

## Fuzzy C Means Algorithm A Review

*International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC FSKD) is a premier international forum for scientists and researchers to present the state of the art of data mining and intelligent methods inspired from nature, particularly biological, linguistic, and physical systems, with applications to computers, circuits, systems, control, robotics, communications, and more*

*Algorithms for Fuzzy ClusteringMethods in c-Means Clustering with ApplicationsSpringer Science & Business Media*

*For decades practitioners have been using the center-based partitioned clustering algorithms like Fuzzy C Means (FCM), which rely on minimizing an objective function, comprising of an appropriately weighted sum of distances of each data point from the cluster representatives. Development of models with explicit mechanisms for data generation from cluster structures is of major interest in order to provide a theoretical framework for cluster structures found in data. Especially appealing in this regard are the so-called typological structures in which observed entities relate in various degrees to one or several prototypes. Such structures are relevant in many areas such as medicine or marketing, where any entity (patient / consumer) may adhere, with different degrees, to one or several prototypes (clinical scenario / consumer behavior), modelling a typological classification. In fuzzy clustering, the fuzzy c-means (FCM) method has become one of the most popular techniques. As a fuzzy analogue of c-means crisp clustering, FCM models a typological classification, much the same way as c-means. However, FCM does not adhere to the statistical paradigm at which the data are considered generated by a cluster structure, while crisp c-means does. The present work proposes a framework for typological classification based on a fuzzy clustering model of data generation.*

*Exploratory Study of Fuzzy Clustering and Set-distance Based Validation Indexes*

*Data Clustering*

*Fuzzy Clustering Via Proportional Membership Model*

*A Genetic Algorithm that Exchanges Neighboring Centers for Fuzzy C-means Clustering*

*Applications of the Fuzzy C-means Clustering Algorithm to the Analysis of Chemical Structures*

*Robust Fuzzy C-Means Clustering Algorithm for Interval Data*

This thesis is concerned with issues related to clustering. In particular, it addresses the convergence speed of fuzzy c-means family of algorithms and cluster validation. The fuzzy c-means clustering algorithm and its objective function is studied along with a literature review of the speed of clustering algorithms. After careful examination, several objective functions are derived by modifying the fuzzy c-means' objective function. In addition, cluster validation is examined and new set distance based cluster validation indexes (CVI) are proposed which are the ratio of separation between clusters to compactness within a cluster. To this end, a new measure of compactness, compactness of a fuzzy partition is presented and fuzzy derivative of Pompeiu-Hausdorff distance is used as separation. The convergence of fuzzy c-means clustering algorithm is tested on real classification and clustering datasets. Under classification datasets, Iris, Breast Cancer Wisconsin and Wine Recognition datasets are used. Water Treatment Plant and Libras Movement datasets are used as clustering datasets. In classification datasets, the class labels in the data set are used to measure the performance. For clustering datasets, Rand index and Jaccard index are used to evaluate clustering results. The new set distance based validation indexes are tested on both synthetic and real datasets. Datasets with three, four, five and six clusters are generated by using Gaussian distributions. The above mentioned real datasets, Iris, Breast Cancer Wisconsin and Wine Recognition are also used to evaluate the performance of set distance based validation indexes. The result (number of clusters) obtained from the set distance based validation indexes are compared with those obtained from [50] to demonstrate efficiency of set distance based validation indexes and how it considers the structure of underlying data unlike others, [50] in particular.

In the beginning of 1983, I came across A. Kaufmann's book "Introduction to the theory of fuzzy sets" (Academic Press, New York, 1975). This was my first acquaintance with the fuzzy set theory. Then I tried to introduce a new component (which determines the degree of non-membership) in the definition of these sets and to study the properties of the new objects so defined. I defined ordinary operations as "n", "u", "+" and "." over the new sets, but I had begun to look more seriously at them since April 1983, when I defined operators analogous to the modal operators of "necessity" and "possibility". The late George Gargov (7 April 1947 - 9 November 1996) is the "god father" of the sets I introduced - in fact, he has invented the name "intuitionistic fuzzy", motivated by the fact that the law of the excluded middle does not hold for them. Presently, intuitionistic fuzzy sets are an object of intensive research by scholars and scientists from over ten countries. This book is the first attempt for a more comprehensive and complete report on the intuitionistic fuzzy set theory and its more relevant applications in a variety of diverse fields. In this sense, it has also a referential character.

