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Khalid Saeed · Jiří Dvorský (Eds.)

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Bialystok, Poland

Jiří Dvorský
VSB - Technical University of Ostrava
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Preface

CISIM 2021 was the 20th conference in a series dedicated to computer information systems and industrial management applications. This year it was held during September 24–26, 2021, in Ełk, Poland, organized by the Faculty of Computer Science at the Bialystok University of Technology.

69 papers were submitted to CISIM 2021 by researchers and scientists from universities around the world. Each paper was assigned to three referees initially, and the decision of acceptance was taken after receiving two positive reviews. In case of conflicting decisions, another expert's review was sought for a number of papers. In total, about 220 reviews were collected from the referees for the submitted papers. Because of the strict restrictions of Springer's *Lecture Notes in Computer Science* series, the number of accepted papers was limited. Furthermore, a number of electronic discussions were held between the Program Committee (PC) chairs and members or external reviewers to make decisions on papers with conflicting reviews and to reach a consensus. After the discussions, the PC chairs decided to accept for publication in the proceedings about 55% of the submitted papers.

The main topics covered by the chapters in this book are biometrics, security systems, multimedia, classification and clustering with application, and industrial management. Besides these, the reader will find interesting papers on computer information systems as applied to wireless networks, computer graphics, and intelligent systems. This is in addition to the five interesting papers on Kansei engineering that were selected from the ten papers submitted to the Workshop on Biometrics and Kansei Engineering (ICBAKE).

We are grateful to the three esteemed speakers for their keynote addresses. The authors of the keynote talks were Alessandra De Benedictis (University of Naples Federico II, Italy), Witold Pedrycz (University of Alberta, Canada), and Roy Maxion (Carnegie Mellon University, USA). Also Anna Bartkowiak from Wrocław University, Poland, submitted a very interesting invited paper.

We would like to thank all the members of the PC and the external reviewers for their dedicated efforts in the paper selection process. We are indebted to Nobuyuki Nishiuchi and Makoto Fukumoto for their efforts in conducting the workshop of ICBAKE. Special thanks are extended to the members of the Organizing Committee, both international and local, and the Springer team for their great efforts to make the conference another success. We are also grateful to Andrei Voronkov, whose EasyChair system eased the submission and selection process.

We hope that the reader's expectations will be met and that the participants enjoyed their stay in the beautiful city of Ełk along with the conference.

September 2021

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Keynotes

Toward the Automation of Security Analysis, Design and Assessment in the Development Process

Alessandra De Benedictis

University of Naples Federico II, Naples, Italy
alessandra.debenedictis@unina.it

Abstract. Modern software development methodologies like DevOps or Agile are very popular and widely used, especially for the development of cloud services and applications, as they dramatically reduce the time-to market by means of continuous software delivery. Unfortunately, traditional DevOps processes do not include security design and risk management practices by default, and often take security into account only after the completion of the coding stage, with the risks that security flaws may be found too late and cause significant delays in the development process.

Recent SecDevOps methodologies aim at integrating security activities such as threat modeling, countermeasure selection, static and dynamic code analysis, security assessment and security testing into DevOps workflows. Since security operations typically require the engagement of (expensive) security teams and inevitably slow down the development process, automated security design and assessment techniques are needed to preserve DevOps productivity and reduce costs.

Despite the efforts that have been recently made to provide techniques and tools able to fully or partially automate security-related activities, security analysis and testing operations still heavily require the intervention of security experts, typically assisted by a plethora of tools whose adoption requires deep technological skills.

This talk aims to discuss possible strategies and techniques meant to reduce the complexity of security management in a development process, and to support developers from the early security analysis stages to post-development security testing by means of partly or fully-automated techniques for threat modeling, risk evaluation, countermeasure selection, static and dynamic assessment.

Experiments, Methods, Measurements, Instruments: A Few Details

Roy Maxion

Carnegie Mellon University, Pennsylvania, USA
maxion@cs.cmu.edu

Abstract. Much of computer science and computer security & privacy is based on the results of experiments. The dependability or reliability of these results turns on a number of details regarding the experimental methodology itself, how various experimental factors are measured, and the instruments with which those measurements are taken. This talk reviews a few details of experimentation that are overlooked at the risk of failure or, perhaps worse, propagating wrong results.

Logic Constructs with Information Granules: Data Analytics

Witold Pedrycz

University of Alberta, Edmonton, Canada
pedrycz@ee.ualberta.ca

Abstract. In data analytics, system modeling, and decision-making models, the aspects of interpretability and explainability are of paramount relevance, just to refer to explainable Artificial Intelligence (XAI). They are especially timely in light of the increasing complexity of systems one has to cope with. We advocate that there are two factors that immensely contribute to the realization of the above important features, namely, a suitable level of abstraction in describing the problem and a logic fabric (topology) of the resultant construct. It is advocated that their conceptualization and the consecutive realization can be conveniently carried out with the use of information granules (for example, fuzzy sets, sets, rough sets, and alike).

Concepts are building blocks forming the interpretable environment capturing the essence of data and key relationships existing there. The emergence of concepts is supported by a systematic and focused analysis of data. At the same time, their initialization is specified by stakeholders or/and the owners and users of data. We present a comprehensive discussion of information granules-directed design of concepts and their description by engaging an innovative mechanism of conditional (concept)- driven clustering. It is shown that the initial phase of the process is guided by the formulation of some generic (say, low profit) or some complex multidimensional concepts (say, poor quality of environment or high stability of network traffic) all of which are described by means of some information granules. In the sequel is explained by other variables through clustering focuses by the context. The description of concepts is delivered by a logic expression whose calibration is completed by a detailed learning of the associated logic neural network. The constructed network helps quantify contributions of individual information granules to the description of the underlying concept and facilitate a more qualitative characterization achieved with the aid of linguistic approximation. This form of approximation delivers a concise and interpretable abstract description through linguistic quantifiers. A detailed case study of systematic interpretability concerns functional rule-based models with the rules in the form "if x is A then y=f(x)". The layers at which interpretability is positioned are structured hierarchically by starting with the initial fuzzy set level (originating from the design of the rules), moving to information granules of finite support (where interval calculus is engaged) and finally ending up with symbols built at the higher level. The rules emerging at the level of symbols are further interpreted by engaging linguistic approximation. For high-dimensional problems, dimensionality reduction is realized with the aid of relational matrix factorization which transforms original fuzzy set-based encoded variables and results in a logic-oriented level of activation of individual rules.

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