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**KEY=FUZZY - ODONNELL LESTER**

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### Metric Spaces of Fuzzy Sets

### Theory and Applications

World Scientific The primary aim of the book is to provide a systematic development of the theory of metric spaces of normal, upper semicontinuous fuzzy convex fuzzy sets with compact support sets, mainly on the base space  $X$ . An additional aim is to sketch selected applications in which these metric space results and methods are essential for a thorough mathematical analysis. This book is distinctly mathematical in its orientation and style, in contrast with many of the other books now available on fuzzy sets, which, although all making use of mathematical formalism to some extent, are essentially motivated by and oriented towards more immediate applications and related practical issues. The reader is assumed to have some previous undergraduate level acquaintance with metric spaces and elementary functional analysis.

### Fuzzy Sets Theory and Applications

Springer Science & Business Media Problems in decision making and in other areas such as pattern recognition, control, structural engineering etc. involve numerous aspects of uncertainty. Additional vagueness is introduced as models become more complex but not necessarily more meaningful by the added details. During the last two decades one has become more and more aware of the fact that not all this uncertainty is of stochastic (random) character and that, therefore, it can not be modelled appropriately by probability theory. This becomes the more obvious the more we want to represent formally human knowledge. As far as uncertain data are concerned, we have neither instruments nor reasoning at our disposal as well defined and unquestionable as those used in the probability theory. This almost infallible domain is the result of a tremendous work by the whole scientific world. But when measures are dubious, bad or no longer possible and when we really have to make use of the richness of human reasoning in its variety, then the theories dealing with the treatment of uncertainty, some quite new and other ones older, provide the required complement, and fill in the gap left in the field of knowledge representation. Nowadays, various theories are widely used: fuzzy sets, belief function, the convenient associations between probability and fuzziness etc. ••• We are more and more in need of a wide range of instruments and theories to build models that are more and more adapted to the most complex systems.

### Applications of Fuzzy Set Theory and Near Vector Spaces to Functional Analysis

### Fuzzy Set Theory and Its Applications

Allied Publishers

### Sequence Space Theory with Applications

CRC Press The book features original chapters on sequence spaces involving the idea of ideal convergence, modulus function, multiplier sequences, Riesz mean, Fibonacci difference matrix etc., and illustrate their involvement in various applications. The preliminaries have been presented in the beginning of each chapter and then the advanced discussion takes place, so it is useful for both expert and nonexpert on aforesaid topics. The book consists of original thirteen research chapters contributed by the well-recognized researchers in the field of sequence spaces with associated applications. Features Discusses the Fibonacci and vector valued difference sequence spaces Presents the solution of Volterra integral equation in Banach algebra Discusses some sequence spaces involving invariant mean and related to the domain of Jordan totient matrix Presents the Tauberian theorems of double sequences Discusses the paranormed Riesz difference sequence space of fractional order Includes a technique for studying the existence of solutions of infinite system of functional integro-differential equations in Banach sequence spaces The subject of book is an active area of research of present time internationally and would serve as a good source for researcher and educators involved with the topic of sequence spaces.

### Fuzzy Set Theory and Advanced Mathematical Applications

Springer Science & Business Media Fuzzy Set Theory and Advanced Mathematical Applications contains contributions by many of the leading experts in the field, including coverage of the mathematical foundations of the theory, decision making and systems science, and recent developments in fuzzy neural control. The book supplies a readable, practical toolkit with a clear introduction to fuzzy set theory and its evolution in mathematics and new results on foundations of fuzzy set theory, decision making and systems science, and fuzzy control and neural systems. Each chapter is self-contained, providing up-to-date coverage of its subject. Audience: An important reference work for university students, and researchers and engineers working in both industrial and academic settings.

### Fuzzy Set Theory — and Its Applications

Springer Science & Business Media

### Fuzzy Set Theory—and Its Applications

Springer Science & Business Media This introduction to fuzzy set theory and its multitude of applications seeks to balance the character of the book with the dynamic nature of the research. This edition includes new chapters on possibility theory, fuzzy logic and approximate reasoning, expert systems, fuzzy control, fuzzy data analysis, decision making and fuzzy set models in operations research. Existing material has been updated, and extended exercises are included.

