CDS xmatch service updates

Thomas Boch
François-Xavier Pineau
Sébastien Derrière

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Service presentation

- Purpose
  - **Positional cross-identification** of sources in 2 tables among:
    - VizieR tables (including very large surveys)
    - SIMBAD
    - User-uploaded tables
- Focus on **large-scale** cross-match
- UI : web application on top of UWS service

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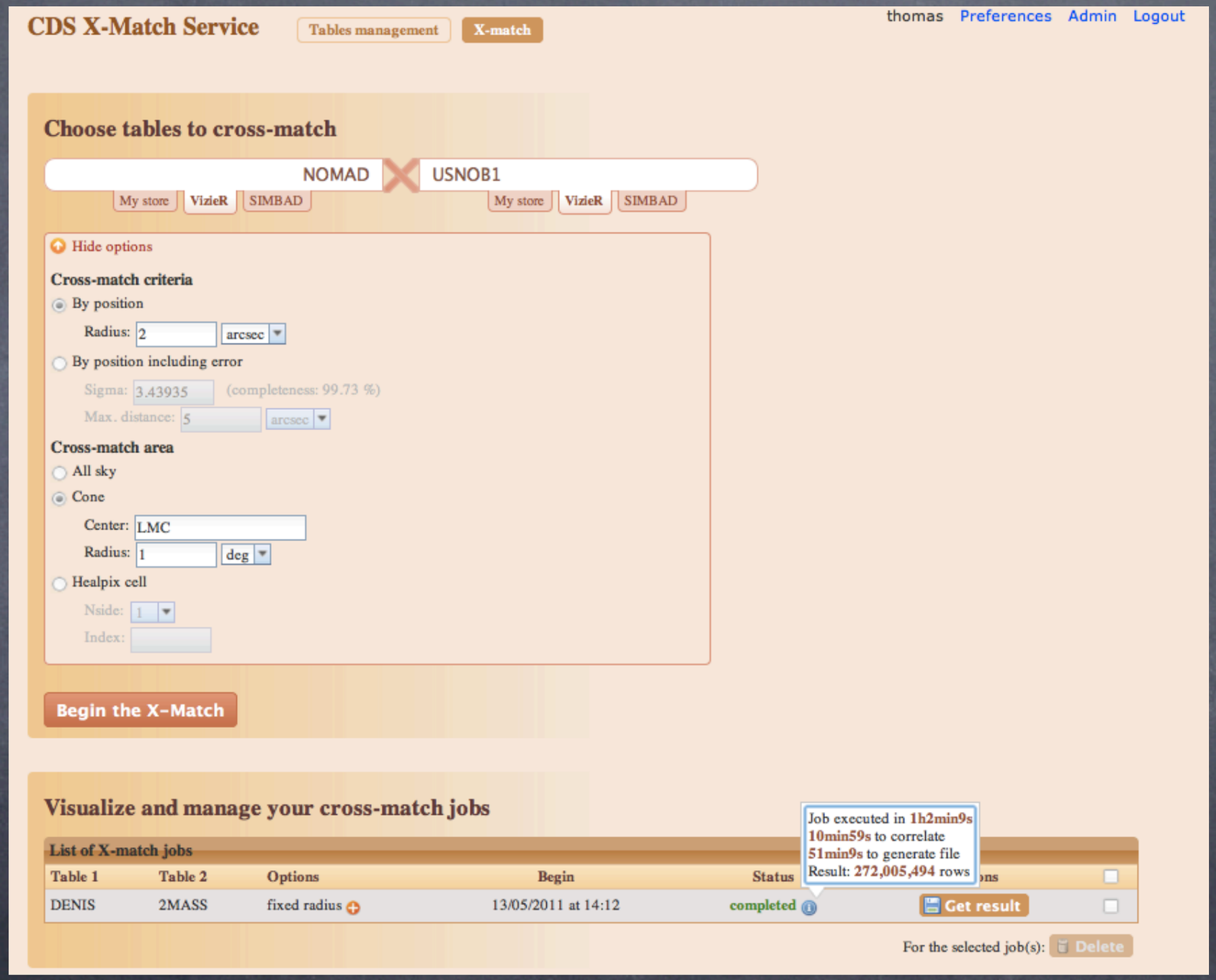
Demo



