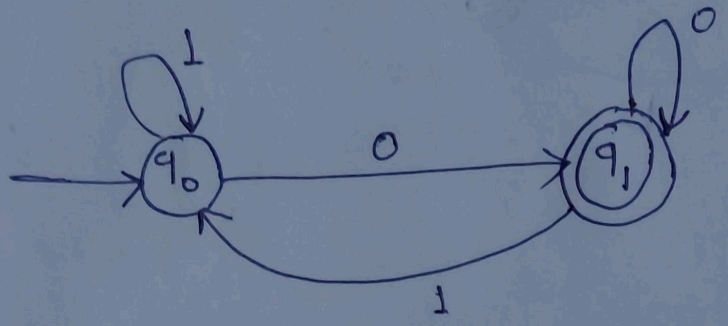
$L = \{0,1\}^*$ string Ending in 0

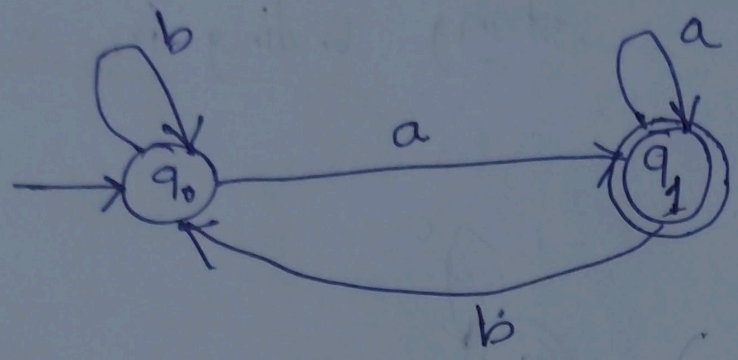


① $L_1 = 0$

② $L_2 = 10$

③ $L_3 = 010$

$L = \{a, b\}^*$ Ending with a



① a ✓

② aa ✓

③ ba

④ aaa
aba
baa
bba } size 3 with End a

⑤ $a^* b^* a$

$a^3 b^4 a$

aaa bbbb a

$$L = (\lambda + (1+a) + 1(1+a) + a(1+a) + 11(1+a) +$$
$$1a(1+a) + a1(1+a) + aa(1+a)$$

$$\Rightarrow ((1+a) + (1+a)\cdot(1+a) + (1+a)(11+1a) +$$
$$(1+a)(a1+aa))$$

$$\Rightarrow ((1+a) + (1+a)^2 + (1+a)\cdot 1(1+a) +$$
$$(1+a)\cdot a(1+a))$$

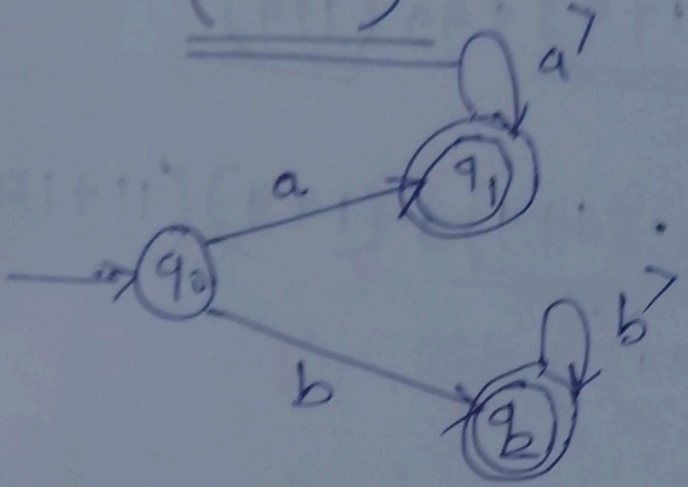
$$\Rightarrow ((1+a) + (1+a)^2 + (1+a)^2\cdot 1 + (1+a)^2\cdot a)$$

$$\Rightarrow ((1+a) + (1+a)^2 + (1+a)^2(1+a))$$

$$\Rightarrow ((1+a) + (1+a)^2 + (1+a)^3)$$

$$= (1+a)^3$$

$L = (a+b)^*$



string of length 3 or less

$L = \{1, a\}$

$L_0 = \{2^0\} = 1 = \{\Lambda\}$

$L_1 = \{2^1\} = 2 = \{1, a\}$

$L_2 = \{2^2\} = 4 = \{11, 1a, a1, aa\}$

$L_3 = \{2^3\} = 8 = \{111, 11a, 1a1, 1aa, a11, a1a, aa1, aaa\}$

$L = \{\Lambda, 1, a, 11, 1a, a1, aa, 111, 11a, 1a1, 1aa, a11, a1a, aa1, aaa\}$

$= (\Lambda + 1 + a + 11 + 1a + a1 + aa + 111 + 11a + 1a1 + 1aa + a11 + a1a + aa1 + aaa)$