## Fuzzy Sets, Fuzzy Logic and Their Applications

**MDPI** The present book contains 20 articles collected from amongst the 53 total submitted manuscripts for the Special Issue “Fuzzy Sets, Fuzzy Logic and Their Applications” of the MDPI journal Mathematics. The articles, which appear in the book in the series in which they were accepted, published in Volumes 7 (2019) and 8 (2020) of the journal, cover a wide range of topics connected to the theory and applications of fuzzy systems and their extensions and generalizations. This range includes, among others, management of the uncertainty in a fuzzy environment; fuzzy assessment methods of human-machine performance; fuzzy graphs; fuzzy topological and convergence spaces; bipolar fuzzy relations; type-2 fuzzy; and intuitionistic, interval-valued, complex, picture, and Pythagorean fuzzy sets, soft sets and algebras, etc. The applications presented are oriented to finance, fuzzy analytic hierarchy, green supply chain industries, smart health practice, and hotel selection. This wide range of topics makes the book interesting for all those working in the wider area of Fuzzy sets and systems and of fuzzy logic and for those who have the proper mathematical background who wish to become familiar with recent advances in fuzzy mathematics, which has entered to almost all sectors of human life and activity.

## Applications of Category Theory to Fuzzy Subsets

**Springer Science & Business Media** This book has a fundamental relationship to the International Seminar on Fuzzy Set Theory held each September in Linz, Austria. First, this volume is an extended account of the eleventh Seminar of 1989. Second, and more importantly, it is the culmination of the tradition of the preceding ten Seminars. The purpose of the Linz Seminar, since its inception, was and is to foster the development of the mathematical aspects of fuzzy sets. In the earlier years, this was accomplished by bringing together for a week small groups of mathematicians in various fields in an intimate, focused environment which promoted much informal, critical discussion in addition to formal presentations. Beginning with the tenth Seminar, the intimate setting was retained, but each Seminar narrowed in theme; and participation was broadened to include both younger scholars within, and established mathematicians outside, the mathematical mainstream of fuzzy sets theory. Most of the material of this book was developed over the years in close association with the Seminar or influenced by what transpired at Linz. For much of the content, it played a crucial role in either stimulating this material or in providing feedback and the necessary screening of ideas. Thus we may fairly say that the book, and the eleventh Seminar to which it is directly related, are in many respects a culmination of the previous Seminars.

## Fuzzy Set Theory — and Its Applications

**Springer Science & Business Media** Since its inception 20 years ago the theory of fuzzy sets has advanced in a variety of ways and in many disciplines. Applications of this theory can be found in artificial intelligence, computer science, control engineering, decision theory, expert systems, logic, management science, operations research, pattern recognition, robotics and others. Theoretical advances, too, have been made in many directions, and a gap has arisen between advanced theoretical topics and applications, which often use the theory at a rather elementary level. The primary goal of this book is to close this gap - to provide a textbook for courses in fuzzy set theory and a book that can be used as an introduction. This revised book updates the research agenda, with the chapters of possibility theory, fuzzy logic and approximate reasoning, expert systems and control, decision making and fuzzy set models in operations research being restructured and rewritten. Exercises have been added to almost all chapters and a teacher's manual is available upon request.

## Investigations Into Living Systems, Artificial Life, and Real-world Solutions

**IGI Global** "This book provides original research on the theoretical and applied aspects of artificial life, as well as addresses scientific, psychological, and social issues of synthetic life-like behavior and abilities"--Provided by publisher.

