

Name: _____

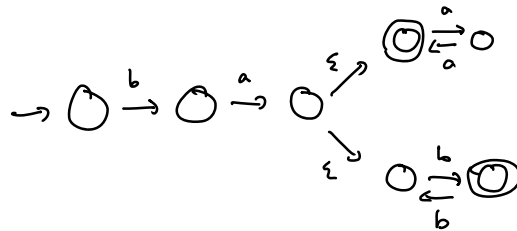
Math 3342 Exam #1

Question 1. For this whole page, let L be this language:

$$L = \{bax \in \{a, b\}^* \mid x = a^n \text{ where } n \text{ is even, or } x = b^n \text{ where } n \text{ is odd}\}$$

a) (12 points) Please give a DFA or NFA whose language is L .

NFA:



b) (10 points) Please give a regular expression which generates L .

$$ba((aa)^* + b(bb)^*)$$

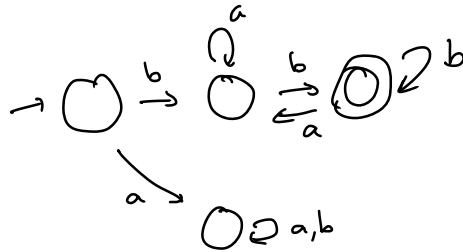
c) (5 points) Is L a regular language? Please say why or why not.

Yes! it has a NFA, so it is regular.

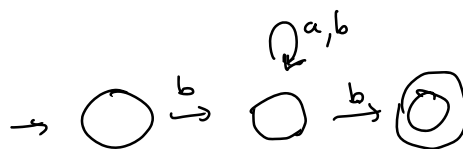
Question 2. For this whole page, let L be this language:

$$L = \{bxb \mid x \in \{a, b\}^*\}$$

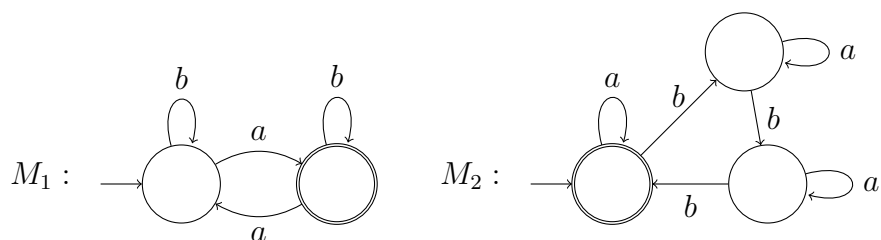
a) (10 points) Please give a DFA for L .



b) (10 points) Please give an NFA for L using fewer states than your DFA used.



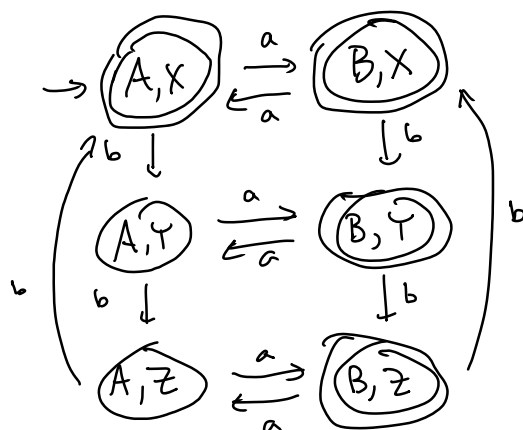
Question 3. Here are 2 DFAs M_1 and M_2 .



a) (8 points) Please give regular expressions for each of $L(M_1)$ and $L(M_2)$.

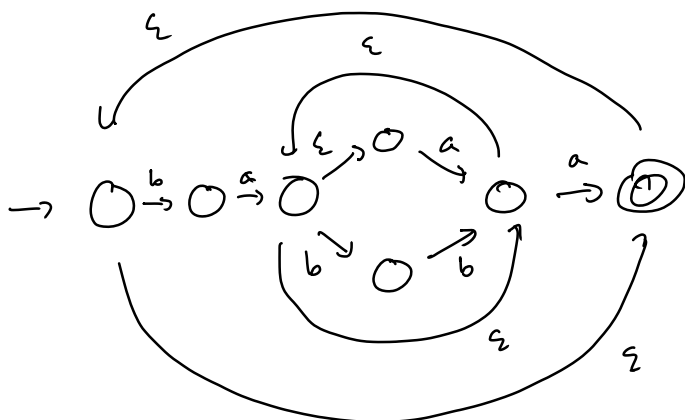
$$M_1: (b^*ab^*ab^*)^*b^*ab^* \quad M_2: (a^*ba^*ba^*ba^* + a^*)^*$$

b) (10 points) Please give a single DFA whose language is $L(M_1) \cup L(M_2)$.



