Technische Universität München
Theoretische Informatik
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Exercise Sheet 3
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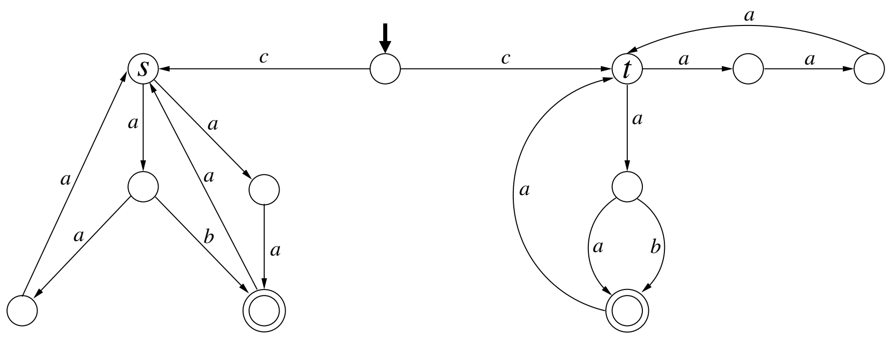
Exercises "Automata and Formal Languages"

Exercise 3.1

Consider the following NFA and show that $s \sim t$. Compute the relations $\sim_0$, $\sim_1$, $\sim_2$, and $\sim_3$ and construct the minimal NFA with respect to bisimulation.



Exercise 3.2

Let R be a bisimulation relation. Must R be reflexive? Symmetric? Transitive?

Exercise 3.3

Let $A = (Q, \Sigma, \delta, q_o, F)$ be an NFA and let $A_q = (Q, \Sigma, \delta, q, F)$ for any $q \in Q$. Prove or disprove: If $\mathcal{L}(A_q) = \mathcal{L}(A_{q'})$ then $q \sim q'$.

Exercise 3.4

Let $A = (Q, \Sigma, \delta, q_o, F)$ be an NFA. A relation $R \subseteq Q \times Q$ is called a *simulation* iff $q_1 \; R \; q_2$ implies

- $q_1 \in F \iff q_2 \in F$ and
- for every $a \in \Sigma$ and every $q_1' \in \delta(q_1, a)$ there exists a $q_2' \in \delta(q_2, a)$ such that $q_1' \; R \; q_2'$.

The relation $\preceq = \bigcup\{R \mid R \text{ is a simulation}\}$ is the largest simulation. If $q \preceq q'$ we say that q is simulated by q'.

- Show that $q \preceq q'$ implies $\mathcal{L}(A_q) \subseteq \mathcal{L}(A_{q'})$.
- Does $q \preceq q'$ and $q' \preceq q$ imply $q \sim q'$?