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
A. Mereacre & H. Yue

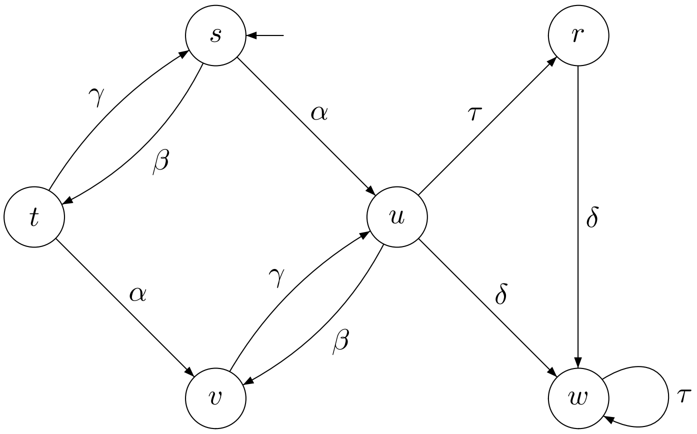
Advanced Model Checking
Summer term 2009

– Series 4 –

Hand in on May 18'th before the exercise class.

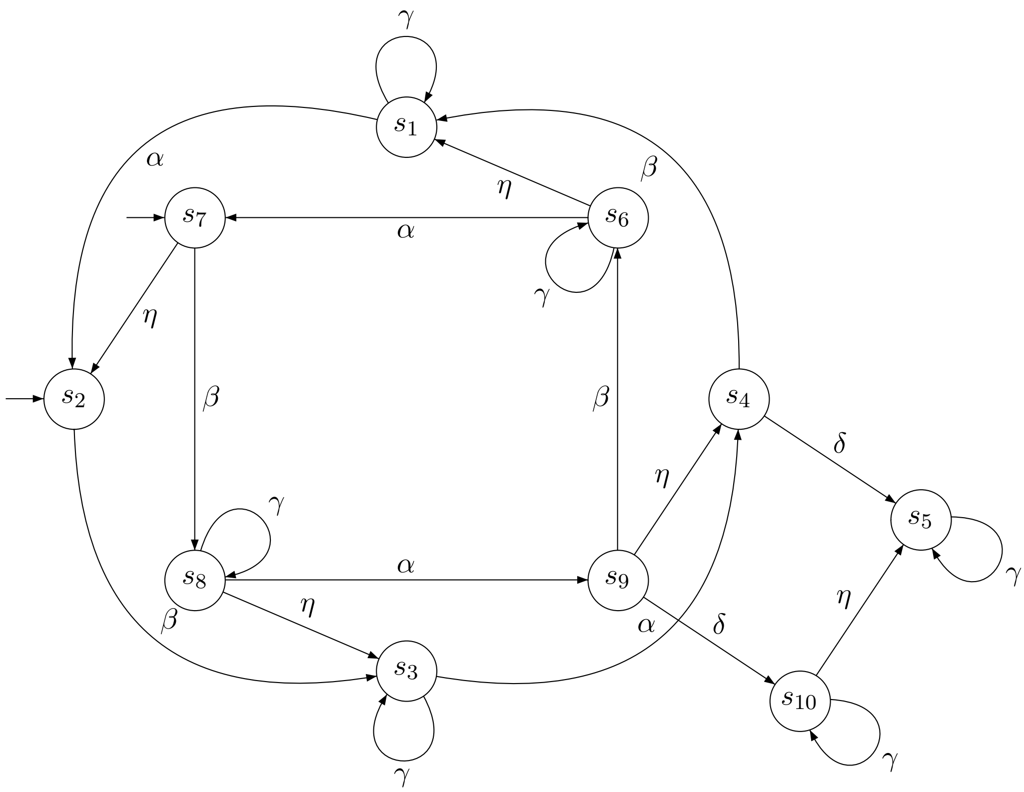
Exercise 1 (4 points)

Given a transition system TS in the following figure with action set $Act = \{\alpha, \beta, \gamma, \delta, \tau\}$. Determine the pairs of independent actions.



Exercise 2 **(6 points)**

Consider the transition system below:



The states labeling is as follows:

- $L(s_{10}) = \emptyset$
- $L(s_6) = L(s_7) = \{a\}$
- $L(s_3) = L(s_4) = L(s_5) = L(s_8) = L(s_9) = \{b\}$
- $L(s_1) = L(s_2) = \{a, b\}$

Prove or disprove that each of the following *ample sets* satisfy requirements *A1* through *A3* on the *ample sets*, also check whether the requirement *A4* holds:

- $ample(s_6) = \{\gamma, \alpha\}$
- $ample(s_7) = \{\beta\}$
- $ample(s_8) = \{\alpha\}$
- $ample(s_9) = \{\alpha, \beta, \delta\}$
- $ample(s_{10}) = \{\gamma, \eta\}$

In case some of the conditions *A1* through *A4* do not hold, modify the *ample sets* in an appropriate way to fix it. Clarify your changes.

Exercise 3 (4 points)

Let $TS_i = (S_i, Act_i, \rightarrow_i, I_i, AP, L_i)$, $i + 1, ...n$ be action-deterministic transition systems such that $Act_i \cap Act_j \cap Act_k = \emptyset$ if $1 \leq i < j < k \leq n$. We consider the parallel composition with synchronization over common actions, i.e. the transition system

$$TS = TS_1 \parallel TS_2 \parallel ... \parallel TS_n.$$

For each states $s = <s_1, ...s_n$ of TS, let $Act_i(s) = Act_i \cap Act(s)$ be the set of actions of TS_i that are enabled in s.

Question:

Show that the dependency condition $(A2)$ holds if for each state s of TS the following conditions (i) and (ii) holds:

(i) If $ample(s) \neq Act(s)$, then $ample(s) = Act_i(s)$ for some $i \in \{1, ..., n\}$.

(ii) If $ample(s) = Act_i(s) \neq Act(s)$, then $ample(s) \cap (\bigcup_{1 \leq j \leq n, j \neq i} Act_j) = \emptyset$.