

Introduction to Model Checking Summer term 2007

– Series 7 –

Hand in on May 25 before the exercise class.

Exercise 1

(6 points)

Prove or disprove the following equivalences of LTL-formulas:

$$\begin{aligned} \Box\varphi \rightarrow \Diamond\psi &\equiv \varphi\mathbf{U}(\psi \vee \neg\varphi) & \Diamond\Box\varphi \rightarrow \Box\Diamond\psi &\equiv \Box(\varphi\mathbf{U}(\psi \vee \neg\varphi)) \\ \Box\Diamond\varphi \rightarrow \Box\Diamond\psi &\equiv \Box(\varphi \rightarrow \Diamond\psi) & \Diamond(\varphi\mathbf{U}\psi) &\equiv \Diamond\psi \end{aligned}$$

Exercise 2

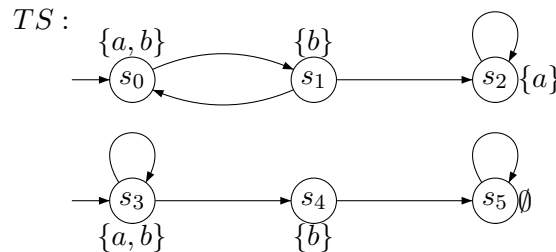
(1 + 1 points)

Transform the LTL-formula $\varphi = \neg\Diamond(\neg(a\mathbf{U}c) \rightarrow ((b \wedge \neg d) \mathbf{U}a))$ in positive normal form, once using the W-operator and once using the R-operator.

Exercise 3

(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 $TS \models_{fair} \varphi_i$:

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

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