CSE 322: Formal Models in Computer Science **Homework #3**
April 17, 2009 Due: **Friday**, April 24, 2009

Reading Assignment: Sipser 1.4

Problems:

1. Give regular expressions for the following languages:

   (a) L_1 , which is the language of all valid comments in the C language. Assume for this problem that a valid comment in C starts with $/\#$ and ends with $\#/$ with no intervening $\#/$. Assume for simplicity that the alphabet for L_1 is $\Sigma = \{/, \#, a, b\}$. For example, $/\#ab\#/$ and $/\#a/\#b\#/$ are in L_1 while $/\#ab$ and $/\#a\#/b\#/$ are not. Assume that $/\#/$ is a valid comment.

   (b) $L_2 = \{w | w \in \{0,1\}^*$ and w does not contain 101 as a substring$\}$.

2. Using the construction given by the proof of Lemma 1.55 (1st edition Lemma 1.29) (as shown in Examples 1.57 and 1.58 (1st edition 1.30 and 1.31)) to draw state diagrams for NFAs that accept the languages given by the following regular expressions. Include all states that would be created by this construction (in other words do not simplify **any** of the steps in the construction.) Yes: your constructions may get large.

   (a) $((ab)^*b)^*$.

   (b) $a^*b(ab^*)^*b^*$

3. Prove or disprove the following identities among regular expressions. Assume that R and S are regular expressions. You may disprove by given a counterexample.

   (a) $(R \cup S)^* = R^* \cup S^*$

   (b) $(R^*S^*)^* = (R \cup S)^*$

4. Consider the DFA $M = (\{q_0, q_1, q_2, q_3\}, \{0,1\}, \delta, q_0, \{q_1\})$ with the following transition function for $i = 0, 1, 2, 3$; $\delta(q_i, 0) = q_{2i \bmod 4}$ and $\delta(q_i, 1) = q_{2i+1 \bmod 4}$.

   (a) Let L_5 be the language accepted by M. Give a simple description of L_5.

   (b) Using the DFA to regular expression procedure covered in class, obtain a regular expression that describes L_5. Please show your steps. You may make obvious reductions in the regular expressions on the GNFA as you proceed.

5. **Extra Credit** Do it for the glory glory glory, not for the points (no tripling of the word points, because the bonus points are minimal.) Prove that every regular language is accepted by a planar NFA. An NFA is planar if it can be embedded in the plane (i.e. one can draw it) such that there are no crossings.