

# “Model checking”

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Assignment 7, January 13, 2011

**Exercise 26 (20 Points)** Consider traffic lights for cars and pedestrians wishing to cross a road, informally described as follows.

The lights  $LC$  for the cars proceed through the following cycle of phases: *Idle* (showing no light), *Yellow*, *Red*, and *RedYellow*. The initial phase is *Idle* and should last for at least 20 seconds (to let cars pass) and otherwise can be arbitrarily long (if no pedestrian wishes to cross). The phase *Yellow* should take 5 seconds, the phase *Red* should take 15 seconds, and the phase *RedYellow* should take 5 seconds.

The light  $LP$  for the pedestrians have the following cycle of phases: *idle* (showing nothing),  $red_1$ ,  $red_2$  (showing both a red light), and *green*. The initial phase *idle* lasts as long as no pedestrian pushes the button attached to the traffic light. When a button is pushed, the phase  $red_1$  is entered and held for 35 seconds, afterwards, the phase *green* is entered and held for 10 seconds. Then the phase  $red_2$  is entered for at most 5 seconds. If a button is pushed during this phase, the phase  $red_1$  is entered again. Otherwise, the light controller returns to the phase *idle*. Pushing the button during the phases  $red_1$  and *green* has no effect.

Model  $LC$  and  $LP$  as well as the pedestrian  $P$  and a network  $N$  of three timed automata working in parallel and synchronising on suitable channels. The pedestrians behaviour is modelled only as far as it is noticeable at the button, i.e. the timed automaton should be able to engage at any moment in an output  $b!$  on channel  $b$  (representing the button). The corresponding input  $b?$  is used in the timed automaton for  $LP$ . To synchronise  $LC$  and  $LP$  appropriately, the timed automata should use a further common channel  $s$ .

Use UPPAAL to verify the following two properties:

- Whenever the pedestrian’s light is in the phase green the light for the cars is in the phase Red.
- Whenever the light for the cars is in the phase Idle, the pedestrian’s light is not in the phase green.

**Handing in this Assignment** Please submit your hand-written solutions on paper no later than January 20, 2010, 18:00 (before the tutorial).

The models shall be placed in a directory that carries the last name of one of the group members. Add a `README` file, or better, a `Makefile`, that explains or automates the modelling and checking procedures. Explain, how to interpret the results of model checking in an accompanying PDF or ASCII file.

Put all this into a tape archive that shares the name with the directory and send it by e-mail to marcel.kyas@fu-berlin.de. Use “Model checking 09 Series 8 *your last names*” as the subject line.