HOMEWORK 2

The problems below are either restatements or slight adaptations of problems in the Sipser textbook.

1. Draw NFAs with the specified number of states recognizing the following languages over the binary alphabet:

   (a) the language $\{0\}$, with two states;

   (b) the language of strings that end in 00, with three states.

2. Draw NFAs for the following languages:

   (a) binary strings that begin with a 1 and end with a 0, or contain at least three 1s;

   (b) binary strings that contain the substring 1010 or do not contain the substring 110.

3. Let $L = \{w : w$ contains an even number of 0s and an odd number of 1s and does not contain the substring $01\}$. Draw a DFA with five states that recognizes L.

4. Let L be the language of all strings over $\{0, 1\}$ that do not contain a pair of 1s that are separated by an odd number of symbols. Draw a DFA with five states that recognizes L.

5. Let $M = (Q, \Sigma, \delta, q_0, F)$ be an NFA that recognizes a language L. Does the NFA $(Q, \Sigma, \delta, q_0, Q \setminus F)$, which is result of swapping the accept and reject states in M, necessarily recognize the complement of L? Prove or give a counterexample.

6. Let L_n be the language of all binary strings of the form $\overbrace{11\ldots1}^{k}$ for some k that is a multiple of n. Show that for each $n \geqslant 1$, the language L_n is regular.

7. Solve Problem 1.48 in the Sipser textbook.