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Concurrency Theory WS 2013/2014

— Series 7 —

Hand in until December 10th before the exercise class.

Exercise 1 (Completed–Trace Equivalence) (1+1 Points)

Let $\mathrm{CT}(P)$ be the set of completed traces of a process P. We say that two processes P and Q are completed–trace equivalent, denoted $P \equiv_{\mathrm{CT}} Q$, if $\mathrm{CT}(P) = \mathrm{CT}(Q)$.

(a) Provide a (preferably small) example for two processes P and Q which are trace equivalent but not completed–trace equivalent!

(b) Prove or disprove: $\equiv_{\mathrm{CT}}$ is a CCS congruence.

Exercise 2 (Ready– and Failure–Trace Equivalence) (1+1+1 Points)

Let $\mathrm{RT}(P)$ be the set of ready traces of a process P and let $\mathrm{FT}(P)$ be the set of its failure traces. We say that two processes P and Q are ready–trace equivalent, denoted $P \equiv_{\mathrm{RT}} Q$, if $\mathrm{RT}(P) = \mathrm{RT}(Q)$ and analogously we say that two processes P and Q are failure–trace equivalent, denoted $P \equiv_{\mathrm{FT}} Q$, if $\mathrm{FT}(P) = \mathrm{FT}(Q)$.

(a) Consider the following process definition:

$$\begin{aligned} P &= b.P + b.Q \\ Q &= a.P \end{aligned}$$

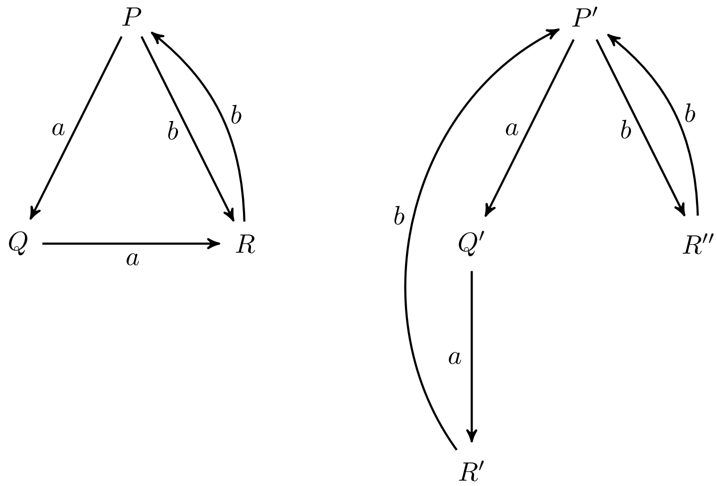
Describe $\mathrm{RT}(P)$ and $\mathrm{FT}(P)$ as a regular expression over the alphabet $\{a, b, A_\emptyset, A_{\{a\}}, A_{\{b\}}, A_{\{a,b\}}\}$, where A_M represents the set $M \subseteq \{a, b\}$!

(b) Provide a (preferably small) example for two processes P and Q which are trace equivalent but not ready–trace equivalent!

(c) Provide a (preferably small) example for two processes P and Q which are trace equivalent but not failure–trace equivalent!

Exercise 3 (Strong Bisimulation) (1+1+1 Points)

Consider the following LTS:



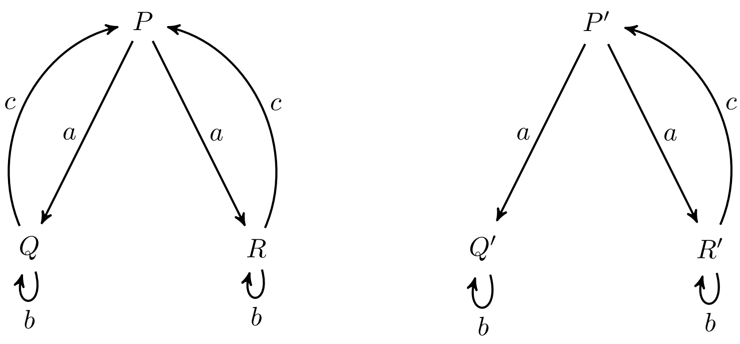
(a) Give the smallest strong bisimulation of the above LTS!

(b) Give the smallest strong bisimulation $\mathcal{R}$, such that at least $P \mathcal{R} P'$!

(c) Prove or disprove: $\mathcal{R}$ is an equivalence relation.

Exercise 4 (Trace Equivalence and Strong Bisimulation) (1+1 Points)

Consider the following LTS:



(a) Show that $P' \equiv_{\mathrm{TR}} P$, where $\equiv_{\mathrm{TR}}$ denotes trace equivalence!

(b) Give $\sim$! Does $P \sim P'$ hold?