Preface

This volume is a result of a special project the purpose of which was twofold. First of all, from a substantial point of view, we wished to provide a bird's view of some novel directions in the broadly perceived "intelligent systems", starting with more philosophical and foundational considerations, through a bunch of promising models for the analysis of data, decision-making, systems modeling, and control, with a message that an approach on the broadly perceived granular computing, soft computing and fuzzy logic can provide in this context some breakthrough views, perspectives, and—as a consequence—solutions, not only relevant from a conceptual and analytic points of view, but also practical, with a high implementation potential.

This book is basically a token of appreciation to Prof. Ronald R. Yager for his great scientific and scholarly achievements, long-time service to the fuzzy logic and more generally to the artificial and computational intelligence communities. It is appreciation for his original novel thinking and his groundbreaking ideas that have reshaped many already well-established fields of science and technology, and have initialized and triggered interest and research in many new ones. He has particularly motivated by providing tools to enable the computerized implementation of the various aspects of human cognition for decision-making and problem solving.

The second purpose of this volume has been to acknowledge the role and contributions of Prof. Ronald R. Yager in all these areas of modern science and technology. In his illustrious research and scholarly career, that has spanned over some decades, he has greatly contributed to the clarification of many foundational issues, proposed new methodological and algorithmic solutions, and has also been instrumental in their real-world applications. His original results cover both contributions in traditional well-established areas like probability theory and statistics, and many new emerging ones like fuzzy logic, possibility theory, the Dempster-Shafer theory, the theory of approximate reasoning, computing with words, to name a few. He has triggered research in new areas related to aggregation and fusion of information, linguistic data summarization, participatory learning, granular computing for

systems modeling, etc. More information will be provided in the dedication part of this volume.

The editors of this volume have a special relation to Prof. Yager because they have spent many years with him as visiting professors and close collaborators. They have been very much privileged to be able to work in the early years of their careers with him, and enjoy both inspiration, wise advice, and also his friendship. This volume is a token of appreciation for him. In fact, practically all authors of contributions included in this volume have also had a very close and fruitful professional relation with Prof. Yager. He has also inspired them, and the dedication of their papers to him is also a proof of their deep appreciation for his great results and role in shaping their scientific interests and careers.

Of course, this volume, meant to be just a token of appreciation for Prof. Yager by our entire community, is small in comparison with what he has done in science, education, and what he has done to virtually all of us by both invaluable inspiration and friendship.

An important part of this volume is "Dedication" in which the contributions, research record, influence, etc. of Prof. Yager have been presented in more detail.

The volume starts with "Part I: Information theoretic and aggregation issues" which contains more basic and foundational contributions of the authors to this volume. They cover some most crucial problems and issues in the scope of this volume.

Enric Trillas and Rudolf Seising ("On the meaning and the measuring of 'probable'") are concerned with some basic issues related to probability, from the point of view of probability theory which is a mathematical theory that is an important part of pure mathematics, and as a long and distinguished history of more than 300 years. It has found a multitude of applications in almost all domains of science and technology. Then, the authors relate this to a relatively short history of fuzzy sets theory of just the lasts 50 years during which it has been theoretically developed and successfully applied in many fields. Then the authors, being aware of some controversies on the nature of fuzzy sets viewed in relation to probability. The paper's purpose is to provide a contribution to the clarification of some differences between fuzzy sets and probabilities, as viewed by the authors.

Didier Dubois, Henri Prade and Agnès Ricó ("Organizing families of aggregation operators into a cube of opposition") are concerned with the so-called cube of opposition which is a structure that extends the traditional square of opposition, known since the ancient times and widely employed in the study of syllogisms. The cube of opposition, which has recently been generalized to non-Boolean, graded statements, is shown in this paper to be applicable to well-known families of idempotent, monotonically increasing aggregation operations, for instance, used in multi-criteria decision-making, which qualitatively or quantitatively provide evaluations between the minimum and the maximum of the aggregated quantities. Some notable examples are here the weighted minimum and maximum, and more generally the Sugeno integrals on the qualitative side, and the Choquet integrals, with the important particular case of the OWA operators, on the quantitative side.

The main advantage of the cube of opposition is its capability to display various possible aggregation attitudes and to show their complementarity.

