Quiz 3

Name: **Time:** Feb 11, 2016

Instructions: Please write down the correct answer for each question in the following box.

1	2	3	4	5	6	7	8	Total Score

1. For a (deterministic or nondeterministic) finite automaton $M = (Q, \Sigma, \delta, q_0, F)$, recall that $\hat{\delta}_M : Q \times \Sigma^* \to 2^Q$ is a function that given a state q and string w returns the set of all states that M could be in after reading w from state q. Formally, $\hat{\delta}_M(q, w) = \{q' \mid q \xrightarrow{w}_M q'\}$. Which of the following statements is true?

   (A) If M is a deterministic finite automaton, then for any $q \in Q$ and $a \in \Sigma$, $\hat{\delta}_M(q, a) = \delta(q, a)$.

   (B) If M is a deterministic finite automaton, then for any $q \in Q$, $\hat{\delta}_M(q, \epsilon) = \{q\}$.

   (C) If M is a nondeterministic finite automaton, then for any $q \in Q$ and $a \in \Sigma$, $\hat{\delta}_M(q, a) = \delta(q, a)$.

   (D) If M is a nondeterministic finite automaton, then for any $q \in Q$, $\hat{\delta}_M(q, \epsilon) = \{q\}$.

2. Let L be recognized by a DFA M and an NFA N. Which of the following statements is necessarily true?

   (A) M and N are the exact same machines.

   (B) M and N have the same number of states.

   (C) N has transitions on ϵ.

   (D) There is an NFA N' that recognizes L which has the same number of states as M.

3. Which of the following statements is true?

   (A) There are languages that can be recognized by an NFA which cannot be recognized by a DFA.

   (B) Languages recognized by NFAs cannot be recognized by DFAs because they can have infinitely many active threads at any given time.

   (C) If L is a language recognized by an NFA then there is a DFA that can recognize L.

   (D) Every language is recognized by an NFA because they are subsets of Σ^*.

4. Let M be a DFA with m states, and N be an NFA with n states such that $\mathbf{L}(M) = \mathbf{L}(N)$. Which of the following statements is necessarily true?

   (A) $2^n \leq m$

   (B) $m < 2^n$

   (C) $n \leq m$

   (D) None of the above

5. Let $L = \{0\}$. Which of the following statements is true?

   (A) $L^* = (LL)^*$

   (B) $L^* = L(L^*)$

(C) $L^* = (L^*)L$

(D) $L^* = L^*L^*$

6. Consider $r = a(ab^*a \cup b^*)^*$. Which of the following is true about $\mathbf{L}(r)$?

   (A) $a \in \mathbf{L}(r)$

   (B) $aa \in \mathbf{L}(r)$

   (C) Every string in $\mathbf{L}(r)$ has at least one b.

   (D) None of the above.

7. Let R_1 and R_2 be two regular expressions with $\mathbf{L}(R_1) = \mathbf{L}(R_2)$. Let N_1 and N_2 be the NFA constructed by the inductive algorithm described in lecture 6, for R_1 and R_2, respectively. Which of the following statements is necessarily true about R_1, R_2, N_1, and N_2?

   (A) R_1 and R_2 must be syntactically the same regular expression.

   (B) N_1 and N_2 have the same number of states.

   (C) N_1 and N_2 have the same number of transitions.

   (D) If R_1 and R_2 are syntactically the same then N_1 and N_2 will have the same number of states and transitions.

8. Which of the following facts is *not* true about GNFAs?

   (A) A GNFA has exactly one final state.

   (B) The initial state of a GNFA could also be a final state.

   (C) The initial state of a GNFA has no incoming transitions.

   (D) The final state of a GNFA has no outgoing transitions.