RHEINISCH-
WESTFÄLISCHE
TECHNISCHE
HOCHSCHULE
AACHEN

LEHRSTUHL FÜR INFORMATIK 2
RWTH Aachen · D-52056 Aachen
http://www-i2.informatik.rwth-aachen.de/

Prof. Dr. Ir. J.-P. Katoen
Yue & Sher & Chakraborty

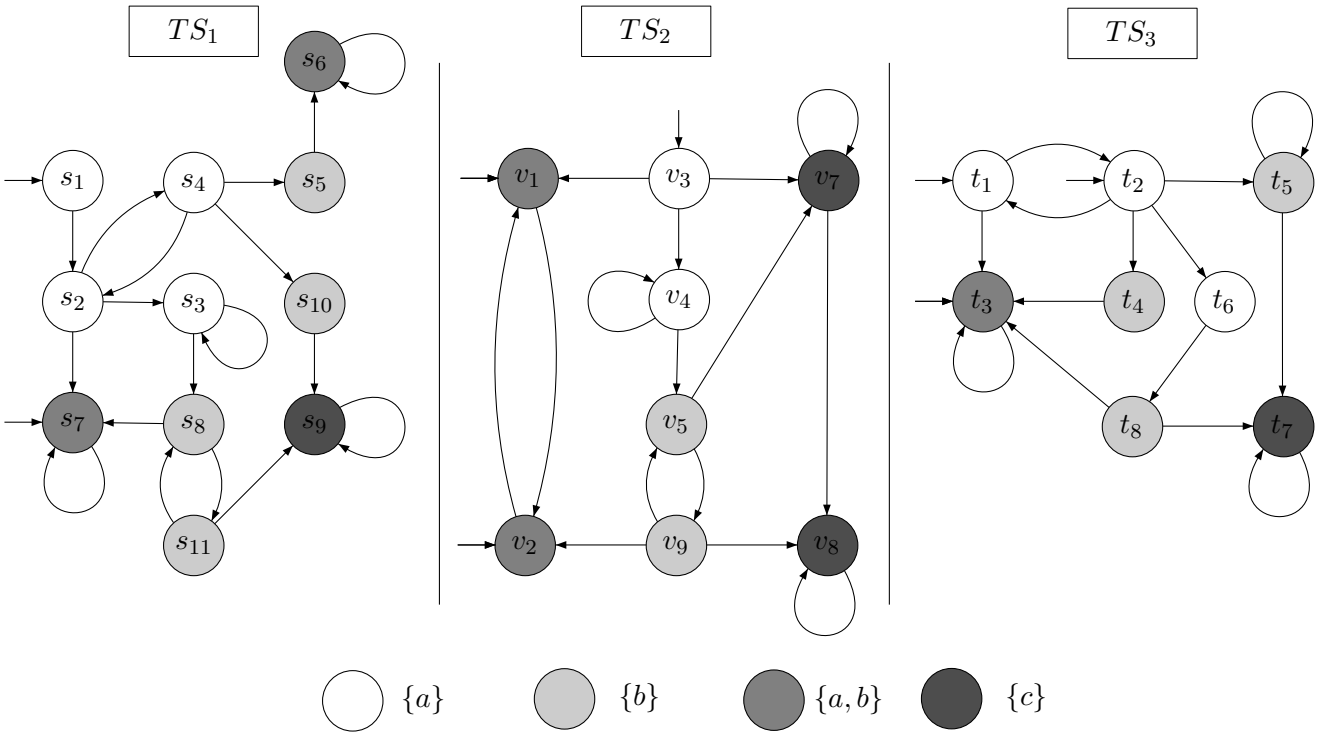
Advanced Model Checking
Summer term 2012

– Assignment 4 –

Hand in on May 16'th before the exercise class.

Exercise 1 (3 points)

Consider three transition systems given in the next figure:

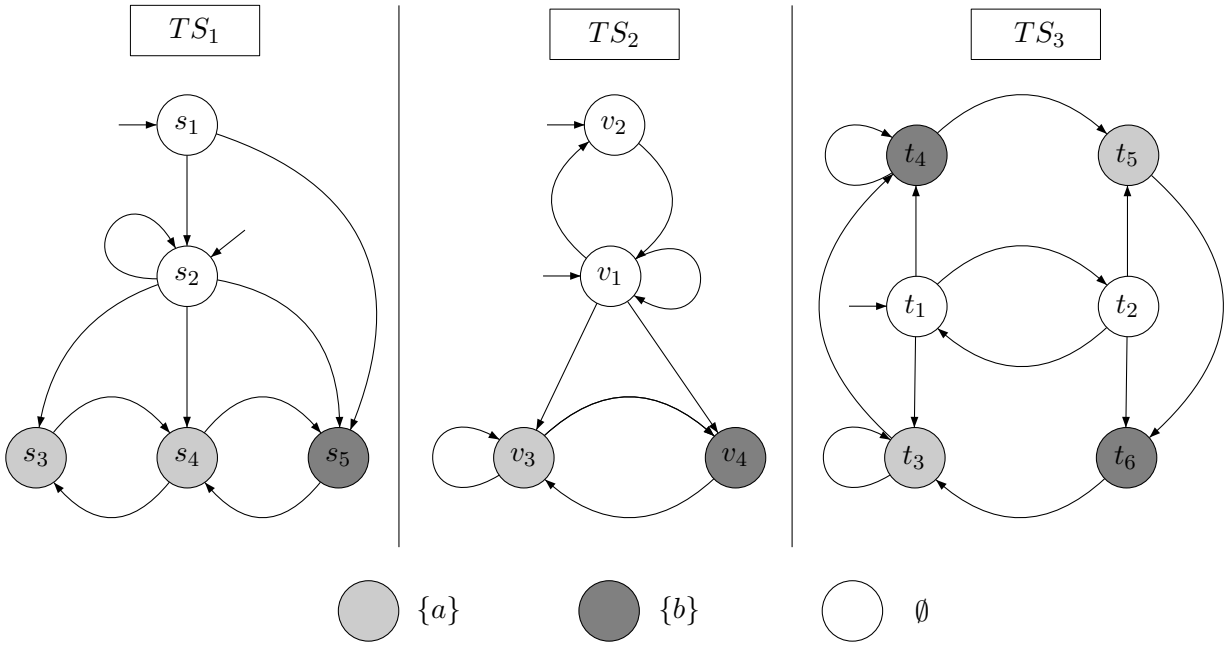


Questions:

For each $i, j \in \{1 \dots 3\} \times \{1 \dots 3\}$, $i \neq j$, determine whether $TS_i \approx TS_j$ or $TS_i \not\approx TS_j$. Justify your answer.

Exercise 2 (3 points)

Consider the transition systems TS_1, TS_2, TS_3 over $AP = \{a, b\}$ shown in the following figure:



Questions:

For each $i, j \in \{1 \dots 3\} \times \{1 \dots 3\}$, $i \neq j$, determine whether $TS_i \preceq TS_j$. Justify your answer.

Exercise 3 (4 points)

Let $TS = (S, Act, \rightarrow, I, AP, L)$ be a transition system. A stutter simulation for TS is a relation $\mathcal{R}$ on S such that for all $(s_1, s_2) \in \mathcal{R}$:

1. $L(s_1) = L(s_2)$.
2. If $s_1' \in Post(s_1)$ with $(s_1, s_1') \notin \mathcal{R}$, then there exists a finite path fragment $s_2\ u_1 \dots u_n\ s_2'$ with $n \geq 0$ and $(s_1, u_i) \in \mathcal{R}$, $i = 1, \dots, n$ and $(s_1', s_2') \in \mathcal{R}$.

s_1 is said to be stutter simulated by s_2, denoted $s_1 \preceq_{st} s_2$, iff there exists a stutter simulation for (s_1, s_2).

A stutter simulation $\mathcal{R}$ for TS is called divergence-sensitive if for all pairs $(s_1, s_2) \in \mathcal{R}$ and each infinite path fragment $\pi_1 = s_{0,1}\ s_{1,1}\ s_{2,1} \dots$ in TS with $s_{0,1} = s_1$ and $(s_{i,1}, s_2) \in \mathcal{R}$ for all $i \geq 0$ there exists a transition $s_2' \in Post(s_2)$ with $(s_{j,1}, s_2') \in \mathcal{R}$ for some $j \geq 1$. We write $s_1 \preceq_{st}^{div} s_2$ iff there exists a divergence-sensitive stutter simulation $\mathcal{R}$ for (s_1, s_2).

Question:

Prove the following statement: let s_1, s_2 be two states in TS. If $s_2 \models \Phi \Rightarrow s_1 \models \Phi$ for any $\Phi \in \forall\text{CTL}^*_{\setminus\bigcirc}$, then $s_1 \preceq_{st}^{div} s_2$.