## Semitopological Vector Spaces

## Hypernorms, Hyperseminorms, and Operators

**CRC Press** This new volume shows how it is possible to further develop and essentially extend the theory of operators in infinite-dimensional vector spaces, which plays an important role in mathematics, physics, information theory, and control theory. The book describes new mathematical structures, such as hypernorms, hyperseminorms, hypermetrics, semitopological vector spaces, hypernormed vector spaces, and hyperseminormed vector spaces. It develops mathematical tools for the further development of functional analysis and broadening of its applications. Exploration of semitopological vector spaces, hypernormed vector spaces, hyperseminormed vector spaces, and hypermetric vector spaces is the main topic of this book. A new direction in functional analysis, called quantum functional analysis, has been developed based on polinormed and multinormed vector spaces and linear algebras. At the same time, normed vector spaces and topological vector spaces play an important role in physics and in control theory. To make this book comprehensible for the reader and more suitable for students with some basic knowledge in mathematics, denotations and definitions of the main mathematical concepts and structures used in the book are included in the appendix, making the book useful for enhancing traditional courses of calculus for undergraduates, as well as for separate courses for graduate students. The material of Semitopological Vector Spaces: Hypernorms, Hyperseminorms and Operators is closely related to what is taught at colleges and universities. It is possible to use a definite number of statements from the book as exercises for students because their proofs are not given in the book but left for the reader.

## Probability Theory for Fuzzy Quantum Spaces with Statistical Applications

**Bentham Science Publishers** The reference considers probability theory in two main domains: fuzzy set theory, and quantum models. Readers will learn about the Kolmogorov probability theory and its implications in these two areas. Other topics covered include intuitionistic fuzzy sets (IF-set) limit theorems, individual ergodic theorem and relevant statistical applications (examples from correlation theory and factor analysis in Atanassov intuitionistic fuzzy sets systems, the individual ergodic theorem and the Poincaré recurrence theorem). This book is a useful resource for mathematics students and researchers seeking information about fuzzy sets in quantum spaces.

## Fixed points of fuzzy neutrosophic soft mapping with decision-making

**Infinite Study** In this paper, we introduce some operations on a fuzzy neutrosophic soft set (fns-set) by utilizing the theories of fuzzy sets, soft sets and neutrosophic sets. We introduce fns-mappings by using a cartesian product with relations on fns-sets and establish some results on fixed points of an fns-mapping. We present an algorithm to deal with uncertainties in the multi-criteria decision making to slenderize energy crises by using an fns-average operator and a comparison table for fns-sets.

## Fuzzy Differential Equations in Various Approaches

**Springer** This book may be used as reference for graduate students interested in fuzzy differential equations and researchers working in fuzzy sets and systems, dynamical systems, uncertainty analysis, and applications of uncertain dynamical systems. Beginning with a historical overview and introduction to fundamental notions of fuzzy sets, including different possibilities of fuzzy differentiation and metric spaces, this book moves on to an overview of fuzzy calculus thorough exposition and comparison of different approaches. Innovative theories of fuzzy calculus and fuzzy differential equations using fuzzy bunches of functions are introduced and explored. Launching with a brief review of essential theories, this book investigates both well-known and novel approaches in this field; such as the Hukuhara differentiability and its generalizations as well as differential inclusions and Zadeh's extension. Through a unique analysis, results of all these theories are examined and compared.

## Fuzzy Information and Engineering and Decision

Springer This book introduces applications of mathematics and fuzzy mathematics in decision science, fuzzy geometric programming and fuzzy optimization as well as operations research and management, based on 44 research papers presented at three successful conferences: (1) The International Conference on Mathematics and Decision Science (ICMDS), September 12-15, 2016, Guangzhou University, Guangzhou, China (www.icodm2020.com). (2) Academic Conference on 30th Anniversary of Fuzzy Geometric Programming Advanced by Professor Cao Bingyuan and his 40 education years (ACFGPACE), July 30 to August 1, 2016, Guangzhou University, Guangzhou, China. (3) The third annual meeting of Guangdong Operational Research Society (TAMGORS), October 22-23, 2016, Foshan University, Guangdong, China. The book is a valuable resource for students, graduates, teachers and other professionals in the field of applied mathematics, artificial intelligence and computers, fuzzy systems and decision-making, as well as operations research and management.

