

LNAI Series Editors

Randy Goebel

University of Alberta, Edmonton, Canada

Yuzuru Tanaka

Hokkaido University, Sapporo, Japan

Wolfgang Wahlster

DFKI and Saarland University, Saarbrücken, Germany

LNAI Founding Series Editor

Joerg Siekmann

DFKI and Saarland University, Saarbrücken, Germany

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

Ngoc Thanh Nguyen · Elias Pimenidis
Zaheer Khan · Bogdan Trawiński (Eds.)

Computational Collective Intelligence

10th International Conference, ICCCI 2018
Bristol, UK, September 5–7, 2018
Proceedings, Part I

Editors

Ngoc Thanh Nguyen
Faculty of Information Technology
Ton Duc Thang University
Ho Chi Minh City
Vietnam

and

Faculty of Computer Science
and Management
Wrocław University of Science
and Technology
Wrocław
Poland

Elias Pimenidis
Department of Computer Science
and Creative Technologies
University of the West of England
Bristol
UK

Zaheer Khan
Department of Computer Science
and Creative Technologies
University of the West of England
Bristol
UK

Bogdan Trawiński
Faculty of Computer Science
and Management
Wrocław University of Science
and Technology
Wrocław
Poland

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-319-98442-1 ISBN 978-3-319-98443-8 (eBook)
<https://doi.org/10.1007/978-3-319-98443-8>

Library of Congress Control Number: 2018950468

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer Nature Switzerland AG 2018

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, express 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

This volume contains the proceedings of the 10th International Conference on Computational Collective Intelligence (ICCCI 2018), held in Bristol, UK, September 5–7, 2018. The conference was co-organized by the University of the West of England, Bristol, UK, and the Wrocław University of Science and Technology, Poland. The conference was run under the patronage of the IEEE SMC Technical Committee on Computational Collective Intelligence.

Following the successes of the First ICCCI (2009) held in Wrocław, Poland, the Second ICCCI (2010) in Kaohsiung, Taiwan, the Third ICCCI (2011) in Gdynia, Poland, the 4th ICCCI (2012) in Ho Chi Minh City, Vietnam, the 5th ICCCI (2013) in Craiova, Romania, the 6th ICCCI (2014) in Seoul, South Korea, the 7th ICCCI (2015) in Madrid, Spain, the 8th ICCCI (2016) in Halkidiki, Greece, and the 9th ICCCI (2017) in Nicosia, Cyprus, this conference continued to provide an internationally respected forum for scientific research in the computer-based methods of collective intelligence and their applications.

Computational collective intelligence (CCI) is most often understood as a sub-field of artificial intelligence (AI) dealing with soft computing methods that facilitate group decisions or processing knowledge among autonomous units acting in distributed environments. Methodological, theoretical, and practical aspects of CCI are considered as the form of intelligence that emerges from the collaboration and competition of many individuals (artificial and/or natural). The application of multiple computational intelligence technologies such as fuzzy systems, evolutionary computation, neural systems, consensus theory, etc., can support human and other collective intelligence, and create new forms of CCI in natural and/or artificial systems. Three subfields of the application of computational intelligence technologies to support various forms of collective intelligence are of special interest but are not exclusive: the Semantic Web (as an advanced tool for increasing collective intelligence), social network analysis (as the field targeted at the emergence of new forms of CCI), and multi-agent systems (as a computational and modeling paradigm especially tailored to capture the nature of CCI emergence in populations of autonomous individuals).

The ICCCI 2018 conference featured a number of keynote talks and oral presentations, closely aligned to the theme of the conference. The conference attracted a substantial number of researchers and practitioners from all over the world, who submitted their papers for the main track and four special sessions.

The main track, covering the methodology and applications of CCI, included: knowledge engineering and Semantic Web, social network analysis, recommendation methods and recommender systems, agents and multi-agent systems, text processing and information retrieval, data mining methods and applications, decision support and control systems, sensor networks and Internet of Things, as well as computer vision techniques. The special sessions, covering some specific topics of particular interest, included: cooperative strategies for decision-making and optimization, complex

decision systems, machine learning in real-world data, as well as intelligent sustainable smart cities.

We received over 240 submissions from 39 countries all over the world. Each paper was reviewed by two to four members of the international Program Committee (PC) of either the main track or one of the special sessions. Finally, we selected 98 best papers for oral presentation and publication in two volumes of the *Lecture Notes in Artificial Intelligence* series.

We would like to express our thanks to the keynote speakers: Andrew Adamatzky from the University of the West of England, UK, Anthony Pipe from the Bristol Robotics Laboratory, UK, Tadeusz Szuba from the AGH University of Science and Technology, Poland, and Jan Treur from the Vrije Universiteit Amsterdam, The Netherlands, for their world-class plenary speeches.

Many people contributed toward the success of the conference. First, we would like to recognize the work of the PC co-chairs and special sessions organizers for taking good care of the organization of the reviewing process, an essential stage in ensuring the high quality of the accepted papers. The workshop and special session chairs deserve a special mention for the evaluation of the proposals and the organization and coordination of the work of seven special sessions. In addition, we would like to thank the PC members, of the main track and of the special sessions, for performing their reviewing work with diligence. We thank the local Organizing Committee chairs, publicity chair, Web chair, and technical support chair for their fantastic work before and during the conference. Finally, we cordially thank all the authors, presenters, and delegates for their valuable contribution to this successful event. The conference would not have been possible without their support.

