Probabilistic Real-time Systems

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Abstract

Probabilistic model checking is a formal verification technique for systems that exhibit stochastic behaviour. It has been used to analyse a wide range of systems, including communication protocols, such as Bluetooth and FireWire, randomised security protocols, e.g. for anonymity and contract signing, and many others. Often, it is also important to consider real-time aspects of the behaviour of such systems. This talk will give an introduction to verification techniques for *probabilistic real-time systems*, which can be modelled as probabilistic timed automata (PTAs). The talk will outline some of the underlying theory, introduce a variety of practical verification techniques for PTAs, and illustrate these ideas with a selection of case studies of probabilistic real-time systems that have been analysed with the probabilistic model checker PRISM.

Background Reading

- For a survey/tutorial on verification of probabilistic timed automata, see [4].

- For tutorial papers on verification techniques for other classes of probabilistic models, see for example [2], which focuses on (discrete- and continuous-time) Markov chains, and [1], which focuses on Markov decision processes and probabilistic automata.

- For a short overview of PRISM, see [3]. For downloads, tutorials, case studies and more, see `http://www.prismmodelchecker.org/`.

References

[1] V. Forejt, M. Kwiatkowska, G. Norman, and D. Parker. Automated verification techniques for probabilistic systems. In M. Bernardo and V. Issarny, editors, *Formal Methods for Eternal Networked Software Systems (SFM'11)*, volume 6659 of *LNCS*, pages 53–113. Springer, 2011.
`http://www.prismmodelchecker.org/bibitem.php?key=FKNP11`.

[2] M. Kwiatkowska, G. Norman, and D. Parker. Stochastic model checking. In M. Bernardo and J. Hillston, editors, *Formal Methods for the Design of Computer, Communication and Software Systems: Performance Evaluation (SFM'07)*, volume 4486 of *LNCS (Tutorial Volume)*, pages 220–270. Springer, 2007.
`http://www.prismmodelchecker.org/bibitem.php?key=KNP07a`.

[3] M. Kwiatkowska, G. Norman, and D. Parker. PRISM 4.0: Verification of probabilistic real-time systems. In G. Gopalakrishnan and S. Qadeer, editors, *Proc. 23rd International Conference on Computer Aided Verification (CAV'11)*, volume 6806 of *LNCS*, pages 585–591. Springer, 2011.
`http://www.prismmodelchecker.org/bibitem.php?key=KNP11`.

[4] Gethin Norman, David Parker, and Jeremy Sproston. Model checking for probabilistic timed automata. *Formal Methods in System Design*, 43(2):164–190, 2013.
`http://www.prismmodelchecker.org/bibitem.php?key=NPS13`.