RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

LEHRSTUHL FÜR INFORMATIK 2
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Introduction to Model Checking
Winter term 08/09

– Series 11 –

Hand in on January 30 before the exercise class.

Exercise 1 (3 + 1 points)

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

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

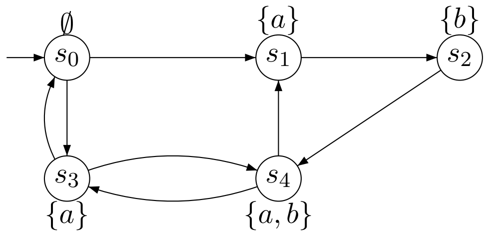
Use the above characterizations to infer efficient algorithms for computing the set $Sat(\exists(\Phi \mathsf{W} \Psi))$ and $Sat(\forall(\Phi \mathsf{W} \Psi))$ in a direct manner!

Exercise 2 (4 points)

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

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

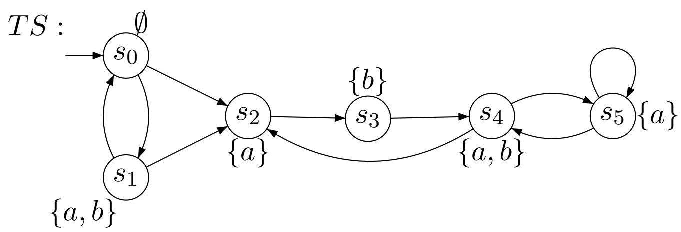
Prove that $TS \models_{fair} \Phi$!



Exercise 3 (4 points)

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

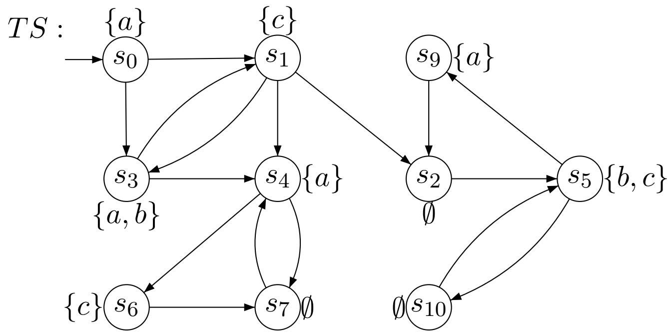
$$sfair = \Box\Diamond\big(\exists\bigcirc\,(a \wedge \neg b)\big) \rightarrow \Box\Diamond\big(\exists\bigcirc\,\neg a\big)$$
$$\Phi = \exists\Diamond\exists\Box a$$



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

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