Our special thanks are also due to Springer for publishing the proceedings and sponsoring awards, and to all the other sponsors for their kind support.

It is our pleasure to announce that the ICCCI conference series continues to have a close cooperation with the Springer journal *Transactions on Computational Collective Intelligence*, and the IEEE SMC Technical Committee on Transactions on Computational Collective Intelligence.

Finally, we hope that ICCCI 2018 contributed significantly to the academic excellence of the field and will lead to the even greater success of ICCCI events in the future.

September 2018

Ngoc Thanh Nguyen
Elias Pimenidis
Zaheer Khan
Bogdan Trawiński

Organization

Organizing Committee

Honorary Chairs

Pierre Lévy	University of Ottawa, Canada
Cezary Madryas	Wroclaw University of Science and Technology, Poland
Paul Olomolaiye	University of the West of England, UK

General Chairs

Ngoc Thanh Nguyen	Wroclaw University of Science and Technology, Poland
Larry Bull	University of the West of England, UK

Program Chairs

Zaheer Khan	University of the West of England, UK
Costin Badica	University of Craiova, Romania
Edward Szczerbicki	University of Newcastle, Australia
Gottfried Vossen	University of Münster, Germany

Special Session Chairs

Bogdan Trawinski	Wroclaw University of Science and Technology, Poland
Mehmet Aydin	University of the West of England, UK

Doctoral Chair

Emmanuel Ogunshile	University of the West of England, UK
--------------------	---------------------------------------

Organizing Chair

Elias Pimenidis	University of the West of England, UK
-----------------	---------------------------------------

Publicity Chair

Nikolaos Polatidis	University of Brighton, UK
--------------------	----------------------------

Local Organizing Committee

Stewart Green	University of the West of England, UK
Kamran Soomro	University of the West of England, UK
Marcin Jodlowiec	Wroclaw University of Science and Technology, Poland
Marek Krotkiewicz	Wroclaw University of Science and Technology, Poland
Marcin Maleszka	Wroclaw University of Science and Technology, Poland
Krystian Wojtkiewicz	Wroclaw University of Science and Technology, Poland

Web Chair

Jake Hallam University of the West of England, UK

Keynote Speakers

Andrew Adamatzky University of the West of England, UK
 Anthony Pipe Bristol Robotics Laboratory, UK
 Tadeusz Szuba AGH University of Science and Technology, Poland
 Jan Treur Vrije Universiteit Amsterdam, The Netherlands

Special Session Organizers

CSDMO 2018: Special Session Cooperative Strategies for Decision-Making and Optimization

Piotr Jedrzejowicz Gdynia Maritime University, Poland
 Dariusz Barbucha Gdynia Maritime University, Poland

CDS 2018: Special Session on Complex Decision Systems

Alicja Wakulicz-Deja University of Silesia, Poland
 Agnieszka Nowak-Brzezinska University of Silesia, Poland
 Malgorzata Przybyła-Kasperek University of Silesia, Poland

MLRWD 2018: Special Session on Machine Learning in Real-World Data

Krzysztof Kania University of Economics in Katowice, Poland
 Przemysław Juszczak University of Economics in Katowice, Poland
 Jan Kozak University of Economics in Katowice, Poland
 Bogna Zaczyn University of Economics in Katowice, Poland

ISSC 2018: Special Session on Intelligent Sustainable Smart Cities

Libuse Svobodova University of Hradec Kralove, Czech Republic
 Ali Selamat Universiti Teknologi Malaysia, Malaysia
 Petra Maresova University of Hradec Kralove, Czech Republic
 Arkadiusz Kawa Poznan University of Economics and Business, Poland
 Bartłomiej Pieranski Poznan University of Economics and Business, Poland
 Peter Brida University of Zilina, Slovakia

Program Committee

Muhammad Abulaish South Asian University, India
 Sharat Akhoury University of Cape Town, South Africa
 Bashar Al-Shboul University of Jordan, Jordan
 Ana Almeida GECAD-ISEP-IPP, Portugal

Orcan Alpar	University of Hradec Kralove, Czech Republic
Mehmet Emin Aydin	University of the West of England, UK
Thierry Badard	Laval University, Canada
Amelia Badica	University of Craiova, Romania
Costin Badica	University of Craiova, Romania
Hassan Badir	Ecole Nationale des Sciences Appliquees de Tanger, Morocco
Dariusz Barbucha	Gdynia Maritime University, Poland
Leon Bobrowski	Bialystok University of Technology, Poland
Mariusz Boryczka	University of Silesia, Poland
Urszula Boryczka	University of Silesia, Poland
Abdelhamid Bouchachia	Bournemouth University, UK
Peter Brida	University of Zilina, Slovakia
Krisztian Buza	Budapest University of Technology and Economics, Hungary
Aleksander Byrski	AGH University of Science and Technology, Poland
Jose Luis Calvo-Rolle	University of A Coruna, Spain
David Camacho	Universidad Autonoma de Madrid, Spain
Alberto Cano	Virginia Commonwealth University, USA
Frantisek Capkovic	Institute of Informatics, Slovak Academy of Sciences, Slovakia
Richard Chbeir	University of Pau and Pays de l'Adour, France
Shyi-Ming Chen	National Taiwan University of Science and Technology, Taiwan
Amine Chohra	Paris East University (UPEC), France
Kazimierz Choros	Wroclaw University of Science and Technology, Poland
Mihaela Colhon	University of Craiova, Romania
Jose Alfredo Ferreira Costa	Universidade Federal do Rio Grande do Norte, Brazil
Ireneusz Czarnowski	Gdynia Maritime University, Poland
Paul Davidsson	Malmo University, Sweden
Tien V. Do	Budapest University of Technology and Economics, Hungary
Nadia Essoussi	University of Tunis, Tunisia
Rim Faiz	University of Carthage, Tunisia
Faiez Gargouri	University of Sfax, Tunisia
Mauro Gaspari	University of Bologna, Italy
Janusz Getta	University of Wollongong, Australia
Daniela Gifu	Alexandru Ioan Cuza University, Romania
Daniela Godoy	ISISTAN Research Institute, Argentina
Antonio Gonzalez-Pardo	Universidad Autonoma de Madrid, Spain
Manuel Grana	University of the Basque Country, Spain
Foteini Grivokostopoulou	University of Patras, Greece
Marcin Hernes	Wroclaw University of Economics, Poland
Huu Hanh Hoang	Hue University, Vietnam