Bernadette Bouchon-Meunier and Christophe Marsala ("Entropy measures and views of information") consider various issues related to entropies and other information measures, relating to some extent their analysis to what Prof. Yager has done. They take into account the very concept of a particular type of a set in question in order to point out a similarity between the quantities introduced in various frameworks to evaluate a kind of entropy. They define the concept of an entropy measure and we show its main characteristics, mainly in the form of monotonicity which are satisfied by the ideas pioneered in this context by Yager.

H. Bustince, J. Fernandez, L. De Miguel, E. Barranechea, M. Pagola, and R. Mesiar ("OWA operators and Choquet integrals in the interval-valued setting") use the notion of an admissible order between intervals to extend the definition of the OWA operators and the Choquet integrals to the interval-valued setting. Then, using this more general and comprehensive setting, the authors present an algorithm for decision-making based on their new concepts and algorithms.

Paul Elmore and Frederick Petry ("Information Theory Applications in Soft Computing") provide an overview of information theoretic metrics and the ranges of their values for extreme probability cases. They heavily relate their analysis to imprecise database models including similarity-based fuzzy models and rough set models. More specifically, they show various entropy measures for these database models' content and responses to querying. Moreover, they discuss the aggregation of uncertainty representations, in particular the possibilistic conditioning of probability aggregation by using information measures to compare the resultant conditioned probability to the original probability for three cases of possibility distributions.

The second part of the volume, Part II: "Applications in modeling, decision making, control, and other areas", provides an account of various applications of modern tools and techniques of broadly perceived intelligent systems, computer science, decision analysis, etc., to formulate and solve many important practical problems.

Uzay Kaymak ("On practical applicability of the generalized averaging operator in fuzzy decision making") provides a deep and constructive analysis of, first, general issues related to the use of aggregation operators in decision-making, and then—more specifically—to the us of the generalized averaging operator as decision functions in the modeling human decision behavior in the context of decision-making. He uses real data to analyze the models discussed and provides a comparison with the results obtained by using compensatory operators. The numerical data suggests that the generalized averaging operator is well suited for the modeling of human decision behavior.

Leandro Maciel, Rosangela Ballini and Fernando Gomide ("Evolving possibilistic fuzzy modeling and application in value-at-risk estimation") propose an evolving possibilistic fuzzy modeling approach for value-at-risk modeling and estimation. Their approach is based on an extension of the possibilistic fuzzy c-means clustering and functional fuzzy rule-based systems. It employs

memberships and typicalities to update clusters centers and forms new clusters using a statistical control distance-based criteria. The paradigm of evolving possibilistic fuzzy modeling (ePFM) also makes use of a utility measure to evaluate the quality of the current cluster structure which implies the fuzzy rule-based model. The authors are concerned with the market risk exposure which plays a key role for financial institutions in risk assessment and management, and use as a means to measure the risk exposure by evaluating the losses likely to incur when the prices of the portfolio assets decline. The value-at-risk (VaR) estimate is one of the most widely used measures of financial downside market risk, and the authors in the computational experiments evaluate the ePFM for the value-at-risk estimation using data of the main equity market indexes of United States (S&P 500) and Brazil (Ibovespa) from January 2000 to December 2012, and the econometric models benchmarks such as GARCH and EWMA, and state-of-the-art evolving approaches, are also compared against the ePFM. The results suggest that the ePFM is a potentially good candidate for the VaR modeling and estimation.

Janusz Kacprzyk, Hannu Nurmi and Sławomir Zadrożny ("Using similarity and dissimilarity measures of binary patterns for the comparison of voting procedures") consider an interesting and important problem of how similar and/or dissimilar voting procedures (social choice functions) are. They first extend their rough set based qualitative-type approach which makes it possible to partition the set of voting procedures considered into some subsets within which the voting procedures are indistinguishable, i.e., (very) similar. Then, they propose an extension towards a quantitative evaluation via the use of degrees of similarity and dissimilarity, not necessarily metrics and dual. The authors consider the following voting procedures: amendment, Copeland, Dodgson, max-min, plurality, Borda, approval, runoff and Nanson, and the following criteria Condorcet winner, Condorcet loser, majority winner, monotonicity, weak Pareto winner, consistency, and heritage. The satisfaction or dissatisfaction of the particular criteria by the particular voting procedures is represented as binary vectors. The similarity and dissimilarity measures of: Jaccard–Needham, Dice, Correlation, Yule, Russell–Rao, Sokal–Michener, Rodgers–Tanimoto, and Kulczyński are employed. The approach is shown to yield much insight into the similarity/dissimilarity of voting procedures.

