TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute for Theoretical Computer Science, Chair for Automata Theory

Selected Topics in Automata and Logic

Exercise Sheet 7

Dr. Rafael Peñaloza / Dipl.-Math. Felix Distel
Summer Semester 2010

Exercise 1

Show that the language $L = \{ww \mid w \in \{a, b\}^*\}$ is not context-free.

Hint: Use the Pumping-Lemma for context-free languages (cf. GThI-lecture notes, Lemma 9.2). If you need to make a case distinction it is okay to do the proof only for the cases you find the most interesting.

Exercise 2

Show that L from Exercise 1 is accepted by a deterministic one-way 3-head automaton and by a non-deterministic one-way 2-head automaton.

Exercise 3

Let $\mathcal{A} = (Q, \Sigma, q_0, \delta, F)$ be a deterministic one-way k-head automaton (For deterministic multihead automata one can use a function $\delta : Q \times \Sigma^k \to Q \times \{0, 1\}^k$ instead of the transition relation Δ).

Prove that there is an automaton $\mathcal{A}' = (Q, \Sigma, q_0, \delta', F)$ such that

a) $L(\mathcal{A}) = L(\mathcal{A}')$, and

b) every transition moves at least one head, i. e. $\delta' : Q \times \Sigma^k \to Q \times (\{0, 1\}^k \setminus \{0\}^k)$.

Hint: Use a construction similar to the construction for removing ε-transitions in the case of single-headed automata.

Exercise 4

Let $\mathcal{A} = (Q, \Sigma, q_0, \delta, F)$ be a deterministic one-way k-head automaton. Show that there is a deterministic one-way k-head automaton that accepts $\overline{L(\mathcal{A})}$.

Hint: Use the automaton from Exercise 3 as a starting point for your construction.