## A Modern Introduction to Fuzzy Mathematics

John Wiley & Sons Provides readers with the foundations of fuzzy mathematics as well as more advanced topics A Modern Introduction to Fuzzy Mathematics provides a concise presentation of fuzzy mathematics., moving from proofs of important results to more advanced topics, like fuzzy algebras, fuzzy graph theory, and fuzzy topologies. The authors take the reader through the development of the field of fuzzy mathematics, starting with the publication in 1965 of Lotfi Asker Zadeh's seminal paper, Fuzzy Sets. The book begins with the basics of fuzzy mathematics before moving on to more complex topics, including: Fuzzy sets Fuzzy numbers Fuzzy relations Possibility theory Fuzzy abstract algebra And more Perfect for advanced undergraduate students, graduate students, and researchers with an interest in the field of fuzzy mathematics, A Modern Introduction to Fuzzy Mathematics walks through both foundational concepts and cutting-edge, new mathematics in the field.

## q-Rung Orthopair Fuzzy Sets

### Theory and Applications

Springer Nature This book collects chapters which discuss interdisciplinary solutions to complex problems by using different approaches in order to save money, time and resources. The book presents the results on the recent advancements in artificial intelligence, computational intelligence, decision-making problems, emerging problems and practical achievements in the broad knowledge management field. q-ROFS is one of the hot topics for all the researchers, industrialists as well as academicians. This book is of interest to professionals and researchers working in the field of decision making and computational intelligence, as well as postgraduate and undergraduate students studying applications of fuzzy sets. The book helps solve different kinds of the decision-making problems such as medical diagnosis, pattern recognition, construction problems and technology selection under the uncertain fuzzy environment. Containing 19 chapters, the book begins by giving a topology of the q-ROFSs and their applications. It then progresses in a logical fashion, dedicating a chapter to each approach, including the generalized information measures for q-ROFSs, implementation of q-ROFSs to medical diagnosis, inventory model, multi-attribute decision-making and approaches to real-life industrial problems such as green campus transportation, social responsibility evaluation pattern and extensions of the q-ROFSs.

## Neutrosophic Approach on Normed Linear Space

Infinite Study This paper proposed the idea of Neutrosophic norm in a linear space. An attempt has been made to find some related results in Neutrosophic normed linear space and study the Cauchy sequence and completeness in this structure.

## Fuzzy Mathematics

MDPI This book is a printed edition of the Special Issue "Fuzzy Mathematics" that was published in Mathematics

## Advances in Fuzzy Sets, Possibility Theory, and Applications

Springer Science & Business Media Since its inception by Professor Lotfi Zadeh about 18 years ago, the theory of fuzzy sets has evolved in many directions, and is finding applications in a wide variety of fields in which the phenomena under study are too complex or too ill-defined to be analyzed by conventional techniques. Thus, by providing a basis for a systematic approach to approximate reasoning and inexact inference, the theory of fuzzy sets may well have a substantial impact on scientific methodology in the years ahead, particularly in the realms of psychology, economics, engineering, law, medicine, decision-analysis, information retrieval, and artificial intelligence. This volume consists of 24 selected papers invited by the editor, Professor Paul P. Wang. These papers cover the theory and applications of fuzzy sets, almost equal in number. We are very fortunate to have Professor A. Kaufmann to contribute an overview paper of the advances in fuzzy sets. One special feature of this volume is the strong participation of Chinese researchers in this area. The fact is that Chinese mathematicians, scientists and engineers have made important contributions to the theory and applications of fuzzy sets through the past decade. However, not until the visit of Professor A. Kaufmann to China in 1974 and again in 1980, did the Western World become fully aware of the important work of Chinese researchers. Now, Professor Paul Wang has initiated the effort to document these important contributions in this volume to expose them to the western researchers.

## Limit Theorems and Applications of Set-Valued and Fuzzy Set-Valued Random Variables

Springer Science & Business Media After the pioneering works by Robbins {1944, 1945} and Choquet (1955), the notation of a set-valued random variable (called a random closed set in literatures) was systematically introduced by Kendall {1974} and Matheron {1975}. It is well known that the theory of set-valued random variables is a natural extension of that of general real-valued random variables or random vectors. However, owing to the topological structure of the space of closed sets and special features of set-theoretic operations ( cf. Beer [27]), set-valued random variables have many special properties. This gives new meanings for the classical probability theory. As a result of the development in this area in the past more than 30 years, the theory of set-valued random variables with many applications has become one of new and active branches in probability theory. In practice also, we are often faced with random experiments whose outcomes are not numbers but are expressed in inexact linguistic terms.