Clustering algorithms are widely used in pattern recognition and data mining applications. Due to their computational efficiency, partitioned clustering algorithms are better suited for applications with large datasets than hierarchical clustering algorithms. K-means is among the most popular partitioned clustering algorithm, but has a major shortcoming: it is extremely sensitive to the choice of initial centers used to seed the algorithm. Unless k-means is carefully initialized, it converges to an inferior local optimum and results in poor quality partitions. Developing improved method for selecting initial centers for k-means is an active area of research. Genetic algorithms (GAs) have been successfully used to evolve a good set of initial centers. Among the most promising GA-based methods are those that exchange neighboring centers between candidate partitions in their crossover operations. K-means is best suited to work when datasets have well-separated non-overlapping clusters. Fuzzy c-means (FCM) is a popular variant of k-means that is designed for applications when clusters are less well-defined. Rather than assigning each point to a unique cluster, FCM determines the degree to which each point belongs to a cluster. Like k-means, FCM is also extremely sensitive to the choice of initial centers. Building on GA-based methods for initial center selection for k-means, this dissertation developed an evolutionary program for center selection in FCM called FCMGA. The proposed algorithm utilized region-based crossover and other mechanisms to improve the GA. To evaluate the effectiveness of FCMGA, three independent experiments were conducted using real and simulated datasets. The results from the experiments demonstrate the effectiveness and consistency of the proposed algorithm in identifying better quality solutions than extant methods. Moreover, the results confirmed the effectiveness of region-based crossover in enhancing the search process for the GA and the convergence speed of FCM. Taken together, findings in these experiments illustrate that FCMGA was successful in solving the problem of initial center selection in partitioned clustering algorithms.

Cluster analysis is an unsupervised process that divides a set of objects into homogeneous groups. This book starts with basic information on cluster analysis, including the classification of data and the corresponding similarity measures, followed by the presentation of over 50 clustering algorithms in groups according to some specific baseline methodologies such as hierarchical, center-based, and search-based methods. As a result, readers and users can easily identify an appropriate algorithm for their applications and compare novel ideas with existing results. The book also provides examples of clustering applications to illustrate the advantages and shortcomings of different clustering architectures and algorithms. Application areas include pattern recognition, artificial intelligence, information technology, image processing, biology, psychology, and marketing. Readers also learn how to perform cluster analysis with the C/C++ and MATLAB programming languages.

*Methods for Classification, Data Analysis and Image Recognition*

*Fuzzy Information and Engineering*

*SI, a Separation Index for Use with the Fuzzy C-Means Algorithm*

*Methods in c-Means Clustering with Applications*

*Proceedings of the Second International Conference of Fuzzy Information and Engineering (ICFIE)*

*Theory and Applications*

In this paper, a new clustering algorithm, neutrosophic c-means (NCM), is introduced for uncertain data clustering, which is inspired from fuzzy c-means and the neutrosophic set framework.

Biological systems are inherently stochastic and uncertain. Thus, research in bioinformatics, biomedical engineering and computational biology has to deal with a large amount of uncertainties. Fuzzy logic has shown to be a powerful tool in capturing different uncertainties in engineering systems. In recent years, fuzzy logic based modeling and analysis approaches are also becoming popular in analyzing biological data and modeling biological systems. Numerous research and application results have been reported that demonstrated the effectiveness of fuzzy logic in solving a wide range of biological problems found in bioinformatics, biomedical engineering, and computational biology. Contributed by leading experts worldwide, this edited book contains 16 chapters presenting representative research results on the application of fuzzy systems to genome sequence assembly, gene expression analysis, promoter analysis, cis-regulation logic analysis and synthesis, reconstruction of genetic and cellular networks, as well as biomedical problems, such as medical image processing, electrocardiogram data classification and anesthesia monitoring and control. This volume is a valuable reference for researchers, practitioners, as well as graduate students working in the field of bioinformatics, biomedical engineering and computational biology.

