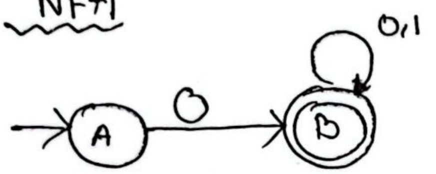
Conversion

~~NFA~~ NFA $\longrightarrow$ DFA

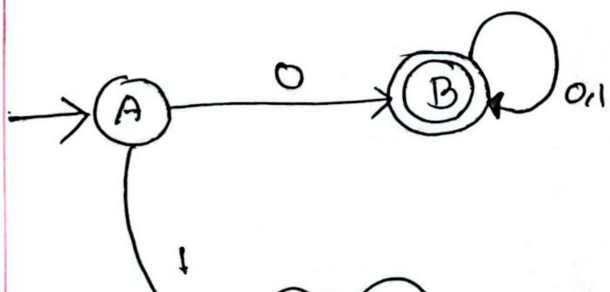
NFA



	0	1
A	B	ϕ
B	B	B

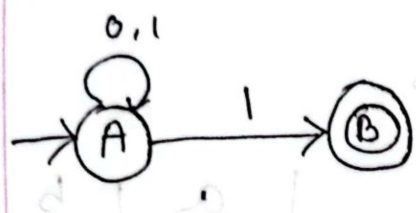
Getting ϕ in NFA means Trap in DFA

DFA



	0	1
A	B	Trap
B	B	B
Trap	Trap	Trap

NFA

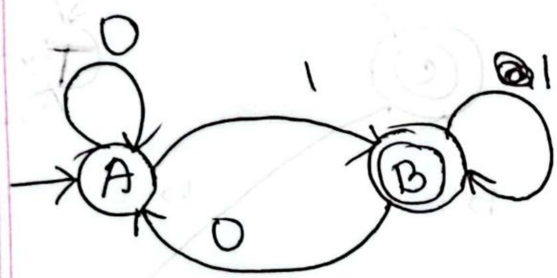


	0	1
A	{A}	{A,B}
B	ϕ	ϕ

AB = Single state

Here AB Relationship will be defined by $A \cup B$.

DFA



	0	1
A	{A}	{AB}
AB	{A}	{AB}

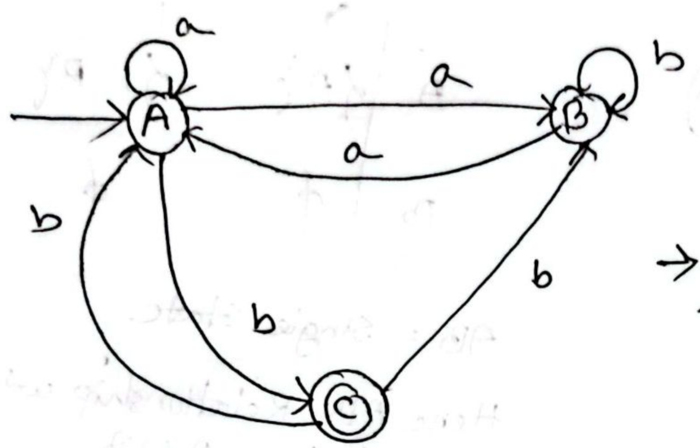
↳ $A \cup \phi = A$

$AB \cup \phi = AB$

Here B এর যাওয়ার কোনো path নেই, তাই B এর path দরকার নেই.

#

NFA

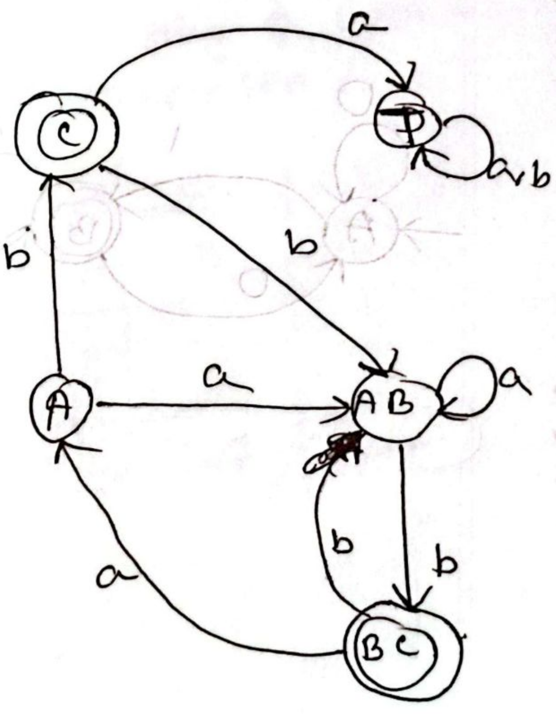


	a	b
→ A	{A,B}	{C}
B	{A}	{B}
C	ϕ	{A,B}

DFA

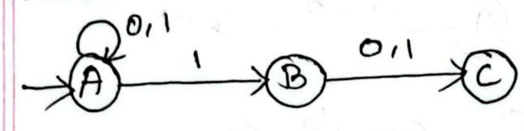
	a	b
→ A	AB	C
AB	AB	BC
BC	A	AB
C	Trap	AB
T	T	T

T=Trap



Design a NFA for a language that accepts all strings over {0,1} in which the second last symbol is always "1". Then convert it to it's equivalent DFA:

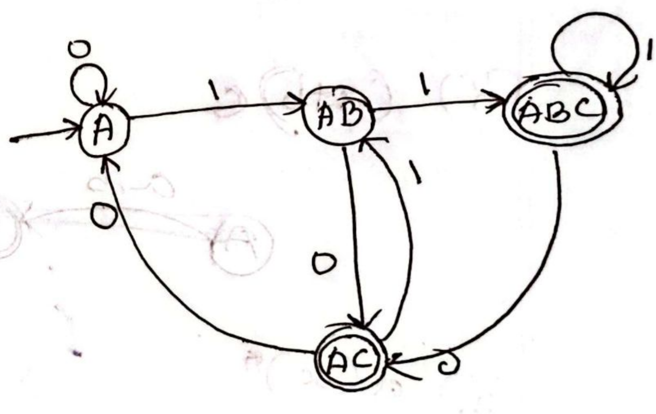
NFA



	0	1
→ A	A	{A, B}
B	C	C
C	ϕ	ϕ

DFA

		0	1
0	→ A	A	AB
1	AB	AC	ABC
2	AC	A	AB
3	ABC	AC	ABC
4	~~C~~	~~T~~	~~T~~
5	~~T~~	~~T~~	~~T~~

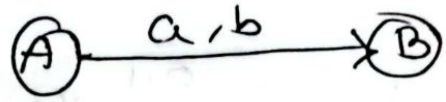


If we look closely there's no way to head to c, so the last 2 will be unnecessary, means there'll be no states called c

