# CS 273: Intro to Theory of Computation, Fall 2007
## Quiz 1 (Thursday, September 13th)

**NAME:**

**NETID:**

This quiz has 3 pages containing 6 questions. None requires a long answer. Some simply need "yes" or "no." No explanations or proofs are required. But do ensure your answers are legible. You have 20 minutes to finish.

1. (1 point) Is zero even?

2. (2 points) Let $X = \{a, b\}$ and $Y = \{b, c\}$. List the elements of $\mathbb{P}(X) \cap \mathbb{P}(Y)$.

3. (5 points) Fill in the two missing parts of this definition:

   Suppose that $M = (Q, \Sigma, \delta, q_0, F)$ is a DFA and $w$ is a string. Let $w = w_1 w_2 ... w_n$. Then $M$ accepts $w$ if there is a sequence of states $r_0 r_1 ... r_n$ in $Q$ such that

   (a) $r_0 = q_0$

   (b)

   (c)

4. (4 points) Let $\Sigma = \{a, b\}$. Draw a state diagram for a DFA with alphabet $\Sigma$ that accepts all strings starting in aab. (E.g. it accepts aab and aabbba, but not abaab.) Be sure to show all states and transitions.

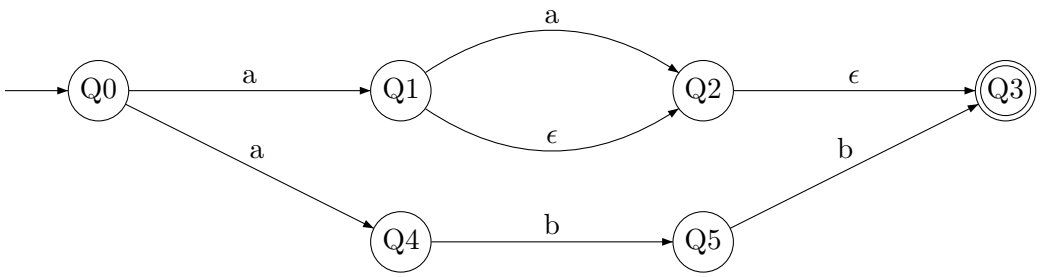
5. (5 points) To prove that regular languages are closed under union using only DFAs (not NFAs), we took two DFAs $M = (Q, \Sigma, \delta, q_0, F)$ and $N = (R, \Sigma, \gamma, r_0, G)$ and constructed a new DFA $M'$ recognizing $L(M) \cup L(N)$. Each individual state of $M'$ was a pair of states, one from $Q$ and one from $R$.

   (a) Name the set of all states in $M'$, using succinct mathematical notation.

   (b) Suppose that $\delta'$ is the transition function for $M'$. We needed to express the values of $\delta'$ in terms of the values given by $\delta$ and $\gamma$. Give the formula for $\delta'((q, r), c)$, where $q \in Q$, $r \in R$, and $c \in \Sigma$.

   $\delta'((q, r), c) =$

6. (8 points) Here is the state diagram for an NFA.




Suppose the transition function is named $\delta$. Fill in the following output values for the transition function:

(a) $\delta(Q0, a) =$

(b) $\delta(Q4, b) =$

(c) $\delta(Q1, \epsilon) =$

(d) $\delta(Q1, b) =$