The Second International Conference on Fuzzy Information and Engineering (ICFIE2007) is a major symposium for scientists, engineers and practitioners in China as well as the world to present their latest results, ideas, developments and applications in all areas of fuzzy information and knowledge engineering. It aims to strengthen relations between industry research laboratories and universities, and to create a primary symposium for world scientists. This book comprises a selection of papers on new methods for analysis and design of hybrid intelligent systems using soft computing techniques from the IFSA 2007 World Congress, held in Cancun, Mexico, June 2007.

*Proceedings of the International Conference on CIDM, 20-21 December 2014*

*Fuzzy Systems in Bioinformatics and Computational Biology*

*Rough Sets and Current Trends in Computing*

*A Data Mining Thinking*

*Recent Advances in Hybrid Metaheuristics for Data Clustering*

*Recent Applications in Data Clustering*

The contributed volume aims to explicate and address the difficulties and challenges that of seamless integration of the two core disciplines of computer science, i.e., computational intelligence and data mining. Data Mining aims at the automatic discovery of underlying non-trivial knowledge from datasets by applying intelligent analysis techniques. The interest in this research area has experienced a considerable growth in the last years due to two key factors: (a) knowledge hidden in organizations' databases can be exploited to improve strategic and managerial decision-making; (b) the large volume of data managed by organizations makes it impossible to carry out a manual analysis. The book addresses different methods and techniques of integration for enhancing the overall goal of data mining. The book helps to disseminate the knowledge about some innovative, active research directions in the field of data mining, machine and computational intelligence, along with some current issues and applications of related topics.

In recent years rough set theory has attracted the attention of many researchers and practitioners all over the world, who have contributed essentially to its development and applications. Wear observing a growing research interest in the foundations of rough sets, including the various logical, mathematical and philosophical aspects of rough sets. Some relationships have already been established between rough sets and other approaches, and also with a wide range of hybrid systems. As a result, rough sets are linked with decision system modeling and analysis of complex systems, fuzzy sets, neural networks, evolutionary computing, data mining and knowledge discovery, pattern recognition, machine learning, and approximate reasoning. In particular, rough sets are used in probabilistic reasoning, granular computing (including information granule calculus based on rough mereology), intelligent control, intelligent agent modeling, identification of autonomous systems, and process specification. Methods based on rough set theory alone or in combination with other approaches have been discovered with wide range applications such as: acoustics, bioinformatics, business and finance, chemistry, computer engineering (e.g., data compression, digital image processing, digital signal processing, parallel and distributed computer systems, sensor fusion, fractal engineering), decision analysis and systems, economics, electrical engineering (e.g., control, signal analysis, power systems), environmental studies, informatics, medicine, molecular biology, musicology, neurology, robotics, social science, software engineering, spatial visualization, Web engineering, and Web mining.

This book is a part of the Proceedings of the Seventh International Symposium on Neural Networks (ISNN 2010), held on June 6-9, 2010 in Shanghai, China. Over the past few years, ISNN has matured into a well-established premier international symposium on neural networks and related fields, with a successful sequence of ISNN series in Dalian (2004), Chongqing (2005), Chengdu (2006), Nanjing (2007), Beijing (2008), and Wuhan (2009). Following the tradition of ISNN series, ISNN 2010 provided a high-level international forum for scientists, engineers, and educators to present the state-of-the-art research in neural networks and related fields, and also discuss the major opportunities and challenges of future neural network research. Over the past decades, the neural network community has witnessed significant breakthroughs and developments from all aspects of neural network research, including theoretical foundations, architectures, and network organizations, modeling and simulation, empirical studies, as well as a wide range of applications across different domains. The recent developments of science and technology, including neuroscience, computer science, cognitive science, nano-technologies and engineering design, among others, has provided significant new understandings and technical challenges to the neural network research towards the development of complex, large scale, and networked brain-like intelligent systems. This long-term goals can only be achieved with the continuous efforts from the community to seriously investigate various issues on neural networks and related topics.

