

Theoretical Computer Science II

Prof. Dr. B. Nebel, Dr. C. Becker-Asano
E. Plaku
Winter semester 2011/2012

University of Freiburg
Department of Computer Science

Exercise Sheet 8

Due: December 19, 2011

Exercise 8.1 (Regular Expressions, 1 + 1 marks)

- (a) Give regular expressions generating the following languages. In all cases the alphabet is $\Sigma = \{0, 1\}$.
- $L = \{w \mid w \text{ has length at least 3 and its 3rd symbol is a 0}\}$
 - $L = \{w \mid w \text{ starts with 0 and has odd length, or starts with 1 and has even length}\}$
- (b) Give a regular expression for the language $L(A)$, recognized by the DFA $A = (Q, \Sigma, \delta, q_0, F)$, where $Q = \{q_0, q_1, q_2\}$, $F = \{q_2\}$, $\Sigma = \{0, 1\}$, and δ given by the following transition table:

δ	0	1
q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_0	q_0

Exercise 8.2 (Pumping Lemma, 1 + 1 + 2 marks)

Are the following languages regular? If yes, prove it by giving a regular expression or a finite automaton that recognizes the language. If not, prove it using the pumping lemma.

- (a) $L = \{a^m b^n \mid m, n \geq 0 \text{ and } m \geq n\}$, $\Sigma = \{a, b\}$
- (b) $L = \{b^2 a^n b^m a^3, m, n \geq 0\}$, $\Sigma = \{a, b\}$
- (c) $L = \{a^n \mid n \text{ is a perfect square}\}$, $\Sigma = \{a\}$

Exercise 8.3 (Context-free Grammars, 1+3 marks)

- (a) Provide a context-free grammar $G = (V, \Sigma, R, S)$ that generates the language of palindromes L_{pal} and that only contains one nonterminal symbol (i.e., $|V| = 1$)
- (b) Prove by induction that $L(G) = L_{pal}$ holds.