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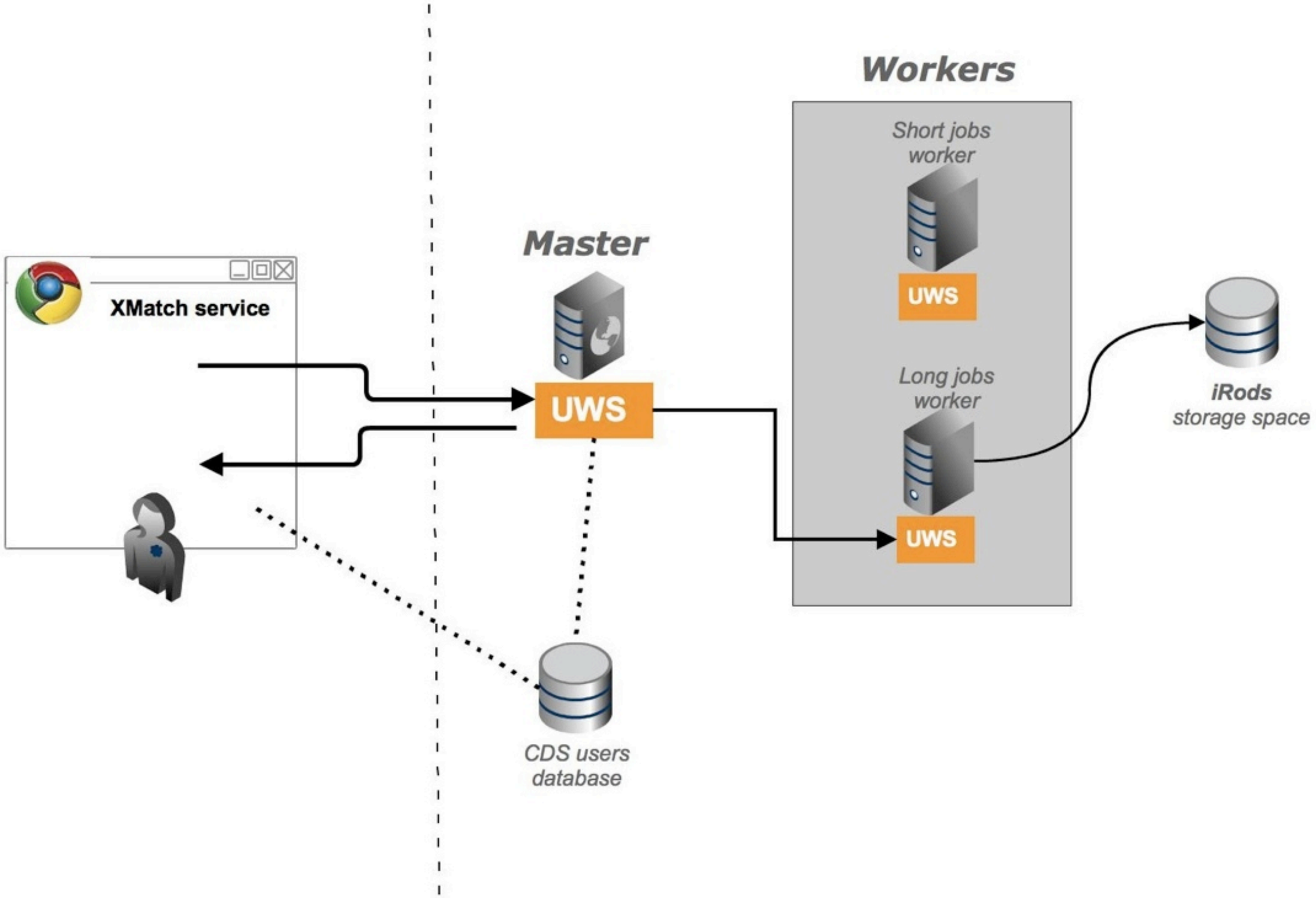
Architecture



