Communications in Computer and Information Science 1196

Editorial Board Members

Joaquim Filipe
Polytechnic Institute of Setúbal, Setúbal, Portugal

Ashish Ghosh
Indian Statistical Institute, Kolkata, India

Raquel Oliveira Prates
Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil

Lizhu Zhou
Tsinghua University, Beijing, China

More information about this series at http://www.springer.com/series/7899

Bart Bogaerts · Gianluca Bontempi ·
Pierre Geurts · Nick Harley ·
Bertrand Lebichot · Tom Lenaerts ·
Gilles Louppe (Eds.)

Artificial Intelligence and Machine Learning

31st Benelux AI Conference, BNAIC 2019,
and 28th Belgian-Dutch Machine Learning Conference, BENELEARN 2019
Brussels, Belgium, November 6–8, 2019
Revised Selected Papers

Springer

Editors
Bart Bogaerts
Vrije Universiteit Brussel
Brussels, Belgium

Pierre Geurts
Université de Liège
Liège, Belgium

Bertrand Lebichot
Université Libre de Bruxelles
Brussels, Belgium

Gilles Louppe
Université de Liège
Liège, Belgium

Gianluca Bontempi
Université Libre de Bruxelles
Brussels, Belgium

Nick Harley
Vrije Universiteit Brussel
Brussels, Belgium

Tom Lenaerts
Université Libre de Bruxelles
Brussels, Belgium

ISSN 1865-0929 ISSN 1865-0937 (electronic)
Communications in Computer and Information Science
ISBN 978-3-030-65153-4 ISBN 978-3-030-65154-1 (eBook)
https://doi.org/10.1007/978-3-030-65154-1

© Springer Nature Switzerland AG 2020
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 31st edition of the annual Benelux Conference on Artificial Intelligence (BNAIC 2019) and the 28th Belgian Dutch Conference on Machine Learning (Benelearn 2019) were jointly organized by the Vrije Universiteit Brussel, the Université Libre de Bruxelles, and the Université de Liège, under the auspices of the Benelux Association for Artificial Intelligence (BNVKI) and the Dutch Research School for Information and Knowledge Systems (SIKS), in collaboration with Brewery of Ideas under the name AI Synergies.

Held yearly, the objective of these conferences is to promote and disseminate recent research developments in Artificial Intelligence (AI) and Machine Learning (ML) in the Benelux. For the first time, we have combined these two conferences with a whole-day business track (on November 6, 2019) and an 'Art-AI' evening (also November 6, 2019) into an overarching event called AI Synergies, with the goal of further expanding the reach and impact of the two conferences and to allow people from industry to get in touch with the academics and learn about their work. This part of the conference was co-organized by the company Brewery of Ideas.

For the scientific part, we welcomed four types of contributions, namely A) regular papers, B) compressed contributions, C) demonstration abstracts, and D) bachelor/master thesis abstracts. We received 127 submissions, 66 for the AI and 61 for the ML tracks. In terms of the four types, we received 10 demonstration abstracts, 24 bachelor/master thesis's, 50 regular paper submissions, and 43 compressed contributions. Submissions were evaluated by three reviewers. From all these submissions, the International Program Committee (see at end) selected 115 for the conference, to be presented either as talk or research pitches in sessions organized around the most important AI and ML topics.

Finally, the BNAIC/Benelearn Program Committee selected the most insightful and relevant papers from both the ML and AI tracks to be included in these post-proceedings. An additional peer-review process was single blind with three reviewers per paper. In total 11 papers were withheld, resulting in the post-proceedings you are currently reading.

For the AI part, the selected papers reflect the diversity of submissions that were also presented at the conference. The post-proceedings include two contributions on the topic of modular design of robot swarms and one contribution that aims to help in the fight against HIV. Additionally, the AI part has a contribution on computational models that can help understand how humans perceive language, as well as a novel method for exploring latent spaces of datasets.

For the ML part, the ratio between fundamental and applied papers is quite balanced: three for each. The applied part of the ML post-proceedings includes papers on various fields: churn prediction in telecommunications, a recommendation system, and a data visualization tool. On the fundamental side, the papers cover defense against adversarial attacks, ordinal classification problems, and detrimental point processes.

With the booming interest in AI and ML in both academia and companies, this edition of the BNAIC/Benelearn conferences was an outstanding success. It revealed that both communities are active and strong in the Benelux, and we hope that future organizations of this event will surpass the one organized in 2019 in Brussels.

