Problem Set 3  Due Thu. 2/25 in class

**Reading:** Tuesday’s lecture will move from finishing “GNFAs” and the big equivalence of finite automata and regular expressions, to covering languages that don’t have regular expressions. In place of the “Pumping Lemma” the weapon of choice will be the Myhill-Nerode Theorem which is a UB-Cornell product. It is covered in the Chapter 1 exercises of the text—with answers for the proof parts—but you may pick it up instead from the handout on the course webpage, http://www.cse.buffalo.edu/~regan/cse396/CSE396MNT.pdf.

**Assignment 3,** due in hardcopy; please staple any multiple-sheet submission

1. (a) Design an NFA $N$ with only 5 arcs such that $L(N)$ equals the language of strings that end in $aba$. Count a single arc with a choice of two options as two arcs.

   (b) Then show the conversion of $N$ into an equivalent DFA, following the method in class. Compare the number of arcs and states that you get between the two. (6+12 = 18 pts.)

2. Convert the following NFA $N$ with $\epsilon$-transitions into an equivalent DFA. Now talk about the increase in arcs and states. (18 pts.)

   $(N = (1, \epsilon, 2), (1, a, 3), (2, b, 2), (2, a, 4), (3, b, 2), (3, b, 4), (4, a, 4), (4, b, 1), s = 1, F = \{ 2 \}.)$

3. Find regular expressions for the languages of the following two FAs. Show the use of the algorithm from class, and then use “sight-reading” to check your work. (Note that arcs going to a dead state are not shown, which is fine if you consider these to be NFAs. 18 pts., for 54 total on the set)

   Here $N_1$ has states $Q_1 = \{ 1, 2, 3 \}$, start state $s_1 = 1$, set of final states $F_1 = \{ 3 \}$, and arcs $\delta_1 = \{ (1, a, 2), (1, b, 3), (2, b, 2), (2, a, 3), (3, a, 1) \}$. And $N_2$ has states $Q_2 = \{ 1, 2, 3, 4 \}$, start state $s_2 = 1$, set of final states $F_2 = \{ 1, 4 \}$, and arcs $\delta_2 = \{ (1, a, 2), (2, b, 1), (1, b, 3), (3, a, 4), (4, b, 3) \}$.

**Practice problem—not graded:** Show how to convert the regular expression $(aa)^*((aab)^*b + (bb)^*a)$ into an equivalent NFA with $\epsilon$-transitions. Use the procedure in class and/or the text as a guide, but take advantage of shortcuts that avoid a gazillion $\epsilon$-arcs. May be covered on Piazza.