CSE 322 Autumn 2004

<u>Homework Assignment # 3</u>

Due Date: Wednesday, October 27 (at the *beginning* of class)

1. (20 points) Draw the state diagrams <u>and</u> write down the formal descriptions (Q, Σ, δ, q_0, F) of NFAs recognizing each of the following languages:
   a. $L_1 = \{w \mid w \in \{0,1\}^*$ and the third <u>and</u> third-to-last symbols of w are both 1$\}$
   b. $L_2 = \{w \mid w \in \{0,1\}^*$ and w contains both or neither 00 and 11 as substrings$\}$

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). You may simplify your DFA if you wish by omitting any states that you consider unnecessary.

3. (25 points) Let $A = \{w \mid w \in \{0,1\}^*$ and w contains an even number of occurrences of substring 01$\}$. Let $B = \{w \mid w \in \{0,1\}^*$ and w ends in 101 or 011$\}$.
   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. (25 points) Inspired by the NFAs discussed in class, you've come up with a new type of NFA called My-Amazing-FInite-Automaton (MAFIA) which is a 5-tuple (Q, Σ, δ, q_0, F). A MAFIA N accepts an input string $w \in \Sigma^*$ iff <u>every</u> computational path of N on w ends in an accepting state (recall that the NFAs we studied in class accept a string iff at least one computational path ends in an accept state). Prove that the class of languages accepted by MAFIAs is exactly the same as the class of regular languages.

5. (20 points) Show that for any language $L \subseteq \Sigma^*$, if L is regular, then the following languages are also regular:
   a. $\text{Prefix}(L) = \{w \mid w \in \Sigma^*$ and $wx \in L$ for some $x \in \Sigma^*\}$
   b. $\text{NoExtend}(L) = \{ w \mid w \in L$ but $wx \notin L$ for all $x \in \Sigma^* - \{\varepsilon\}\}$