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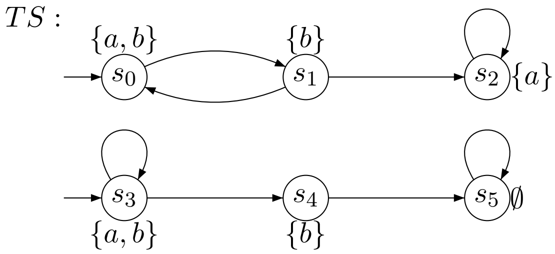
Introduction to Model Checking
Summer term 2010

– Series 7 –

Hand in on June 16 before the exercise class.

Exercise 1 (4 points)

Let $AP = \{a, b, c\}$. Consider the transition system TS over AP outlined below



and the LTL fairness assumption $fair = (\Box\Diamond(a \wedge b) \rightarrow \Box\Diamond\neg c) \wedge (\Diamond\Box(a \wedge b) \rightarrow \Box\Diamond\neg b)$.

a) Specify the fair paths of TS!

b) Decide for each of the following LTL formulas φ_i whether it holds $TS \models_{fair} \varphi_i$:

$$\varphi_1 = \bigcirc\neg a \rightarrow \Diamond\Box a \qquad \varphi_2 = b\,\mathsf{U}\,\Box\neg b \qquad \varphi_3 = b\,\mathsf{W}\,\Box\neg b.$$

In case $TS \not\models_{fair} \varphi_i$, indicate a path $\pi \in FairPaths(TS)$ for which $\pi \not\models \varphi$ holds.

Exercise 2 (4 points)

We consider the release operator R which is defined as $\varphi\mathsf{R}\psi := \neg(\neg\varphi\mathsf{U}\neg\psi)$.

a) Informally describe the meaning of the expansion law for the release operator R. Then prove its correctness formally.

b) Prove the following two equivalence laws that express R by W and vice versa:

- $\varphi\mathsf{R}\psi \equiv (\neg\varphi \wedge \psi)\,\mathsf{W}\,(\varphi \wedge \psi)$
- $\varphi\mathsf{W}\psi \equiv (\neg\varphi \vee \psi)\,\mathsf{R}\,(\varphi \vee \psi)$