

Lecture Notes in Artificial Intelligence

11979

Subseries of Lecture Notes in Computer Science

Series Editors

Randy Goebel

University of Alberta, Edmonton, Canada

Yuzuru Tanaka

Hokkaido University, Sapporo, Japan

Wolfgang Wahlster

DFKI and Saarland University, Saarbrücken, Germany

Founding Editor

Jörg Siekmann

DFKI and Saarland University, Saarbrücken, Germany

More information about this series at <http://www.springer.com/series/1244>

Mar Marcos · Jose M. Juarez · Richard Lenz ·
Grzegorz J. Nalepa · Sławomir Nowaczyk ·
Mor Peleg · Jerzy Stefanowski · Gregor Stiglic (Eds.)


Artificial Intelligence in Medicine


Knowledge Representation and Transparent
and Explainable Systems

AIME 2019 International Workshops, KR4HC/ProHealth and TEAAM
Poznan, Poland, June 26–29, 2019
Revised Selected Papers


Editors

Mar Marcos 
Universitat Jaume I
Castellón, Spain

Richard Lenz 
Friedrich-Alexander-University
of Erlangen-Nuremberg
Erlangen, Germany

Slawomir Nowaczyk 
Halmstad University
Halmstad, Sweden

Jerzy Stefanowski
Poznań University of Technology
Poznan, Poland

Jose M. Juarez 
University of Murcia
Murcia, Spain

Grzegorz J. Nalepa 
Jagiellonian University and AGH University
of Science and Technology
Kraków, Poland

Mor Peleg 
University of Haifa
Haifa, Israel

Gregor Stiglic 
University of Maribor
Maribor, Slovenia

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-030-37445-7 ISBN 978-3-030-37446-4 (eBook)
<https://doi.org/10.1007/978-3-030-37446-4>

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The Artificial Intelligence in Medicine (AIME) society was established in 1986 with the main goals of fostering fundamental and applied research in the application of Artificial Intelligence (AI) techniques to medical care and medical research, and providing a forum for discussing any progress made. For this purpose, a series of AIME conferences have been organized on a biennial basis since 1987. The last edition of the AIME conference was held in Poznan, Poland, in June 2019. Two workshops were organized in conjunction with the AIME 2019 main conference. The first one was the 7th Joint Workshop on Knowledge Representation for Health Care and Process-Oriented Information Systems in Health Care (KR4HC/ProHealth 2019). The second AIME workshop was the First Workshop on Transparent, Explainable and Affective AI in Medical Systems (TEAAM 2019). This volume contains a selection of the best papers presented in the KR4HC/ProHealth 2019 and TEAAM 2019 workshops.

The KR4HC/ProHealth 2019 workshop was the seventh time that two separate research communities merged to address common medical issues, to discuss new trends, and to propose solutions to healthcare issues by means of the integration of knowledge representation and process management technologies. As part of medical informatics, the knowledge-representation for health care (KR4HC) view focuses on representing and reasoning with medical knowledge in computers to support knowledge management, clinical decision-making, healthcare modeling, and simulation. As part of business process management, the process-oriented information systems in healthcare (ProHealth) view focuses on using business process management technology to provide effective solutions for the management of healthcare processes.

In total 13 papers were submitted to the KR4HC/ProHealth 2019 workshop, among which 7 papers were full research papers and 6 were short papers describing preliminary research, position papers, or demonstrations of implemented systems. All submitted papers underwent a single-blind peer-review process, in which each submission was reviewed by at least three Program Committee members. Based on the review reports, the Program Committee chairs accepted a total of 11 papers for oral presentation during the workshop, 5 papers for full presentation (20 minutes), and 6 for short presentation. In addition to oral presentations of accepted papers, the workshop had a keynote speech delivered by Prof. Wojtek Michalowski, from the University of Ottawa (Canada), as well as a final panel discussion with the participation of all attendees. In his keynote speech, Prof. Michalowski covered different aspects related to the use of logic-based approaches for the management of multi-morbid patients. The KR4HC/ProHealth 2019 papers presented in this volume correspond to the works selected for full presentation, which largely coincide with the best-rated papers after the review process.

