

Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen 

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger 

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this subseries at <http://www.springer.com/series/7409>


Thoralf Reis · Marco X. Bornschlegl ·
Marco Angelini · Matthias L. Hemmje (Eds.)

Advanced Visual Interfaces

Supporting Artificial Intelligence
and Big Data Applications


AVI 2020 Workshops, AVI-BDA and ITAVIS
Ischia, Italy, June 9, 2020 and September 29, 2020
Revised Selected Papers

Editors

Thoralf Reis 
University of Hagen
Hagen, Germany

Marco Angelini 
Sapienza University of Rome
Rome, Italy

Marco X. Bornschlegl
University of Hagen
Hagen, Germany

Matthias L. Hemmje 
University of Hagen
Hagen, Germany

ISSN 0302-9743

ISSN 1611-3349 (electronic)

Lecture Notes in Computer Science

ISBN 978-3-030-68006-0

ISBN 978-3-030-68007-7 (eBook)

<https://doi.org/10.1007/978-3-030-68007-7>

LNCS Sublibrary: SL3 – Information Systems and Applications, incl. Internet/Web, and HCI

© Springer Nature Switzerland AG 2021

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 of AVI-BDA Workshop

First of all, this volume contains the full papers presented, discussed, extended, and revised in the context of the 15th Conference on Advanced Visual Interfaces (AVI) within the Workshop on Road Mapping Infrastructures for Artificial Intelligence Supporting Advanced Visual Big Data Analysis (AVI-BDA), held on June 9th, 2020. The workshop initializing the work was organized by us in our capacity as PhD student, as postdoc, and as Chair of Multimedia and Internet Applications at the Faculty of Mathematics and Computer Science at the University of Hagen, Germany. The workshop was curated by an international Program Committee of fourteen scientists from nine different universities in six different countries.

Handling the complexity of Big Data requires new visualization techniques in regards to data access, perception, and interaction. Employing Artificial Intelligence can help to lower the entry barriers for different types of Big Data Analysis users and ease their journeys from data integration to data transformation and data exploration. Then again it introduces further challenges for human-computer interaction and interoperability. Therefore, this workshop addressed these issues with a special focus on supporting AI-based intelligent advanced visual user interfaces for Big Data Analysis. In this way, the purpose of this research road-mapping workshop was threefold. Firstly, it aimed at consolidating information, technical details, and research directions from the diverse range of academic R&D projects currently available. Secondly, based on visions of future infrastructures and gaps in the current state of the art, a new reference model was presented, and thirdly, this reference model was validated by the workshop participants. To achieve these aims the workshop brought together researchers and practitioners who are able to contribute and to aid in the research road-mapping, in the validation of a novel reference model, and in providing publications based on their own work in correspondence to the derived reference model. The results of this validation and the corresponding reference model can be used to inform, influence, and disseminate ideas to the wider research community. In consequence, the Call for Papers of the workshop invited contributions from academic researchers and practitioners working in the areas of Big Data Analysis, Visualization, and Artificial Intelligence. The nine initial submissions of position papers from six different countries were each carefully reviewed by three Program Committee members.

Based on submitted position papers and existing research, the workshop outlined the current baseline of infrastructures for AI-based intelligent advanced visual user interfaces for Big Data Analysis. Furthermore, it outlined research gaps that need to be filled to achieve the targeted research and development ambitions. Realizing these ambitions was supported by the presentation and discussion of research aiming at delivering Artificial Intelligence and Big Data Analysis application scenarios, e.g. through intelligent advanced visual user interfaces, supporting researchers and organizations in applying and maintaining distributed (spatially, physically, as well as potentially

cross-domain) research resources. These application scenarios served to validate a reference model that utilizes open standards and that can be materialized through an open architecture and components derived from state-of-the-art research results and which is able to deal with Big Data Analysis, Visualization, and Artificial Intelligence resources and services at scale. In this way, the validated reference model can pave the way towards collaboration on the development of an AI-based Big Data Analysis and Visualization tool suite that adopts common existing open standards for access, analysis, and visualization. Thereby, it helps to realize a ubiquitous collaborative workspace for researchers which is able to facilitate the research process and its Big Data Analysis and Artificial Intelligence applications.

The workshop took place during a full day and was structured in four sessions to provide maximum time for group discussion and brainstorming. In the first session the participants introduced themselves together with their accepted paper. Following this, the workshop presented a novel reference model for Artificial Intelligence supporting Big Data Analysis and Visualization. In the third session, a gap analysis and validation was completed on the basis of each presented research domain perspective and on the basis of the derived reference model. In the fourth session the group summarized the gaps and set out a timeline and areas for completing their corresponding full publications in order to reflect the gaps and fully validate the derived reference model.

We would like to thank all the authors for contributing high-quality research position papers to the workshop and full papers as well as revisions of these full papers after an additional review to establish the content for these proceedings. We would also like to express our sincere thanks to the Organizing and Program Committees, to the members of our Editorial Board, as well as to all the additional external reviewers for reviewing the papers within a very short period of time. Finally, we thank Springer for publishing the proceedings in the Lecture Notes in Computer Science series.

