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Concurrency Theory WS 2019/2020

— Exercise 6 —

Hand in until November 21th before the exercise class.

Exercise 1 (30 Points)

Prove or disprove the following statements.

1. Trace equivalence is a congruence w.r.t. parallel composition.
2. Completed Trace equivalence is a congruence w.r.t. the restriction-operator.

Exercise 2 (30 Points)

1. Provide an example of two processes which are trace equivalent, but not completed trace equivalent.
2. Consider the following rules for the semantics of the sequential composition $P;Q$ of two CCS processes P and Q, which you already know from Exercise 1.2:

$$\frac{\nexists \alpha\ \nexists P' \colon P \xrightarrow{\alpha} P'}{P;Q \xrightarrow{\tau} Q} \qquad \frac{P \xrightarrow{\alpha} P'}{P;Q \xrightarrow{\alpha} P';Q}$$

   Check whether trace equivalence is a congruence w.r.t. sequential compostion.

Exercise 3 (40 Points)

Let A be a finite set and A^ω be the set of all *infinite* sequences of symbols in A. For $w \in A^\omega$, we denote the first symbol of w by $w[0]$ and the remaining sequence by w', i.e., $w = w[0] \cdot w'$, where $w[0] \in A$ and $w' \in A^\omega$. A relation $\sim \subseteq A^\omega \times A^\omega$ is called a *bisimulation* (of infinite sequences) if it satisfies the following property: For $u, v \in A^\omega$ it holds that if $u \sim v$, then $u[0] = v[0]$ and $u' \sim v'$.

Show for the *largest* bisimulation $\sim \subseteq A^\omega \times A^\omega$ that for all $u, v \in A^\omega$, we have

$$u = v \quad \text{if and only if} \quad u \sim v\ .$$