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SOFSEM 2017: Theory and Practice of Computer Science

43rd International Conference on Current Trends in Theory and Practice of Computer Science
Limerick, Ireland, January 16–20, 2017
Proceedings

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Preface

This volume contains the invited and contributed papers selected for presentation at the 43rd Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM 2017), held January 16–20, 2017, in Limerick, Ireland.

SOFSEM (originally SOFtware SEMinar) is devoted to leading research and fosters cooperation among researchers and professionals from academia and industry in all areas of computer science. SOFSEM started in 1974 in the former Czechoslovakia as a local conference and winter school combination. The renowned invited speakers and the growing interest of the authors from abroad gradually turned SOFSEM in the mid-1990s into an international conference with proceedings published in the Springer LNCS series, in the last two years in their prestigious subline ARCoSS: *Advanced Research in Computing and Software Science*. SOFSEM became a well-established and fully international conference maintaining the best of its original winter school aspects, such as a higher number of invited talks and an in-depth coverage of novel research results in selected areas of computer science. SOFSEM 2017, accordingly, was organized around the following three thematic tracks:

- Foundations of Computer Science (chaired by Christel Baier, TU Dresden)
- Software Engineering: Methods, Tools, Applications (chaired by Mark van den Brand, TU Eindhoven)
- Data, Information, and Knowledge Engineering (chaired by Johann Eder, U. Klagenfurt)

With its three tracks, SOFSEM 2017 covered the latest advances in research, both theoretical and applied, in selected areas of computer science. The SOFSEM 2017 Program Committee consisted of 62 international experts from 22 different countries, representing the track areas with outstanding expertise. After a detailed reviewing process, 34 papers were selected for presentation, namely: 27 in the Foundations of Computer Science, four in the Software Engineering, and three in the Data, Information, and Knowledge Engineering tracks.

As usual, SOFSEM 2017 comprised seven invited talks There was unifying talk:

- "Dependable and Optimal Cyber-Physical Systems," by Kim Guldstrand Larsen (Aalborg University, Denmark)

And two talks for each thematic track:

- "Trends and Challenges in Predictive Analytics," by Jaakko Hollmèn (Aalto University, Finland)
- "On Featured Transition Systems," by Axel Legay (Rennes University and Inria, France)
- "Domain-Specific Languages: A Systematic Mapping Study," by Marjan Mernik (University of Maribor, Slovenia)

- "Model-Driven Development in Practice: From Requirements to Code," by Óscar Pastor López (Polytechnic University of Valencia, Spain)
- "Network Constructors: A Model for Programmable Matter," by Paul G. Spirakis (University of Liverpool, UK)
- "Verifying Parametric Thread Creation," by Igor Walukiewicz (Bordeaux University and CNRS, France).

An integral part of SOFSEM 2017 was the traditional SOFSEM Student Research Forum (chaired by Anila Mjeda, University of Limerick and Lero, Ireland), organized with the aim of presenting student projects in both the theory and practice of computer science, and to give the students feedback on the originality of their results. The papers presented at the Student Research Forum were published in separate local proceedings, available as the *Lero Technical Report*.

In addition, this year's edition introduced an industry track that included a full-day track ASE@SOFSEM organized by Yaping Luo of Altran, The Netherlands, and several demonstrations and presentations.

Moreover, five tutorials profiled emergent and established technologies:

- "Cinco: A Simplicity-Focused Language Workbench for Domain-Specific Graphical Modeling Environments," by Stefan Naujokat, Johannes Neubauer, Bernhard Steffen (TU Dortmund, Germany)
- "Unifying Theories of Programming: Principles, Theories and Tools," by Andrew Butterfield (Trinity College Dublin and Lero, Ireland)
- "Verification and Test-case Generation from Architectural Models of Automotive Systems," by Cristina Seceleanu (Mälardalen Technical University, Sweden)
- "Plasma Lab Statistical Model Checker: Architecture, Usage, and Extension," by Axel Legay and Louis-MarieTraonouez (Rennes University and Inria, France)
- "Becoming Goldilocks: Privacy and Data Sharing in 'Just Right' Conditions for Software Engineering," by Fayola Peters (University of Limerick and Lero, Ireland) – the Early Career Researcher tutorial