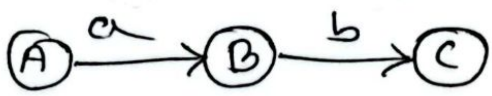
Regular Expression → FA

Some Important Rules

$(a+b) \longrightarrow$

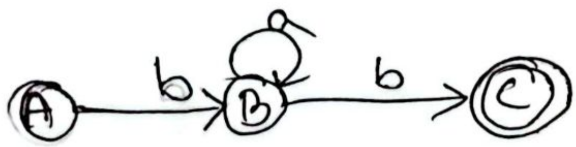


$(ab) \longrightarrow$



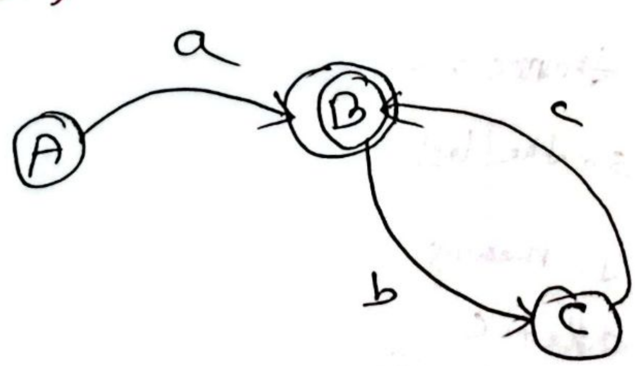
$a^* \longrightarrow$

(i) ba^*b

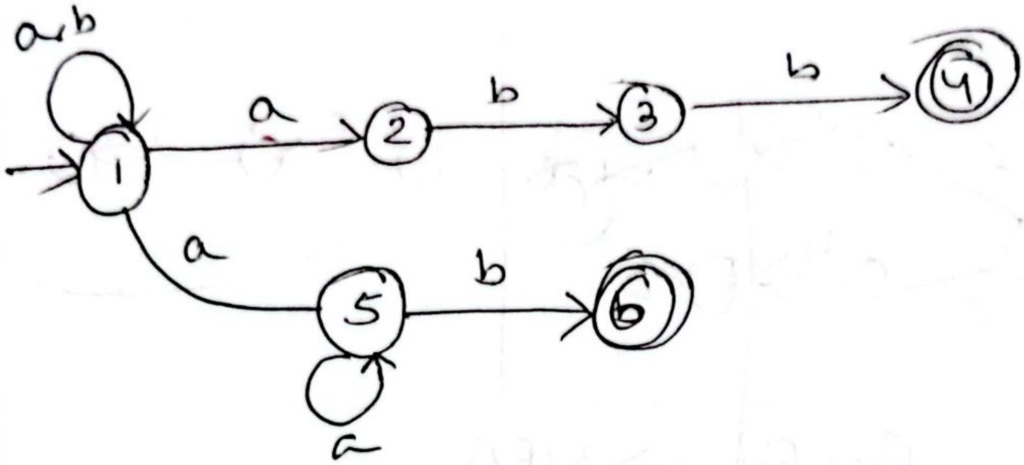


(ii) $(a+b)c$

(iii) $a(bc)^*$

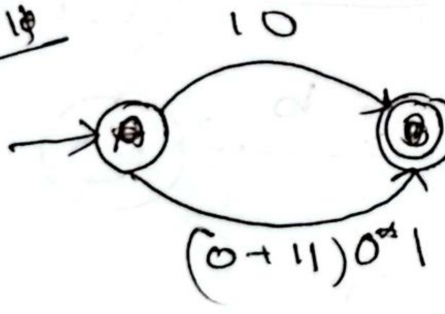


$(a|b)^* (abb|a^*b)$

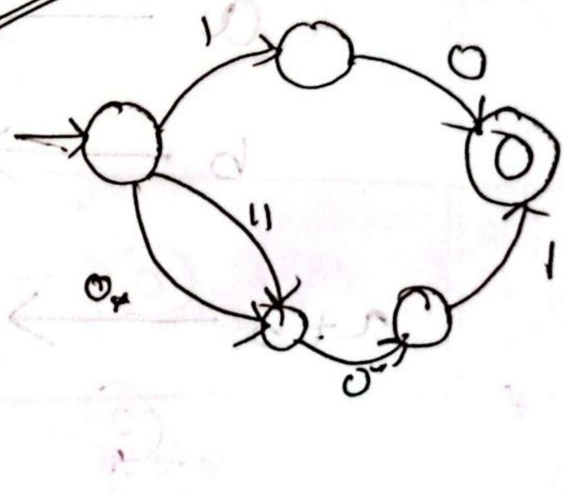


$10 + (0+11)\,0^*1$

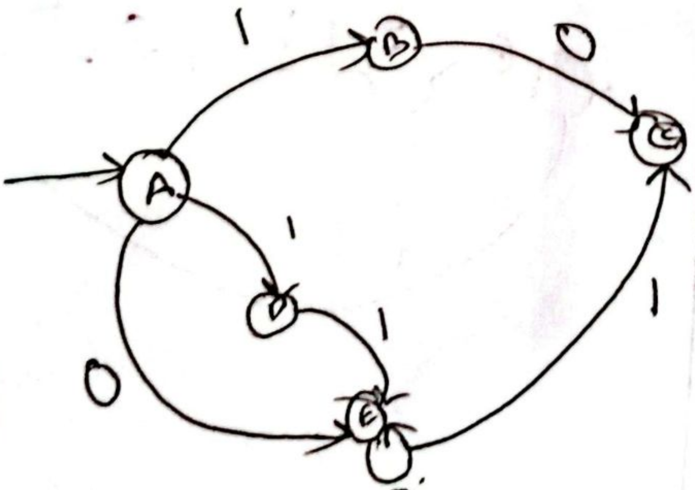
step-1



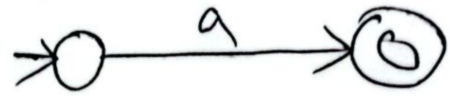
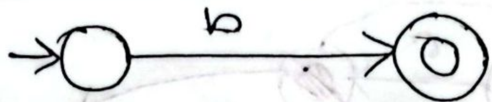
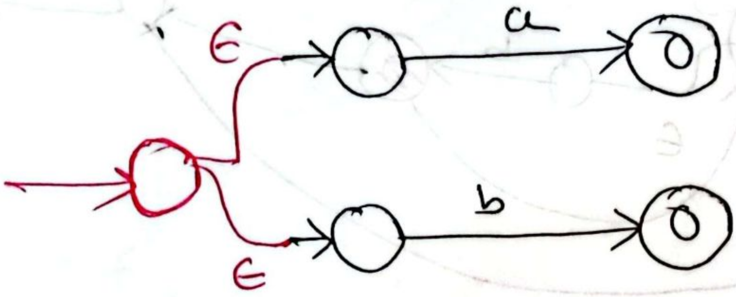
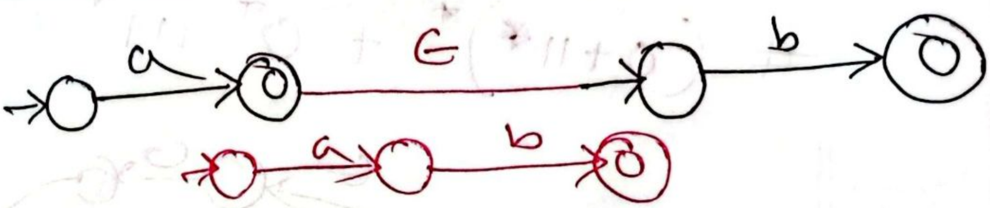
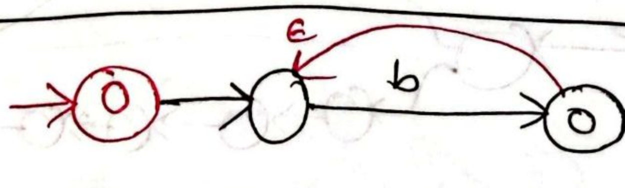
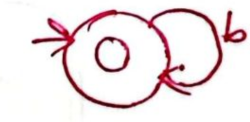
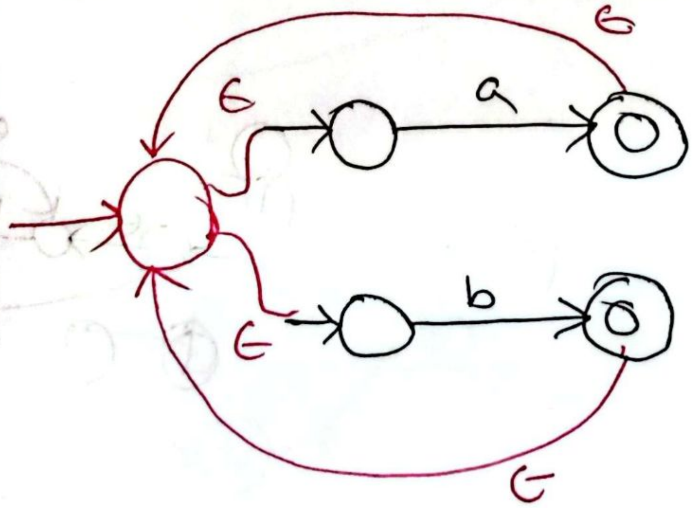
2nd step

