PostGIS
GEO in your DB

Vincent Picavet
Oslandia

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Context

Bisonvert.net

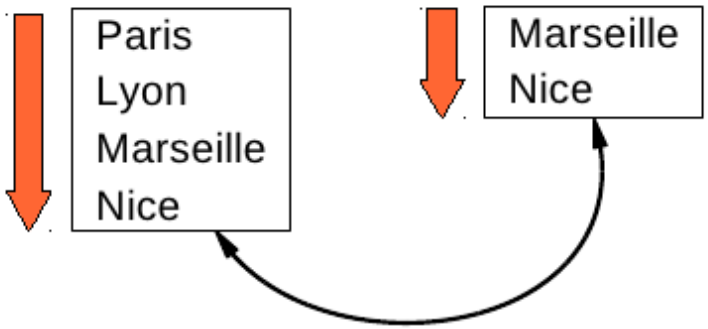
Car-sharing free software

Goal :

match people doing the same journey

Current method

Match from/to via names



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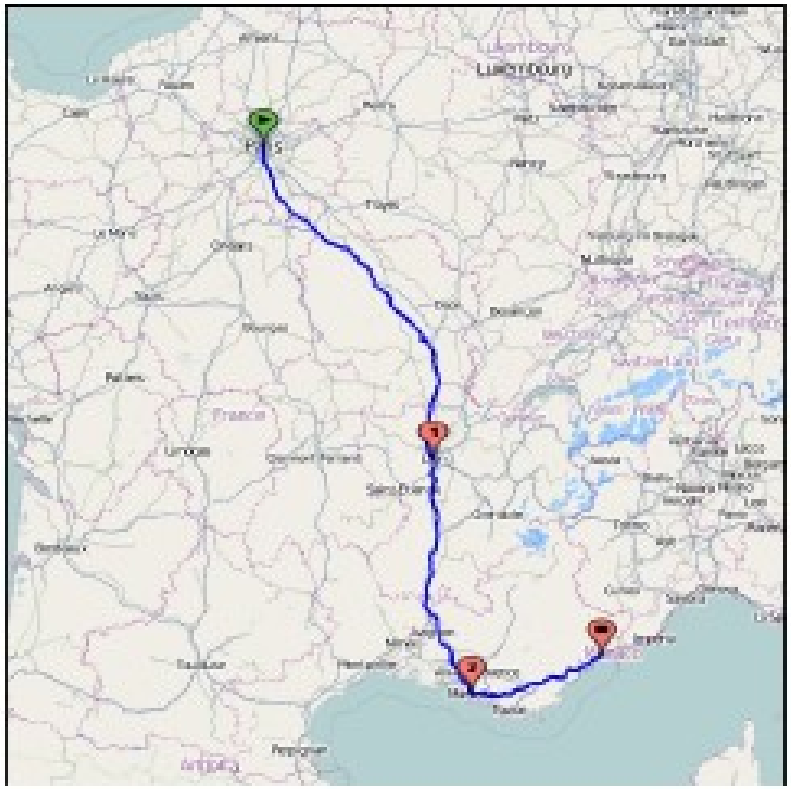
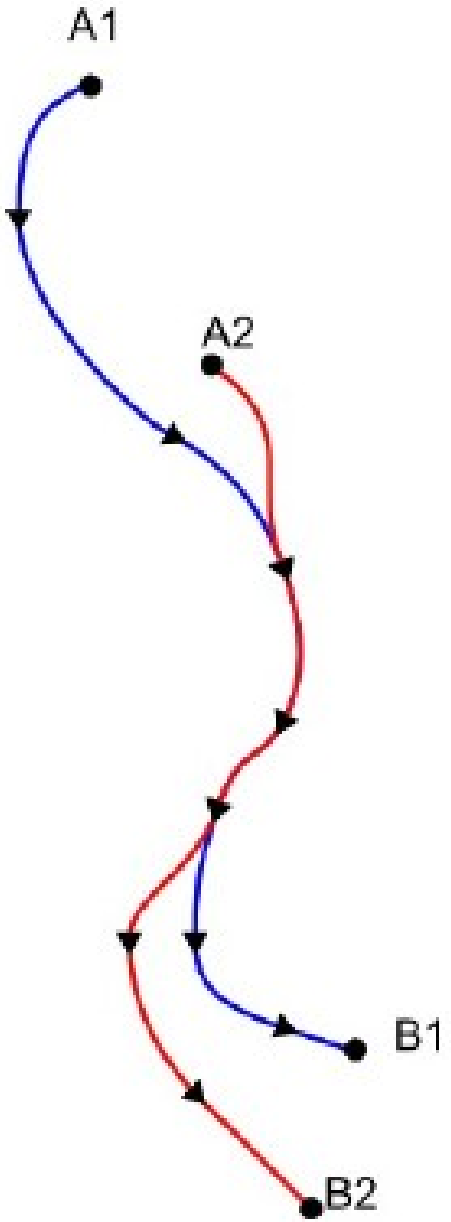
Solution :

