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Concurrency Theory WS 2017/2018

— Series 8 —

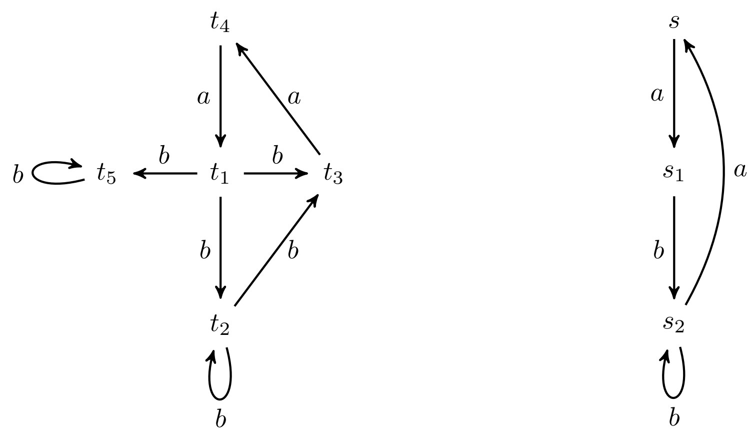
Hand in until December 15th before the exercise class.

Exercise 1 (Greatest Fixed Point Characterization of $\sim$) (2 Points)

Prove that the greatest fixed point of $\mathcal{F}$ is equal to $\sim$.

Exercise 2 (Strong Bisimilarity as a Game) (2 Points)

Decide whether $s \sim t$ in the following LTS. For that, either give a universal winning strategy for the attacker (i.e., $s \not\sim t$) or for the defender (i.e., $s \sim t$). If $s \sim t$, define a strong bisimulation relating the pair of processes.



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

A binary relation $\mathcal{R}$ over the set of states of an LTS is a *branching bisimulation* if and only if it is symmetric and, whenever $P \mathrel{\mathcal{R}} Q$ holds and $\alpha \in Act$ (including τ): if $P \xrightarrow{\alpha} P'$ then either $\alpha = \tau$ and $P' \mathrel{\mathcal{R}} Q$ or there is a $k \geq 0$ and a sequence of transitions

$$Q = Q_0 \xrightarrow{\tau} Q_1 \xrightarrow{\tau} \dots \xrightarrow{\tau} Q_k \xrightarrow{\alpha} Q'$$

such that $P \mathrel{\mathcal{R}} Q_j$ holds for each $j \in \{0, \dots, k\}$ and $P' \mathrel{\mathcal{R}} Q'$.

Two states P and Q are *branching bisimilar* if and only if there is a branching bisimulation $\mathcal{R}$ such that $P \mathrel{\mathcal{R}} Q$. The largest branching bisimulation is called *branching bisimilarity.*

1. Show that branching bisimilarity is contained in weak bisimilarity.
2. Prove or disprove: If P and Q are branching bisimilar then P and Q are weakly bisimilar.
3. Prove or disprove: If P and Q are weakly bisimilar then P and Q are branching bisimilar.

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Exercise 4 (Characteristic HML Formula) (3 Points)

Consider the LTS provided below. Provide an HML formula F for each pair of states $s \neq s'$ such that $s \models F$ and $s' \not\models F$.