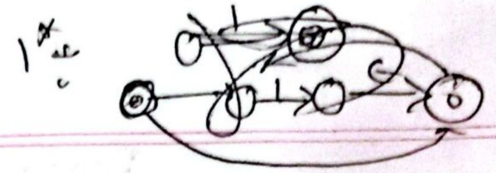


Final step

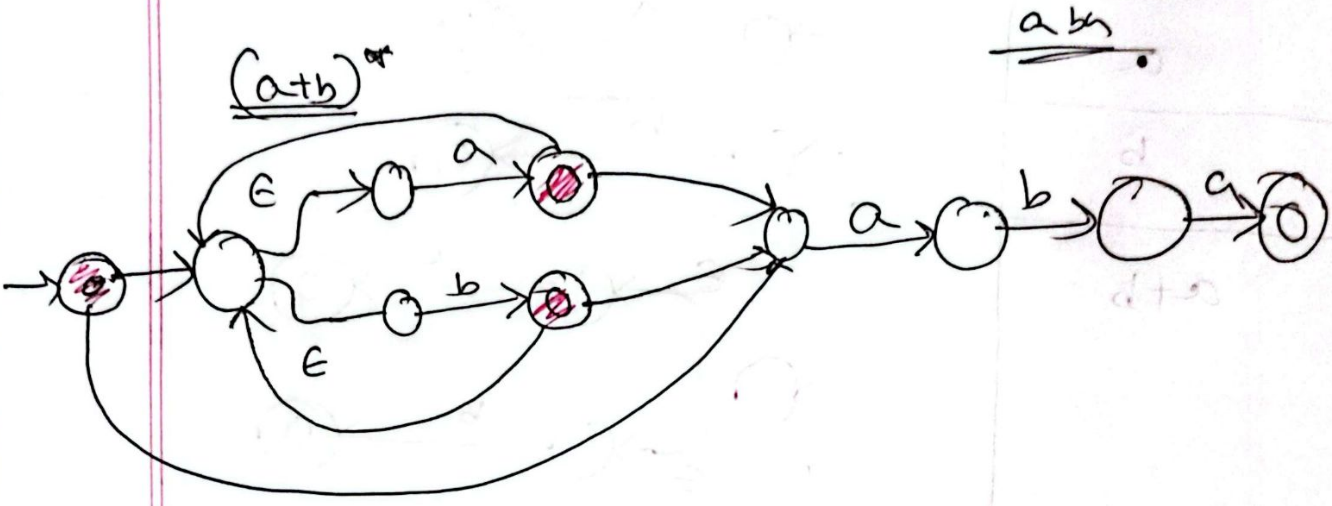


RegEx to NFA

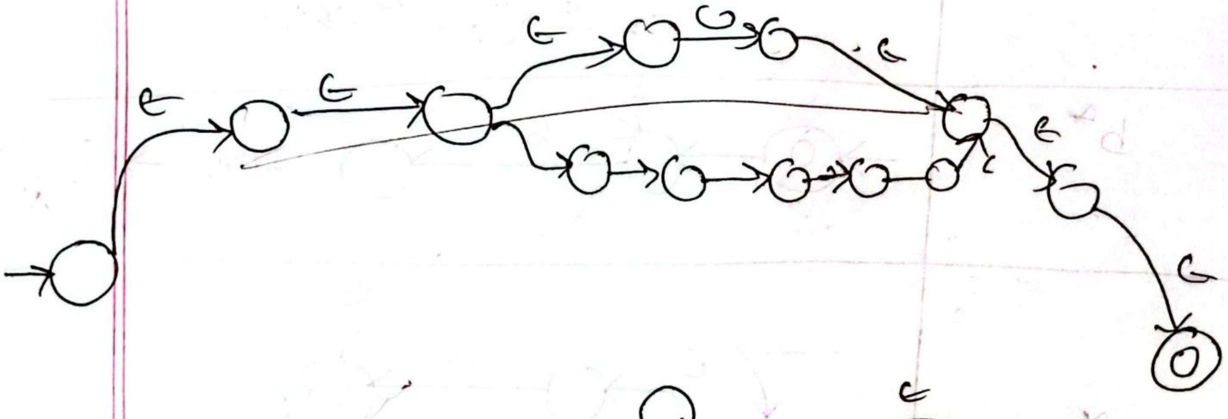
a	
b	
a+b	
ab	
b^*	 অথবা, 
$(a+b)^*$	

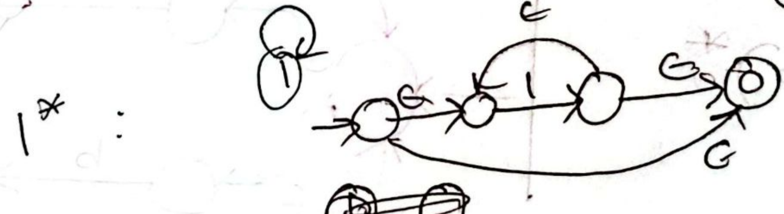


$(a+b)^* aba$

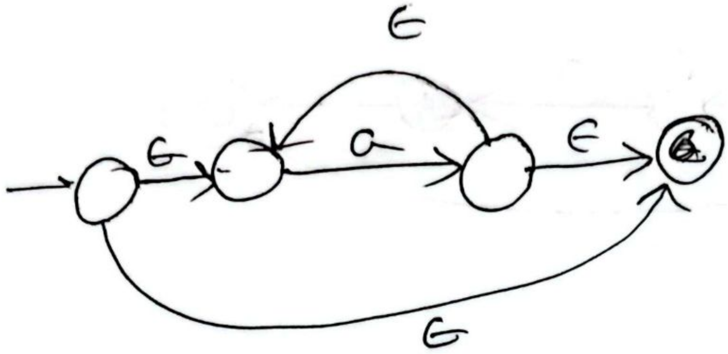


$(0+11^*)^* + 0^* 111^*$

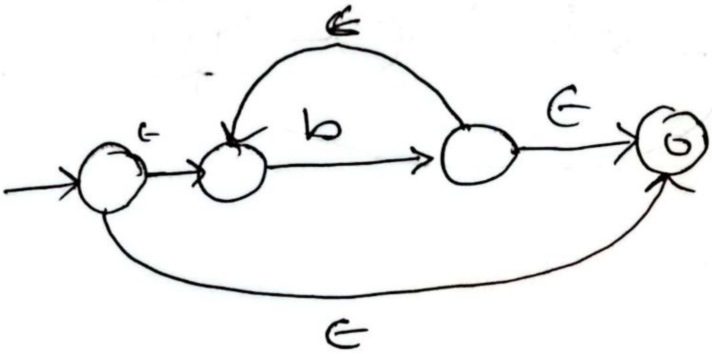




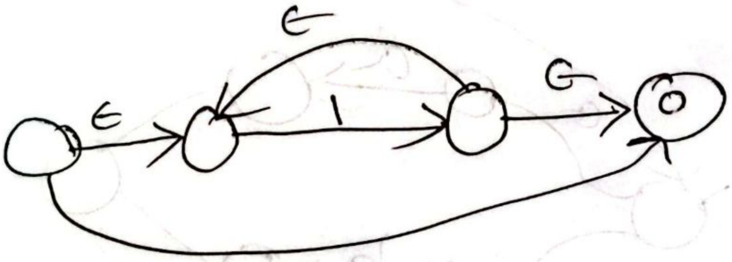
a^*



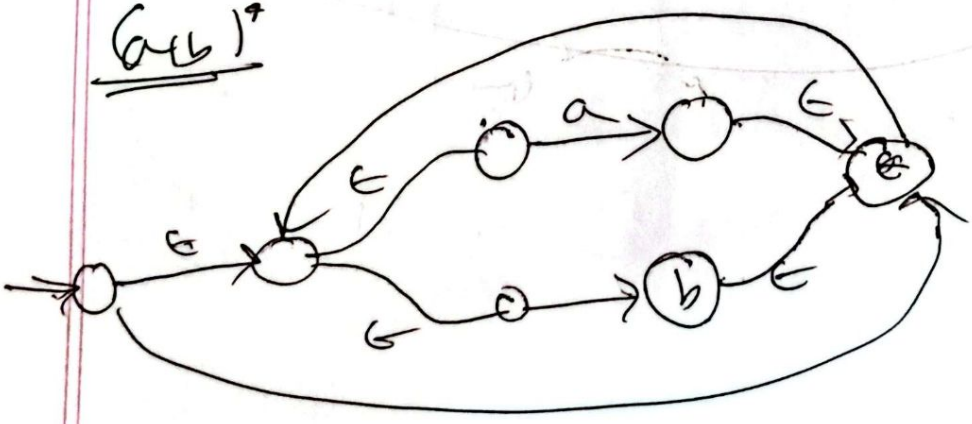
b^*



1^*

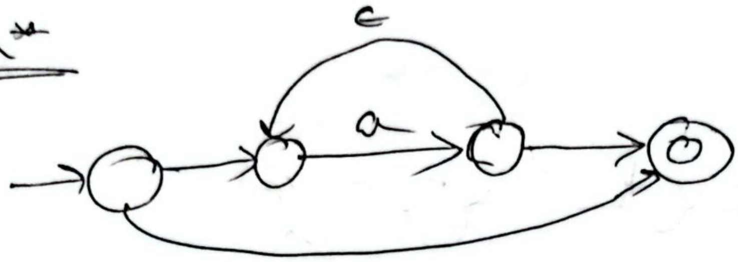


$(a+b)^*$

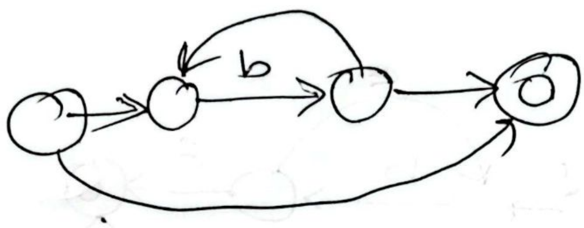


~~$(a+b)^*$~~

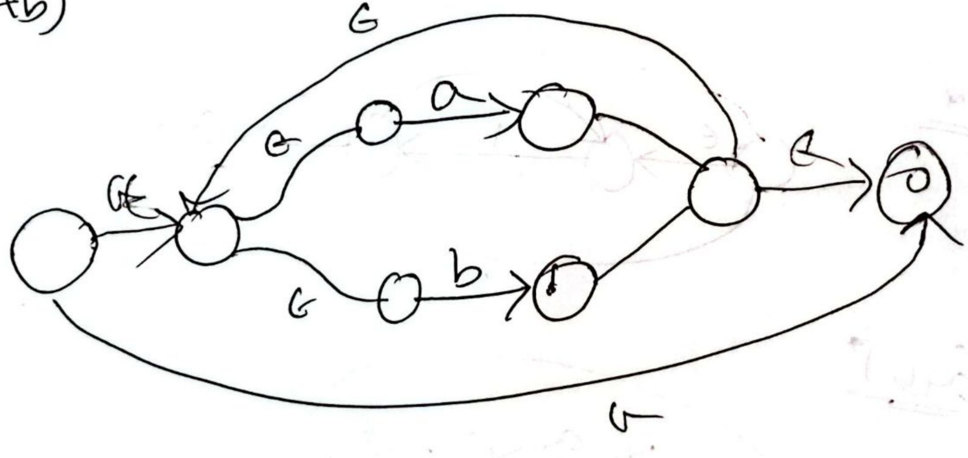
$\underline{a^*}$



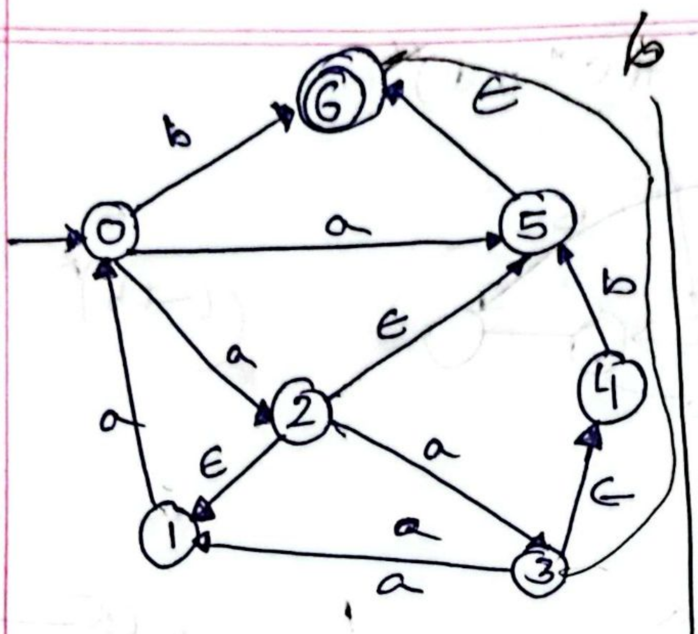
$\underline{b^*}$



$(a+b)^*$



Subset Construction



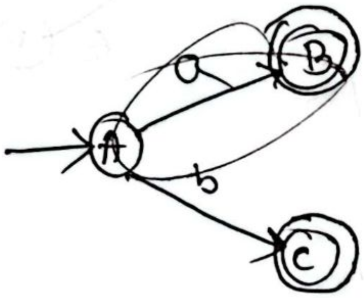
Start state

ϵ closer (0) = {0} = A

