CSE396, Spring 2017 **Problem Set 3 Makeup** **From Spring 2015**

(1) With $\Sigma = \{a, b\}$, design a nondeterministic finite automaton for the language L of strings that end in *aba*, using only 5 *arcs*. Count a single arc with a choice of two options as two arcs.

Then show the conversion of your NFA into an equivalent DFA, following the method in class. Compare the number of arcs and states that you get between the two.

Finally write a regular expression for the *complement* of L, that is, the set of strings x over Σ that *don't* end in *aba*. You are *not* expected to follow the algorithm shown on Tuesday from the complemented DFA. Instead reason about the other things x could end in—for instance, $r_1 = (a+b)^*b$ captures all the strings that end in b. Write the complement of L as a union of r_1 with other regular expressions. (6 + 12 + 9 = 27 pts.)

(2) Convert the following NFA N with ϵ-transitions into an equivalent DFA. Now talk about the increase in arcs and states. The code for N has $Q = \{ 1, 2, 3, 4 \}$, $\Sigma = \{ a, b \}$,

$$\delta = \{ (1, \epsilon, 2), (1, a, 3), (2, a, 2), (2, b, 4), (3, b, 2), (3, b, 4), (4, a, 4), (4, b, 1) \},$$

$s = 1$, and $F = \{ 2 \}$. A diagram has been added to the notes for the Thu. 2/19 lecture (week 4 part b).

Finally—using the original NFA not your DFA—write a regular expression r for the language of strings which N can process from start back to start, which Tuesday's lecture will call "L_{11}." Since the destination state is the same, $r = r_0^*$ where r_0 expresses the language of strings that N can process from 1 back to 1 without going through state 1 in-between. In this particular N the "flow" is simple enough that you should be able to do this by considering the various ways to get from 1 to 4, then "dawdling" in 4 before jumping back to 1. (That is again, you *not* expected to follow the algorithm to be shown on Tuesday–rather, if you try hacking at this problem before Tuesday you'll appreciate the lecture and the rest of section 1.3 better. 18 + 9 = 27 pts., for 54 total on the set.)