T-79.148 **Spring 2002**
Introduction to Theoretical Computer Science
Tutorial 3, 12-14 February
Problems

Homework problems:

1. Design a finite automaton that models the behaviour of a simple TV set. The power switch of the TV has two alternative positions (on/off), the channel selector has three (1/2/3), and the voice control has two (hi/lo). The automaton does not need to have any distinct "final states".

2. Design finite automata that recognise the following languages:

   (a) $\{w \in \{a,b\}^* \mid w \text{ contains } ab \text{ as a substring}\}$;

   (b) $\{w \in \{a,b\}^* \mid w \text{ contains } aba \text{ as a substring}\}$;

   (c) $\{w \in \{a,b\}^* \mid \text{ the last symbol of } w \text{ is } a\}$;

   (d) $\{w \in \{a,b\}^* \mid \text{ the next to last symbol of } w \text{ is } a\}$;

   (e) $\{w \in \{a,b\}^* \mid w \text{ contains an even number of } a\text{'s}\}$.

3. Design a finite automaton that accepts precisely those binary strings that contain an even number of both 0's and 1's (e.g. 0011 and 1010, but not 001).

Demonstration problems:

4. Formulate the model of a simple coffee machine presented in class (lecture notes p. 15) precisely according to the mathematical definition of a finite automaton (Definition 2.1). What is the formal language recognized by this automaton?

5. Design finite automata that recognise the following languages:

   (a) $\{a^m b^n \mid m = n \mod 3\}$;

   (b) $\{w \in \{a,b\}^* \mid w \text{ contains equally many } a\text{'s and } b\text{'s, modulo } 3\}$.

   (The notation "$m = n \mod 3$" means that the numbers m and n yield the same remainder when divided by three.)

6. Design a finite automaton that recognizes sequences of integers separated by plus and minus signs (e.g. 11+20-9, -5+8). Implement your automaton as a computer program that also calculates the numerical value of the input expression.