


Lecture Notes in Business Information Processing

449

Series Editors

Wil van der Aalst 

RWTH Aachen University, Aachen, Germany

John Mylopoulos 

University of Trento, Trento, Italy

Sudha Ram 

University of Arizona, Tucson, AZ, USA

Michael Rosemann 

Queensland University of Technology, Brisbane, QLD, Australia

Clemens Szyperski

Microsoft Research, Redmond, WA, USA

More information about this series at <https://link.springer.com/bookseries/7911>

Mohamed Fakir · Mohamed Baslam ·
Rachid El Ayachi (Eds.)

Business Intelligence

7th International Conference, CBI 2022
Khouribga, Morocco, May 26–28, 2022
Proceedings

Editors

Mohamed Fakir 
Sultan Moulay Slimane University
Beni-Mellal, Morocco

Mohamed Baslam 
Sultan Moulay Slimane University
Beni Mellal, Morocco

Rachid El Ayachi 
Sultan Moulay Slimane University
Beni-Mellal, Morocco

ISSN 1865-1348 ISSN 1865-1356 (electronic)
Lecture Notes in Business Information Processing
ISBN 978-3-031-06457-9 ISBN 978-3-031-06458-6 (eBook)
<https://doi.org/10.1007/978-3-031-06458-6>

© Springer Nature Switzerland AG 2022

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

In 2022 we had the great opportunity to organize the 7th edition of the International Conference on Business Intelligence (CBI 2022). The conference has grown to be a reputable event for the scientific and business communities. This book of proceedings collects papers accepted for presentation at CBI 2022.

CBI 2022 was organized by the Faculty of Sciences and Techniques (FST) and the laboratory of Information Processing and Decision Support (TIAD) at Sultan Moulay Slimane University along with the Association of Business Intelligence (AMID), and held during May 26–28, 2022, in Khouribga, Morocco.

For this edition, we received 68 submissions, which were reviewed by a Program Committee of 72 international experts in various fields related to business intelligence and decision support. Out of these submissions, the Program Committee decided to accept 23 regular papers, yielding an acceptance rate of 33.8%. The contributions are organized in topical sections: Decision Support and Artificial Intelligence; Business Intelligence and Database; and Optimization and Dynamic Programming.

As program chairs of CBI 2022 and editors of these proceedings, we would like to thank the President of Sultan Moulay Slimane University and the Dean of the Faculty of Sciences and Techniques for their support to the conference. In addition, we want to warmly thank again all the authors for their high-quality contributions and all the Program Committee members for their invaluable hard work. We also sincerely thank our keynote speakers for sharing their precious insights and expertise. Finally, our special thanks go to the Organizing Committee and to all the local arrangements coordinators. We cordially invite you to visit the CBI website at <https://www.cbi-bm.com/> and to join us at future CBI conferences.