## Fuzzy Systems and Data Mining VII

IOS Press

### Neutrosophic Sets and Systems Book Series, Vol. 30, 2019

Infinite Study "Neutrosophic Sets and Systems" has been created for publications on advanced studies in neutrosophy, neutrosophic set, neutrosophic logic, neutrosophic probability, neutrosophic statistics that started in 1995 and their applications in any field, such as the neutrosophic structures developed in algebra, geometry, topology, etc.

## Statistical Modeling, Analysis and Management of Fuzzy Data

Physica The contributions in this book state the complementary rather than competitive relationship between Probability and Fuzzy Set Theory and allow solutions to real life problems with suitable combinations of both theories.

## Advanced Intelligent Computing Theories and Applications

## Third International Conference on Intelligent Computing, ICIC 2007, Qingdao, China, August 21-24, 2007, Proceedings

Springer This volume, in conjunction with the two volumes CICS 0002 and LNCS 4681, constitutes the refereed proceedings of the Third International Conference on Intelligent Computing held in Qingdao, China, in August 2007. The 139 full papers published here were carefully reviewed and selected from among 2,875 submissions. These papers offer important findings and insights into the field of intelligent computing.

## Neutrosophic Supra Topological Applications in Data Mining Process

Infinite Study The primary aim of this paper is to introduce the neutrosophic supra topological spaces. Neutrosophic subspaces and neutrosophic mappings are presented by which some contradicting examples of the statements of Abd-Monsef and Ramadan[9] in fuzzy supra topological spaces are derived. Finally, a new method is proposed to solve medical diagnosis problems by using single valued neutrosophic score function.

## Rough Set Theory: A True Landmark in Data Analysis

Springer Science & Business Media Part 1 of this book deals with theoretical contributions of rough set theory, and parts 2 and 3 focus on several real world data mining applications. The book thoroughly explores recent results in rough set research.

## Mathematics of Fuzzy Sets

## Logic, Topology, and Measure Theory

Springer Science & Business Media Mathematics of Fuzzy Sets: Logic, Topology and Measure Theory is a major attempt to provide much-needed coherence for the mathematics of fuzzy sets. Much of this book is new material required to standardize this mathematics, making this volume a reference tool with broad appeal as well as a platform for future research. Fourteen chapters are organized into three parts: mathematical logic and foundations (Chapters 1-2), general topology (Chapters 3-10), and measure and probability theory (Chapters 11-14). Chapter 1 deals with non-classical logics and their syntactic and semantic foundations. Chapter 2 details the lattice-theoretic foundations of image and preimage powerset operators. Chapters 3 and 4 lay down the axiomatic and categorical foundations of general topology using lattice-valued mappings as a fundamental tool. Chapter 3 focuses on the fixed-basis case, including a convergence theory demonstrating the utility of the underlying axioms. Chapter 4 focuses on the more general variable-basis case, providing a categorical unification of locales, fixed-basis topological spaces, and variable-basis compactifications. Chapter 5 relates lattice-valued topologies to probabilistic topological spaces and fuzzy neighborhood spaces. Chapter 6 investigates the important role of separation axioms in lattice-valued topology from the perspective of space embedding and mapping extension problems, while Chapter 7 examines separation axioms from the perspective of Stone-Cech-compactification and Stone-representation theorems. Chapters 8 and 9 introduce the most important concepts and properties of uniformities, including the covering and entourage approaches and the basic theory of precompact or complete  $[0,1]$ -valued uniform spaces. Chapter 10 sets out the algebraic, topological, and uniform structures of the fundamentally important fuzzy real line and fuzzy unit interval. Chapter 11 lays the foundations of generalized measure theory and representation by Markov kernels. Chapter 12 develops the important theory of conditioning operators with applications to measure-free conditioning. Chapter 13 presents elements of pseudo-analysis with applications to the Hamilton-Jacobi equation and optimization problems. Chapter 14 surveys briefly the fundamentals of fuzzy random variables which are  $[0,1]$ -valued interpretations of random sets.

