Finite Automata Theory and Formal Languages
TMV027/DIT321 – LP4 2018

Context-free Languages

Assignment 6 – Deadline: Sunday 20th of May 23:59

Assignments should be done and submitted individually!

For obtaining full points the answers should contain enough explanation/description so that they are easy to understand.

1. Consider the following grammar over the alphabet $\{0, 1, 2, 3, 4, 5\}$ and with start symbol S:

   $S \to 01 \mid PSQ \mid RST \quad P \to 0P \mid Q \quad Q \to \epsilon \mid Q1 \quad R \to 2 \mid 2R \mid T$
   $T \to 3T \mid 4U \quad U \to UU \quad V \to VV \mid 5$

   (a) (1pt) State which are the nullable variables in the grammar and eliminate the ϵ-productions.

   (b) (1pt) State which are the unit productions in the grammar from a) and eliminate them.

   (c) (0.75pt) State which are non-generating symbols in the grammar from b) and eliminate them.

   (d) (0.75pt) State which are non-reachable symbols in the grammar from c) and eliminate them.

   (e) (1pt) Convert the simplified grammar into Chomsky normal form.

2. (2.5pts) Use the pumping lemma for context-free languages to show that the following language is not context-free:

   $$\mathcal{L} = \{0^i 1^j \mid j = i^2\}$$

3. (3pts) Consider the following grammar with start variable S:

   $$\begin{array}{lcl} S & \to & AS \mid AB \mid CS \\ A & \to & AA \mid BC \mid a \\ B & \to & SB \mid BB \mid b \\ C & \to & CA \mid b \end{array}$$

   Use the CYK algorithm to determine whether the word *abbabb* belongs to the language generated by the grammar or not. Show the table obtained in the CYK algorithm and use the table to justify your answer.