TINS

Basic geometric types

Polyhedral Surface

Triangulated Irregular Network (TIN)

POSTGIS GEOGRAPHY TYPE (ROUND)

extension: postgis

Model of space as spheroid. Takes into consideration the earth or any given planet whose spatial reference is defined in *spatial_ref_sys* table.

GEODETIC (GEOGRAPHY) 4326 (WGS 84 LON LAT) IN GEOGRAPHY

POSTGIS **RASTER** TYPE (MATRIX)

extension: `postgis_raster`

Model of space as a flat numeric matrix (with cells (called pixels) that have values (on) or don't have values (off))

- Elevation
- Soil
- Weather
- Fire
- Aerial
- Population
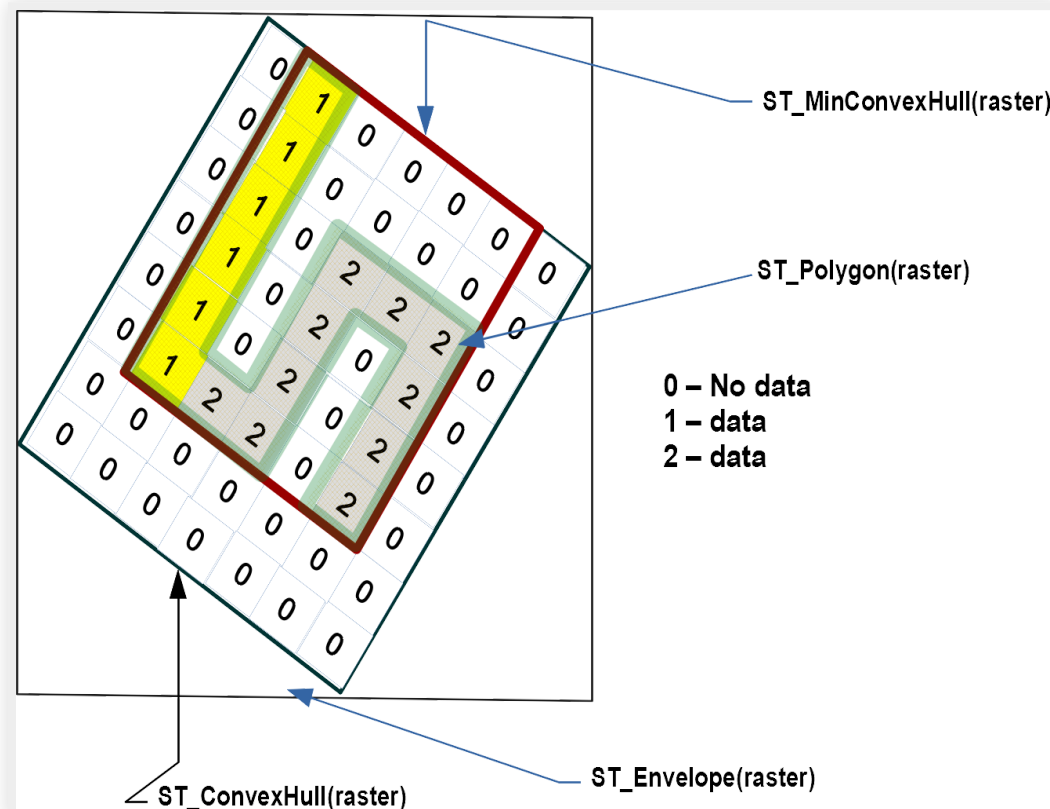
POSTGIS TOPOGEOMETRY TYPE (DECLARATIVE)

extension: `postgis_topology`

Defined in SQL/MM Topology-Geometry specs. Spatialite has it too. Topology partitions space into **edges**, **nodes**, and **faces**. Then it says this thing called **topogeometry** is space composed of these **edges**, **nodes**, **faces** and other topogeometries (which are again just a bunch of edges, nodes,and faces). If two topogeometries have the same set of (edges,nodes,faces) then they are the same.

```
(1,1,2,3) -> topology_id, layer_id, id, type
```

```sql
SELECT topo::geometry AS geom, (topo).*
FROM  some_topo_table;
```

POSTGIS PACKAGED COMMAND-LINE TOOLS

These are part of PostGIS, but often shipped by packagers in a separate package from PostGIS extensions.

