Theoretical Computer Science II

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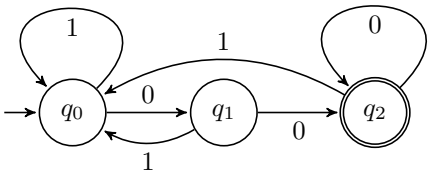
Exercise Sheet 9

Due: December 23, 2009

Exercise 9.1 (Context-free grammars, 1 + 1 + 2 marks)

(a) Construct a context-free grammar for the following DFA:

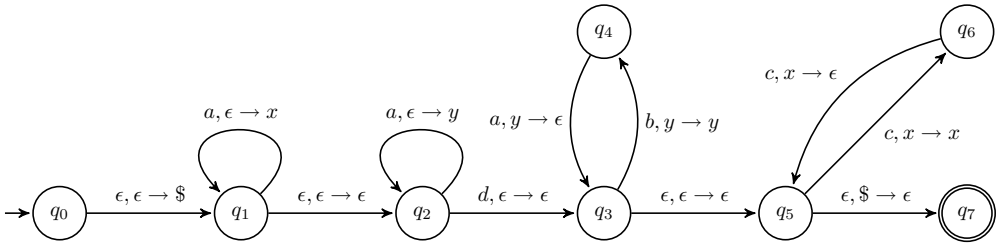


(b) Show that the grammar $(\{S\}, \{a, b\}, R, S)$ with rules $R = S \to aS \mid aSbS \mid \epsilon$ is ambiguous.

(c) Give a grammar in Chomsky Normal Form that generates the same language as the grammar $G = (V, \Sigma, R, S)$ with $V = \{S, X, Y\}$, $\Sigma = \{a, b, c\}$, and R being the following set of rules:

$$S \to XY$$
$$X \to abb \mid aXb \mid \epsilon$$
$$Y \to c \mid cY$$

Exercise 9.2 (Pushdown Automata, 1 + 2 marks)
Consider the following PDA:



(a) Show that the PDA accepts the word *aaadbabacc* by giving an accepting sequence of steps (similar to the right-hand side of slide 31).

(b) Which language L does the given PDA accept?

Exercise 9.3 (Pushdown Automaton, 3 marks)

Create a PDA that recognizes the following context free language. Do *not* construct a CFG that recognizes this language and then transform it, rather construct the PDA from scratch. You can either hand in a formal definition or a state diagram (readable!):

$$L = \{a^* w c^k \mid w \in \{a, b\}^* \text{ and } k = |w|_a \ (k = \text{the number of } a\text{s in } w)\}$$