* String of Length 8 or less

$L = \{a, b\}$

$L = \{\Lambda, a, b, aa, ab, ba, bb, aaa,$
$aab, aba, baa, \ldots$
$bbbbbbbb\}$

$L^0 = 2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$2^6 = 64$

$2^7 = 128$

$2^8 = 256$

$= \underline{\underline{511}}$

$L = (a + b + aa + ab + ba + bb + aaa + aab$
$\ldots + abbbbbbb + bbbbbbbb)$

$= ((a+b) + a(a+b) + b(a+b) + aa(a+b)$
$+ ab(a+b) + \ldots + bbbbbbb(a+b))$

$= (a+b)^8$

① String of Even Length

$L = \{0,1\}^*$

$L^0 = \{\Lambda\} = 2^0 = 1$

$L^2 = \{00, 01, 10, 11\} = 2^2 = \underline{\underline{4}}$

$L^4 = \{0000, 0001, 0010, 0011, \ldots, 1111\}$

$= 2^4 = \underline{\underline{16}}$

$L^6 = 2^6 = \underline{\underline{64}}$

$L^8 = 2^8 = 256$

$L = (\Lambda, 00, 01, 10, 11, 0000, 0001, \ldots$

$= \underline{\underline{(00, 01, 10, 11)^*}}$

$= (00+01+10+11)^*$

$= (0(0+1) + 1(0+1))^*$

$= ((0+1)(0+1))^*$

$= ((0+1)^2)^*$

$\boxed{E = (0+1)^*}$

$(0+1)^* = (1+0)^*$

00, 01, 10, 11   11, 10, 01, 00

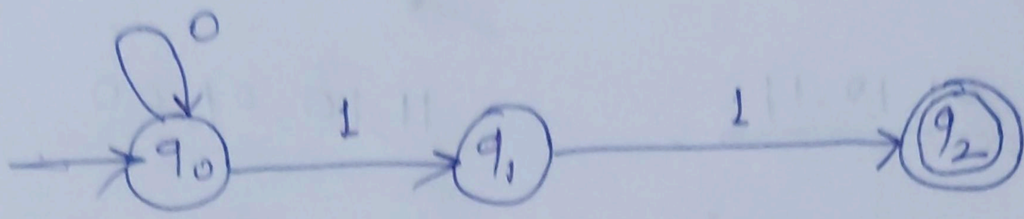
$(00+01+10+11)$ $(11+10+01+00)$

$(0+1)^*$

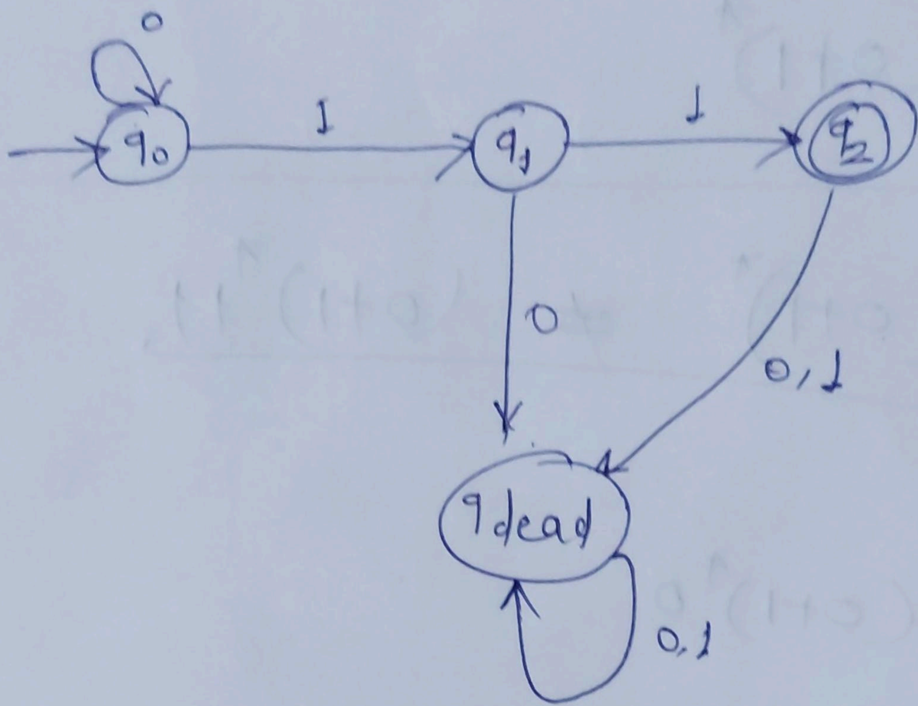
$11(0+1)^* \neq (0+1)^*11$

$(0+1)^*0$

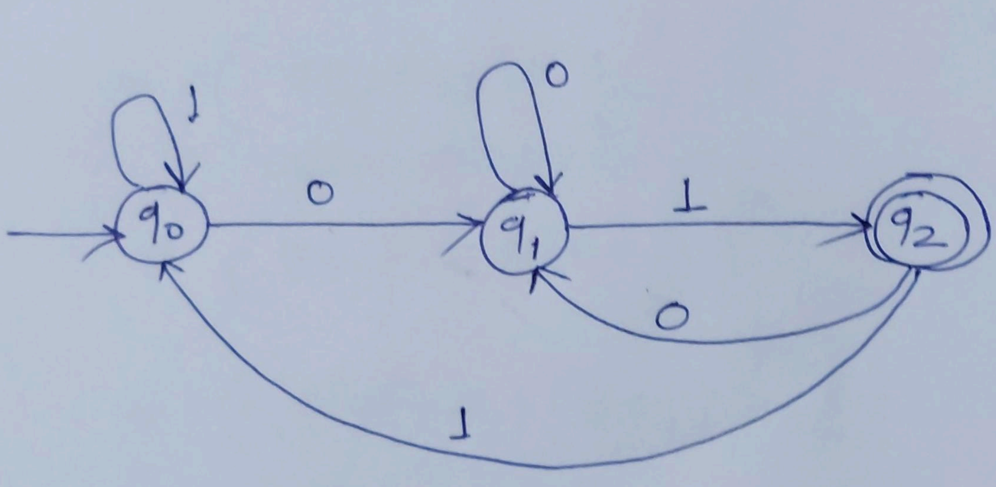
(III)



(IV)



$* \; L_2 = \{1+0\}^* \, 01$



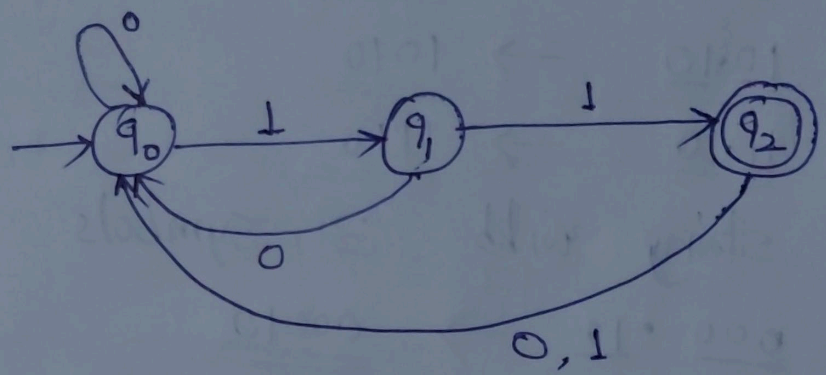
	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_2	q_1
q_2	q_0	q_1

(1) $L_1 = \{0\}^* 11$

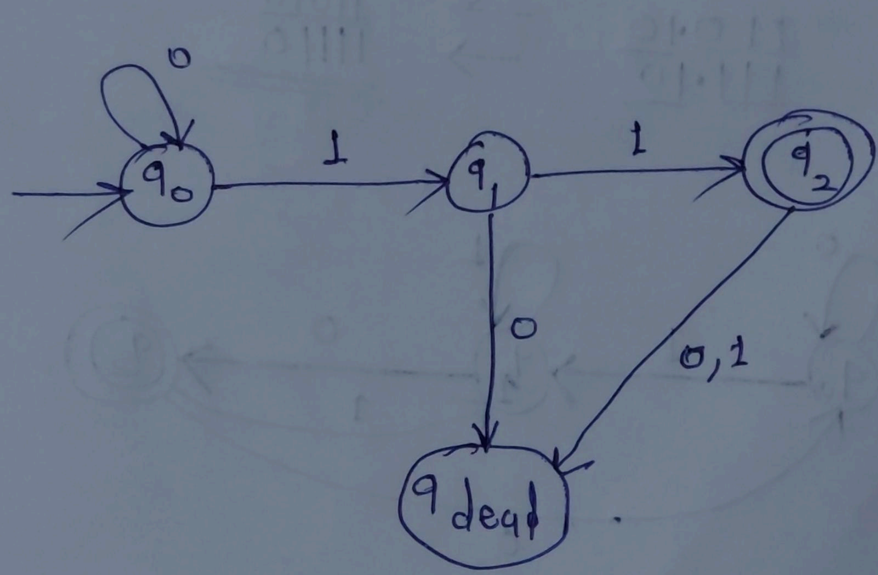
(2) $L_2 = \{1+0\}^* 01$

$L_1 \Rightarrow$

(1)



(11)