As editors of these proceedings, we are grateful to everyone who contributed to the scientific program of the conference, especially the invited speakers and all the authors of contributed papers. We would like to express our special thanks to:

- The members of the SOFSEM 2017 Program Committee and all external reviewers for their careful reviewing of the submissions
- Anila Mjeda for her preparation and handling of the Student Research Forum
- The SOFSEM Steering Committee, chaired by Július Štuller and supported by Jan van Leeuwen, for guidance and support throughout the preparation of the conference
- The local Organizing Committee, chaired by Anna-Lena Lamprecht (University of Limerick and Lero), with Pavel Tyl (TU Liberec, Czech Republic) as Website Chair and the help and support of Susan Mitchell and Dara O'Connor (Lero), Andrew Butterfield, Brian Fitzgerald, Clare McInerney and Brian O'Donnellan (Lero), Gerard Mulligan and Denis Hogan (Lero, tech support), Colm Mc Gettrick and Tony Irwin (CSIS, tech support)

- The OCS team in Dortmund for their support with the OCS conference management system and their immediate reaction to requests
- Springer for their continued support of the SOFSEM conferences
- Lero for publishing the second volume of the proceedings (at conference)

We are greatly indebted to Easy Conferences, in particular Petros Stratis, Melita Rolandi Stratis, Boyana Slavova, Sotia Demetriou, Marios Christou, and Kyriakos Georgiadis, for the event management of SOFSEM 2017.

We received generous sponsoring: We thank the Science Foundation Ireland, whose support through the SFI Conference and Workshops program made this rich program and in particular the many keynotes possible, and Altran (Eindhoven, The Netherlands) for their industrial sponsorship of the ASE@SOFSEM track. The generosity of the Slovak Society for Computer Science sponsored again the Best Student Paper Award.

We hope the readers of the proceedings gain valuable new insights that hopefully contribute to their research and its uptake.

November 2017

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Trends and Challenges in Predictive Analytics (Abstract of Invited Talk)

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Abstract. Predictive analytics is one of the most popular areas in machine learning and data mining. I will start by reviewing some fundamentals in data science and then focus on time series analysis and prediction. In the talk, I will present recent trends in predictive analytics, covering reducing dimensionality of the data space, stream processing, learning interpretable models, and connections to multi-label classification. I will also speak about patterns of missing data and its implications on predictive analytics in stream processing where no missing data imputation is possible. The solutions will be demonstrated in the areas of environmental informatics, medical science and transportation areas.

Introduction

The research fields of machine learning [1] and data mining [3] have enjoyed increased attention in recent years, thanks to their ability to generalize beyond recorded past experience in the form of individual cases. The generalized laws can be deployed to function as part of an operational data processing systems to make estimations of unknown quantities or predictions.

In the talk, I will review fundamentals of data analysis, including the curse of dimensionality and the concept of generalization. Then, I will speak about recent trends in predictive analysis, including highlights from my own research. Making predictive models transparent and understandable has high priority in many domains such as medical diagnostics. One approach is to reduce the number of variables in the prediction model, or to make the model representation compact, or sparse. Sparsity can be enforced by a search procedure in the space of regressors [10, 12] or by optimizing a penalized cost function that enforces sparsity [2, 11]. Reporting of results in a compact and understandable form has been the topic our previous pattern mining research in the context of cancer genomics application [4]. Prediction models could very well be described in natural language [9] as well. Recent work in multi-label classification and its connections to sequence prediction will be reviewed [5, 7, 8].

Although the popular discussion around Big Data has emphasized the power of fusing data from many sources to improve results, the heterogeneity of the data poses many challenges. The missing data found in many practical data sources is so prevalent that only a rather small portion of the data contains valid values. If we select variables

to be included in the analysis by the prevalence of missing data, we may end up with only a handful of variables, despite the large number of original data sources. This provides an immediate motivation for investigating missing data in the context of predictive models. Our theoretical studies [13] and applications in predicting quantities in environmental monitoring context [14] show how the prediction results rapidly deteriorate when missing values are present and when missing value imputation [6] is not possible. We provide novel optimization criteria for learning linear predictive models, when the prevalence of missing data is known.

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