# FCA and Knowledge Discovery (Tutorial)

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# FCA and Knowledge Discovery

**Tutorial at ICCS 2020**

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## 1 Introduction and Motivation

In this tutorial we will introduce and discuss how FCA [5,2,1,4] and two main extensions, namely Pattern Structures [3,7] and Relational Concept Analysis (RCA) [9], can be used for knowledge discovery purposes, especially in pattern and rule mining, in data and knowledge processing, data analysis, and classification. Indeed, FCA is aimed at building a concept lattice starting from a binary table where objects are in rows and attributes in columns. But FCA can deal with more complex data. Pattern Structures allow to consider objects with descriptions based on numbers, intervals, sequences, trees and general graphs [3,6]. RCA was introduced for taking into account relational data and especially relations between objects [9]. These two extensions rely on adapted FCA algorithms and can be efficiently used in real-world applications for knowledge discovery, e.g. text mining and ontology engineering, information retrieval and recommendation, analysis of sequences based on stability, semantic web and classification of Linked Open Data, biclustering, and functional dependencies.

## 2 Program of the tutorial

The tutorial will be divided in three main parts, including (i) the basics of FCA, (ii) the processing of complex data with Pattern Structures and Relational Concept Analysis, and (iii) a presentation of some applications about the mining of linked data, the discovery of functional dependencies, and some elements about biclustering. A tentative program is given here below.

- Introduction to Formal Concept Analysis (basics and examples): formal context, Galois connections, formal concept, concept lattice, and basic theorem of FCA.
- Reduced notation, conceptual scaling for non binary contexts, implications and association rules in a concept lattice.
- Algorithms for computing formal concepts and the associated concept lattice, complexity of the design process, building and visualizing concept lattices.
- Measures for selecting interesting concepts in the concept lattice [8].
- Basics on Pattern Structures for mining complex data, the example of numerical and interval data, pattern concepts and pattern concept lattice.

– Elements on Relational Concept Analysis, relational context family, relational concepts and relational concept lattice.
– Applications: mining definitions in linked data, mining functional dependencies, biclustering, hybrid Knowledge Discovery...

## 3 Conclusion

FCA is nowadays gaining more and more importance in knowledge and data processing, especially in knowledge discovery, knowledge representation, data mining and data analysis. Moreover, our experience in the domain shows that FCA can be used with benefits in a wide range of applications, as it also offers very efficient algorithms able to deal with complex and possibly large data.

In addition, interested researchers have the possibility to attend the two main Conferences, International Conference on Concept Lattices and Applications (CLA) and International Conference on Formal Concept Analysis (ICFCA). Moreover, a companion workshop, namely FCA4AI, is regularly organized by Sergei O. Kuznetsov, Amedeo Napoli and Sebastian Rudolph (see `http://fca4ai.hse.ru/`). This year, we have the eighth edition of the the FCA4AI workshop co-located with the ECAI 2020 Conference at the end of August 2020. The whole series of the proceedings of the seven preceding workshops is available as CEUR proceedings (again see `http://fca4ai.hse.ru/`).

## References


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