PhD Lecture

In partial fulfillment of the terms for obtaining the PhD degree, Frederik Meyer Bønneland will give a lecture on the following subject:

Time For Stubborn Game Reductions

on Monday 7th of June 2021, 09:00 at Microsoft Teams

Abstract:
Computers have grown to encompass almost every aspect of human life. We expect that these systems operate seamlessly and without error, but this can sometimes be unrealistic. While testing is widely used to provide some assurance of fault-freeness, it is an incomplete approach that does not guarantee the absence of errors. For safety-critical systems, we require fault-freeness to safely deploy them in the real world, supported by formal methods such as model checking. However, high computational complexity caused by the state-state explosion problem encumbers model checking.

This thesis seeks to alleviate the state-space explosion and improve model checking's practical applicability by extending the theory of static partial order reductions to timed systems and games, and exploring orthogonal, complementary, and combined techniques.

Partial order reductions prune redundant interleavings of system actions. We extend static partial order reductions to timed systems by exploiting urgent states where time cannot elapse. We develop partial order reductions that preserves winning reachability strategies regardless of antagonistic environment actions. Lastly, we combine these two techniques into a single framework for timed games. We ensure the techniques are correct for general labelled transition systems, and instantiate the techniques to Petri net variants to novelly show significant time and space reductions with limited overhead on a set of case studies.

Next, we refine structural reductions for Petri nets and compare it with static partial order reductions. We show that the two technique are synergistic and allows for verifying more model checking problems.

To improve both structural reductions and static partial order reductions, we extend state equations for Petri nets to formula simplification of CTL formulae. Simplification significantly increases the applicability of both static partial order reductions and structural reductions on the database of models from the 2017 Model Checking Contest.

Members of the assessment committee are Professor Kristian Torp, Aalborg University, Denmark, Professor Karsten Wolf, University of Rostock, Germany, and Professor Doron Peled, Bar Ilan University, Israel. Professor Kim Guldstand Larsen and Professor Jiri Srba are Frederik Meyer Bønneland's supervisors. The moderator is Associate Professor René Rydhof Hansen.

If you want to participate, please send a mail to Professor Kristian Torp, torp@cs.aau.dk