Due September 19

1. Give DFAs that recognize the following languages
   (a) \( \{ w \in \{0,1\}^* | w \text{ starts with a } 0 \text{ and has odd length} \} \).
   (b) \( \{ w \in \{0,1\}^* | w \text{ contains 011 as a substring} \} \).
   (c) \( \{00,001\}^* \).

2. Using the complementation construction and one of the DFAs from Exercise 1, give a DFA that recognizes the language
   \( \{ w \in \{0,1\}^* | w \text{ does not contain 011 as a substring} \} \).

3. Let \( L_1 = \{0^n | n \text{ is divisible by 2} \} \) and \( L_2 = \{0^n | n \text{ is divisible by 3} \} \).
   In class, we gave a two-state DFA \( M_1 \) that recognizes \( L_1 \) and a three-state DFA \( M_2 \) that recognizes \( L_2 \). Using the union construction of Theorem 1.25, combine the \( M_1 \) and \( M_2 \) to obtain a DFA that recognizes \( L = \{0^n | n \text{ is divisible by 2 or 3} \} \). How does \( M \) compare with the DFA we gave in class that recognizes \( L \)?

4. Let \( L = \{ w \in \{0,1\}^* | w \text{ starts with a } 0 \text{ and has even length} \} \). Starting with DFAs for two simpler languages, use the intersection construction to give a DFA that recognizes \( L \).

5. (a) Give an NFA with four states that recognizes \( L_1 = \{ w \in \{0,1\}^* | \text{one of the last three symbols in } w \text{ is a } 1 \} \).
    (b) Give an NFA with three states that recognizes the language \( L_2 = 0^*1^* \cup 0^*1^*2 \).

6. Convert the NFA given in Figure 1.27 of the textbook into a DFA. Show only the reachable states of the DFA.