July 2020

Bart Bogaerts
Gianluca Bontempi
Pierre Geurts
Nick Harley
Bertrand Lebichot
Tom Lenaerts
Gilles Louppe

Organization

General Chairs

Tom Lenaerts	Université Libre de Bruxelles, Belgium
Johan Loeckx	Vrije Universiteit Brussel, Belgium
Claudio Truzzi	iCity and Université Libre de Bruxelles, Belgium

Program Committee Chairs

Bart Bogaerts	Vrije Universiteit Brussel, Belgium
Gianluca Bontempi	Université Libre de Bruxelles, Belgium
Pierre Geurts	Université de Liège, Belgium
Nick Harley	Vrije Universiteit Brussel, Belgium
Bertrand Lebichot	Université Libre de Bruxelles, Belgium
Gilles Louppe	Université de Liège, Belgium

Industry Chairs

Peter Buelens	Brewery of Ideas, Belgium
Jonathan Duplicy	Innoviris, Belgium
Annerieke Heuvelink	Philips, The Netherlands
Johan Loeckx	Vrije Universiteit Brussel, Belgium
Leander Schietgat	Vrije Universiteit Brussel, Belgium
Claudio Truzzi	iCity and Université Libre de Bruxelles, Belgium

Demo Chairs

Katrien Beuls	Vrije Universiteit Brussel, Belgium
Paul Van Eecke	Vrije Universiteit Brussel, Belgium

Arts Chairs

Christophe De Jaeger	Gluon, Belgium
Luc Steels	Vrije Universiteit Brussel, Belgium
Geraint Wiggins	Vrije Universiteit Brussel, Belgium

Program Committee

Martin Atzmueller	Tilburg University, The Netherlands
Reyhan Aydogan	Technische Universiteit Delft, The Netherlands
Souhaib Ben Taieb	Université de Mons, Belgium
Floris Bex	Universiteit Utrecht, The Netherlands

Hendrik Blockeel	Katholieke Universiteit Leuven, Belgium
Tibor Bosse	Vrije Universiteit Amsterdam, The Netherlands
Bert Bredeweg	Universiteit van Amsterdam, The Netherlands
Tom Claassen	Radboud Universiteit, The Netherlands
Walter Daelemans	Universiteit Antwerpen, Belgium
Gregoire Danoy	University of Luxembourg, Luxembourg
Mehdi Dastani	Universiteit Utrecht, The Netherlands
Jesse Davis	Katholieke Universiteit Leuven, Belgium
Bernard De Baets	Universiteit Gent, Belgium
Marc Denecker	Katholieke Universiteit Leuven, Belgium
Kurt Driessens	Universiteit Maastricht, The Netherlands
Ad Feelders	Universiteit Utrecht, The Netherlands
Maria C. F. de Oliveira	Universidade de São Paulo, Brazil
George H. L. Fletcher	Technische Universiteit Eindhoven, The Netherlands
Lieke Gelderloos	Tilburg University, The Netherlands
Pierre Geurts	Université de Liège, Belgium
Nicolas Gillis	Université de Mons, Belgium
Tom Heskes	Radboud Universiteit, The Netherlands
Arjen Hommersom	Open Universiteit Nederland, The Netherlands
Mark Hoogendoorn	Vrije Universiteit Amsterdam, The Netherlands
Geert-Jan Houben	Technische Universiteit Delft, The Netherlands
Ilkka Kivimäki	Aalto University, Finland
Walter Kosters	Universiteit Leiden, The Netherlands
Johan Kwisthout	Radboud Universiteit, The Netherlands
Frederic Lavancier	Université de Nantes, France
John Lee	Université catholique de Louvain, Belgium
Jan Lemeire	Vrije Universiteit Brussel, Belgium
Daniel Lizotte	University of Western Ontario, Canada
Peter Lucas	Universiteit Leiden, The Netherlands
Bernd Ludwig	Université Regensburg, Germany
Bernard Manderick	Vrije Universiteit Brussel, Belgium
Elena Marchiori	Radboud Universiteit, The Netherlands
Wannes Meert	Katholieke Universiteit Leuven, Belgium
Vlado Menkovski	Technische Universiteit Eindhoven, The Netherlands
John-Jules Meyer	Universiteit Utrecht, The Netherlands
Arno Moonens	Vrije Universiteit Brussel, Belgium
Ann Nowe	Vrije Universiteit Brussel, Belgium
Frans Oliehoek	Technische Universiteit Delft, The Netherlands
Aske Plaat	Universiteit Leiden, The Netherlands
Marie Postma	Tilburg University, The Netherlands
Eric Postma	Tilburg University, The Netherlands
Henry Prakken	Universiteit Utrecht, The Netherlands
Marco Saerens	Université catholique de Louvain, Belgium
Yvan Saeys	Universiteit Gent, Belgium
Javier Sánchez-Monedero	Cardiff University, UK
Stefan Schlobach	Vrije Universiteit Amsterdam, The Netherlands

