

Web картографија

Предавање 3

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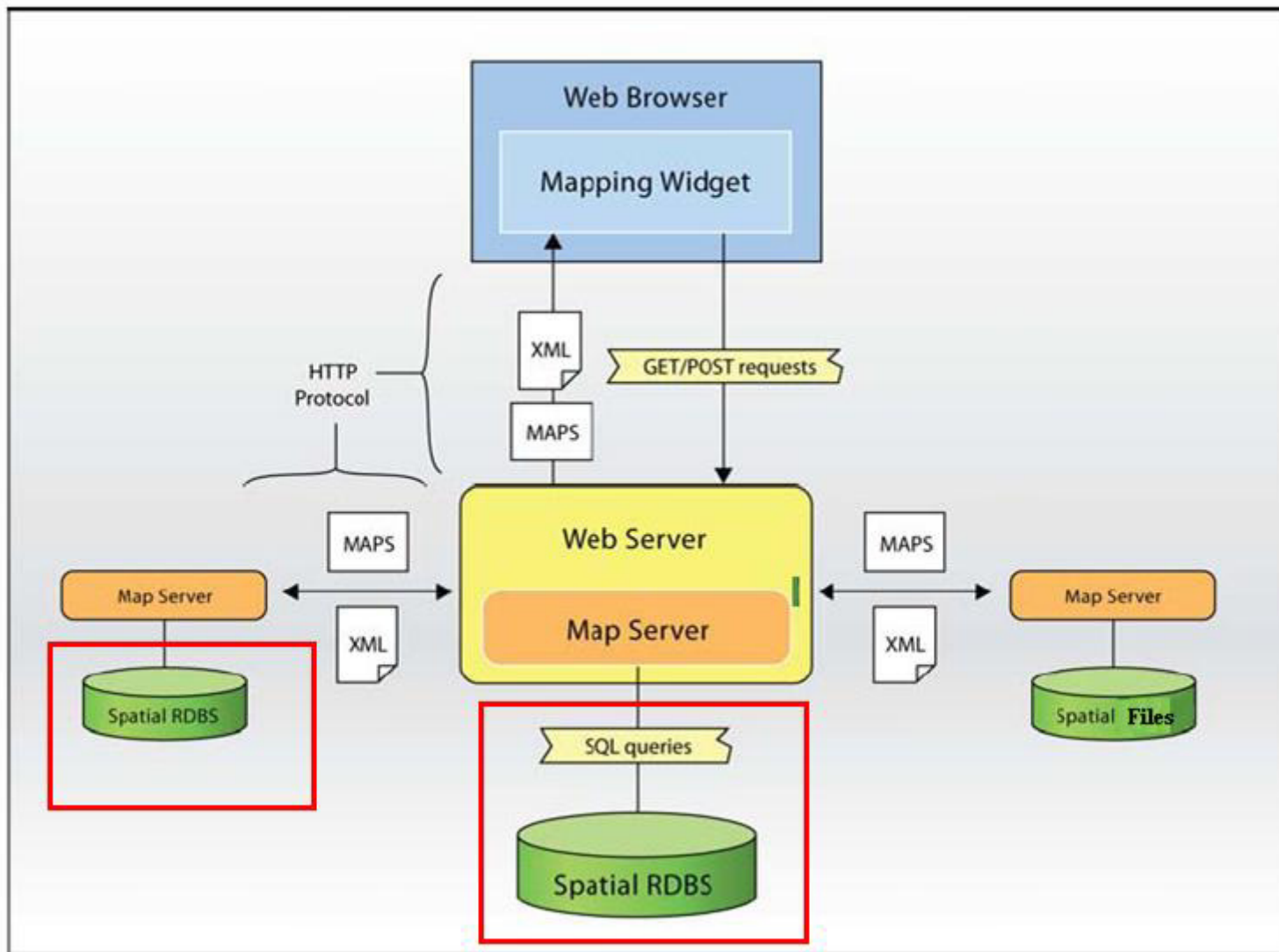
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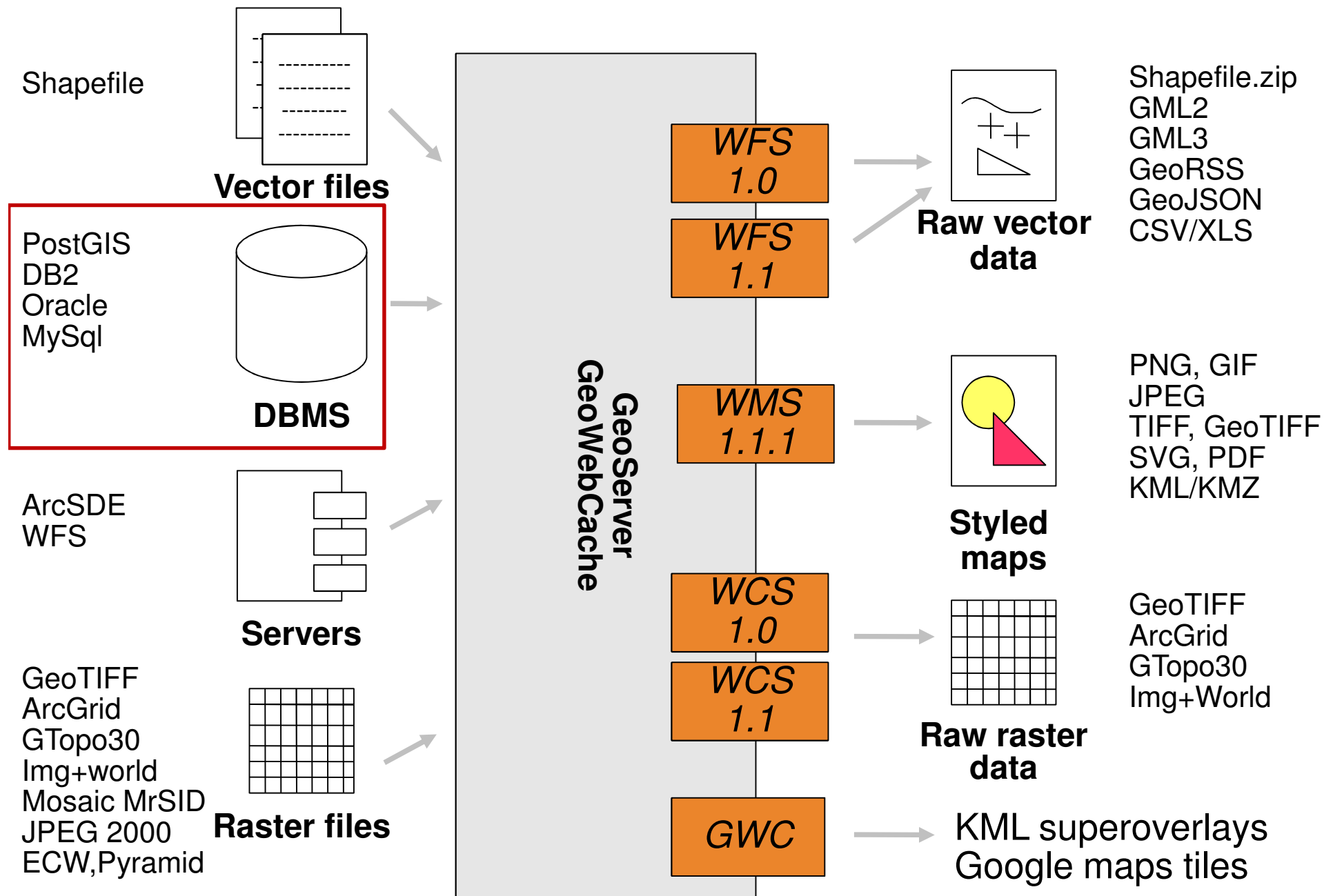
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Садржај предавања





Садржај предавања

Просторне базе података;

PostgreSQL и PostGIS ;

Креирање просторне табеле из ГИС фајла;

Координатни реферетни системи, просторни упити,
просторни индекси.

Просторна база или просторни фјалови

Зашто користити просторну базу за векторске податке, а не
нпр SHAPE фајл?

1. **БРЗИНА.** Боље перформансе за манипулацију великим количинама података. Базе података су дизајниране тако да омогућавају манипулацију са великом количином података који су поновљиви, такве могућности се односе и на просторне базе.
2. **ВИШЕКОРИСНИЧКА ПОДРШКА.** Просторне базе се често користе као референтни сетови података које користе различите групе корисника. Могућ је удаљени приступ подацима преко стандарног интерфејса.
3. **УПТИТИ.** Стандарни и просторни упити над подацима.

