GALACTIC architecture

The **GALACTIC** Organization <contact@thegalactic.org>

2018-2023  [1]

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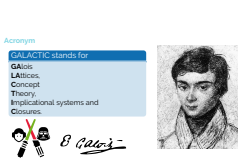
Acronym

GALACTIC stands for

GAlois
LAttices,
Concept
Theory,
Implicational systems and
Closures.



- the **GALACTIC** logo is a tribute to the french mathematician Évariste Galois who died following a gallant duel at the age of twenty;
- it is also a graphical summary of lattice drawings.

Purpose

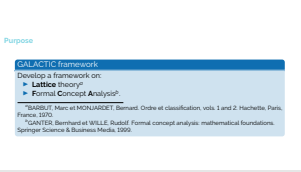
GALACTIC framework

Develop a framework on:

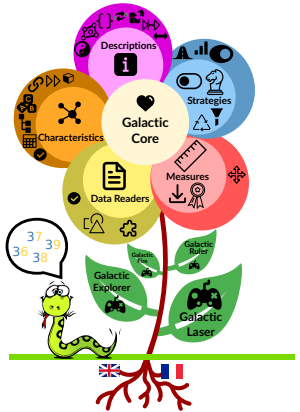
- **Lattice** theory[a]
- **F**ormal **C**oncept **A**nalysis[b].

[a] BARBUT, Marc et MONJARDET, Bernard. Ordre et classification, vols. 1 and 2. Hachette, Paris, France, 1970.

[b] GANTER, Bernhard et WILLE, Rudolf. Formal concept analysis: mathematical foundations. Springer Science & Business Media, 1999.



Architecture



- the core library is the center of the flower;
- the applications are in the leaves;
- characteristic plugins are in the orange petal;
- strategy plugins are in the blue petal;
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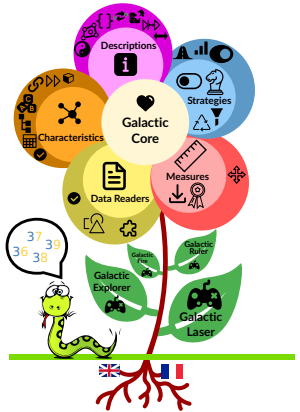

Written in python, Fully extensible

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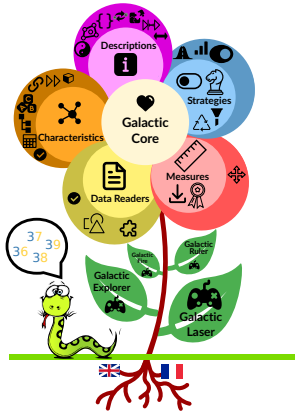

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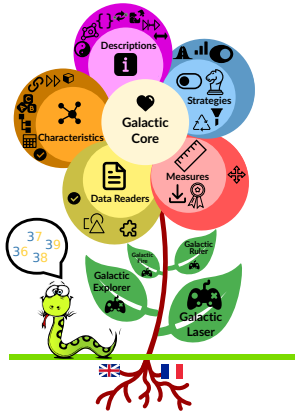

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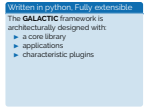

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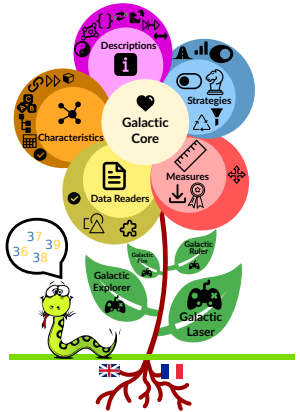

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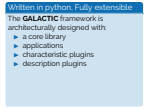

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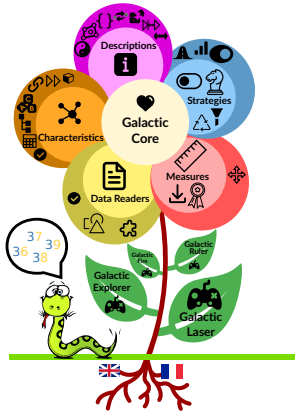