Evgueni Smirnov	Universiteit Maastricht, The Netherlands
Felix Sommer	Université catholique de Louvain, Belgium
Gerasimos Spanakis	Universiteit Maastricht, The Netherlands
Jennifer Spenader	University of Groningen, The Netherlands
Miguel Suau	Technische Universiteit Delft, The Netherlands
Johan Suykens	Katholieke Universiteit Leuven, Belgium
Dirk Thierens	Universiteit Utrecht, The Netherlands
Frank Van Harmelen	Vrije Universiteit Amsterdam, The Netherlands
Remco Veltkamp	Universiteit Utrecht, The Netherlands
Joost Vennekens	Katholieke Universiteit Leuven, Belgium
Arnoud Visser	Universiteit van Amsterdam, The Netherlands
Willem Waegeman	University of Groningen, Belgium
Louis Wehenkel	Université de Liège, Belgium
Gerhard Weiss	Universiteit Maastricht, The Netherlands
Wolfgang Wiedermann	University of Missouri, USA
Marco Wiering	Rijksuniversiteit Groningen, The Netherlands
Jef Wijsen	Université de Mons, Belgium
Mark H. M. Winands	Universiteit Maastricht, The Netherlands
Marcel Worring	Universiteit van Amsterdam, The Netherlands
Duo Xu	Georgia Institute of Technology, USA
Yingqian Zhang	Technische Universiteit Eindhoven, The Netherlands
Tim van Erven	Universiteit Leiden, The Netherlands
Nanne van Noord	Universiteit van Amsterdam, The Netherlands
Marieke van Vugt	Rijksuniversiteit Groningen, The Netherlands
Egon L. van den Broek	Universiteit Utrecht, The Netherlands
Peter van der Putten	Universiteit Leiden, The Netherlands
Leon van der Torre	University of Luxembourg, Luxembourg

Additional Reviewers

Wissam Siblini
Menno van Zaanen

Contents

Artificial Intelligence Part: BNAIC

AutoMoDe-IcePop: Automatic Modular Design of Control Software for Robot Swarms Using Simulated Annealing 3
Jonas Kuckling, Keneth Ubeda Arriaza, and Mauro Birattari

Evaluation of Alternative Exploration Schemes in the Automatic Modular Design of Robot Swarms 18
Gaëtan Spaey, Miquel Kegeleirs, David Garzón Ramos, and Mauro Birattari

Towards a Phylogenetic Measure to Quantify HIV Incidence 34
Pieter Libin, Nassim Versbraegen, Ana B. Abecasis, Perpetua Gomes, Tom Lenaerts, and Ann Nowé

Cognitively Plausible Computational Models of Lexical Processing Can Explain Variance in Human Word Predictions and Reading Times 51
Wietse de Vries

Latent Space Exploration Using Generative Kernel PCA 70
David Winant, Joachim Schreurs, and Johan A. K. Suykens

Machine Learning Part: Benelearn

Calibrated Multi-probabilistic Prediction as a Defense Against Adversarial Attacks 85
Jonathan Peck, Bart Goossens, and Yvan Saeys

Machine Learning Methods for Ordinal Classification with Additional Relative Information 126
Mengzi Tang, Raúl Pérez-Fernández, and Bernard De Baets

Towards Deterministic Diverse Subset Sampling 137
J. Schreurs, M. Fanuel, and J. A. K. Suykens

Extended Bayesian Personalized Ranking Based on Consumption Behavior 152
Alireza Gharahighehi and Celine Vens

SubSect—An Interactive Itemset Visualization 165
Joey De Pauw, Sandy Moens, and Bart Goethals

Understanding Telecom Customer Churn with Machine Learning: From Prediction to Causal Inference 182
Théo Verhelst, Olivier Caelen, Jean-Christophe Dewitte, Bertrand Lebichot, and Gianluca Bontempi

Author Index 201