Problem Sheet 7: Verification of Real-Time Systems

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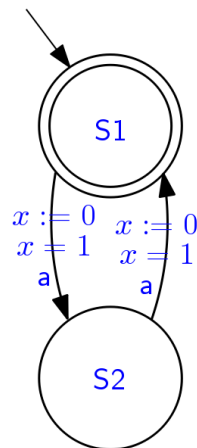Starred exercises ($*$) are more challenging than the others.

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

> http://se.inf.ethz.ch/courses/2015b_fall/sv/slides/13-RealTimeSystems.pdf

Assume that the time domain consists of the non-negative real numbers.
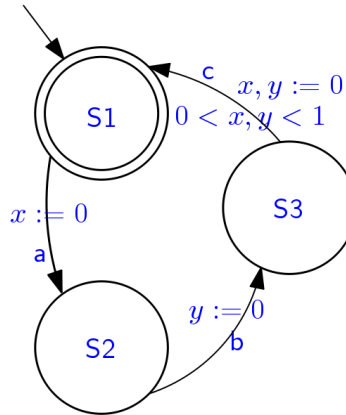
1 MTL Property Checking

Consider first the following timed automaton:

Do the following properties hold?

  i. $\Box\, a$

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

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

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Consider now the following timed automaton:

Do the following properties hold?

iv. $\Box \, (a \to \Diamond(0,1) \ c)$

v. $\Box \, (a \to \Diamond(0,1) \ b)$

vi. $\Box \, (a \to (a \lor b) \ \mathsf{U}(0,1) \ c)$

vii. $\Box \, (a \to (a \lor b) \ \mathsf{U}(1,2) \ c)$

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 (exercise taken from *Alur & Dill, 1994*):

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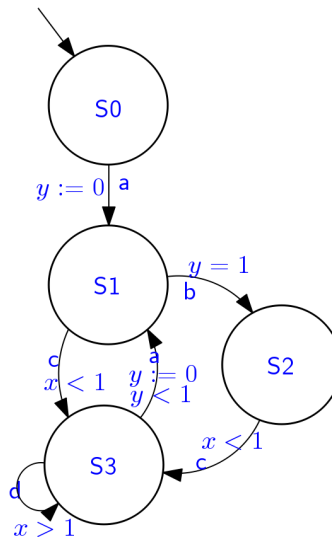
3 Semantics of MTL Formulae

i. Is the formula $\square\,\lozenge\,{>}0$ true satisfied by any timed word?

ii. Is the formula $\square\,\lozenge\,{\geq}0$ 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 $0 \leq a \leq b \leq c \leq d$?