

Preface

It is the 10th anniversary of the death of Prof. Zdzisław Pawlak, the father of rough set theory, in 2016. He set up the rough set theory in 1982, which has become one of the major theories for processing uncertain information.

As Prof. Lotfi A. Zadeh said, Prof. Pawlak was a great scientist and a great human being. He entered science history as not only the father of rough set theory, but also as the designer of the first grammar of DNA, the precursor of mosaic and picture grammars, the inventor of the digital computer based on -2 system and a random numbers generator. Besides these great scientific achievements, he was a very warm, cordial man, demanding but fair, and a man of many talents and interests, a painter, a poet, an ardent tourist, a craftsman, a truly renaissance man.

In observance of the 10th anniversary of his departure, the International Rough Set Society (IRSS) organized two special memorial sessions commemorating him in 2016, that is, the plenary panel on the legacy of Prof. Zdzisław Pawlak at FedCSIS'16, September 11–14, 2016, and the special memorial session for Prof. Pawlak at IJCRS2016, October 7–11, 2016. Polish Information Processing Society under the auspices of the Institute of Computer Science at Warsaw University of Technology organized a special session celebrating the 90th anniversary of birth of Prof. Zdzisław Pawlak on December 6, 2016. Moreover, a special plenary session celebrating the 35th anniversary of the pioneering work on rough sets by Prof. Zdzisław Pawlak will be held at IJCRS'17, in Olsztyn, Poland, July 3–7, 2017.

In addition to these special sessions, IRSS is going to publish this special memorial book entitled “Thriving Rough Sets: 10th Anniversary—Honoring Professor Zdzisław Pawlak’s Life and Legacy & 35 years of Rough Sets”, in 2017.

This book includes 20 chapters. They are divided into four sections, that is, historical review of Prof. Zdzisław Pawlak and rough set, review of rough set research, rough set theory, and rough set-based data mining.

The first part of this book is about the historical review of Prof. Zdzisław Pawlak and rough set. In Chapter “[The Born and Growing of Chinese Rough Set Community with Help of Professor Zdzisław Pawlak](#)”, Prof. Guoyin Wang introduces the history of the born and quick growing of Chinese rough set community with the help of Prof. Pawlak. China is becoming a very active country in the field

of rough set theory. In Chapter “[Zdzisław Pawlak as I Saw Him and Remember Him Now](#)”, Prof. Lech Polkowski sums up his experiences of working and living with Prof. Pawlak, shares what he knows about him, and introduces some less known achievements of him. In Chapter “[Recent Development of Rough Computing: A Scientometrics View](#)” by JingTao Yao and Adeniyi Onasanya, the authors use scientometrics approach to quantitatively analyze the contents and citations of rough set publications. They find some interesting results in key indicators between 2013 and 2016 results. Their study results indicate that rough sets as a research domain is attracting more researchers and growing healthily in recent years.

The second part of this book is about the review of rough set research. In Chapter “[Rough Sets, Rough Mereology and Uncertainty](#)”, Prof. Lech Polkowski reviews the rough set research in many realms like morphology, intelligent agents, linguistics, behavioral robotics, mereology, and granular computing. He sums up his personal experience and results, and in a sense to unify them into a coherent conceptual scheme following the main themes of rough set theory: to understand uncertainty and to cope with it in data. In Chapter “[Rough Sets in Machine Learning: A Review](#)” by Rafael Bello and Rafael Falcon, the authors survey the existing literature and report the most relevant theoretical developments and applications of rough set theory in a broad field of machine learning. Chapter “[Application of Tolerance Rough Sets in Structured and Unstructured Text Categorization: A Survey](#)” by Sheela Ramanna, James Francis Peters, and Cenker Sengoz, presents a survey of literature, where tolerance rough set model is used as a text categorization and learning model. It demonstrates the versatility of the tolerance form of rough sets and its successful application in text categorization and labeling. In Chapter “[Medical Diagnosis: Rough Set View](#)”, Prof. Shusaku Tsutomoto discusses the formalization of medical diagnosis from the viewpoint of rule reasoning based on rough sets. In Chapter “[Rough Set Analysis of Imprecise Classes](#)”, Prof. Masahiro Inuiguchi proposes to use the lower approximations of unions of k decision classes to enrich the applicability of rough set approaches instead of the lower approximations of single classes in the classical rough set approaches. In Chapter “[Pawlak’s Many Valued Information System, Non-deterministic Information System, and a Proposal of New Topics on Information Incompleteness Toward the Actual Application](#)” by Hiroshi Sakai, Michinori Nakata, and Yiyu Yao, the authors discuss Pawlak’s many valued information systems (MVISs), non-deterministic information systems (NISs), and related new topics on information incompleteness toward the actual application. They survey their previous research and propose new topics toward the actual application of NIS, namely data mining under various types of uncertainty, rough set-based estimation of an actual value, machine learning by rule generation, information dilution, and privacy-preserving issue, in NISs.