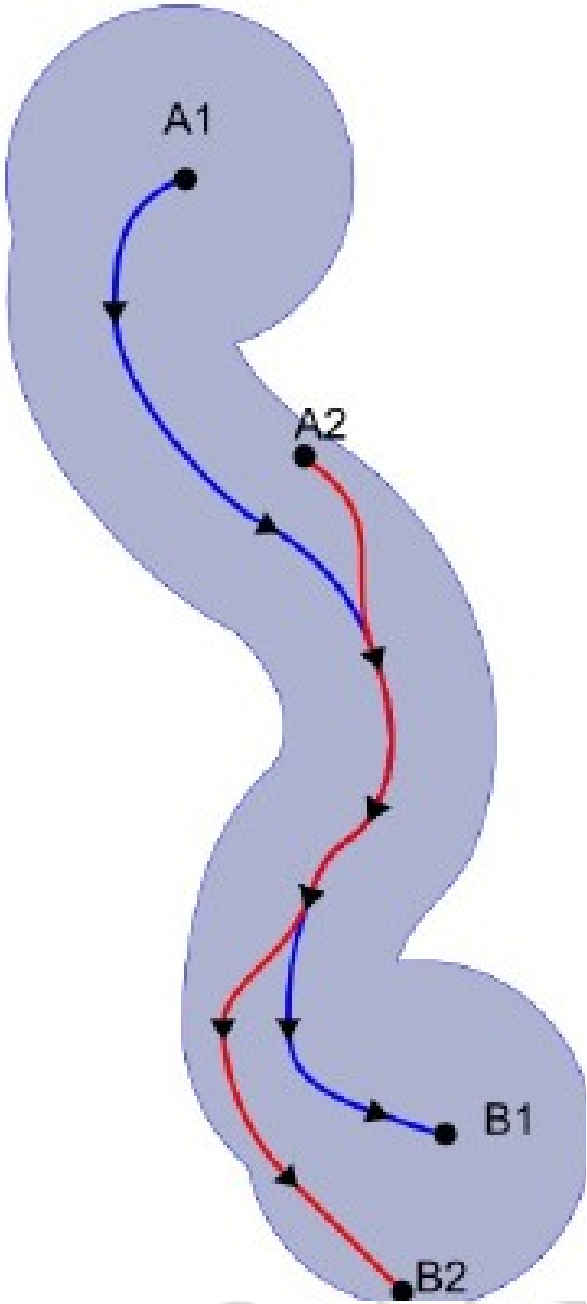
Use real paths

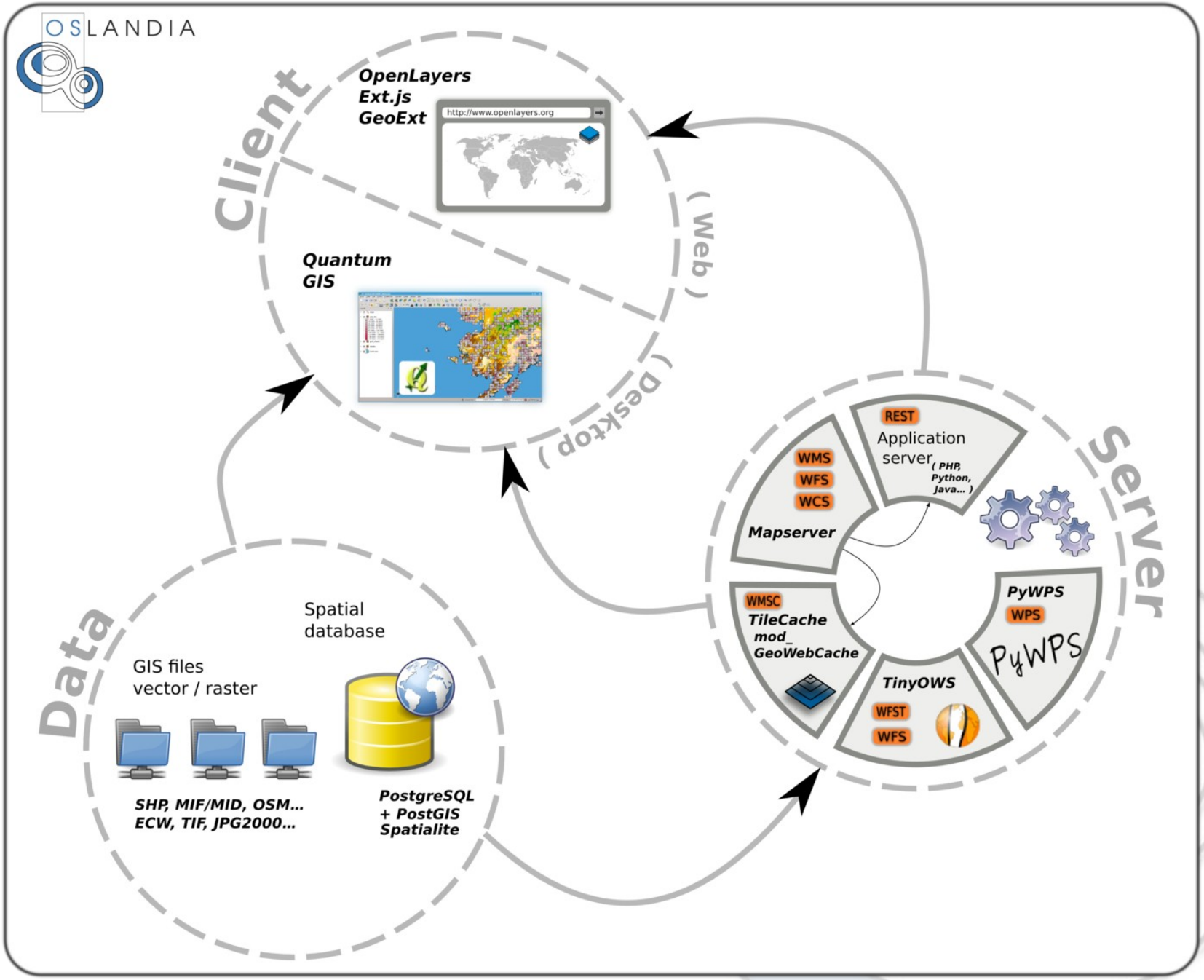
1/ Compute path (routing)

2/ Match paths
(Spatial analysis)





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Client
OpenLayers
Ext.js
GeoExt
http://www.openlayers.org
Quantum
GIS
(Web)
(Desktop)
Server
REST
Application
server
(PHP,
Python,
Java...)
WMS
WFS
WCS
Mapserver
WMSC
TileCache
mod_
GeoWebCache
PyWPS
WPS
PyWPS
TinyOWS
WFST
WFS
Data
Spatial
database
GIS files
vector / raster
SHP, MIF/MID, OSM...
ECW, TIF, JPG2000...
PostgreSQL
+ PostGIS
Spatialite

PostGIS Project

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Spatial RDBMS

- Geometry + attributes = «feature»
- SQL queries
  - Attributes
  - Spatial
- High load
  - Big data
  - Long and complex processing
- Acceptable performances
- Respect standards

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Standards

International standards

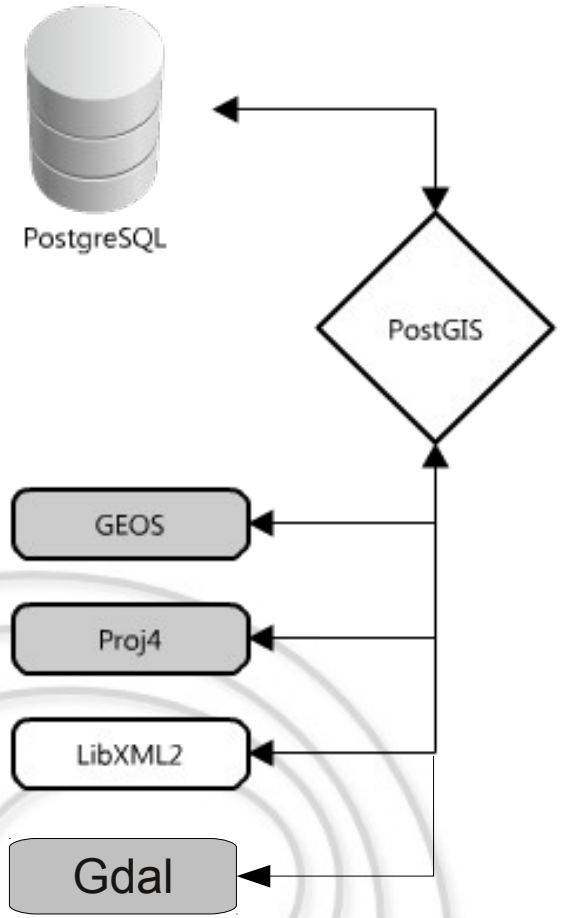
Specifications

- OGC SFS (Simple Feature for SQL)
- ISO SQL/MM part 3

What's in :

- Geometry types
- Spatial functions prototypes
- Tables and additional processing for referential integrity

Overview



Plugin PostgreSQL
Written in C
Based on external libs →
Implements OGC SFS 1.1
+ ISO SQL/MM
+ lots of extra features

History

2001 first alpha version

2003 version 0.8 – production ready

2005 version 1.0

- Core rewrite, LWGEOM
- OGC SFS 1.1 compatibility

2006 version 1.2

- Aim at ISO SQL/MM (curves, ST_ prefixes…)

2009 version 1.4

- PSC and OSGeo incubation

2011 version 1.5.3

- Geodesy

2012 version 2.0

- Raster

2013 version 2.1

- 3D

Users

Public users

- **IGN : French nat. geographical institute**
- **IRSN : Institut de Radioprotection et de sûreté Nucléaire**
- **EEA : European Environment Agency**
- **NOAA …**

Private sector

- **France Telecom, Infoterra, Digital Globe, Mediapost, Mappy, NY Times…**
- **Heroku !**

A lot of others !

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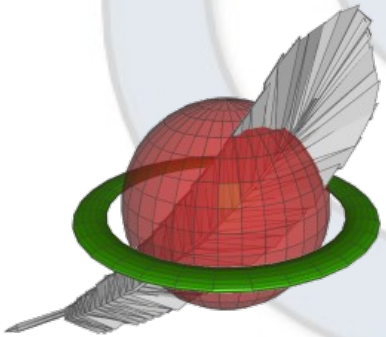
Community

Worldwide
Thousands of users
Very active postgis-users ML

Commiters :
LisaSoft
OpenGeo
Oslandia
CadCorp
Paragon Corporation
Refractions Research
Sandro Santilli
Sirius
Some others and individuals…

What else ?