★ $L = \{0,1\}^* \{10\}$

$(0+1)^* (10)$

① $\Lambda \cdot 10 \rightarrow 10$ ✓

② 1st string with 1 symbol

$0 \cdot 10 \rightarrow 010$ ✓

$1 \cdot 10 \rightarrow 110$ ✓

③ 1st string with 2 symbols

$00 \cdot 10 \rightarrow 0010$

$01 \cdot 10 \rightarrow 0110$

$10 \cdot 10 \rightarrow 1010$

$11 \cdot 10 \rightarrow 1110$

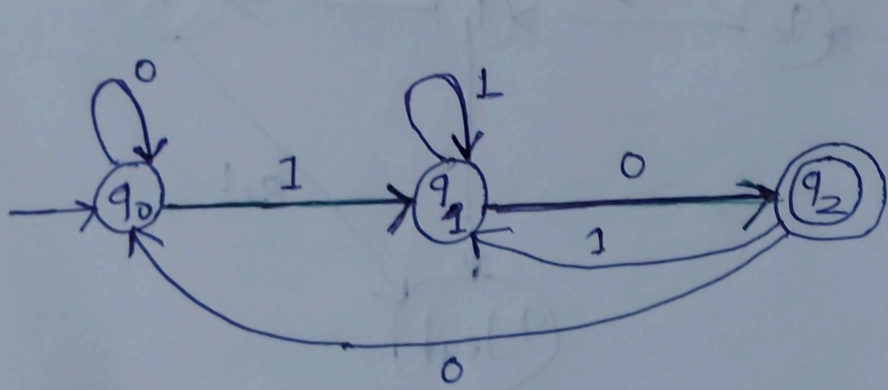
④ string with 3 symbols

$000 \cdot 10 \rightarrow 00010$

⋮

$110 \cdot 10 \rightarrow 11010$

$111 \cdot 10 \rightarrow 11110$

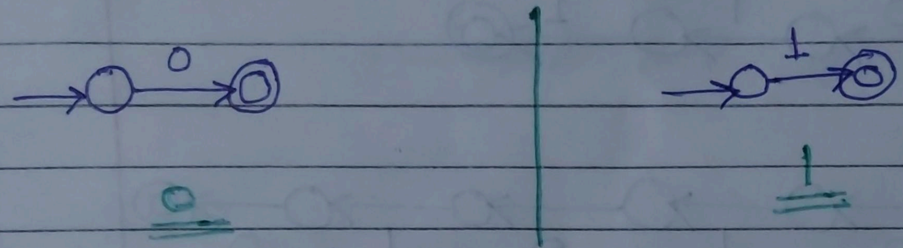


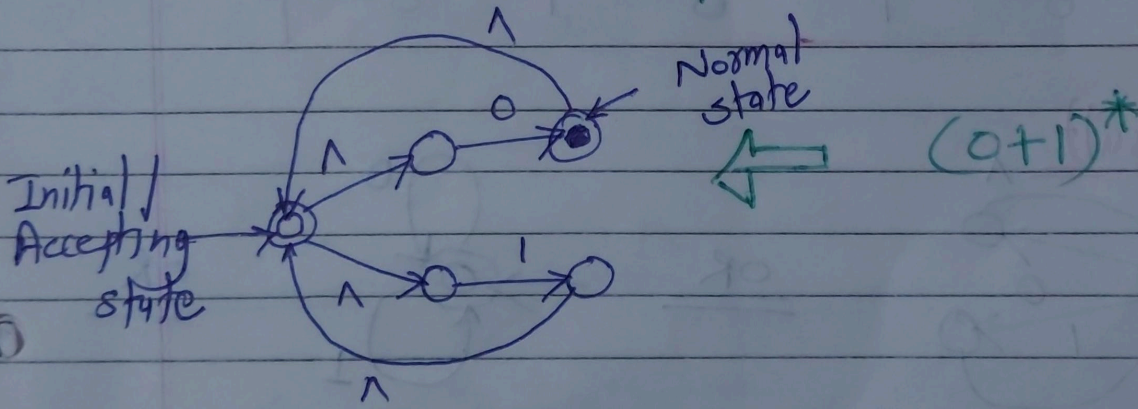
④ $(0+1)^* (011+01010) (0+1)^*$ // **Example**

1st sub string (RE) | 2nd (RE) | 3rd (RE)

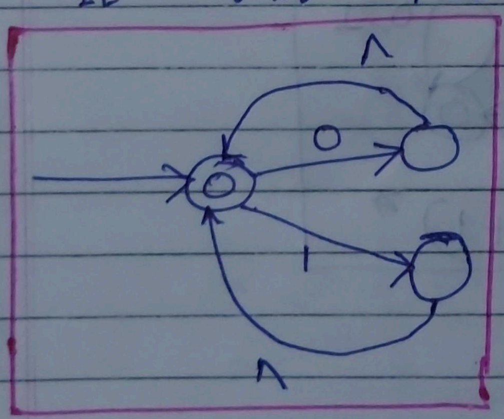
① $(0+1)^*$

Now $(0+1)$ Gives



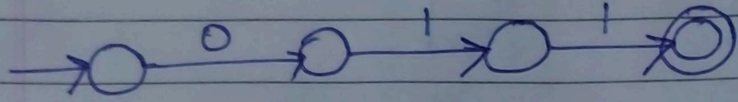


It will Reduce to

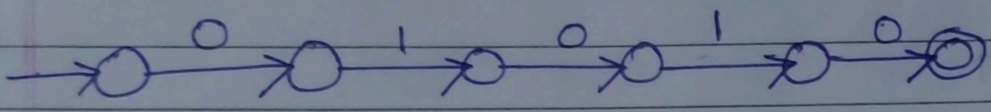


The Required NFA-Λ for 1st & 3rd sub Regular Expression from original RE

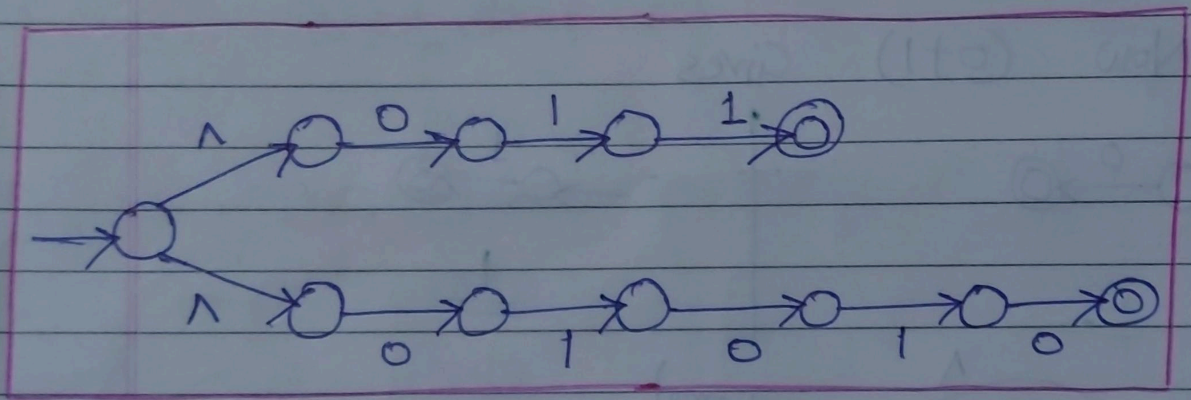
② (011 + 01010)



