MTAT.05.125: Introduction to Theoretical Computer Science **University of Tartu**

Homework assignment 4

Due date: November 3rd, 2016

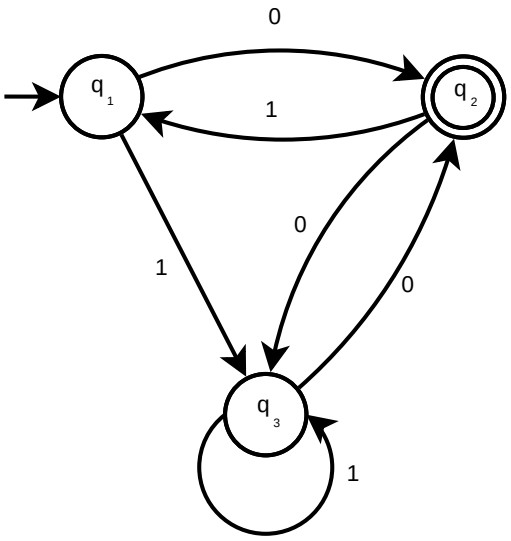
It is possible to collect up to 110 points in this homework.

1. Construct a nondeterministic finite automaton (NFA) that recognizes the language described by the following regular expression:

   (a) $(1\,(0 \cup 1)^*\,1) \cup \epsilon$

   (b) $(10^+1) \cup (01^+0) \cup \varnothing$

2. Construct a regular expression for the language $\mathcal{L}$ defined by the following deterministic finite automaton (DFA):



3. Prove that the following languages are nonregular:

   (a) $\mathcal{L} = \{w\#x \mid x \text{ is a substring of } w\}$, where $\Sigma = \{0, 1, \#\}$;

   (b) $\mathcal{L} = \left\{1^{n^2+1} \mid n \geq 0\right\}$, where $\Sigma = \{1\}$.

4. Is the following language regular or not, where $\Sigma = \{a, b\}$? (Prove your answer.)

   (a) $\mathcal{L} = \{(aba)^n \mid n \geq 0\}$;

   (b) $\mathcal{L} = \{a^n b^m a^\ell \mid n, m, \ell \geq 0\}$;

   (c) $\mathcal{L} = \{a^n b^m a^n \mid n, m \geq 0\}$.