Contents: Introduction: Basic Concepts of Fuzzy Sets: Fuzzy Relations: Fuzzy Models for Image Processing and Pattern Recognition: Membership Functions: Introduction: Heuristic Selection: Clustering Approaches: Tuning of Membership Functions: Concluding Remarks: Optimal Image Thresholding: Introduction: Threshold Selection Based on Statistical Decision Theory: Non-fuzzy Thresholding Algorithms: Fuzzy Thresholding Algorithm: Unified Formulation of Three Thresholding Algorithms: Multilevel Thresholding Applications: Concluding Remarks: Fuzzy Clustering: Introduction: C-Means Algorithm: Comparison between Hard and Fuzzy Clustering Algorithms: Cluster Validity Applications: Concluding Remarks: Line Pattern Matching: Introduction: Similarity Measures between Line Segments: Basic Matching Algorithm: Dealing with Noisy Patterns: Dealing with Rotated Patterns: Applications: Concluding Remarks: Fuzzy Rule-based Systems: Introduction: Learning From Examples: Decision Tree Approach: Fuzzy Aggregation Network: Approaches: Minimization of Fuzzy Rules: Defuzzification and Optimization Applications: Concluding Remarks: Combined Classifiers: Introduction: Voting Schemes: Maximum Posteriori Probability: Multilayer Perceptron Approach: Fuzzy Measures and Fuzzy Integrals: Applications: Concluding Remarks: Readership: Engineers and computer scientists. keywords:

*2016 12th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC FSKD)*

*Noise Resistant Clustering Through the Credibilistic Fuzzy C Means Algorithm*

*Advances in K-means Clustering*

*12th Mexican Conference, MCPR 2020, Morelia, Mexico, June 24-27, 2020, Proceedings*

*Third International Conference, FSKD 2006, Xi'an, China, September 24-28, 2006, Proceedings*

*Advances in Fuzzy Clustering and its Applications*

*This book constitutes the proceedings of the First International Conference on Computational Intelligence and Information Technology, CIIT 2011, held in Pune, India, in November 2011. The 58 revised full papers, 67 revised short papers, and 32 poster papers presented were carefully reviewed and selected from 483 initial submissions. The papers are contributed by innovative academics and industrial experts in the field of computer science, information technology, computational engineering, mobile communication and security and offer a stage to a common forum, where a constructive dialog on theoretical concepts, practical ideas and results of the state of the art can be developed. Nearly everyone knows K-means algorithm in the fields of data mining and business intelligence. But the ever-emerging data with extremely complicated characteristics bring new challenges to this "old" algorithm. This book addresses these challenges and makes novel contributions in establishing theoretical frameworks for K-means distances and K-means based consensus clustering, identifying the "dangerous" uniform effect and zero-value dilemma of K-means, adapting right measures for cluster validity, and integrating K-means with SVMs for rare class analysis. This book not only enriches the clustering and optimization theories, but also provides good guidance for the practical use of K-means, especially for important tasks such as network intrusion detection and credit fraud prediction. The thesis on which this book is based has won the "2010 National Excellent Doctoral Dissertation Award", the highest honor for not more than 100 PhD theses per year in China.*

Recently many researchers are working on cluster analysis as a main tool for exploratory data analysis and data mining. A notable feature is that specialists in different fields of sciences are considering the tool of data clustering to be useful. A major reason is that clustering algorithms and software are flexible in sense that different mathematical frameworks are employed in the algorithms and a user can select a suitable method according to his application. Moreover clustering algorithms have different outputs ranging from the old dendrogram of agglomerative clustering to more recent self-organizing maps. Thus, a researcher or user can choose an appropriate output suited to his purpose, which is another flexibility of the methods of clustering. An old and still most popular method is the K-means which use K-cluster centers. A group of data is gathered around a cluster center and thus forms a cluster. The main subject of this book is the fuzzy c-means proposed by Dunn and Bezdek and their variations including recent studies. A main reason why concentrate on fuzzy c-means is that most methodology and application studies in fuzzy clustering use fuzzy c-means and thus c-means should be considered to be a major technique of clustering in general, regardless whether one is interested in fuzzy methods or not. Moreover recent advances in clustering techniques are rapid and we require a new textbook that includes recent algorithms. We should also note that several books have recently been published but the contents do not include some methods studied herein.