SDBMS

SDBMS је софтвер који:

- Ради под системима за управљање базама података **DBMS**,
- Подржава различите моделе просторних података и упитне језике којима се ови модели могу позвати,
- Подржава просторно индексирање, просторне алгоритме и специфична правила за оптимизацију упита.

Софтвери за SDBMS

<i>Spatial Database Product</i>	<i>Cost</i>
IBM DB2 spatial extender	For earlier versions of DB2, cost to add SpatialExtender \$9,250 Now included in DB2v8.1 & higher: IBM DB2 Personal Edition \$461 IBM DB2 cost varies with number of licenses: Express Edition \$4,874 to Enterprise Server Edition \$33,125
ArcSDE	Start from \$10,000 for commercial version
Oracle Spatial	Enterprise Edition: • Named user license: \$800 • Processor license: \$40,000 Oracle Spatial: • Named user license: \$200 • Processor license: \$10,000
PostgreSQL / PostGIS	Refractions Research under the GNU General Public License developed PostGIS for open source, free to the public distribution. It and the PostgreSQL database are completely open-source and can be easily downloaded over the internet for free.

Софтвери за SDBMS

<http://www.oracle.com/technology/products/spatial>

<http://www-306.ibm.com/software/data/spatial/>

<http://www.esri.com/software/arcgis/arcade/>

<http://www.mapinfo.com/>

[**http://postgis.refractory.net**](http://postgis.refractory.net)

PostgreSQL и PostGIS

PostgreSQL је opensource DBMS, који пружа готово све могућности као и скупи комерцијални DBMS софтвери.

PL/pgSQL (Procedural Language/PostgreSQL Structured Query Language) је процедурални језик подржан од [PostgreSQL RDBMS](#) (relational database management system).

Просторни додатак PostgreSQL-у је PostGIS, којим се активирају функције за манипулацију просторним подацима.

PostGIS и OGC стандарди

1. PostGIS имплементира OGC's Simple_Features for SQL стандард
2. PostGIS подржава све OGC типове података: ТАЧКУ, ЛИНИЈУ, ПОЛИГОН, МУЛТИТАЧЕКЕ, МУЛТИЛИНИЈЕ, МУЛТИПОЛИГОНЕ, GEOMETRYCOLLECTION и операције над овим типовима података.
3. PostGIS користи OGC well-known text format на SQL командној линији за претсављање просторних ентитета.

PostGIS компоненте

PostGIS обезбеђује **Open Database Connectivity ODBC** connectivity. PostgreSQL ODBC драјвери омогућују транспарентан приступ ГИС објектима из PostGIS-а. (део OGC стандарда)

PostGIS такође обезбеђује **Java Database Connectivity (JDBC)**. (није део OGC стандарда)

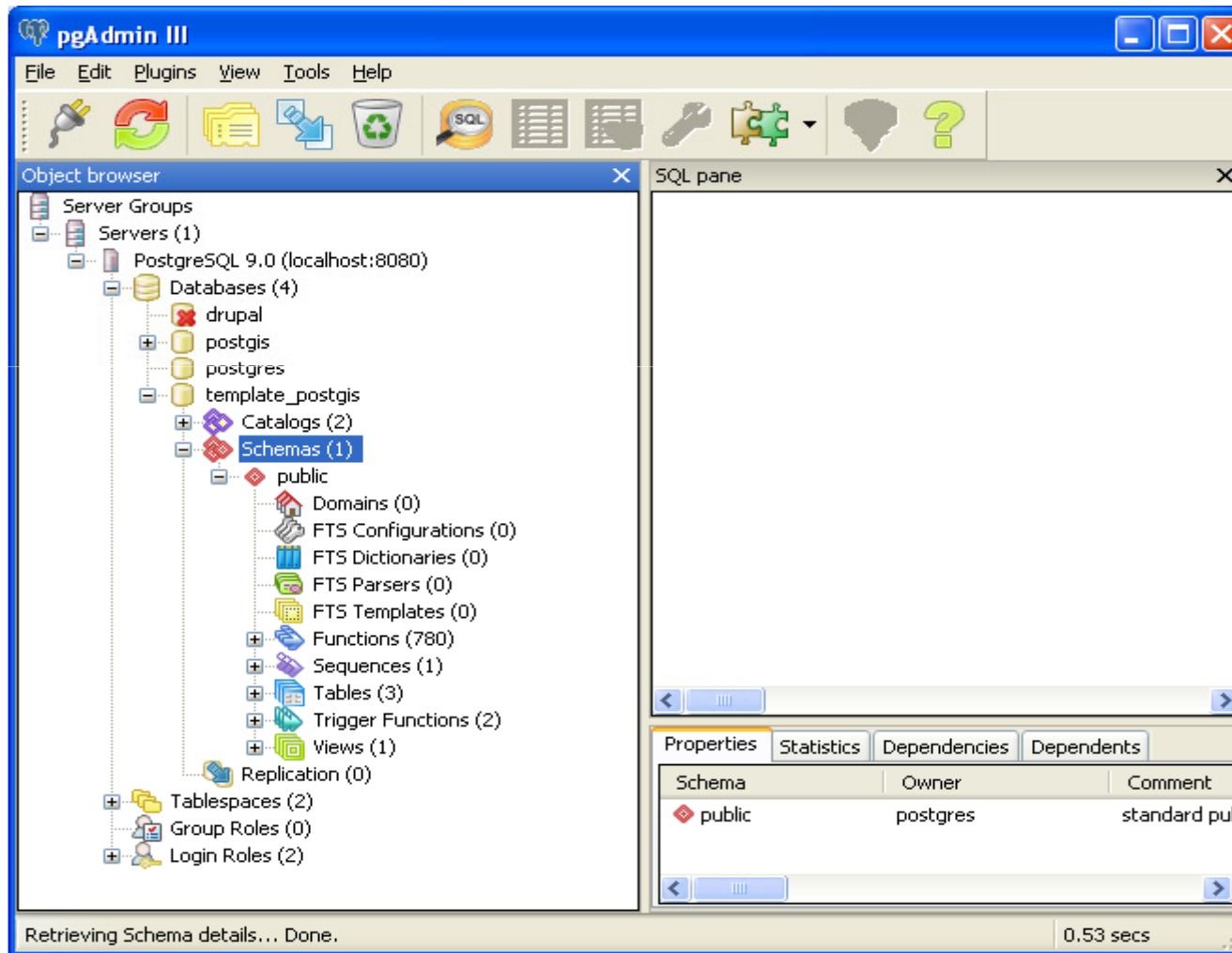
GiST (Generalized Search Tree) обезбеђује велику брзину просторног индексирања.

PROJ.4 open source библиотеку која обезбеђује координатне репројекције између координатних референтних система.

