

Ph.D. Lecture

In partial fulfillment of the terms for obtaining the Ph.D.-degree, Mikkel Larsen Pedersen will give a lecture on the following subject:

Specification Theories for Probabilistic Systems

on Thursday 15th of December 2011, 13.00, in room 02.13 at Selma Lagerlöfs Vej 300

Abstract:

Today systems are too complex to be developed by a single team of developers, thus specifications of subsystems need to be supplied to subcontractors that work independently of each other. To avoid misunderstanding between designer and the subcontractor, specifications must be formal allowing to write specifications in a rigorous and precise manner, and it should be possible to check whether an implementation is a valid realization of a specification.

Throughout the thesis, we focus on systems exhibiting probabilistic behaviour. Probabilities are introduced in system design to model various aspects of real-life systems such as failures or uncertainties, e.g. the risk that a transmission of a message will fail may be estimated with a probability, and the uncertainty of a weather forecast may be represented by assigning probabilities to the possible outcome of the weather.

We advocate and present new results on specification theories for systems exhibiting both non-deterministic and probabilistic behavior. A specification theory is equipped with notions covering the relation between implementation and specification (satisfaction), the relation between specifications (refinement) together with composition operators that allow combining specifications (structural composition and logical composition).

Initially, we consider Markov Chains (MCs) as a basic model for representing probabilistic implementations. We investigate Interval Markov Chains (IMCs), as a specification theory for MCs. Whereas transitions of a given MC are taken with a specific probability, IMCs specify an interval of allowed probabilities. As IMCs are not closed under conjunction and parallel composition, we introduce the concept of Constraint Markov Chains (CMCs), that is the first complete specification theory for MCs.

We further explore the influence of non-deterministic behaviour by mixing CMCs and Modal Transition Systems, a well-known specification theory for Labelled Transition Systems, and consider Probabilistic Automata (PAs), that can be seen as extensions of MCs; in this model, state changes are additionally guarded by actions. We present a specification theory for PAs, namely Abstract Probabilistic Automata (APAs).

Finally, the tool APAC, that implements algorithms for CMCs and APAs, is introduced.

Members of the assessment committee are Director, Professor Dr. Jos Baeten, CWI, The Netherlands, Professor Dr. Roberto Segala, Università di Verona, Italy, and Professor Dr. Anders P. Ravn, Aalborg University, Denmark. Director, Dr. Professor Kim G. Larsen is Mikkel Larsen Pedersen's supervisor.

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