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LEHRSTUHL FÜR INFORMATIK II
RWTH Aachen · D-52056 Aachen
http://www-i2.informatik.rwth-aachen.de/

Prof. Dr. Ir. J.-P. Katoen
T.Han, I.Zapreev

Exercises to the lecture *"Advanced Model Checking"*, winter term 2006

– Assignment 2 –

The solutions are collected on Nov. 3rd at the beginning of the exercise class.

Exercise 1 (4 points)

Prove or disprove the following claims:

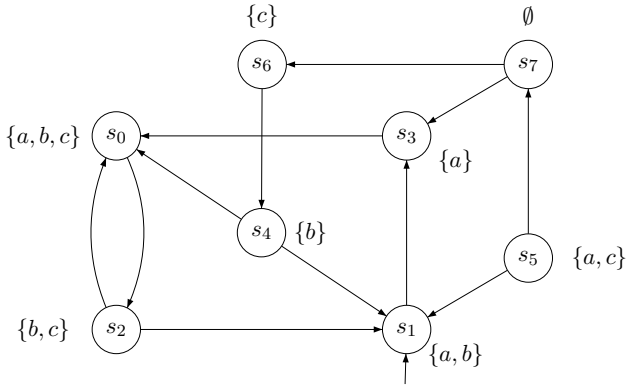
(a) $\forall\Diamond\forall\bigcirc a \equiv_{CTL} \forall\bigcirc\forall\Diamond a$.

(b) The CTL formula $\forall\Diamond\forall\bigcirc\forall\Box a$ and the LTL formula $\Diamond\bigcirc\Box a$ are equivalent.

Exercise 2 (4 points)

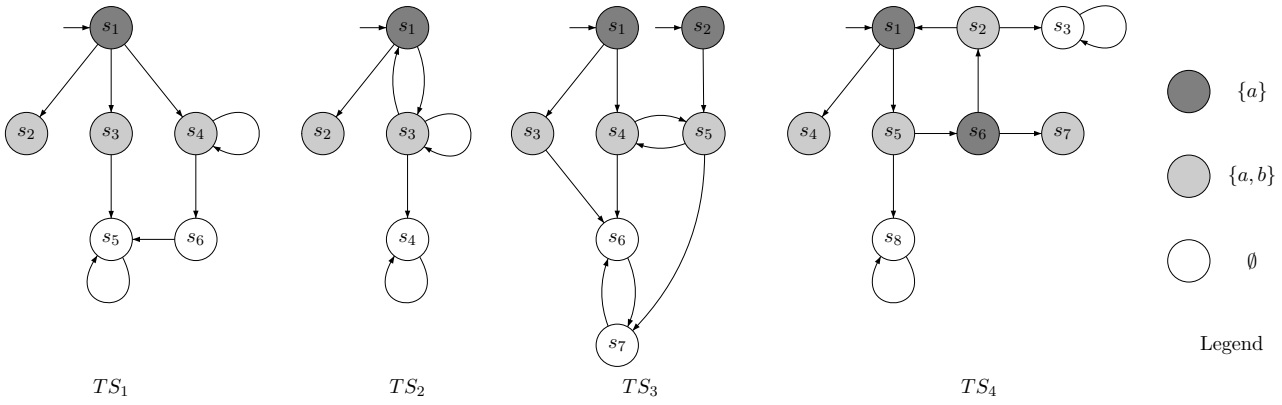
Consider the transition system TS on the right.

Decide whether $TS \models_{CTL} \Phi$ for $\Phi = \exists\Big((\forall\bigcirc a)\mathsf{U}(\forall\Diamond(c \rightarrow b))\Big)$ using the CTL model checking algorithm from the lecture. Sketch its main steps!



Exercise 3 (4 points)

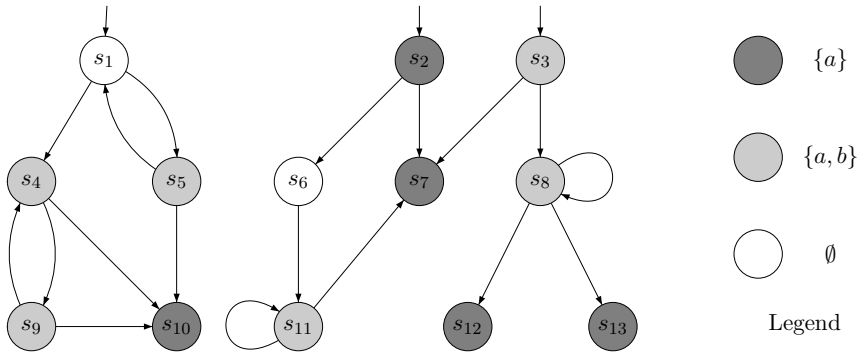
Which of the following transition systems are bisimulation equivalent? Justify your answers by providing bisimulations or $\mathrm{CTL}_{\setminus \mathsf{U}}$ formulae that distinguish the considered transition systems. (Note that a $\mathrm{CTL}_{\setminus \mathsf{U}}$ formula contains no U-operator or its derived operators.)



TS_1 TS_2 TS_3 TS_4

Exercise 4 (4 points)

Consider the transition system TS over $AP = \{a, b\}$ shown in the figure below:



(a) Determine the bisimulation equivalence $\sim_{TS}$ and depict the bisimulation quotient system $TS/\sim$.

(b) Provide CTL master formulae Φ_C for each bisimulation equivalence class $C \in S/\sim$.