Chapter XVIII
Looking for Information in Fuzzy Relational Databases Accessible Via Web

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ABSTRACT

The Semantic Web has resulted in a wide range of information (e.g., HTML, XML, DOC, PDF documents, ontologies, interfaces, forms, etc.) being made available in semantic queries, and the only requirement is that these are described semantically. Generic Web interfaces for querying databases (such as ISQLPlus ©) are also part of the Semantic Web, but they cannot be semantically described, and they provide access to one or many databases. In this chapter, we will highlight the importance of using ontologies to represent database schemas so that they are easier to access. The representation of the fuzzy data in fuzzy databases management systems (FDBMS) has certain special requirements, and these characteristics must be explicitly defined to enable this kind of information to be accessed. In addition, we will present an ontology which allows the fuzzy structure of a fuzzy database schema to be represented so that fuzzy data from FDBMS can also be available in the Semantic Web.

INTRODUCTION

The Semantic Web is the result of extending the standard Web with languages, information, and resources to enable us to extract information about the meaning of the Web contents automatically (Berners-Lee, Hendler, & Lassila, 2001). This content can be stored in different formats, for example, Web documents, semi-structured schemes, or dynamic data (Hendler, Berners-Lee, & Miller, 2002) as shown in Figure 1. In the Semantic Web, each information source is extended with a structured representation of its semantics (or its meaning). There are several approximations for
Looking for Information in Fuzzy Relational Databases Accessible Via Web

An ontology is a formal description for the discourse domain of a concrete problem, and the intention is for it to be shared between different applications. One of its advantages is that it can be expressed in a language (mostly based on first-order logic) which can be used for reasoning (Gómez-Pérez, Fernández-López, & Corcho-García, 2003b; Noy, 2004; Staab & Studer, 2004).

A dynamic Web page is a type of Web content which is generated by querying a database (usually using technologies such as JSP, ASP, or PHP). In this case, Web pages cannot be semantically represented since they are front-end for the database. They can, however, be defined by the representation of the database contents which are accessed. Other types of Web pages are even more complex to be defined semantically, for example, generic Web interfaces for querying databases such as ISQLPlus (Oracle ©, n.d.) or WebinTool (Hu, Nicholson, Mungall, Hillyard, & Archibald, 1996) or those developed with database-accessing packages such as LIBSDB (Eriksson, n.d.). These pages allow us to access database information, but they cannot be semantically indexed because their contents depend on the accessed database.

A search in the Semantic Web, however, does not always look for Web documents but data registers. Database schemas allow to access to DB information, but they are also a representation of a particular domain. In this case, such a representation can be very useful in the search retrieval process, and alternative result to classical data. Other alternative results can be references to existing databases (when their schemas are known) or client applications which can enrich the resulting answer. Final users could then choose the answers they need.

Fuzzy databases representing imprecise information (Blanco, Martinez-Cruz, Serrano, & Vila, 2005b; Ma, 2005) are also part of the information which can be shared in the Semantic Web. This representation allows us to store uncertain and imprecise data together with classical data. However, the difficulty of accessing the database information becomes more complicated when fuzzy information is incorporated into the problem as shown in Blanco et al. (2005b). Agents need to know about the metadata of the fuzzy database in order to search information within it.

Representation and manipulation of fuzzy data in the Semantic Web include certain advantages in the Web search. One such advantage is the capability of including fuzzy information in the answers (including fuzzy database schemas), but the main one might well be the new opportunities that this type of information adds to the data integration process from heterogeneous data, format, or sources.

The use of fuzzy databases in the Semantic Web, however, is closely connected to its formal representation. An ontology representing a fuzzy database can be seen as an interface (Blanco, Martínez-Cruz, Marin, & Vila, 2005a; Calero, Ruiz, Baroni, Abreu, & Piattini, 2005; Perez de Laborda & Conrad, 2005) between the database and the Semantic Web. This interface separates the data representation from its storage and simplifies its definition for accessing it. The resulting ontology represents the metaclasses that define the information structure (the fuzzy database catalog) and the metaclasses containing the stored fuzzy data (the fuzzy database schema). This ontology can be treated homogeneously with all the ontologies in the Web, that is, it can be shared, merged, pruned, or evaluated (Gómez-Pérez et al., 2003b).

The second section of this chapter briefly describes the main topics relating to fuzzy database integration, and describes various concepts about fuzzy databases and the relation between ontologies and relational databases. In the third section, we propose an ontology as an interface for integrating fuzzy databases into the Semantic Web, and also include an example of a fuzzy schema representation. The final section discusses new trends and presents our conclusions.