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Kim Guldstrand Larsen · Igor Potapov
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Reachability Problems

10th International Workshop, RP 2016
Aalborg, Denmark, September 19–21, 2016
Proceedings

Editors

Kim Guldstrand Larsen
Aalborg University
Aalborg
Denmark

Jiří Srba
Aalborg University
Aalborg
Denmark

Igor Potapov
University of Liverpool
Liverpool
UK

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Preface

This volume contains the papers presented at the 10th International Workshop on Reachability Problems (RP), held on September 19–21, 2016, at Aalborg University, Denmark. Previous workshops in the series were located at: the University of Warsaw (2015), the University of Oxford (2014), Uppsala University (2013), the University of Bordeaux (2012), the University of Genoa (2011), Masaryk University Brno (2010), École Polytechnique (2009), the University of Liverpool (2008), and Turku University (2007).

The aim of the conference is to bring together scholars from diverse fields with a shared interest in reachability problems, and to promote the exploration of new approaches for the modelling and analysis of computational processes by combining mathematical, algorithmic, and computational techniques. Topics of interest include (but are not limited to): reachability for infinite state systems; rewriting systems; reachability analysis in counter/timed/cellular/communicating automata; Petri nets; computational aspects of semigroups, groups, and rings; reachability in dynamical and hybrid systems; frontiers between decidable and undecidable reachability problems; complexity and decidability aspects; predictability in iterative maps, and new computational paradigms. The invited speakers at the 2016 workshop were:

- Alain Finkel, ENS de Cachan, France
- Axel Legay, INRIA, Rennes Cedex, France
- Jaco van de Pol, University of Twente, Netherlands.

The workshop received 18 submissions. Each submission was reviewed by three Program Committee (PC) members. The members of the PC and the list of external reviewers can be found on the next two pages. The PC is grateful for the high quality work produced by these external reviewers. Based on these reviews, the PC decided to accept 11 papers, in addition to the three invited talks. Overall this volume contains 11 contributed papers and 2 papers by invited speakers. The workshop also provided the opportunity to researchers to give informal presentations, prepared shortly before the event, informing the participants about current research and work in progress.

We gratefully acknowledge the help of Rikke W. Uhrenholt in organizing the event, as well as CISS (Center for Embedded Software Systems) for the financial support. It is also a pleasure to thank the team behind the EasyChair system and the Lecture Notes in Computer Science team at Springer, who together made the production of this volume possible in time for the workshop. Finally, we thank all the authors for their high-quality contributions, and the participants for making RP 2016 a success.

September 2016

Kim Guldstrand Larsen
Igor Potapov
Jiří Srba

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Abstracts of Invited Talks

The Ideal Theory for WSTS

Alain Finkel

LSV, ENS Cachan and CNRS, Université Paris-Saclay, Cachan, France
finkel@lsv.ens-cachan.fr

Abstract. We begin with a survey on well structured transition systems and, in particular, we present the ideal framework which was recently used to obtain new deep results on Petri nets and extensions. We argue that the theory of ideals prompts a renewal of the theory of WSTS by providing a way to define a new class of monotonic systems, the so-called Well Behaved Transition Systems, which properly contains WSTS, and for which coverability is still decidable by a forward algorithm. We then recall the completion of WSTS which leads to defining a conceptual Karp-Miller procedure that terminates in more cases than the generalized Karp-Miller procedure on extensions of Petri nets.

Rare Events for Statistical Model Checking: An Overview

Axel Legay, Sean Sedwards, and Louis-Marie Traonouez

Inria Rennes – Bretagne Atlantique, Rennes, France

Abstract. This invited paper surveys several simulation-based approaches to compute the probability of rare bugs in complex systems. The paper also describes how those techniques can be implemented in the professional toolset Plasma.

High Performance Reachability

Algorithms – Extensions – Interface

Jaco van de Pol

University of Twente, Enschede, The Netherlands

Abstract. Reachability analysis is heavily used in the verification of complex systems with discrete dynamics. Due to the combinatorial nature of data and processes, the graphs corresponding to their state space become very large. Algorithmic improvements can lead to exponential gains, as witnessed by BDD technology (binary decision diagrams) and POR (partial order reduction). Implementing these algorithms on massively parallel hardware can yield several extra orders of speedup. However, parallelising graph analysis applications is notoriously hard.

This invited lecture will address the many challenges in designing parallel graph algorithms and discuss the intricacies of symbolic verification algorithms for reachability and liveness. We will also address the required effort to develop prototypes that demonstrate actual speedup on distributed and multi-core computers. We will share the experience we gained with the LTSmin toolset¹.

LTSmin offers distributed and parallel algorithms for explicit-state model checking (with POR) and symbolic reachability analysis (with BDDs). It offers LTL model checking (linear-time liveness properties) and mu-calculus model checking (a powerful branching time logic). At the same time, it provides this functionality to a wide variety of specification formalisms, including process algebras, timed automata, Petri nets, and languages in the Promela and B-families.

The key to this generality is an interface that abstracts from language details on the one hand, but exposes sufficient model structure on the other hand. Our PINS interface is based on state vectors and disjunctive transition groups, and equipped with static information on transitions, like their read/write dependencies on variables, and their mutual independence.

We will also shortly discuss the limitations and future perspectives of integrating more analysis algorithms, or more specification formalisms, or verify software directly, and of exploiting heterogeneous hardware, for instance GPU clusters.

¹ <http://fmt.cs.utwente.nl/tools/ltsmin>

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