COMS W3261: Theoretical Computer Science.
Instructor: Tal Malkin

Problem Set 2

Due: Thur, 02/05/09.
Reading: Chapters 1.1, 1.2.

1. 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) $L_1 = \{w||w| \text{ is an integer multiple of } 4\}$ (recall that $|w|$ is the length of the string).
   (b) $L_2 = \{w|w \text{ is a representation of a binary number that is an integer multiple of } 4\}$.
   (c) (extra credit): $L_3 = \{w|w \text{ is a representation of a binary number that is an integer multiple of } 3\}$.
   (d) $L_4 = \{w|w \text{ does not contain the substring } 110\}$
2. Let $L_5 = \{w| \text{ the two symbols before the last one in } w \text{ are } 01\}$ (over the alphabet $\Sigma = \{0, 1\}$). For example, 11011 is in L_5 but 110111 is not in L_5.
   (a) Construct a DFA with 5 states for L_5.
   (b) Construct an NFA with 4 states for L_5.
   (c) Give the computation tree of of your NFA from (b) on the word 01010.
3. For each of the following languages, give a state diagram of an NFA that recognizes the language. For the third language L_8, also give the formal description of the NFA you construct. All languages are over the alphabet $\Sigma = \{0, 1\}$.
   (a) $L_6 = \{0, 1\}$
   (b) $L_7 = \emptyset$
   (c) $L_8 = \{w|w \text{ contains an even number of 0s or exactly two 1s}\}$
   (d) $L_9 = \{w|w \text{ contains two 0s separated by a string } w' \text{ in } L_1\}$ where L_1 is the language defined in problem 1a above.