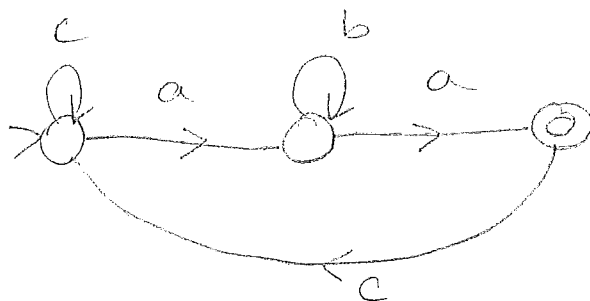




6. (5 marks) Use the construction to find the RE that describes the language accepted by the following FA.



- (b) Give a DFA for the language  $L = \{w \in \{a, b\}^* : w \text{ does not contain the substring } bab \}$ .

- (c) (4 marks) Let  $M_1$  and  $M_2$  be two DFA's, where

$$M_1 = \{Q_1, \Sigma, \delta_1, q_1, F_1\}$$

$$M_2 = \{Q_2, \Sigma, \delta_2, q_2, F_2\}$$

Show how to construct the DFA  $M' = \{Q', \Sigma, \delta', q', F'\}$  for the language  $L(M_1) \cap L(M_2)$ . That is, show the construction for the intersection of regular languages. Do so by giving the following:

$Q'$  :

$q'$  :

$F'$  :

$\delta'$  :

You are encouraged to use the mathematical notation given in class, but it is also acceptable to describe the sets, ordered pairs, or functions above in precise English. (You may wish to do part (d) below first, as a model for your general solution.)

1. (8 marks) Prove, using the Pumping Lemma for Regular Languages, that the language  $L = \{xx : x \in \{a,b\}^*\}$  is not regular. (To understand the language  $L$ : for example,  $\epsilon \in L$ , since  $\epsilon = \epsilon \cdot \epsilon$ ; however, the string  $aabbaa$  is not in  $L$  because the first half of the string,  $aab$ , does not match the last half of the string,  $baa$ .)

2. (8 marks) Let  $L$  be the language  $\{w \in \{a, b, c\}^* : w \text{ contains at least two occurrences of the letter } c, \text{ and the substring between the first } c \text{ and the second } c \text{ contains } a \text{ and } b \text{ in equal number.}\}$  An example of a string in the language  $L$  is  $aabcaababbcbbbbacacc$ . Show using the Pumping Lemma that  $L$  is not regular. It is recommended you use the closure theorems.

3. (4 marks) For this question, you may refer to the following languages by name, and may assume that they are non-regular:

$A^nB^n$  is the language  $\{a^n b^n : n \in \{0, 1, 2, \dots\}\}$ .

Evenpal over  $\Sigma$  is the language defined as  $\{ww^R : w \in \Sigma^*\}$ .

Pal over  $\Sigma$  is the language defined as  $\{w : w = w^R \in \Sigma^*\}$ .

Show, using the closure theorems and the fact that the above-mentioned languages are not regular, that the language  $L$  is not regular, where  $L = \{w \in \{a, b, c\}^* : \#_a(w) + \#_c(w) = \#_b(w)\}$ .