Move(A,a) $\xrightarrow{\epsilon}$ {2,5} $\xrightarrow{\epsilon}$ {1,2,5,6} = B

Move(A,b) = {6} $\xrightarrow{\epsilon}$ {6} = C

Move (B,a) = {0,3



Start state

ϵ closer (0) = {0} = A

Move (A,a) = {5,2} $\xrightarrow{\epsilon}$ {1,2,5,6} = B

Move (A,b) = {6} $\xrightarrow{\epsilon}$ {6} = C

Move (B,a) = {0,3} $\xrightarrow{\epsilon}$ {0,3,4} = D

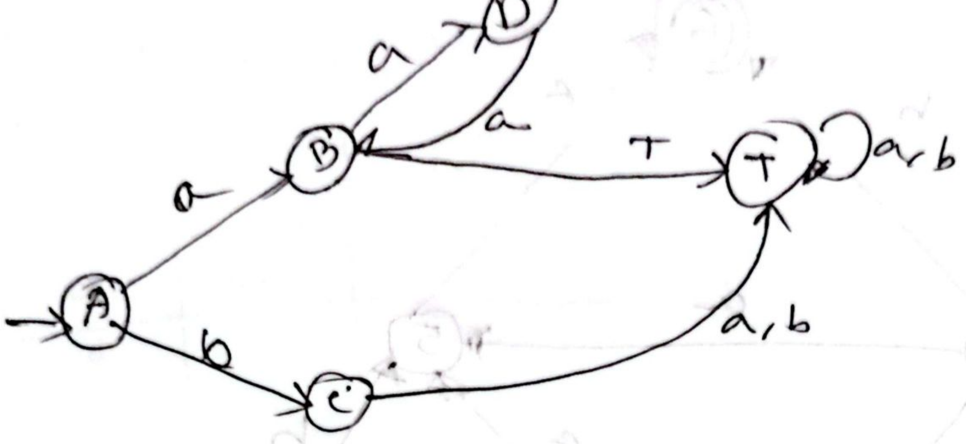
Move(B,b) = {} $\longrightarrow$ ϕ = T

Move(C,a) = {} $\rightarrow$ ϕ

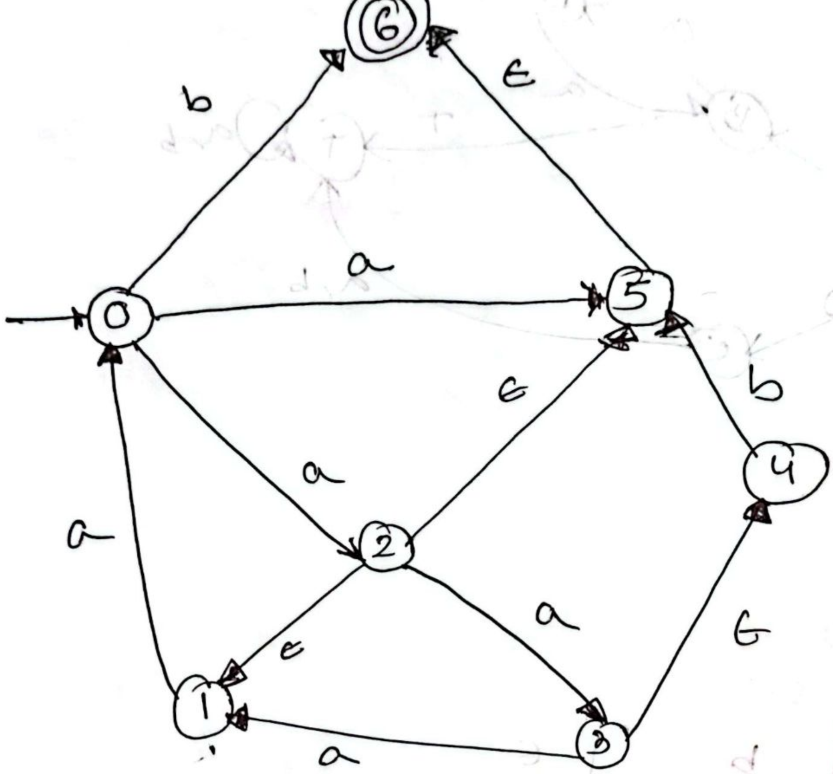
Move(C,b) = {} $\rightarrow$ ϕ

Move(D,a) = {5,2,3} $\xrightarrow{\epsilon}$ ~~{1,2,3,4,5,6~~ {1,2,5,6}

Move(D,B) =



	a	b	ε
0	{5,2}	6	{5,2,6,1}
1	0	φ	φ
2	1,3		
3			
4			
5			
6			



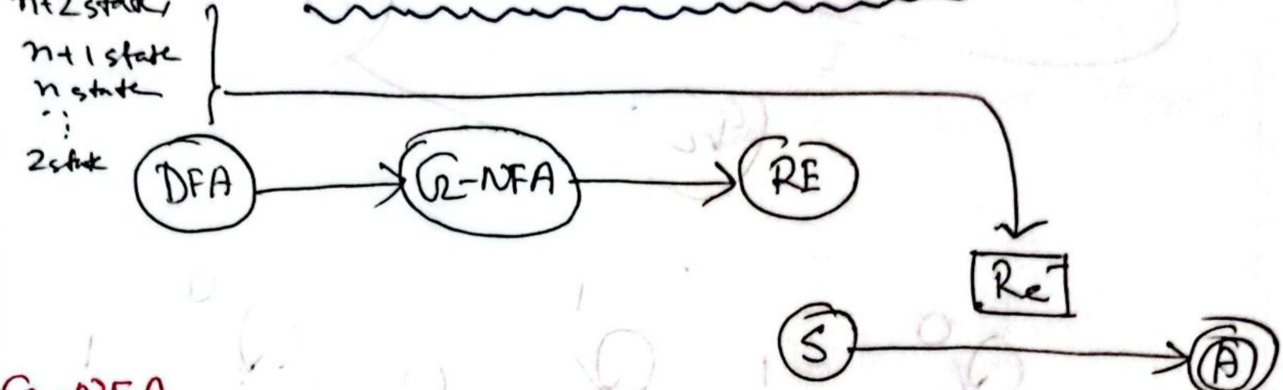
	a	b	ε
0	5,2	6	φ
1	0	φ	φ
2	3	φ	1,5
3	1	φ	4
4	φ	5	φ
5	φ	φ	6
6	φ	φ	φ

