

**Guest Editorial: Fuzzy logic and soft computing
in an effective and efficient processing of imperfect
information — in memoriam Ashley Morris**

by

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During last decades we have witnessed a tremendous development of electronic data processing. A vision of the Information Society becomes a reality in front of our eyes. Huge amounts of data are gathered and processed every day. This calls for efficient and effective methods of information processing. Even if the ever growing capacity of computers alleviates this problem to some extent, new ideas and techniques are definitely still needed. There is one dimension of data access effectiveness which requires special attention, namely *consistency with human perception*. Accessing databases and retrieving textual information from document collections is an experience not any more reserved to IT specialists. In the Information Society virtually everybody is performing this kind of activity more or less often. An average user is neither prepared nor willing to express his or her requirements in the form usually expected by information systems. A very important aspect of man-machine interaction is the difficulty of matching the rigid, binary logic of a computer and the flexible, often vague and imprecise character of natural language, which is the most important way of communication for a human being. Natural language modelling and understanding is a multi-faceted problem. One of the basic problems is the proper account for the different aspects of information imperfection related to the concepts expressed using natural language. This problem is addressed from different perspectives and in different contexts by the papers collected in this special issue.

The papers gathered here deal with various problems related to data modelling and processing using elements of *fuzzy logic*. Fuzzy logic provides a sound mathematical framework for the development of relevant models, tools and techniques. The support for human consistent data processing is one of its main, generally meant, goals since the start of the development of this theory. This

special issue comprises mainly extended versions, enriched with new results, of selected contributions to the special mini track on “The application of fuzzy logic and soft computing in flexible querying” that we organised at the IFSA 2007 World Congress in Cancun, Mexico, June 18-21, 2007. The large number of submitted papers, as well as the size of the audience attending the three sessions of the track proved the importance of the topic and encouraged us to undertake this follow-up initiative. This special issue is accompanied by another one guest-edited by us and published in parallel in the *Fuzzy Sets and Systems* journal.

The first two papers deal with the foundations of fuzzy logic based information processing. González, Marín, Pons and Vila, in the first paper of this issue, address an important issue of multifaceted imperfection of information. Namely, they assume that a piece of information is both imprecise and uncertain. Thus, they address the problem of certainty-qualified linguistic statements introduced by Zadeh in the framework of possibility theory. The novelty of the proposed approach consists in the assumption that the degrees of both imprecision and uncertainty are given in the form of fuzzy numbers. The authors propose a method to combine both degrees and motivate this by studying its properties. The proposed solution is readily applicable to the representation of imperfect preferences in a user query as well as to the modelling of imperfectly known data in a fuzzy database. The second paper, by Bronselaer, Hallez and De Tré, proposes operators for sets and multisets comparison using the apparatus of possibility theory, and in particular the concept of possibilistic truth values. The operators make it possible to compare objects with a complex structure. In a comprehensive study of the problem the authors investigate properties of the proposed operators, introduce an advanced learning strategy to tune their parameters and present some algorithms needed to apply the operators in an effective and efficient way.

Next three papers deal in a novel way with the classical topics related to the application of fuzzy logic for data querying, modelling and mining. Wei, Chen and Zhou study the concept of functional dependencies with associated degrees of satisfaction. The authors focus on discovering such dependencies as a form of useful semantic knowledge and provide an in-depth analysis of their properties. Moreover, the authors propose a number of optimization strategies for pre-processing, which make the mining of dependencies much more efficient. The next paper, by Lietard and Rocacher, deals with the evaluation of fuzzy queries against a relational database when the aggregation operators are involved. This is one of the issues, which has not yet been solved in a commonly accepted way. The difficulty consists in defining what e.g., “maximum salary of *young* employees” means, i.e., when a standard aggregation operator is applied to a fuzzy set of values. The authors propose to cope with that problem using the concept of so-called gradual numbers. In the third paper, Angryk offers an approach to extract data from a fuzzy database in such a way so as to make it amenable to classical data mining algorithms. A rich model of a fuzzy database

is assumed and the extraction process refers to the attribute oriented induction technique. Emphasis is put on the scalability of the proposed approach.

The important area of textual information retrieval is dealt with by the next two papers. Ortiz-Arroyo and Christensen propose a new approach to retrieving passages, a subtask of a question answering problem. The essence of the proposed solution is the use of a sophisticated, fuzzy similarity based measure designed in order to compare a query with the passages. High efficiency of the algorithm is obtained via parameters tuning using genetic algorithm. The paper by Wallace also addresses textual information retrieval but with an emphasis on the semantic analysis of both queries and documents. Explicit knowledge representation in the form of an ontology is assumed. Elements of fuzzy logic are applied to grasp the inherent vagueness of natural language and knowledge representation.

The paper by Verstraete concerns the modelling of fuzzy information in geographic databases. The author studies the concept of a fuzzy region and, in particular, the interpretation in this context of the surface area and distance. This makes it possible to more adequately handle the fuzziness that is inherent to a geographical representation of the real world.

The papers gathered in this special issue cover well the broad research area of applying fuzzy logic and soft computing in information management. We hope that the reader will find inspiration and motivation for the further development of this interesting research field. We warmly invite all interested readers to visit the Web site of the EUSFLAT Working Group on Soft Computing in Database Management and Information Retrieval at <http://scdmir.ugent.be>. This Working Group is coordinated by Gabriella Pasi and ourselves. The present special issue should be seen in part as an effect of the activities of this Working Group. In particular, we encourage the visitors to register and take an active part in the discussion on relevant topics using the forum available at the mentioned Web site. We hope this will foster the research and discussion in our community. The topics of the papers collected in this special issue, and possibly the papers themselves, may trigger the first threads of the discussion on the forum.

As guest editors of this special issue, we would like to express our gratitude to the authors for their contributions and to the reviewers for their help. We are grateful to Professor Zbigniew Nahorski and Dr. Jan W. Owsinski, the Editors, for their support and encouragement, and for an efficient cooperation.

While preparing this special issue we were struck by the sudden death of **Ashley Morris** in April 2008. Ashley was an active member of the fuzzy databases community and contributed to this broadly meant area with several papers. We dedicate this special issue to his memory and enclose a short obituary inside.

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