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Chapter IX

Object-Oriented Database Design

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INTRODUCTION

In spite of the fact that relational databases still hold the first place in the market, object-oriented databases are becoming, each day, more widely accepted. Relational databases are suitable for traditional applications supporting management tasks such as payroll or library management. Recently, as a result of hardware improvements, more sophisticated applications have emerged. Engineering applications, such as CAD/CAM (Computer Aided Design/ Computer Aided Manufacturing), CASE (Computer Aided Software Engineering) or CIM (Computer Integrating Manufacturing), office automation systems, multimedia systems such as GIS (Geographic Information Systems) or medical information systems, can be characterized as consisting of complex objects related by complex interrelationships. Representing such objects and relationships in the relational model implies that the objects must be decomposed into a large number of tuples. Thus, a considerable number of *joins* is necessary to retrieve an object and, when tables are too deeply nested, performance is dramatically reduced (Bertino and Marcos, 2000).

A new database generation has arisen to solve the above-mentioned problems and it includes both object-relational (Stonebraker and Brown, 1999) and object databases (Bertino and Martino, 1993). Object-relational technology is relational systems extended with new capabilities, such as triggers or object-oriented capabilities allowing us to support complex objects required by new applications. Object databases are well suited for storing and retrieving complex data by allowing one to navigate through the data.

Nonetheless, good technology is not enough to support complex objects and applications. The next step should be to provide appropriate guidelines to get a

correct object-oriented database design and not much work has been done in this field.

Some approaches to object-oriented database design are available (Silva and Carlson, 1995; Blaha and Premerlani, 1998; Ullman and Widom, 1997; Kovács and Van Bommel, 1998; Muller, 1999; Bertino and Marcos, 2000). Unfortunately, none of these proposals can be considered as "the method" neither for object-relational nor for object databases. They can be considered just as the first approaches to a standard method, but none of them have been universally accepted by the database community. In addition, despite the fact that some of the mentioned proposals are so recent, they do not take into account the new standards. We can notice that SQL:1999, the standard for object-relational databases, after seven years of discussion and more than four different proposals of the object-relational model, has been approved in 1999 (Eisenberg and Meltón, 1999). On the other hand, latest revision of the ODMG (Object Database Management Group) standard, the standard for object databases, was published January 2000 (Cattell et al., 2000). The main features of the two mentioned standards are shown in a subsequent section.

The main objective of this chapter is to review the state-of-the-art in database design for complex-systems, including both perspectives mentioned above: object-relational and object database technologies. With this aim we sum-up the SQL:1999 and ODMG object models, comparing the main advantages and disadvantages of these two approaches. We also pose, through an example, the main problems of the relational model to represent complex objects and relationships, and we use the same example to explain how these problems can be addressed by the object-relational and object-databases.

In addition to the above-mentioned problems, Web systems each day become more and more important systems. Database integration on the Web involves different problems from traditional databases, that have to be taken into account in the design task. This is the reason, nowadays, that some approaches to Web database design are appearing (Schawe and Rossi, 1995; Atzeni et al.,1998; Fraternali and Paolini, 1998). The last part of the chapter poses the main trends in Web database design.

The remainder of the chapter is organized as follows: the next section provides the needed background summing up object-relational models (SQL:1999 object model) and object database models (ODMG object model); a subsequent section proposes, through an example, some guidelines for object-relational and object database design; then the next section summarizes the new trends in Web database design; the final section finishes with the main conclusions.

BACKGROUND

The application areas covered by relational technology are mainly focused on tasks such as management, invoicing, etc. New database technology, including object-relational and object databases, covers a wide spectrum of application areas