CS 311 Homework 3

October 16, 2013

1. (1.17 from Sipser)
   (a) Give an NFA recognizing the language $(01 \cup 001 \cup 010)^*$
   (b) Convert this NFA to an equivalent DFA. Give only the portion of the DFA that is reachable from the start state.

2. (1.18 from Sipser) Give regular expressions for the following languages
   (a) $\{w | w$ contains at least three $1s\}$
   (b) $\{w | w$ every odd position of w is a $1\}$
   (c) $\{w | w$ contains an even number of $0s$ or contains exactly two $1s\}$

3. (1.19 and 1.28 from Sipser) Use the procedure described in Lemma 1.55 to convert the following regular expressions to NFAs. Recall, R^+ is shorthand for RR^*. Note, in parts (a) through (c) the alphabet is $\{0, 1\}$. In the other parts it is $\{a, b\}$.
   (a) $(0 \cup 1)^* 000 (0 \cup 1)^*$
   (b) $(((00)^*(11)) \cup 01)^*$
   (c) $\emptyset^*$
   (d) $a(abb)^* \cup b$
   (e) $a^+ \cup (ab)^+$
   (f) $(a \cup b^+)a^+b^+$

4. (1.38 from Sipser) An all-NFA M is a 5-tuple $(Q, \Sigma, \delta, q_0, F)$ that accepts $x \in \Sigma^*$ if every possible state that M could be in after reading input x is a state from F. Note, in contrast, that an ordinary NFA accepts a string if at least one state among these possible states is an accept state. Prove that all-NFAs recognize the class of regular languages. Hint: to show that something recognizes the class of regular languages it suffices to show that it is equivalent to another notion of computation that recognizes the class of regular languages. How do you do this? By construction!