Reminder: you are permitted to collaborate and use outside sources provided that you document your collaborators and sources for each problem, and you produce your own written solutions. Solutions to each problem should be electronically typeset and submitted online via Blackboard; see the E-Homework Guide http://www.cse.wustl.edu/~bjuba/cse547t/f15/ehomework/ for instructions.

The problem numbers are for the second edition (2e) and/or third edition (3e) of Introduction to the Theory of Computation by Michael Sipser. Unfortunately, the international edition has different numbers for the problems! To avoid confusion, I have typeset the problems I mean on this homework. In the future, I’ll simply also include problem numbers for the international third edition as well.

1. Exercise 1.14 (2e/3e)
   (a) Show that if $M$ is a DFA that recognizes language $B$, swapping the accept and nonaccept states in $M$ yields a new DFA recognizing the complement of $B$. Conclude that the class of regular languages is closed under complement.
   (b) Show by giving an example that if $M$ is an NFA that recognizes language $C$, swapping the accept and nonaccept states in $M$ doesn’t necessarily yield a new NFA that recognizes the complement of $C$. Is the class of languages recognized by NFAs closed under complement? Explain your answer.

2. Exercise 1.17 (2e/3e)
   (a) Given 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.

3. Problem 1.31 (2e/3e)
   For any string $w = w_1w_2\cdots w_n$, the reverse of $w$, written $w^R$, is the string $w$ in reverse order, $w_n\cdots w_2w_1$. For any language $A$, let $A^R = \{w^R : w \in A\}$. Show that if $A$ is regular, so is $A^R$.

4. Problem 1.70 (3e):
   We define the avoids operation for languages $A$ and $B$ to be
   
   \[ A \text{ avoids } B = \{w : w \in A \text{ and } w \text{ doesn’t contain any string in } B \text{ as a substring}\}. \]

   Prove that the class of regular languages is closed under the avoids operation.