November 2020

Thoralf Reis
Marco X. Bornschlegl
Matthias L. Hemmje

Preface of ITAVIS Workshop

In addition, this volume also contains the proceedings of the 2nd edition of the ITAVIS workshop. The second edition of the ITAVIS workshop consolidated and expanded the encouraging results obtained from the first edition (ITA.WA.- Italian Visualization & Visual Analytics workshop). The goal was to make an additional step toward the creation of an Italian research community on the topics of Visualization, Visual Analytics, HCI and Design, allowing identification of research directions, joining forces in achieving them, linking researchers and practitioners and developing common guidelines and programs for teaching activities in the fields of Visualization and Visual Analytics. The workshop accepted for the first time five contributions, split into two full research papers, one position paper and two activity presentation reports. The workshop took place during a half-day and was structured in 3 sessions: a keynote speaker session, a research paper session and an activity presentation session. This program fostered a lively discussion and helped in the formation of new connections between research institutions on the topics of Visualization and Visual Analytics. Finally, the ITAVIS workshop produced a future road-map to strengthen the effort of creating an Italian community on these subjects. I would like to thank all the authors for contributing high-quality papers. My thanks go to the Organizing and Program Committees for helping to create an interesting program. I thank Springer for publishing the proceedings in the Lecture Notes in Computer Science series.

November 2020

Marco Angelini

Organization of AVI-BDA Workshop

Organizing Committee

Thoralf Reis	University of Hagen, Germany
Marco X. Bornschlegl	University of Hagen, Germany
Matthias L. Hemmje	University of Hagen, Germany

Program Committee

Haithem Afli	Munster Technological University, Ireland
Marco X. Bornschlegl	University of Hagen, Germany
Paolo Buono	University of Bari Aldo Moro, Italy
Tiziana Catarci	Sapienza University of Rome, Italy
Abbas Cheddad	Blekinge Institute of Technology, Sweden
Felix C. Engel	University of Hagen, Germany
Anna Esposito	University of Campania Luigi Vanvitelli, Italy
Matthias L. Hemmje	University of Hagen, Germany
Massimo Mecella	Sapienza University of Rome, Italy
Andrea Molinari	Università di Trentino, Italy
Thoralf Reis	University of Hagen, Germany
María Inés Torres	University of the Basque Country, Spain
Haiying Wang	Ulster University, UK
Huiru Zheng	Ulster University, UK

Organization of ITAVIS Workshop

Organizing Committee

Marco Angelini	Sapienza University of Rome, Italy
Giuseppe Santucci	Sapienza University of Rome, Italy

Program Committee

Paolo Buono	University of Bari Aldo Moro, Italy
Tiziana Catarci	Sapienza University of Rome, Italy
Antonina Dattolo	University of Udine, Italy
Giuseppe Desolda	University of Bari Aldo Moro, Italy
Sara Di Bartolomeo	Northeastern University, Boston, USA
Giuseppe Di Battista	Roma Tre University, Italy
Paolo Federico	Vienna University of Technology, Austria
Beatrice Gobbo	Politecnico di Milano, Italy
Simone Lenti	Sapienza University of Rome, Italy
Giuseppe Liotta	University of Perugia, Italy
Fabrizio Montecchiani	University of Perugia, Italy
Maurizio Patrignani	Roma Tre University, Italy
Laura Tarantino	Università dell'Aquila, Italy

Contents

AI2VIS4BigData: A Reference Model for AI-Based Big Data Analysis and Visualization	1
<i>Thoralf Reis, Marco X. Bornschlegl, and Matthias L. Hemmje</i>	
A Visual Analytics Technique to Compare the Performance of Predictive Models	19
<i>Paolo Buono and Alessandra Legretto</i>	
Affective Analytics and Visualization for Ensemble Event-Driven Stock Market Forecasting	28
<i>Praveen Joshi and Haithem Afli</i>	
Understanding the Role of (Advanced) Machine Learning in Metagenomic Workflows	56
<i>Thomas Krause, Bruno G. N. Andrade, Haithem Afli, Haiying Wang, Huiru Zheng, and Matthias L. Hemmje</i>	
Intelligent Advanced User Interfaces for Monitoring Mental Health Wellbeing	83
<i>Anna Esposito, Zoraida Callejas, Matthias L. Hemmje, Michael Fuchs, Mauro N. Maldonato, and Gennaro Cordasco</i>	
Towards Explainable Artificial Intelligence and Explanation User Interfaces to Open the ‘Black Box’ of Automated ECG Interpretation	96
<i>Khaled Rjoob, Raymond Bond, Dewar Finlay, Victoria McGilligan, Stephen J. Leslie, Ali Rababah, Aleeha Iftikhar, Daniel Guldenring, Charles Knoery, Anne McShane, and Aaron Peace</i>	
Recognition and Visualization of Facial Expression and Emotion in Healthcare	109
<i>Hayette Hadjar, Thoralf Reis, Marco X. Bornschlegl, Felix C. Engel, Paul Mc Kevitt, and Matthias L. Hemmje</i>	
Machine Learning in Healthcare: Breast Cancer and Diabetes Cases	125
<i>Abbas Cheddad</i>	
AI2VIS4BigData: Qualitative Evaluation of an AI-Based Big Data Analysis and Visualization Reference Model	136
<i>Thoralf Reis, Marco X. Bornschlegl, and Matthias L. Hemmje</i>	
Progressive Visualization of Epidemiological Models for COVID-19 Visual Analysis.	163
<i>Marco Angelini and Giorgio Cazzetta</i>	

An Experience on Cooperative Development of Interactive Visualizations
for the Analysis of Urban Data 174
*Paolo Buono, Maria Costabile, Alessandra Legretto,
and Palmalisa Marra*

Explaining AI Through Critical Reflection Artifacts: On the Role
of Communication Design Within XAI 184
Beatrice Gobbo

Information Visualization and Visual Analytics at IVU Lab 189
Paolo Buono

Visual Analytics for Financial Crime Detection at the University
of Perugia 195
*Emilio Di Giacomo, Walter Didimo, Luca Grilli, Giuseppe Liotta,
and Fabrizio Montecchiani*

Author Index 201