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

Regular Languages

Assignment 4 – Deadline: Sunday 29th of April 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. (2.5pts) Show as formal and clear as possible that $a^*(b + ab^*) = b + aa^*b^*$.

2. Give concrete examples of languages $\mathcal{L}_1$ and $\mathcal{L}_2$ over the alphabet $\{0, 1\}$ such that

   (a) (1pt) Both $\mathcal{L}_1$ and $\mathcal{L}_2$ are non-regular, but $\mathcal{L}_1 \cup \mathcal{L}_2$ is regular;

   (b) (1pt) Both $\mathcal{L}_1$ and $\mathcal{L}_2$ are non-regular, and $\mathcal{L}_1 \cap \mathcal{L}_2$ is infinite and non-regular;

   (c) (1pt) $\mathcal{L}_1$ is regular, $\mathcal{L}_2$ is non-regular, and $\mathcal{L}_1 \cup \mathcal{L}_2$ is regular

   Justify your answer by explicitly giving the resulting language in each case. If it is not easily clear why the languages are regular/non-regular, you need to even justify this.

3. (2.25pts) Use the Pumping lemma for regular languages to show that the language $\{w \in \{0, 1, 2\}^* \mid \#_0(w) + \#_1(w) = \#_2(w)\}$ is not a regular language, where $\#_0, \#_1$ and $\#_2$ are functions counting the number of 0's, 1's and of 2's, respectively, in a word.

4. Minimise the following automaton:

	0	1
$\rightarrow {}^*q_0$	q_1	q_3
q_1	q_4	q_2
${}^*q_2$	q_1	q_5
q_3	q_0	q_4
q_4	q_4	q_4
q_5	q_2	q_4

   (a) (1.5pts) Show the table that identifies the distinguishable states;

   (b) (0.3pts) Indicate the equivalent clases of states resulting from the information in the table;

   (c) (0.45pts) Give the minimised automaton.