Formal methods 2019: lab exam simulation

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1 SPIN: pedestrian crossing

A person needs to cross a road. The crossing is controlled by 2 semaphores, one for the cars and one for the pedestrians. A semaphore can either be GREEN or RED; you can assume that every element of the system can observe the current state of the semaphores.

- Initially the pedestrian semaphore is RED and the car semaphore is GREEN.
- Non-deterministically the pedestrian decides to cross the road.
- When a pedestrian wants to cross the road it asks the pedestrian semaphore to switch to GREEN by sending it a message.
- The pedestrian semaphore waits for the requests on a channel; when it receives a request from the pedestrian to switch to GREEN it first asks (through another channel) the car semaphore to switch to RED.
- The pedestrian semaphore, after requesting the car semaphore to become RED, waits until the car semaphore switches to RED and then it changes its own state to GREEN.
- When the pedestrian semaphore is GREEN, the pedestrian can cross the road, this transition takes a non-deterministic number of steps.
- Once the pedestrian has reached the other side of the road it sends a message to the pedestrian semaphore saying that it can switch back to RED and returns in its initial state (potentially crossing again).
- The pedestrian semaphore, when switching from GREEN to RED, sends a message to the car semaphore notifying that it can switch back to GREEN.
- The car semaphore waits for the requests of the pedestrian semaphore on a channel and executes them.

Verify that the pedestrian crosses the road only if the car semaphore is RED and the pedestrian semaphore is GREEN.

2 NuSMV, nuXmv: SIR model

SIR is a popular model for the spread of a disease in a population. Each person can be in one of three states: Susceptible, Infected or Removed. In our modelling we are interested in the number of persons that are susceptible to the disease, currently infected and spreading the disease or removed.

- There is a population of N (pick some value $N \geq 5$) individuals.
- $\frac{N}{5}$ of them are initially infected with a disease, all the others are susceptible.
- A susceptible person becomes infected with a probability proportional to the current number of infected people over N.
- An infected person becomes removed eventually in the future (FAIRNESS).
- A "removed" person remains immune.

Write and verify the following properties:

1. Verify that it is possible that the number of infected people does not increase.
2. Verify that it is possible that all the people are eventually infected.
3. Verify that if every person gets infected at some point, then eventually all the people will become immune.