The TEAAM 2019 workshop aimed to provide a forum for discussing AI approaches that are comprehensive, credible, and trusted in healthcare. Today, the positive

impact of AI techniques in medical care is put under the spotlight regarding clinical responsibilities, the emerging interest in regulations of algorithms, and the need of explanations. Particular attention was also paid to topics such as comprehensive and interpretable knowledge representations, identifications of the most important features in the complex machine learning (ML) models, new visualization approaches, and interactions with humans. This was the main motivation of the first edition of the TEAAM workshop.

The TEAAM 2019 workshop received 10 full paper submissions. All papers were carefully peer reviewed (single-blind review) by at least two experts from the Program Committee. The reviewers judged the overall quality, its novelty, and the relevance to the TEAAM workshop. As a result, 8 papers were finally accepted. Each paper was presented in 20-minute oral presentations. The workshop also had the privilege of hosting the keynote speaker Prof. Marcin Grzegorzec from the University of Lubeck, Germany. Prof. Grzegorzec discussed and shared his experience about human-centred pattern recognition for assistive health technologies. The workshop was concluded by an interesting discussion of participants on the current status and the role of explainable AI/ML in medical systems. The papers presented during the workshop were invited to be extended and improved to form part of this volume.

To conclude, we would like to express our gratitude to the AIME 2019 organization, to the invited keynote speakers for their participation, and to all the members of the Program Committees for their invaluable support in making the KR4HC/ProHealth 2019 and TEAAM 2019 workshops a success. We would also like to extend our gratitude to the EasyChair conference management system for the support provided, and to Springer publisher for the trust placed in this endeavor.

We hope that you will find our selection of papers of the KR4HC/ProHealth 2019 and TEAAM 2019 workshops included in this proceedings volume interesting and stimulating.

November 2019

Mar Marcos
Jose M. Juarez

Organization KR4HC/ProHealth Workshop

Program Committee Chairs

Mor Peleg	University of Haifa, Israel
Mar Marcos	Universitat Jaume I, Spain
Richard Lenz	Friedrich-Alexander-University of Erlangen-Nuremberg, Germany

Program Committee

Luca Anselma	Università di Torino, Italy
Gregor Endler	Friedrich-Alexander-University of Erlangen-Nuremberg, Germany
Jesualdo T. Fernández-Breis	Universidad de Murcia, Spain
David Isern	Universitat Rovira i Virgili, Spain
Vassilis Koutkias	Institute of Applied Biosciences, Greece
Nekane Larburu	Vicomtech, Spain
Giorgio Leonardi	Università del Piemonte Orientale, Italy
Wendy MacCaull	St. Francis Xavier University, Canada
Begoña Martínez-Salvador	Universitat Jaume I, Spain
Martin Michalowski	University of Minnesota, USA
Silvia Miksch	Vienna University of Technology, Austria
Stefania Montani	Università del Piemonte Orientale, Italy
Øystein Nytrø	Norwegian University of Science and Technology, Norway
Leon Osterweil	University of Massachusetts Amherst, USA
Manfred Reichert	University of Ulm, Germany
David Riaño	Universitat Rovira i Virgili, Spain
Brigitte Seroussi	Sorbonne Université, France
Martin Sedlmayr	Dresden University of Technology, Germany
Erez Shalom	Playwork Intelligent Physiotherapy Technology, Israel
Annette Ten Teije	Vrije Universiteit Amsterdam, The Netherlands
Paolo Terenziani	Università del Piemonte Orientale, Italy
Lucinéia Heloisa Thom	Federal University of Rio Grande do Sul, Brazil
Maria Taboada	University of Santiago de Compostela, Spain
Frank van Harmelen	Vrije Universiteit Amsterdam, The Netherlands
Dongwen Wang	Arizona State University, USA

Organization TEAAM Workshop

Program Committee Chairs

Grzegorz J. Nalepa	AGH University of Science and Technology and Jagiellonian University, Poland
Gregor Stiglic	University of Maribor, Slovenia
Sławomir Nowaczyk	Halmstad University, Sweden
Jose M. Juarez	University of Murcia, Spain
Jerzy Stefanowski	Poznan University of Technology, Poland