Updates

- Since Nara Interop:
  - cross-match jobs **dispatched on 2 machines** (one for short jobs, one for long jobs)
  - inclusion of **VizieR tables > 10M rows** (USNOB1, 2MASS, SDSS7, NOMAD, PPMXL, GLIMPSE, ...)
  - cross-match on all-sky **or in a cone** (position or object name + radius) **or for a given HEALPix cell**
  - choice of position+errors metadata (for user-uploaded tables)
  - faster HDDs (15,000 rpm)
  - faster output generation

Service performances

Cross-match at 5 arcsec :

Table 1	Table 2	Computation time	Result generation	Result size	Total time
SDSS *357M rows*	**2MASS** *470M rows*	7 min	12 min	**13 GB**	**19 min**
DENIS *355M*	**2MASS** *470M*	11 min	51 min	**58 GB**	**1 hour 2 min**
GLIMPSE *104M*	**NOMAD** *1.1 billion*	6 min	17 min	**19 GB**	**23 min**
SIMBAD *5M*	**USNOB1** *1 billion*	3 min	1 min	**1 GB**	**4 min**
SIMBAD *5M*	**PPMX** *18M*	20 seconds	20 seconds	**440 MB**	**40 sec**

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I/O limitations

- When computing the associations :
  - **Reading input catalogues** is the main limiting factor

- When generating the result file :
  - Performance mainly limited by the **network bandwidth between workers and iRods** (≃12Mbyte/s)

- When the user downloads the result :
  - Downloading SDSS-2MASS result at 1Mbyte/s takes 3.7 hours

Hardware

- Worker 1:
  - 2x Quad Core 2.27 GHz ⟶ 16 threads
  - RAM : 24GB @1333MHz
- Worker 2:
  - 2x Six Core 2.27 GHz ⟶ 24 threads
  - RAM : 32GB @1333MHz
- 6TB RAID5 array with 15,000 rpm disks
  - Read : 570 MB/s
  - Write : 130 MB/s

CDS XMatch service updates: the engine

François-Xavier Pineau[1], Thomas Boch[1] and Sebastien Derrière[1]

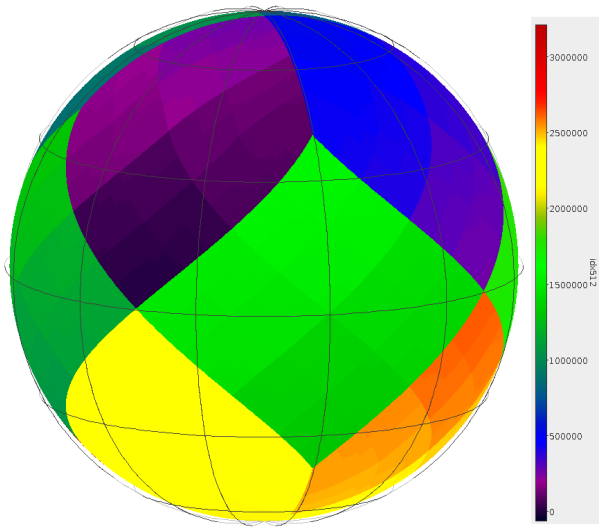
[1]CDS, Observatoire Astronomique de Strasbourg

Interop Napoli, 17 May 2011

The xmatch engine : 2 main components

A catalog file format (*CatFile*)

- Binary data
- Compressed data
- Sources sorted and indexed by Healpix cell numbering
- 2 formats: by rows (.rcf) , by blocks (.bcf)



Healpix hierarchical sky partitioning

A correlation engine

- Multi-threaded special kd-trees (ra, dec)
- Healpix partitioning (for large catalogs)
- *CatFile* (for large catalogs)
  - for the correlation (.bcf)
  - to build the output (.rcf)
- *STIL* to read VOTable, FITS, ...