Provides a timely and important introduction to fuzzy cluster analysis, its methods and areas of application, systematically describing different fuzzy clustering techniques so the user may choose methods appropriate for his problem. It provides a very thorough overview of the subject and covers classification, image recognition, data analysis and rule generation. The application examples are highly relevant and illustrative, and the use of the techniques are justified and well thought-out. Features include: \* Sections on inducing fuzzy if-then rules by fuzzy clustering and non-alternating optimization fuzzy clustering algorithms \* Discussion of solid fuzzy clustering techniques like the fuzzy c-means, the Gustafson-Kessel and the Gath-Geva algorithm for classification problems \* Focus on linear and shell clustering techniques used for detecting contours in image analysis \* Accompanying software and data sets pertaining to the examples presented, enabling the reader to learn through experimentation \* Examination of the difficulties involved in evaluating the results of fuzzy cluster analysis and of determining the number of clusters with analysis of global and local validity measures This is one of the most comprehensive books on fuzzy clustering and will be welcomed by computer scientists, engineers and mathematicians in industry and research who are concerned with different methods, data analysis, pattern recognition or image processing. It will also give graduate students in computer science, mathematics or statistics a valuable overview.

*Software Engineering*

*Analysis and Design of Intelligent Systems Using Soft Computing Techniques*

*Fuzzy C-mean Clustering using Data Mining*

*Mapping Semi-supervised Fuzzy C-means Clustering Algorithm Onto a Distributed System*

*Pattern Recognition with Fuzzy Objective Function Algorithms*

*Algorithms for Fuzzy Clustering*

This report introduces two robust statistics – the fuzzy median and the fuzzy median absolute deviation from the median – that have been developed for use with fuzzy data sets. The two statistics were applied to the fuzzy c-Means algorithm, a powerful clustering algorithm that normally employs linear statistics. The modified algorithm showed improved performance, being able to cluster data sets generated by heavy-tailed distributions like the Cauchy and Slash distributions.

The fuzzy set was conceived as a result of an attempt to come to grips with the problem of pattern recognition in the context of imprecisely defined categories. In such cases, the belonging of an object to a class is a matter of degree, as is the question of whether or not a group of objects form a cluster. A pioneering application of the theory of fuzzy sets to cluster analysis was made in 1969 by Ruspini. It was not until 1973, however, when the appearance of the work by Dunn and Bezdek on the Fuzzy ISODATA (or fuzzy c-means) algorithms became a landmark in the theory of cluster analysis, that the relevance of the theory of fuzzy sets to cluster analysis and pattern recognition became clearly established. Since then, the theory of fuzzy clustering has developed rapidly and fruitfully, with the author of the present monograph contributing a major share of what we know today. In their seminal work, Bezdek and Dunn have introduced the basic idea of determining the fuzzy clusters by minimizing an appropriately defined functional, and have derived iterative algorithms for computing the membership functions for the clusters in question. The important issue of convergence of such algorithms has become much better understood as a result of recent work which is described in the monograph.

A comprehensive, coherent, and in depth presentation of the state of the art in fuzzy clustering. Fuzzy clustering is now a mature and vibrant area of research with highly innovative advanced applications. Encapsulating this through presenting a careful selection of research contributions, this book addresses timely and relevant concepts and methods, whilst identifying major challenges and recent developments in the area. Split into five clear sections, Fundamentals, Visualization, Algorithms and Computational Aspects, Real-Time and Dynamic Clustering, and Applications and Case Studies, the book covers a wealth of novel, original and fully updated material, and in particular offers: a focus on the algorithmic and computational augmentations of fuzzy clustering and its effectiveness in handling high dimensional problems, distributed problem solving and uncertainty management, presentations of the important and relevant phases of cluster design, including the role of information granules, fuzzy sets in the realization of human-centricity facet of data analysis, as well as system modelling demonstrations of how the results facilitate further detailed development of models, and enhance interpretation aspects a carefully organized illustrative series of applications and case studies in which fuzzy clustering plays a pivotal role This book will be of key interest to engineers associated with fuzzy control, bioinformatics, data mining, image processing, and pattern recognition, while computer engineers, students and researchers, in most engineering disciplines, will find this an invaluable resource and research tool.

