T-79.1002 Introduction to Theoretical Computer Science Y (2 ECTS)
Exam Wed 30 Aug 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 30.8.2006"
- The total number of answer sheets you are submitting for grading

Note that you CANNOT use this exam to compensate for course T-79.148 in the pre-2005 study requirements!!! If you want to take an exam for this course, or the post-2005 two-period course T-79.1001, please ask for another exam sheet!!!

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

    (a) Any language recognised (decided) by a nondeterministic finite automaton can be described by a regular expression. *2p.*

    (b) The union of two context-free languages is context-free. *2p.*

    (c) The intersection of two context-free languages is regular. *2p.*

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

2. Show that each of the following languages is regular, by describing it either in terms of a regular expression or in terms of a finite automaton:

    (a) $\{w \in \{0,1\}^* \mid |w| \geq 2, w \text{ begins and ends with the same symbol}\}$, *5p.*

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

    (c) $\{w \in \{0,1\}^* \mid w \text{ does not contain substring 1101}\}$. *5p.*

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

    $$L = \{ucvcw \mid u,v,w \in \{0,1\}^*, v = u^R \text{ or } v = w^R \text{ (or both)}\}.$$

    (Notation x^R denotes the reverse of string x, i.e. string x written backwards.) *5 p.*

    (b) Show that the grammar you gave in part (a) is ambiguous. *5 p.*

4. Justify the claim: if a language $L \subseteq \{0,1,\#\}^*$ is recognised by some finite automaton, then so is the language $L_\#$, which is obtained by removing all #'s from each string in L. *7p.*

Total 40p.