CSE 322: Introduction to Formal Models in Computer Science
Assignment #1
September 29, 2006
due: Friday, October 6

In the assignments, all references to the textbook refer to the Second Edition. I will try to also give the corresponding reference to the First Edition, when it exists, in square brackets as follows: "[1st Ed: ...]". You are responsible for making sure you do the correct problem!

1. (a) Give the formal description (i.e., the 5-tuple) of the DFA M_4 from Example 1.11 [1st Ed.: Example 1.4] on page 38. Use a 5×2 table to describe δ.
   (b) Show the sequence of configurations through which M_4 goes in its computation on the input bbabaa, using the $\vdash_{M_4}$ notation from lecture. Does M_4 accept the input bbabaa? Why or why not?
   (c) Show the sequence of configurations through which M_4 goes in its computation on the input ε, using the $\vdash_{M_4}$ notation from lecture. Does M_4 accept the input ε? Why or why not?
2. Exercise 1.6 [1st Ed: Exercise 1.4], parts a, f, i.
3. Give the state diagram for a DFA that accepts the language $0^*1^*0^+$ of Exercise 1.7(e), using as many states as you need.
4. Problem 1.32 [1st Ed: Problem 1.25].
5. (a) Give the state diagram for a DFA M that accepts the language

$$L = \{w \in \{0,1\}^* \mid w \text{ is the binary representation of a multiple of } 5\}.$$

   For the purposes of this problem, assume that ε represents the integer 0, and that leading 0's are o.k. For instance, ε, 11001, and 00101 are all in L, but 110 and 00001 are not.
   Hint: Let the state set be $\{q_0, q_1, q_2, q_3, q_4\}$, and maintain the property that $(q_0, w) \vdash_M^* (q_i, \varepsilon)$ (that is, w takes M from q_0 to q_i) if and only if $w' \bmod 5 = i$, where w' is the integer with binary representation w. Now think, for example, about what the remainder mod 5 of (the integer with binary representation) $w1$ would be, if you know that the remainder mod 5 of (the integer with binary representation) w is 3.
   (b) Problem 1.37 [1st Ed: Problem 1.30]. Just specify the 5-tuple; you do not have to prove that it is correct.
   Hint: Take the state set to be $\{q_0, q_1, \ldots, q_{n-1}\}$, generalizing the hint above. The key part of the construction is to state, for $\sigma \in \{0,1\}$, what $\delta(q_i, \sigma)$ would be.