

- BSc/MSc Thesis -

Model Checking Stochastic Games

What is quantitative model checking all about?

In times of ever more complex system designs, it becomes increasingly difficult and often even impossible to manually analyze systems. Yet, for certain systems, e.g. safety-critical ones or ones for which the repair of previously undetected errors may be very cost-intensive, it is crucial to determine whether they behave correctly with respect to the requirements that they are intended to fulfill. Model checking is a fully automated technique to verify properties on a model of the system in a mathematically rigorous way.

Most often real-world models tend to involve stochastic behavior. For example, hardware components inside the system may fail with a given probability or it might be of crucial interest that the system satisfies certain timing constraints. Quantitative model checking extends conventional model checking in a way that enables formal analysis of models involving quantitative aspects.

What is to be done?

Simple stochastic games (SSG) are models in which two players compete for achieving individual goals. In addition to that, certain choices in the game are determined by a probabilistic element, for example a flipping a coin or rolling a die. While these games are structurally simple, there currently is no algorithm that computes the probabilities for achieving the goals that runs in polynomial time. Yet, it has not been proven that the problem is NP-hard, so there is hope for such an algorithm. These games arise naturally when abstracting other probabilistic systems and solving richer formalisms can be reduced to solving SSGs, which implies that is crucial to be able to rapidly verify them in order to enable the analysis of other formalisms. In this thesis, we would like you to

1. implement techniques that solve SSGs in our model checker,
2. survey recent literature and implement promising additions/performance enhancements for solving SSGs,
3. show that your implementation is on par with state-of-the-art solvers for these models.

Optimally, you should...

- be motivated to outperform other tools,
- have some programming experience,
- have basic knowledge in automata theory,
- be capable of working independently.

All other knowledge/skills can be obtained on-the-fly.

We offer...

- a task that requires you to understand the theoretical background of model checking complex models as well as turn your knowledge into an implementation that performs well in practice,
- work at the interface of theory and application,
- a nice coffee machine.

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