CSE396, Spring 2019 **Problem Set 4** **Due Thu. 3/7, 11:59pm**

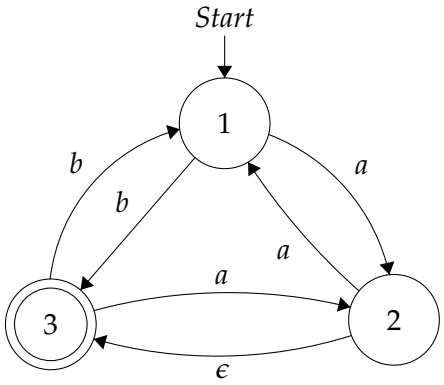
The **First Prelim Exam** will be held in class period on **Tuesday, March 12**. It will be closed-book, closed-notes except for 1 notes sheet (front-and-back OK) which you can prepare beforehand. A practice exam (last year's first prelim) will be posted next Tuesday.

Tuesday's lecture will give more Myhill-Nerode proof examples, illustrate how the distinguishing idea also applies to regular languages in terms of how many states their DFAs need, and summarize the meaning of the divide between regular and nonregular languages. It will finish by introducing *context-free languages* (CFLs) and that will carry into Thursday. CFLs are *not in the domain of the first exam*. So the exam covers chapters 0 and 1 and the supplementary notes assigned. Really it covers the contents of Assignments 1–4 except that there may be short questions on general factual material about regular languages, such as in a True/False segment. Nevertheless, *please read section 2.1* in one chunk over the weekend. This section will occupy us for several weeks but (a) it is relatively short and (b) I will not go in strict order of pages.

Homework—part online and all *individual work*—due **Thu.** 3/7, 11:59pm:

(1) Using *TopHat*, the "Worksheet" titled **Spr'19 HW4.1**. There are 10 questions, each worth 2 points, for 20 total.

(2) Consider the following NFA N. It has $\Sigma = \{a, b\}$, $Q = \{1, 2, 3\}$, $s = 1$, $F = \{3\}$, and $\delta = \{(1, a, 2), (1, b, 3), (2, a, 1), (2, \epsilon, 3), (3, a, 2), (3, b, 1)\}$.



Calculate a regular expression r such that $L(r)$ equals **the complement of** $L(N)$. Show your strategy and calculations clearly. (30 pts. total)

(3) Prove that the following languages are nonregular via the Myhill-Nerode Theorem. All use the alphabet $\Sigma = \{a, b\}$. (The $\cdot$ in (a) means numerical multiplication.)

(a) $L_a = \{x : \#a(x) = 2 \cdot \#b(x)\}$.

(b) $L_b = \{xby : \#a(x) = \#b(y)\}$.

(c) $L_c = \{a^i b a^j b a^k : i - j = k,\ i, j, k \geq 1\}$.

Here again $\#c(x)$ means the number of occurrences of the character c in the string x. ($3 \times 12 = 36$ pts., for 86 total on the set)