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ICT Innovations 2019

Big Data Processing and Mining

11th International Conference, ICT Innovations 2019
Ohrid, North Macedonia, October 17–19, 2019
Proceedings

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Preface

The ICT Innovations conference series, organized by the Macedonian Society of Information and Communication Technologies (ICT-ACT) is an international forum for presenting scientific results related to innovative fundamental and applied research in ICT. The 11th ICT Innovations 2019 conference that brought together academics, students, and industrial practitioners, was held in Ohrid, Republic of North Macedonia, during October 17–19, 2019.

The focal point for this year’s conference was “Big Data Processing and Mining,” with topics extending across several fields including social network analysis, natural language processing, deep learning, sensor network analysis, bioinformatics, FinTech, privacy, and security.

Big data is heralded as one of the most exciting challenges in data science, as well as the next frontier of innovations. The spread of smart, ubiquitous computing and social networking have brought to light more information to consider. Storage, integration, processing, and analysis of massive quantities of data pose significant challenges that have yet to be fully addressed. Extracting patterns from big data provides exciting new fronts for behavioral analytics, predictive and prescriptive modeling, and knowledge discovery. By leveraging the advances in deep learning, stream analytics, large-scale graph analysis and distributed data mining, a number of tasks in fields like, biology, games, robotics, commerce, transportation, and health care have been brought within reach.

Some of these topics were brought to the forefront of the ICT Innovations 2019 conference. This book presents a selection of papers presented at the conference which contributed to the discussions on various aspects of big data mining (including algorithms, models, systems, and applications). The conference gathered 184 authors from 24 countries reporting their scientific work and solutions in ICT. Only 18 papers were selected for this edition by the international Program Committee, consisting of 176 members from 43 countries, chosen for their scientific excellence in their specific fields.

We would like to express our sincere gratitude to the authors for sharing their most recent research, practical solutions, and experiences, allowing us to contribute to the discussion on the trends, opportunities, and challenges in the field of big data. We are grateful to the reviewers for the dedicated support they provided to our thorough reviewing process. Our work was made easier by following the procedures developed and passed along by Prof. Slobodan Kaljadziski, the co-chair of the ICT Innovations 2018 conference. Special thanks to Ilinka Ivanoska, Bojana Koteska, and Monika Simjanoska for their support in organizing the conference and for the technical preparation of the conference proceedings.

October 2019

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Abstract of Keynotes

Machine Learning Optimization and Modeling: Challenges and Solutions to Data Deluge

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Abstract. A single server can no longer handle all of the data of a machine learning problem. Today's data is fine granular, usually has the temporal dimension, is often streamed, and thus distributed among several compute nodes on premise or in the cloud. More hardware buys you only so much; in particular, the underlying models and algorithms must be capable of exploiting it. We focus on distributed optimization algorithms where samples and features are distributed, and in a different setting where data is streamed by an infinite pipeline. Algorithms and convergence analyses will be presented. Fine granular data with a time dimension also offers opportunities to deep learning models that outperform traditional machine learning models. To this end, we use churn predictions to showcase how recurrent neural networks with several important enhancements squeeze additional business value.

Keywords: Distributed optimization • Deep learning • Recurrent neural networks

Computing and Probing Cancer Immunity

Zlatko Trajanoski

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Abstract. Recent breakthroughs in cancer immunotherapy and decreasing costs of high-throughput technologies sparked intensive research into tumour-immune cell interactions using genomic tools. However, the wealth of the generated data and the added complexity pose considerable challenges and require computational tools to process, analyse and visualise the data. Recently, a number of tools have been developed and used to effectively mine tumour immunologic and genomic data and provide novel mechanistic insights. In this talk I will first review and discuss computational genomics tools for mining cancer genomic data and extracting immunological parameters. I will focus on higher-level analyses of NGS data including quantification of tumour-infiltrating lymphocytes (TILs), identification of tumour antigens and T cell receptor (TCR) profiling. Additionally, I will address the major challenges in the field and ongoing efforts to tackle them.

In the second part I will show results generated using state-of-the-art computational tools addressing several prevailing questions in cancer immunology including: estimation of the TIL landscape, identification of determinants of tumour immunogenicity, and immuno editing that tumors undergo during progression or as a consequence of targeting the PD-1/PD-L1 axis. Finally, I will propose a novel approach based on perturbation biology of patient-derived organoids and mathematical modeling for the identification of a mechanistic rationale for combination immunotherapies in colorectal cancer.

Keywords: Cancer immunotherapy • Tumour-infiltrating lymphocytes • Perturbation biology

Bioinformatics Approaches for Sing Cell Transcriptomics and Big Omics Data Analysis

Ming Chen

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Abstract. We are in the big data era. Multi-omics data brings us a challenge to develop appropriate bioinformatics approaches to model complex biological systems at spatial and temporal scales. In this talk, we will describe multi-omics data available for biological interactome modeling. Single cell transcriptomics data is exploited and analyzed. An integrative interactome model of non-coding RNAs is built. We investigated to characterize coding and non-coding RNAs including microRNAs, siRNAs, lncRNAs, ceRNAs and cirRNAs.