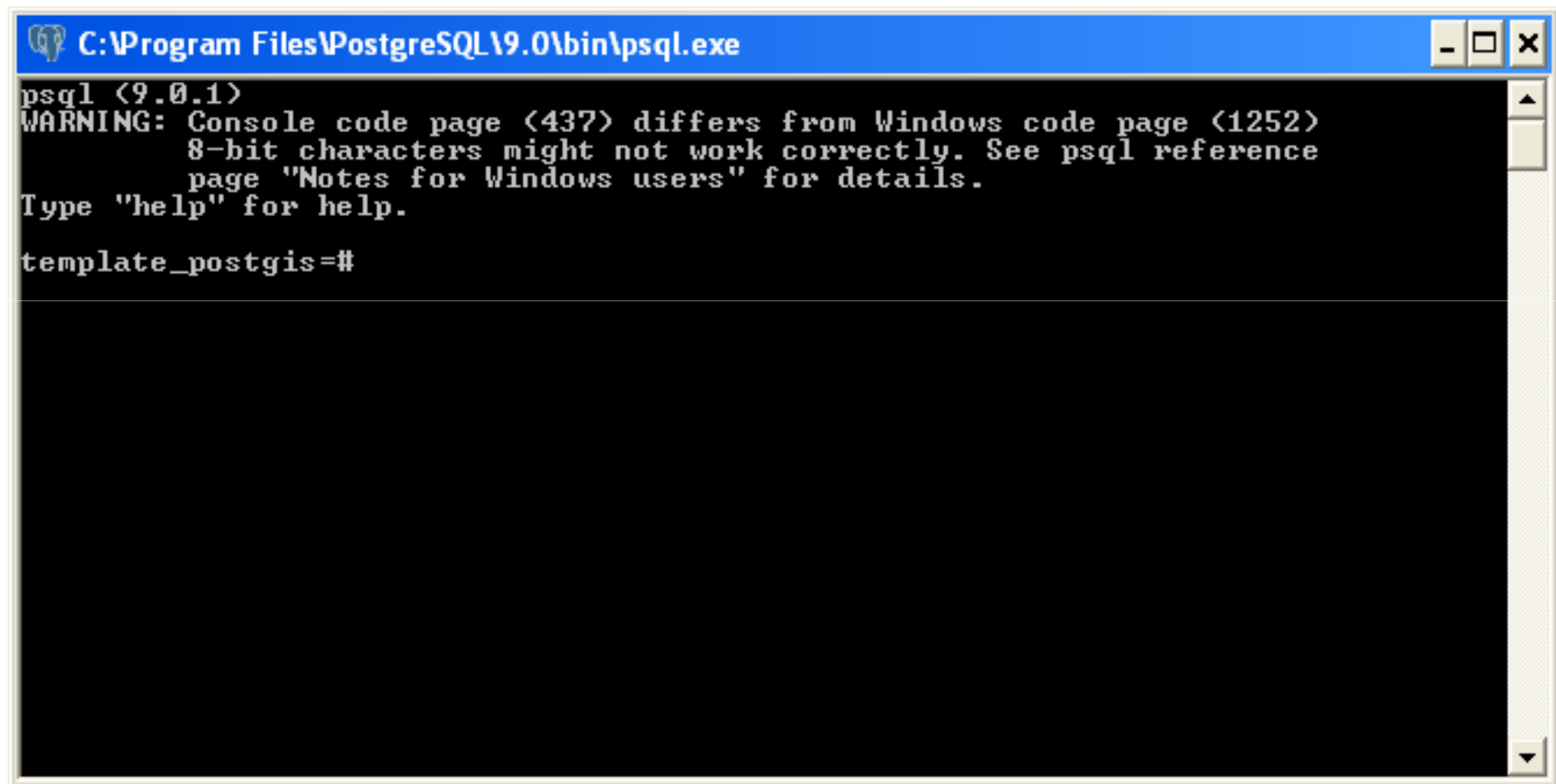
GEOS (Geometry Engine, Open Source) је библиотека која обезбеђује операције у OpenGIS Simple Features for SQL Specification. GEOS библиотека обезбеђује геометријске тестове (ST_Touches(), ST_Contains(), ST_Intersects()) и операције (ST_Buffer(), ST_Union(), ST_Intersection() ST_Difference()) у PostGIS-у.

pgAdmin III

pgAdmin III je najpopularnija administrativna i razvojna platforma za PostgreSQL.



PSQL консоль

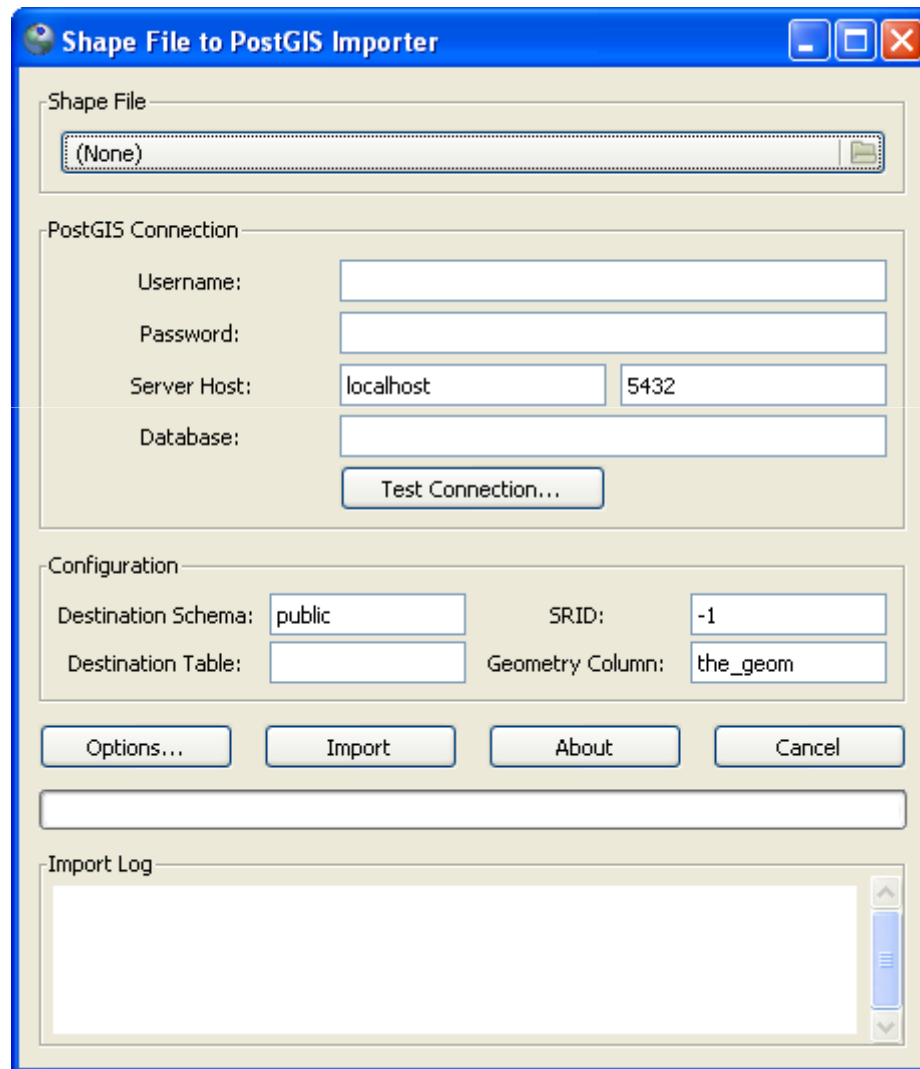


A screenshot of a Windows command prompt window titled "C:\Program Files\PostgreSQL\9.0\bin\psql.exe". The window has a blue title bar and standard Windows window controls (minimize, maximize, close). The main area is black with white text. The text displayed is as follows:

```
psql (9.0.1)  
WARNING: Console code page (437) differs from Windows code page (1252)  
        8-bit characters might not work correctly. See psql reference  
        page "Notes for Windows users" for details.  
Type "help" for help.  
template_postgis=#
```

The text is in a monospaced font. The prompt "template_postgis=#" is at the bottom of the visible text. There are vertical scrollbar controls on the right side of the window.

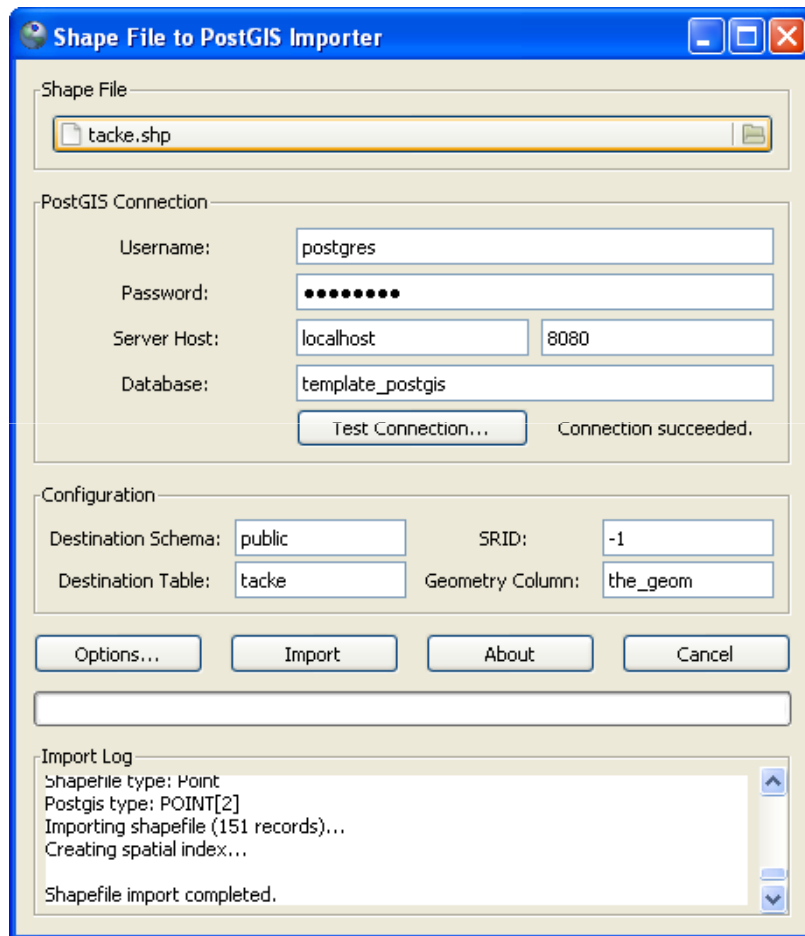
Shape to PostGIS Importer



The image shows a Windows-style dialog box titled "Shape File to PostGIS Importer". It contains several sections for configuring the import process:

- Shape File:** A text field with "(None)" and a folder icon.
- PostGIS Connection:** Fields for Username, Password, Server Host (localhost), and Database. A port field contains "5432". A "Test Connection..." button is below.
- Configuration:** Fields for Destination Schema (public), SRID (-1), Destination Table, and Geometry Column (the_geom).
- Buttons:** Options..., Import, About, and Cancel.
- Import Log:** A large text area at the bottom for logging the process.

