RHEINISCH-
WESTFÄLISCHE
TECHNISCHE
HOCHSCHULE
AACHEN

CHAIR OF
COMPUTER SCIENCE 2
SOFTWARE MODELING
AND VERIFICATION
(MOVES)

- Bachelor or Master Thesis -

Modeling and analysis of probabilistic programs

What is it all about?

A wide variety of events in natural sciences or businesses processes can be described by (some variant of) stochastic processes. Once a mathematical formalism for such a process has been found one can analyse various properties of the given process by means of calculus of probabilities. For example, one can ask for the probability of a particular event or for the average outcome.

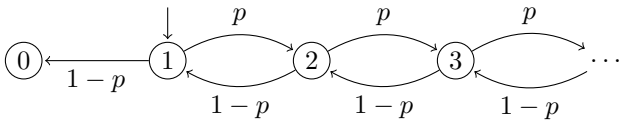
On the other hand, programs in computer science represent processes as well. Over the last decades many different verification techniques have been developed in order to analyse programs and prove correctness, i.e., to show that the program has some desired property.

Recently there is a growing interest in randomised or probabilistic programs. This is where concepts from stochastics meet techniques from computer science:

- What sort of stochastic processes are captured by probabilistic programs?
- Can we lift automatic analysis techniques to deal with such probabilistic programs?
- Can we thereby automate the analysis of stochastic processes to a certain degree?

The aim of this project is to get a better understanding of the capabilities of probabilistic programs and see to what extent current verification techniques can be applied to the analysis of stochastic processes. The ultimate goal is to compose an extensive benchmark suite that can be used to measure the effectiveness of automated analysis tools for probabilistic programs.

As a first intuition consider the following probabilistic process given as an infinite graph and its representation as a probabilistic program. This process is an instance of what is called a random walk. Here the process "walks" on a line and it can do a step to the right with probability p and to the left with probability $1-p$.



(a) (Infinite) graph representation

```
n:=0;
x:=1;

while(x > 0) {
    (x := x-1 [p] x := x+1);
    n := n+1;
}
```

(b) pGCL program with a counter

What is to be done?

- Model a variety of stochastic processes using the probabilistic Guarded Command Language (pGCL).
- Determine properties like average outcomes of the modelled processes.
- Report on successful and failed analysis attempts

Requirements

- Interest in theoretical computer science
- Proactive work attitude

Contact

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