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2023-01-17

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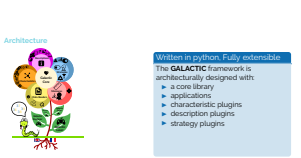

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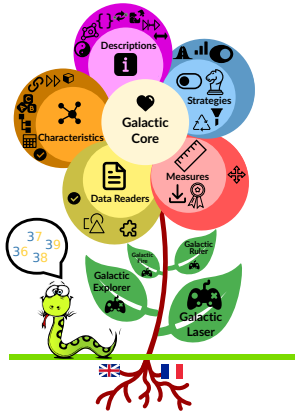

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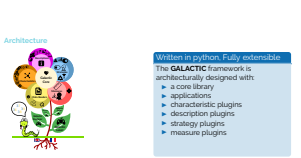

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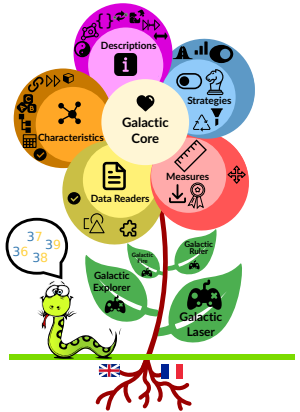

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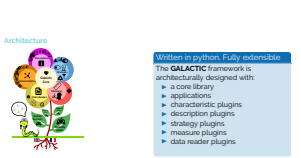

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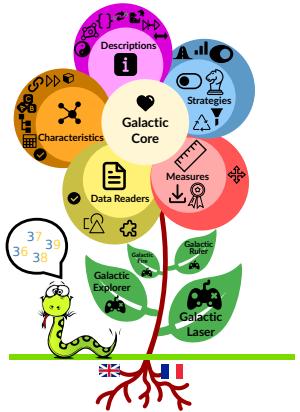

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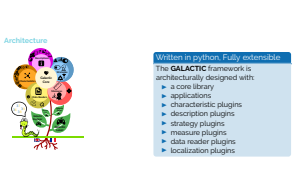

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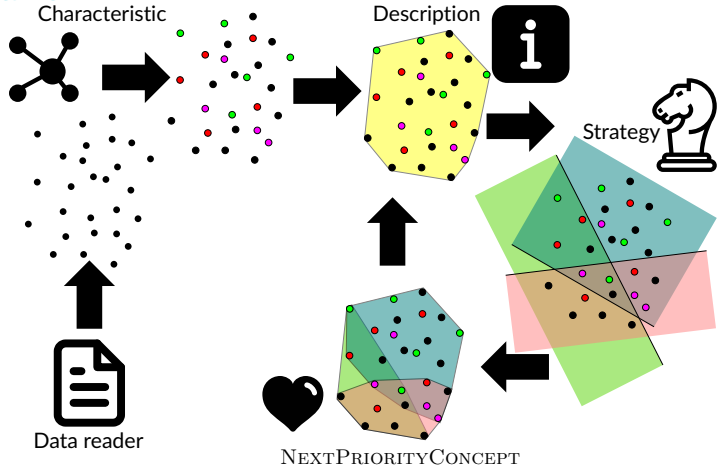
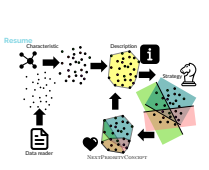
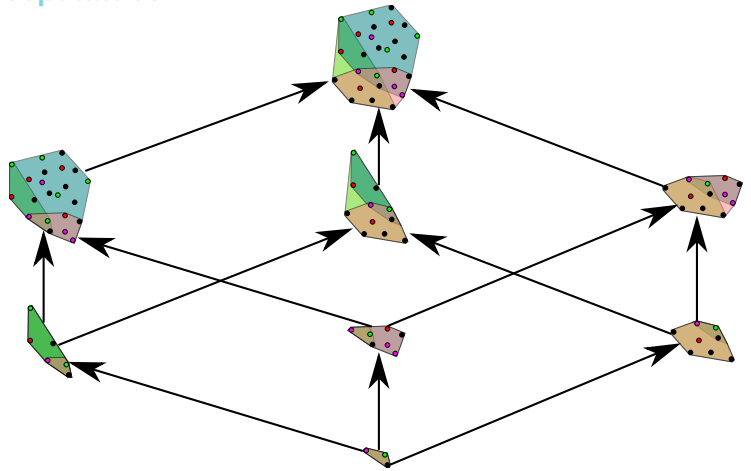
Resume

