Problem Set 3

Due: Thur, 02/12/09.
Reading: Chapter 1.2.

1. Let $L = \{0^i1^j | i \geq 0, j \geq 1\}$.
   (a) Give a state diagram of an NFA for $L$.
   (b) Give a short informal description of $L^*$.
   (c) Use the construction given in class (found in the proof of theorem 1.49) to give
       the state diagram of the NFA recognizing $L^*$.

2. (a) Problem 1.16(b) in text (NFA to DFA conversion).
   (b) Problem 1.8(a) in text (using union construction).
   (c) Problem 1.9(b) in text (using concatenation construction).

3. In class we showed that given a DFA that recognizes a language $L$, swapping the accept
   and nonaccept states yields a new DFA that recognizes the complement of $L$. We also
   mentioned that this is not necessarily true for NFAs. In this problem you will prove
   the latter,\footnote{part (a) proves that $L_2 \not\subseteq L_1$, and part (b) proves that $L_1 \not\subseteq L_2$, so either one of them suffices to prove that $L_2 \neq L_1$.} and show a construction that does work for NFAs.
   Let $N_1 = (Q, \Sigma, \delta, q_0, F)$ be an NFA recognizing the language $L_1 = L(N_1)$. Consider
   the NFA $N_2 = (Q, \Sigma, \delta, q_0, Q \setminus F)$ obtained by swapping the accept and nonaccept
   states in $N_1$. Let $L_2 = L(N_2)$. For parts (a) and (b) below you should provide state
   diagrams, while for part (c) you should use the formal notation.
   (a) Give an example of an NFA $N_1$ and a string such that the string is accepted by
       both $N_1$ and $N_2$.
   (b) Give an example of an NFA $N_1$ and a string such that the string is rejected by
       both $N_1$ and $N_2$.
   (c) Given the NFA $N_1$ for the language $L_1$, show how to construct an NFA (or a
       DFA) that recognizes $\overline{L_1}$ (the complement of $L_1$).

4. Problem 1.31 in text (showing that the class of regular languages is closed under the
   reverse operation).