	a	b
0	5,2	6
5,2	5,2	6
6		

Finals

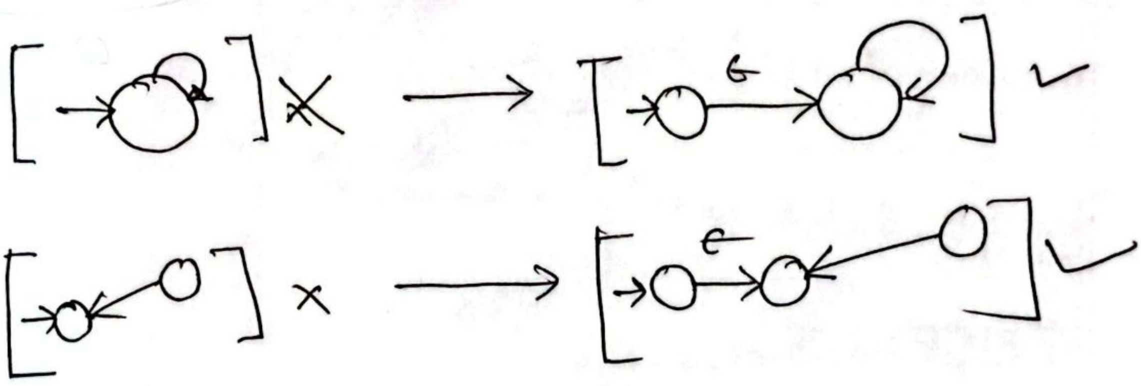
DFA To RE

State Elimination Method



Ω-NFA

(i) No incoming arrow into starting state.

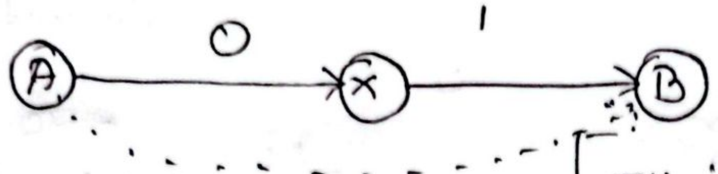


(ii) [a] Only 1 accepting state

[b] No outgoing arrow from accepting state

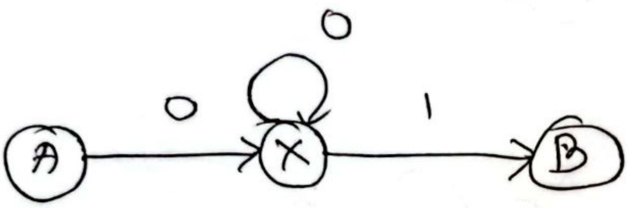
Ex

#

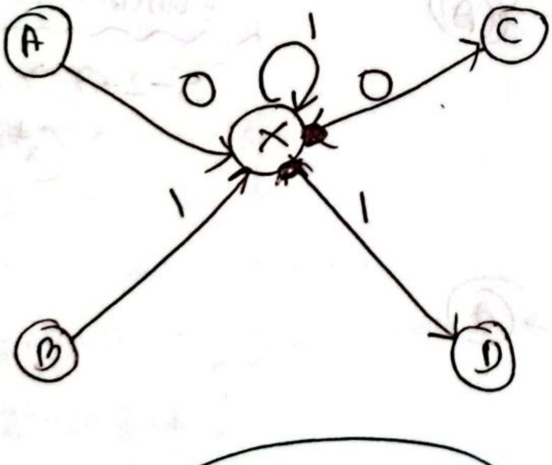


[Eliminating state x]

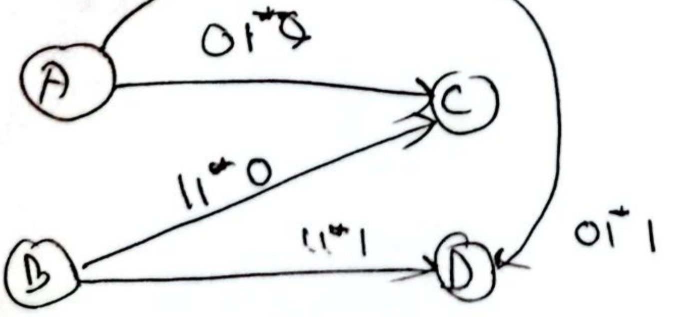
#



#



Total Transition
= # Incoming arrows (w/o self loop)
× # Outgoing arrows (w/o self loop)



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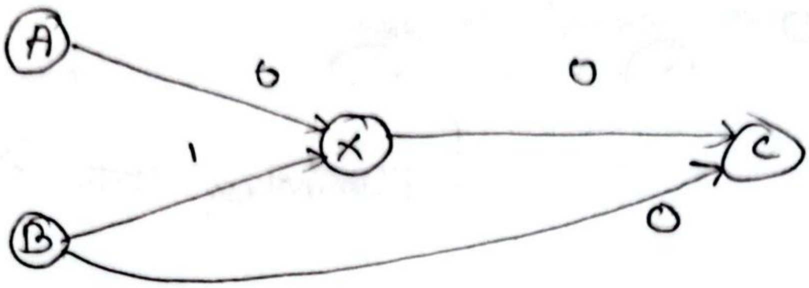
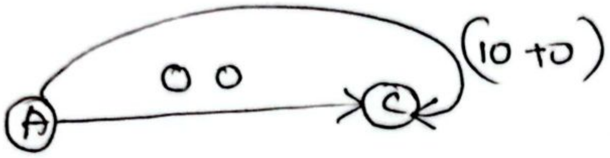


Eliminating (x)

~~A→0~~

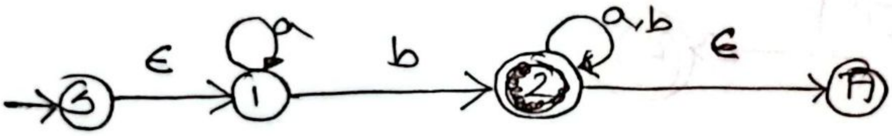
A-x-C → AC(00)

B-x-C → BC(10+0)



#

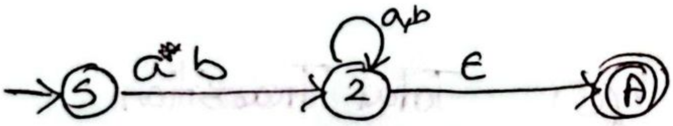
1st step



Eliminating 1

S-1-2 → S-2 (a^*b)

2nd step



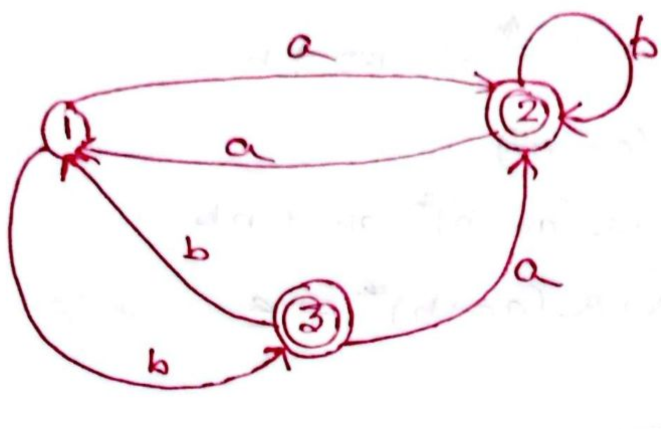
Eliminating 2

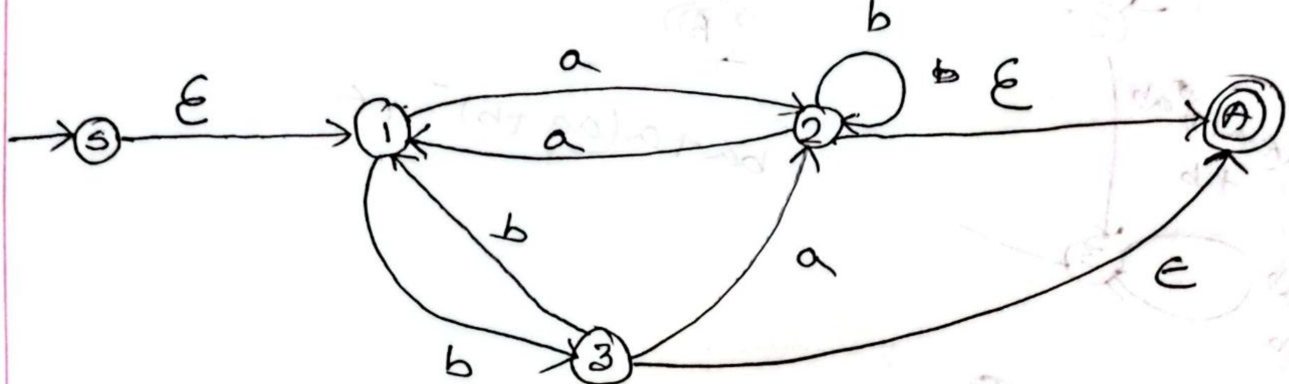
S-2-A → S-A

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

3rd step

#





Eliminating - 1 (3x2)