Oracle spatial (and locator)
ESRI ArcSDE
IBM DB2
MS SQL Server (>2008)
Actian
Spatialite
Sybase (last version)



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Basics

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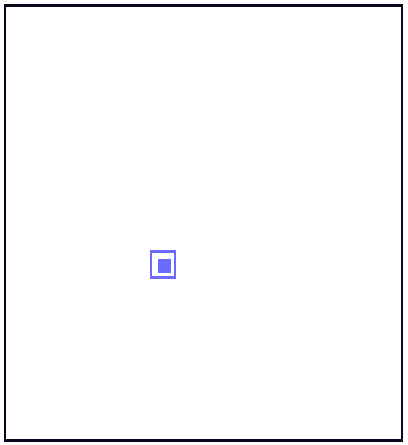
Geometry

- Geometry (or HEWKB)
  - Native database storage
  - Binary format with hexadecimal encoding
- WKT (Well Known Text)
  - Textual representation
- Dimensions
  - 2D, 3D, or 4D
- Projection system id (SRID)

Point



POINT (10 10)

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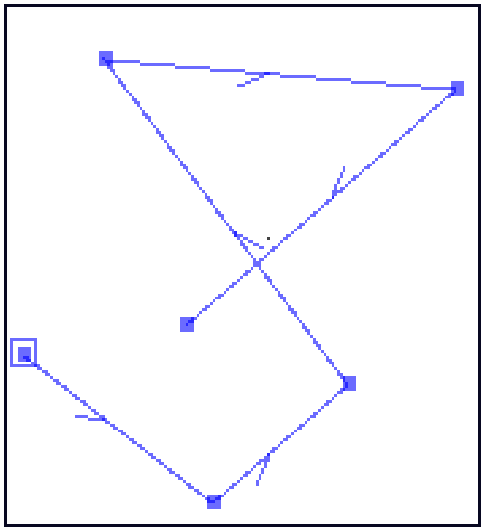
Line



```
LINESTRING
 (
  0 5, 5 1, 9 4, 2 14, 14 13, 4 4
 )
```

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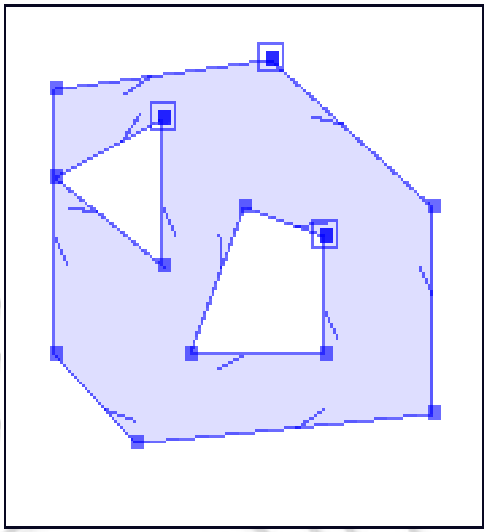
```
POLYGON
(
 (9 13,13 9,13 3,4 2,1 4,1 12, 9 13),
 (5 11,5 6,1 9,5 11),
 (10 7, 10 4, 6 4, 8 8, 10 7)
)
```

Polygon



1) Mandatory first ring is external ring
2) Rings coordinates must be closed

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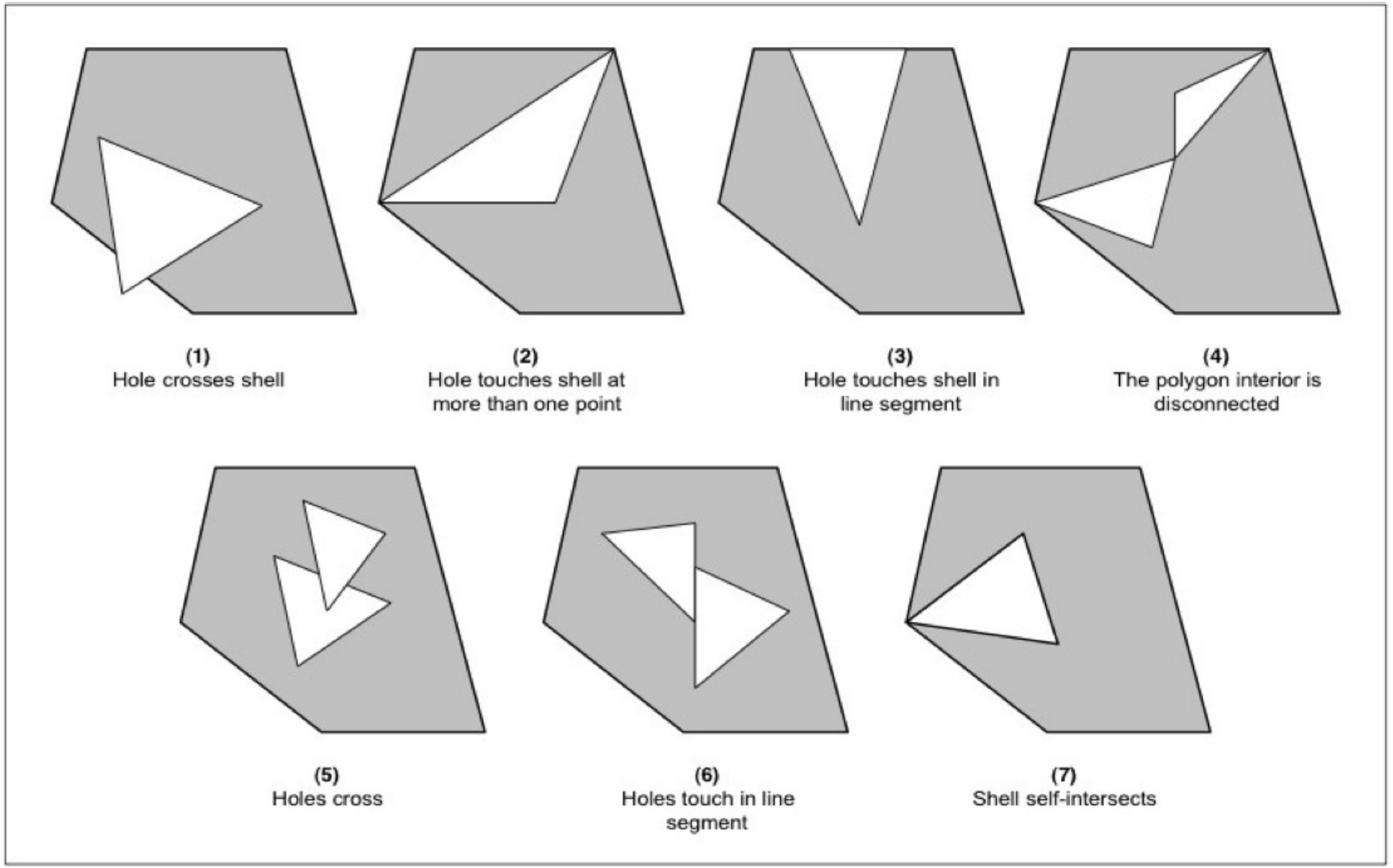
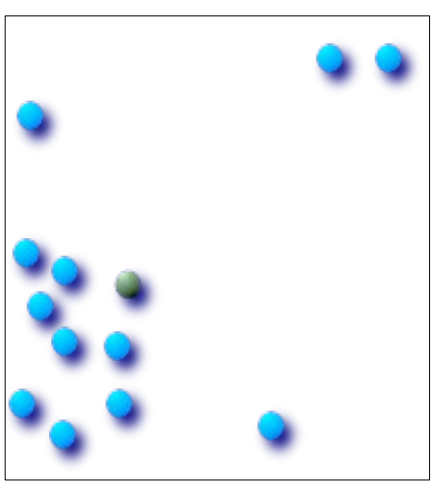
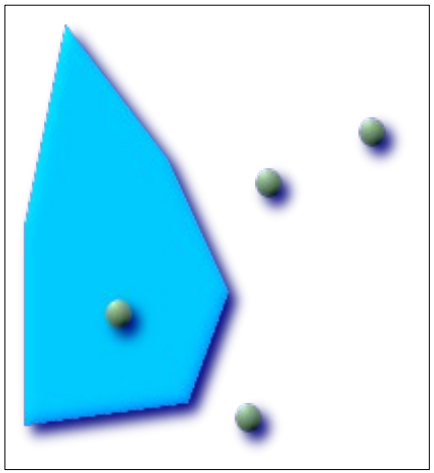
SFS (in)validity