## IVI-octahedron sets and their application to groupoids

Infinite Study In this paper, we introduce the concepts of (internal, external) IVI-octahedron sets, and study some of their properties and give some examples.

## Axiomatic Fuzzy Set Theory and Its Applications

Springer Science & Business Media It is well known that “fuzziness”—information granules and fuzzy sets as one of its formal manifestations— is one of important characteristics of human cognition and comprehension of reality. Fuzzy phenomena exist in nature and are encountered quite vividly within human society. The notion of a fuzzy set has been introduced by L. A. Zadeh in 1965 in order to formalize human concepts, in connection with the representation of human natural language and computing with words. Fuzzy sets and fuzzy logic are used for modeling imprecise modes of reasoning that play a pivotal role in the remarkable human abilities to make rational decisions in an environment affected by uncertainty and imprecision. A growing number of applications of fuzzy sets originated from the “empirical-semantic” approach. From this perspective, we were focused on some practical interpretations of fuzzy sets rather than being oriented towards investigations of the underlying mathematical structures of fuzzy sets themselves. For instance, in the context of control theory where fuzzy sets have played an interesting and practically relevant function, the practical facet of fuzzy sets has been stressed quite significantly. However, fuzzy sets can be sought as an abstract concept with all formal underpinnings stemming from this more formal perspective. In the context of applications, it is worth underlying that membership functions do not convey the same meaning at the operational level when being cast in various contexts.

## Fundamentals of Fuzzy Sets

Springer Science & Business Media Fundamentals of Fuzzy Sets covers the basic elements of fuzzy set theory. Its four-part organization provides easy referencing of recent as well as older results in the field. The first part discusses the historical emergence of fuzzy sets, and delves into fuzzy set connectives, and the representation and measurement of membership functions. The second part covers fuzzy relations, including orderings, similarity, and relational equations. The third part, devoted to uncertainty modelling, introduces possibility theory, contrasting and relating it with probabilities, and reviews information measures of specificity and fuzziness. The last part concerns fuzzy sets on the real line - computation with fuzzy intervals, metric topology of fuzzy numbers, and the calculus of fuzzy-valued functions. Each chapter is written by one or more recognized specialists and offers a tutorial introduction to the topics, together with an extensive bibliography.

## Artificial Intelligence and Global Society

### Impact and Practices

CRC Press In the constant battle between human intelligence and machine intelligence, machines are close to surpassing human intelligence. The unrestrained use of digital technologies in automating processes is one of the prime advantages of the third industrial revolution. As a result, all developed and developing nations have started to digitalize mundane tasks. Thus, digital technologies for information and communication technologies (ICT) have achieved high market space in terms of infrastructure building, employment generation, education sector reforms, funds mobilization, electronic governance, hardware manufacturing, software development, etc. Hence, it is evident that every segment of society has been penetrated by ICT or digitalization. This book attempts to spotlight areas where AI is thriving. FEATURES Impact of digitalization and AI on governance Novel AI practices being followed across the global community in security, healthcare, crime prevention and detection, education, agriculture, sensor networks, etc. Innovative techniques that can be adopted to ensure better quality and better delivery of services to the society Avenues for further research by the research community and student fraternity This book is a guide for university students (especially those from technical backgrounds), industries, NGOs, and policy makers.

### Database Theory and Application, Bio-Science and Bio-Technology

## International Conferences, DTA / BSBT 2010, Held as Part of the Future Generation Information Technology Conference, FGIT 2010, Jeju Island, Korea, December 13-15, 2010. Proceedings

