Principles of Model Checking
Exercise class 5

Abstraction

Prof. Dr. Joost-Pieter Katoen, Dr. Taolue Chen, and Ir. Mark Timmer

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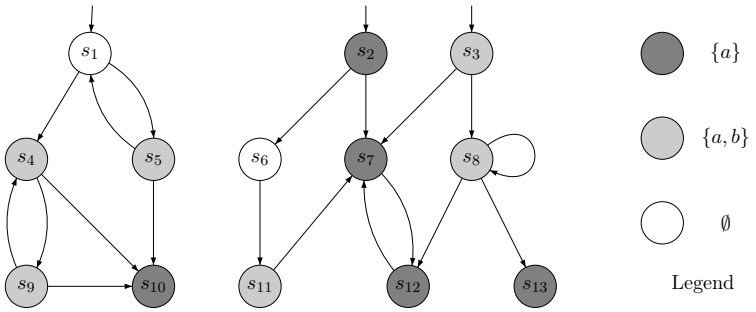
Problem 1

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



Determine the bisimulation quotient system $TS/\sim$ using the inefficient quotienting algorithm.

Problem 2

Let $TS = (S, Act, \rightarrow, I, AP, L)$ be a transition system. The relations $\sim_n \subseteq S \times S$ are inductively defined by:

- $s_1 \sim_0 s_2$ iff $L(s_1) = L(s_2)$.
- $s_1 \sim_{n+1} s_2$ iff:
  - $L(s_1) = L(s_2)$,
  - for all $s_1' \in Post(s_1)$ there exists a $s_2' \in Post(s_2)$ with $s_1' \sim_n s_2'$,
  - for all $s_2' \in Post(s_2)$ there exists a $s_1' \in Post(s_1)$ with $s_1' \sim_n s_2'$.

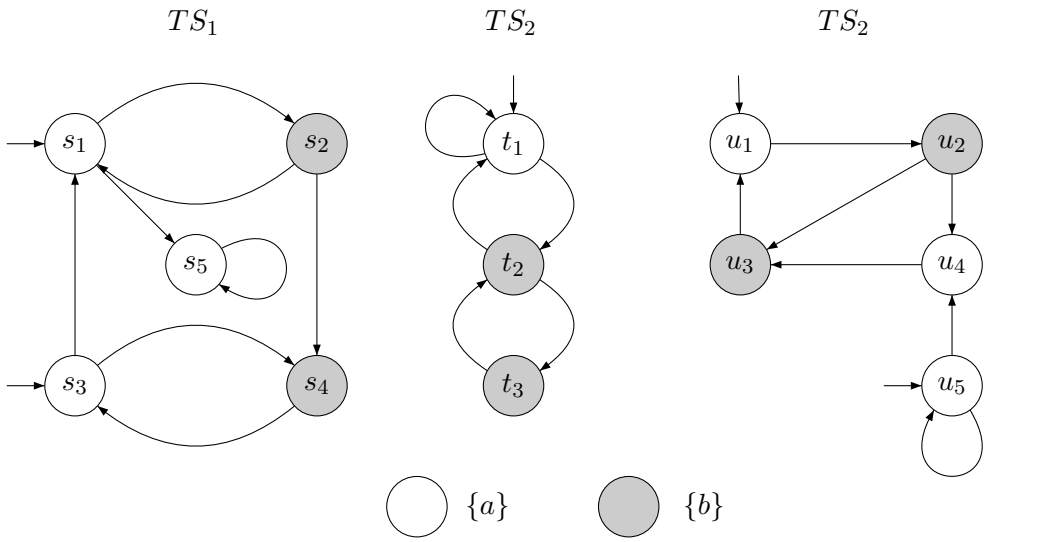
(i) Show that for *finite* TS it holds that $\sim_{TS} = \bigcap_{n \geq 0} \sim_n$, i.e.,

$$s_1 \sim_{TS} s_2 \text{ if and only if } s_1 \sim_n s_2 \text{ for all } n \geq 0$$

(ii) Does this also hold for infinite transition systems (provide either a proof or a counterexample)?

Problem 3

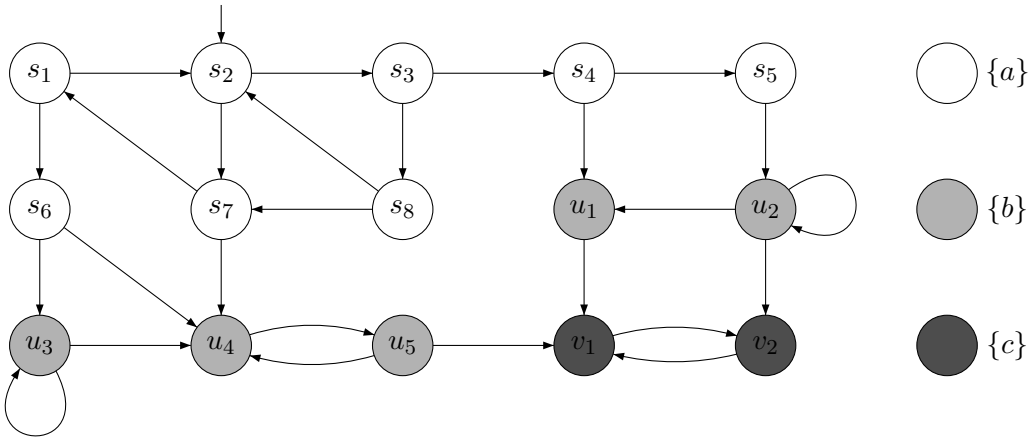
Consider the following transition systems:



For each $i, j \in \{1, 2, 3\}$, $i \neq j$, determine whether $TS_i \trianglelefteq TS_j$ or $TS_i \not\trianglelefteq TS_j$.

Problem 4

Consider the following transition system TS:



1. Give the divergence-sensitive expansion $\overline{TS}$.
2. Determine the divergence stutter bisimulation quotient $\overline{TS}/\approx$.
3. Give $TS/\approx^{div}$.