Different projection systems cannot be mixed
Neither can different dimensions





MULTIPOINT
MULTILINESTRING
MULTIPOLYGON
GEOMETRYCOLLECTION

Multi / Aggregate

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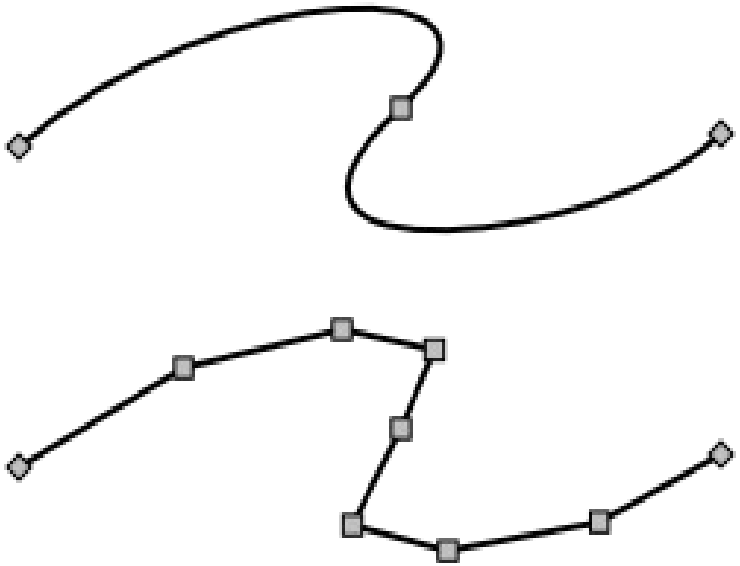
Curves

«curves» types :

CIRCULARSTRING

COMPOUNDCURVE

MULTISURFACE



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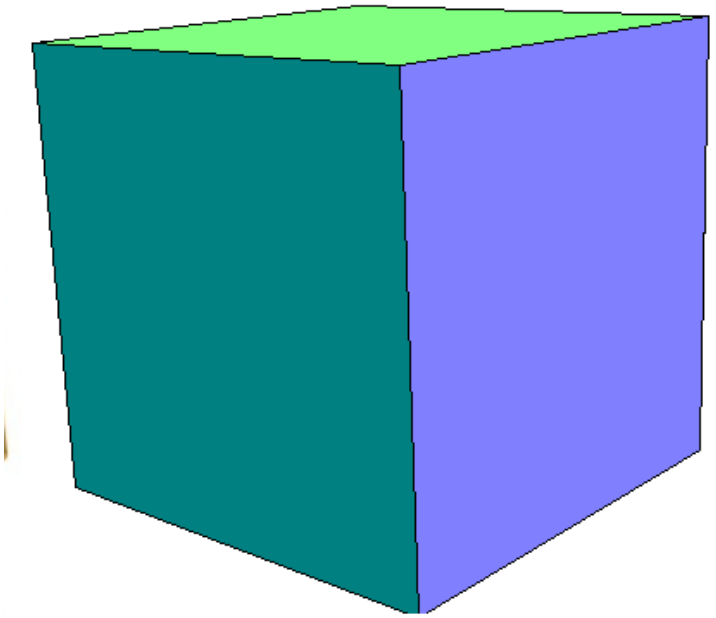
PolyhedralSurface

```
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)))
```



metadata

	oid	f_table_catalog [PK] character va	f_table_schema [PK] character v	f_table_name [PK] character v	f_geometry_column [PK] character varyi	coord_dimension integer	srid integer	type character varying(30)
1	709958	''	public	dept	the_geom	2	27582	MULTIPOLYGON
2	709957	''	public	world	the_geom	2	4326	MULTIPOLYGON

geometry_columns : spatial fields catalog

	srid [PK] integer	auth_name character var	auth_srid integer	srtext character varying(2048)	proj4text character varying(2048)
1	2000	EPSG	2000	PROJCS["Anguilla 1957 / British We	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.999
2	2001	EPSG	2001	PROJCS["Antigua 1943 / British We	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.999
3	2002	EPSG	2002	PROJCS["Dominica 1945 / British W	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.999

spatial_ref_sys: projection systems catalog

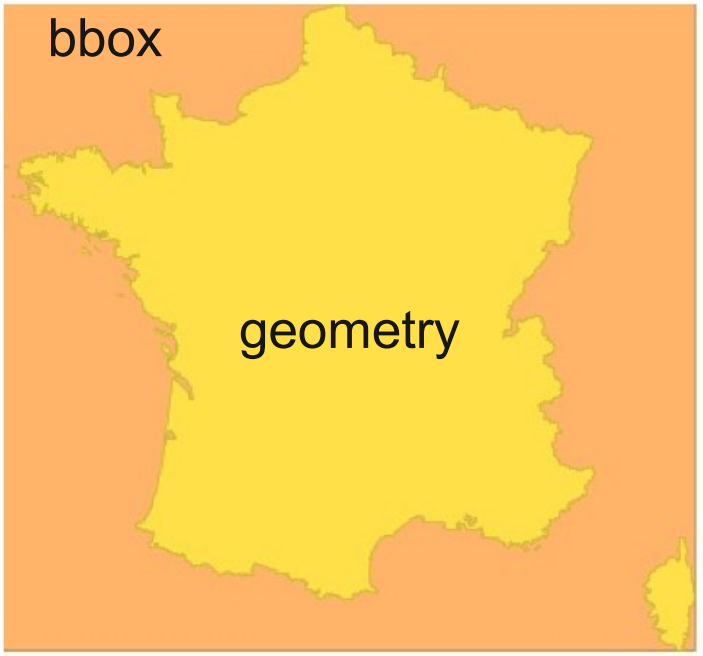
geography_columns : geography fields view

