

Fuzzy Systems in Medicine

Klaus-Peter Adlassnig
Department of Medical Computer Sciences
Section on Medical Expert and Knowledge-Based Systems
University of Vienna Medical School
Spitalgasse 23, A-1090 Vienna, Austria
e-mail: kpa@akh-wien.ac.at

Abstract

In the near future, every medical information system will be equipped with a function that provides knowledge-based decision support. Data-driven knowledge-based decision support consists, in the first place, of a medical data-to-concept conversion step and, second, a knowledge base containing medical relationships from medical concepts to decisions. Both, concept and relationship modeling in medicine can be done by using fuzzy sets, fuzzy relationships, and fuzzy decision making algorithms to conserve the inherent fuzziness of medical concepts and medical relationships. Examples of the application of type-n fuzzy sets to model medical concepts and of fuzzy logic, fuzzy decision graphs, fuzzy control, and fuzzy automata in medical diagnosis, interpretative analysis of test results, device control, and data monitoring are given in the present study.

Keywords: Knowledge-Based Methodology, Fuzzy Concepts, Fuzzy Relationships, MedFrame/CADLAG-IV, FuzzyTempToxopert, FuzzyKBWean, FuzzyARDS.

1 Introduction

Patient-specific diagnostic and therapeutic decision support will become a part of every medical information system in the near future [1].

Hospital information systems are being equipped with rule firing mechanisms to automatically generate intelligent alerts, warnings, and recommendations to the attending physician [2-4]. A rule editor with access to medical data dictionaries

allows the user to define rules on contraindication alerts, drug interaction warnings, diagnostic and treatment recommendations, etc.

Some laboratory information systems generate the written laboratory report automatically by means of an intelligent reporting system based on medical knowledge stored in a knowledge base [5,6]. These systems may soon become available on Web servers, thus providing worldwide service for medical laboratories [7,8].

Patient data management systems (PDMSs) in intensive care units (ICUs) try to overcome the flood of information by combining and aggregating individual information items to high-level descriptions of patients' findings [9,10]. These high-level descriptions usually constitute the medical terms used by physicians in communication regarding the patient.

Last but not least, stand-alone as well as integrated, frequently very extensive medical consultation systems, are already able to support the differential diagnostic process in areas such as internal medicine: support that is far-reaching and frequently outperforms the diagnostic ability of the individual physician. This becomes obvious in rare medical cases or in cases of multimorbidity [11-14].

2 Knowledge-Based Systems in Medicine

Medicine naturally applies linguistic concepts to model medical knowledge such as disease descriptions, treatment recommendations, prognostic information, and best medical practice management guidelines. Therefore, statements like "Highly increased amylase activity nearly confirms acute pancreatitis" may be found as part of diagnostic knowledge.

Fuzzy Systems In Medicine

**Horia-Nicolai L Teodorescu, Abraham
Kandel, Lakhmi C. Jain**



Fuzzy Systems In Medicine:

Fuzzy and Neuro-Fuzzy Systems in Medicine Horia-Nicolai L Teodorescu, Abraham Kandel, Lakhmi C. Jain, 2017-11-22 Fuzzy and Neuro Fuzzy Systems in Medicine provides a thorough review of state of the art techniques and practices defines and explains relevant problems as well as provides solutions to these problems After an introduction the book progresses from one topic to another with a linear development from fundamentals to applications Fuzzy Systems in Medicine Piotr S. Szczepaniak, Paulo J.G. Lisboa, 2000-01-24 Provides an introduction to the fundamental concepts of fuzziness together with a compilation of recent advances in the application to medicine The tutorials in the first part of the book range from basic concepts through theoretical frameworks to rule simplification through data clustering methodologies and the design of multivariate rule bases through self learning by mapping fuzzy systems onto neural network structures The case studies which follow are representative of the wide range of applications currently pursued in relation to medicine The majority of applications presented in this book are about bridging the gap between low level sensor measurements and intermediate or high level data representations The book offers a comprehensive perspective from leading authorities world wide and provides a tantalising glimpse into the role of sophisticated knowledge engineering methods in shaping the landscape of medical technology in the future Fuzzy Systems in Medicine Piotr S. Szczepaniak, Paulo J.G. Lisboa, 2012-08-27 Provides an introduction to the fundamental concepts of fuzziness together with a compilation of recent advances in the application to medicine The tutorials in the first part of the book range from basic concepts through theoretical frameworks to rule simplification through data clustering methodologies and the design of multivariate rule bases through self learning by mapping fuzzy systems onto neural network structures The case studies which follow are representative of the wide range of applications currently pursued in relation to medicine The majority of applications presented in this book are about bridging the gap between low level sensor measurements and intermediate or high level data representations The book offers a comprehensive perspective from leading authorities world wide and provides a tantalising glimpse into the role of sophisticated knowledge engineering methods in shaping the landscape of medical technology in the future *Fuzzy and Neuro-Fuzzy Systems in Medicine* Horia-Nicolai L Teodorescu, Abraham Kandel, Lakhmi C. Jain, 2017-11-22 Fuzzy and Neuro Fuzzy Systems in Medicine provides a thorough review of state of the art techniques and practices defines and explains relevant problems as well as provides solutions to these problems After an introduction the book progresses from one topic to another with a linear development from fundamentals to applications **Fuzzy Logic in Medicine** Senen Barro, Roque Marin, 2013-03-20 To say that Fuzzy Logic in Medicine or FLM for short is an important addition to the literature of fuzzy logic and its applications is an understatement Edited by two prominent informaticians Professors S Barro and R Marin it is one of the first books in its field Between its covers FLM presents authoritative expositions of a wide spectrum of medical and biological applications of fuzzy logic ranging from image classification and diagnostics to anaesthesia control and risk

assessment of heart diseases As the editors note in the preface recognition of the relevance of fuzzy set theory and fuzzy logic to biological and medical systems has a long history In this context particularly worthy of note is the pioneering work of Professor Klaus Peter Adlassnig of the University of Vienna School of Medicine However it is only within the past decade that we began to see an accelerating growth in the visibility and importance of publications falling under the rubric of fuzzy logic in medicine and biology a leading example of which is the Journal of the Biomedical Fuzzy Systems Association in Japan Why did it take so long for this to happen First a bit of history

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Intelligent and Adaptive Systems in Medicine Olivier C. L. Haas, Keith J. Burnham, 2008-03-19 Intelligent and adaptive techniques are rapidly being used in all stages of medical treatment from the initial diagnosis to planning delivery and follow up therapy To realize the full potential of these techniques developers and end users must understand both the underlying technology and the specifics of the medical application considered Focus

Fuzziness and Medicine: Philosophical Reflections and Application Systems in Health Care Rudolf Seising, Marco Elio Tabacchi, 2013-03-01 This book is a collection of contributions written by philosophers and scientists active in different fields such as mathematics logics social sciences computer sciences and linguistics They comment on and discuss various parts of and subjects and propositions introduced in the Handbook of Analytical Philosophy of Medicine from Kadem Sadegh Zadeh published by Springer in 2012 This volume reports on the fruitful exchange and debate that arose in the fuzzy community upon the publication of the Handbook This was not only very much appreciated by the community but also seen as a critical starting point for beginning a new discussion The results of this discussion which involved many different perspectives from science and the humanities and was warmly encouraged by Kadem Sadegh Zadeh himself are accurately reported in this volume which is intended to be a critical companion to Kadem Sadegh Zadeh's handbook Rudolf Seising is currently an adjunct researcher at the European Centre for Soft Computing in Mieres Asturias Spain and a college lecturer at the Faculty of History and Arts at the Ludwig Maximilians University of

