CSE 322 Spring 2004

Homework Assignment # 3

Due Date: Friday, April 23 (at the *beginning* of class)

1. (20 points) Draw the state diagrams and write down the formal descriptions ($Q, \Sigma, \delta, q_0, F$) of NFAs with the specified number of states recognizing each of the following languages:
   a. $L_1 = \{w \in \{0,1\}^* \mid$ the string 1110 occurs at least once in w$\}$ with five states
   b. $L_2 = \{w \in \{0,1\}^* \mid$ w contains exactly two 0s, or an odd number of 1s$\}$ with six states

2. (10 points) Convert your NFA for L_2 in Problem 1 (b) above to an equivalent DFA using the "subset construction" idea we discussed in class (also described in the proof of Theorem 1.19 and Example 1.21 in the textbook).

3. (30 points) Let $A = \{w \in \{0,1\}^* \mid$ w is of even length or w contains 00$\}$ and let $B = \{w \in \{0,1\}^* \mid$ w starts and ends with the same symbol$\}$.
   a. Draw the state diagrams of NFAs recognizing A and B.
   b. Draw the state diagrams of NFAs recognizing the following languages using the constructions in Theorems 1.22, 1.23, and 1.24:
      i. $A \cup B$
      ii. $A \circ B$
      iii. A^*

4. (20 points) Recall that x^R denotes the reverse of the string x (see page 14 in the textbook). Prove that if a language A is regular, then $A^R = \{x^R \mid x \in A\}$ is also regular.

5. (20 points) The year is 1952 and you are on the job-market as a finite-automata developer. Based on your stellar performance in 322, your instructor wrote you a "walks-on-water" reference letter which landed you a job at the reputed firm Moregone Stanley. Your first assignment is to design a finite automaton (NFA or DFA) which, when given a set of three input binary numbers verifies that the last number is the sum of the first two. Draw the state diagram or give a formal description of your finite automaton and explain how it solves the problem. (Hint: See Problem 1.25 on page 88 in the textbook).