Quantitative Verification Session 11

January 26, 2017

Probabilistic Timed Automata (PTA)

Recall. Probabilistic actions added to timed automata. Like MDPs, there is a concept of a scheduler for PTAs. In a state, there could be multiple actions available. The decision about which action to take and when to take it rests with the scheduler. When we talk about probabilities in a PTA, like in MDPs, it is either the supremum or the infimum of the probabilities given by each scheduler. Hence we always ask what is the maximum/minimum probability of some event taking place.

Some example questions which can be answered using PTAs:

- The maximum probability of an airbag failing to deploy within 0.02 s.
- The minimum probability that a packet is correctly delivered in 1 s.
- The maximum expected time for the protocol to terminate

Example 1. Load `<PRISM ROOT>/prism-examples/pta/simple/formats-09.nm` into Prism and check a few max/min properties on it. See `formats-09.pctl` for some example properties.

Continuous-time Markov Chain (CTMC)

Length of stay in a state is determined by an exponential distribution parameterised by the rate of the action.

For the example worked out in class, see Tutorial: Part 3 on Prism's website [1]. The comments and instructions on the page are very helpful. In class, we saw

- How to simulate the CTMC and look at various traces
- Transient and Steady-state computation in Prism (from the *Models* menu)

- Checking steady-state properties like `S=? [q > q_max/2]`, `S<=0.001 [ q = q_max ]`
- Using the rewards operator for instantaneous rewards `R{"queue_size"}=? [ I=5 ]` and for steady-state rewards `R{"queue_size"}=? [ S ]`
- We also examined what happens when the service provider's serve rate was changed to a value comparable to the arrival rate. The queue started filling and sometimes, service requests even got lost as the queue became full.

References

[1] Tutorial: Part 3 - Dynamic power management