COMS W3261: Theoretical Computer Science.
Instructor: Tal Malkin

Problem Set 2

Due: Thur, 02/03/11.
Reading: Chapters 1.1, 1.2.

1. Problem 1.3 in the textbook.

2. For each of the following languages, give a state diagram of a DFA that recognizes the language. For the first language L_1, also give the formal description of the DFA you construct. All languages are over the alphabet $\Sigma = \{0, 1\}$.

   (a) $L_1 = \{w | w$ starts with a 0 and has odd length, or starts with a 1 and has even length $\}$

   (b) $L_2 = \{w | w$ does not contain the substring $001\}$

   (c) $L_3 = \{w |$ the number of 0's in w is an integer multiple of $5\}$

   (d) (extra credit): $L_4 = \{w | w = \epsilon$ or w is a representation of a binary number that is an integer multiple of $5\}$.

3. Let $L_5 = \{w \in \{a, b\}^* |$ the third to last symbol in w is $a\}$.

   (a) Construct a DFA for L_5. Give the computation path (i.e., sequence of states) of your DFA on the word *aabb*.

   (b) Construct a 4-state NFA for L_5. Give the computation tree of your NFA on the word *aabb*.

4. For each of the following languages, give a state diagram of an NFA that recognizes the language. For the second language L_7, also give the formal description of the NFA you construct. All languages are over the alphabet $\Sigma = \{0, 1\}$.

   (a) $L_6 = \{0, 1, 000, \epsilon\}$

   (b) $L_7 = \{w | w$ contains exactly one 1 or exactly one $0\}$.

   (c) $L_8 = \{w | w$ consists of two 0s separated by a string w' in $L_1\}$ where L_1 is the language defined in problem 2a above.

5. **This problem was postponed to Problem Set 3:**

   problem 1.31 in the textbook.