experiments showing that it can be combined with numerical machine learning

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dimensionality reduction, and noise reduction. Then data mining approaches can be supervised or unsupervised, w.r.t. the task at hand, and the availability of examples and counterexamples. As there is no universal approach, a reasonable strategy is to
design a hybrid process based on several tactics whose output is a combination of outputs of the involved procedures.

Fourthly, it is interesting to study hybrid data mining methods that combine complex numerical models with explanatory symbolic models, in order to make the mining process more "interpretable". One way can be to attach some "integrity constraints" --"pre" and "post-conditions" to be fulfilled-- to build and then deliver understandable explanations on the work of numerical models. In practice, numerical models often prove to be more flexible and better suited to capture the complexity of some tasks such as recognition. However, symbolic ML models are more often used in pattern mining and in domains where the learning model should be understandable by human experts, or be related to domain ontologies for knowledge representation and problem-solving.

A final aspect is that patterns allow for explanations in "crisp terms", quite exactly what Deep Learning lacks. The more powerful the pattern language, the richer this explanation language, but also, the harder is to understand it. By adapting the richness of the pattern language, we have tools to approximate Deep Learning expressiveness, but keeping the power of a formal language.

What about Pattern Mining and FCA?

Pattern mining --and the close formalism of Formal Concept Analysis-- are naturally exploratory and exploration is based on the underlying (concept) lattice structure. But pattern mining and FCA are also knowledge-based as they allow to take into account domain knowledge under different forms. However, pattern mining alone is not hybrid and does not offer any explanation facility strictly speaking. There are some experiments showing that it can be combined with numerical machine learning.
methods for performing knowledge discovery tasks.

**Principales activités**
The Organization of the Research Work

The research work will be organized around three main tasks, namely:

(i) Study of the various characteristics of pattern mining,
(ii) Basis of an integrated platform for a first version of "deep pattern mining",
and (iii) Publications.

No particular risk is expected within this postdoc research project.

**Compétences**
A PhD Thesis in Computer Science or Applied Mathematics.
Prior research on knowledge discovery, data mining and machine learning will be highly appreciated.

**Avantages**
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

**Rémunération**
Salary: 2653€ gross/month