



Software Engineering Seminar (WS 2015)

SMT-Based Bisimulation and Verification of Markov Models

Description

Markov models are a popular mean for modeling and verification of a system's non-functional properties. However, most of the verification procedures are based on heavy numerical routines and suffer of state space explosion issues. Bisimulation minimization is a state space reduction technique that can often reduce the impact of state space explosion. On the other hand, it usually requires an explicit representation of the state space, which might be unfeasible for large systems.

In [2] a bisimulation minimization approach has been proposed, which leverage an SMT solver to extract the minimized system from the extended specification.

The goal of this seminar is to study and reproduce the approach of [2] for bisimulation minimization, using the SMT solver Microsoft Z3. As an additional extension, the student may develop an SMT-based verification.

This work might be optionally extended for a MS Thesis.

Prerequisites

A basic knowledge of SAT and SMT, and familiarity with automata and logics are required.

References

- [1] Christel Baier, Joost-Pieter Katoen, et al. *Principles of model checking*, volume 26202649. MIT press Cambridge, 2008.
- [2] J.-P. Katoen C. Dehnert and D. Parker. SMT-based bisimulation minimisation of Markov models. In R. Giacobazzi, J. Berdine, and I. Mastroeni, editors, *Proc. 14th International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI'13)*, volume 7737 of *LNCS*, pages 28–47. Springer, 2013.
- [3] Joost-Pieter Katoen, Tim Kemna, Ivan Zapreev, and DavidN. Jansen. Bisimulation minimisation mostly speeds up probabilistic model checking. In Orna Grumberg and Michael Huth, editors, *Tools and Algorithms for the Construction and Analysis of Systems*, volume 4424 of *Lecture Notes in Computer Science*, pages 87–101. Springer Berlin Heidelberg, 2007.

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