Preface

In order to write this preface, I began to read one of the most inspiring books I have ever read. I read many of the underlined sentences (I always underline good books). Suddenly, the muses visited me and they said to me that it would be easier if I quoted some interesting text. One of the most prestigious Italian philosophers, Ludovico Geymonat (1908-1991), said,[1]

"*The first step of the human reason is satisfied, in all investigation, showing the existing difficulties in it, not hiding them, even if they are very serious. Only who knows them, not who ignores them, can feel the impulse to search for the indispensable means to dominate them; and this search is the decisive spring for the scientific progress.*"

I think that, today, most of research papers are focused on only a few possible solutions to a very small and very concrete subject, and even with a very local point of view. Is this useful? I think so, of course. However, it is possible that many researchers are more interested in increasing the number of publications than the quality of these works, or if these works can be extended with a wider point of view, studying previous works and showing the most important "existing difficulties." In this book, the referees and I have spared no effort to reduce these troubles, but I am not sure if we have achieved it. Indeed, in science and research (at least) it is important not to be really sure of anything. Skepticism is important for scientific progress, and thus it was taught by scholars from Pirrón of Elis (365-275 B.C.) to René Descartes (1596-1650), including the doctor Sextus Empiricus (second to third centuries, B.C.) or Michel de Montaigne (1533-1592). Thus, with this humility that must characterize every research work, we present this book and hope that it contributes a bit to scientific progress and therefore to a better world.

In the context of this handbook, Vila and Delgado defend in the foreword that the treatment of imprecise and uncertain information in databases is a very interesting research line. Imprecision has been studied in order to elaborate systems, databases, and consequently applications that support this kind of information. Most works that studied the imprecision in information have used possibility, similarity, and fuzzy techniques. In this foreword, the reader can find an interesting overview of each chapter of this volume.

Basically, a fuzzy database is a database with fuzzy characteristics, particularly fuzzy attributes. These may be defined as attributes of an item, row, or object in a database that allow the storage of fuzzy

information (imprecise or uncertain data). There are many forms of adding flexibility in fuzzy databases. The simplest technique is to add a fuzzy membership degree to each record, that is, an attribute in the range [0,1]. However, there are other kinds of databases allowing fuzzy values to be stored in fuzzy attributes, using fuzzy sets (including fuzzy spatial data types), possibility distributions, or fuzzy degrees associated with some attributes and with different meanings (membership degree, importance degree, fulfillment degree, etc.). Sometimes, the expression *fuzzy databases* is used for classical databases with fuzzy queries or with other fuzzy aspects, such as constraints. The first chapter gives a wide historical point of view summarizing the main fuzzy database models, but this scientific field has a very promising future.

The research on fuzzy databases has been developing for about 20 years and is concentrated mainly on the following six research lines.

1. Fuzzy querying in classical databases
2. Fuzzy queries on fuzzy databases
3. Extension of classical data models in order to achieve fuzzy databases (fuzzy relational databases, fuzzy object-oriented databases, etc.)
4. Fuzzy conceptual modeling tools
5. Fuzzy data mining techniques
6. Applications of these advances in real databases

All of these different issues have been studied in different chapters of this volume, except the fourth item because, in general, there is little interest in fuzzy conceptual issues and this subject has been studied in some other works in a very exhaustive manner (see related references in Chapter I).

Querying with imprecision, contrary to classical querying, allows users to implement fuzzy linguistic labels (also named linguistic terms) and express their preferences to better qualify the data they wish to get. An example of a flexible query, also named in this context a fuzzy query, would be "a list of the young employees working in a department with a big budget." This query contains the fuzzy linguistic labels *young* and *big budget*. These labels are words, in natural language, that express or identify a fuzzy set (fixed or context dependent). Summarizing, fuzzy queries are useful to reflect the preferences of the end user and to rank the solutions.

The ability to make fuzzy queries in classical databases is very useful because currently there are many classical databases. The second research line includes the first one, but we prefer to separate them because this second line finds new problems that must be studied, and because it must be framed in a concrete fuzzy database model (third research line). These two first lines are summarized by Zadrożny et al. in their chapter. On the other hand, Chapters IV to XIII study concrete problems about the fuzzy querying world (bipolar queries, fuzzy languages, quantified queries, etc.).

This handbook also includes interesting chapters about the third item, extending classical data models in order to achieve fuzzy databases. They study useful topics, such as how a database administrator may achieve a fuzzy relational database, a new fuzzy relational model with a fuzzy query language including the possibility to specify priorities for fuzzy statements, a good approach to creating a fuzzy object-relational database model, fuzzy spatial data types, and even more.

Regarding fuzzy data mining issues, this handbook includes a complete review chapter by Feil and Abonyi studying the main fuzzy data mining methods. This is probably the most promising area because today there are many databases that may give us information if we use the proper tools. Perhaps the more interesting and useful tools are fuzzy clustering and fuzzy dependencies, and both are also studied in different chapters of this handbook.

The last research line, applications, is also studied in some chapters. These chapters mix different theoretical issues, like data mining, with real contexts to achieve different goals. Many chapters end with some examples or applications of the topics; however, we want to highlight that the third part of this handbook includes some chapters with very interesting applications.