Program Committee

Martin Atzmueller	University of Tilburg, The Netherlands
Piotr Augustyniak	AGH University of Science and Technology and Jagiellonian University, Poland
Jerzy Błaszczyński	Poznań University of Technology, Poland
David Camacho	Universidad Autonoma de Madrid, Spain
Manuel Campos	University of Murcia, Spain
Alex Freitas	University of Kent, UK
Alejandro Rodríguez González	Universidad Politecnica de Madrid, Spain
Giorgio Leonardi	University Piemonte Orientale, Italy
Peter Lucas	Leiden University, The Netherlands
Agnieszka Ławrynowicz	Poznań University of Technology, Poland
Juan Carlos Nieves	Umeå University, Sweden
Jose Palma	University of Murcia, Spain
Niels Peek	The University of Manchester, UK
Stephen Swift	Brunel University, UK
Allan Tucker	Brunel University, UK

Contents

KR4HC/ProHealth - Joint Workshop on Knowledge Representation for Health Care and Process-Oriented Information Systems in Health Care

A Practical Exercise on Re-engineering Clinical Guideline Models Using Different Representation Languages.	3
<i>Mar Marcos, Cristina Campos, and Begoña Martínez-Salvador</i>	
A Method for Goal-Oriented Guideline Modeling in PROforma and Its Preliminary Evaluation	17
<i>Mor Peleg, Alexandra Kogan, and Samson W. Tu</i>	
Differential Diagnosis of Bacterial and Viral Meningitis Using Dominance-Based Rough Set Approach.	29
<i>Ewelina Gowin, Jerzy Błaszczyński, Roman Słowiński, Jacek Wysocki, and Danuta Januszkiewicz-Lewandowska</i>	
Modelling ICU Patients to Improve Care Requirements and Outcome Prediction of Acute Respiratory Distress Syndrome: A Supervised Learning Approach	39
<i>Mohammed Sayed and David Riaño</i>	
Deep Learning for Haemodialysis Time Series Classification	50
<i>Giorgio Leonardi, Stefania Montani, and Manuel Striani</i>	

TEAAM - Workshop on Transparent, Explainable and Affective AI in Medical Systems

Towards Understanding ICU Treatments Using Patient Health Trajectories. . .	67
<i>Alexander Galozy, Sławomir Nowaczyk, and Anita Sant'Anna</i>	
An Explainable Approach of Inferring Potential Medication Effects from Social Media Data.	82
<i>Keyuan Jiang, Tingyu Chen, Liyuan Huang, Ravish Gupta, Ricardo A. Calix, and Gordon R. Bernard</i>	
Exploring Antimicrobial Resistance Prediction Using Post-hoc Interpretable Methods	93
<i>Bernardo Cánovas-Segura, Antonio Morales, Antonio López Martínez-Carrasco, Manuel Campos, Jose M. Juarez, Lucía López Rodríguez, and Francisco Palacios</i>	

Local vs. Global Interpretability of Machine Learning Models in Type 2 Diabetes Mellitus Screening	108
<i>Leon Kopitar, Leona Cilar, Primož Kocbek, and Gregor Stiglic</i>	
A Computational Framework Towards Medical Image Explanation	120
<i>Xuwen Wang, Yu Zhang, Zhen Guo, and Jiao Li</i>	
A Computational Framework for Interpretable Anomaly Detection and Classification of Multivariate Time Series with Application to Human Gait Data Analysis	132
<i>Erica Ramirez, Markus Wimmer, and Martin Atzmueller</i>	
Self-organizing Maps Using Acoustic Features for Prediction of State Change in Bipolar Disorder	148
<i>Olga Kamińska, Katarzyna Kaczmarek-Majer, Karol Opara, Wit Jakuczun, Monika Dominiak, Anna Antosik-Wójcińska, Łukasz Święcicki, and Olgierd Hryniewicz</i>	
Explainable Machine Learning for Modeling of Early Postoperative Mortality in Lung Cancer.	161
<i>Katarzyna Kobylińska, Tomasz Mikołajczyk, Mariusz Adamek, Tadeusz Orłowski, and Przemysław Biecek</i>	
Author Index	175