LIACS
Leiden University

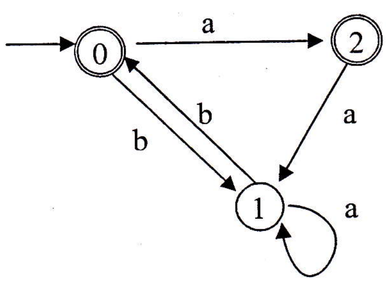
Examination Fundamentele Informatica 2
14 January 2015, 10:00 - 13:00

Question 1: **[1 point]**
Give five distinguishable strings for the language L = {0,1}*{00}{0,1} and show why they are pairwise distinguishable.

Question 2: **[2 points]**
a) Give a *deterministic* finite automaton M_1 recognizing the language L_1 over the alphabet $\Sigma = \{a,b\}$ containing all strings with no two consecutive equal alphabet symbols.
b) Construct a *deterministic* finite automaton M_2 recognizing the language L_2 denoted by the regular expression (a+ab)*bb*.
c) Give a *deterministic* finite automaton M_3 recognizing the complement of the above language L_2.

Question 3: **[1,5 points]**
a) Construct a *nondeterministic* finite automaton M recognizing the language L(G) generated by the *regular grammar* G with the following productions
$S \rightarrow bA \qquad A \rightarrow aA \mid aS \mid aB \mid \Lambda \qquad B \rightarrow bS \mid \Lambda$
b) Use the *powerset construction* to construct a *deterministic* finite automaton N recognizing the same language as the above *nondeterministic* automaton M.
c) Use the automaton N above to construct a *regular grammar* generating the same language accepted by N. It may be helpful to rename the states of the automaton N.

Question 4: **[1 point]**
Use the *state elimination* method of Brzozowski and McCluskey to construct a regular expression for the language recognized by the following finite automaton



Question 5: **[1 point]**
Use the pumping lemma to show that the language $L = \{a^n b^n a^m \mid n \geq 0, m \geq n\}$ is not regular.

Question 6: **[2 points]**
a) Find a context-free grammar G_1 generating the language $L_1 = \{a^n b^n \mid n > 0\}$.
b) Find a context-free grammar G_2 generating the language $L_2 = \{b^n \mid n > 0\}$.
c) Use the above two grammar to give a context free grammar for the language $L_3 = L_1 \cdot L_2$.
d) Find a context-free grammar G generating the language $L_4 = L_3^*$.

Question 7: **[1.5 points]**
a) Draw a pushdown automaton M recognizing the language $L = \{a^n b^m \mid m > n > 0\}$ using as alphabet symbols only A and Z_0 (the initial stack symbol).
b) Use the above pushdown automaton M to construct a new pushdown automaton M_e accepting the above language L by *empty stack* (thus without accepting states).

The final score is given by the sum of the points obtained.