S-1-2 ⟶ S-2 ; a

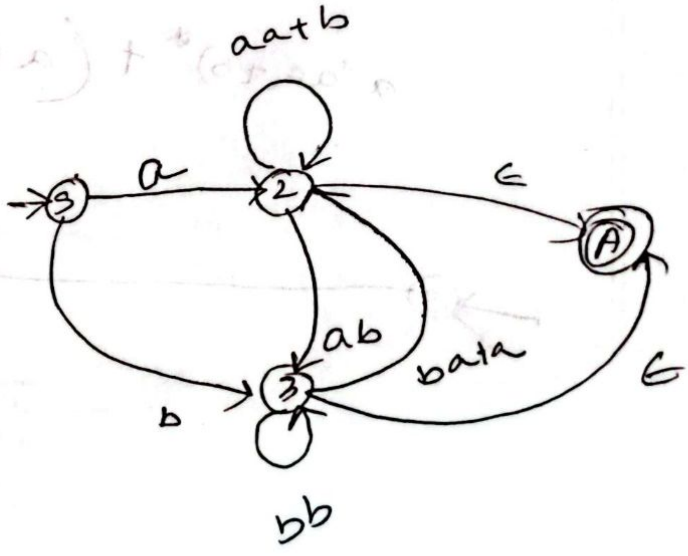
S-1-3 ⟶ S-3 ; b

2-1-2 ⟶ 2-2 ; aa+b

2-1-3 ⟶ 2-3 ; ab

3-1-2 ⟶ 3-2 ; ba+a

3-1-3 ⟶ 3-3 ; bb



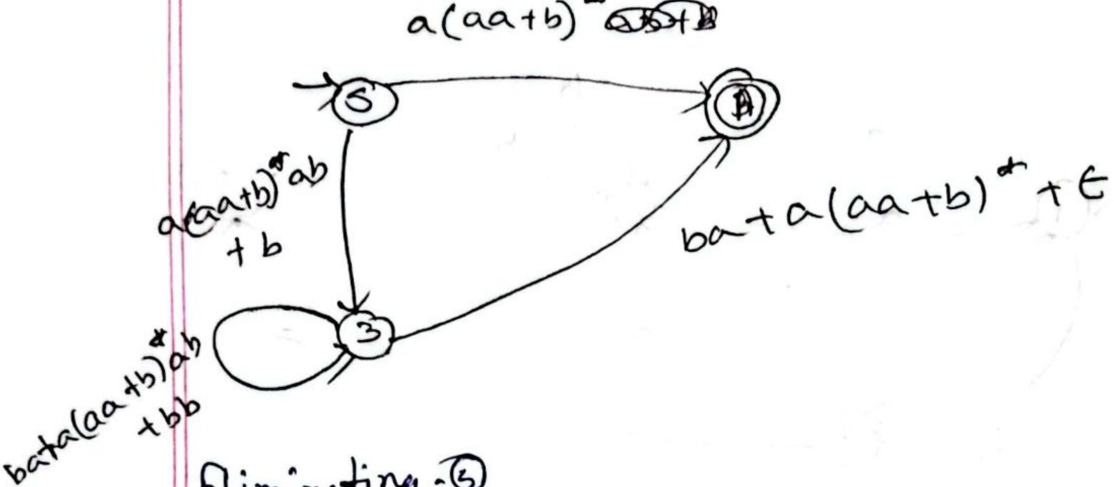
Eliminating - 2 2x2

$S-2-3 \rightarrow S-3$; $a(aa+b)^* ab + b$

$S-2-A \rightarrow S-A$; $a(aa+b)$

$3-2-3 \rightarrow 3-3$; $ba+a(aa+b)^* ab + bb$

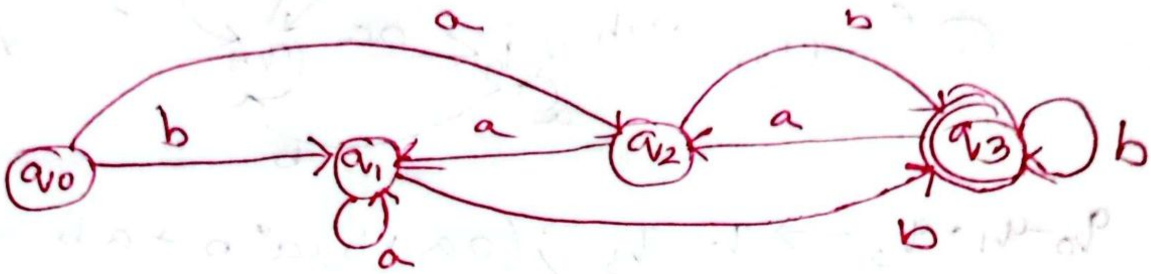
$3-2-A \rightarrow 3-A$; $ba+a(aa+b)^* + \epsilon$

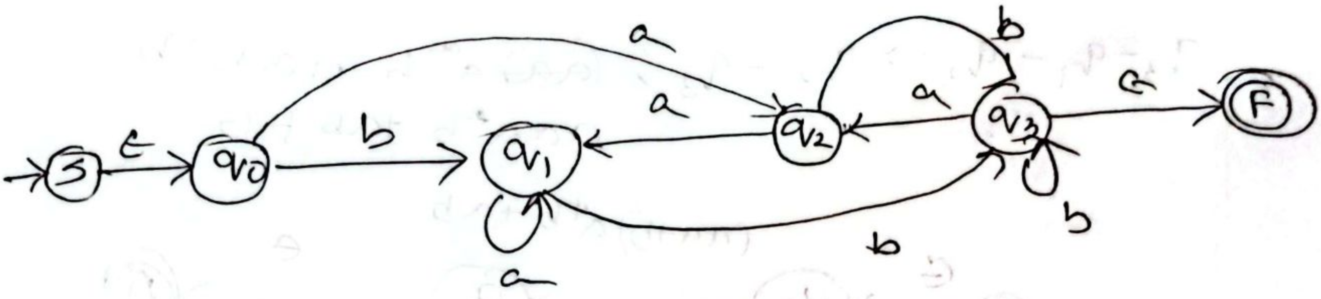


Eliminating - 3

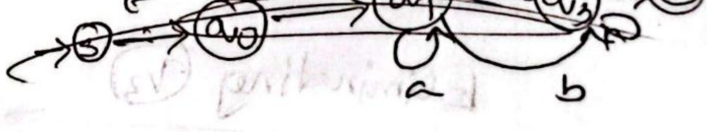
$a(aa+b)^* + (a(aa+b)^* ab + b)(ba+a(aa+b)^* ab + bb)^* (ba+a(aa+b)^* + \epsilon)$

