In partial fulfillment of the terms for obtaining the PhD degree, Søren Enevoldsen will give a lecture on the following subject:

**Abstract Dependency Graphs for Model Verification**

on Thursday 15th of December 2022, 13:00, in room 0.2.13 at Selma Lagerlöfs Vej 300

**Abstract:**
Computational systems are ubiquitous nowadays and it is necessary that they operate as intended. Model verification is one technique to formally verify that our design satisfies the properties required of the system. One of the challenges of model verification is that the complexity of the systems modelled is subject to state-space explosion, rendering the system too large to represent in memory. On-the-fly techniques construct only the state space needed for verification and can therefore sometimes avoid using excessive memory. This thesis focuses on extensions and improvements to the on-the-fly algorithms for the dependency graph framework.

We demonstrate, by developing a distributed algorithm, that despite the problem of computing the minimum fixed-point assignment on a dependency graph being P-complete, we can still achieve substantial speed up compared to the original Liu & Smolka fixed point algorithm. The addition of `certain-zero' allows pruning of further computation improving termination speed and memory usage, increasing the number of problems that are solvable. The model checker TAPAAL uses the resulting algorithm and has won gold medals in the CTL model checking category of the annual Model Checking Contest in the years 2018-2022.

The abstract dependency graph framework encompasses many of the separate extensions developed to the original dependency graph framework. We demonstrate the applicability of the framework by encoding CTL model checking of Petri nets and weighted Kripke structures, as well as bisimulation of CCS processes, and simulation of task graphs. The most complex encoding demonstrated in practice is to solve probabilistic weighted ATL on stochastic turn-based games. Comparing against other tools, the abstract dependency graph framework is shown to use only slightly more memory and time; and in some cases the on-the-fly approach enables our algorithm to terminate with the result much sooner.

On a case study we propose a probabilistic FlexOffer, affording more energy flexibility, compared to normal FlexOffers. We demonstrate using UPPAAL Stratego, that not only can we synthesize a controller, but we can also quantify the chance of success for any given schedule.

Members of the assessment committee are Professor Jaco van de Pol, Aarhus University (Denmark), Doctor Radu Mateescu, Inria Grenoble (France), and Associate Professor Álvaro Torralba (Chairman), Aalborg University (Denmark). Supervisor for the thesis has been Professor Kim Gulstrand Larsen, Aalborg University. Co-supervisor for the thesis has been Professor Jirí Srba, Aalborg University and Associate Professor Arne Skou, Aalborg University. Moderator Associate Professor Danny Bøgsted Poulsen.

All interested parties are welcome. After the defense the department will be hosting a small reception in cluster 1.