Lecture Notes in Artificial Intelligence 11177

Subseries of Lecture Notes in Computer Science

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Preface

This volume contains the papers selected for presentation at the 24th International Symposium on Methodologies for Intelligent Systems (ISMIS 2018), which was held in Limassol, Cyprus, October 29–31, 2018. The symposium was organized by the Department of Computer Science at the University of Cyprus. ISMIS is a conference series that started in 1986. Held twice every three years, it provides an international forum for exchanging scientific, research, and technological achievements in building intelligent systems. In particular, major areas selected for ISMIS 2018 include bioinformatics and health informatics, graph mining, image analysis, intelligent systems, mining complex patterns, novelty detection and class imbalance, social data analysis, spatio-temporal analysis, topic modeling and opinion mining. This year, three special sessions were organized: namely, Special Session on Intelligent Methodologies for Traffic Data Analysis and Mining, Special Session on Advanced Methods in Machine Learning for Modeling Complex Data, and Special Session on Granular and Soft Clustering for Data Science. Moreover, this year, the ISMIS conference was co-located with the 21st International Conference on Discovery Science (DS 2018).

We received 59 submissions that were carefully reviewed by three or more Program Committee members or external reviewers. Papers submitted to special sessions were subject to the same reviewing procedure as those submitted to regular sessions. After a rigorous reviewing process, 32 regular papers, eight short papers, and four application papers were accepted for presentation at the conference and publication in the ISMIS 2018 proceedings volume.

It is truly a pleasure to thank all the people who helped this volume come into being and made ISMIS 2018 a successful and exciting event. In particular, we would like to express our appreciation for the work of the ISMIS 2018 Program Committee members and external reviewers who helped assure the high standard of accepted papers. We would like to thank all authors of ISMIS 2018, without whose high-quality contributions it would not have been possible to organize the conference. We are grateful to the organizers of special sessions of ISMIS 2018: Pawan Lingras, Georg Peters, Richard Weber, and Hong Yu (Special Session on Granular and Soft Clustering for Data Science), Fabio Liuzzi and Fulvio Rotella (Special Session on Intelligent Methodologies for Traffic Data Analysis and Mining), Yang Liu, Jiming Liu, and Keith C. C. Chan (Special Session on Advanced Methods in Machine Learning for Modeling Complex Data). We also thank the DS program chairs, Larisa Soldatova and Joaquin Vanschoren, for ensuring the smooth coordination with DS and myriad other organizational aspects.

Invited talks were shared between the two meetings (ISMIS and DS). The invited talks for ISMIS 2018 were “Mining Big and Complex Data” by Sašo Džeroski from Jozef Stefan Institute, Slovenia; “Artificial Intelligence and the Industrial Knowledge Graph” by Michael May from Siemens, Germany, and “Bridging the Gap Between Data Diversity and Data Dependencies” by Jean-Marc Petit from INSA Lyon and
Université de Lyon, France. The DS invited talks were “Automating Predictive Modeling and Knowledge Discovery” by Ioannis Tsamardinos from the University of Crete, Greece, and “Emojis, Sentiment, and Stance in Social Media” by Petra Kralj Novak from Jozef Stefan Institute, Slovenia. Abstracts of all five invited talks are included in these proceedings. We wish to express our thanks to all the invited speakers for accepting our invitation to give plenary talks.

We are thankful to Alfred Hofmann of Springer for supporting the ISMIS 2018 Best Paper and Best Student Paper awards and for his continuous support. We also thank Anna Kramer from Springer for her work on the proceedings.

We believe that the proceedings of ISMIS 2018 will become a valuable source of reference for your ongoing and future research activities.

July 2018

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Invited Talks
Mining Big and Complex Data

Sašo Džeroski
Jozef Stefan Institute and Jozef Stefan International Postgraduate School, Slovenia

Abstract. Increasingly often, data mining has to learn predictive models from big data, which may have many examples or many input/output dimensions and may be streaming at very high rates. Contemporary predictive modeling problems may also be complex in a number of other ways: they may involve (a) structured data, both as input and output of the prediction process, (b) incompletely labelled data, and (c) data placed in a spatio-temporal or network context.

The talk will first give an introduction to the different tasks encountered when learning from big and complex data. It will then present some methods for solving such tasks, focusing on structured-output prediction, semi-supervised learning (from incompletely annotated data), and learning from data streams. Finally, some illustrative applications of these methods will be described, ranging from genomics and medicine to image annotation and space exploration.
Artificial Intelligence and the Industrial Knowledge Graph

Michael May
Siemens, Munich, Germany

Abstract. In the context of digitalization Siemens is leveraging various technologies from artificial intelligence and data analytics connecting the virtual and physical world to improve the entire customer value chain. The internet of things has made it possible to collect vast amount of data about the operation of physical assets in real time, as well as storing them in cloud-based data lakes. This rich set of data from heterogeneous sources allows addressing use cases that have been impossible only a few years ago. Using data analytics e.g. for monitoring and predictive maintenance is nowadays in wide-spread use.

