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Department of Information and Computer Science
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T-79.1002 Introduction to Theoretical Computer Science Y (2 cr)
Exam Thu 25 Aug 2011 9.00–12.00

Write on every answer sheet:
- Name, degree programme, student number
- The text: "T-79.1002 Introduction to Theoretical Computer Science Y 25.8.2011"
- The total number of answer sheets submitted for grading

1. Describe the following languages as regular expressions:
   (a) $\{w \in \{0,1\}^* \mid w \text{ starts or ends with the substring } 101\}$ *3p.*
   (b) $\{w \in \{a,b\}^* \mid w \text{ begins and ends with the same character}\}$ *3p.*
   (c) $\{w \in \{0,1\}^* \mid w \text{ contains an even number of 0s or exactly two 1s}\}$ *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 $bb(cab \cup ab)^*$.
3. (a) Design a context-free grammar for the language

$$L = \{a^n cacb^m \mid m \geq n+1, n \geq 0\}.$$

   5p.
   (b) Give the leftmost derivation of *acacbbb* and a parse tree of *acacbb* in your grammar. *5p.*
4. Properties of language classes.
   (a) Let L be a formal language over the alphabet Σ. Show that if $|L| = n$ for some $n \in \mathbb{N}$, then L is regular. *5p.*
   (b) Let L_1 and L_2 be languages over alphabet Σ. Show that if the language L_1 is context-free and the language L_2 is regular, then the language $L_1 \cup L_2$ is context-free. *5p.*

Total 40p.