Spatial index

Better spatial filter performance

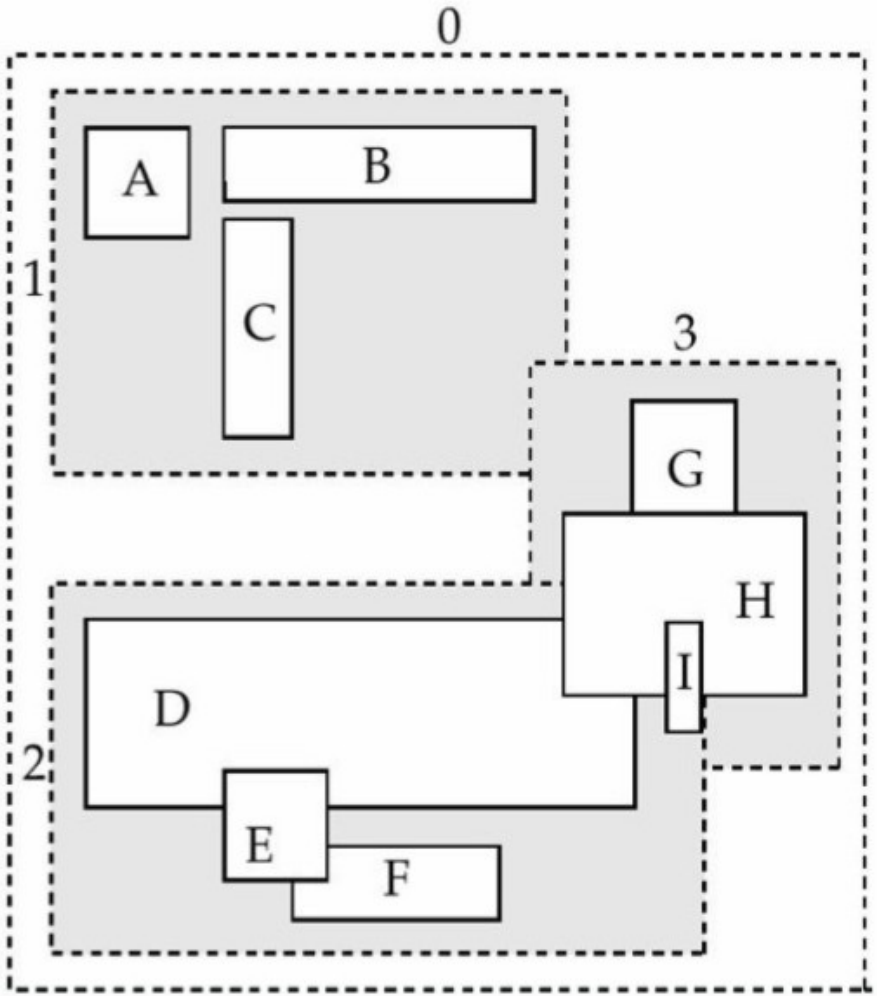
Geometry approximation with bbox

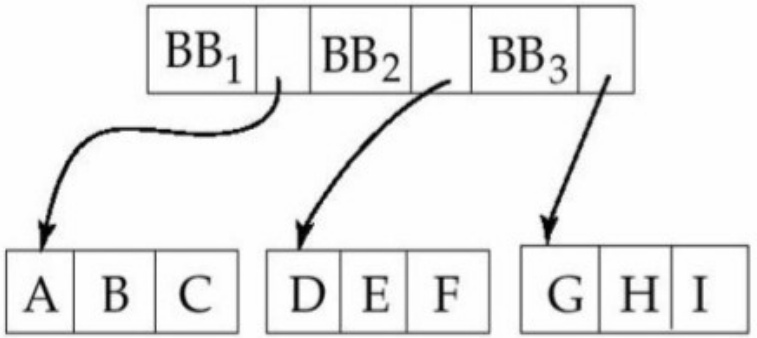
Spatial index creation :




```
CREATE INDEX index_name ON table_name
USING GIST(geom_column_name);
```

R-TREE

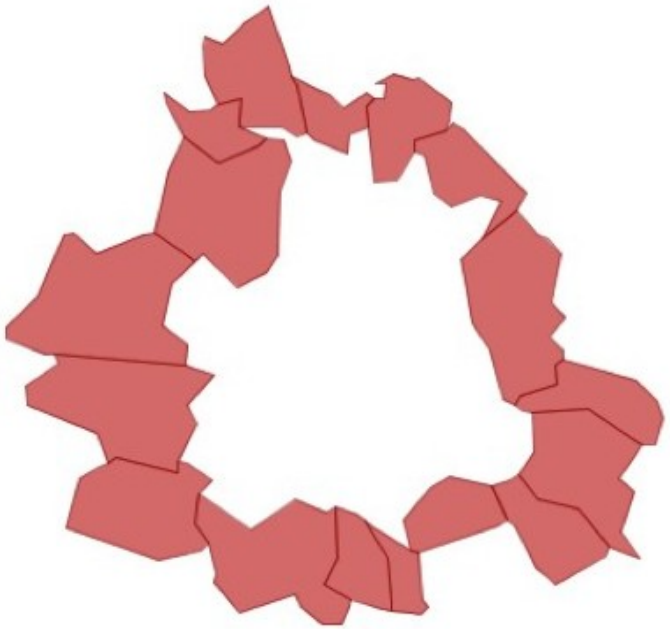




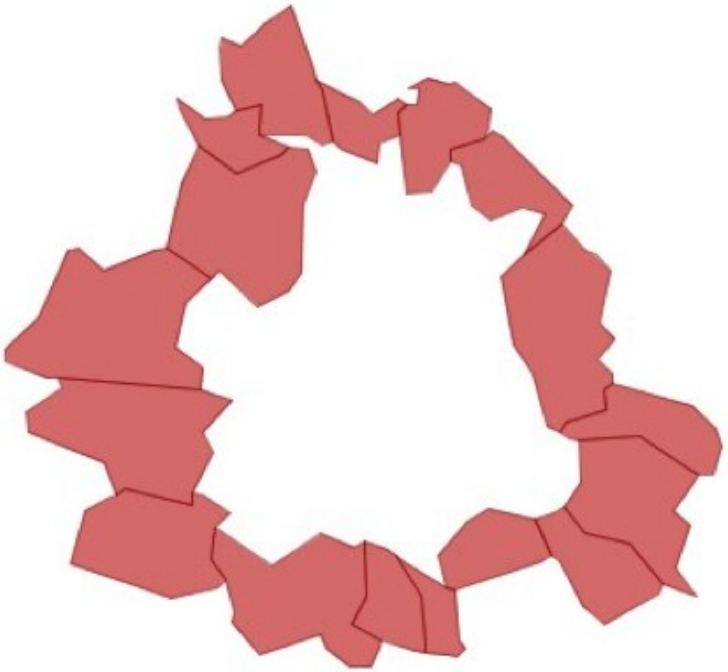
Bounding boxes are grouped in regions of the index

Indexes / perf

```
SELECT
  c1.nom
FROM
  communes c1, communes c2
WHERE
  c2.nom = 'Toulouse'
  AND ST_Touches(c1.the_geom, c2.the_geom);
```



Sans index: temps = 150 ms



Avec index: temps = 30 ms

Documentation

Documentation:

Regina Obe,
Kevin Neufeld

Improved in 1.4

Name

ST_Simplify — Returns a "simplified" version of the given geometry using the Douglas-Peuker algorithm.

Synopsis

```
geometry ST_Simplify(geometry geomA, float tolerance);
```

Description

Returns a "simplified" version of the given geometry using the Douglas-Peuker algorithm. Will actually do something only with (multi)lines and (multi)polygons but you can safely call it with any kind of geometry. Since simplification occurs on a object-by-object basis you can also feed a GeometryCollection to this function.

Note! Note that returned geometry might loose its simplicity (see ST_IsSimple)

Note! Note topology may not be preserved and may result in invalid geometries. Use (see ST_SimplifyPreserveTopology) to preserve topology.

Performed by the GEOS module.

Availability: 1.2.2

Examples

A circle simplified too much becomes a triangle, medium an octagon,

```
SELECT ST_Npoints(the_geom) As np_before, ST_NPoints(ST_Simplify(the_geom,0.1)) As np01_notbadcircle, ST_NPoints(ST_Si
ST_NPoints(ST_Simplify(the_geom,1)) As np1_octagon, ST_NPoints(ST_Simplify(the_geom,10)) As np10_triangle,
(ST_Simplify(the_geom,100) is null) As  np100_geometrygoesaway
FROM (SELECT ST_Buffer('POINT(1 3)', 10,12) As the_geom) As foo;
-result
 np_before | np01_notbadcircle | np05_notquitecircle | np1_octagon | np10_triangle | np100_geometrygoesaway
-----------+-------------------+---------------------+-------------+---------------+------------------------
        49 |                33 |                  17 |           9 |             4 | t
```

