Problem Sheet 7: Verification of Real-Time Systems

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Starred exercises (*) are more challenging than the others.

The following exercises are based on the lectures about verifying real-time systems:


Assume that the time domain consists of the non-negative real numbers.

1 MTL Property Checking

Consider first the following timed automaton:

Do the following properties hold?

i. $\Box a$

ii. $\Box (\Diamond = 1 a)$

iii. $\Box (\Box = 1 a)$
Consider now the following timed automaton:

![Timed Automaton Diagram]

Do the following properties hold?

iv. $\square (a \rightarrow \diamond (0,1) c)$

v. $\square (a \rightarrow \diamond (0,1) b)$

vi. $\square (a \rightarrow (a \lor b) \mathbf{U}(0,1) c)$

vii. $\square (a \rightarrow (a \lor b) \mathbf{U}(1,2) c)$

2 Region Automaton Construction

i. Construct the region automaton for the first timed automaton in Section 1.

ii. Construct the region automaton for the second timed automaton in Section 1.

iii. (∗) Construct the region automaton for the following timed automaton (exercise taken from Alur & Dill, 1994):
3 Semantics of MTL Formulae

i. Is the formula $\Box \lozenge 0$ true satisfied by any timed word?

ii. Is the formula $\Box \lozenge 0$ true satisfied by any timed word?

iii. Is $\lozenge [a, b] \lozenge [c, d] q$ equivalent or non-equivalent to $\lozenge [a+c, b+d] q$ for all $0 \leq a \leq b \leq c \leq d$?