$\Rightarrow$ 011

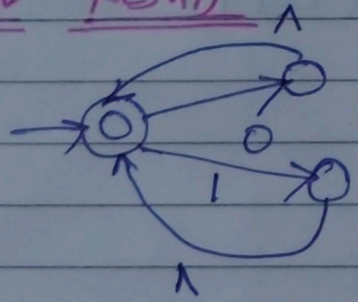


$\Rightarrow$ 01010

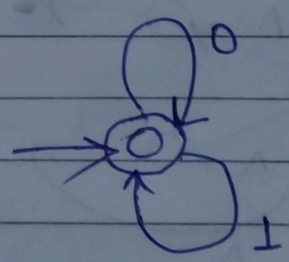


Final Result

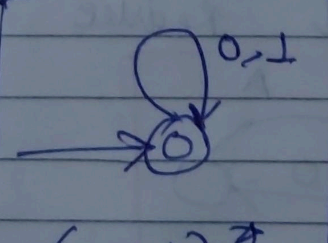
① or II



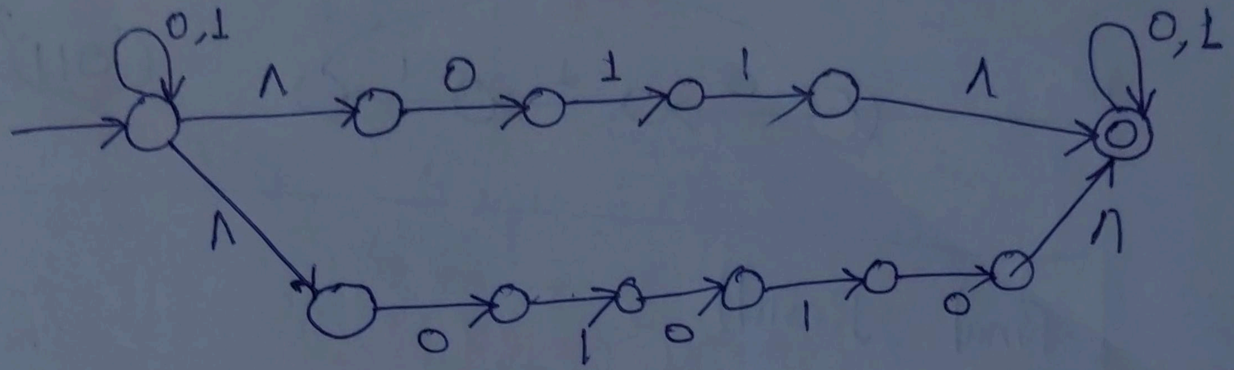
OR



OR

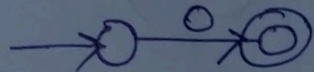


$(0+1)^*$

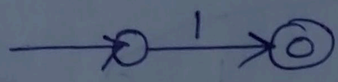


Example $(0+1)(01)^*(011)^*$

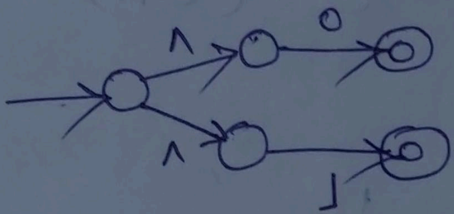
Ⓐ $(0+1)$



|| 0

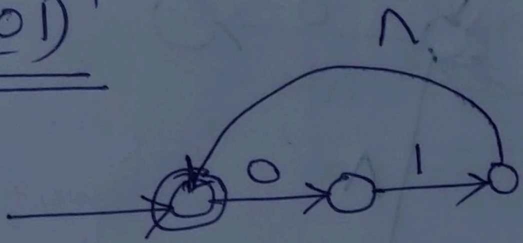


|| 1

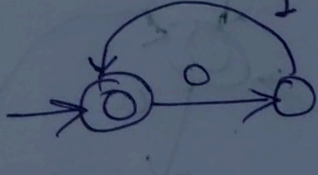


|| $(0+1)$

② $(01)^*$

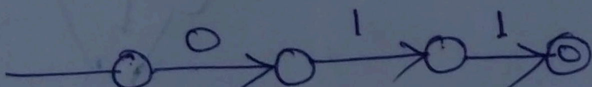


OR

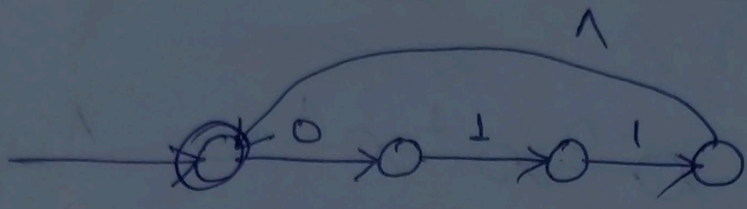


|| $(01)^*$

③ $(011)^*$



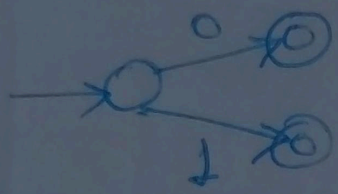
|| $(011)^*$



$(011)^*$

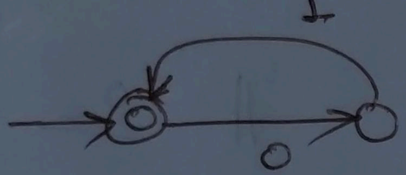
Final Result

1



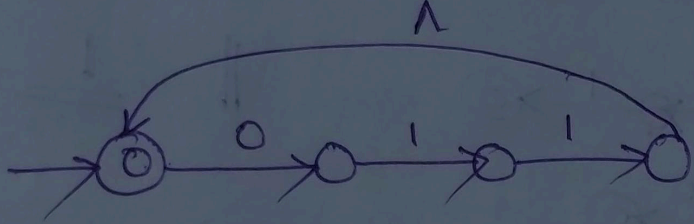
$\underline{\underline{0+1}}$

2

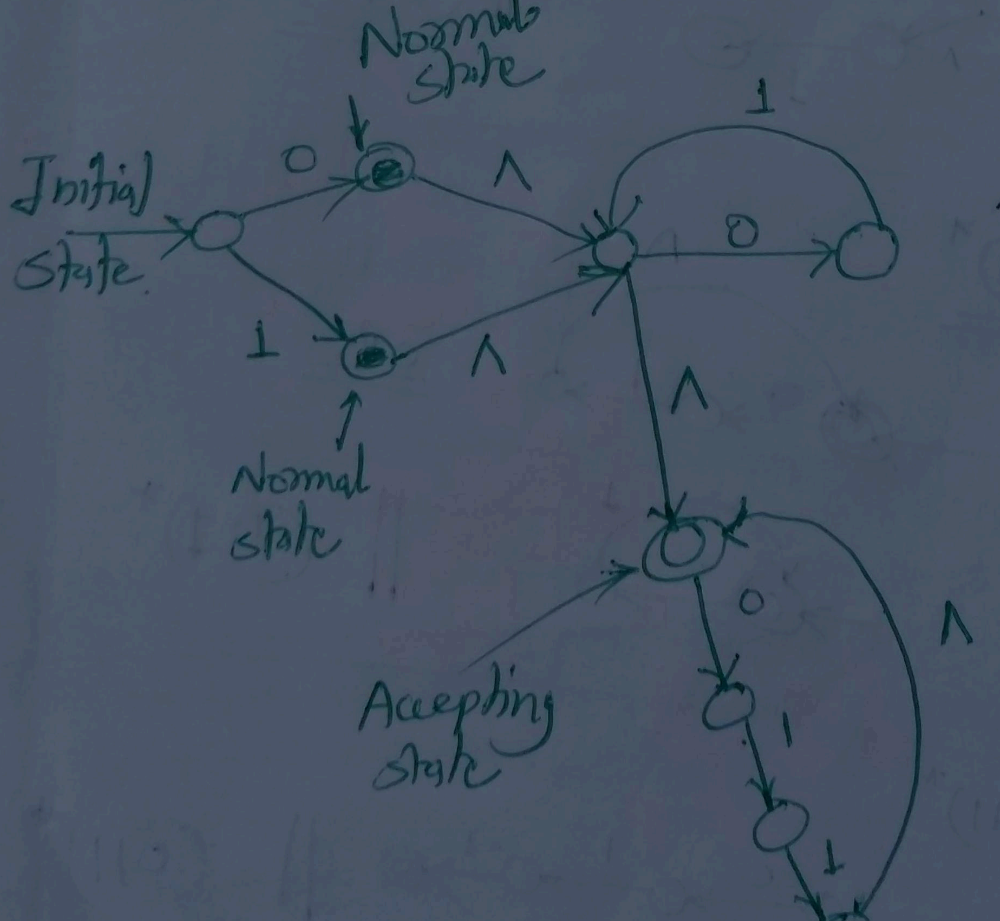


$(01)^*$

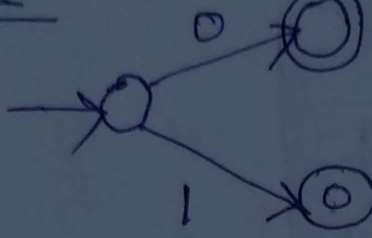
3



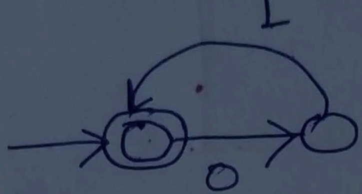
