Theoretical Computer Science (Bridging Course)

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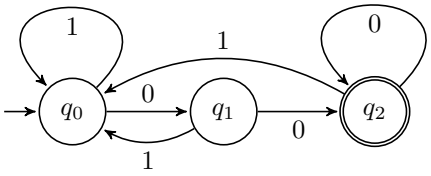
Exercise Sheet 4

Due: 27th November 2014

Exercise 4.1 (Context-free grammars, Chomsky normal form)

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

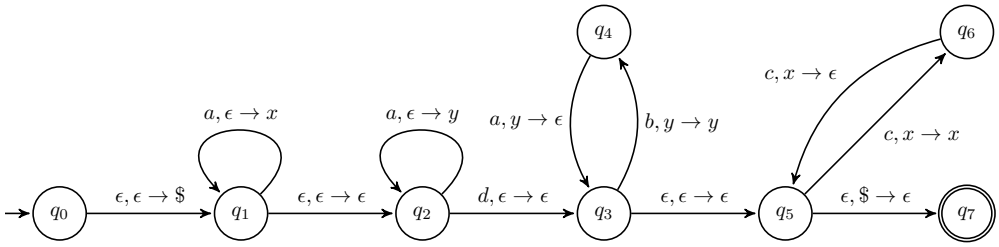


(b) Show that the grammar $(\{S\}, \{a, b\}, R, S)$ with rules $R = S \to aS \mid aSbS \mid \epsilon$ is ambiguous.

(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 4.2 (Pushdown Automata)
Consider the following PDA:



(a) Show that the PDA accepts the word *aaadbabacc*.

Exercise 4.3 (Pushdown Automata)
Create a PDA that recognizes the following context free language:

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

Exercise 4.4 (Pushdown Automata)
Create a PDA that recognizes the following language.

$$L = \{a^i b^j c^k \mid i, j \geq 0,\ k = i + j\}$$