The third part is about recent achievements of the study of rough set theory. In Chapter “[From Information Systems to Interactive Information Systems](#)” by Andrzej Skowron and Soma Dutta, the authors propose a departure from classical notion of information systems, and bring in the background of agent’s interaction

with physical reality in arriving at a specific information system. They propose to generalize the notion of information systems from two aspects. In Chapter “[Back to the Beginnings: Pawlak's Definitions of the Terms Information System and Rough Set](#)”, Prof. Davide Ciucci discusses two basic notions and terms, rough set and information system, which have no crystal clear definitions in rough set theory. In Chapter “[Knowledge and Consequence in AC Semantics for General Rough Sets](#)”, Prof. A. Mani introduces an antichain based semantics for general rough sets. She develops two different semantics, one for general rough sets and another for general approximation spaces over quasi-equivalence relations, and studies the epistemological aspects of the semantics. Chapter “[Measuring Soft Roughness of Soft Rough Sets Induced by Covering](#)” by Amr Zakaria studies some important properties of soft rough sets induced by soft covering. A measure of soft roughness is introduced via soft covering approximation. A new approach of soft rough approximation space is presented via a measure of soft roughness. Chapter “[Rough Search of Vague Knowledge](#)” by Edward Bryniarski and Anna Bryniarska discusses the theoretical basis of the vague knowledge search, introduces some data granulation methods in semantic networks. In Chapter “[Vagueness and Uncertainty: An F-Rough Set Perspective](#)” by Dayong Deng and Houkuan Huang, the authors investigate vagueness and uncertainty from the viewpoints of F-rough sets. Some indexes, including two types of F-roughness, two types of F-membership-degree and F-dependence degree etc., are defined. In Chapter “[Directions of Use of the Pawlak's Approach to Conflict Analysis](#)”, Prof. Malgorzata Przybyla-Kasperek applies the Pawlak's model to analyze the conflicts that arise between classifiers in decision making. Chapter “[Lattice Structure of Variable Precision Rough Sets](#)” by Sumita Basu studies the algebraic properties of set of variable precision rough sets for a particular imprecise set.

The fourth part of this book is about the application of rough set in data mining. In Chapter “[Mining for Actionable Knowledge in Tinnitus Datasets](#)” by Katarzyna A. Tarnowska, Zbigniew W. Ras, and Pawel J. Jastreboff, the authors verify the possibility of applying theory of traditional machine learning techniques, such as classification and association rules, as well as novel data mining methods, including action rules and meta actions, to a practical decision problem in the area of medicine. Knowledge discovery approaches with an ultimate goal of building rule-based recommender system for tinnitus treatment and diagnosis are investigated. Chapter “[Rough-Granular Computing for Relational Data](#)” by Piotr Honko introduces three rough-granular approaches dedicated to handle complex data such as relational one. The three approaches are also compared in terms of construction of information systems, information granules, and approximation spaces. In Chapter “[The Boosting and Bootstrap Ensembles for the Pair Classifier Based on the Dual Indiscernibility Matrix](#)” by Piotr Artiemjew, Lech Polkowski, Bartosz Nowak, and Przemysław Gorecki, the authors examine selected methods for stabilization of the pair classifier like bootstrap ensemble, arcing based bootstrap, Ada-Boost with Monte Carlo split.

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Guoyin Wang
Andrzej Skowron
Yiyu Yao
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Lech Polkowski

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