Tzung-Pei Hong	National University of Kaohsiung, Taiwan
Mong-Fong Horng	National Kaohsiung University of Applied Sciences, Taiwan
Frédéric Hubert	Laval University, Canada
Maciej Huk	Wroclaw University of Science and Technology, Poland
Zbigniew Huzar	Wroclaw University of Science and Technology, Poland
Dosam Hwang	Yeungnam University, South Korea
Lazaros Iliadis	Democritus University of Thrace, Greece
Agnieszka Indyka-Piasecka	Wroclaw University of Science and Technology, Poland
Dan Istrate	Universite de Technologie de Compiègne, France
Mirjana Ivanovic	University of Novi Sad, Serbia
Jaroslav Jankowski	West Pomeranian University of Technology, Szczecin, Poland
Joanna Jedrzejowicz	University of Gdansk, Poland
Piotr Jedrzejowicz	Gdynia Maritime University, Poland
Gordan Jezic	University of Zagreb, Croatia
Geun Sik Jo	Inha University, South Korea
Kang-Hyun Jo	University of Ulsan, South Korea
Jason Jung	Chung-Ang University, South Korea
Tomasz Kajdanowicz	Wroclaw University of Science and Technology, Poland
Petros Kefalas	University of Sheffield, Greece
Rafal Kern	Wroclaw University of Science and Technology, Poland
Zaheer Khan	University of the West of England, UK
Marek Kisiel-Dorohinicki	AGH University of Science and Technology, Poland
Attila Kiss	Eötvös Loránd University, Hungary
Marek Kopel	Wroclaw University of Science and Technology, Poland
Leszek Koszalka	Wroclaw University of Science and Technology, Poland
Leszek Kotulski	AGH University of Science and Technology, Poland
Ivan Koychev	University of Sofia St. Kliment Ohridski, Bulgaria
Jan Kozak	University of Economics in Katowice, Poland
Adrianna Kozierekiewicz	Wroclaw University of Science and Technology, Poland
Bartosz Krawczyk	Virginia Commonwealth University, USA
Ondrej Krejcar	University of Hradec Kralove, Czech Republic
Dalia Kriksciuniene	Vilnius University, Lithuania
Dariusz Krol	Wroclaw University of Science and Technology, Poland
Marek Krotkiewicz	Wroclaw University of Science and Technology, Poland
Elzbieta Kukla	Wroclaw University of Science and Technology, Poland
Julita Kulbacka	Wroclaw Medical University, Poland
Marek Kulbacki	Polish-Japanese Academy of Information Technology, Poland
Piotr Kulczycki	Polish Academy of Science, Systems Research Institute, Poland
Kazuhiro Kuwabara	Ritsumeikan University, Japan
Halina Kwasnicka	Wroclaw University of Science and Technology, Poland

Mark Last	Ben-Gurion University of the Negev, Israel
Hoai An Le Thi	Universite de Lorraine, France
Florin Leon	Gheorghe Asachi Technical University of Iasi, Romania
Edwin Lughofer	Johannes Kepler University Linz, Austria
Juraj Machaj	University of Zilina, Slovakia
Bernadetta Maleszka	Wroclaw University of Science and Technology, Poland
Marcin Maleszka	Wroclaw University of Science and Technology, Poland
Yannis Manolopoulos	Aristotle University of Thessaloniki, Greece
Urszula Markowska-Kaczmar	Wroclaw University of Science and Technology, Poland
Adam Meissner	Poznan University of Technology, Poland
Héctor Menéndez	University College London, UK
Mercedes Merayo	Universidad Complutense de Madrid, Spain
Jacek Mercik	WSB University in Wroclaw, Poland
Radoslaw Michalski	Wroclaw University of Science and Technology, Poland
Peter Mikulecky	University of Hradec Kralove, Czech Republic
Javier Montero	Universidad Complutense de Madrid, Spain
Ahmed Moussa	Universite Abdelmalek Essaadi, Morocco
Dariusz Mrozek	Silesian University of Technology, Poland
Kazumi Nakamatsu	University of Hyogo, Japan
Grzegorz J. Nalepa	AGH University of Science and Technology, Poland
Fulufhelo Nelwamondo	Council for Scientific and Industrial Research, South Africa
Filippo Neri	University of Naples Federico II, Italy
Linh Anh Nguyen	University of Warsaw, Poland
Loan T. T. Nguyen	Nguyen Tat Thanh University, Vietnam
Adam Niewiadomski	Lodz University of Technology, Poland
Agnieszka Nowak-Brzezinska	University of Silesia, Poland
Alberto Núñez	Universidad Complutense de Madrid, Spain
Manuel Núñez	Universidad Complutense de Madrid, Spain
Tarkko Oksala	Aalto University, Finland
Mieczyslaw Owoc	Wroclaw University of Economics, Poland
Marcin Paprzycki	Systems Research Institute, Polish Academy of Sciences, Poland
Marek Penhaker	VSB -Technical University of Ostrava, Czech Republic
Isidoros Perikos	University of Patras, Greece
Marcin Pietranik	Wroclaw University of Science and Technology, Poland
Elias Pimenidis	University of the West of England, UK
Nikolaos Polatidis	University of Brighton, UK
Piotr Porwik	University of Silesia, Poland
Radu-Emil Precup	Politehnica University of Timisoara, Romania
Ales Prochazka	University of Chemistry and Technology, Czech Republic
Paulo Quaresma	Universidade de Evora, Portugal
Mohammad Rashedur Rahman	North South University, Bangladesh

