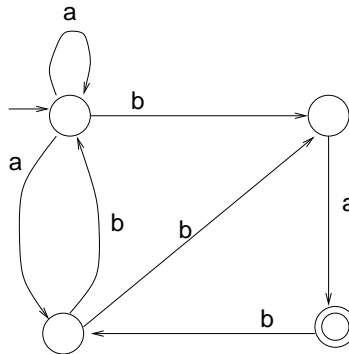


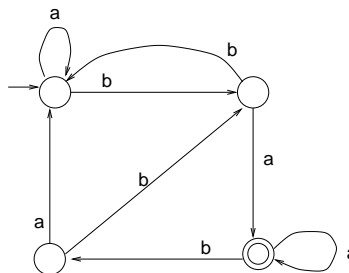
Due: Thursday, Feb. 11
25 points

On homework, you may discuss with other students in the course about how to solve a problem, but the write-up should be your own. You **must include the names** of any students you consulted with. Give credit where credit is due.

1. (3 pts) Consider the following nfa. Give an equivalent regular expression.



2. (3 pts) Give a regular grammar for the following DFA.



3. (9 pts) Construct a regular grammar for the following languages.

(a) $L = \{a^n b^m c^p \mid n \text{ is even, } m > 0 \text{ and } p \text{ is odd}\}$

(b) $L = \{w \in \Sigma^* \mid w \text{ has an even number of } a\text{'s and an odd number of } b\text{'s}\}$

Note that $abbaaba \in L$.

(c) $L = \{w \in \Sigma^* \mid (n_a(w) - n_b(w)) \bmod 3 = 1\}$, where $n_a(w)$ is the number of a 's in w .

4. (5 pts) Define $\text{Suf}(L) = \{w \in \Sigma^* \mid x = yw \text{ for some } x \in L, y \in \Sigma^*\}$ (the set of suffixes of L)

Prove that $\text{Suf}(L)$ is closed under the regular languages. (Hint: Given a DFA for L , construct a DFA for $\text{Suf}(L)$.)

5. (5 pts) Consider the following property, doublefirst_a .

$$\Sigma = \{a, b, c, d\} \quad \text{doublefirst}_a(L) = \{waav \mid wav \in L, v \in \Sigma^*, \text{ and } w \in \Sigma - \{a\}^*\}$$

The property doublefirst_a applied to a language L replaces the *first* occurrence of a in each string by aa . For example, if the string $babbab$ is in L , then $baabbab$ is in $\text{doublefirst}_a(L)$.

Prove that the regular languages are closed under the doublefirst_a property.