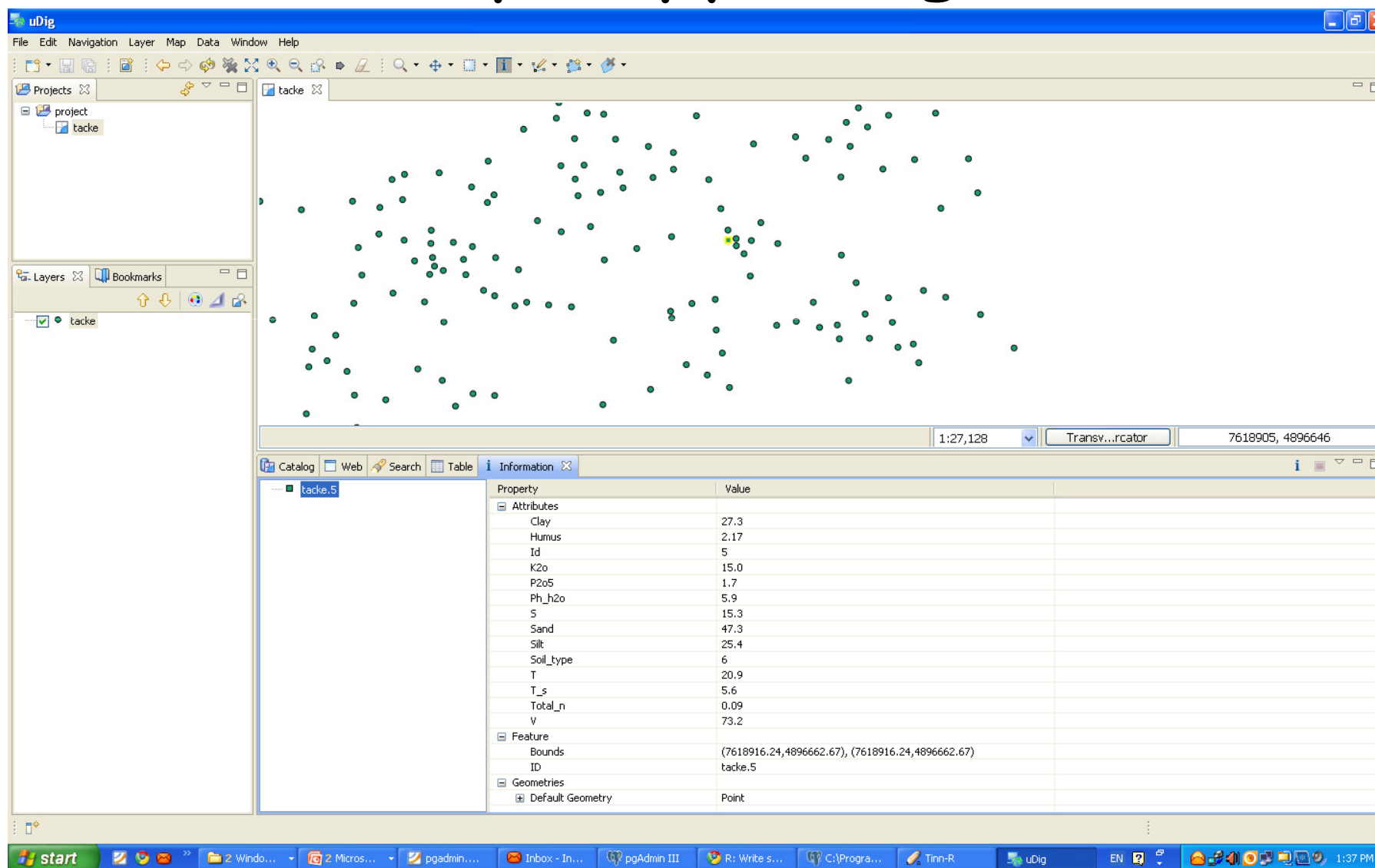
Креирање просторне табеле из shp фајла



```
CREATE TABLE tacke
(  
    gid serial NOT NULL,  
    id double precision,  
    soil_type double  
precision,  
    humus numeric,  
    ...  
    the_geom geometry,  
    CONSTRAINT  
tacke_pkey PRIMARY KEY  
(gid),  
    ...
```

```
shp2pgsql -i -s <epsgcode> <ShapeFileName> <TableName> <dbName> >  
<filename>
```

Приказ у стандартном ГИС софтверу (uDig)



Контрола из конзоле приказ свих табела

```
C:\Program Files\PostgreSQL\9.0\bin\psql.exe
psql (9.0.1)
WARNING: Console code page (437) differs from Windows code page (1252)
        8-bit characters might not work correctly. See psql reference
        page "Notes for Windows users" for details.
Type "help" for help.

template_postgis=# \d
               List of relations
Schema |      Name      | Type   | Owner
-----+-----+-----+-----
public | geography_columns | view   | postgres
public | geometry_columns | table  | postgres
public | soil            | table  | postgres
public | soil_gid_seq    | sequence | postgres
public | spatial_ref_sys | table  | postgres
public | tacke           | table  | postgres
public | tacke_gid_seq   | sequence | postgres
(7 rows)

template_postgis=#
```

Контрола из pgAdmin III

The screenshot displays the pgAdmin III interface. On the left, the 'Object browser' shows the database structure: PostgreSQL 9.0 (localhost:8080) > Databases (4) > template_postgis > Catalogs (2) > public > Tables (4) > tacke. The 'tacke' table has 16 columns: gid, id, soil_type, humus, ph_h2o, total_n, k2o, p2o5, t_s, s, t, v, sand, silt, clay, and the_geom. The 'Edit Data' window is open, showing 151 rows of data. The 'the_geom' column is highlighted with a red oval. The status bar at the bottom indicates 'Retrieving Table details... Done.' and '0.00 secs'.