Keywords: Big data • Multi-omics data • RNA

Crosslingual Document Embedding as Reduced-Rank Ridge Regression

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Abstract. There has recently been much interest in extending vector-based word representations to multiple languages, such that words can be compared across languages. In this paper, we shift the focus from words to documents and introduce a method for embedding documents written in any language into a single, language-independent vector space. For training, our approach leverages a multilingual corpus where the same concept is covered in multiple languages (but not necessarily via exact translations), such as Wikipedia. Our method, Cr5 (Crosslingual reduced-rank ridge regression), starts by training a ridge-regression-based classifier that uses language-specific bag-of-word features in order to predict the concept that a given document is about. We show that, when constraining the learned weight matrix to be of low rank, it can be factored to obtain the desired mappings from language-specific bags-of-words to language-independent embeddings. As opposed to most prior methods, which use pretrained monolingual word vectors, postprocess them to make them crosslingual, and finally average word vectors to obtain document vectors, Cr5 is trained end-to-end and is thus natively crosslingual as well as document-level. Moreover, since our algorithm uses the singular value decomposition as its core operation, it is highly scalable. Experiments show that our method achieves state-of-the-art performance on a crosslingual document retrieval task. Finally, although not trained for embedding sentences and words, it also achieves competitive performance on crosslingual sentence and word retrieval tasks.

Keywords: Crosslingual • Reduced-rank • Ridge regression •
Retrieval • Embeddings

Contents

Automatic Text Generation in Macedonian Using Recurrent Neural Networks	1
<i>Ivona Milanova, Ksenija Sarvanoska, Viktor Srbinoski, and Hristijan Gjoreski</i>	
Detection of Toy Soldiers Taken from a Bird's Perspective Using Convolutional Neural Networks	13
<i>Saša Sambolek and Marina Ivašić-Kos</i>	
Prediction of Student Success Through Analysis of Moodle Logs: Case Study	27
<i>Neslihan Ademi, Suzana Loshkovska, and Slobodan Kalajdziski</i>	
Multidimensional Sensor Data Prediction	41
<i>Stefan Popov and Biljana Risteska Stojkoska</i>	
Five Years Later: How Effective Is the MAC Randomization in Practice? The No-at-All Attack.	52
<i>Ivan Vasilevski, Dobre Blazhevski, Veno Pachovski, and Irena Stojmenovska</i>	
Improvement of the Binary Varshamov Bound	65
<i>Dejan Spasov</i>	
Electrical Energy Consumption Prediction Using Machine Learning	72
<i>Simon Stankoski, Ivana Kiprijanovska, Igor Ilievski, Jovanovski Slobodan, and Hristijan Gjoreski</i>	
Diatom Ecological Modelling with Weighted Pattern Tree Algorithm by Using Polygonal and Gaussian Membership Functions	83
<i>Andreja Naumoski, Georgina Mirceva, and Kosta Mitreski</i>	
A Study of Different Models for Subreddit Recommendation Based on User-Community Interaction.	96
<i>Andrej Janchevski and Sonja Gievska</i>	
Application of Hierarchical Bayesian Model in Ophthalmological Study	109
<i>Biljana Tojtovska, Panche Ribarski, and Antonela Ljubic</i>	
Friendship Paradox and Hashtag Embedding in the Instagram Social Network	121
<i>David Serafimov, Miroslav Mirchev, and Igor Mishkovski</i>	

An In-Depth Analysis of Personality Prediction	134
<i>Filip Despotovski and Sonja Gievska</i>	
Ski Injury Predictions with Explanations	148
<i>Sandro Radovanović, Andrija Petrović, Boris Delibašić, and Milija Suknović</i>	
Performance Evaluation of Word and Sentence Embeddings for Finance Headlines Sentiment Analysis	161
<i>Kostadin Mishev, Ana Gjorgjevikj, Riste Stojanov, Igor Mishkovski, Irena Vodenska, Ljubomir Chitkushev, and Dimitar Trajanov</i>	
A Hybrid Model for Financial Portfolio Optimization Based on LS-SVM and a Clustering Algorithm	173
<i>Ivana P. Marković, Jelena Z. Stanković, Miloš B. Stojanović, and Jovica M. Stanković</i>	
Protein Secondary Structure Graphs as Predictors for Protein Function.	187
<i>Frosina Stojanovska and Nevena Ackovska</i>	
Exploring the Attention Mechanism in Deep Models: A Case Study on Sentiment Analysis	202
<i>Martina Toshevska and Slobodan Kalajdziski</i>	
Image Augmentation with Neural Style Transfer	212
<i>Borijan Georgievski</i>	
Author Index	225