April 2022

Mohamed Fakir
Mohamed Baslam
Rachid El Ayachi

Organization

General Chair

Mohamed Fakir

Sultan Moulay Slimane University, Morocco

Program Chairs

Mohamed Baslam

Sultan Moulay Slimane University, Morocco

Rachid El Ayachi

Sultan Moulay Slimane University, Morocco

Steering Committee

A. Manuel de Oliveira Duarte

University of Aveiro, Portugal

Abderrahim Salhi

Sultan Moulay Slimane University, Morocco

Belaïd Bouikhalene

Sultan Moulay Slimane University, Morocco

Brahim Minaoui

Sultan Moulay Slimane University, Morocco

Charki Daoui

Sultan Moulay Slimane University, Morocco

Driss Ait Omar

Sultan Moulay Slimane University, Morocco

Ebad Banissi

London South Bank University, UK

Halima El Biaze

University of Quebec at Montreal, Canada

Hammou Fadili

National Conservatory of Arts and Crafts, France

Hicham Zougagh

Sultan Moulay Slimane University, Morocco

Karim Benouaret

Université Claude Bernard Lyon 1, France

Majed Haddad

University of Avignon, France

Mohamed Biniz

Sultan Moulay Slimane University, Morocco

Mohamed Erritali

Sultan Moulay Slimane University, Morocco

Mostafa Jourhmane

Sultan Moulay Slimane University, Morocco

Mourad Nachaoui

Sultan Moulay Slimane University, Morocco

Muhammad Sarfraz

Kuwait University, Kuwait

Najlae Idrissi

Sultan Moulay Slimane University, Morocco

Nora Tigziri

Université Mouloud Mammeri de Tizi-Ouzou,
Algeria

Suliman Hawamdeh

University of North Texas, USA

Youssef El Mourabit

Sultan Moulay Slimane University, Morocco

Program Committee

A. Manuel de Oliveira Duarte	University of Aveiro, Portugal
Abdelali Elmoufidi	Sultan Moulay Slimane University, Morocco
Abdelhak Mahmoudi	Mohammed V University, Morocco
Abdelkaher Ait Abdelouahad	Chouaib Doukkali University, Morocco
Abdellatif Dahmouni	Chouaib Doukkali University, Morocco
Abderrahim Salhi	Sultan Moulay Slimane University, Morocco
Abderrazak Farchane	Sultan Moulay Slimane University, Morocco
Abdullah Saif Altobi	Sultan Qaboos University, Oman
Adnan Mahmood	Macquarie University, Australia
Ali Kartit	Chouaib Doukkali University, Morocco
Antonio Lucadamo	University of Sannio, Italy
Aroa Casado	University of Barcelona, Spain
Ashesh Mahidadia	University of New South Wales, Australia
Belaïd Bouikhalene	Sultan Moulay Slimane University, Morocco
Bernhard Bauer	University of Augsburg, Germany
Charki Daoui	Sultan Moulay Slimane University, Morocco
Chih-Ming Chu	National Dong Hwa University, Taiwan
Daniel O'Leary	University of Southern California, USA
Driss Ait Omar	Sultan Moulay Slimane University, Morocco
Farzaneh Elahifasae	Shanghai Jiao Tong University, China
Goce Trajceviski	Northwestern University, USA
Hajar El Hammouti	King Abdullah University of Science and Technology, Saudi Arabia
Halima Elbiaze	Université du Québec à Montréal, Canada
Hamid Aksasse	Ibn Zohr University, Morocco
Hamid Garmani	Sultan Moulay Slimane University, Morocco
Hammou Fadili	National Conservatory of Arts and Crafts, France
Han-Chieh Chao	National Dong Hwa University, Taiwan
Harald Kitzmann	University of Tartu, Estonia
Hassan Silkan	University Chouaib Doukkali, Morocco
Hicham Mouncif	Sultan Moulay Slimane University, Morocco
Insaf Bellamine	Chouaib Doukkali University, Morocco
Ismail Khalil	Johannes Kepler University Linz, Austria
Jemal H. Abawajy	Deakin University, Australia
Jilali Antari	Ibn Zohr University, Morocco
Karim Benouaret	Université Claude Bernard Lyon 1, France
Khalid Housni	Ibn Tofail University, Morocco
Manhua Liu	Shanghai Jiao Tong University, China
Meryeme Hadni	Sidi Mohamed Ben Abdellah University, Morocco
Mhamed Outanoute	Sultan Moulay Slimane University, Morocco
Mohamed Baslam	Sultan Moulay Slimane University, Morocco

Mohamed Biniz	Sultan Moulay Slimane University, Morocco
Mohamed El Hajji	Ibn Zohr University, Morocco
Mohamed Erritali	Sultan Moulay Slimane University, Morocco
Mohamed Fakir	Sultan Moulay Slimane University, Morocco
Mohamed Kayyali	Harvard University, USA
Mohamed Ouhda	Sultan Moulay Slimane University, Morocco
Mohammed Boutalline	Sultan Moulay Slimane University, Morocco
Mohammed Elammari	University of Benghazi, Libya
Mohammed Elamrani	Sultan Moulay Slimane University, Morocco
Mostafa Abd-El-Barr	Kuwait University, Kuwait
Mounira Harzallah	University of Nantes, France
Muhammad Sarfraz	Kuwait University, Kuwait
Nora Tigziri	Université Mouloud Mammeri, Algeria
Nouf Mejwal	Kuwait University, Kuwait
Noureddine Falih	Sultan Moulay Slimane University, Morocco
Ouchitachen Hicham	Sultan Moulay Slimane University, Morocco
Parth Nagarkar	New Mexico State University, USA
Pedro Teixeira Isaias	University of Queensland, Australia
Putsadee Pornphol	Phuket Rajabhat University, Thailand
Rachid El Ayachi	Sultan Moulay Slimane University, Morocco
Ravi Patnayakuni	University of Alabama in Huntsville, USA
Said Safi	Sultan Moulay Slimane University, Morocco
Salwa Belaqqiz	Ibn Zohr University, Morocco
Scott Spangler	IBM Almaden Research Center, USA
Seng Loke	Deakin University, Australia
Suliman Hawamdeh	University of North Texas, USA
Tan Xiao Jian	Tunku Abdul Rahman University, Malaysia
Urairat Makchan	Phuket Rajabhat University, Thailand
Wei-Ming Chen	National Chung Cheng University, Taiwan
Weitong Chen	University of Queensland, Australia
Youssef El Mourabit	Sultan Moulay Slimane University, Morocco
Youssef Es-Saady	Ibn Zohr University, Morocco

