CSE 322: Formal Methods in Computer Science Spring 2003

PROBLEM SET 3

Due Friday, April 25, 2003, in class

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1. Apply the state elimination procedure described in class to convert the finite automata (c) from Problem 2.3.7 on Page 84 of Lewis and Papadimiriou into a regular expression. Simplify the resulting regular expression as much as you can.

2. Write down regular expressions for each of the following languages over the alphabet $\{0, 1\}$.

   (a) $L_1 = \{w \mid w$ starts with 0 and has odd length, or starts with 1 and has even length$\}$.

   (b) $L_2 = \{w \mid w$ is any string except 00 or 000$\}$.

   (c) $L_3 = \{w \mid w$ does not contain the substring 110$\}$.

3. Lewis and Papadimitriou, Problem 1.8.4.
   (You **must** give a regular expressions based proof to receive credit, i.e., do **not** resort to a DFA/NFA construction to prove regularity of L'.)

4. Let r and s be regular expressions where the language represented by r does not contain the empty string ϵ. Consider the equation $X = r \circ X \cup s$ (where $\circ$ stands for concatentation of regular expressions, and $\cup$ for union) with unknown variable X. Find a solution (namely, a regular expression) for X that satisfies the above equation and prove that this solution is unique. (Comment: *This question is harder than the others!*)

5. (a) By first constructing an NFA and then adding the necessary backward transitions, construct the DFA useful for determining whether the pattern *aababaabaaa* occurs in a string over the alphabet $\{a, b\}$.

   (b) Lewis and Papadimitriou, Problem 2.6.3, Part (c).

   (c) (Just for fun; no need to turn anything in for this part) Think about why such an NFA as in (b) above is good to have; this is actually Part (d) of Problem 2.6.3. (Again, you **don't have to** turn in a solution to this part.)