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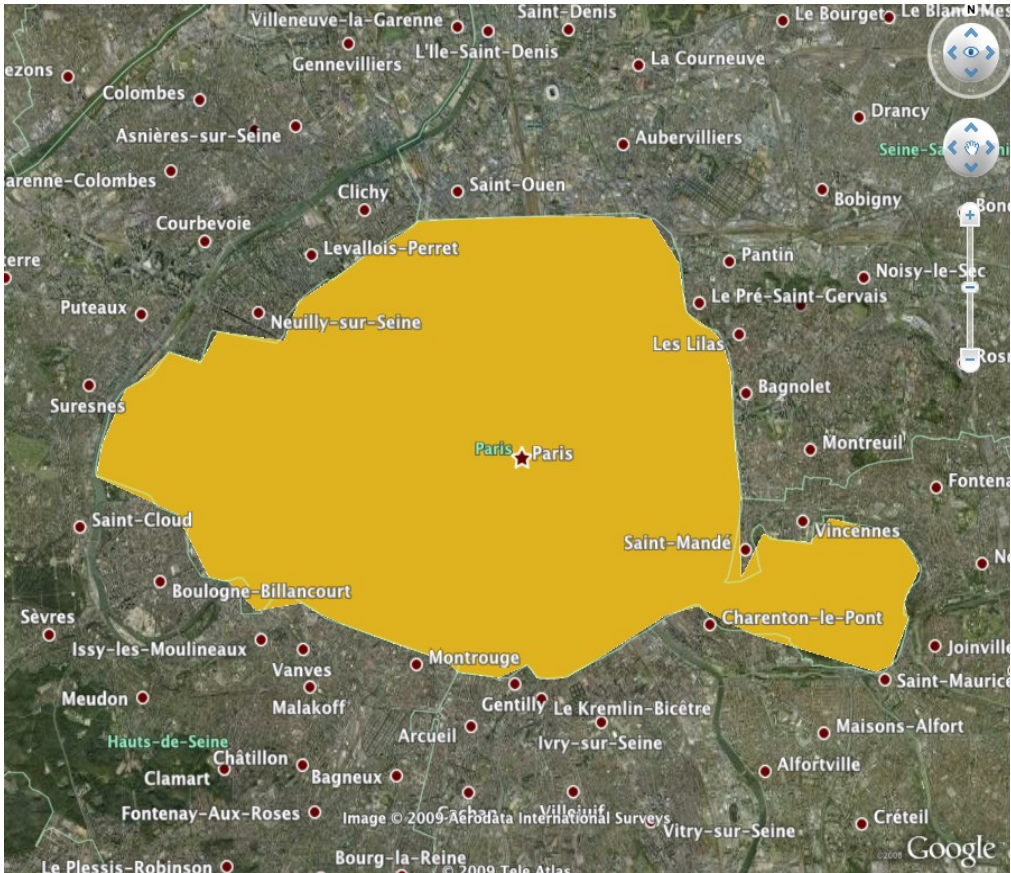
Functions

KML

```
SELECT ST_AsKML(the_geom, 5)
FROM dept
WHERE code_dept='75' ;
```



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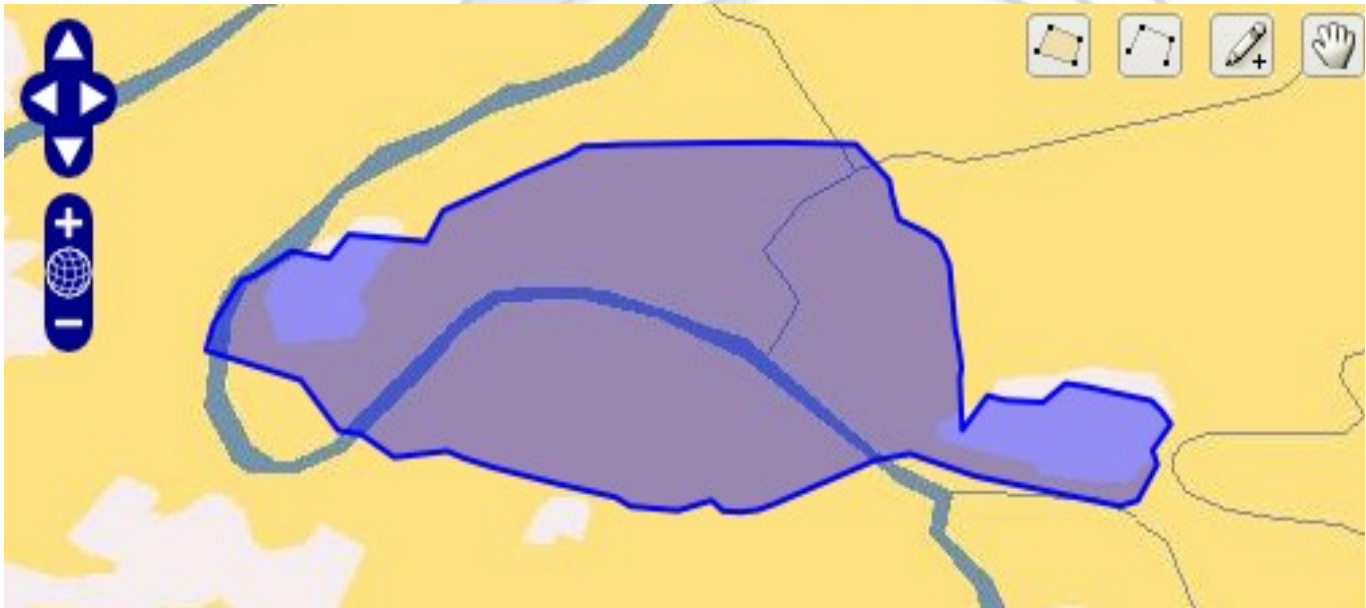
GeoJSON

```
SELECT ST_AsGeoJSON(
  ST_Transform(the_geom, 4326), 5)
FROM dept
WHERE
  code_dept='75' ;
```



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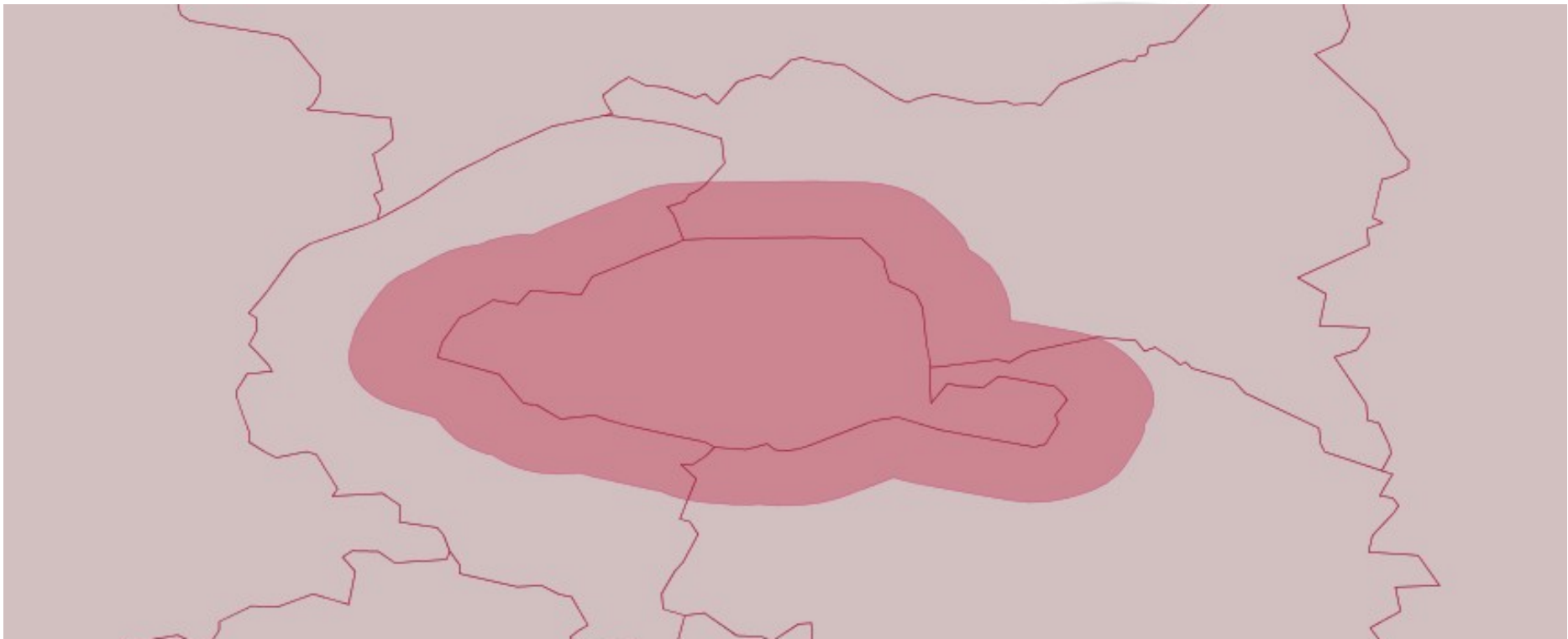
Buffer

```
SELECT ST_Buffer(the_geom, 2500)
FROM dept
WHERE code_dept='75';
```



