

Helsinki University of Technology
Laboratory for Theoretical Computer Science
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T-79.1002 Introduction to Theoretical Computer Science Y (2 cr)
Exam Thu 21 Dec 2006 2 p.m. to 5 p.m.

Write on every answer sheet:

- Name, degree programme, student number
- The text: "T-79.1002 Introduction to Theoretical Computer Science Y 21.12.2006"
- The total number of answer sheets submitted for grading

1. Show that the following languages are regular by describing each of them as a regular expression or as a finite state automaton:

- (a) $\{w \in \{0,1\}^* \mid w \text{ starts or ends with the substring } 101\}$, 3p.
- (b) $\{w \in \{a,b\}^* \mid w \text{ contains an even number of } bs\}$, 3p.
- (c) $\{w \in \{0,1\}^* \mid w \text{ does not contain three consecutive ones}\}$. 4p.

2. Design

- (a) a nondeterministic finite state automaton, 4p.
- (b) a deterministic finite state automaton, and 3p.
- (c) the deterministic finite state automaton with the minimal number of states 3p.

that accept the language described by the regular expression $b(abb \cup ab)^*$.

3. (a) Describe verbally the language produced by the following grammar:

$$\begin{aligned} S &\longrightarrow ASb \mid \varepsilon \\ A &\longrightarrow aA \mid a \end{aligned}$$

- (b) Show that the above grammar is ambiguous. 3p.
- (c) Design a nonambiguous context-free grammar that produces the same language. 4p.
- (c) Design a nonambiguous context-free grammar that produces the same language. 3p.

4. (a) Design a context-free grammar for the language

$$L = \{a^m ccb^n \mid m = n + 2, n \geq 0\}.$$

- (b) Give the leftmost and rightmost derivation of $aaacccb$ in your grammar. 5p.
- (b) Give the leftmost and rightmost derivation of $aaacccb$ in your grammar. 5p.

Total 40p.