CSE 322 Spring 2004

Homework Assignment # 4

Due Date: Friday, April 30 (at the beginning of class)

1. (40 points) Give regular expressions that generate the following languages. In all cases, the alphabet is $\Sigma = \{0,1\}$.
   a. $\{ w \mid w \text{ contains an odd number of 0s} \}$
   b. $\{ w \mid w \neq \varepsilon \text{ and every even position of } w \text{ is a 0} \}$
      (Note: Use $w = w_1w_2\ldots w_n (w_i \in \Sigma)$ for determining position)
   c. $\{ w \mid w \text{ contains no 0s and } |w| < 3 \}$
   d. $\{ w \mid w \text{ begins and ends in the same symbol and } |w| > 1 \}$
   e. $\{ w \mid w \text{ contains no 1s or each 1 in } w \text{ is immediately followed by a 0} \}$
   f. $\{ w \mid 01 \text{ occurs at least twice in } w \}$
   g. $\{ w \mid w \text{ is not 00 or 11} \}$
   h. $\{ w \mid w \text{ has neither 00 nor 11 as a substring} \}$

2. (20 points) Convert the following regular expressions to NFAs using the procedure discussed in class (see lecture slides and Lemma 1.29 in the text):
   a. $1^*((0 \cup 1)(00 \cup 11))^* \cup 0$
   b. $(1 \cup \varepsilon)\emptyset$

3. (10 points) Convert the DFA in Example 1.5 in the textbook (page 39) to a regular expression using the GNFA procedure discussed in class (see lecture slides and Lemma 1.32 in the text).

4. (20 points) Show that the following languages over $\Sigma = \{0,1\}$ are not regular:
   a. $\{ 0^m1^n10^{m+n} \mid m, n \geq 1 \}$
   b. $\{ w \mid w \text{ contains more 0s than 1s} \}$

5. (10 points) Show that for any regular language $L$ over $\Sigma$, the language:
   $\text{MAX}(L) = \{ w \mid w \in L \text{ and for all non-empty strings } x \in \Sigma^*, wx \notin L \}$ is also regular. Give the formal description of any finite automata you use in your proof.