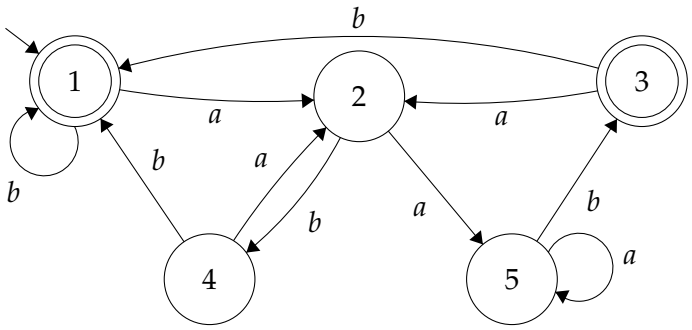
CSE396 **Problem Set 4** **Due 3/8, 11:59pm**

Reading: Tuesday's lecture will finish the coverage of Chapter 1 and transition to Chapter 2. Hence please read section 2.1 in one block this weekend. Although it is not covered on **Prelim I** which is being given *in class period* on **Tuesday, March 13**, it is good to get the reading done while you are not preparing for the exam.

(1) This problem is "HW4 Online Part" on *TopHat*, worth 20 pts. as before. The following DFA is used for the *TopHat* questions 6–10 and is also used on problem (2) below.



(2) Convert the above DFA M into a regular expression r such that $L(M) = L(r)$. First reduce the machine as the *TopHat* part may suggest, then show the steps of the algorithm. It is AOK to do this one completely "graphically" with certain shortcuts—indeed it is IMHO almost "sight-readable" to begin with. (Hence only 12 pts.)

(3) Let $r_1 = (a + ba^*b)^*$ and $r_2 = (a + b)^*bb(a + b)^*$. Calculate a regular expression r_3 such that $L(r_3) = L(r_1) \setminus L(r_2)$ by applying the ideas and procedures at the end of the Tuesday 2/27 lecture. Note that r_2 and complementary machines were part of the *TopHat* portion, which may assist you in working out things here. (18 pts. total)

(4) Prove that the following languages are not regular by using the Myhill-Nerode technique. All are over the alphabet $\Sigma = \{a, b, c\}$. Recall that $\#c(w)$ means the number of c's in the string w.

- $A = \{w \in \Sigma^* : \#a(w) + \#b(w) = \#c(w)\}$.
- $B = \{w \in \Sigma^* : \#a(w) + \#b(w) > \#c(w)\}$. (Same as A but with a $>$ comparison.)
- $C = \{w \in \Sigma^* :$ for every two c's in cwc, if v is the string between them, then $\#a(v) \geq \#b(v)\}$.

As a hint and intuition for C, think of a as "spear" and b as "dragon" and being able to hold as many spears as you like until you hit a c, at which point you have to drop all your spears and start again from scratch. When you are choosing S and setting up your strings, don't use any more c's than are already implied in treating the input w as cwc—figuratively meaning there are automatic"checkstops" at the beginning and end of the "dungeon." Depending on how you did A, it is OK for your answer to B to exhibit substantial "proof code reuse." (9 + 6 + 9 = 24 pts., for 74 total on the set)