	ph_h2o numeric	total_n numeric	k2o numeric	p2o5 numeric	t_s numeric	s numeric	t numeric	v numeric	sand numeric	silt numeric	clay numeric	the_geom geometry
1	5.10000000000000	0.12000000000000	25.30000000000000	9.10000000000000	11.90000000000000	13.00000000000000	24.89999999999999	52.20000000000000	39.89999999999999	33.29999999999999	26.80000000000000	0101000000E17
2	6.52000000000000	0.13000000000000	19.19999999999999	2.20000000000000	4.40000000000000	27.30000000000000	31.69999999999999	86.00000000000000	32.39999999999999	29.30000000000000	38.29999999999999	0101000000EC5
3	5.64000000000000	0.11000000000000	16.89999999999999	7.90000000000000	8.10000000000000	16.19999999999999	24.30000000000000	66.70000000000000	51.60000000000000	21.30000000000000	27.10000000000000	0101000000E17
4	5.96000000000000	0.11000000000000	23.30000000000000	6.50000000000000	6.30000000000000	18.00000000000000	24.30000000000000	68.90000000000000	42.00000000000000	25.69999999999999	32.29999999999999	01010000009A5
5	5.90000000000000	0.09000000000000	15.00000000000000	1.70000000000000	5.60000000000000	15.30000000000000	20.89999999999999	73.20000000000000	47.29999999999999	25.39999999999999	27.30000000000000	0101000000F62
6	7.70000000000000	0.20000000000000	32.20000000000000	16.30000000000000	1.30000000000000	57.89999999999999	59.20000000000000	97.70000000000000	30.39999999999999	31.80000000000000	37.79999999999999	01010000000333
7	7.14000000000000	0.20000000000000	32.20000000000000	22.50000000000000	2.90000000000000	33.00000000000000	35.89999999999999	92.00000000000000	33.29999999999999	29.69999999999999	37.00000000000000	010100000008FC
8	6.84000000000000	0.14000000000000	22.69999999999999	2.40000000000000	3.50000000000000	24.10000000000000	27.60000000000000	87.29999999999999	37.10000000000000	30.10000000000000	32.79999999999999	0101000000052B
9	6.36000000000000	0.10000000000000	21.19999999999999	2.40000000000000	4.60000000000000	10.40000000000000	15.00000000000000	69.40000000000000	60.10000000000000	22.10000000000000	17.80000000000000	01010000000F62
10	6.44000000000000	0.14000000000000	23.60000000000000	4.90000000000000	5.50000000000000	20.00000000000000	25.50000000000000	78.50000000000000	51.39999999999999	23.19999999999999	25.39999999999999	01010000000D7A
11	7.08000000000000	0.18000000000000	24.50000000000000	4.70000000000000	3.60000000000000	20.89999999999999	24.50000000000000	85.09999999999999	58.89999999999999	20.10000000000000	21.00000000000000	01010000000F62
12	6.68000000000000	0.09000000000000	25.89999999999999	2.10000000000000	3.70000000000000	24.10000000000000	27.80000000000000	86.59999999999999	31.10000000000000	31.69999999999999	37.20000000000000	01010000000666
13	5.70000000000000	0.10000000000000	10.19999999999999	5.80000000000000	8.40000000000000	9.50000000000000	17.80000000000000	53.10000000000000	46.10000000000000	33.60000000000000	20.30000000000000	01010000000000
14	7.04000000000000	0.07000000000000	21.10000000000000	2.90000000000000	3.00000000000000	19.89999999999999	22.89999999999999	86.79999999999999	50.20000000000000	21.39999999999999	28.39999999999999	010100000008FC

151 rows.

Fill factor: 151
Rows (counted): No
Inherits tables: No
Inherited tables count: 0
Has OIDs?: No
System table?: No
Comment: No

Приказ геометрије

`select id, the_geom from tacke;`

C:\Program Files\PostgreSQL\9.0\bin\psql.exe		WKB
id	the_geom	
1	0101000000E17A142E5B105D41D7A370DD1AC5241	
2	0101000000EC51B8BE4D105D4185EB513812AD5241	
3	0101000000E17A146E42105D41B81E855B3DAD5241	
4	01010000009A9999A940105D418FC2F55877AD5241	
5	0101000000F6285C0F59105D41AE47E1AAE5AD5241	
6	01010000003333331382105D41666666D6A2AD5241	
7	01010000008FC2F578B3105D41295C8F3246AD5241	
8	010100000052B81E9528115D41CDCCCCBBC2CAD5241	
9	0101000000F6285CDF60115D41EC51B8DE2DAD5241	
10	0101000000D7A370DD96115D41E17A142E1DAD5241	
11	0101000000F6285C9FB2115D41EC51B81E23AD5241	
12	01010000006666668603115D41CDCCC3C42AD5241	
13	0101000000000000900A105D41666666A6FCAC5241	
14	01010000008FC2F50868105D4114AE4751DBAD5241	
15	0101000000B81E852B15105D4114AE47916FAD5241	
16	0101000000666666F6D7105D41D7A3708D4DAD5241	
17	0101000000B81E85FBEE0F5D417B14AE07ECAD5241	
18	0101000000B81E85EBAD0F5D41B81E851BD6AD5241	
19	0101000000B81E853B710F5D411F85EBC1C0AD5241	
20	0101000000713D0A37ED0F5D411F85EB1161AD5241	
21	01010000005C8FC255EF0F5D41713D0A5754AD5241	
22	0101000000E17A146E820F5D41333333432AAD5241	
23	0101000000B81E85BBC70F5D4148E17A54CEAC5241	
24	0101000000E17A149E6E0F5D41333333D3B1AC5241	
25	010100000052B81E55A40E5D413D0AD7F3C2AC5241	
26	0101000000EC51B8FE7B0E5D41A4703D2AC6AC5241	

Приказ геометрије

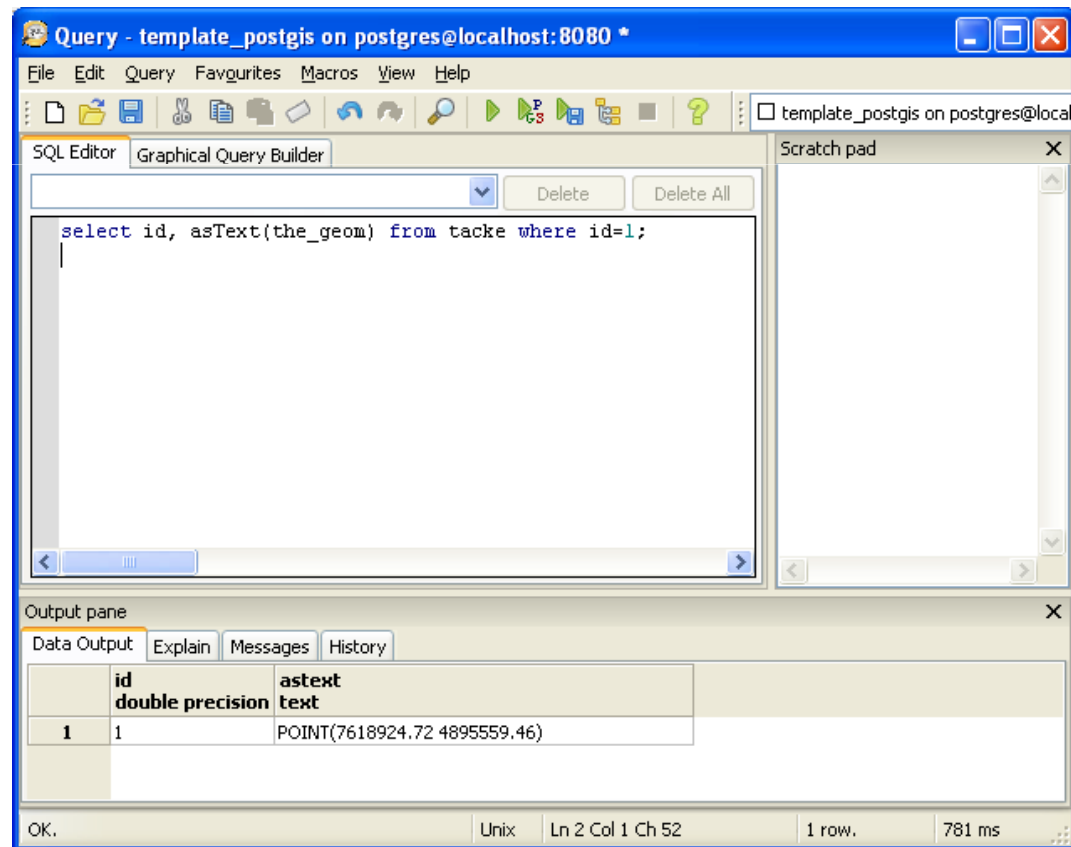
```
select id, asText(the_geom) from tacke  
where id=1;
```

```
C:\Program Files\PostgreSQL\9.0\bin\psql.exe  
68 | 0101000000EC51B89EED0C5D41D7A370FD2DAE5241  
template_postgis=#  
template_postgis=# select id=1,asText(the_geom) from tacke where id=1;  
?column? | astext  
-----+-----  
t | POINT(7618924.72 4895559.46)  
(1 row)
```

WKT

Приказ геометрије

`select id, asText(the_geom) from tacke
where id=1;`



Примери Well Known Text геометрије:

```
POINT(2572292.2 5631150.7)
```

```
LINESTRING (2566006.4 5633207.9, 2566028.6 5633215.1, 2566062.3 5633227.1)
```

