
Real-Time Systems

<http://swt.informatik.uni-freiburg.de/teaching/WS2017-18/rtsys>

Exercise Sheet 5

Early submission: Monday, 2017-12-18, 14:00

Regular submission: Tuesday, 2017-12-19, 14:00

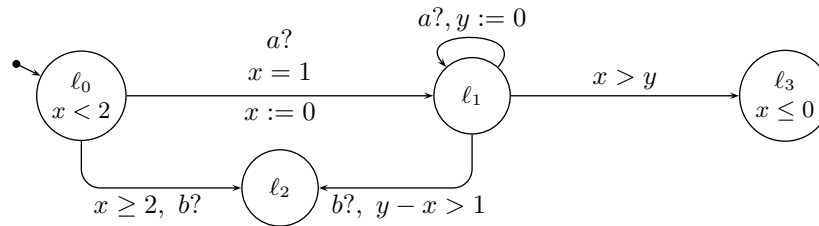


Figure 1: Timed Automaton for Exercise 1.

Exercise 1 — Playing with Definitions [1]

(10/20 Points)

Consider the timed automaton \mathcal{A} in Figure 1.

- (i) Give the abstract syntax corresponding to the graphical representation of \mathcal{A} . (1)
- (ii) Give the set of configurations of $\mathcal{T}(\mathcal{A})$. (1)
Do not just repeat the definition but illustrate and explain which pairs of location and valuation are configurations and which are not.
- (iii) Provide an interesting transition sequence of \mathcal{A} using at least one delay and one action transition. (1)
- (iv) Provide a computation path of \mathcal{A} . (1)
- (v) Provide a run of \mathcal{A} . (1)
- (vi) Does \mathcal{A} have a timelock? (1)
- (vii) Does \mathcal{A} have Zeno behaviour? (1)
- (viii) For each location from $\{\ell_1, \ell_2, \ell_3\}$, check whether it is reachable. (3)

Exercise 2 — Playing with Uppaal

(5/20 Points)

Model the timed automaton from Figure 1 in UPPAAL¹ together with the timed automaton from Figure 2 on page 2 to obtain a network of timed automata.

Check your answers to Task (viii) from Exercise 1 using the simulation feature of UPPAAL.

Hint: Please submit your UPPAAL model together with trace files so that your tutor can check your claims. In your submission, explain briefly what's going on in the traces and how this relates to your answers to Task viii from Exercise 1.

¹Cf. UPPAAL usage instructions on Page 2.

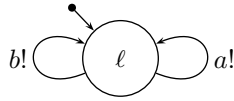


Figure 2: Additional timed automaton for Exercise 2.

Exercise 3 — The Jamming Device Revisited (5/20 Points + 5 Bonus)

- (i) Provide an UPPAAL model of the design for the jamming device from the previous exercise sheet.² (5)
 Assume that the customer added the following requirement (R4) as a reaction on our demand for clarification:
- (R4)** When switching on the device, no frequency should be jammed.
- (ii) Provide a second UPPAAL model of the jamming device *without* assuming (R4), that is, one which may jam any of the four channels on system startup, and where jamming phases right after system startup may last shorter than 1 s. (5 Bonus)

For each task, explain your UPPAAL model, relate its locations and transitions to the controller design from the previous exercise sheet. Submit your model and at least one trace file which demonstrates that your model is “not completely broken”; explain what’s going on in the trace file, i.e. how it relates to behaviour of a real jamming device.

Uppaal Usage Instructions

UPPAAL is installed in the Linux machines of the computer pool.

To execute it, use the following command line:

```
/usr/local/ufrb/uppaal/uppaal-4.1.19/uppaal
```

References

- [1] Ernst-Rüdiger Olderog and Henning Dierks. *Real-Time Systems - Formal Specification and Automatic Verification*. Cambridge University Press, 2008.

²The “evil one” for the purpose of examining the wireless fire alarm system in the most challenging way, i.e. the design which may exhibit as many evolutions as possible which still satisfy the requirements.