Quantitative formal verification of probabilisitic systems

Mini-couse with Dr. Milan Češka
Brno University of Technologies, Czech Republic

Room: 11.3.21

Sessions:

Basic	**Advanced**	**Industrial case-studies**
October 3, 2019	October 3, 2019	October 4, 2019
10:00-12:30	14:30-17:00	10:00-12:30

Abstract:

Probabilistic programs are key to deal with randomisation and uncertainty that play key roles in many application domains, e.g. planning under unpredictable environments, dependability wrt. uncertain system components or randomisation for symmetry braking. Probabilistic programs are typically small but intricate and their development is complex and error prone process requiring quantitative reasoning. To mitigate this complexity, quantitative formal verification techniques have been developed.

In this tutorial, we first introduce Markov Chains and Markov Decision Processes providing the semantics of the probabilistic programs. Further, we introduce probabilisitic temporal logic allowing us to formalise specification of the programs. We use several simple examples to demonstrate these concepts in action. Finally, we present basic model-checking algorithms deciding whether the program under study satisfies a given specification formula.

In the second part, we focus on PRISM, a state-of-the-art tool for probabilistic verification. We discuss PRISM high-level modelling language, main verification engines implemented in the tool and their usage. We demonstrate the tool in action: we show how to model some simple as well as more complicated probabilistic systems/protocols, how to formalise their required behaviour, and how to run PRISM and interpret the obtained results.

In the last part (industrial session), we present some interesting case studies demonstrating how PRISM and its various extensions have been used in practically relevant engineering problems in the areas such as distributed algorithms, communication protocols, planning, and system biology.

Short biography:

Milan Češka has completed his Ph.D. thesis in the area of data-parallel algorithms for model checking at the Faculty of Informatics, Masaryk University, Brno, Czech Republic in Jun 2012. Afterwards, he was a research assistant in the Systems Biology Laboratory at the same faculty under supervision of prof. Lubos Brim. From February 2014, he was a postdoctoral researcher at Department of Computer Science at Oxford University in the group led by prof. Marta Kwiatkowska. In May 2016, he returned to Czech Republic as an assistant professor at Faculty of Information Technology, Brno University of Technology. His current research interests include formal methods for automated design of probabilistic and approximate systems, and formal analysis of biochemical systems.