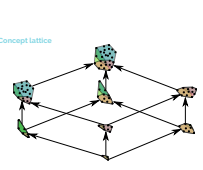




- data readers convert data files to context;
- subsets of individuals are described by sets of predicates called descriptions;
- strategies divide individuals into subsets;
- the NextPriorityConcept algorithm maintains the notion of **Lattice** during the process;
- the lattice can be converted into a minimum and consistent **Basis of rules**.

Concept lattice





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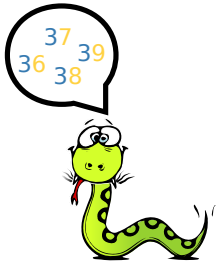
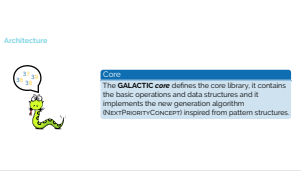


Core

The **GALACTIC *core*** defines the core library, it contains the basic operations and data structures and it implements the new generation algorithm (NextPriorityConcept) inspired from pattern structures.



- written for python >= 3.6
- the NextPriorityConcept algorithm will be published in an international journal this autumn.

Sergei Kuznetsov was invited to the L3i in 2016, and after our discussions, we managed to propose this new algorithm.

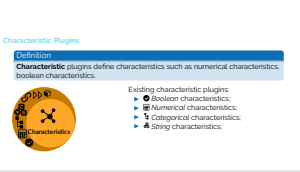
Characteristic Plugins

Definition

Characteristic plugins define characteristics such as numerical characteristics, boolean characteristics.

Existing characteristic plugins:

- *Boolean* characteristics;
- *Numerical* characteristics;
- *Categorical* characteristics;
- *String* characteristics;



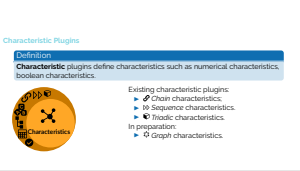
Characteristic Plugins

Definition

Characteristic plugins define characteristics such as numerical characteristics, boolean characteristics.

Existing characteristic plugins:
- *Chain* characteristics;
- *Sequence* characteristics.
- *Triadic* characteristics.

In preparation:
- *Graph* characteristics.



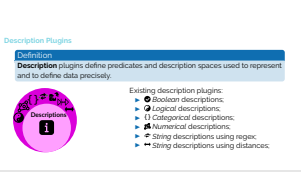
Description Plugins

Definition

Description plugins define predicates and description spaces used to represent and to define data precisely.

Existing description plugins:

- *Boolean* descriptions;
- *Logical* descriptions;
- {} *Categorical* descriptions;
- *Numerical* descriptions;
- *String* descriptions using regex;
- *String* descriptions using distances;



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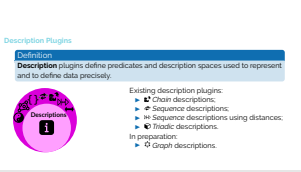


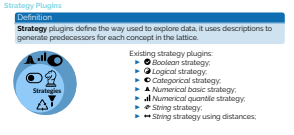
Strategy Plugins

Definition

Strategy plugins define the way used to explore data, it uses descriptions to generate predecessors for each concept in the lattice.

