Chapter V

Representation of Fuzzy Knowledge in Relational Databases: FIRST-2

The Relational Model was developed by E.F. Codd of IBM and published in 1970. It is currently the most used and has been a milestone in the history of databases, revolutionizing the market. In fact, relational databases have been the most widespread of all databases. On a theoretical level, many Fuzzy Relational Database models (Chapter II), which are based on the relational model, extend this so that vague and uncertain information can be stored and/or treated with or without fuzzy logic (see Chapter I).

The FuzzyEER Model (see Chapter IV) is an extension of the EER Model for creating conceptual schemas with fuzzy semantics and notations. This extension is a good eclectic synthesis between different models (see Chapter III) and provides new and useful definitions: fuzzy attributes, fuzzy entities, fuzzy relationships, fuzzy specializations, and so forth.

In this chapter, we propose the incorporation of FuzzyEER concepts into a relational DBMS. Our aim is to present this extension as simply and usefully as possible. We then extend the FIRST definitions (Medina, 1994; Medina, Pons, & Vila, 1995; Galindo, 1999), which have been used in some applications
(Blanco, Cubero, Pons, & Vila, 2000; Carrasco, 2003). FIRST-2 is the extension of FIRST in order to incorporate these new definitions. Chapter VI describes the steps of an algorithm for FuzzyEER-to-FIRST-2 mapping. Chapter VII defines the FSQL language (Fuzzy SQL), which facilitates fuzzy database access and creation (queries, updates, etc.). Although FSQL is independent of FIRST-2, FSQL needs a fuzzy database as powerful as the one represented by using FIRST-2. Chapter VIII shows some applications of fuzzy databases, FIRST-2, and the FSQL language.

The section “Fuzzy Values: Fuzzy Attributes and Fuzzy Degrees” in Chapter IV showed the fuzzy attributes included in the FuzzyEER Model. We then define how to represent fuzzy data and fuzzy metaknowledge data. For each fuzzy attribute type, it is necessary to clarify two aspects:

1. How to represent the values (which the attribute can store). This question is examined in the first two main sections in this chapter.
2. What information needs to be stored in the Fuzzy Metaknowledge Base (FMB) to process it, and how this information should be organized. This question is explained in the third main section of this chapter.

The FMB will be responsible for organizing all the information related to the inexact nature or context of these attributes. The FMB is contemplated as an extension of the catalogue of the system (Data Dictionary), and it organizes the information by using tables or relations.

In this chapter, we focus on these two aspects. Firstly, for each fuzzy type of information, we define its representation in the database of data, and then we detail the structure of the FMB, clarifying the second point. Certain approaches sharing this objective, such as Bosc and Galibourg (1989), have focused on queries rather than on representation issues.

In this representation, the following aspects have predominated (Medina, 1994):

- Execution speed against storage economy: For some of the types that this attribute can collect, it might be possible to use a more compact representation. However, this would result in a slower execution of the operations that involve fuzzy attributes.
- Uniformity in the presentation: Classical attributes are used to represent fuzzy attributes.