Ewa Ratajczak-Ropel	Gdynia Maritime University, Poland
Tomasz M. Rutkowski	University of Tokyo, Japan
Virgilijus Sakalauskas	Vilnius University, Lithuania
Jose L. Salmeron	University Pablo de Olavide, Spain
Ali Selamat	Universiti Teknologi Malaysia, Malaysia
Andrzej Sieminski	Wroclaw University of Science and Technology, Poland
Dragan Simic	University of Novi Sad, Serbia
Vladimir Sobeslav	University of Hradec Kralove, Czech Republic
Stanimir Stoyanov	University of Plovdiv Paisii Hilendarski, Bulgaria
Yasufumi Takama	Tokyo Metropolitan University, Japan
Zbigniew Telec	Wroclaw University of Science and Technology, Poland
Diana Trandabat	University Alexandru Ioan Cuza of Iasi, Romania
Bogdan Trawinski	Wroclaw University of Science and Technology, Poland
Jan Treur	Vrije Universiteit Amsterdam, The Netherlands
Maria Trocan	Institut Supérieur d'Electronique de Paris, France
Krzysztof Trojanowski	Cardinal Stefan Wyszyński University in Warsaw, Poland
Ualsher Tukeyev	Al-Farabi Kazakh National University, Kazakhstan
Olgierd Unold	Wroclaw University of Science and Technology, Poland
Bay Vo	Ho Chi Minh City University of Technology, Vietnam
Lipo Wang	Nanyang Technological University, Singapore
Izabela Wierzbowska	Gdynia Maritime University, Poland
Krzysztof Wojtkiewicz	Wroclaw University of Science and Technology, Poland
Slawomir Zadrozny	Systems Research Institute, Polish Academy of Sciences, Poland
Danuta Zakrzewska	Lodz University of Technology, Poland
Constantin-Bala Zamfirescu	Lucian Blaga University of Sibiu, Romania
Katerina Zdravkova	St. Cyril and Methodius University, Macedonia
Aleksander Zgrzywa	Wroclaw University of Science and Technology, Poland
Adam Ziebinski	Silesian University of Technology, Poland
Drago Zagar	University of Osijek, Croatia

Special Session Program Committees

CSDMO 2018: Special Session Cooperative Strategies for Decision - Making and Optimization

Dariusz Barbucha	Gdynia Maritime University, Poland
Vincenzo Cutello	University of Catania, Italy
Ireneusz Czarnowski	Gdynia Maritime University, Poland
Joanna Jedrzejowicz	Gdansk University, Poland
Piotr Jedrzejowicz	Gdynia Maritime University, Poland
Edyta Kucharska	AGH University of Science and Technology, Poland
Antonio D. Masegosa	University of Deusto, Spain
Javier Montero	Complutense University of Madrid, Spain
Ewa Ratajczak-Ropel	Gdynia Maritime University, Poland

Iza Wierzbowska
Mahdi Zargayouna

Gdynia Maritime University, Poland
IFSTTAR, France

CDS 2018: Special Session on Complex Decision Systems

Alicja Wakulicz-Deja	University of Silesia, Katowice, Poland
Grzegorz Baron	Silesian University of Technology, Gliwice, Poland
Rafal Deja	Academy of Business in Dabrowa Gornicza, Poland
Michal Draminski	Institute of Computer Science, Polish Academy of Sciences, Warsaw, Poland
Agnieszka Duraj	Lodz University of Technology, Poland
Katarzyna Harezlak	Silesian University of Technology, Gliwice, Poland
Michal Kozielski	Silesian University of Technology, Gliwice, Poland
Dariusz Mrozek	Silesian University of Technology, Gliwice, Poland
Bozena Malysiak-Mrozek	Silesian University of Technology, Gliwice, Poland
Agnieszka Nowak-Brzezinska	University of Silesia, Katowice, Poland
Malgorzata Przybyla-Kasperek	University of Silesia, Katowice, Poland
Roman Siminski	University of Silesia, Katowice, Poland
Urszula Stanczyk	Silesian University of Technology, Gliwice, Poland
Beata Zielosko	University of Silesia, Katowice, Poland
Tomasz Xieski	University of Silesia, Katowice, Poland