This article presents a New Neutrosophic C-Means (NNCMs) method for clustering. It uses the neutrosophic logic (NL), to generalize the Fuzzy C-Means (FCM) clustering system.

*NCM: Neutrosophic c-means clustering algorithm*

*Axiomatic generalization of the membership degree weighting function for fuzzy C means clustering: heoretical development and convergence analysis*

*Image Classification- Based on Fuzzy C Means Clustering Algorithm*

*Intuitionistic Fuzzy Sets*

*Proceedings of CSI 2015*

*Computational Intelligence in Data Mining - Volume 2*

Clustering has emerged as one of the more fertile fields within data analytics, widely adopted by companies, research institutions, and educational entities as a tool to describe similar/different groups. The book Recent Applications in Data Clustering aims to provide an outlook of recent contributions to the vast clustering literature that offers useful insights within the context of modern applications for professionals, academics, and students. The book spans the domains of clustering in image analysis, lexical analysis of texts, replacement of missing values in data, temporal clustering in smart cities, comparison of artificial neural network variations, graph theoretical approaches, spectral clustering, multiview clustering, and model-based clustering in an R package. Applications of image, text, face recognition, speech (synthetic and simulated), and smart city datasets are presented.

This book constitutes the refereed proceedings of the Third International Conference on Fuzzy Systems and Knowledge Discovery, FSKD 2006, held in federation with the Second International Conference on Natural Computation ICNC 2006. The book presents 115 revised full papers and 50 revised short papers. Coverage includes neural computation, quantum computation, evolutionary computation, DNA computation, fuzzy computation, granular computation, artificial life, innovative applications to knowledge discovery, finance, operations research, and more.

Containing twenty six contributions by experts from all over the world, this book presents both research and review material describing the evolution and recent developments of various pattern recognition methodologies, ranging from statistical, linguistic, fuzzy-set-theoretic, neural, evolutionary computing and rough-set-theoretic to hybrid soft computing, with significant real-life applications. Pattern Recognition and Big Data provides state-of-the-art classical and modern approaches to pattern recognition and mining, with extensive real life applications. The book describes efficient soft and robust machine learning algorithms and granular computing techniques for data mining and knowledge discovery, and the issues associated with handling Big Data. Application domains considered include bioinformatics, cognitive machines (or machine mind developments), biometrics, computer vision, the e-nose, remote sensing and social network analysis.

This book constitutes the proceedings of the 12th Mexican Conference on Pattern Recognition, MCPR 2020, which was due to be held in Morelia, Mexico, in June 2020. The conference was held virtually due to the COVID-19 pandemic. The 31 papers presented in this volume were carefully reviewed and selected from 67 submissions. They were organized in the following topical sections: pattern recognition techniques; image processing and analysis; computer vision; industrial and medical applications of pattern recognition; natural language processing and recognition; artificial intelligence techniques and recognition.