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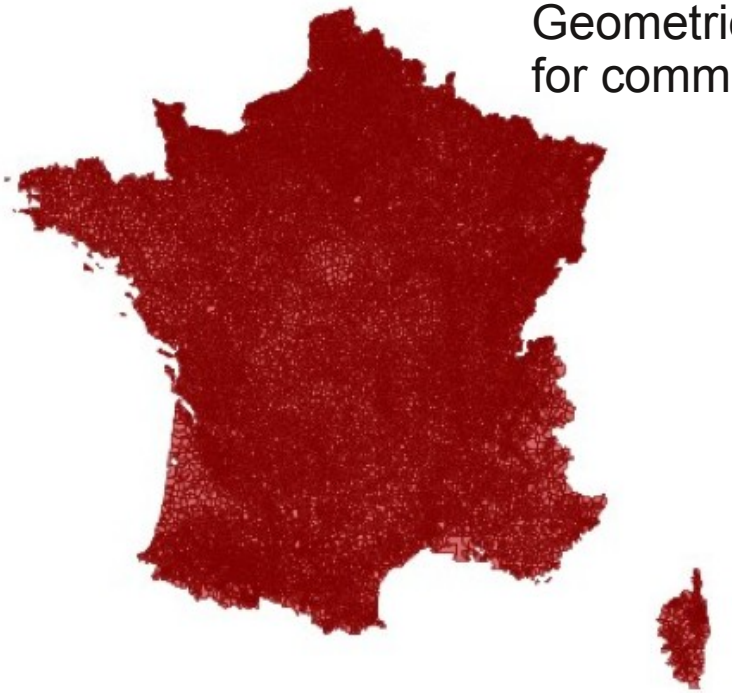
Aggregate

```
SELECT ST_Union(the_geom)
FROM commune
GROUP BY code_dept;
```

Geometries
for communes



Geometries for departments
built from communes

OSLA

Intersection

```
SELECT nom_dept
FROM dept
WHERE ST_Intersects(the_geom,
  (SELECT ST_Buffer(the_geom, 2500)
   FROM dept WHERE code_dept='75')
);
```

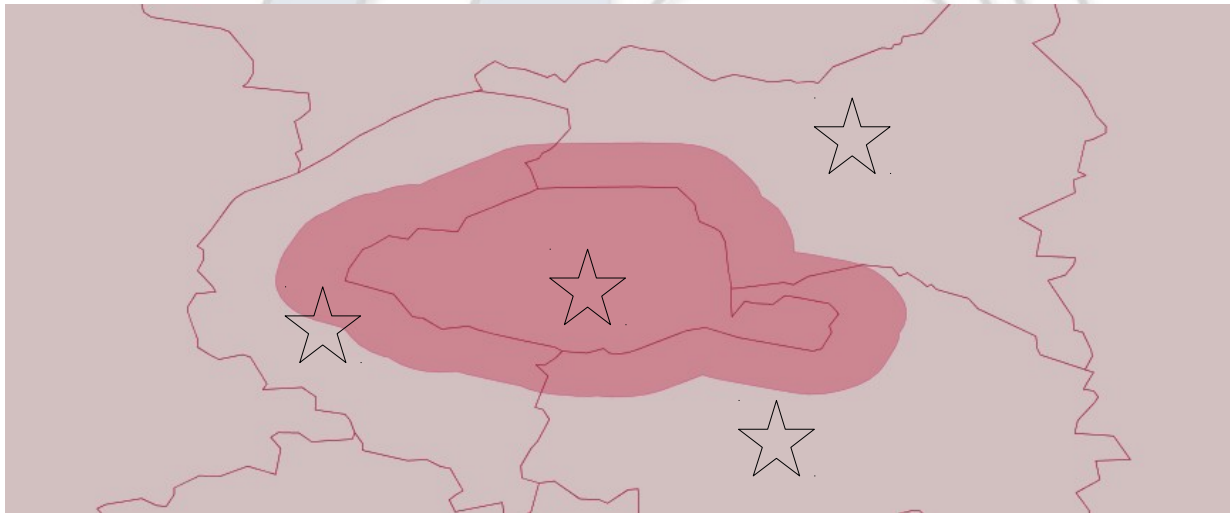
Results :

PARIS

HAUTS-DE-SEINE

SEINE-SAINT-DENIS

VAL-DE-MARNE



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Distance

```
SELECT code_dept, round(
  ST_Distance(ST_Centroid(the_geom),
  (SELECT ST_Centroid(the_geom)
   FROM dept WHERE code_dept='75')) / 1000)
  AS distance
FROM dept ORDER BY distance LIMIT 4;
```

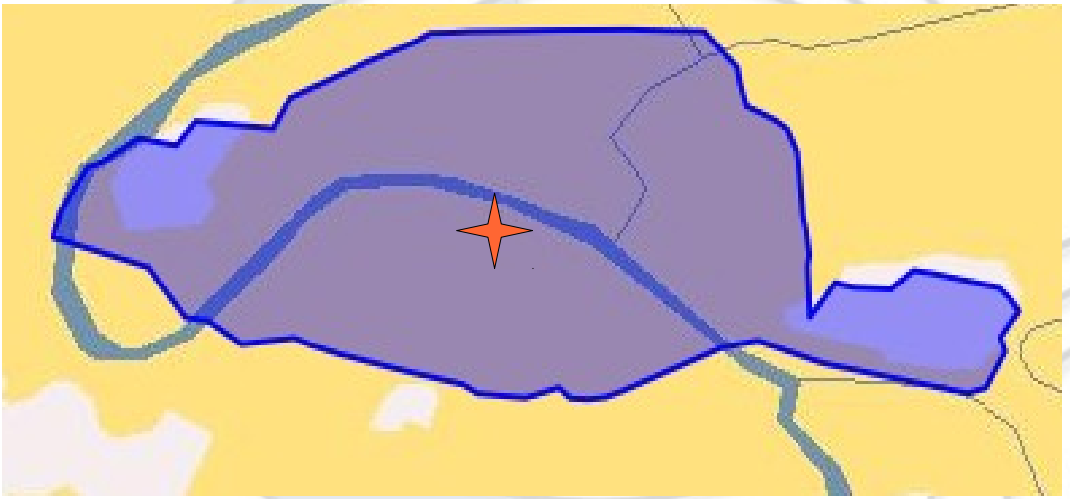
Results:

```
75|0
92|7
93|12
94|13
```

Creation

```
SELECT nom_dept
FROM dept
WHERE St_Within(
   GeometryFromText('POINT(600440 2428685)'
   , 27572), the_geom);
```

Result : PARIS



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Import GML

```
SELECT ST_AsText(
        ST_GeomFromGML(
            '<gml:Point srsName="EPSG:27572">
               <gml:pos srsDimension="2">
                  600440 2428686
               </gml:pos>
            </gml:Point>'
        )
    );
```