MLRWD 2018: Special Session on Machine Learning in Real-World Data

Franciszek Bialas	University of Economics in Katowice, Poland
Grzegorz Dzikowski	University of Economics in Katowice, Poland
Marcin Grzegorzek	University of Siegen, Germany
Ignacy Kaliszewski	Systems Research Institute, Polish Academy of Sciences, Poland
Krzysztof Kania	University of Economics in Katowice, Poland
Jan Kozak	University of Economics in Katowice, Poland
Przemyslaw Juszczuk	University of Economics in Katowice, Poland
Janusz Miroforidis	Systems Research Institute, Polish Academy of Sciences, Poland
Agnieszka Nowak-Brzezinska	University of Silesia, Poland
Dmitry Podkopaev	Systems Research Institute, Polish Academy of Sciences, Poland
Malgorzata Przybyla-Kasperek	University of Silesia, Poland
Tomasz Stas	University of Economics in Katowice, Poland
Magdalena Tkacz	University of Silesia, Poland
Bogna Zacny	University of Economics in Katowice, Poland

ISSC 2018: Special Session on Intelligent Sustainable Smart Cities

Costin Badica	University of Craiova, Romania
Peter Bracinik	University of Zilina, Slovakia
Peter Brida	University of Zilina, Slovakia
Davor Dujak	University of Osijek, Croatia
Martina Hedvicakova	University of Hradec Kralove, Czech Republic
Marek Hoger	University of Zilina, Slovakia
Petra Maresova	University of Hradec Kralove, Czech Republic
Hana Mohelska	University of Hradec Kralove, Czech Republic
Arkadiusz Kawa	Poznan University of Economics and Business, Poland
Waldemar Koczkodaj	Laurentian University, Canada
Ondrej Krejcar	University of Hradec Kralove, Czech Republic
Martina Latkova	University of Zilina, Slovakia
Juraj Machaj	University of Zilina, Slovakia
Miroslava Mikusova	University of Zilina, Slovakia
Jaroslav Olejniczak	Wroclaw University of Economics, Poland
Pawel Piatkowski	Poznan University of Technology, Poland
Bartlomiej Pieranski	Poznan University of Economics and Business, Poland
Petra Poulova	University of Hradec Kralove, Czech Republic
Michal Regula	University of Zilina, Slovakia
Marek Roch	University of Zilina, Slovakia
Carlos Andres Romano	Polytechnic University of Valencia, Spain
Ali Selamat	Universiti Teknologi Malaysia, Malaysia
Marcela Sokolova	University of Hradec Kralove, Czech Republic
Libuse Svobodova	University of Hradec Kralove, Czech Republic
Emese Tokarcikova	University of Zilina, Slovakia
Hana Tomaskova	University of Hradec Kralove, Czech Republic
Marek Vokoun	Institute of Technology and Business in Ceske Budejovice, Czech Republic

Contents – Part I

Knowledge Engineering and Semantic Web

ViewpointS: Towards a Collective Brain	3
<i>Philippe Lemoisson and Stefano A. Cerri</i>	
Intelligent Collectives: Impact of Diversity on Susceptibility to Consensus and Collective Performance	13
<i>Van Du Nguyen, Hai Bang Truong, Mercedes G. Merayo, and Ngoc Thanh Nguyen</i>	
The Increasing Bias of Non-uniform Collectives	23
<i>Marcin Maleszka</i>	
Framework for Merging Probabilistic Knowledge Bases.	31
<i>Van Tham Nguyen, Ngoc Thanh Nguyen, and Trong Hieu Tran</i>	
Representation of Autoimmune Diseases with RDFS	43
<i>Martina Husáková</i>	
EVENTSKG: A Knowledge Graph Representation for Top-Prestigious Computer Science Events Metadata	53
<i>Said Fathalla and Christoph Lange</i>	
Assessing the Performance of a New Semantic Similarity Measure Designed for Schema Matching for Mediation Systems	64
<i>Aola Yousfi, Moulay Hafid Elyazidi, and Ahmed Zellou</i>	
The Impact of Data Dispersion on the Accuracy of the Data Warehouse Federation’s Response.	75
<i>Rafał Kern</i>	

Social Network Analysis

Physical Activity Contagion and Homophily in an Adaptive Social Network Model.	87
<i>Marit van Dijk and Jan Treur</i>	
e-School: Design and Implementation of Web Based Teaching Institution for Enhancing E-Learning Experiences.	99
<i>Md. Shohel Rana, Touhid Bhuiyan, and A. K. M. Zaidi Satter</i>	