*Generalization of Fuzzy C-Means Based on Neutrosophic Logic*

*A hybrid Fuzzy C-Means and Neutrosophic for jaw lesions segmentation*

*Computational Intelligence and Information Technology*

*Fuzzy Systems and Knowledge Discovery*

*Fuzzy Cluster Analysis*

*Theory, Algorithms, and Applications*

The goal of traditional clustering is to assign each data point to one and only one cluster. In contrast, fuzzy clustering assigns different degrees of membership to each point. The membership of a point is thus shared among various clusters. This creates the concept of fuzzy boundaries which differs from the traditional concept of well-defined boundaries. In hard clustering, data is divided into distinct clusters, where each data element belongs to exactly one cluster. In fuzzy clustering (also referred to as soft clustering), data elements can belong to more than one cluster, and associated with each element is a set of membership levels. These indicate the strength of the association between that data element and a particular cluster. Fuzzy clustering is a process of assigning these membership levels, and then using them to assign data elements to one or more clusters. This algorithm uses the FCM traditional algorithm to locate the centers of clusters for a bulk of data points. The potential of all data points is being calculated with respect to specified centers. The availability of dividing the data set into large number of clusters will slow the processing time and needs more memory size for the program. Hence traditional clustering should divide the data to four clusters and each data point should be located in one specified cluster. Imprecision in data and information gathered from and about our environment is either statistical (e.g., the outcome of a coin toss is a matter of chance) or no statistical (e.g., "apply the brakes pretty soon"). Many algorithms can be implemented to develop clustering of data sets. Fuzzy C-mean clustering (FCM) is efficient and common algorithm. We are tuning this algorithm to get a solution for the rest of data point which omitted because of its fairness from all clusters. To develop a high performance algorithm that sort and group data set in variable number of clusters to use this data in control and managing of those clusters.

It is really important to diagnose jaw tumor in its early stages to improve its prognosis. A differential diagnosis could be performed using X-ray images; therefore, accurate and fully automatic jaw lesions image segmentation is a challenging and essential task. The aim of this work was to develop a novel, fully automatic and effective method for jaw lesions in panoramic X-ray image segmentation.

This book presents selected proceedings of the annual convention of the Computer Society of India. Divided into 10 topical volumes, the proceedings present papers on state-of-the-art research, surveys, and succinct reviews. They cover diverse topics ranging from communications networks to big data analytics, and from system architecture to cyber security. This book focuses on Software Engineering, and informs readers about the state of the art in software engineering by gathering high-quality papers that represent the outcomes of consolidated research and innovations in Software Engineering and related areas. In addition to helping practitioners and researchers understand the chief issues involved in designing, developing, evolving and validating complex software systems, it provides comprehensive information on developing professional careers in Software Engineering. It also provides insights into various research issues such as software reliability, verification and validation, security and extensibility, as well as the latest concepts like component-based development, software-process models, process-driven systems and human-computer collaborative systems.

An authoritative guide to an in-depth analysis of various state-of-the-art data clustering approaches using a range of computational intelligence techniques Recent Advances in Hybrid Metaheuristics for Data Clustering offers a guide to the fundamentals of various metaheuristics and their application to data clustering. Metaheuristics are designed to tackle complex clustering problems where classical clustering algorithms have failed to be either effective or efficient. The authors—noted experts on the topic—provide a text that can aid in the design and development of hybrid metaheuristics to be applied to data clustering. The book includes performance analysis of the hybrid metaheuristics in relationship to their conventional counterparts. In addition to providing a review of data clustering, the authors include in-depth analysis of different optimization algorithms. The text offers a step-by-step guide in the build-up of hybrid metaheuristics and to enhance comprehension. In addition, the book contains a range of real-life case studies and their applications. This important text: Includes performance analysis of the hybrid metaheuristics as related to their conventional counterparts Offers an in-depth analysis of a range of optimization algorithms Highlights a review of data clustering Contains a detailed overview of different standard metaheuristics in current use Presents a step-by-step guide to the build-up of hybrid metaheuristics Offers real-life case studies and applications Written for researchers, students and academics in computer science, mathematics, and engineering, Recent Advances in Hybrid Metaheuristics for Data Clustering provides a text that explores the current data clustering approaches using a range of computational intelligence techniques.

*Sub Pixel Classification Using Remote Sensed Data*

*First International Conference, CIIT 2011, Pune, India, November 7-8, 2011. Proceedings*

*Pattern Recognition And Big Data*

*Fuzzy Robust Statistics for Application to the Fuzzy C-Means Clustering Algorithm*

*A New Weighted Fuzzy C-means Algorithm*

*4th International Conference, RSCTC 2004, Uppsala, Sweden, June 1-5, 2004, Proceedings*