

Semiconcept and Protoconcept Algebras: The Basic Theorems

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The concern of this paper is to elaborate a basic understanding of semiconcepts and protoconcepts as notions of Formal Concept Analysis. First, semiconcepts and protoconcepts are motivated by their use for effectively describing formal concepts. It is shown that one can naturally operate with those units of description, namely with operations which constitute algebras of semiconcepts and algebras of protoconcepts as so-called double Boolean algebras. The main results of this paper are the two basic theorems which characterize semiconcept resp. protoconcept algebras as pure resp. fully contextual double Boolean algebras whose related Boolean algebras are complete and atomic. Those theorems may, for instance, be applied to check whether line diagram representations of semiconcept and protoconcept algebras are correct.

Protoconcept exploration is developed as a knowledge acquisition tool for exploring the structure of protoconcept algebras similar to concept exploration for concept lattices. In this paper first results are presented. In particular, an algorithm is introduced that interactively determines the finitely generated subalgebra of a protoconcept algebra. Although it creates a redundant set of questions it shows clearly which information from the user is needed and it serves as a basis for a future, optimized algorithm.

In order to define a negation on formal concepts in Formal Concept Analysis, the more general notions of semiconcepts and protoconcepts were introduced. The theory of the resulting protoconcept and semiconcept algebras is developed in Boolean Concept Logic as a part of Contextual Logic. In this paper it is shown that each complete subalgebra of a semiconcept algebra is itself the semiconcept algebra of an appropriate context. An analogous result holds for the complete subalgebras of protoconcept algebras. These contexts can be obtained from the original context through partitions of the object and the attribute set satisfying certain conditions. Characterizations of the complete subalgebras of semiconcept and protoconcept algebras in terms of contexts, in terms of subsets, and through closed subrelations are given.

The concern of such papers is to elaborate a basic understanding of *semiconcepts* and *protoconcepts* as notions of Formal Concept Analysis. First, semiconcepts and protoconcepts are motivated by their use for effectively describing formal concepts. It is shown that one can naturally operate with those units of description, namely with operations which constitute algebras of semiconcepts and algebras of protoconcepts as so-called *double Boolean algebras*. The main results of these papers are the two basic theorems which characterize *semiconcept* resp. *protoconcept algebras* as pure resp. fully contextual double Boolean algebras whose related Boolean algebras are complete and atomic. Those theorems may, for instance, be applied to check whether line diagram representations of semiconcept and protoconcept algebras are correct.