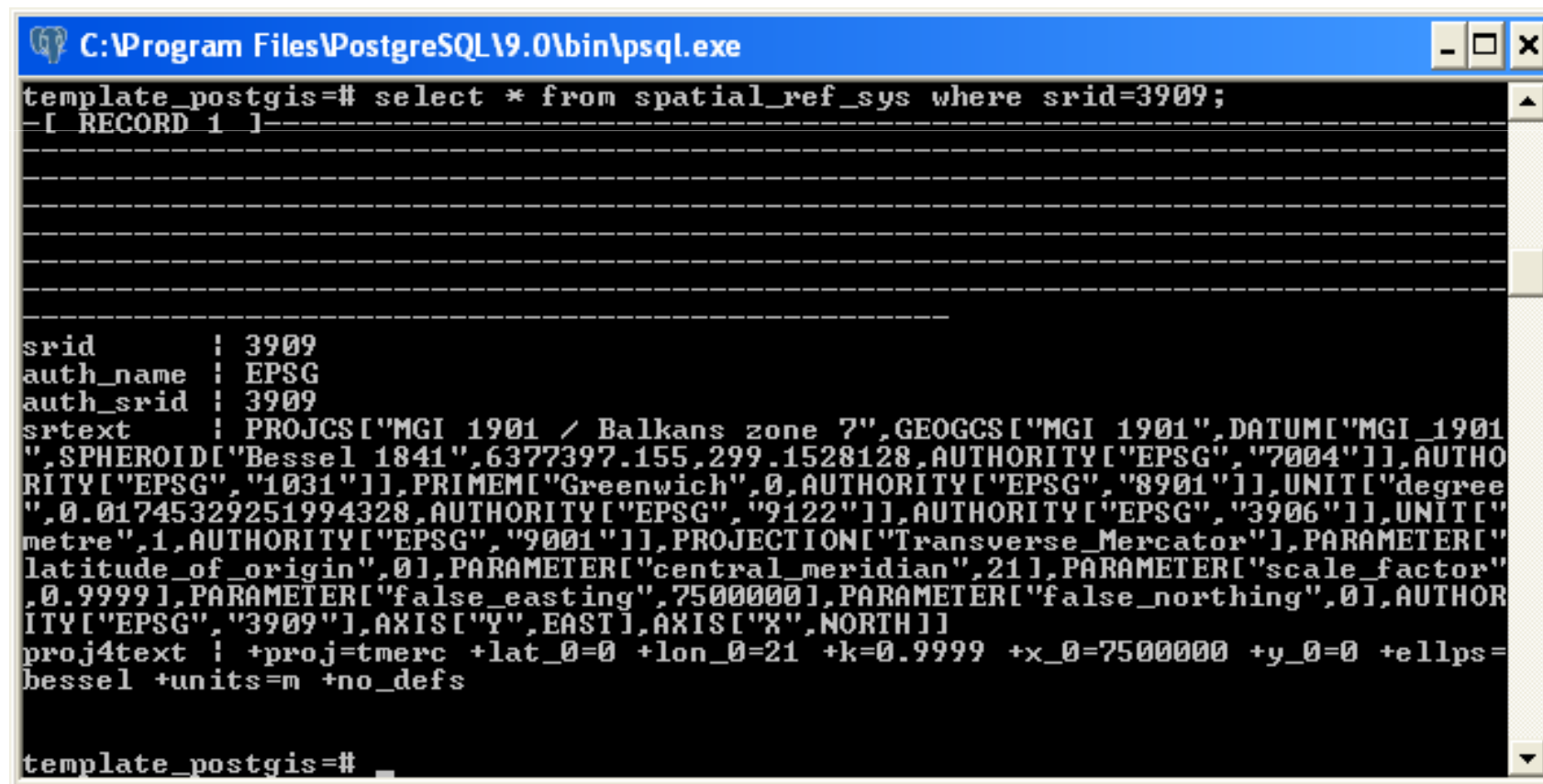
```
MULTILINESTRING((2566006.4 5633207.9, 2566028.6 5633215.1), (2566062.3  
5633227.1, 2566083 5633234.8))
```

```
POLYGON (2568262.1 5635344.1, 2568298.5 5635387.6, 2568261.04 5635276.15,  
2568262.1 5635344.1);
```

```
MULTIPOLYGON(((2568262.1 5635344.1, 2568298.5 5635387.6, 2568261.04 5635276.15,  
2568262.1 5635344.1), (2568194.2 5635136.4, 2568199.6 5635264.2, 2568200.8  
5635134.7, 2568194.2 5635136.4 )))
```

Координатни референти систем у PostGIS-у

```
select * from spatial_ref_sys where  
srid=3909;
```



```
C:\Program Files\PostgreSQL\9.0\bin\psql.exe
template_postgis=# select * from spatial_ref_sys where srid=3909;
-[ RECORD 1 ]-----
srid      | 3909
auth_name | EPSG
auth_srid | 3909
srtext    | PROJCS["MGI 1901 / Balkans zone 7",GEOGCS["MGI 1901",DATUM["MGI 1901",SPHEROID["Bessel 1841",6377397.155,299.1528128,AUTHORITY["EPSG","7004"]],AUTHORITY["EPSG","1031"]],PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","3906"]],UNIT["metre",1,AUTHORITY["EPSG","9001"]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",21],PARAMETER["scale_factor",0.9999],PARAMETER["false_easting",7500000],PARAMETER["false_northing",0],AUTHORITY["EPSG","3909"],AXIS["Y",EAST],AXIS["X",NORTH]]
proj4text | +proj=tmerc +lat_0=0 +lon_0=21 +k=0.9999 +x_0=7500000 +y_0=0 +ellps=bessel +units=m +no_defs
template_postgis=#
```

Координатни референти систем у PostGIS-у

```
select SRID(the_geom) from tacke;
```

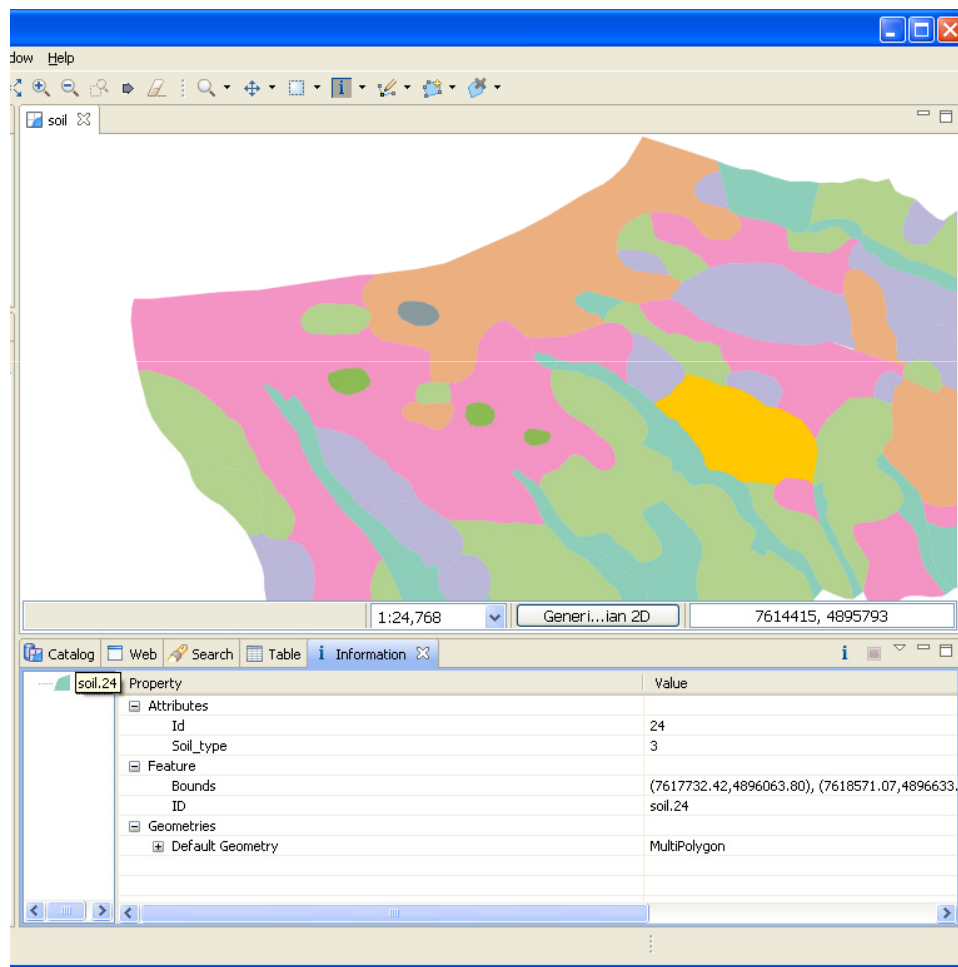
Како променити координатни референтни систем ако је погрешно специфициран приликом импортовања просторних података?

```
select updategeometrysrid('tacke', 'the_geom',  
3909); - мења опис КРС за целу табелу
```

```
select setsrid (the_geom, 3909) from tacke;
```

- за сваку тачку понаособ

Упити у PostGIS-у



Који тип
земљишта има
селектовани
полигон ?

