HOMEWORK 2

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

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 5 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 5 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 $\overbrace{111\ldots1}^{k}$ for some k that is a multiple of n. For each $n \geq 1$, construct a DFA or NFA that recognizes L_n.

7 Let D be the language of binary strings that contain an equal number of occurrences of the substrings 01 and 10. Thus $101 \in D$ because 101 contains a single 01 and a single 10, but $1010 \notin D$ because 1010 contains two 10s and one 01. Construct a DFA or NFA for D.