$(011)^*$



$(0+1)$



β) $(01)^*$



Now Concatenate $(0+1)\cdot(01)^*$

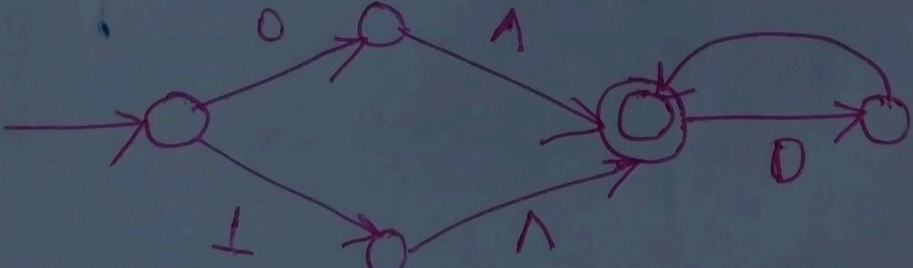
i) In Case of kleen's 1 theorem

(a) Initial state of 1st FA will remain initial state in (·) Operation

(b) Final / Accepting state will remain same of second FA

(c) 1st FA's Accepting state will become Normal state

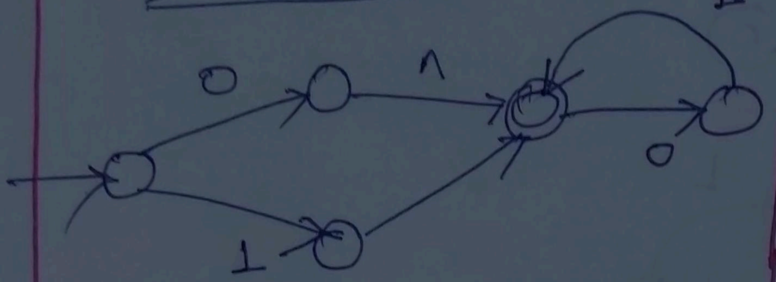
(d) Give Λ transition from 1st FA's final state to 2nd FA's initial state



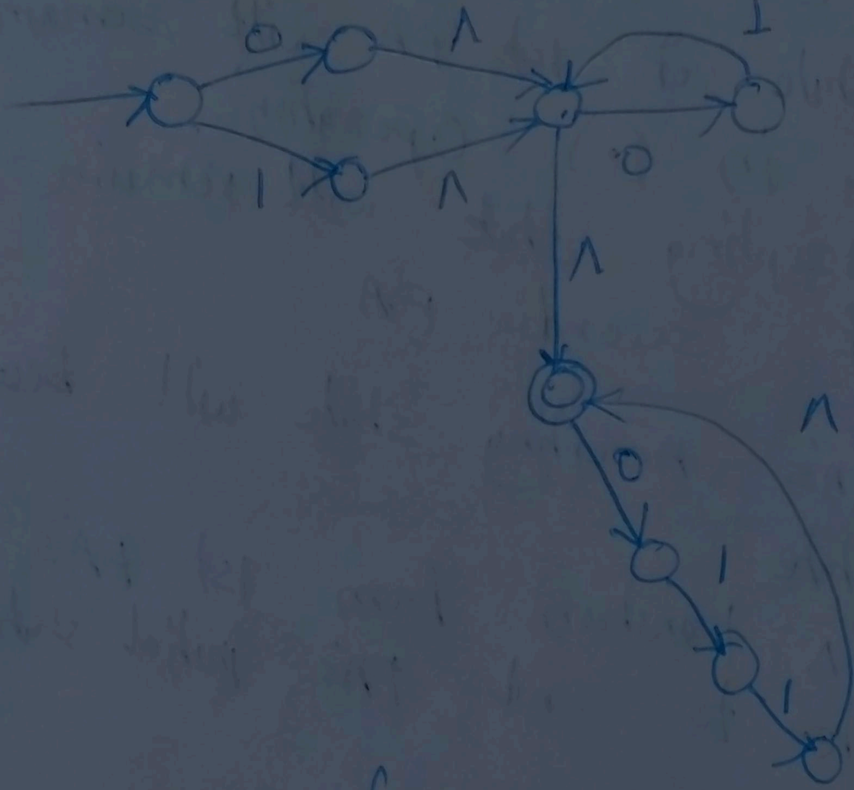
Result for NFA-Λ $((0+1)\cdot(01)^*)$

$(0+1)(01)^*(011)^*$

(A) $(0+1)(01)^*$



(B) Concatenation of $((0+1)\cdot(01)^*)\cdot(011)^*$



NFA-Λ for $(0+1)(01)^*(011)^*$

Problem

$010^* + 0(01+10)^* 11$

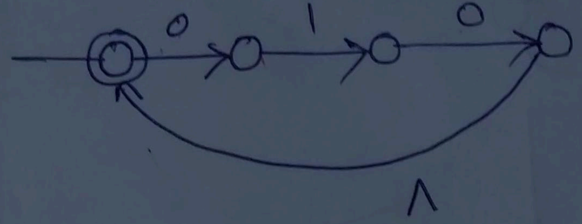
The regular Expression Consists of 3 RE's

i) 010^*

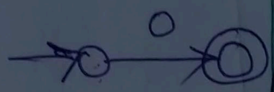
ii) $0(01+10)^*$

iii) 11

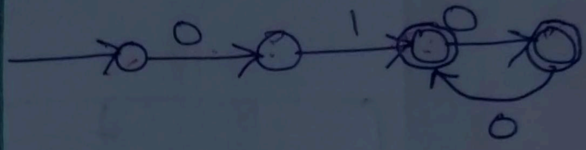
Now (1) $(010)^*$



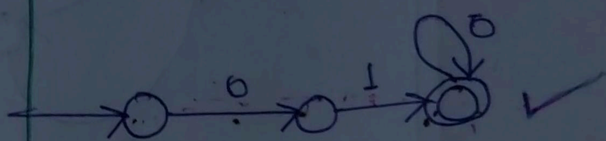
(2) i) (0)



