Yamine Aït-Ameur
Florin Crăciun (Eds.)

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Theoretical Aspects of Software Engineering

16th International Symposium, TASE 2022
Cluj-Napoca, Romania, July 8–10, 2022
Proceedings

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Preface

The International Symposium on Theoretical Aspects of Software Engineering (TASE) gathers researchers and practitioners interested by the new results on innovative advances in software engineering. It records the latest developments in formal and theoretical software engineering methods and techniques.

The 16th edition of TASE was held in the beautiful city of Cluj-Napoca in Romania during July 8–10, 2022. TASE 2022 received 71 submissions covering different areas of theoretical software engineering. Each paper was reviewed by at least three reviewers and the Program Committee accepted 21 long papers and five short papers leading to an attractive scientific program.

This edition of TASE was enhanced by the presence of four keynote speakers. The first talk, given by Erika Àbrahàm from RWTH Aachen University in Germany, entitled "SMT Solving: Historical Roots, Recent Developments and Future Directions" dealt with SMT-based formal verification techniques and provided a technical view on the progress in SMT solving. In the second talk entitled "Practical Theory of Computation on Structures", Klaus-Dieter Schewe, from the ZJU-UIUC Institute in China, sketched a theory of computation centered around the notion of algorithmic systems. The two other talks dealt with formal software engineering and artificial intelligence. The talk of Sun Jun, from the Singapore Management University in Singapore, entitled "Neural Network Discrimination: Evaluation, Mitigation and Certification" addressed certification of fairness of neural networks using formal verification techniques. The last talk entitled "Rigorous system design for AI software" given by Saddek Bensalem, from Verimag at the University of Grenoble Alpes in France, presented the results of the FOCETA European project in rigorous verification and validation of critical systems.

TASE 2022 would not have succeeded without the deep investment and involvement of the Program Committee members and the external reviewers who evaluated (with more than 215 reviews) and selected the best contributions. This event would not exist without the authors and contributors who submitted their proposals. We address our thanks to everyone—reviewers, authors, Program Committee members, and organization committee members—involved in the success of TASE 2022.

The EasyChair system was set up for the management of TASE 2022, supporting submission, review, and volume preparation processes. It proved to be a powerful framework.

TASE 2022 had one affiliated workshop, the International Workshop on Formal Engineering of Cyber-Physical Systems, which brought additional participants to the symposium and helped make it an interesting and successful event. We thank all the workshop chairs, organizers, and authors for their hard work on this.

TASE 2022 was hosted and sponsored by Babeș-Bolyai University, Cluj-Napoca, Romania. The local organization committee offered all the facilities to run the event in a lovely and friendly atmosphere. Many thanks to all the local organizers.

Lastly, we wish to express our special thanks to the steering committee members, in particular Shengchao Qin and Huibiao Zhu, for their valuable support.

July 2022

Yamine Aït-Ameur
Florin Crăciun

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Keynotes

Neural Network Discrimination: Evaluation, Mitigation and Certification

Jun Sun

Singapore Management University

Abstract. In recent years, neural network based machine learning has found its way into various aspects of people's daily life, such as face recognition, personal credit rating, and medical diagnose. One desirable property of neural networks for applications with societal impact is fairness. Since there are often societal biases in the training data, the resultant neural networks might be discriminative as well. Recently, there have been multiple attempts on improving fairness of neural networks, with a focus on fairness testing.

In this line of research, we develop a series of approaches and associated software tool-kits to evaluate a given neural network's fairness by systematically generating discriminatory instance (published at ICSE'20), to mitigate discrimination in the neural network by fining tuning a small number of guilty neurons (published at ICSE'22), and to certify the neural network's fairness through formal verification (published at FM'21). We demonstrate that with our approaches are both effective and efficiency using real-world applications.

SMT Solving: Historical Roots, Recent Developments and Future Directions

Erika Ábrahám

RWTH Aachen University, Germany

The development of decision procedures for checking the satisfiability of logical formulas has a long history in mathematical logic and symbolic computation. Besides theoretical interest, their automation in the 60's raised their practical importance and increased the intensity of research in this area. Besides computer algebra systems on the mathematical side, in the 90's another line of developments has been initiated in computer science. Unified under the name *satisfiability checking*, powerful SAT and SAT-modulo-theories (SMT) solvers have been developed that are nowadays at the heart of many techniques for the synthesis and analysis of software and hardware systems with probabilistic, timed, discrete, dynamical or discrete-continuous components, and in general for all types of large combinatorial problems like complex planning and scheduling tasks.

In this talk we give a historical overview of this development, describe our own solver SMT-RAT, discuss some fascinating new developments for checking the satisfiability of real-arithmetic formulas, and conclude with some challenges for potential future research directions.

Rigorous System Design for AI Software

Saddek Bensalem

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Abstract. The convergence of scientific and technological developments in computing and networking with the physical side and Artificial Intelligence (AI) will impact the forthcoming period concerning several system aspects and disciplines. Learning-enabled Systems represent an example of that convergence, which embraces engineering and technological products. The learning-enabled system technologies are expected to bring large-scale improvements through new products and services across various applications ranging from healthcare to logistics through manufacturing, transport, and more. Software is inarguably the enabling factor for realizing such systems. Unfortunately, we still encounter deployment limitations in the safety-critical application (transportation, healthcare, etc.) due to a lack of trust, behavioral uncertainty, and technology compatibility with safe and secure system development methods. I will first provide an overview of the project FOCETA1 (FOundations for Continuous Engineering of Trustworthy Autonomy) and discuss its strategic goal and its challenges. In the second part of my talk, I will present the problem of the verification and validation methods considered in the project and discuss future research directions.

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