CS 360 W10 Assignment 1

Due date: Tuesday Feb. 2nd, at the beginning of class.

All questions are worth the same amount. Please ensure that your name and student number appear, in ink, on each page of your assignment.
Work is to be done individually.
Turn your assignments in to me at the beginning of class.
Assignment questions:

1. Write a regular expression that represents the set of strings over $\{0, 1\}$ with at most one pair of consecutive 0's or 1's.

2. Convert the regular expression from the first question into an NFA accepting the same language. Justify your answer.

3. Consider the following NFA, $A = (\{p, q, r, s\}, \{0, 1\}, \delta, p, \{q, s\})$. Where δ is defined as follows: $\delta(p, 0) = \{q, s\}$, $\delta(p, 1) = \{q\}$, $\delta(q, 0) = \{r\}$, $\delta(q, 1) = \{q, r\}$, $\delta(r, 0) = \{s\}$, $\delta(r, 1) = \{p\}$, and $\delta(s, 1) = \{p\}$. Build a DFA that accepts the same language as A and explain how you know the two machines accept the same language.

4. Convert the DFA in the previous question into a regular expression. Justify your answer.

5. Consider the NFA A from question 3. Provide an automaton A' such that $\mathcal{L}(A') = \{0, 1\}^\star \setminus \mathcal{L}(A)$.

6. Let δ be the transition function for the DFA, $A = (\Sigma, Q, \delta, q_0, F)$. Prove that for any input strings $x, y \in \Sigma^*$, and for any $q \in Q$, $\delta(q, xy) = \delta(\delta(q, x), y)$.

7. Prove or disprove the following equivalence between regular expressions R and S.
   $\mathcal{L}((R + S)^*S) = \mathcal{L}((R^*S)^*)$.