Foundation of Computer Science — FM2

Assignment 5

Watch the video lectures 12 of Week 3 and 13, 14, 15 of Week 4.

1. Design a pushdown automaton accepting the language L by accepting state:

   $$L = \{w \in \{a, b\}^* \mid w \text{ is of odd length and the symbol in the centre is an } a\}.$$

2. Given the context-free grammar $G = (\{S, B, U\}, \{a, b\}, P, S)$ with

   $$P = \{S \to BU,\ B \to aBa,\ B \to bBb,\ B \to \varepsilon,\ U \to aUb,\ U \to \varepsilon\}.$$

   (a) Construct a pushdown automaton M accepting $L(G)$ by empty stack. Follow the construction given in the proof showing equivalence between context-free grammars and pushdown automata.

   (b) Give a leftmost derivation for $aaab$.

   (c) Give an accepting computation of M for input $aaab$.

3. Prove that the language $\{\, ww \mid w \in \{a, b\}^* \,\}$ is not context-free.

4. Given the context-free grammar $G = (\{S, A, B, C\}, \{a, b\}, P, S)$ with

   $$P = \{S \to AB, S \to BC, A \to BA, A \to a, B \to CC, B \to b, C \to AB, C \to a\}.$$

   (a) Use the Cocke-Younger-Kasami algorithm in order to determine which of the words $w_1 = abbba$, $w_2 = baaba$ und $w_3 = bbbaaa$ belong to $L(G)$.

   (b) Investigate whether $L(G)$ is finite or infinite.