Springer Welcome to the proceedings of the 2010 International Conferences on Database Theory and Application (DTA 2010), and Bio-Science and Bio-Technology (BSBT 2010) - two of the partnering events of the Second International Mega- Conference on Future Generation Information Technology (FGIT 2010). DTA and BSBT bring together researchers from academia and industry as well as practitioners to share ideas, problems and solutions relating to the multifaceted aspects of databases, data mining and biomedicine, including their links to computational sciences, mathematics and information technology. In total, 1,630 papers were submitted to FGIT 2010 from 30 countries, which includes 175 papers submitted to DTA/BSBT 2010. The submitted papers went through a rigorous reviewing process: 395 of the 1,630 papers were accepted for FGIT 2010, while 40 papers were accepted for DTA/BSBT 2010. Of the 40 papers 6 were selected for the special FGIT 2010 volume published by Springer in the LNCS series. 31 papers are published in this volume, and 3 papers were withdrawn due to technical reasons. We would like to acknowledge the great effort of the DTA/BSBT 2010 International Advisory Boards and members of the International Program Committees, as well as all the organizations and individuals who supported the idea of publishing this volume of proceedings, including SERSC and Springer. Also, the success of these two conferences would not have been possible without the huge support from our sponsors and the work of the Chairs and Organizing Committee.

### Data Mining, Rough Sets and Granular Computing

Physica During the past few years, data mining has grown rapidly in visibility and importance within information processing and decision analysis. This is particularly true in the realm of e-commerce, where data mining is moving from a "nice-to-have" to a "must-have" status. In a different though related context, a new computing methodology called granular computing is emerging as a powerful tool for the conception, analysis and design of information/intelligent systems. In essence, data mining deals with summarization of information which is resident in large data sets, while granular computing plays a key role in the summarization process by drawing together points (objects) which are related through similarity, proximity or functionality. In this perspective, granular computing has a position of centrality in data mining. Another methodology which has high relevance to data mining and plays a central role in this volume is that of rough set theory. Basically, rough set theory may be viewed as a branch of granular computing. However, its applications to data mining have predated that of granular computing.

### Fuzzy Operator Theory in Mathematical Analysis

Springer This self-contained monograph presents an overview of fuzzy operator theory in mathematical analysis. Concepts, principles, methods, techniques, and applications of fuzzy operator theory are unified in this book to provide an introduction to graduate students and researchers in mathematics, applied sciences, physics, engineering, optimization, and operations research. New approaches to fuzzy operator theory and fixed point theory with applications to fuzzy metric spaces, fuzzy normed spaces, partially ordered fuzzy metric spaces, fuzzy normed algebras, and non-Archimedean fuzzy metric spaces are presented. Surveys are provided on: Basic theory of fuzzy metric and normed spaces and its topology, fuzzy normed and Banach spaces, linear operators, fundamental theorems (open mapping and closed graph), applications of contractions and fixed point theory, approximation theory and best proximity theory, fuzzy metric type space, topology and applications.

### Neutrosophic Sets and Systems, Vol. 31, 2020

Infinite Study "Neutrosophic Sets and Systems" has been created for publications on advanced studies in neutrosophy, neutrosophic set, neutrosophic logic, neutrosophic probability, neutrosophic statistics that started in 1995 and their applications in any field, such as the neutrosophic structures developed in algebra, geometry, topology, etc.

### Fuzzy Logic in Its 50th Year

### New Developments, Directions and Challenges

Springer This book offers a multifaceted perspective on fuzzy set theory, discussing its developments over the last 50 years. It reports on all types of fuzzy sets, from ordinary to hesitant fuzzy sets, with each one explained by its own developers, authoritative scientists well known for their previous works. Highlighting recent theorems and proofs, the book also explores how fuzzy set theory has come to be extensively used in almost all branches of science, including the health sciences, decision science, earth science and the social sciences alike. It presents a wealth of real-world sample applications, from routing problem to robotics, and from agriculture to engineering. By offering a comprehensive, timely and detailed portrait of the field, the book represents an excellent reference guide for researchers, lecturers and postgraduate students pursuing research on new fuzzy set extensions.

## Neutrosophic Sets and Systems, Book Series, Vol. 31, 2020. An International Book Series in Information Science and Engineering

Infinite Study "Neutrosophic Sets and Systems" has been created for publications on advanced studies in neutrosophy, neutrosophic set, neutrosophic logic, neutrosophic probability, neutrosophic statistics that started in 1995 and their applications in any field, such as the neutrosophic structures developed in algebra, geometry, topology, etc.