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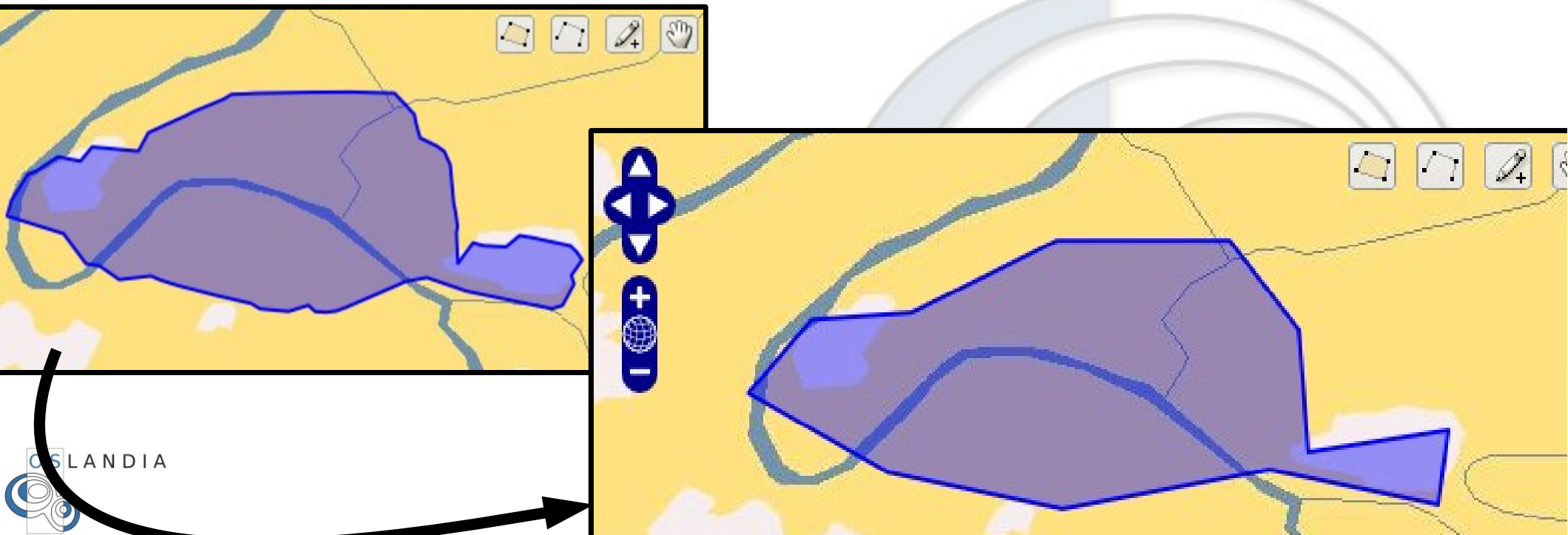
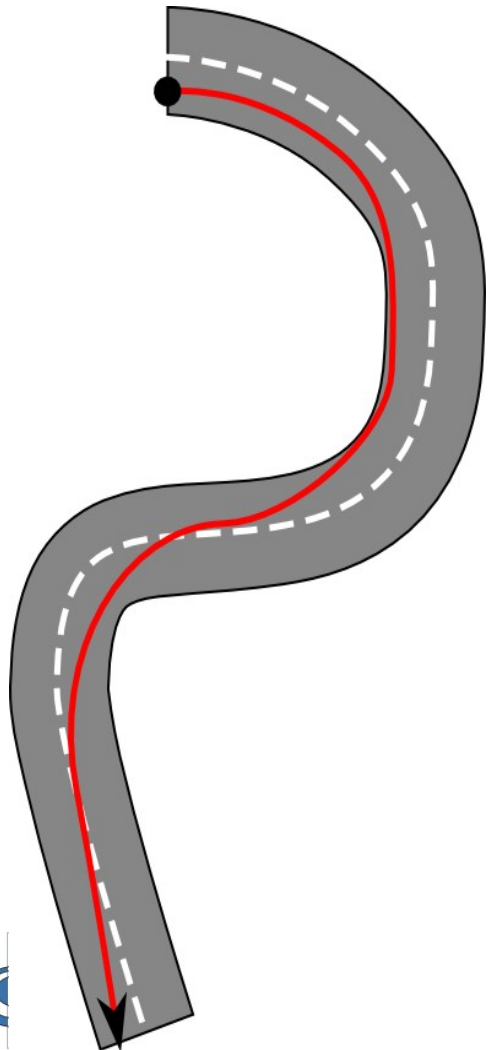
Generalization

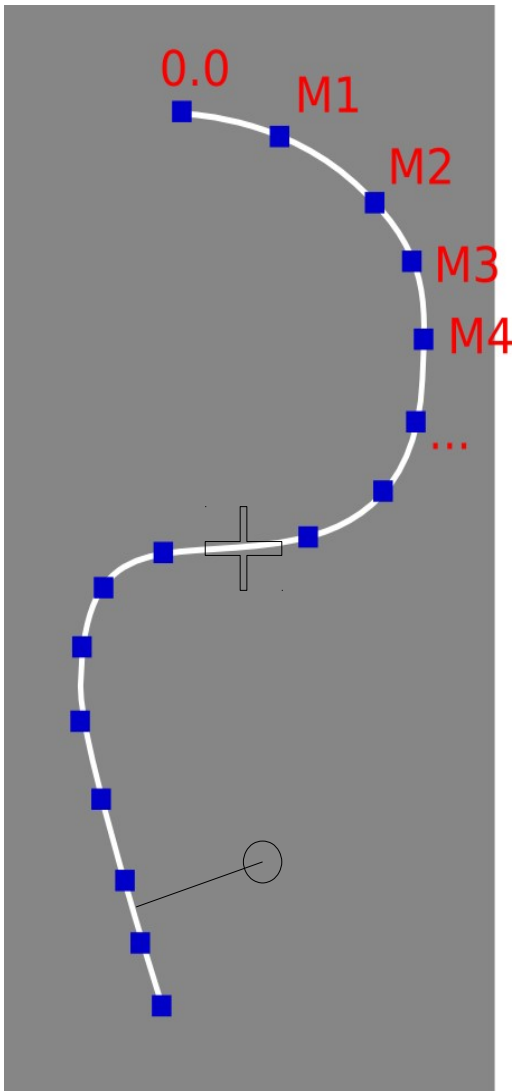
Algorithm : Douglas-Peuker

```
SELECT ST_AsGeoJSON(
            ST_Transform(
                ST_Simplify(the_geom, 800),
            4326), 5)
FROM dept WHERE code_dept='75';
```



Linear referencing





Functions for linear referencing (Road network for example)

Aka LRS

ST_line_interpolate_point(linestring, location)

ST_line_substring(linestring, start, end)

ST_line_locate_point(LineString, Point)

ST_locate_along_measure(geometry, float8)

PgRouting

PgRouting, additional module for graph routing

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Gegraphy

Type 'geography' : latitude, longitude

= «geodetic support»

Functions for this type

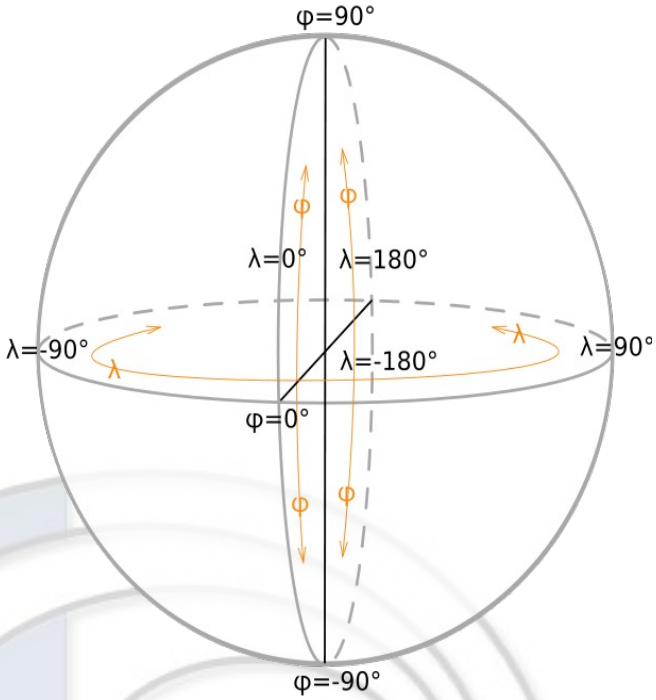
Area, distance, indexation

Only a subset

Import and export functions

GML, KML, GeoJSON

Use it or not according to use case



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