Categorizing Air Quality Information Flow on Twitter Using Deep Learning Tools	109
<i>Brigitte Juanals and Jean-Luc Minel</i>	
A Computational Network Model for the Effects of Certain Types of Dementia on Social Functioning	119
<i>Charlotte Commu, Jan Treur, Annemieke Dols, and Yolande A. L. Pijnenburg</i>	
Homophily Independent Cascade Diffusion Model Based on Textual Information	134
<i>Thi Kim Thoa Ho, Quang Vu Bui, and Marc Bui</i>	
A Semi-automated Security Advisory System to Resist Cyber-Attack in Social Networks	146
<i>Samar Muslah Albladi and George R. S. Weir</i>	
The Role of Mapping Curve in Swarm-Like Opinion Formation	157
<i>Tomasz M. Gwizdała</i>	
Popularity and Geospatial Spread of Trends on Twitter: A Middle Eastern Case Study	167
<i>Nabeel Albishry, Tom Crick, Tesleem Fagade, and Theo Tryfonas</i>	
On the Emergence of Segregation in Society: Network-Oriented Analysis of the Effect of Evolving Friendships	178
<i>Christianne Kappert, Rosalyn Rus, and Jan Treur</i>	
Computational Analysis of Bullying Behavior in the Social Media Era	192
<i>Fakhra Jabeen and Jan Treur</i>	
Recommendation Methods and Recommender Systems	
A Hybrid Feature Combination Method that Improves Recommendations.	209
<i>Gharbi Alshammari, Stelios Kapetanakis, Abduallah Alshammari, Nikolaos Polatidis, and Miltos Petridis</i>	
A Neural Learning-Based Clustering Model for Collaborative Filtering	219
<i>Grzegorz P. Mika and Grzegorz Dzikowski</i>	
Influence Power Factor for User Interface Recommendation System	228
<i>Marek Krótkiewicz, Krystian Wojtkiewicz, and Denis Martins</i>	
A Generic Framework for Collaborative Filtering Based on Social Collective Recommendation	238
<i>Leschek Homann, Bernadetta Maleszka, Denis Mayr Lima Martins, and Gottfried Vossen</i>	

Recommender System Based on Fuzzy Reasoning and Information Systems. . . <i>Martin Tabakov</i>	248
Proposal of a Recommendation System for Complex Topic Learning Based on a Sustainable Design Approach. <i>Xanat Vargas Meza and Toshimasa Yamanaka</i>	260
A Group Recommender System for Selecting Experts to Review a Specific Problem <i>Dinh Tuyen Hoang, Ngoc Thanh Nguyen, and Dosam Hwang</i>	270
Agents and Multi-Agent Systems	
An Agent-Based Collective Model to Simulate Peer Pressure Effect on Energy Consumption. <i>Fatima Abdallah, Shadi Basurra, and Mohamed Medhat Gaber</i>	283
Agents' Knowledge Conflicts' Resolving in Cognitive Integrated Management Information System – Case of Budgeting Module. <i>Marcin Hernes, Anna Chojnacka-Komorowska, Adrianna Kozierkiewicz, and Marcin Pietranik</i>	297
Agent-Based Decision-Information System Supporting Effective Resource Management of Companies <i>Jaroslav Kožlak, Bartłomiej Śnieżyński, Dorota Wilk-Kołodziejczyk, Stanisława Kluska-Nawarecka, Krzysztof Jaśkowiec, and Małgorzata Żabińska</i>	309
Evolutionary Multi-Agent System in Planning of Marine Trajectories <i>Maciej Gawel, Tomasz Jakubek, Aleksander Byrski, Marek Kisiel-Dorohinicki, Kamil Pietak, and Daniel Hernandez</i>	319
Airplane Boarding Strategies Using Agent-Based Modeling and Grey Analysis. <i>Camelia Delcea, Liviu-Adrian Cotfas, and Ramona Paun</i>	329
Agent-Based Optimization of the Emergency Exits and Desks Placement in Classrooms <i>Camelia Delcea, Liviu-Adrian Cotfas, and Ramona Paun</i>	340
Agents Interaction and Queueing System Model of Real Time Control of Students Service Center Load Balancing <i>Malika Abdrakhmanova, Galimkair Mutanov, Zhanl Mamykova, and Ualsher Tukeyev</i>	349

Text Processing and Information Retrieval

Handling Concept Drift and Feature Evolution in Textual Data Stream Using the Artificial Immune System	363
<i>Amal Abid, Salma Jamoussi, and Abdelmajid Ben Hamadou</i>	
A Tweet Summarization Method Based on Maximal Association Rules	373
<i>Huyen Trang Phan, Ngoc Thanh Nguyen, and Dosam Hwang</i>	
DBpedia and YAGO Based System for Answering Questions in Natural Language	383
<i>Tomasz Boliński, Julian Szymański, Bartłomiej Dudek, Paweł Zalewski, Szymon Dompke, and Maria Czarnecka</i>	
Bidirectional LSTM for Author Gender Identification	393
<i>Bassem Bsir and Mounir Zrigui</i>	
A New Text Semi-supervised Multi-label Learning Model Based on Using the Label-Feature Relations	403
<i>Quang-Thuy Ha, Thi-Ngan Pham, Van-Quang Nguyen, Minh-Chau Nguyen, Thanh-Huyen Pham, and Tri-Thanh Nguyen</i>	

Sensor Networks and Internet of Things

A DC Programming Approach for Worst-Case Secrecy Rate Maximization Problem.	417
<i>Phuong Anh Nguyen and Hoai An Le Thi</i>	
System for Detailed Monitoring of Dog's Vital Functions	426
<i>David Sec, Jan Matyska, Blanka Klimova, Richard Cimler, Jitka Kuhnova, and Filip Studnicka</i>	
Driver Supervisor System with Telegram Bot Platform	436
<i>Emir Husni and Faisal Hasibuan</i>	
Multi-agent Base Evacuation Support System Using MANET.	445
<i>Shohei Taga, Tomofumi Matsuzawa, Munehiro Takimoto, and Yasushi Kambayashi</i>	
Analysis of Software Routing Solution Based on Mini PC Platform for IoT . . .	455
<i>Josef Horalek and Vladimir Sobeslav</i>	