Id: 24
Soil_type: 3

Упити у PostGIS-у

`select id, Soil_type from soil where id=24;`



A screenshot of a PostgreSQL command window titled "C:\Program Files\PostgreSQL\9.0\bin\psql.exe". The window has a blue title bar and standard Windows window controls (minimize, maximize, close). The main area is black with white text. The prompt "template_postgis=#" is shown at the top. The user has entered the query "select id, Soil_type from soil where id=24;". The output shows a single record with id 24 and soil_type 3. The prompt "template_postgis=#" is shown again at the bottom.

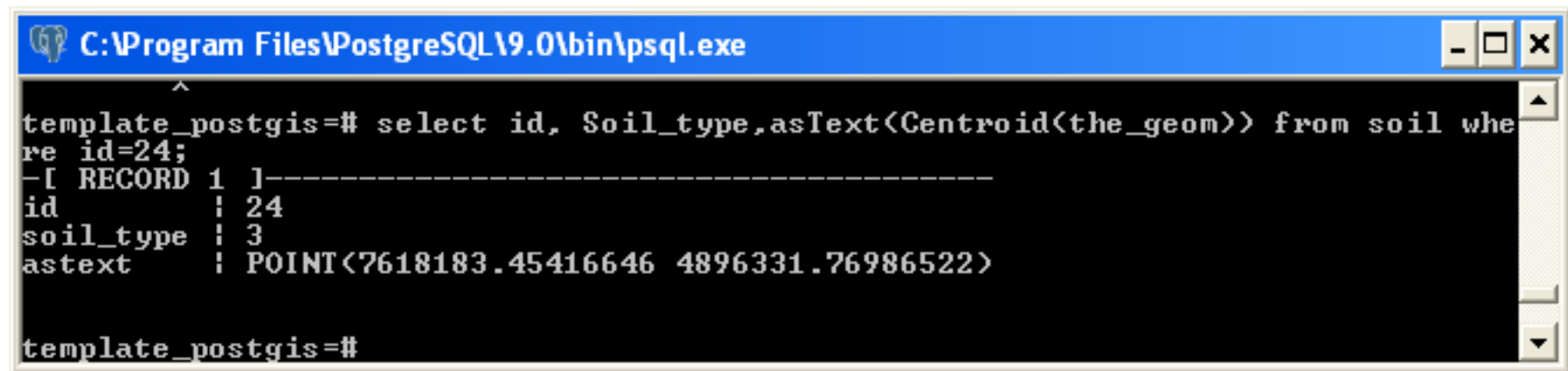
```
template_postgis=#
template_postgis=# select id, Soil_type from soil where id=24;
-[ RECORD 1 ]-
id          | 24
soil_type   | 3

template_postgis=#
```

Просторни упити у PostGIS-у

Тежиште полигона са id=24?

```
select id, Soil_type,  
asText(Centroid(the_geom)) from soil  
where id=24;
```



The screenshot shows a PostgreSQL command window titled "C:\Program Files\PostgreSQL\9.0\bin\psql.exe". The command prompt shows the execution of the query: `template_postgis=# select id, Soil_type,asText(Centroid(the_geom)) from soil where id=24;`. The output is displayed as a table with one record. The columns are `id`, `soil_type`, and `astext`. The values are `24`, `3`, and `POINT(7618183.45416646 4896331.76986522)` respectively.

```
template_postgis=# select id, Soil_type,asText(Centroid(the_geom)) from soil where id=24;
-[ RECORD 1 ]-----
id          | 24
soil_type   | 3
astext      | POINT(7618183.45416646 4896331.76986522)

template_postgis=#
```

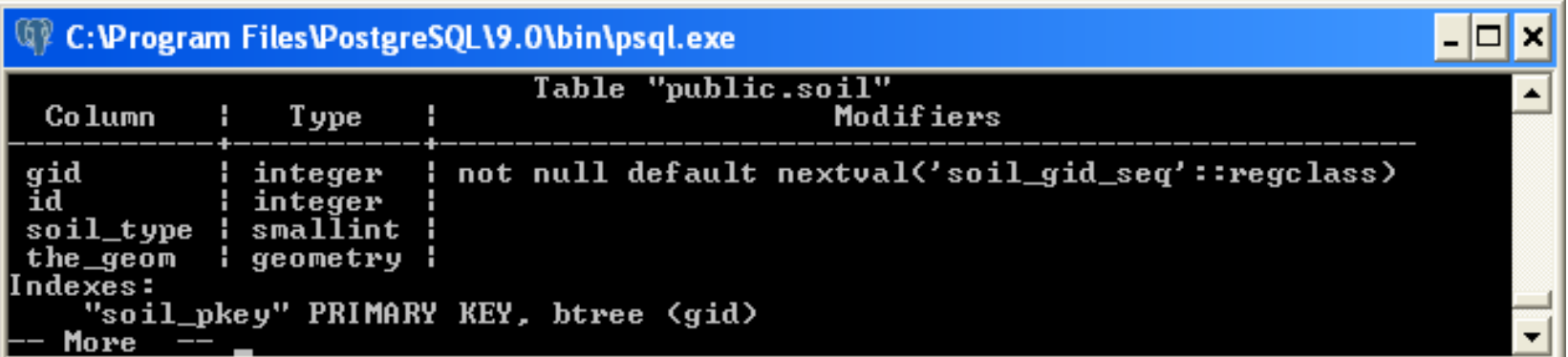
Индексирање у PostGIS-у

Индексирање увећава перформансе упита.

Нема претраге по сваком пољу табеле, већ се директно приступа индексу који се односи на поље које је најчешће предмет упита.

PostGIS сам формира индексно поље.

\d soil

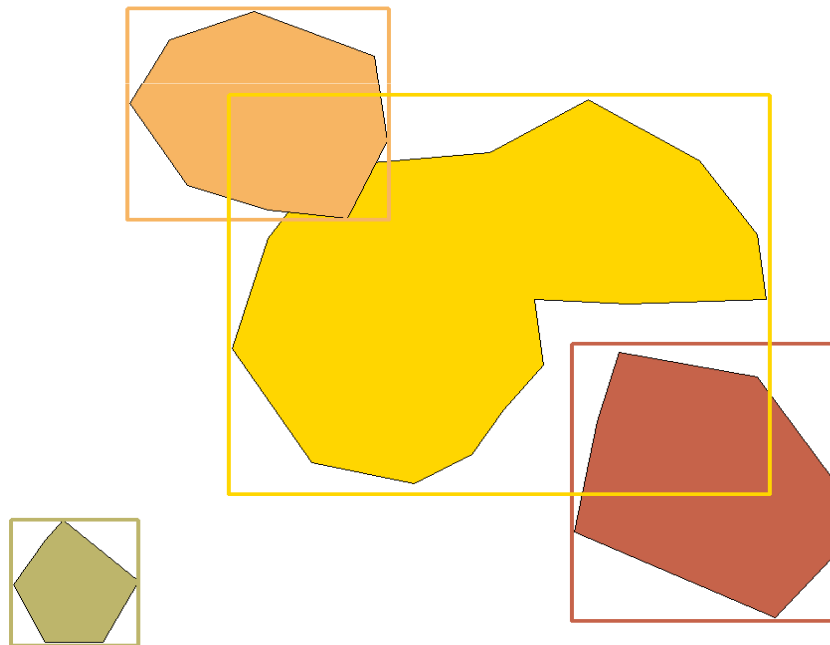


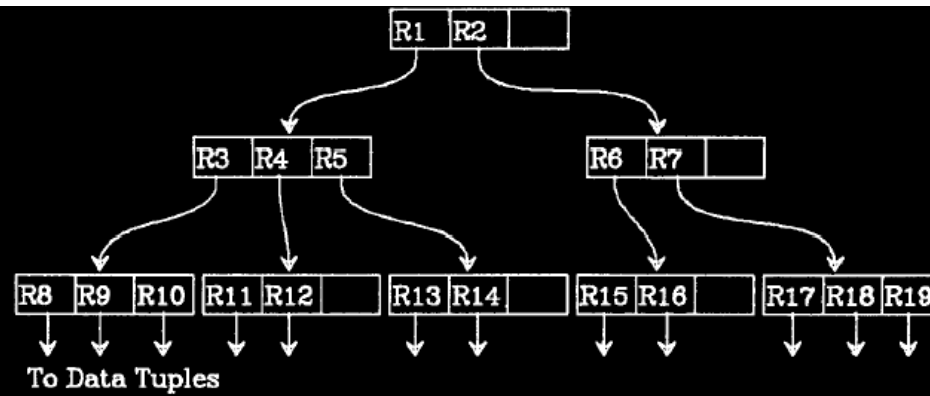
```
C:\Program Files\PostgreSQL\9.0\bin\psql.exe

Table "public.soil"
  Column | Type          | Modifiers
-----+-----+-----
gid      | integer       | not null default nextval('soil_gid_seq'::regclass)
id       | integer
soil_type | smallint
the_geom | geometry
Indexes:
  "soil_pkey" PRIMARY KEY, btree (gid)
-- More --
```