- **shp2pgsql** - Loads data from ESRI Shapefile format
- **pgsql2shp** - Exports data from PostGIS format to ESRI shapefile format (for other formats use **ogr2ogr** (part of GDAL suite of tools) or **ogr_fdw**
- **raster2pgsql** - Loads data into postgis raster from hundreds of different raster formats (thru the power of GDAL)
- **pgtopo_export** - New in upcoming PostGIS 3.3.0, export topologies
- **pgtopo_import** - Import topologies (New in PostGIS 3.3.0)

NEED TO GEOCODE US DATA?

extension: postgis_tiger_geocoder

Geocoding and Reverse Geocoding using US Census Tiger data.

Companion **extension:** address_standardizer

Loading the data

```
SELECT ST_AsText(g.geomout), pprint_addy(g.addy)
FROM geocode('1600 Pennsylvania Avenue NW, Washington, DC 20500', 1) AS g;
```

```
                    st_astext                    |                 pprint_addy
-------------------------------------------------+---------------------------------------------
 POINT(-77.03511478601034 38.89867093615472)     | 1600 Pennsylvania Ave NW, Washington, DC 20500
```

```
SELECT pprint_addy(rg.addy[1])
FROM reverse_geocode(ST_Point(-77.03511, 38.89867)) AS rg;
```

```
                 pprint_addy
---------------------------------------------
 692 E Executive Ave NW, Washington, DC 20006
```

POSTGIS + CGAL

extension: `postgis_sfcgal`

Power of CGAL in PostGIS via the SFCGAL library. Used for advanced 3-D and 2-D processing.

- Many functions specifically targeted for Polyhedral surfaces and TINS
- **New in PostGIS 3.3.0**

ST_3DConvexHull ST_OptimalAlphaShape
ST_AlphaShape

INSTALLING

```sql
CREATE SCHEMA postgis;
ALTER DATABASE gisdb set search_path=public,postgis;
set search_path=public,postgis;
-- included with postgis
CREATE EXTENSION postgis SCHEMA postgis; --only vector in 3.0
CREATE EXTENSION postgis_raster SCHEMA postgis; -- raster separate in 3.0
CREATE EXTENSION postgis_topology;
CREATE EXTENSION fuzzystrmatch; -- needed by geocoder
CREATE EXTENSION postgis_tiger_geocoder;
CREATE EXTENSION postgis_sfcgal SCHEMA postgis;
CREATE EXTENSION address_standardizer;
CREATE EXTENSION address_standardizer_data_us; -- lex and rules
```

PGROUTING

extension: pgrouting

Uses graph algorithms: **edges** have **costs**, **nodes** connect edges.

- Find shortest path consider costs (road network, one way, toll price etc).
- Maximum service area
- Decision trees - compute most favorable path given where you are in the tree.
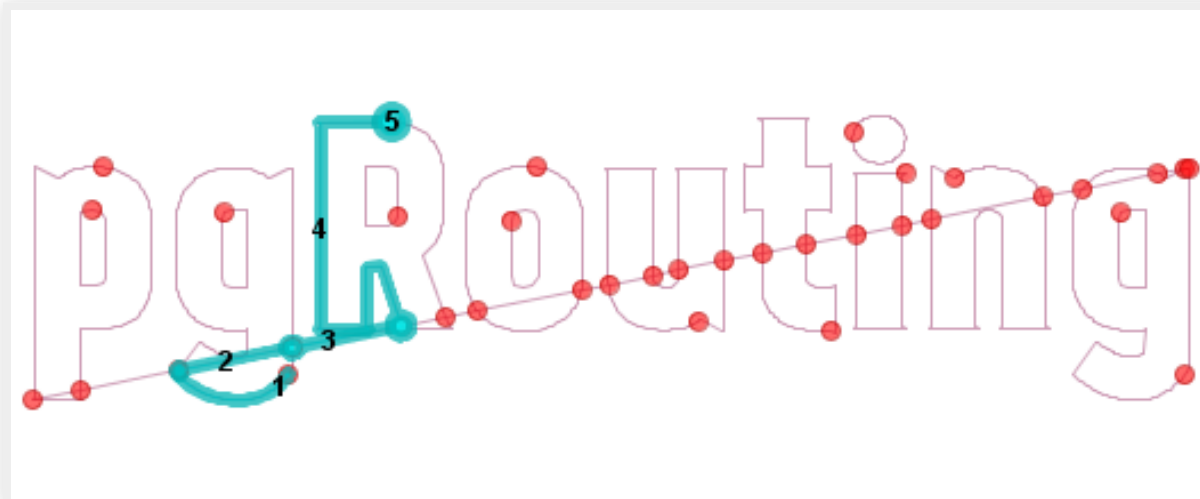
MOBILITYDB