In summary, this handbook includes a very good selection of works by leaders in this field. Each chapter includes a good introduction, shows some of the new advances and the future lines in its corresponding topic, and gives some key-term definitions. We can be assured that fuzzy databases will be studied and developed in the upcoming years with the main target of improving current databases. It is easy to see that scientific and technological development, including information science, can assist humankind in making the world a better place to live. Therefore, why is it not achieved on the whole planet? Why is this world so unjust? Why can we not enhance our lives without destroying other forms of life, plants, animals, and our own fellow people? Perhaps it is useful to reflect on one dissertation by Geymonat in which he studies the antiquity after Aristotle of Estagira (384-322 B.C.). He studied Archimedes of Syracuse (287-212 B.C.) and Herón of Alexandria (about first century, A.D.), and their fusion of science and technology. Then he wondered why the ancient world did not develop a mechanic civilization. He said that, probably, the reason was in the social structure of the Latin Greek world, which did not feel the necessity of inventing new machines because they had cheap and efficient machines: slaves. The Latin writer Marcus Terentius Varro (116-27 B.C.) confirms that slavery was then seen as a true machine.

The French economist Bertrand De Jouvenel (1903-1987) would say that our modern machines work because we have made "the big mutation" from soil forces (animals, water, wind) to subsoil forces (coal, petroleum). In this way, the invention by the Scotch engineer James Watt (1736-1819), patented in 1769, "provokes a huge difference between leader countries and other civilizations that in the 18th century it had never crossed somebody mind to consider like inferior ones."[2]

These dissertations invite us to think that perhaps it is impossible to reach a very comfortable society without using slavery or subsoil forces, two options with a lot of big problems. It is sad, but our world is now using both options, especially rich countries. Modern slavery is located in far-off and poor countries (many adults and children work in very bad conditions making sport shoes, footballs, ephemeral toys, and even in the dangerous fields of gold and diamond mining, tobacco plantations, etc.). On July 4, 2007, newspapers wrote that in Brazil more than 1,000 slaves were freed from a sugar-cane plantation where they were being forced to work 14-hour days in horrendous conditions cutting cane for ethanol production. Human-rights groups and labour organizations believe that between 25,000 and 80,000 people could be working in conditions akin to slavery in Brazil (on deforestation and on sugar-cane, coffee, and cotton plantations). Most of these products (e.g., wood) go to rich countries. The same newspapers published that Brazil, one of the world's largest producers of alternative fuel and the number-one exporter of ethanol made from sugar cane, plans to double production of the biofuel over the next 5 years, and more than the 50% will go to ecological Europe. Biofuels[3] may be with an interesting alternative to subsoil forces, especially for a hungry planet. They may be a renewable energy source (using the appropriate manure and when not being transported over a long distance, for example). I am not sure whether Brazilian biofuel is a good environmental option for Europe, but it is not an ethical option if we do not know whether it uses forced labour or abusive work conditions, which are illegal in Europe, or even whether it uses ecological agriculture techniques or not.

Where is the solution? The solution is in our hands, in you and me, in all the citizens of the world. All of us must demand ethical politics and refuse such a very comfortable and consumerist society. It is a pleasure to drive a car or to eat meat everyday, or to have many shoes, jackets, rings, and necklaces, but, unfortunately, it is not sustainable. I do not know if we will be able to achieve sustainable development or if it is even possible, but in any case, we must use every endeavor to reach it. We must decide

whether development is more or less important than sustainability because many times we will have to choose between these two concepts.

Unfortunately, I do not have global solutions but I need to believe that solutions exist. For now, I can think of some local proposals like planting trees (in order to preserve soil, water, and biodiversity), not eating meat everyday or buying unnecessary or "fussy" objects (because they need large quantities of energy), and living with open eyes and mind, looking for situations where we can help to achieve a better world. Our life is not neutral. We contribute to changing this world, for worse or for better. Our activity and knowledge have an influence on our little planet.

Geymonat wrote that knowledge is not only the result of personal ingenuity, but that "it sinks its own roots in the whole collection of the diverse human activities," and that there are two kinds of scientific and philosophic research. One of them consists of well-connected systems (such as those by Aristotle or Euclid), while the other one consists of connected fragments. Neither is better than the other because the best one is that "which provokes the highest interest to continue researching and the highest trust in the investigation powerful." Like other philosophers, such as the Spanish Ortega y Gasset (1883-1955), Geymonat said that preserving the past and looking for the new are complementary aspects, and both of them are indispensable at the same level.

This book brings together some connected fragments and they are a well-connected system in the particular area of fuzzy databases. I think that it will provoke at least some interest to continue researching and some trust in the investigation. Maybe the next generation of database management systems will include many fuzzy characteristics and users will enjoy fuzzy interfaces, fuzzy queries, fuzzy dependencies, and fuzzy data mining even without knowing anything about t-norms, fuzzy measures, FSQL, or a man called Zadeh. In this sense, I think and I hope that this book will be at least a bit useful.

This book was a big effort for me, but it was also a big effort for the authors, referees, and publisher. Each chapter has been reviewed by three to five referees who looked for errors and areas in need of improvement, proposing interesting approaches, references, and so forth. I will be very satisfied if someone finds more errors or improvements because it means that this handbook provokes at least some interest to continue researching. All of us must undertake a continuous process of apprenticeship, research, meditation, and thinking over everything. If we refuse to do that, then the television, mass media, and politicians will be very happy because they will do that for us.

ENDNOTES

[1]   Ludovico Geymonat was a professor in the Milan University. His book *Historia de la Filosofía y de la Ciencia* (2nd edition in Spanish, 2006, translated as *History of Philosophy and Science*) is a synthesis of his two masterpieces *Storia della Filosofia* and *Storia del Pensiero Filosofico*. An abstract in Spanish is available at http://www.resumelibros.tk and http://www.lcc.uma.es/~ppgg/libros.

[2]   Bertrand De Jouvenel's (1976) *The Civilization of Power: From Political Economy to Political Ecology* (abstract in Spanish available at http://www.resumelibros.tk and http://www.lcc.uma.es/~ppgg/libros)

[3]   BirdLife International's (2005) *Bioenergy: Fuel for the Future? A BirdLife International Position Paper on Bioenergy Use in the EU* (retrieved from http://www.birdlife.org)

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