Existing strategy plugins:

- *Boolean* strategy;
- *Logical* strategy;
- *Categorical* strategy;
- *Numerical basic* strategy;
- *Numerical quantile* strategy;
- *String* strategy;
- *String* strategy using distances;



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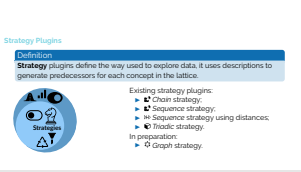


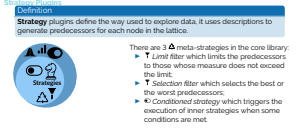
Strategy Plugins

Definition

Strategy plugins define the way used to explore data, it uses descriptions to generate predecessors for each node in the lattice.

There are 3 ♺ meta-strategies in the core library:

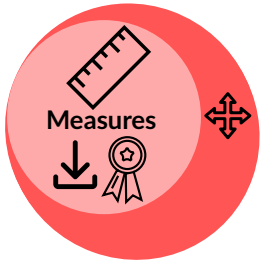
- ⍑ *Limit filter* which limits the predecessors to those whose measure does not exceed the limit;
- ⍑ *Selection filter* which selects the best or the worst predecessors;
- ⚯ *Conditioned strategy* which triggers the execution of inner strategies when some conditions are met.



Measure Plugins

Definition

Measure plugins are parameters of the *filter strategies* predefined in the core library.

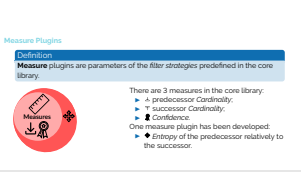


There are 3 measures in the core library:

- predecessor *Cardinality*;
- successor *Cardinality*;
- *Confidence*.

One measure plugin has been developed:

- *Entropy* of the predecessor relatively to the successor.



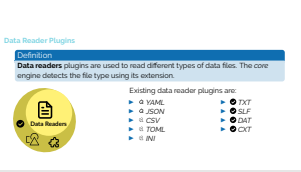
Data Reader Plugins

Definition

Data readers plugins are used to read different types of data files. The *core* engine detects the file type using its extension.

Existing data reader plugins are:

- *YAML*
- *JSON*
- *CSV*
- *TOML*
- *INI*
- *TXT*
- *SLF*
- *DAT*
- *CXT*



Localization Plugins

Definition

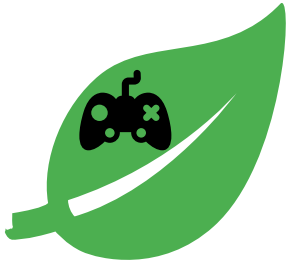
Localization plugins are used for translating the applications to other languages. The basic language is English.

- French translation of the **GALACTIC** applications.

Applications

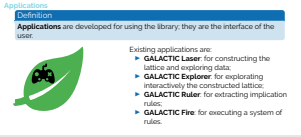
Definition

Applications are developed for using the library; they are the interface of the user.



Existing applications are:

- **GALACTIC Laser**: for constructing the lattice and exploring data;
- **GALACTIC Explorer**: for explorating interactively the constructed lattice;
- **GALACTIC Ruler**: for extracting implication rules;
- **GALACTIC Fire**: for executing a system of rules.



Collaborative version control

git

The library is developed using the collaboration tool **`git`**, in the **`gitlab`** of the university. We are using

- ***pylint*** and ***flake8*** (with plugins) for testing code quality;
- ***tox*** for generating tests.

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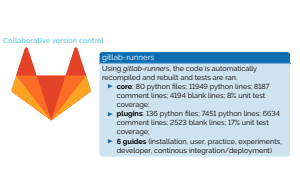
Collaborative version control

gitlab-runners

Using *gitlab-runners*, the code is automatically recompiled and rebuilt and tests are ran.

- **core**: 80 python files; 11949 python lines; 8187 comment lines; 4194 blank lines; 8% unit test coverage;
- **plugins**: 136 python files; 7451 python lines; 6634 comment lines; 2523 blank lines; 17% unit test coverage;
- **6 guides** (installation, user, practice, experiments, developer, continous integration/deployment)



Conclusion

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  - https://ml.univ-lr.fr/sympa/info/galactic
- the **GALACTIC** applications, the various manuals and documentation guides are available under certain conditions.

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