#





Eliminating q_2

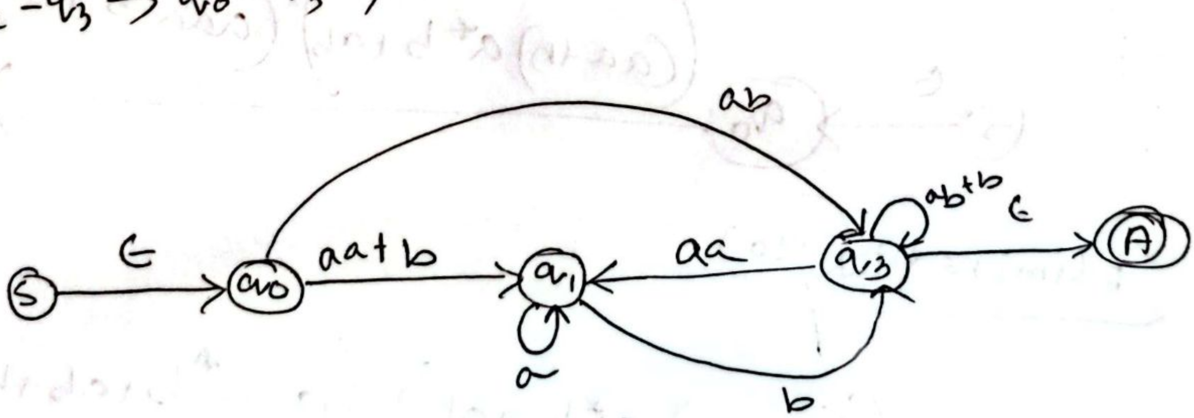


$q_3 - q_2 - q_1 \rightarrow q_3 - q_1$; aa

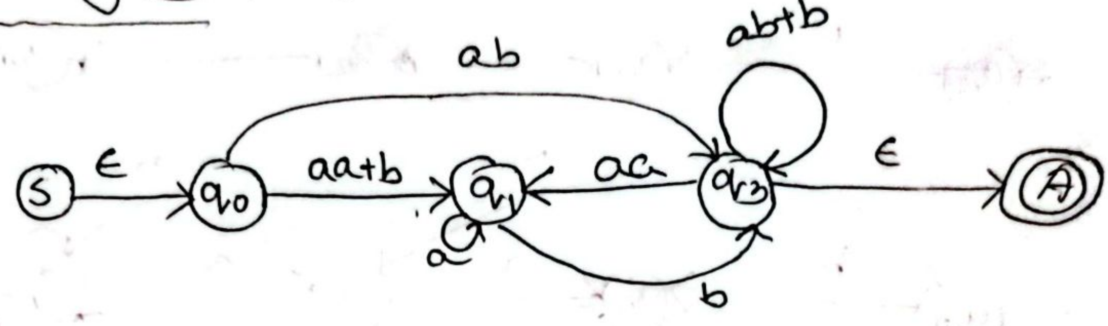
$q_3 - q_2 - q_3 \rightarrow q_3 - q_3$; ab+b

$q_0 - q_2 - q_1 \rightarrow q_0 - q_1$; aa+b

$q_0 - q_2 - q_3 \rightarrow q_0 - q_3$; ab



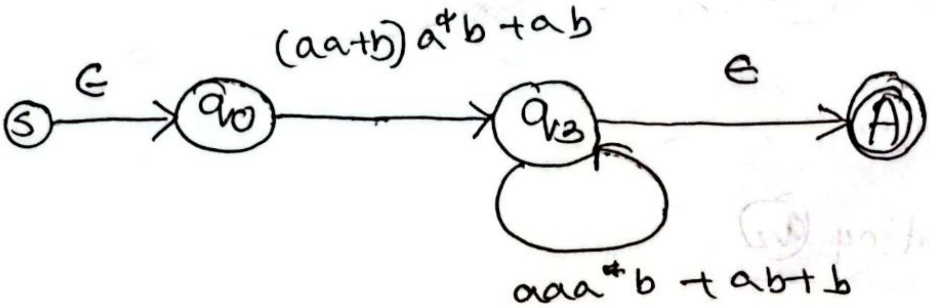
Eliminating q_1 [2×1]



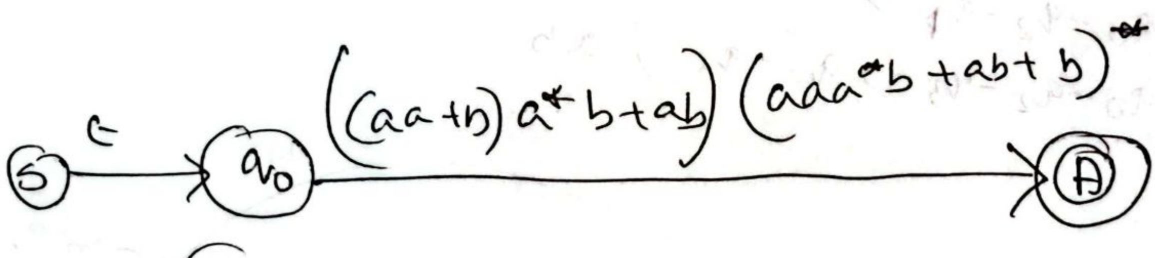
$q_0 - q_1 - q_3 \rightarrow q_0 - q_3$; $(aa+b)a^*b + ab$

$q_3 - q_1 - q_3 \rightarrow q_3 - q_3$; $\cancel{(aa)\,a^*b + ab + b}$

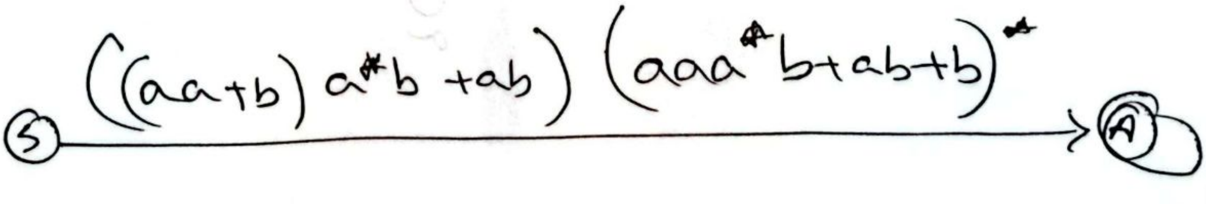
$aaa^*b + ab + b$



Eliminating q_3



Eliminating q_0



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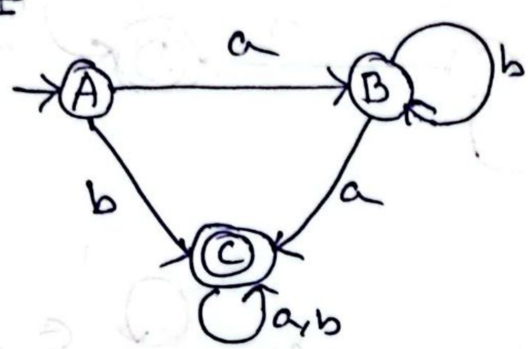
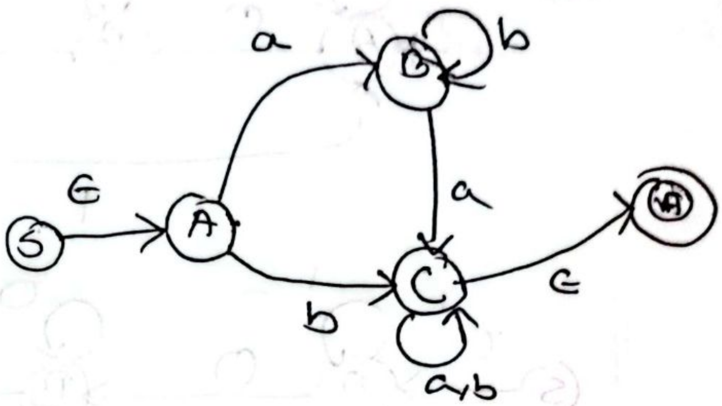
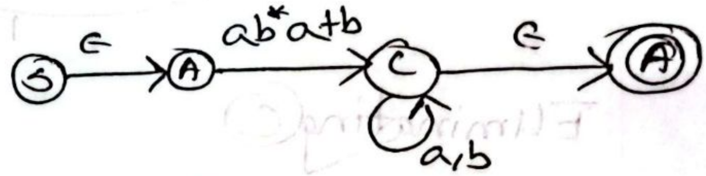