Munich Germany Marco Elio Tabacchi is currently the Scientific Director of the Italian National Research Survey Organization Demopolis and a research assistant in the Soft Computing Group at University of Palermo Italy Theoretical Advances and Applications of Fuzzy Logic and Soft Computing Oscar Castillo, Patricia Melin, Oscar Montiel Ross, Roberto Sepúlveda Cruz, Witold Pedrycz, 2007-10-10 This book comprises a selection of papers on theoretical advances and applications of fuzzy logic and soft computing from the IFSA 2007 World Congress held in Cancun Mexico June 2007 These papers constitute an important contribution to the theory and applications of fuzzy logic and soft computing methodologies

Fuzzy Logic in Medicine Senén Barro, Roque Marin, 2014-01-15 *Foundations of Evidence-Based Medicine* Milos Jenicek, 2019-09-19 This comprehensive text focuses on reasoning critical thinking and pragmatic decision making in medicine Based on the author s extensive experience and filled with definitions formulae flowcharts and checklists this fully revised second edition continues to provide invaluable guidance to the crucial role that clinical epidemiology plays in the expanding field of evidence based medicine Key Features Considers evidence based medicine as a universal initiative common to all health sciences and professions and all specialties within those disciplines Demonstrates how effective practice is reliant on proper foundations such as clinical and fundamental epidemiology and biostatistics Introduces the reader to basic epidemiological methods meta analysis and decision analysis Shows that structured modern argumentative reasoning is required to build the best possible evidence and use it in practice and research Outlines how to make the most appropriate decisions in clinical care disease prevention and health promotion Presenting a range of topics seldom seen in a single resource the innovative blend of informal logic and structured evidence based reasoning makes this book invaluable for anyone seeking broad in depth and readable coverage of this complex and sometimes controversial field *Hybrid Intelligent Systems in Control, Pattern Recognition and Medicine* Oscar Castillo, Patricia Melin, 2019-11-23 This book describes the latest advances in fuzzy logic neural networks and optimization algorithms as well as their hybrid combinations and their applications in areas such as intelligent control and robotics pattern recognition medical diagnosis time series prediction and optimization of complex problems The book is divided into five main parts The first part proposes new concepts and algorithms based on type 1 and type 2 fuzzy logic and their applications the second explores new concepts and algorithms in neural networks and fuzzy logic applied to recognition The third part examines the theory and practice of meta heuristics in various areas of application while the fourth highlights diverse applications of fuzzy logic neural networks and hybrid intelligent systems in medical contexts Finally the fifth part focuses on applications of fuzzy logic neural networks and meta heuristics to robotics problems New Medical Diagnosis Models Based on Generalized Type-2 Fuzzy Logic Patricia Melin, Emanuel Ontiveros-Robles, Oscar Castillo, 2021-06-03 This book presents different experimental results as evidence of the good results obtained compared with respect to conventional approaches and literature references based on fuzzy logic Nowadays the evolution of intelligence systems for decision making has been reached considerable levels of success as these

systems are getting more intelligent and can be of great help to experts in decision making One of the more important realms in decision making is the area of medical diagnosis and many kinds of intelligence systems provide the expert good assistance to perform diagnosis some of these methods are for example artificial neural networks can be very powerful to find tendencies support vector machines that avoid overfitting problems and statistical approaches e g Bayesian However the present research is focused on one of the most relevant kinds of intelligent systems which are the fuzzy systems The main objective of the present work is the generation of fuzzy diagnosis systems that offer competitive classifiers to be applied in diagnosis systems To generate these systems we have proposed a methodology for the automatic design of classifiers and is focused in the Generalized Type 2 Fuzzy Logic because the uncertainty handling can provide us with the robustness necessary to be competitive with other kinds of methods In addition different alternatives to the uncertainty modeling rules selection and optimization have been explored Besides different experimental results are presented as evidence of the good results obtained when compared with respect to conventional approaches and literature references based on Fuzzy Logic

