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T-79.1002 Introduction to Theoretical Computer Science Y (2 ECTS)
Exam Thu 26 October 2006, 1–4 p.m.

Write down on each answer sheet:
- Your name, department, and student id
- The text: "T-79.1002 Introduction to Theoretical Computer Science Y 26.10.2006 "
- The total number of answer sheets you are submitting for grading

1. Which of the following claims are true (T) and which are false (F)?

   (a) Every context-free language can be described with a nondeterministic finite automaton. *2p.*

   (b) The complement of a language recognized by a deterministic finite automaton can be described as a regular expression. *2p.*

   (c) The intersection of a context-free language and a regular language is regular. *2p.*

   (d) The complement of a regular language is context-free. *2p.*

2. Show that each of the following languages is regular, for example by describing them as a regular expression or finite automaton:

   (a) $\{w \in \{0,1\}^* \mid |w| \geq 2, |w| \text{ is odd}\}$, *5p.*

   (b) $\{w \in \{0,1\}^* \mid |w| \geq 3, w \text{ starts with 010 or ends with 110}\}$, *5p.*

   (c) $\{w \in \{a,b,c\}^* \mid w \text{ contains neither } ab \text{ nor } cc \text{ as a substring}\}$. *5p.*

3. Consider strings over the alphabet $\{0,1\}$. Let $n_0(w)$ denote the number of 0s in the string w. Let
   $$L_1 = \{0^i 1^j \mid i > j \geq 0\}$$
   and
   $$L_2 = \{w \mid n_0(w) \leq 3\}.$$
   Give context-free grammars that produce L_1 and $L_1 \cup L_2$. *10p.*

4. Justify the claim: if language $L \subseteq \{a,b,c\}^*$ can be recognized by a finite automaton, then so can language $L' \subseteq \{a,b\}^*$, that is obtained by replacing each c in the strings of L with the string ab. *7p.*

Total 40p.