Reviving and extending *Pgsphere*

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- About Pgsphere
- Pgsphere revival
- Extending Pgsphere with MOC
About Pgsphere

- Pgsphere???
About Pgsphere

- Exotic back-end stuff?

- PostgreSQL server extension: new SQL data types, functions, indexes

- SQL data types: “spherical points” (right ascension, declination), “spherical lines, polygons, ellipses, paths”, spherical transformations (rotations)
VO Usage of Pgsphere

X-match
Database indexes of spherical coordinates for:

- Cone search
- Cross-match
- Images (e.g., digitised astronomical plates)

Pervasive use in astronomical community

- Alternatives (Q3C, H3C) exist for part of Pgsphere's functionality
- Not just VO data centres
Pgsphere internals

Database indexes of spherical coordinates for, e.g.:

- Cone search
- Cross-match
- Images (e.g., digitised astronomical plates)
Pgsphere internals

R-tree
Pgsphere internals

Index:
3D R-tree on unit sphere
Pgsphere development history

Janko Richter

Teodor Sigaev  Oleg Bartunov

Igor Chilingarian
State of Pgsphere: June 2015

- Patches required to build on PostgreSQL 9.2+ (09/2012)
- Maybe problems when building on Macintosh
- Open bugs on http://pgfoundry.org/projects/pgsphere
- Test suite does not pass (even hangs on current Linux distributions)
- Pre-PostgreSQL 8.2 syntax for SQL “contains” operators
- Improved R-tree indexing: https://github.com/akorotkov/pgsphere
- Several bug fixes at various places
State of Pgsphere: now

https://github.com/mnullmei/pgsphere

- Add. branch fixes-1-1-1 with portability and stability fixes for latest release
- All known open bugs fixed (plus several others)
- Test suite: works, some extensions, easier to use
- Addition of new-style SQL “contains” operators
- Included improved R-tree indexing of Alexander Korotkov and Oleg Bartunov
- Some fixes to numerical stability
- Several documentation fixes
- Maintenance efforts also on https://github.com/akorotkov/pgsphere
State of Pgsphere: remaining goals

- Coordination of official release (maybe on pgfoundry.org)
- More fixes to numerical stability
- Increasing numerical precision (presently, cut-off at 0.2 m arcsec)
- Modernising the code; add PostgreSQL “server extension” patch
- Overhaul of documentation
- Official packages for Debian Linux (and thereby, Ubuntu)
- Extending Pgsphere with ….
Extending Pgsphere with MOC

MOC = Multi-order coverage  
(HEALPix Multi-Order Coverage map)

- Concise mapping of one catalog's coverage of the sphere

- Coverage made up from discrete elements

- Make MOC a first-class SQL data type  
  ALL DESIGN PHASE below...
MOC in PostgreSQL / Pgsphere: goals

MOC as indexable SQL data type

- I/O to / from files
- Create one MOC from table column or query
- Specify your own MOC and search over all catalogs of a data center:

  SELECT name FROM catalogs WHERE my_moc <$@ catalogs.moc ;
MOC: discretisation

- Based on HEALPix

- Start with 12 diamonds
- Subdivide by fours
MOC: internal data structure for PostgreSQL

- List of ranges of HEALPix element numbers

... at finest discretisation level

- Works because of nested numbering of HEALPix elements
MOC: indexing

- R-trees of questionable use (too many overlaps...)
- Proper PostgreSQL index implementation is quite involved
- Feasible surrogate as first step:
  - use a (global) SQL table like this:

<table>
<thead>
<tr>
<th>RANGES OF NUMBERS OF HEALPIX ELEMENTS</th>
<th>SETS OF MOC IDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>range0</td>
<td>{ id7, id11 }</td>
</tr>
<tr>
<td>range1</td>
<td>{ id2, id108, id109 }</td>
</tr>
<tr>
<td>range2</td>
<td>{ id108, id732, id11030 }</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

- MOC IDs: probably SHA1
Your involvement

• Download, use & test:
  https://github.com/mnullmei/pgsphere
  https://github.com/akorotkov/pgsphere

• Send in bug reports
• Send in test cases
• Send in patches
• Send in feature requests :-)