Data Mining Methods and Applications

SVM Parameter Optimization Using Swarm Intelligence for Learning from Big Data	469
<i>Yongquan Xie, Yi Lu Murphey, and Dev S. Kochhar</i>	

A CNN Model with Data Imbalance Handling for Course-Level Student Prediction Based on Forum Texts	479
<i>Phuc Hua Gia Nguyen and Chau Thi Ngoc Vo</i>	
Purity and Out of Bag Confidence Metrics for Random Forest Weighting . . .	491
<i>Mandlenkosi Victor Gwetu, Serestina Viriri, and Jules-Raymond Tapamo</i>	
A New Computational Method for Solving Fully Fuzzy Nonlinear Systems . . .	503
<i>Raheleh Jafari, Sina Razvarz, and Alexander Gegov</i>	
Facial Expression Recognition: A Survey on Local Binary and Local Directional Patterns	513
<i>Kennedy Chengeta and Serestina Viriri</i>	
Energy-Based Centroid Identification and Cluster Propagation with Noise Detection	523
<i>Alexander Krassovitskiy and Rustam Mussabayev</i>	
An Approach to Property Valuation Based on Market Segmentation with Crisp and Fuzzy Clustering	534
<i>Adrian Malinowski, Mateusz Piwowarczyk, Zbigniew Telec, Bogdan Trawiński, Olgierd Kempa, and Tadeusz Lasota</i>	
Predicting Solar Intensity Using Cluster Analysis	549
<i>Waseem Ahmad, Sahil Sahil, and Aftab Mughal</i>	
Author Index	561

Contents – Part II

Decision Support and Control Systems

Design of Recursive Digital Filters with Penalized Spline Method.	3
<i>Elena Kochegurova, Ivan Khozhaev, and Tatyana Ezangina</i>	
An Adaptive Temporal-Causal Network Model for Decision Making Under Acute Stress	13
<i>Jan Treur and S. Sahand Mohammadi Ziabari</i>	
Chess Problem: CSA Algorithm Based on Simulated Annealing and Experimentation System.	26
<i>Jakub Klikowski, Lukasz Karnicki, Martyna Poslednik, Leszek Koszalka, Iwona Pozniak-Koszalka, and Andrzej Kasprzak</i>	
Single Machine Weighted Tardiness Problem: An Algorithm and Experimentation System.	36
<i>Kacper Petrynski, Robert Szost, Iwona Pozniak-Koszalka, Leszek Koszalka, and Andrzej Kasprzak</i>	
Large-Scale Evolutionary Optimization Using Multi-Layer Strategy Differential Evolution	45
<i>Tarik Eltaeib and Ausif Mahmood</i>	
OPC UA Communication Traffic Control for Analogue Values in an Automation Device with Embedded OPC UA Servers	56
<i>Olav Sande and Marcin Fojcik</i>	
Application of Decision Trees for Quality Management Support	67
<i>Rafal Cupek, Adam Ziebinski, and Marek Drewniak</i>	
Heuristic Algorithm for a Personalised Student Timetable	79
<i>Dalibor Cimr and Josef Hynek</i>	
A Flexible Evolutionary Algorithm for Task Allocation in Multi-robot Team	89
<i>Muhammad Usman Arif and Sajjad Haider</i>	
Predictive Memetic Algorithm (PMA) for Combinatorial Optimization in Dynamic Environments	100
<i>Stephen M. Akandwanaho and Serestina Viriri</i>	

Modeling Competitive Game Players with a Positioning Strategy in the Great Turtle Race.	111
<i>Michał Przybylski and Dariusz Król</i>	
Proposition of a BDI-Based Distributed Partitioning Approach for a Multirobot System.	121
<i>Nourchene Ben Slimane and Moncef Tagina</i>	
Diversifying Search in Bee Algorithms for Numerical Optimisation.	132
<i>Muharrem Düğenci and Mehmet Emin Aydin</i>	
Solving the Quadratic Assignment Problem (QAP) Through a Fine-Grained Parallel Genetic Algorithm Implemented on GPUs	145
<i>Roberto Poveda and Jonatan Gómez</i>	
A New Distance Function for Consensus Determination in Decision Support Systems	155
<i>Marcin Hernes, Jadwiga Sobieska-Karpińska, Adrianna Kozierkiewicz, and Marcin Pietranik</i>	
Cooperative Strategies for Decision Making and Optimization	
Hitchcock Birds Inspired Algorithm	169
<i>Reinaldo G. Morais, Luiza M. Mourelle, and Nadia Nedjah</i>	
Solving DVRPTW by a Multi-agent System with Vertical and Horizontal Cooperation	181
<i>Dariusz Barbucha</i>	
Cluster-Based Instance Selection for the Imbalanced Data Classification	191
<i>Ireneusz Czarnowski and Piotr Jędrzejowicz</i>	
Building Collaboration in Multi-agent Systems Using Reinforcement Learning.	201
<i>Mehmet Emin Aydin and Ryan Fellows</i>	
The Shapley Value for Multigraphs.	213
<i>Stefan Forlicz, Jacek Mercik, Izabella Stach, and David Ramsey</i>	
Group Affect in Complex Decision-Making: Theory and Formalisms from Psychology and Computer Science	222
<i>Amine Chohra, Kurosh Madani, and Chantal Natalie van der Wal</i>	
Parallel GEP Ensemble for Classifying Big Datasets	234
<i>Joanna Jędrzejowicz, Piotr Jędrzejowicz, and Izabela Wierzbowska</i>	