010^*

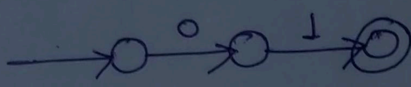


OR

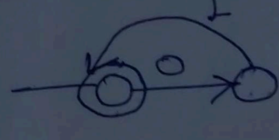


ii) $(01+10)^*$

01

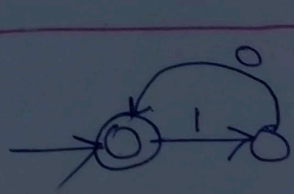


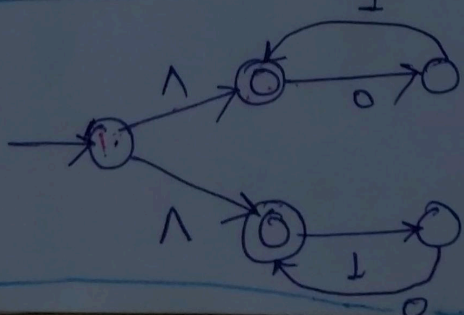
OR



10

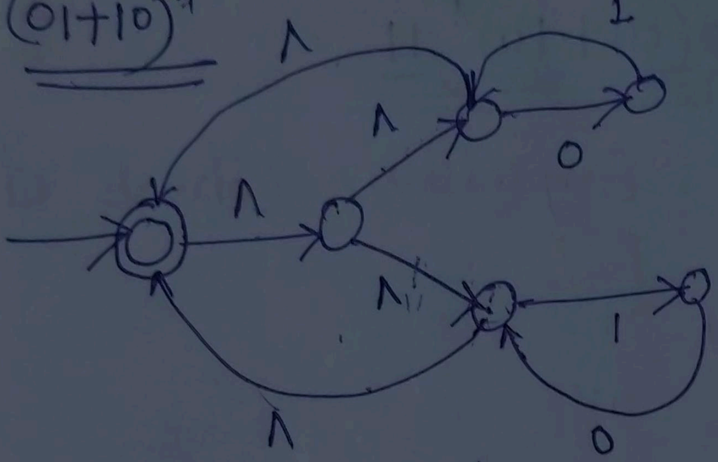
OR



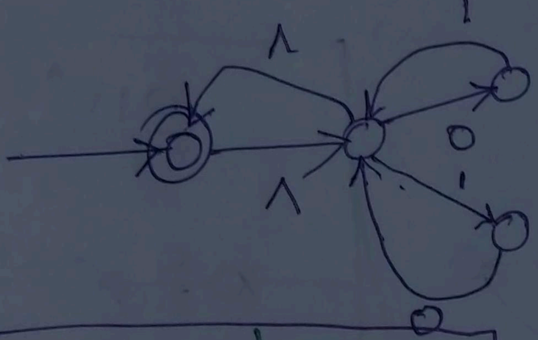


$01+10$

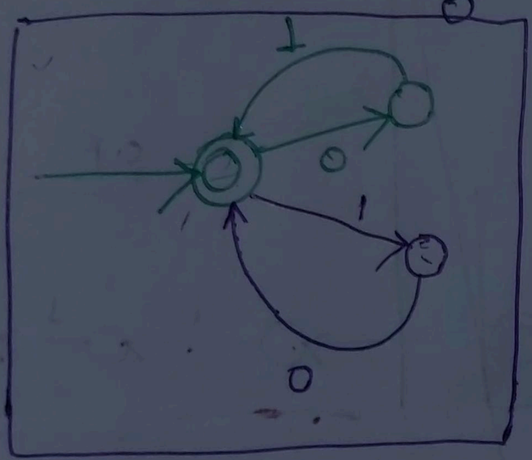
$(01+10)^*$



OR

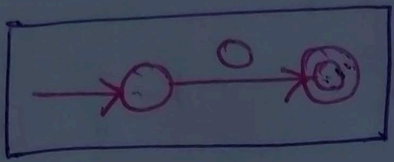


OR

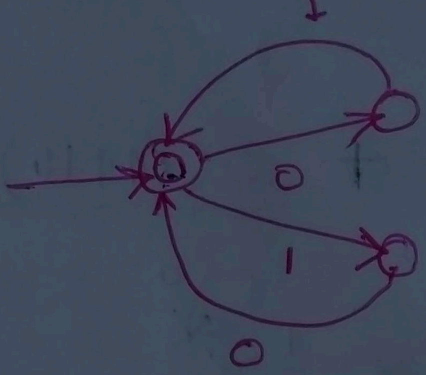


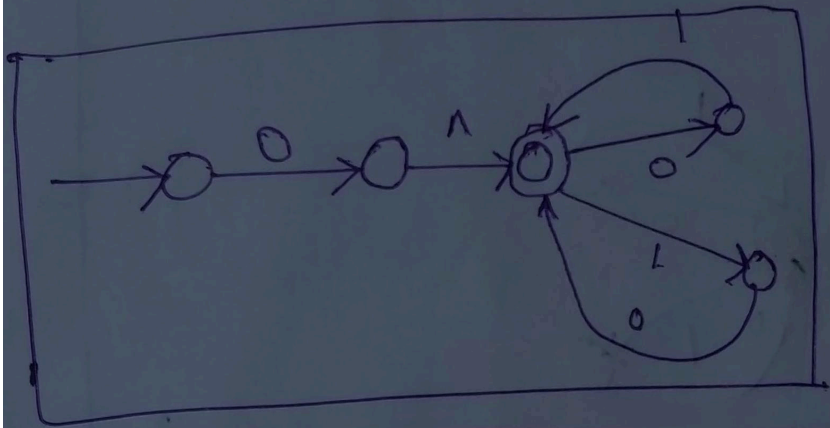
$0 \cdot (01+10)^*$

$0 \Rightarrow$

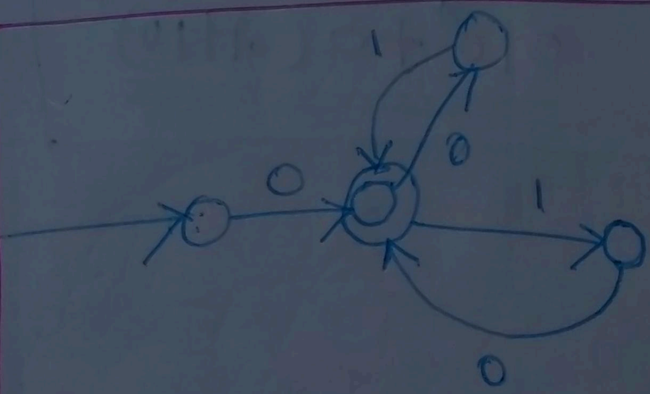


$(01+10)^* \Rightarrow$



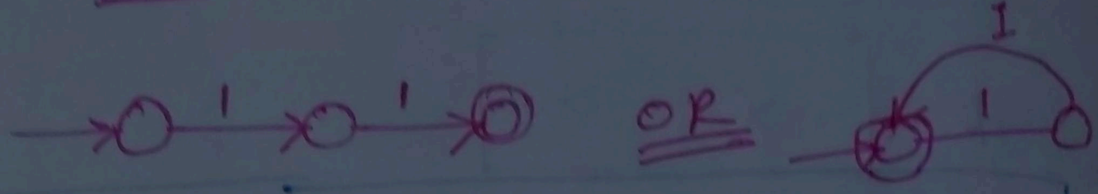


OR



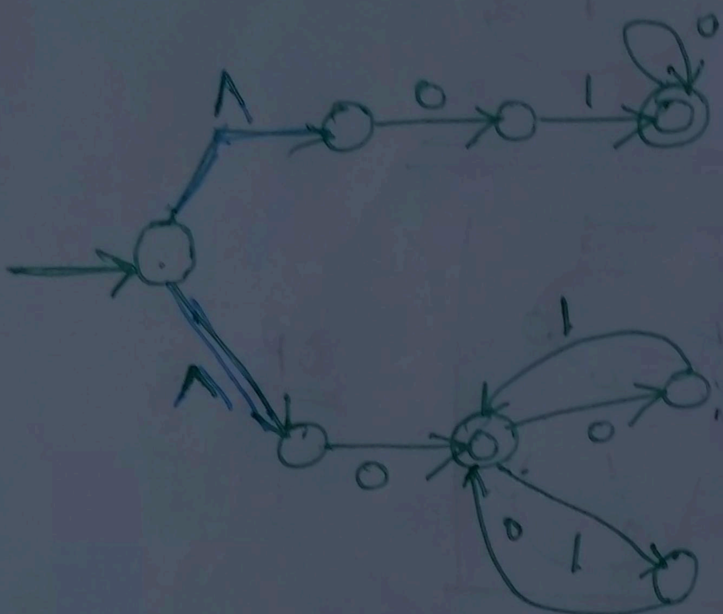
NFA for $\boxed{0 \cdot (01+10)^*}$

3rd RE ie 11

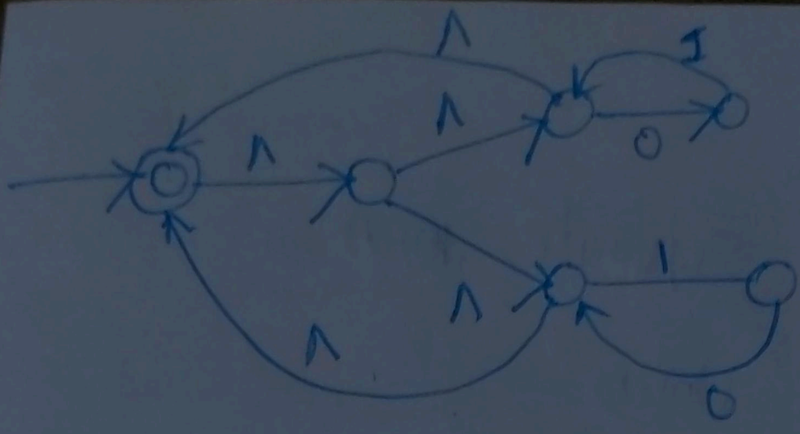


Final Result

$01\,0^* + 0(01+10)^*$



