

Chapter 1.9

An Overview of Fuzzy Approaches to Flexible Database Querying

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ABSTRACT

In reality, a lot of information is available only in an imperfect form. This might be due to imprecision, vagueness, uncertainty, incompleteness, or ambiguities. Traditional database systems can only adequately cope with perfect data. Among others, fuzzy set theory has been applied to deal with imperfections of data in a more natural way and to enhance the accessibility of databases. In this chapter, we give an overview of main trends in the research on flexible querying techniques that are based on fuzzy set theory. Both querying techniques for traditional databases as well

as querying techniques for fuzzy databases are described. The discussion comprises both the relational and the object-oriented database modeling approaches.

INTRODUCTION

Databases are a very important component in computer systems. Because of their increasing number and volume, good and accurate accessibility to a database becomes even more important. A lot of research has already been done to improve database access. In this research, many

aspects have been dealt with, among which we mention file organization, indexing, querying techniques, query languages, and other data access techniques.

In this chapter, we give an overview of the main research results on the development of flexible querying techniques that are based on fuzzy set theory (Zadeh, 1965) and its related possibility theory (Dubois & Prade, 1988; Zadeh, 1978). The scope of the chapter is further limited to an overview of those techniques that aim to enhance database querying by introducing fuzzy preferences (Bosc, Kraft, & Petry, 2005). Other techniques not dealt with in this chapter include:

- Self-correcting querying systems that can correct syntactic and semantic errors in query formulations.
- Navigational querying systems that allow intelligent navigation through the database.
- Cooperative querying systems that support “indirect” answers like summaries, conditional answers, and contextual background information for (empty) results. (Gaasterland, Godfrey, & Minker, 1992)

We will assume a simplified view of the database query as a combination of a number of *conditions* that are to be met by the data sought. The introduction of fuzzy preferences in queries can be done at two levels: *inside* query conditions and *between* query conditions. Fuzzy preferences are introduced *inside* query conditions via flexible search criteria and allow to express that some values are more desirable than others in a gradual way. Fuzzy preferences *between* query conditions are expressed via grades of importance assigned to particular query conditions indicating that the satisfaction of some query conditions is more desirable than the satisfaction of others. Because of the use of fuzzy preferences and the central role of fuzzy set theory, the flexible querying approaches dealt with in this chapter will be called *fuzzy querying* in the remainder of the chapter.

The research on fuzzy querying already has a long history. It has been inspired by the success of fuzzy logic in modeling natural language propositions. The use of such propositions in queries, in turn, seems to be very natural for human users of any information system, notably the database management system. Later on, the interest in fuzzy querying has been reinforced by the omnipresence of network based applications, related to buzzwords of modern information technology, such as e-commerce, e-government, and so forth. These applications evidently call for a flexible querying capability when users are looking for some goods, hotel accommodations, and so forth, that may be best described using natural language terms like *cheap*, *large*, *close to the airport*, and so on. Another amplification of the interest in fuzzy querying comes from developments in the area of data warehousing and data mining related applications. For example, a combination of fuzzy querying and data mining interfaces (Kacprzyk & Zadrozny, 2000a, 2000b) or fuzzy logic and the OLAP (Online Analytical Processing) technology (Laurent, 2003) may lead to new, effective, and more efficient solutions in this area.

The remainder of the chapter is organized as follows. In the next section, some preliminaries are presented. In Fuzzy Querying of Crisp Relational Databases section, the results on fuzzy querying in classical relational databases are presented, while the Fuzzy Querying of Fuzzy Relational Databases and Object-Oriented Approaches sections deal with the same issues for fuzzy and object oriented cases, respectively. Finally, some concluding remarks are given.

Other chapters in this volume also deal with some particular cases of fuzzy querying. Among the most relevant ones, we want to mention here the chapters written by:

- Thomopoulos, Buche, and Haemmerlé who describe flexible querying with hierarchical fuzzy sets.

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