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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 Friday March 8th, 2013, 13:00–16:00

Write on every answer sheet:
- Name, degree programme, student number
- The text: "T-79.1002 Introduction to Theoretical Computer Science Y 8.3.2013"
- The total number of answer sheets submitted for grading

Note: if you have not completed your computerized home assignments, your exam will not be graded.

1. Describe the following languages as regular expressions:
   (a) $\{w \in \{0,1\}^* \mid w$ starts or ends with the substring $001\}$ *3p.*
   (b) $\{w \in \{a,b\}^* \mid w$ begins and ends with a different character$\}$ *3p.*
   (c) $\{w \in \{a,b\}^* \mid w$ contains exactly two bs or the number of as in w is divisible by $3\}$ *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 $ac(bac \cup bc^*)^*c$.

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. Closure properties of language classes:
   Given a language L over an alphabet Σ, let $L^R = \{w^R \mid w \in L\}$ be the language obtained by reversing each string in L. Here w^R is the reverse of w (for example, $(gnat)^R = tang$).
   (a) Show that if L is regular, then L^R is regular. *5 p.*
   (b) Show that if L is context-free, then L^R is context-free. *5 p.*

Total 40p.