Contents

Decision Support and Artificial Intelligence

Optimization Focused on Parallel Fuzzy Deep Belief Neural Network for Opinion Mining	3
<i>Fatima Es-sabery, Khadija Es-sabery, Bouchra El Akraoui, and Abdellatif Hair</i>	
A Convolutional Neural Networks-Based Approach for Potato Disease Classification	29
<i>Khalid El Moutaouakil, Brahim Jabir, and Noureddine Falih</i>	
Performance Investigation of a Proposed CBIR Search Engine Using Deep Convolutional Neural Networks	41
<i>Smail Zitan, Imad Zeroual, and Said Agoujl</i>	
Decision Boundary to Improve the Sensitivity of Deep Neural Networks Models	50
<i>Mohamed Ouriha, Youssef El Habouz, and Omar El Mansouri</i>	
Facial Expression Recognition Using a Hybrid ViT-CNN Aggregator	61
<i>Rachid Bousaid, Mohamed El Hajji, and Youssef Es-Saady</i>	
Machine Learning Approach to Automate Decision Support on Information System Attacks	71
<i>Younes Wadii and Mohamed Baslam</i>	
Deep Reinforcement Learning for Bitcoin Trading	82
<i>Bouchra El Akraoui and Cherki Daoui</i>	
An Exploration of Student Grade Retention Prediction Using Machine Learning Algorithms	94
<i>Aomar Ibourk and Ismail Ouadi</i>	
Deep Learning Model for Educational Recommender Systems	107
<i>Abdelkader Grota, Mohammed Erritali, and Elmoufidi Abdelali</i>	
Comparative Study of Deep Learning Models for Detection and Classification of Intracranial Hemorrhage	122
<i>Lale El Mouna, Hassan Silkan, Youssef Haynf, Amal Tmiri, and Abdellatif Dahmouni</i>	

Business Intelligence and Database

Increasing Student Engagement in Lessons and Assessing MOOC
Participants Through Artificial Intelligence 135
Younes-aziz Bachiri and Hicham Mouncif

Mining Frequents Itemset and Association Rules in Diabetic Dataset 146
Youssef Fakir, Abdelfatah Maarouf, and Rachid El Ayachi

Automatic Text Summarization for Moroccan Arabic Dialect Using
an Artificial Intelligence Approach 158
*Kamel Gaanoun, Abdou Mohamed Naira, Anass Allak,
and Imade Benelallam*

Automatic Change Detection Based on the Independent Component
Analysis and Fuzzy C-Means Methods 178
Abdelkrim Maarir, Es-said Azougaghe, and Belaid Bouikhalene

Sentiment Analysis Decision System for Tracking Climate Change
Opinion in Twitter 188
Mustapha Lydiri, Youssef El Habouz, and Hicham Zougagh

Analysis of Decision Tree Algorithms for Diabetes Prediction 197
Youssef Fakir and Naoum Abdelmotalib

How far can Deep Learning Improve Arabic Part of Speech Tagging? 206
Mohamed Bouzahir, Abdelkafer Ait Abdelouahad, and Mohamed Nabil

Optimization and Dynamic Programming

Analysis of Several Algorithms for DOA Estimation in Two Different
Communication Models by a Comparative Study 219
Hassan Ougraz, Said Safi, and Miloud Frikel

A Novel Hybrid Approach for Improving the Accuracy of the Supervised
Link Prediction Based on Graph Structure Features in Social Networks 231
Mohamed Badiy, Fatima Amounas, and Moha Hajar

Intelligent System Based on GAN Model for Decision Support in Brain
Tumor Segmentation 243
*Omar El Mansouri, Yousef El Mourabit, Youssef El Habouz,
Nassiri Boujemaa, and Mohamed Ouriha*

Hospital Room Management for Covid-19 Patients Using Petri Nets 254
Ayoub El Bazzazi, Bouchra El Akraoui, and Abdelhadi Larach

Dimensionality Reduction of MI-EEG Data via Convolutional Autoencoders with a Low Size Dataset	263
<i>Mouad Riyad, Mohammed Khalil, and Abdellah Adib</i>	
Car Tracking Technique for DLES Project	279
<i>Abderrahman Azi, Abderrahim Salhi, and Mostafa Jourhmane</i>	
Author Index	295