Result for $010^* + 0(01+10)^*$



NFA-Λ for $(01+10)^*$

Regular Expression

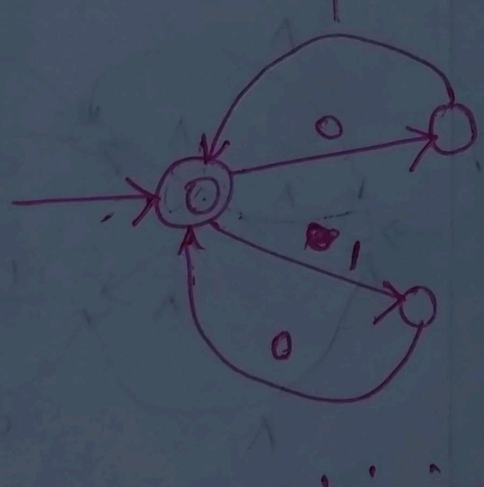
$(01+10)^*$

1) $(01+10)^0 = \{\Lambda\} = (\Lambda)$

2) $(\{01+\{10\}\}) = (01+10)$

1st Read 2nd read

3) $(01+10)^2 = (01+10)(01+10)$



Minimized NFA

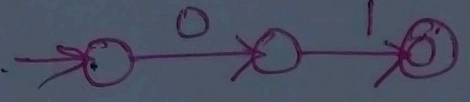
$(01+10)^*$

$(01 \quad 10)$ Seperate DFA

$(+)$ — Union ✓

$(*)$ — kleene

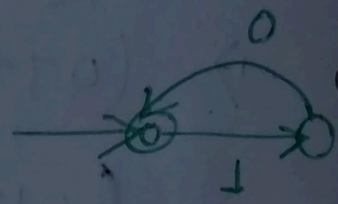
Ⓐ $\underline{\underline{01}}$



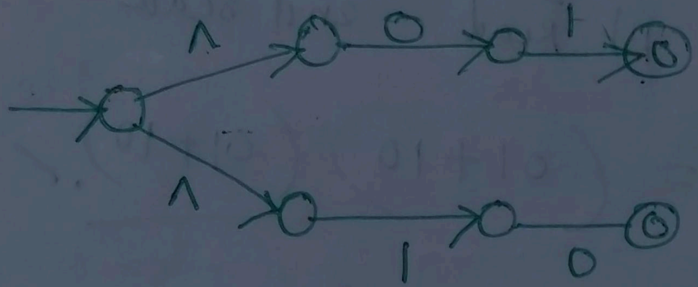
OR

Ⓑ $\underline{\underline{10}}$

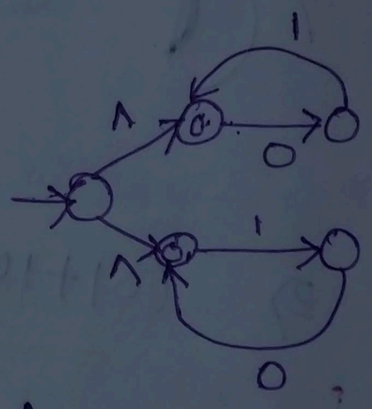
OR



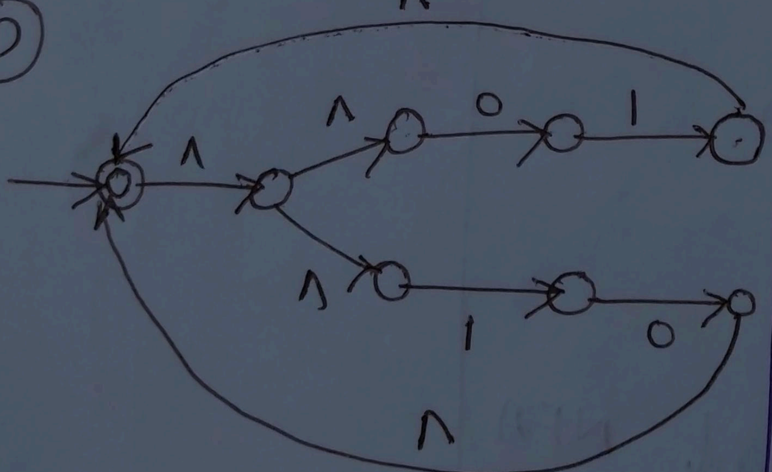
Ⓒ

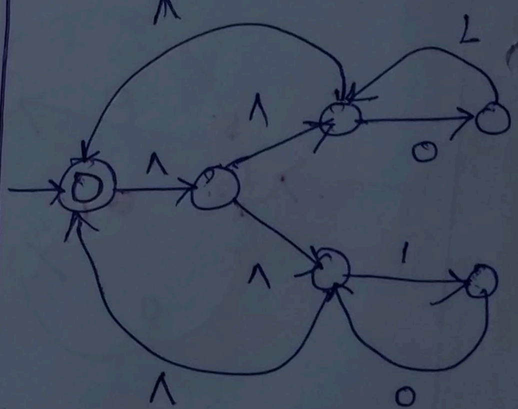


OR



Ⓓ

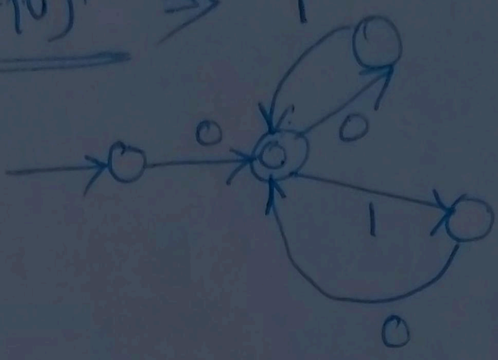




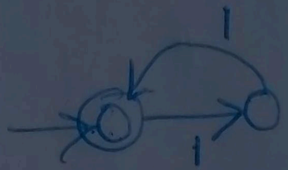
NFA·Λ for $\underline{\underline{(01+10)^*}}$

