

Table Goes In, Picture Comes Out
or
An Introduction to Formal Concept Analysis

Sonat Sür

November 25, 2025

2025-11-25

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make it into a concept, and later turn it into an idea.*

Party Guest
from the movie
Annie Hall by Woody Allen

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Party Guest
from the movie
Annie Hall by Woody Allen

1. Funny quote, but kind of realizable with the help of FCA.
2. I have always been bad with wide data but almost never had problem with depth.
3. EID hub is wide, not deep. So I made a visualisation tool to deal with wide data using FCA.

scribe.

What

Formal concept analysis, despite its fancy name, is a simple method to understand and communicate data presented as a feature matrix.

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└─What

1. Some shopping sites let you compare products by feature matrices.
2. There are applications in data mining, software design and knowledge management
3. In this talk we will mostly focus on visualization

What

Formal concept analysis, despite its fancy name, is a simple method to understand and communicate data presented as a feature matrix.

Basic Notions: Context

Formal concept analysis (FCA) adopts a simple worldview which is given by a *formal context*. In a given formal context

- we have a fixed set of *objects*,
- we have a fixed set of *attributes*,
- the objects may have some (possibly none) of the attributes.

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└ Basic Notions: Context

1. Typically this is represented as a boolean matrix.
2. So many examples! May have a few in your docs.
3. Example from eID Hub: objects are ids, attributes are fields they can complete, etc.

Basic Notions: Concept

First of all, what is a concept generally? As an example, what is the concept of a *cat*?

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- Basic Notions: Concept

Motivation: How do you explain the notion of a cat to an alien? The alien has a limited vocabulary and understands only the attributes in our context.

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The first question we should ask is *In which (formal) context?* Let us say in the context of animals. This means that our objects are animals (or rather, animal species) and the attributes are a set of agreed upon predicates which are meaningful for animals.

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scrive.

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Basic Notions: Concept

An Introduction to Formal Concept Analysis

Now let us try to turn this into a definition. In *aggrcn* formal context, define a formal concept to be a pair (O, A) where

- O is a set of objects (called the extent of the concept),
- A is a set of attributes (called the intent of the concept)

such that every object in O has every attribute in A .

Remember the alien. Suppose we have only lion as an object and mamal as an attribute in our concept, say we were lazy or we simply made a mistake. An alien would ask, for instance, why only lions because there are other mamals –and the dual question.

- scrive.

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- Basic Notions: Concept

Concepts are maximal. Concepts are expressible in the given vocabulary.

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Here is the actual definition. In a given formal context, define a formal concept to be a pair (O, A) where

- O is a set of objects (called the extent of the concept).
- A is a set of attributes (called the intent of the concept).
- every object in O has every attribute in A ,
- if o is an object not in O then there is an attribute a in A such that o does not have a ,
- if a is an attribute not in A then there is an object o in O such that o does not have a .

Basic Notions: Concept Lattice

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Now imagine you are the alien. You immediately realize that you don't need humans once you have the context. You can compute all the concepts. So it becomes about discovery, not communication.

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Demo

I made a small tool:

<https://sonatsuer.github.io/homemade-fca/>

Implementation notes:

- Written after Martin Janiczek's talk on Graphviz and Mermaid.
- Main language is Purescript with a little JS to manipulate dom instead of a full fledged framework.
- Thanks to Francesco Orsenigo for UX tips.
- Feel free to open a ticket or contribute.

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└ Demo

It is a shame that I had to implement this. It should have already existed.

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