

Introduction to Model Checking Summer term 2007

– Series 11 –

Hand in on June 29 before the exercise class.

Exercise 1

(3 + 1 points)

a) Prove that $Sat(\exists(\Phi W \Psi))$ is the largest set T such that

$$T \subseteq Sat(\Psi) \cup \{s \in Sat(\Phi) \mid Post(s) \cap T \neq \emptyset\}.$$

b) Prove that $Sat(\forall(\Phi W \Psi))$ is the largest set T such that

$$T \subseteq Sat(\Psi) \cup \{s \in Sat(\Phi) \mid Post(s) \subseteq T\}.$$

Use the above characterizations to infer efficient algorithms for computing the set $Sat(\exists(\Phi W \Psi))$ and $Sat(\forall(\Phi W \Psi))$ in a direct manner!

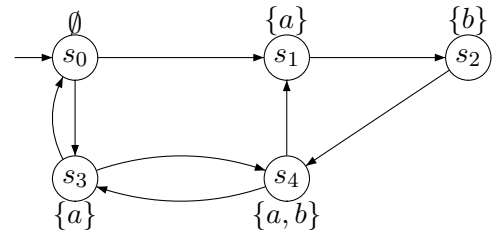
Exercise 2

(4 points)

Consider the CTL-formula $\Phi = \forall \square (a \rightarrow \forall \diamond (b \wedge \neg a))$ together with the following CTL fairness assumption

$$\begin{aligned} fair &= \square \diamond \forall \bigcirc (a \wedge \neg b) \rightarrow \square \diamond \forall \bigcirc (b \wedge \neg a) \\ &\quad \wedge \square \diamond \exists \diamond b \rightarrow \square \diamond b. \end{aligned}$$

Prove that $TS \models_{fair} \Phi$!

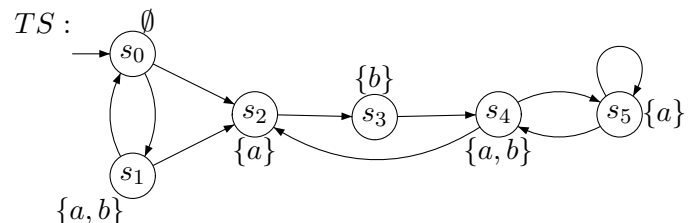


Exercise 3

(4 points)

Consider the transition system TS , the strong fairness assumption $sfair$ and the CTL formula Φ :

$$\begin{aligned} sfair &= \square \diamond (\exists \bigcirc (a \wedge \neg b)) \rightarrow \square \diamond (\exists \bigcirc \neg a) \\ \Phi &= \exists \diamond \exists \square a \end{aligned}$$



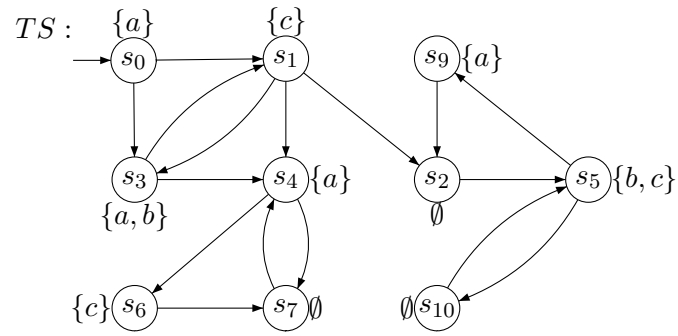
Apply the fair CTL model checking algorithm from the lecture to check $TS \models_{sfair} \Phi$.

Sketch its main steps.

Hint: You do not need to formally apply the basic CTL and LTL model checking algorithms!

Exercise 4**(2 points)**

Consider the following transition system TS over $AP = \{a, b, c\}$:



Provide a counterexample or an evidence for the following CTL-formulas, dependent on their validity:

a) $\Phi_1 = \forall((a \vee \neg b)\mathbf{U}\forall\Diamond c)$

b) $\Phi_2 = \exists\Box\exists\bigcirc\forall\Diamond b$