Question 4. (10 points) Please convert this regular expression to NFA:

$$(ba(a + b^2)^*a)^*$$



Question 5. Consider this NFA:

$$M = (\{A, B, C, D\}, \{a, b\}, \delta, B, \{C, D\})$$

$$\delta(A, a) = \{B, C\}$$

$$\delta(A, b) = \{C\}$$

$$\delta(A, \varepsilon) = \emptyset$$

$$\delta(B, a) = \{D\}$$

$$\delta(B, b) = \emptyset$$

$$\delta(B, \varepsilon) = \{A\}$$

$$\delta(C, a) = \{D\}$$

$$\delta(C, b) = \{B\}$$

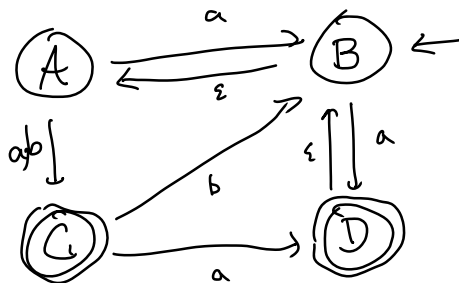
$$\delta(C, \varepsilon) = \emptyset$$

$$\delta(D, a) = \emptyset$$

$$\delta(D, b) = \emptyset$$

$$\delta(D, \varepsilon) = \{B\}$$

a) (8 points) Please draw the diagram for M .



b) (5 points) Is $abba$ accepted or rejected? Please either describe a path through the diagram which makes it accepted, or say why it's rejected.

It is accepted! we can do it like $\varepsilon ab \varepsilon ba$,
finishing in state D

c) (9 points) Please compute each of these (don't forget about those ε s!):

$$\text{i) } \delta^*(A, b^2) = \{A, B\}$$

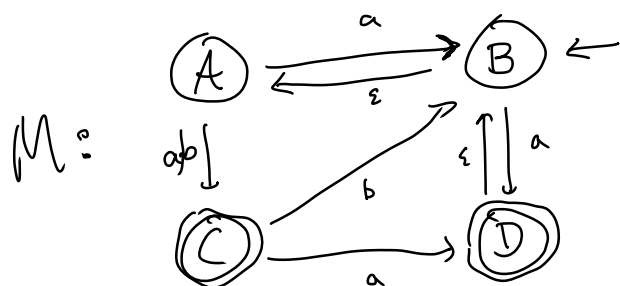
$$\text{ii) } \delta^*(A, a^2) = \{A, B, D\}$$

$$\text{iii) } \delta^*(C, ab) = \{C\}$$

d) (3 points) Please give a string x (other than those mentioned above) which is rejected by N , or say that there are none.

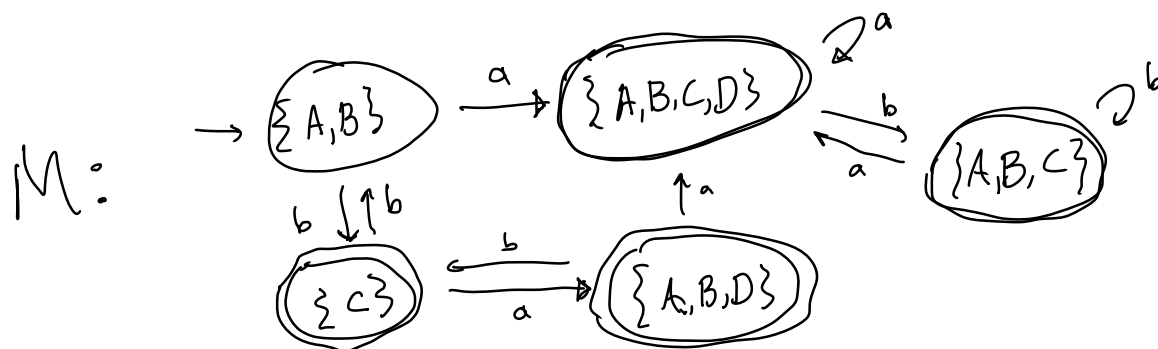
$$x = \varepsilon$$

Bonus Question. (+3 points) What is the language of the NFA from #5?

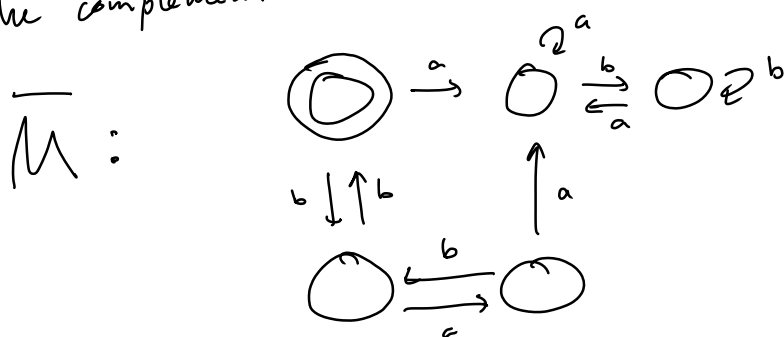


All strings except $(bcab)^*b)^*$

To see why: Convert M to DFA:



The complement:



$\overline{M}$ accepts $(b(ab)^*b)^*$

M accepts everything except $(bcab)^*b)^*$