CSE396, Spring 2017  Problem Set 3  Due Thu. 3/2* in class

Reading:
We will cover non-regular languages in section 1.4, but with a different tool: the Myhill-Nerode Theorem which is a UB-Cornell product. Please read the Myhill-Nerode handout on the course webpage. It is also covered in the chapter exercises as noted. This is the last material in the domain of Prelim I and will be on assignment 4 before it.

Assignment 3, due in hardcopy and in class Thu. 3/2*
(*except R4 may submit Fri. 3/3 1–2pm) Please staple any multiple-sheet submission.

And: please write your name, Student ID#, and recitation attended atop your HW.

(1) Convert the following two NFAs \( N_1 \) and \( N_2 \) into equivalent DFAs. Both have \( \Sigma = \{a, b\} \). For each one, say how many more (or less?) states and instructions the DFA has, whether it is possible for the NFA to “die,” and whether it is possible for a string to activate all 3 states of \( N_1 \) at the same time. \( 18 + 18 + 9 = 45 \) pts.

\[
\begin{align*}
\text{In particular} & \quad \begin{array}{c}
1 \\
2 \\
3
\end{array} \\
a & \quad \begin{array}{c}
2 \\
1 \\
3
\end{array} \\
b & \quad \begin{array}{c}
1 \\
3 \\
2
\end{array} \\
a & \quad \begin{array}{c}
2 \\
3 \\
1
\end{array} \\
b & \quad \begin{array}{c}
3 \\
2 \\
1
\end{array}
\end{align*}
\]

\( N_1 \) has states \{1, 2, 3\}, instructions \( \delta_1 = \{(1, a, 2), (1, a, 3), (1, b, 2), (2, a, 3), (3, b, 1), (3, b, 2)\} \), start state 1, and \( F_1 = \{2\} \).

\( N_2 \) has \( \delta_2 = \{(1, \varepsilon, 2), (1, a, 3), (2, a, 2), (2, b, 4), (3, b, 2), (3, b, 4), (4, a, 4), (4, b, 1)\} \), \( Q_2 = \{1, 2, 3, 4\} \), \( s_2 = 1 \), \( F_2 = \{2\} \).

(2) Find regular expressions for the following languages. In all cases you must give some reasoning to explain how you got the expression—and it is your job to explain your interpretation of any element of the description that is possibly ambiguous. It is AOK but not necessary to sketch a DFA as part of this reasoning, nor demanded that you use the DFA-to-regexp conversion. \( 9+9 = 18 \) pts., for 63 total on the set.

(a) The language of strings over \( \{a, b, \#\} \) that have a single \# in them, and that either have at least two a’s immediately before the #, or at least two b’s somewhere after the #.
(The two b’s need not be consecutive like the two a’s.)

(b) The language of strings over \( \{a, b\} \) that do not begin with the substring bba.