extension: `mobilitydb`
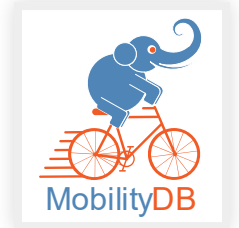
Analysis and managing spatial movement in a compact way. Follows the OGC Moving Features spec. Extends postgis geometry and geography types with time elements. Raw data often comes in General Transit Feed Specification (GTFS) format and GPX (that stuff from your GPS device). Extends postgis geometry and geography types to form temporal spatial types: `tgeompoint`, `tgeogpoint`, and many others.

- Store massive amounts of movement data in a compact way.
- Do short and fast computations on travel.
- What's the average speed a cat travels when on the hunt for prey.
- Integration with QGIS for viewing movement data.

PGPOINTCLOUD

extension: pointcloud, postgis_pointcloud **data types**
pcpatch, pcpoint

Load data in using another open source tool PDAL: Point Data Abstraction Library

What are point clouds? a bag of fat points collected by satellites, drones, planes, 3d scanners, and used to develop other forms of data: spatial data formats (particularly 3D models).

FOREIGN DATA WRAPPERS

Foreign data wrappers allow you to query data not in your database as if it is a table in your database.

- oracle_fdw: Oracle sdo_geometry -> postgis::geometry
- ogr_fdw: spatial anything -> postgis::geometry

OGR_FDW (MEGA FOREIGN DATA WRAPPER)