Medical Imaging: Concepts, Methodologies, Tools, and Applications Management Association, Information Resources,2016-07-18 Medical imaging has transformed the ways in which various conditions injuries and diseases are identified monitored and treated As various types of digital visual representations continue to advance and improve new opportunities for their use in medical practice will likewise evolve Medical Imaging Concepts Methodologies Tools and Applications presents a compendium of research on digital imaging technologies in a variety of healthcare settings This multi volume work contains practical examples of implementation emerging trends case studies and technological innovations essential for using imaging technologies for making medical decisions This comprehensive publication is an essential resource for medical practitioners digital imaging technologists researchers and medical students **Medical Informatics: Concepts, Methodologies, Tools, and Applications** Tan, Joseph,2008-09-30 Provides a collection of medical IT research in topics such as clinical knowledge management medical informatics mobile health and service delivery and gene expression

Intelligent Control Systems Using Computational Intelligence Techniques A.E. Ruano,2005-07-18 Intelligent Control techniques are becoming important tools in both academia and industry Methodologies developed in the field of soft computing such as neural networks fuzzy systems and evolutionary computation can lead to accommodation of more complex processes improved performance and considerable time savings and cost reductions Intelligent Control Systems using Computational Intelligence Techniques details the application of these tools to the field of control systems Each chapter gives an overview of current approaches in the topic covered with a set of the most important references in the field and then details the author's approach examining both the theory and practical applications **Machine Learning with Health Care Perspective** Vishal Jain,Jyotir Moy Chatterjee,2020-03-09 This unique book introduces a variety of techniques designed to represent enhance and empower multi disciplinary and multi institutional machine learning research in

healthcare informatics Providing a unique compendium of current and emerging machine learning paradigms for healthcare informatics it reflects the diversity complexity and the depth and breadth of this multi disciplinary area Further it describes techniques for applying machine learning within organizations and explains how to evaluate the efficacy suitability and efficiency of such applications Featuring illustrative case studies including how chronic disease is being redefined through patient led data learning the book offers a guided tour of machine learning algorithms architecture design and applications of learning in healthcare challenges *Medical Applications of Artificial Intelligence* Arvin Agah,2013-11-06 Enhanced more reliable and better understood than in the past artificial intelligence AI systems can make providing healthcare more accurate affordable accessible consistent and efficient However AI technologies have not been as well integrated into medicine as predicted In order to succeed medical and computational scientists must dev

Scientific Philosophy and Principles in Medicine Zekâi Şen,2022-12-01 Scientific Philosophy and Principles in Medicine is an accessible treatise on the philosophy that guides medical practice It lays the foundation of a multidisciplinary framework behind the development of the medical profession The book presents 10 chapters that cover issues that are frequently encountered by medical professionals in their career philosophical and linguistic principles of rational thought scientific crisp and fuzzy logic diagnostic aspects the history of medicine epistemological concepts approximate reasoning principles of medical wisdom numerical and graphical diagnostics and the collaboration of researchers involved in the fields of engineering and medicine The author of the book brings several years of teaching experience and medical practice into this reference with the goal of integrating principles of scientific philosophy and logic into medical education Readers will understand the process of devising rational diagnostic and treatment approaches that support human health as a generative process that seeks to solve problems through creativity rather than a classical process of following medical protocols This book is intended as a basic reference for medical students teachers and general readers interested in the application of logic philosophy and scientific principles in medicine Computational Intelligence Processing in Medical Diagnosis Manfred Schmitt,Horia-Nicolai Teodorescu,Ashlesha Jain,Ajita Jain,Sandhya Jain,2013-11-11 Computational intelligence techniques are gaining momentum in the medical prognosis and diagnosis This volume presents advanced applications of machine intelligence in medicine and bio medical engineering Applied methods include knowledge bases expert systems neural networks neuro fuzzy systems evolvable systems wavelet transforms and specific internet applications The volume is written in view of explaining to the practitioner the fundamental issues related to computational intelligence paradigms and to offer a fast and friendly managed introduction to the most recent methods based on computer intelligence in medicine

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