Problems and Exercises
“Nichtsequentielle Systeme und nebenläufige Prozesse”, SS04
Part 4

Prof. Helmut Veith
Dipl.-Ing. Christian Schallhart
Dr. Stefan Katzenbeisser

SPIN

Use SPIN to solve the following exercises. SPIN can be obtained from
http://spinroot.com

1. Traffic Simulation. Simulate a street intersection of two streets with
   no precedence signs and no traffic light. Is a deadlock possible?

2. Street Network. Build a small street network and simulate the traffic
   within this network. Verify whether it is deadlock free. The network
   should contain at least two street intersections. (Optional: Can you
   prove other properties of the network?)

3. Unreliable Channel. Model an unreliable channel, i.e., a channel which
   might loose packets. Use this channel transmit packets from a sender
   to a receiver process. Use SPIN to simulate the system.

4. Unreliable Channel: Proof. Prove that the channel is unreliable, i.e.,
   that not every packet that is sent, will arrive at the receiver.

5. * Token Ring. A token ring consists of \( m \) independent processors
   which are arranged in a cycle, where each processor is connected to its
   left and right neighbors. The processes of the token ring use a token
   (represented by a message in channel) to synchronize each other. After
   each processing step, the token is passed on to one of its neighbors.

1
• Implement the token ring for $m = 4$, where the token is passed to one of the neighbors nondeterministically. Simulate the token ring in the interactive environment.

• Use SPIN to check whether it is guaranteed that at most one processor gets access to the critical section at the same time.

• Use SPIN to check whether a deadlock can occur.

• Use SPIN to check whether at least one process enters the critical section infinitely often, i.e., whether progress is achieved.

• Repeat the above steps for a model where the token is passed deterministically to the left.

• Optional: Find the maximal $m$ for which you can verify the model on your machine.

6. * Token Ring: Fairness. Use the two models from the last exercise. Use SPIN to produce a never claim which states that each process gets access to the critical section infinitely often, i.e., whether each process is able to make progress. Check this condition.