Gloria Bordogna, Simone Sterlacchini, Paolo Arcaini, Giacomo Cappellini, Mattia Cugini, Elisabetta Mangioni, and Chrysanthi Polyzoni ("A geo-spatial data infrastructure for flexible discovery, retrieval and fusion of scenario maps in preparedness of emergency") are concerned with the following problem. In order to effectively plan both preparedness and response to emergency situations it is necessary to access and analyze timely information on plausible scenarios of occurrence of dangerous events. They use the so-called scenario maps which represent the estimated susceptibility, hazard or risk of occurrence of an event on a territory. Their generalization to real time is unfortunately difficult. Moreover, the application of physical or statistical models using environmental parameters representing current dynamic conditions is time-consuming and numerically demanding. To overcome these difficulties the authors propose an offline generation of scenario maps under diversified environmental dynamic parameters, and a geo-Spatial Data

Infrastructure (SDI) to allow people in charge of emergency preparedness and response activities to flexibly discover, retrieve, fuse and visualize the most plausible scenarios that may happen given some ongoing or forecasted dynamic conditions influencing the event. The solution proposed is novel in that it provides an ability to interpret flexible queries in order to retrieve risk scenario maps that are related to the current situation and to show the most plausible worst and best scenarios that may occur in each elementary area of the territory. A prototypical implementation concerns the use of scenarios maps for wild fire events.

Dimitar Filev and Hao Ying ("The multiple facets of fuzzy controllers: look-up-tables—A special class of fuzzy controllers") deal with look-up table (LUT) controllers which are among the most widely known and employed control tools in practice due to their conceptual simplicity, ease of use, inexpensive hardware implementation. Moreover, strong nonlinearity and multimodal behaviors can easily be handled by such controllers in many cases, only by experimentally measured data. The authors, in their previous paper, showed that the two-dimensional (2D) LUT controllers and one special type of two-input Mamdani fuzzy controllers are related as they have the identical input–output mathematical relation, demonstrated how to represent the LUT controllers by the fuzzy controllers, and showed how to determine the local stability of the LUT control systems. In the present work, they extend these results to the n-dimensional LUT controllers and the special type of the n-input Mamdani fuzzy controllers.

Pablo J. Villacorta, Carlos A. Rabelo, David A. Pelta and José Luis Verdegay ("FuzzyLP: an R package for solving fuzzy linear programming problems") consider fuzzy linear programming which is meant to overcome some inherent limitation of the traditional, widely used linear programming in which we need to know precisely all the conditions and parameters of the problem modeled. Since this is not always possible, a suitable alternate solution can be fuzzy linear programming which makes it possible to use imprecise data and constraints. The authors try to overcome a serious deficiency in that, in spite of a three decade long existence of fuzzy linear programming, there is still a serious difficulty in its proliferation, namely a lack of software developed for free use. The authors present an open-source R package to deal with fuzzy constraints, fuzzy costs and fuzzy coefficients in linear programming. First, the theoretical foundations for solving each type of problem are introduced, and then examples of the code. The package is accompanied by a user manual and can be freely downloaded, used and modified by any R user.

The last part of the volume, Part III: "Some bibliometric remarks", is somewhat unorthodox and special. It includes one paper which presents a detailed bibliometric analysis of main contributions of Prof. Yager, and their influence on research activities of many people from various areas who have been prolific and have developed their field of interest, to a large extent thanks to Yager's inspiration. This unusual part of the volume is fully justified by an extraordinarily high publication record and its wide recognition of Yager.

More specifically, José M. Merigó, Anna M. Gil-Lafuente and Janusz Kacprzyk ("A bibliometric analysis of the publications of Ronald R. Yager") present a

bibliometric analysis of the vast publications record of Prof. Ronald R Yager. They use the data available in the Web of Science where he has more than 500 publications. This bibliometric review considers a wide range of issues including a specific analysis of his publications, collaborators and citations. A novel use of a viewer software is used to visualize his publication and citation network though bibliographic coupling and a co-citation analysis. The results clearly show his strong influence in computer science, although it also shows his strong influence in engineering and applied mathematics too.

We wish to thank all the contributors to this volume. We hope that their papers, which consititute a synergistic combination of foundational and application-oriented works, including relevant real-world implementations, will be interesting and useful for a large audience.

We also wish to thank Dr. Tom Ditzinger, Dr. Leontina di Cecco, and Mr. Holger Schaepe from Springer for their dedication and help to implement and finish this publication project on time maintaining the highest publication standards.

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Dedicated to Professor Ronald R. Yager

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