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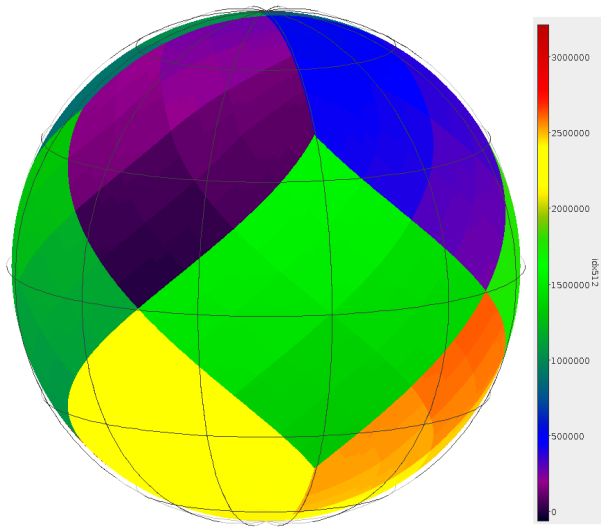

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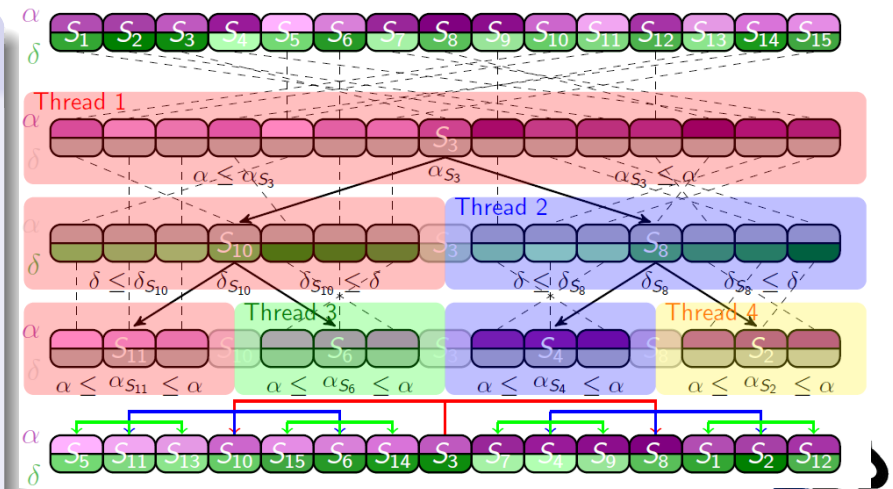
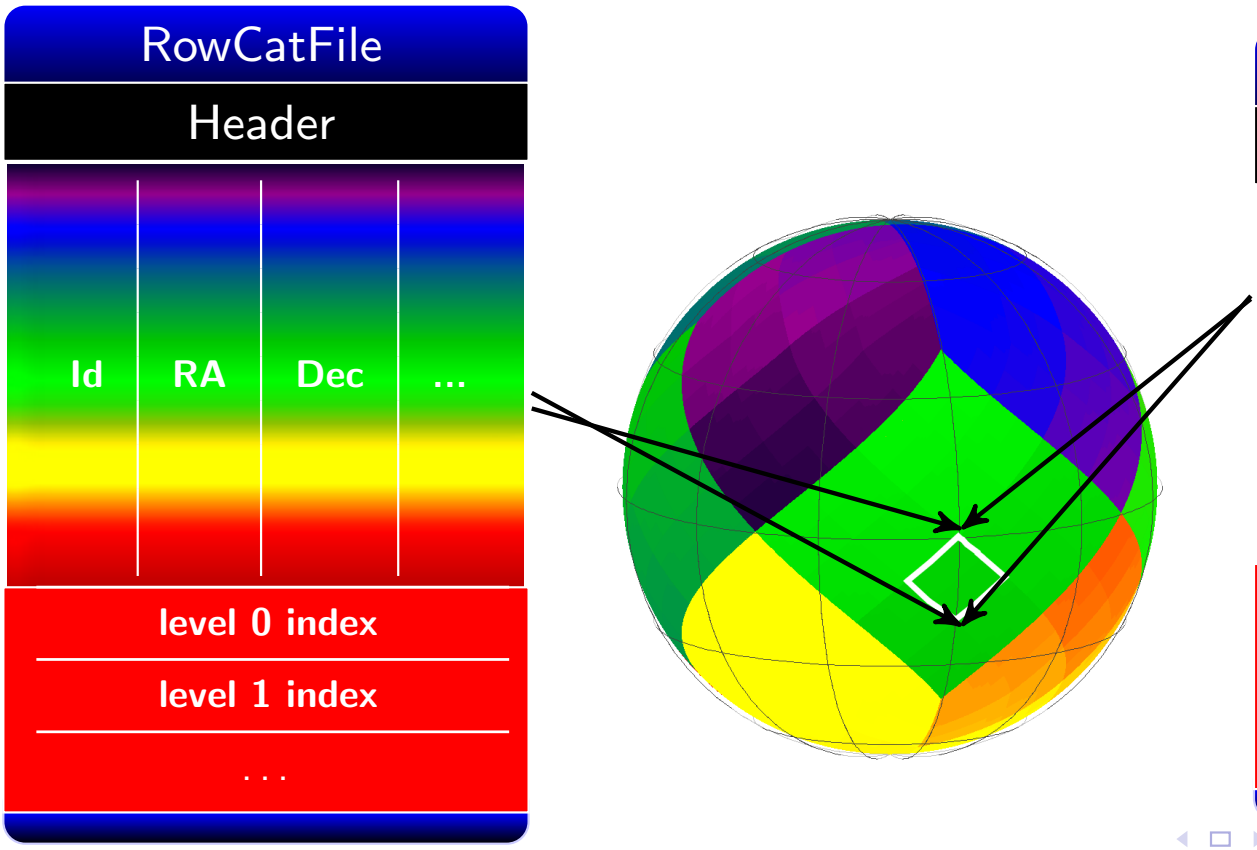


