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Augusto Sampaio · Farn Wang (Eds.)

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13th International Colloquium
Taipei, Taiwan, ROC, October 24–31, 2016
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Preface

This volume contains the papers presented at ICTAC 2016, the 13th International Colloquium on Theoretical Aspects of Computing, held during October 24–31, 2016, in Taipei, Taiwan, ROC.

The International Colloquium on Theoretical Aspects of Computing (ICTAC) is a series of annual events founded in 2004 by the United Nations International Institute for Software Technology. Its purpose is to bring together practitioners and researchers from academia, industry, and government to present research results and exchange experiences and ideas. Beyond these scholarly goals, another main purpose is to promote cooperation in research and education between participants and their institutions from developing and industrial regions.

The city of Taipei, where this edition of ICTAC took place, is the capital and the largest city of Taiwan, ROC (Republic of China). The National Taiwan University (NTU), host of the colloquium, is the top university in Taiwan with 17,000 undergraduate students and 15,000 graduate students. The Department of Electrical Engineering of NTU, where most ICTAC 2016 sessions have been held, is the leading research group in Taiwan and has technical contributions to Taiwan's world-renowned giants, including TSMC, MediaTek, Quanta Computers, etc. ICTAC 2016 was sponsored by Microsoft Research, Springer, EasyChair, the Ministry of Science and Technology (ROC), the Ministry of Education (ROC), the Ministry of Economical Affairs (ROC), the Taipei Municipal Government, and the National Taiwan University.

In this edition of ICTAC, we had four invited speakers: Hsu-Chun Yen, from the National Taiwan University; Leonardo de Moura, from Microsoft Research, USA; Heike Wehrheim, form Universität Paderborn, Germany; and Wen-Lian Hsu, from Academia Sinica, Taiwan. They delivered keynote speeches as well as tutorials.

ICTAC 2016 received 60 submissions from 26 different countries. Each submission was reviewed by at least three members of the Program Committee, along with help from external reviewers. Out of these 60 submissions, 23 regular papers were accepted. The committee also accepted one short paper and one tool paper. Apart from the paper presentations and invited talks, ICTAC 2016 continued the tradition of previous ICTAC conferences in holding a five-course school on important topics in theoretical aspects of computing.

We thank all the authors for submitting their papers to the conference, and the Program Committee members and external reviewers for their excellent work in the review, discussion, and selection process. We are indebted to all the members of the Organizing Committee, including Dr. Churn-Jung Liau (Academia Sinica), Prof. Jonathan Lee (NTU), Dr. Yu-Fang Chen (Academia Sinica), and Prof. Fang Yu (National Cheng-Chi University), for their hard work in all phases of the conference, as well as to Filipe Arruda and Gustavo Carvalho, who helped enormously with managing EasyChair and several other operational aspects of the reviewing and proceedings

creation process. We also acknowledge our gratitude to the Steering Committee for their constant support.

We are also indebted to EasyChair that greatly simplified the assignment and reviewing of the submissions as well as the production of the material for the proceedings. Finally, we thank Springer for their cooperation in publishing the proceedings, and for the sponsorship of the two best paper awards.

August 2016

Augusto Sampaio
Farn Wang

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Invited Papers

Verification of Concurrent Programs on Weak Memory Models

Oleg Travkin and Heike Wehrheim

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Abstract. Modern multi-core processors equipped with weak memory models seemingly reorder instructions (with respect to program order) due to built-in optimizations. For concurrent programs, weak memory models thereby produce interleaved executions which are impossible on sequentially consistent (SC) memory. Verification of concurrent programs consequently needs to take the memory model of the executing processor into account. This, however, makes most standard software verification tools inapplicable.

In this paper, we propose a technique (and present its accompanying tool WEAK2SC) for *reducing* the verification problem for weak memory models to the verification on SC. The reduction proceeds by generating – out of a given program and weak memory model (here, TSO or PSO) – a new program containing all reorderings, thus already exhibiting the additional interleavings on SC. Our technique is *compositional* in the sense that program generation can be carried out on single processes without ever needing to inspect the state space of the concurrent program. We formally prove compositionality as well as soundness of our technique.

WEAK2SC takes standard C programs as input and produces program descriptions which can be fed into automatic model checking tools (like SPIN) as well as into interactive provers (like KIV). Thereby, we allow for a wide range of verification options. We demonstrate the effectiveness of our technique by evaluating WEAK2SC on a number of example programs, ranging from concurrent data structures to software transactional memory algorithms.

Petri Nets and Semilinear Sets (Extended Abstract)

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Abstract. Semilinear sets play a key role in many areas of computer science, in particular, in theoretical computer science, as they are characterizable by Presburger Arithmetic (a decidable theory). The reachability set of a Petri net is not semilinear in general. There are, however, a wide variety of subclasses of Petri nets enjoying semilinear reachability sets, and such results as well as analytical techniques developed around them contribute to important milestones historically in the analysis of Petri nets. In this talk, we first give a brief survey on results related to Petri nets with semilinear reachability sets. We then focus on a technique capable of unifying many existing semilinear Petri nets in a coherent way. The unified strategy also leads to various new semilinearity results for Petri nets. Finally, we shall also briefly touch upon the notion of *almost semilinear sets* which witnesses some recent advances towards the general Petri net reachability problem.

The Lean Theorem Prover

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Abstract. Lean is a new open source theorem prover being developed at Microsoft Research and Carnegie Mellon University, with a small trusted kernel based on dependent type theory. It aims to bridge the gap between interactive and automated theorem proving, by situating automated tools and methods in a framework that supports user interaction and the construction of fully specified axiomatic proofs. The goal is to support both mathematical reasoning and reasoning about complex systems, and to verify claims in both domains. Lean is an ongoing and long-term effort, and much of the potential for automation will be realized only gradually over time, but it already provides many useful components, integrated development environments, and a rich API which can be used to embed it into other systems.

In this talk, we provide a short introduction to the Lean theorem prover, describe how mathematical structures are encoded in the system, quotient types, the type class mechanism, and the main ideas behind the novel meta-programming framework available in Lean. More information about Lean can be found at http://leanprover.github.io. The interactive book "Theorem Proving in Lean"[1] is the standard reference for Lean. The book is available in PDF and HTML formats.

[1] http://leanprover.github.io/tutorial.

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