(CS 310) Automata Theory 18 Jan, 2017

Quiz 1

[**Total:** 20 marks]

Notation Let A be a finite state automata. Let $\mathcal{L}(A)$ be the language recognized by A. For any set X, let $\overline{X}$ be the complement of the set. Let Σ^* be the set of all strings over the alphabet Σ. Let Σ^+ be the set of all non-zero length strings over the alphabet Σ.

1. Let L be defined as follows:

   $$L = \{w \in \{0,1\}^* \mid w \text{ is a binary representation of a number which is } 1 \pmod 3\}.$$

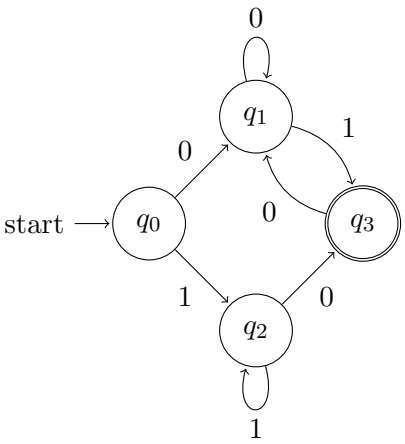
   Give a DFA for this language. (Only a drawing of a DFA is sufficient. No formal construction or correctness is expected for this question.) (2)

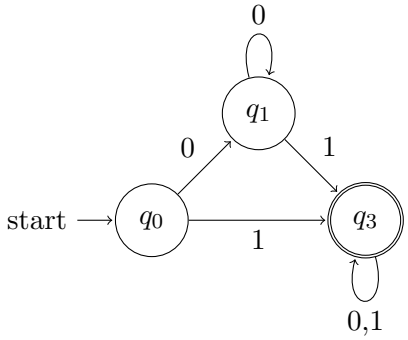
2. Give NFAs for the following regular expressions (Only a drawing of a DFA is sufficient. No formal construction or correctness is expected for this question.): (2+2)

   (a) $a^* \cdot b^*$

   (b) $(a \cup b)^+$

3. Give regular expressions corresponding to the following automata. (Intermediate steps are not necessary if you are sure about the answer. You will get partial marks if your final answer is wrong, but your intermediate steps are correct.) (2+2)





4. For any language L let a/L be defined as follows: $a/L := \{w \mid a \cdot w \in L\}$. For example, if $L = \{a, aab, baba\}$ then $a/L = \{\varepsilon, ab\}$. Prove that if L is regular then a/L is also regular. Give a full detailed construction of an NFA/DFA for a/L, assuming a DFA for L and prove the correctness of your construction. (3+4)

5. Prove that the following language is not regular. $L = \{w \mid \#_a(w) = \#_b(w)\}$. You may use results proved in class without proof, if needed. (3)