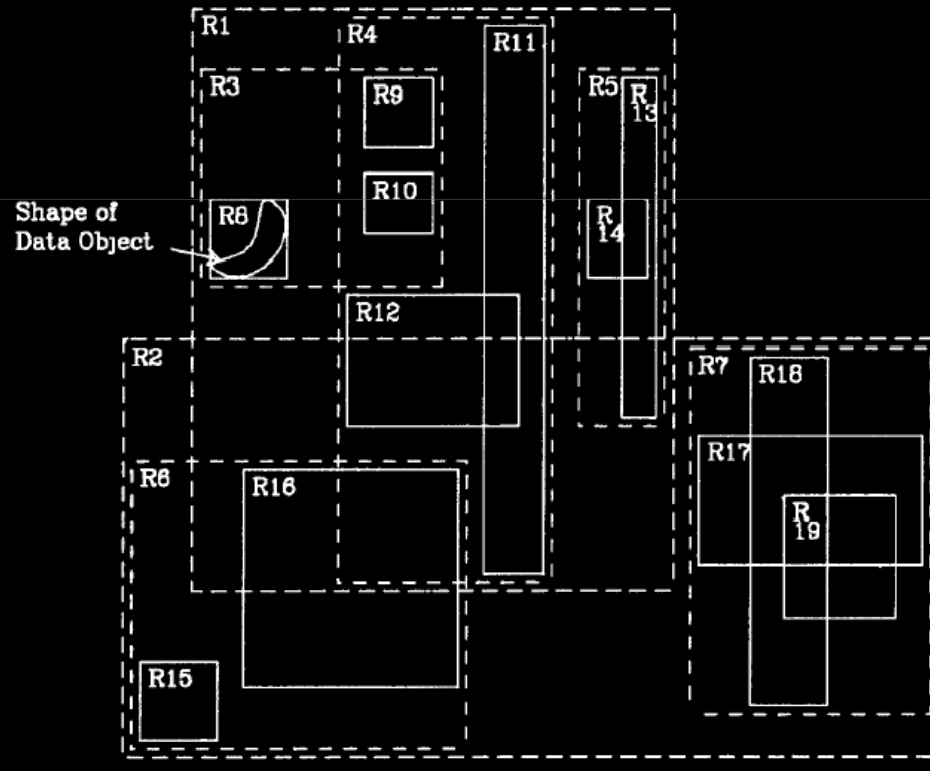
Просторно индексирање у PostGIS-у

Просторни индекс је BBOX. Не памти се компликована геомтрија полигона него упрошћена.





(a)

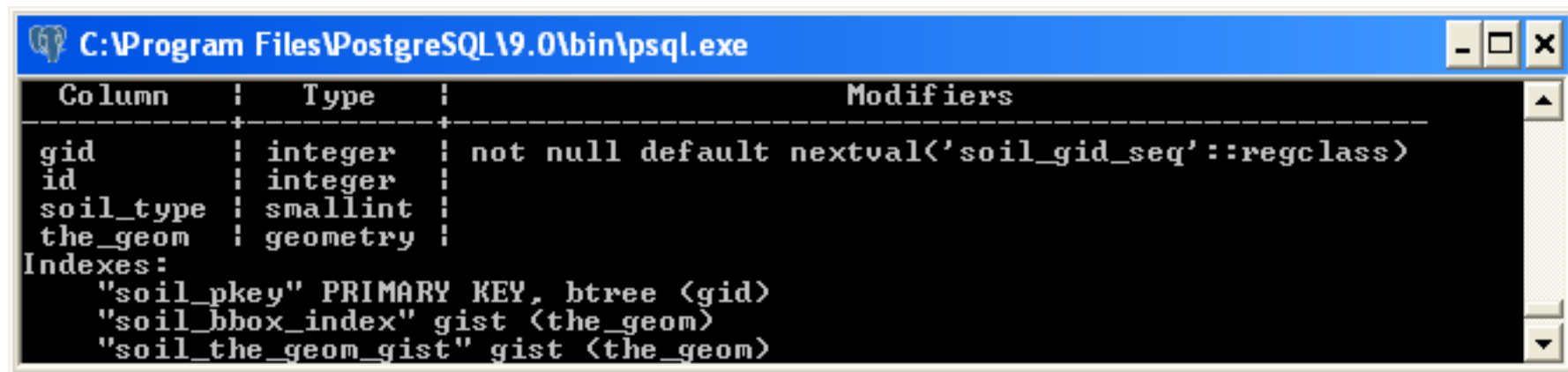


Guttman A.: 'R-trees: A Dynamic Index Structure for Spatial Searching', Proc ACM SIGMOD Int. Conf. on Management of Data, 1984

Просторно индексирање у PostGIS-у

Креирање просторног индекса.

```
create index soil_bbox_index on soil  
using gist (the_geom);
```



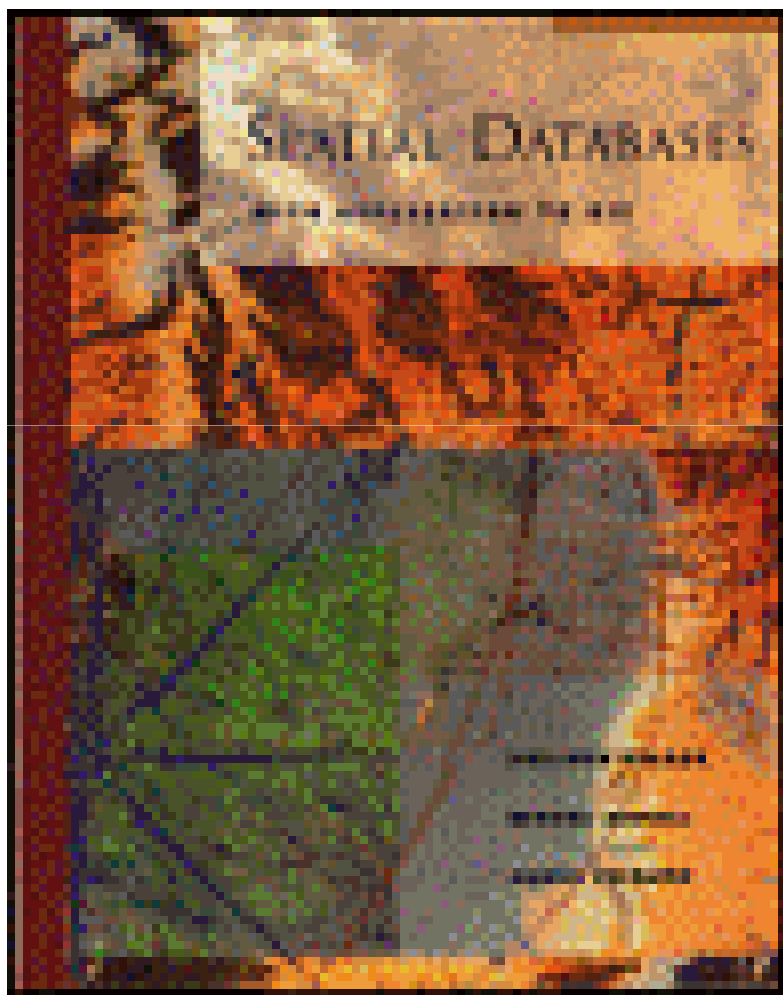
The screenshot shows a PostgreSQL command window titled "C:\Program Files\PostgreSQL\9.0\bin\psql.exe". The window displays the schema of a table named "soil" and the indexes created on it.

Column	Type	Modifiers
gid	integer	not null default nextval('soil_gid_seq'::regclass)
id	integer	
soil_type	smallint	
the_geom	geometry	

Indexes:

- "soil_pkey" PRIMARY KEY, btree (gid)
- "soil_bbox_index" gist (the_geom)
- "soil_the_geom_gist" gist (the_geom)

Литература (рекомендация)



*Spatial Databases: With
Application to GIS Rigaux,
Scholl, Voisard*