

# Formal Concept Analysis

## III Knowledge Discovery

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slides based on a lecture by Prof. Gerd Stumme

## 5 Attribute Exploration

- compute the stem base interactively,
- without knowing the context beforehand,
- or knowing only parts of the context

We modify NEXT CLOSURE for computing the stem base:

The context can be *modified* while the list  $\mathcal{L}$  of implications is computed by taking into account *new objects*. If these objects *respect all implications* that have been computed so far, then the computation can be continued with the results obtained so far. This is the result of the following Lemma:

**Lemma:** Let  $\mathbb{K}$  be a context and let  $P_1, P_2, \dots, P_n$  be the first  $n$  pseudo-intents of  $\mathbb{K}$  with respect to the lexic order. If  $\mathbb{K}$  is extended by an object  $g$  the object intent  $g'$  of which respects the implications  $P_i \rightarrow P_i'', i \in \{1, \dots, n\}$ , then  $P_1, P_2, \dots, P_n$  are also the lexically first  $n$  pseudo-intents of the extended context.

# Attribute Exploration: Approach

Therefore, if we have found a new pseudo-intent  $P$ , we can stop the algorithm and ask, *whether the implication  $P \rightarrow P''$  should be added to  $\mathcal{L}$ ?*

user answers **yes**: continue

user answers **no**: add counter example which does not contradict already confirmed implications

In the extreme case, the procedure can be started with a context the object set of which is empty. In this case, the user will have to enter all counter-examples, thereby creating a concept system with a given “attribute logic”.

# Attribute Exploration: Example

Instead of a detailed algorithm description: an example.

We compute the concept lattice for

$$G = \mathbb{N}$$

$$M = \{\text{even, odd, prime, square, cubic, not prime, not square, not cubic}\}$$

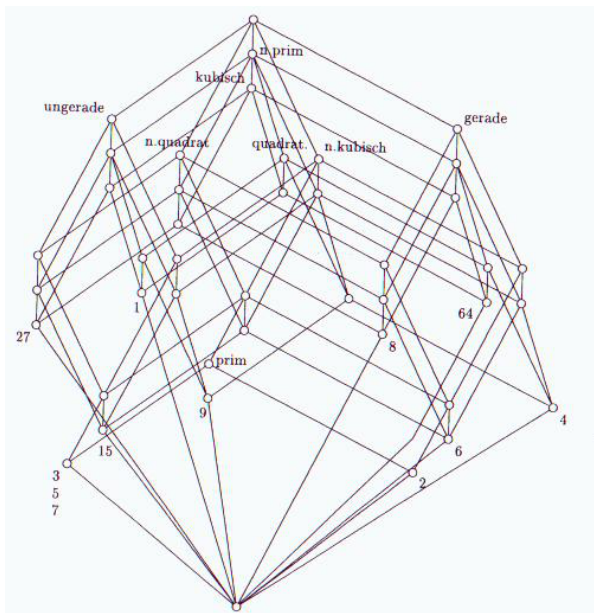
# Attribute Exploration: Example

The accepted implications, i.e., the stem base, which holds for all natural numbers, looks this way:

1.: cubic	→ not prime
2.: square	→ not prime
3.: prime	→ not square, not cubic
4.: cubic, not cubic	→ $\perp$
5.: square, not square	→ $\perp$
6.: prime, not prime	→ $\perp$
7.: even, odd	→ $\perp$

# Attribute Exploration: Example

The corresponding concept lattice. All implications that can be read off hold for *all* natural numbers.





# Attribute Exploration

 On the blackboard: another example

country	EU	€	Schengen	NATO	monarchy	inland	> 10M inhab.
Ireland							
Italy							
UK							