Problem Sheet 10: Verification of Real-Time Systems

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

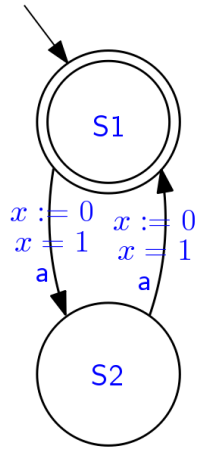
The exercises in this problem sheet are all based on the third set of lecture slides on model checking:

http://se.inf.ethz.ch/courses/2013b_fall/sv/slides/13-RealTime.pdf

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

1 MTL Property Checking

Consider first the following timed automaton:



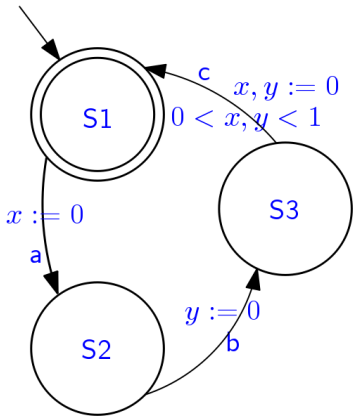
Do the following properties hold?

i. $\Box\, a$

ii. $\Box\, (\Diamond_{=1}\, a)$

iii. $\Box\, (\Box_{=1}\, a)$

Consider now the following timed automaton:



Do the following properties hold?

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

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

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

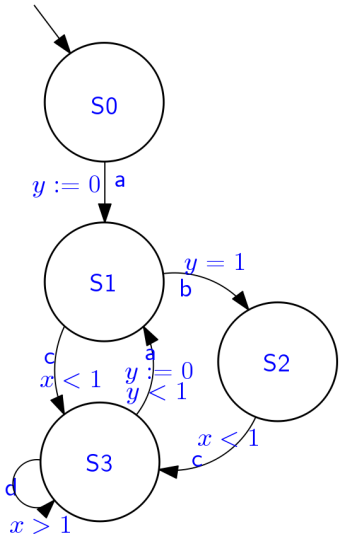
vii. $\square\ (a \rightarrow (a \vee b)\ \mathsf{U}(1,2)\ c)$

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 (from *Alur & Dill, 1994*):



3 Semantics of MTL Formulae

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

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

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