extension: ogr_fdw

Links external (sometimes spatial) data in PostGIS/PostgreSQL format. **It is an abstraction**: this data over there is a table in my database.
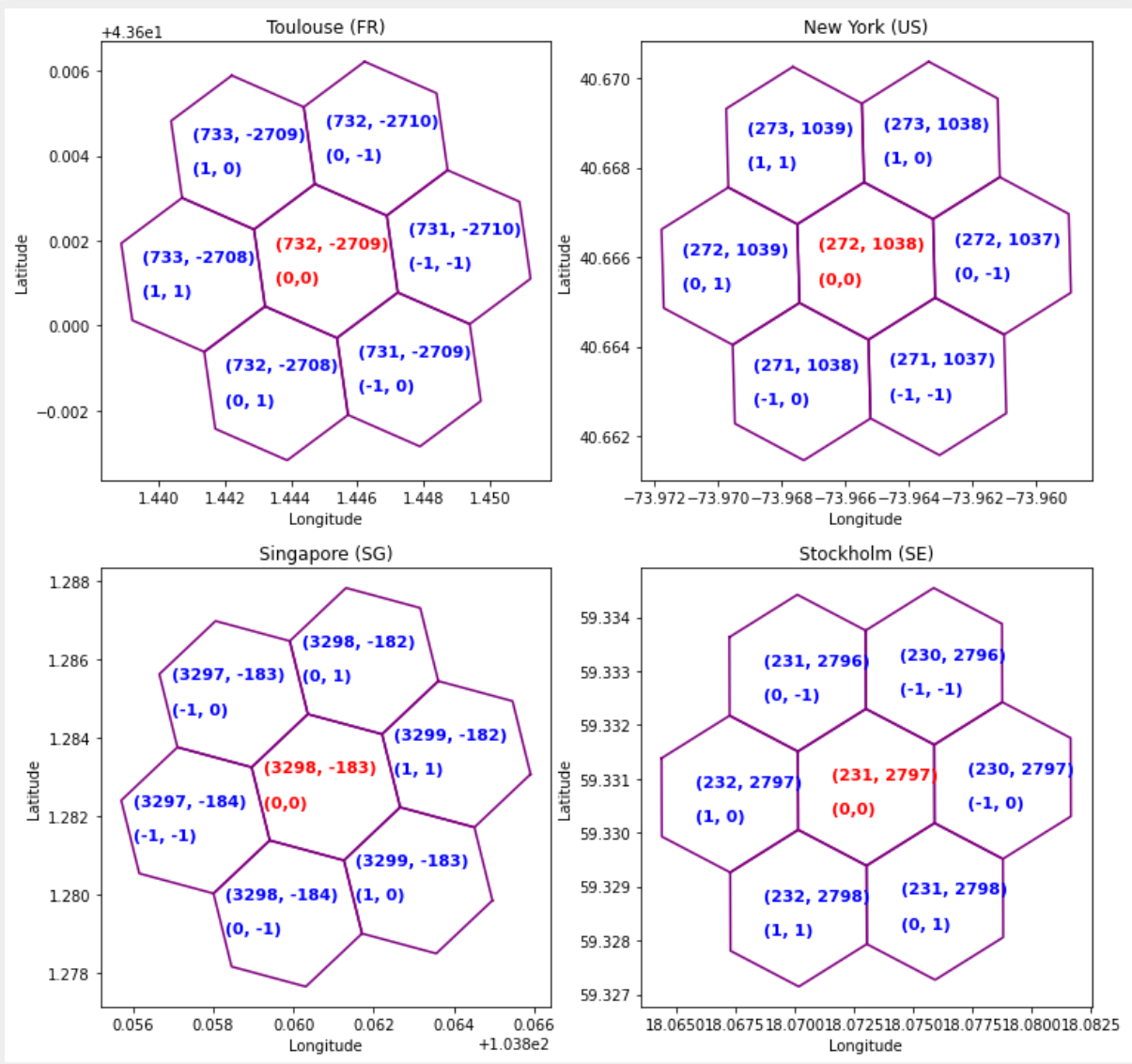
- If you have spatial data it can link it.
- If you have non-spatial data, it can link it.
- If you have no clue what this random file someone gave you is, it can probably link it.

H3 HIERARCHICAL GEOSPATIAL INDEXING SYSTEM

extension: pgh3

Exposes Uber's Hexagonal tiling scheme as a PostgreSQL SQL API. Leverages PostGIS geometry support.

LIVE DEMO

https://postgis.us/presentations/pgcon_2022.sql

- postgis
- postgis_sfcgal
- postgis_topology
- postgis_raster
- address_standardizer
- postgis_tiger_geocoder
- ogr_fdw
- mobilitydb
- pgrouting

POSTGIS 3.3.0ALPHA1 RELEASED LAST WEEK

Works with PostgreSQL 11-15beta1. Packagers have started or finished packaging it.

Can't enable in database with `CREATE EXTENSION` unless have binaries

- **Available from packagers:** (apt.postgresql.org, yum.postgresql.org, Windows Stackbuilder, bsd ports, homebrew) postgis packaged extensions, pointcloud/pointcloud_postgis, pgrouting, ogr_fdw, oracle_fdw

- **Support via Database As a Service (DBaaS):** postgis extensions (except sometimes not postgis_sfcgal), pgrouting (a lot of the time, but popular ask when not), oracle_fdw (sometimes), ogr_fdw (rarely)

- **Need to compile yourself or use provided container setups:** - mobilitydb,pgh3

FIN

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