COMS W3261: Theoretical Computer Science.
Instructor: Tal Malkin

Problem Set 3

Due: Thur, 02/17/11.

1. Let $L_a = \{a^i | i \geq 1\}$ and $L_b = \{b^i | i \geq 0\}$ (both languages over the alphabet $\{a, b\}$).

   (a) Give an informal English description for each of L_a, L_b, $\bar{L_b}$ (the completment of L_b), and $L_a \cup L_b$.

   (b) Construct an NFA for $L_a^* \circ L_b$, by using the constructions given in class in the proofs of closure of regular langauges under regular operations (do not try to simplify or optimize the NFA).

2. Problem 1.16(b) in the text (NFA to DFA conversions).

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 (twice).

   Let $N_1 = (Q, \Sigma, \delta, q_0, F)$ be an NFA recognizing some 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 $L_2 = L(N_2)$. In the following, provide state diagrams for example N_1, N_2 satisfying the required properties.

   (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.

4. problem 1.31 in the textbook.