We also find an increasing number of use cases based on Deep Learning, especially for imaging applications. In my talk I will argue that these techniques should be complemented by AI-based approaches that have originated in the knowledge representation & reasoning communities.

Especially industrial knowledge graphs play an important role in structuring and connecting all the data necessary to make our digital twins smarter and more effective. The talk gives an overview of existing and planned application scenarios incorporating AI technologies, data analytics and knowledge graphs within Siemens, e.g. building digital companions for product design and configuration or capturing the domain knowledge of engineering experts from service reports using Natural Language Processing.
Bridging the Gap Between Data Diversity and Data Dependencies

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1 Motivation

Data are one of the four pillars of computer science, along with algorithms, languages and machines, and play a major role in the development of our digital societies. Data are diverse, they can be very simple or arbitrarily complex. Moreover, “real-life” data are known to be inconsistent, uncertain, heterogeneous and therefore often qualified as dirty. In addition, their diversity comes also from their implicit intended meaning related to the applications which produce them. Data diversity is one of the main problem in practise to deal with large amount of data.

Around the notion of data, data dependencies are declarative statements allowing to express constraints that data have to satisfy in every possible instance. By essence, data dependencies can be qualified as clean.

They turn out to be useful in many applications: for years, we know their importance in database design where functional dependencies and many others like inclusion dependencies or multi-valued dependencies have played a major role [1] to explain why database schemas have to be normalized to avoid update, insertion and suppression anomalies. Another, more recent, application of data dependencies is related to data quality where many dependencies such as conditional functional dependencies, matching dependencies [7] or denial dependencies [6] have been proposed to partially bring answers to dirty data problems.

For the former application, dependencies are specified before data production occurs whereas for the latter, dependencies are defined whereas the data are already around.

Roughly speaking, many data dependencies have been proposed to take into account some aspects of data diversity. Moreover “clean” data dependencies for dirty data have been extensively studied by different communities, for instance in databases [4, 7], fuzzy systems [8] or formal concept analysis [2, 3] to mention a few.
2 Keynote Overview

In this talk, my ambition is to bridge the gap between data diversity and data dependencies. I will come back to the very simple notion of logical implication, a concept introduced for years in logics and used by humankind since the beginning of humanity. Then I will introduce the main ingredients to represent most of data dependencies proposed in the literature. Focusing on dependencies similar to functional dependencies, a declarative query language, called RQL, will be presented. RQL turns out to be a user-friendly SQL-like query language devoted to data dependencies [5]. Finally, I will consider how lattice theory based structural properties of attribute domains give an original angle to revisit existing data dependencies [9].

Acknowledgments. Most of the material presented here follows from intense (and diverse !) discussions with Prof. Lhouari Nourine (Université Clermont Auvergne), without forgetting those with Marie Pailloux, Brice Chardin and Emmanuel Coquery. This work is partially supported by the Qualisky project (http://projets.isima.fr/qualisky/), funded by the CNRS under the Mastodon program.

References

Automating Predictive Modeling and Knowledge Discovery

Ioannis Tsamardinos

University of Crete, Greece

Abstract. There is an enormous, constantly increasing need for data analytics (collectively meaning machine learning, statistical modeling, pattern recognition, and data mining applications) in a vast plethora of applications and including biological, biomedical, and business applications. The primary bottleneck in the application of machine learning is the lack of human analyst expert time and thus, a pressing need to automate machine learning, and specifically, predictive and diagnostic modeling. In this talk, we present the scientific and algorithmics problems arising from trying to automate this process, such as appropriate choice of the combination of algorithms for preprocessing, transformations, imputation of missing values, and predictive modeling, tuning of the hyper-parameter values of the algorithms, and estimating the predictive performance and producing confidence intervals. In addition, we present the problem of feature selection and how it fits within an automated analysis pipeline, arguing that feature selection is the main tool for knowledge discovery in this context.
Abstract. Social media are computer-based technologies that provide means of information and idea sharing, as well as entertainment and engagement handly available as mobile applications and websites to both private users and businesses. As social media communication is mostly informal, it is an ideal environment for the use of emoji. We have collected Twitter data and engaged 83 human annotators to label over 1.6 million tweets in 13 European languages with sentiment polarity (negative, neutral, or positive). About 4% of the annotated tweets contain emojis. We have computed the sentiment of the emojis from the sentiment of the tweets in which they occur. We observe no significant differences in the emoji rankings between the 13 languages. Consequently, we propose our Emoji Sentiment Ranking as a European language-independent resource for automated sentiment analysis. In this talk, several emoji, sentiment and stance analysis applications will be presented, varying in data source, topics, language, and approaches used.
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