A-Team Solving Distributed Resource-Constrained Multi-project Scheduling Problem.	243
<i>Piotr Jedrzejowicz and Ewa Ratajczak-Ropel</i>	

Complex Decision Systems

Solving the Uncapacitated Traveling Purchaser Problem with the MAX–MIN Ant System	257
<i>Rafał Skinderowicz</i>	
Experimental Implementation of Web-Based Knowledge Base Verification Module	268
<i>Roman Simiński, Agnieszka Nowak-Brzezińska, and Michał Simiński</i>	
Methods of Rule Clusters’ Representation in Domain Knowledge Bases	279
<i>Agnieszka Nowak-Brzezińska</i>	
Different Methods for Cluster’s Representation and Their Impact on the Effectiveness of Searching Through Such a Structure.	290
<i>Tomasz Xięski and Agnieszka Nowak-Brzezińska</i>	
Comparison of Dispersed Decision Systems with Pawlak Model and with Negotiation Stage in Terms of Five Selected Fusion Methods	301
<i>Małgorzata Przybyła-Kasperek</i>	
Optimized Algorithm for Node Address Assigning in a Large-Scale Smart Automation Environment	311
<i>David Sec, Dalibor Cimr, Jan Stepan, Richard Cimler, and Jitka Kuhnova</i>	
A System to Evaluate an Air-Strike Threat Level Using Fuzzy Methods	322
<i>Dalibor Cimr, Hana Tomaskova, Richard Cimler, Jitka Kuhnova, and Vlastimil Slouf</i>	

Machine Learning in Real-World Data

Ant Colony Optimization Algorithms in the Problem of Predicting the Efficiency of the Bank Telemarketing Campaign	335
<i>Jan Kozak and Przemysław Juszczuk</i>	
Investigating Patterns in the Financial Data with Enhanced Symbolic Description	345
<i>Krzysztof Kania, Przemysław Juszczuk, and Jan Kozak</i>	
The Mechanism to Predict Folders in Automatic Classification Email Messages to Folders in the Mailboxes	355
<i>Barbara Probiez</i>	

On XLE Index Constituents' Social Media Based Sentiment Informing the Index Trend and Volatility Prediction.	366
<i>Frédéric Maréchal, Daniel Stamate, Rapheal Olaniyan, and Jiri Marek</i>	
Evaluation of Tree Based Machine Learning Classifiers for Android Malware Detection	377
<i>Md. Shohel Rana, Sheikh Shah Mohammad Motiur Rahman, and Andrew H. Sung</i>	
Review on General Techniques and Packages for Data Imputation in R on a Real World Dataset.	386
<i>Fitore Muharemi, Doina Logofătu, and Florin Leon</i>	

Intelligent Sustainable Smart Cities

Project Management Model with Designed Data Flow Diagram: The Case of ICT Hybrid Learning of Elderly People in the Czech Republic . . .	399
<i>Libuše Svobodová and Miloslava Černá</i>	
Web Portals to Support Financial Literacy in Blended Learning in the Czech Republic	409
<i>Martina Hedvicakova and Libuše Svobodová</i>	
Use of Smart Technologies for Hybrid Learning as a Way to Educate People Became Full Smart Cities Residents	419
<i>Libuše Svobodová and Martina Hedvicakova</i>	
Technological and Economical Context of Renewable and Non-renewable Energy in Electric Mobility in Slovakia and Hungary	429
<i>Miroslava Mikušová, Adam Torok, and Peter Brída</i>	
Development of Self-sufficient Floating Cities with Renewable Resources . . .	437
<i>Ayca Kirimtat and Ondrej Krejcar</i>	
Energy-Daylight Optimization of Louvers Design in Buildings	447
<i>Ayca Kirimtat and Ondrej Krejcar</i>	
Automation System Architecture for a Smart Hotel	457
<i>Jan Stepan, Richard Cimler, and Ondrej Krejcar</i>	

Computer Vision Techniques

Ensemble of Texture and Deep Learning Features for Finding Abnormalities in the Gastro-Intestinal Tract	469
<i>Shees Nadeem, Muhammad Atif Tahir, Syed Sadiq Ali Naqvi, and Muhammad Zaid</i>	

Fuzzy Segmentation Driven by Modified ABC Algorithm Using Cartilage Features Completed by Spatial Aggregation: Modeling of Early Cartilage Loss.	479
<i>Jan Kubicek, Iveta Bryjova, Marek Penhaker, David Oczka, Martin Augustynek, and Martin Cerny</i>	
A Case-Based Reasoning Approach to GBM Evolution	489
<i>Ana Mendonça, Joana Pereira, Rita Reis, Victor Alves, António Abelha, Filipa Ferraz, João Neves, Jorge Ribeiro, Henrique Vicente, and José Neves</i>	
Novel Nature-Inspired Selection Strategies for Digital Image Evolution of Artwork	499
<i>Gia Thuan Lam, Kristiyan Balabanov, Doina Logofătu, and Costin Badica</i>	
Video Genre Classification Based on Length Analysis of Temporally Aggregated Video Shots	509
<i>Kazimierz Choroś</i>	
Author Index	519