Due September 25, 9:00 a.m.

Problem 1

Sipser, 1.8a, 1.9b, 1.10c.

Problem 2

Sipser, 1.14.

Problem 3

Give regular expressions for the following languages over \( \Sigma = \{a, b\} \):

a. \( L = \) all strings do not contain the substring \( ba \)

b. \( L = \{a^n b^m \mid n \geq 1, m \geq 1, nm \geq 3\} \) (\( nm \) is \( n \) times \( m \))

c. \( L = \) all strings containing a number of \( a \)'s that is a multiple of 3.

Problem 4

Are the regular expressions over \( \Sigma = \{a, b, c\} \) in each pair equivalent? Explain your answer. If the two are not equivalent, show a string that is in one language and not the other.

a. \((a \cup b)^* a^* \) and \(((a \cup b)a)^* \)

b. \(((a \cup b)c)^* \) and \((ac \cup bc)^* \)

c. \((ab \cup ac) \) and \((ba \cup ba)(b \cup c) \)

Problem 5

Let \( L \) be the language denoted by the regular expression \((ba)^* \cup bb)(e \cup b)\). Construct an NFA that recognizes \( L \) using the procedure outlined in class. Show your steps.
Problem 6

Use the state elimination method to convert the following finite automaton to a regular expression. Please eliminate the states in this order: $q_3$, $q_1$, $q_2$, $q_0$. 

![Diagram of the finite automaton]