Fundamentals and Pragmatics of an Entity-Relationship Approach[1]

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Studying modern database languages one recognizes that there is a gap between language features and theoretical foundations:

- Studies of the formal foundations exist for the relational data model but not for the Entity-Relationship model, which is a model used by numerous practical people. Also, most extensions of the Entity-Relationship model and other semantic data models lack a precise formal description.
- Certain features of database query languages such as aggregation or grouping are offered by the corresponding database systems but the theoretical foundations in terms of algebras or calculi frequently neglect these features.

These observations were the starting point for studying the fundamentals of the most prominent data model for database design, which is without doubt the Entity-Relationship model.

- This text presents a comprehensive introduction to an extended Entity-Relationship model both on a conceptual and on a formal, mathematical level. The model concentrates concepts of known semantic data models in a few syntactical constructs. It can therefore serve as a basis for comparing the different data models. But in contrast to many other proposals for semantic data models the text gives a rigorous mathematical description of what is expressed by the various constructs.
- In addition to the primitives given by the data model the text introduces a language for the formulation of constraints in order to restrict database states to consistent ones. The same language can be used to query databases. As for the model, a rigorous mathematical semantics is provided for this so-called extended Entity-Relationship calculus. This is in contrast to many proposals in the database field which usually describe the semantics of languages only by means of examples.
- The text explains an implementation of the approach chosen in the logic programming language PROLOG and discusses in this context the computational power of the proposed calculus.
- The extended Entity-Relationship calculus is applied in order to define the meaning of the relational query language SQL. The language SQL is considered as a very important database language due to its standardization and due to the fact that almost all relational database systems offer interfaces to this language. A nice feature of the approach put forward here is that it becomes possible to prove language properties on a sound mathematical basis.

[1] Also: An Extended Entity-Relationship Model - Fundamentals and Pragmatics. Springer, Berlin, LNCS 767 (1994)