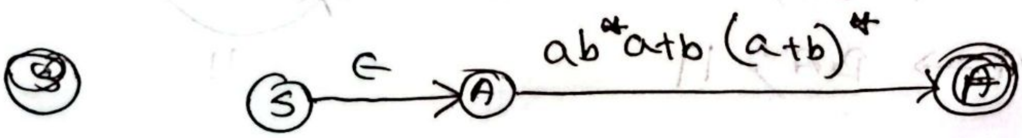


Eliminating B

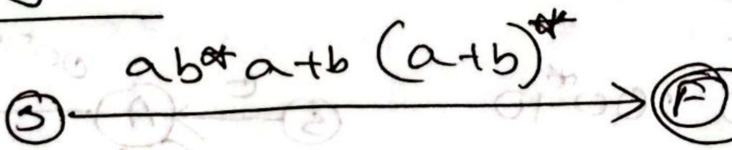
A-B-C $\rightarrow$ AC ; ab^*a+b



Eliminating C



Eliminating A



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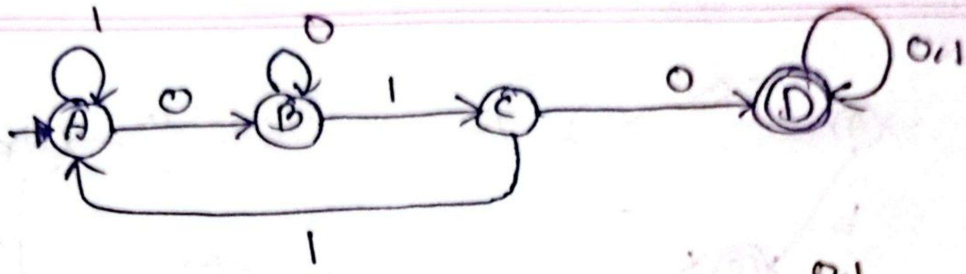
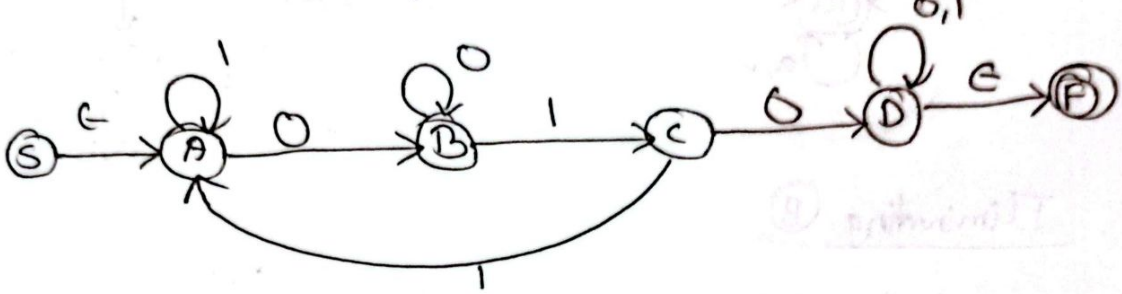
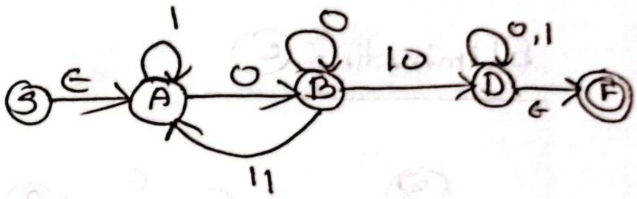




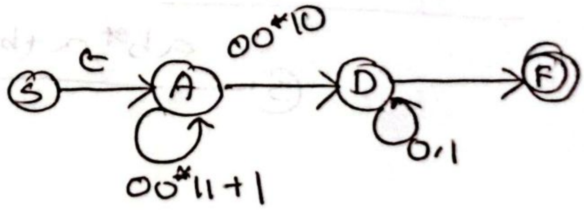
Eliminating C



$B\text{-}C\text{-}D \rightarrow BD;\ 10$

$B\text{-}C\text{-}A \rightarrow BA;\ 11$

Eliminating B



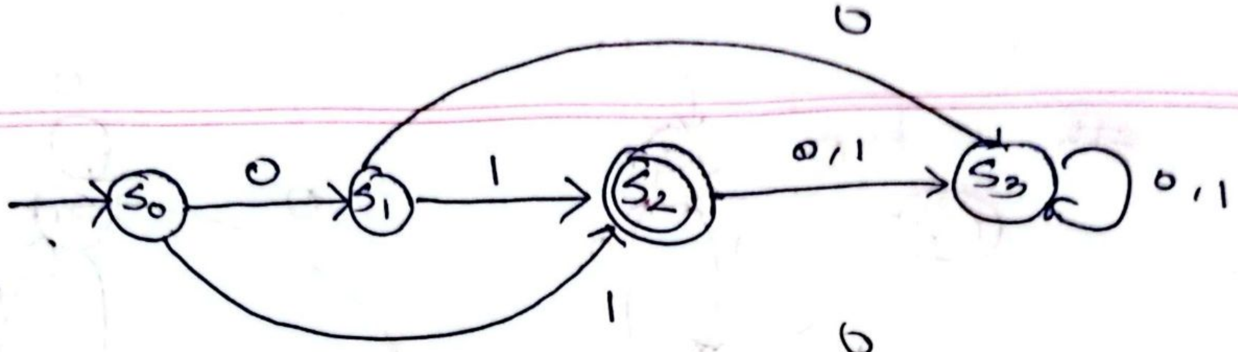
$A\text{-}B\text{-}D \rightarrow AD;\ 00^*10$

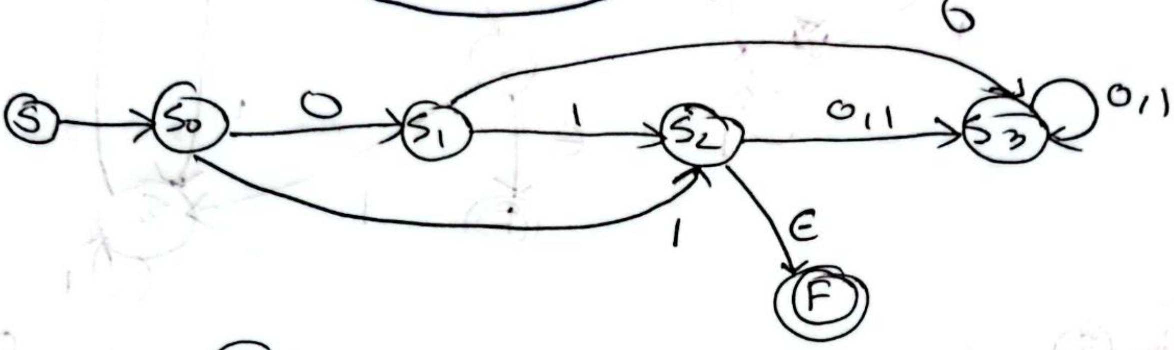
$A\text{-}B\text{-}A \rightarrow AA;\ 00^*11+1$

Eliminating D

$$\therefore\ S \xrightarrow{(00^*11+1)^*\,00^*10(0+1)} F$$

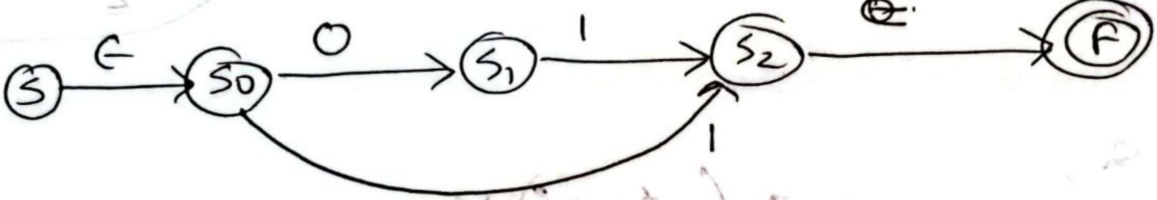
#





Eliminating S_3

Trap State, S_0, No work

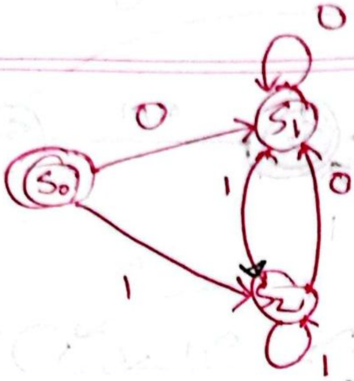


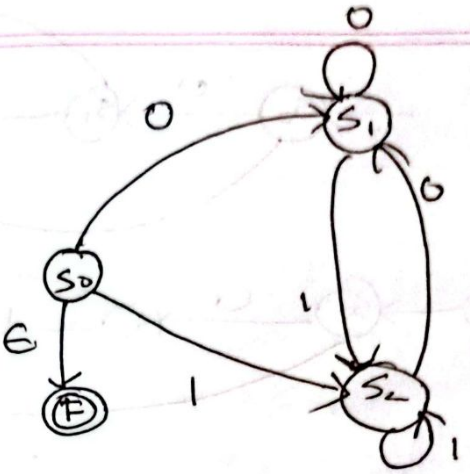
Eliminating - S_1

$S_0 - S_1 - S_2 \to S_0 - S_2$; 01+1

S_0,

#11.

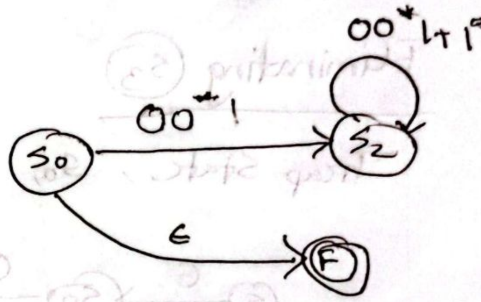




Elim- S_1

$S_0 - S_1 - S_2 \rightarrow S_0 - S_2$; 00^*1

$S_2 - S_1 - S_2 \rightarrow S_2 - S_2$; $00^*1 + 1^*$



S_1,