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Brainomics - A management system for exploring and merging heterogeneous brain mapping data

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Introduction

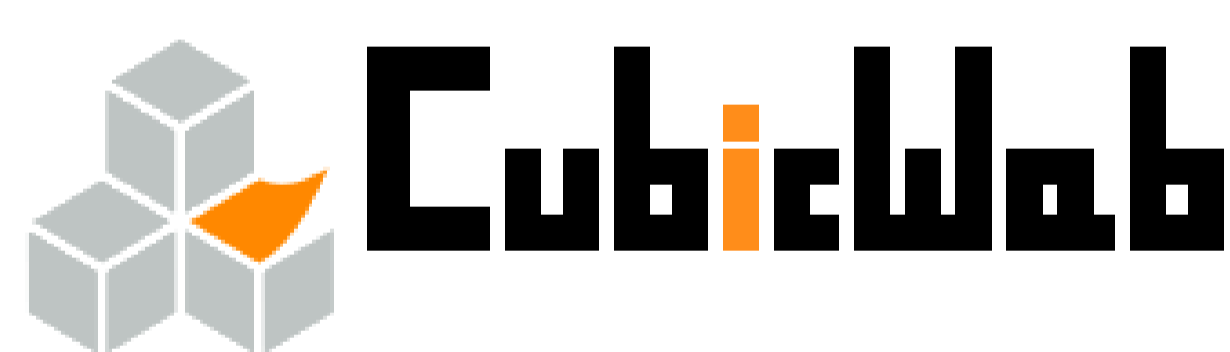
- Number of large datasets for brain mapping have been released [1, 2].
- Neuroimaging datasets more routinely include clinical data or genetics data.
- Exploitation requires
 - An efficient organization to integrate all the measures
 - An easy access to the relevant information.
- Neuroimaging [3] and genomics[4] databases are dedicated to their own field of research.

<http://www.brainomics.net/demo/>

- Brings together **brain imaging and genetics data**.
- Relies on a **high-level query language (RQL)**.
- Solution based on **CubicWeb**, a semantic framework.
- Visualizing / exporting data** in several formats.

The screenshot shows the Brainomics Demo interface. It features a search bar at the top right. Below it are four main categories: Subjects, Images, Genetics, and Questionnaires, each with a representative icon. The 'Subjects' section is expanded, showing a list of subjects with details like age and handedness. There are filters on the left for 'contient le texte', 'age', 'Gender', and 'Handedness'. Below the subject list are buttons for 'Download Xcede', 'Download CSV', and 'View Images'. The 'Scan_plural' section shows a list of scans with details like sequence type and resolution. There are also buttons for 'Download Xcede', 'Download Zip', and 'Download CSV'.

The screenshot shows a detailed view of a scan and its associated questionnaire data. The 'Scan_plural' section is expanded, showing details for a scan named 'anatomy (anat_1062132)'. It includes a list of sequences and their parameters. Below this is a table of questionnaire data for 'ados_1062132'. The table has columns for 'question', 'text', and 'score'. The 'Questionnaire' section is expanded, showing a list of questions and their answers. There is also a snippet of XML code showing the structure of the data.



<http://www.cubicweb.org/>

- ✓ **Data management framework**, 10 years of industrial uses (e.g. [5]).
- ✓ Well established core technologies: **SQL, Python, HTML5, Javascript**.
- ✓ Licensed under **LGPL** since 2008.
- ✓ Used in production environments since 2005.
- ✓ Fine-grained **security system** coupled to the data model definition.
- ✓ **Migration mechanisms** controls model version / ensures data integrity.

Data model

- ✓ Described in Python, using reusable modules called "cubes".
- ✓ Modelisation of Scans, Questionnaires, Genomics results, Behavioral results, Subjects and Studies information.
- ✓ Data model optimized for large volumes (> 2000 subjects).
- ✓ Tested with several publicly available datasets [1, 2].

Query using RQL

- ✓ Similar to the W3C's SPARQL [6].
- ✓ Supports the basic operations (selection, insertion, etc.).
- ✓ Subquerying, ordering, counting, ...

Query all the female subjects of the database, with an age greater than 30
Any S WHERE S is Subject, S age > 30, S gender "female"

Query all the Cmap scans of subjects with an age greater than 25, and that have a score greater than 4.0 for the "algebre" question
Any SA WHERE S is Subject, S age > 25, X is QuestionnaireRun, X concerns S, A is Answer, A questionnaire_run X, A question Q, Q text "algebre", A value > 4, SA is Scan, SA concerns S, SA type "c map"

Views

- ✓ Each query result can be seen using different views.
- ✓ HTML pages, ZIP files, spreadsheets, XCEDE XML, ...
- ✓ May include processing (stat. maps computed on the fly).

Conclusion

- ✓ **Open source solution to manage brain imaging datasets and associated meta data.**
- ✓ **Powerful querying and reporting tool, customized for emerging imaging-genetics field.**

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[1] <http://openfmri.org/data-sets>

[2] fcon_1000.projects.nitrc.org/indi/abide/

[3] Olsen, M.D. (2007). The extensible neuroimaging archive toolkit. Neuroinformatics 5, 11–33

[4] Vallon-Christersson, J. (2009). 'BASE - 2nd generation software for microarray data management and analysis'

[5] Publishing bibliographic records on the Web of data: opportunities for the BnF (French national Library). ESWC 2013

[6] <http://www.w3.org/TR/rdf-sparql-query/>