Chapter III

From Conceptual Database Schemas to Logical Database Tuning

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Abstract

This chapter revisits conceptual database design and focuses on the so-called “logical database tuning”. We first recall fundamental differences between constructor-oriented models (like extended Entity-Relationship models) and attribute-oriented models (like the relational model). Then, we introduce an integrated algorithm for translating ER-like conceptual database schemas to relational database schemas. To consider the tuning of such logical databases, we highlight two extreme cases: null-free databases and efficient — though non redundant — databases. Finally, we point out how SQL workloads could be used a posteriori as a help for the designers and/or the database administrators to reach a compromise.
between these extreme cases. While a lot of papers and books have been devoted for many years to database design, we hope that this chapter will clarify the understanding of database designers when implementing their databases and database administrators when maintaining their databases.

Introduction

Semantic data modeling is the activity of specifying the structure and the semantics of the data to be managed within an application. Since the 1970s, semantic data modeling has been the subject of a large body of work in several areas, including databases, information systems, software engineering and knowledge representation. For database design, approaches to data modeling advocate the use of abstract formalisms, such as the popular Entity Relationship model (Chen, 1976), for describing data, mostly based on the notion of class or entities.

Two main families of semantic data models are addressed in the literature:

- **Attribute-oriented models**: Data structure is captured through the notion of attributes, i.e., objects and relationships between objects are modeled thanks to attributes. Most of data semantics is expressed by means of additional constraints. The relational data model or object-oriented data models fall into this family.

- **Constructor-oriented models**: Data semantics is captured through various constructors, including attributes but also a constructor for objects and another one for relationships between objects. A key feature of such models is that most of data semantics is already expressed by the constructors. Entity-Relationship models (Chen, 1976) fall into this family.

Conceptual data models like ER models provide a high-level abstraction for information concerning an application domain. To do so, they rely on many constructors, such as relationship-type which is very powerful to capture data semantics at a high level abstraction. Moreover, such models are widely used in practice, as advocated by methods of information systems design like MERISE (Moulin, 1976; Tardieu, 1979) or R.U.P. (Rational Unified Process) based on UML (Jacobson, 1999). Most of them have conceptual data models derived from ER models except that the interpretation of relationship cardinalities substantially differs. As an example, a database schema created with one interpretation of relationship cardinalities is quite different from the same database schema created with the other interpretation. This point is often left to
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