Multi-threaded 2d-tree

CatFile catalog file format

- (compressed) data stored by rows
  - as few random access as possible
- (compressed) data stored by blocks
  - read as few bytes as possible

- data close on file / sources closed on sky
- Healpix indexed
  - $\rightsquigarrow$ direct acces to a pixel data
- creation from .csv: $\sim$1h (SDSS)



XMatch engine: correlation modes

Correlation modes

- 3 catalog sizes (arbitrary)

  small: $< 150\,000$ sources
  medium: $< 20.10^6$ sources
  large: $> 20.10^6$ sources

- correlation modes
  - small vs medium, medium vs medium
    - brute-force (1 kd-tree)
  - small vs large
    - compute Healpix touched cells
    - brute-force (1 kd-tree)
  - medium vs large, large vs large

Results (xmatch only)

- medium vs medium
  - SIMBAD (5.10^6) vs PPMX (18.10^6): 20s
- small vs large
  - Downes (1830) vs 2MASS (470.10^6): 10s, <1s (disk cache)
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    - cell by cell (192 Healpix cells)
    - compute Healpix touched sub-cells?
    - brute-force (1 kd-tree by cell)

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  - Tycho2 (2.10^6) vs 2MASS (470.10^6): 2min
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  - SDSS7 (350.10^6) vs 2MASS (470.10^6): 4min
  - 2MASS (470.10^6) vs USNO-B1 (1.10^9): 20min

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  - interested in testing the service: thomas.boch@astro.unistra.fr
- First release in summer

Future developments

- Service:
  - to take into account proper motions
  - identification probabilites
  - add constraints on both catalogs and the result (colors, magnitudes, ...)
- CatFile:
  - add a proper motions block
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