$0(01+10)^* \cdot 11$

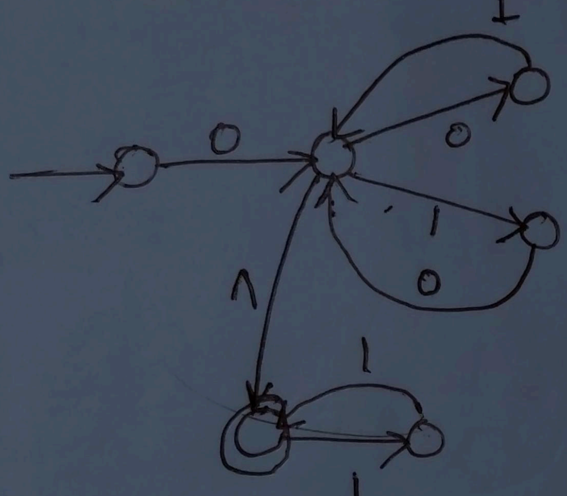
(A) $0(01+10)^* \Rightarrow$



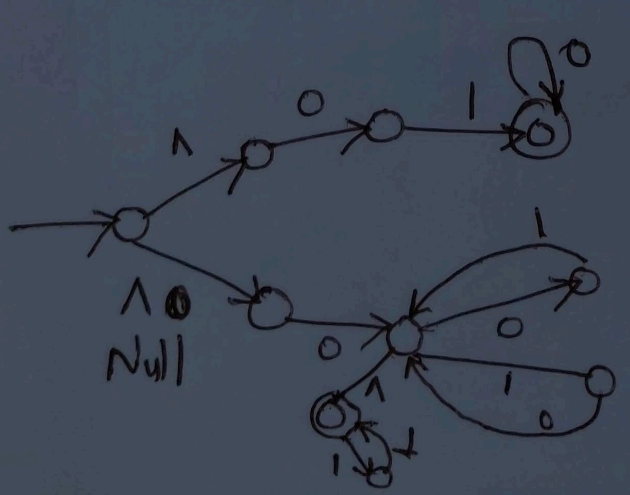
(B) $11 \Rightarrow$

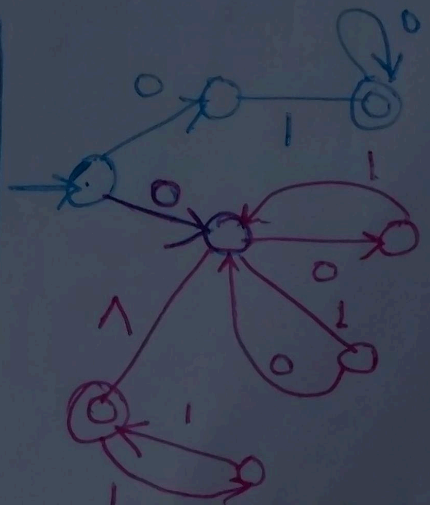


(C) $0(01+10)^* \cdot 11$



(D) $(010^*) + (0(01+10)^* 11)$





Construct NFA-Λ for $(00+1)^* \cdot (10)^*$

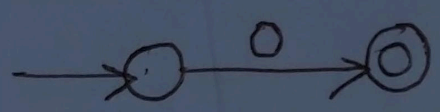
$(00+1)^* \; (10^*)$

$(00+1)^*$ $\qquad$ $(10)^*$

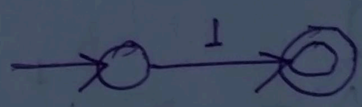
$(00 + 1)^*$ $\qquad$ $(10)^*$

(A) 00 $\Longrightarrow$

0

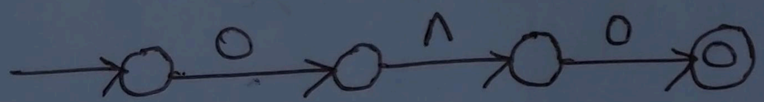


1



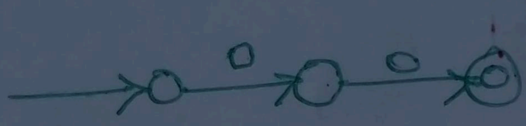
Now I have to draw NFAΛ for 00

00



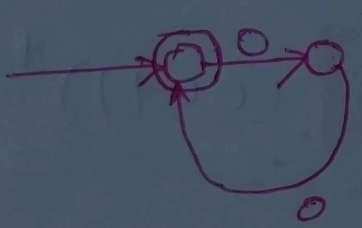
OR

00

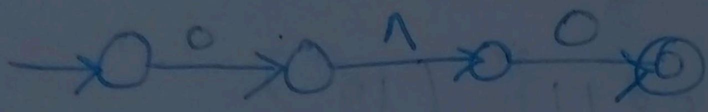


OR

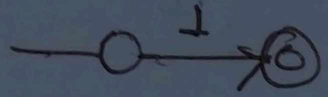
00



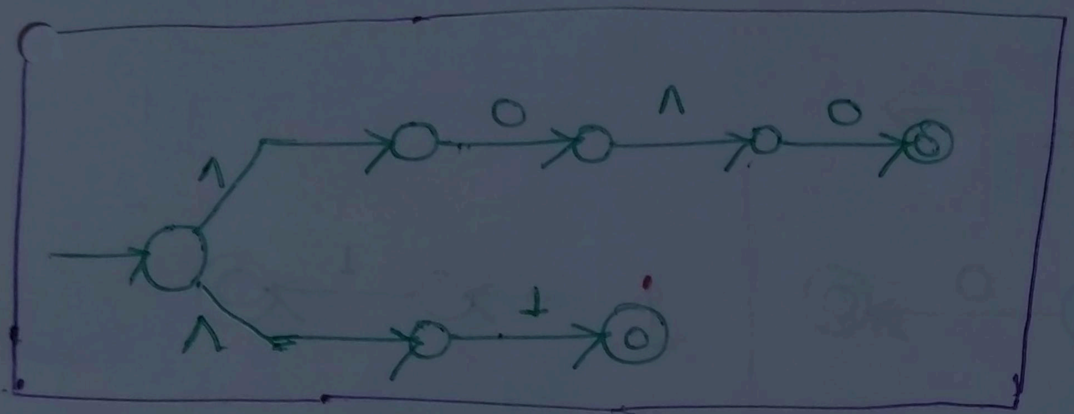
(B) 00



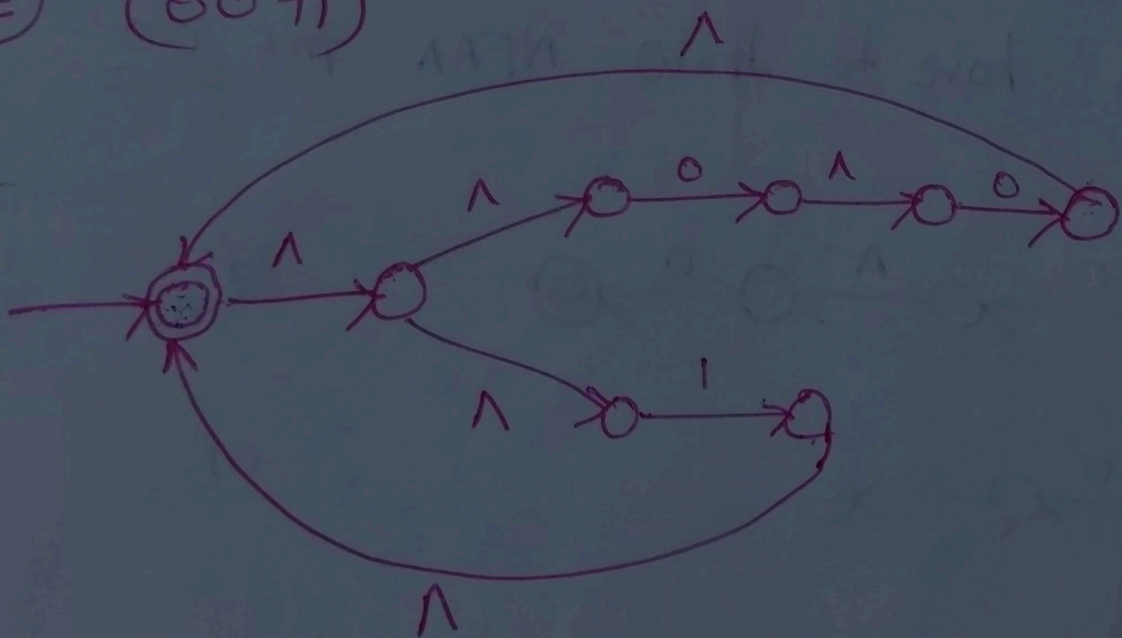
(C) 1



(D) (00+1)



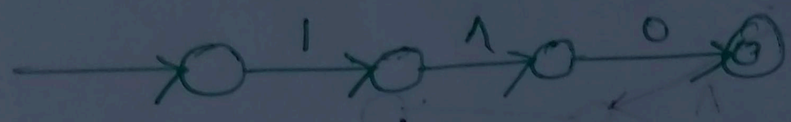
(E) $(00+1)^*$



NFA-Λ for $(00+1)^*$

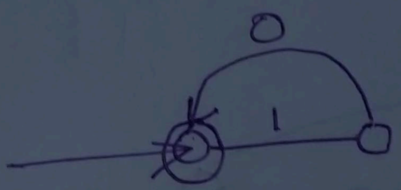
(F) $(10)^*$

(G) 10

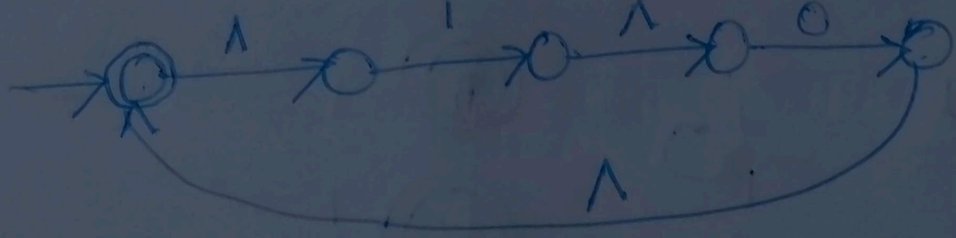


OR

OR



(H) $(10)^*$

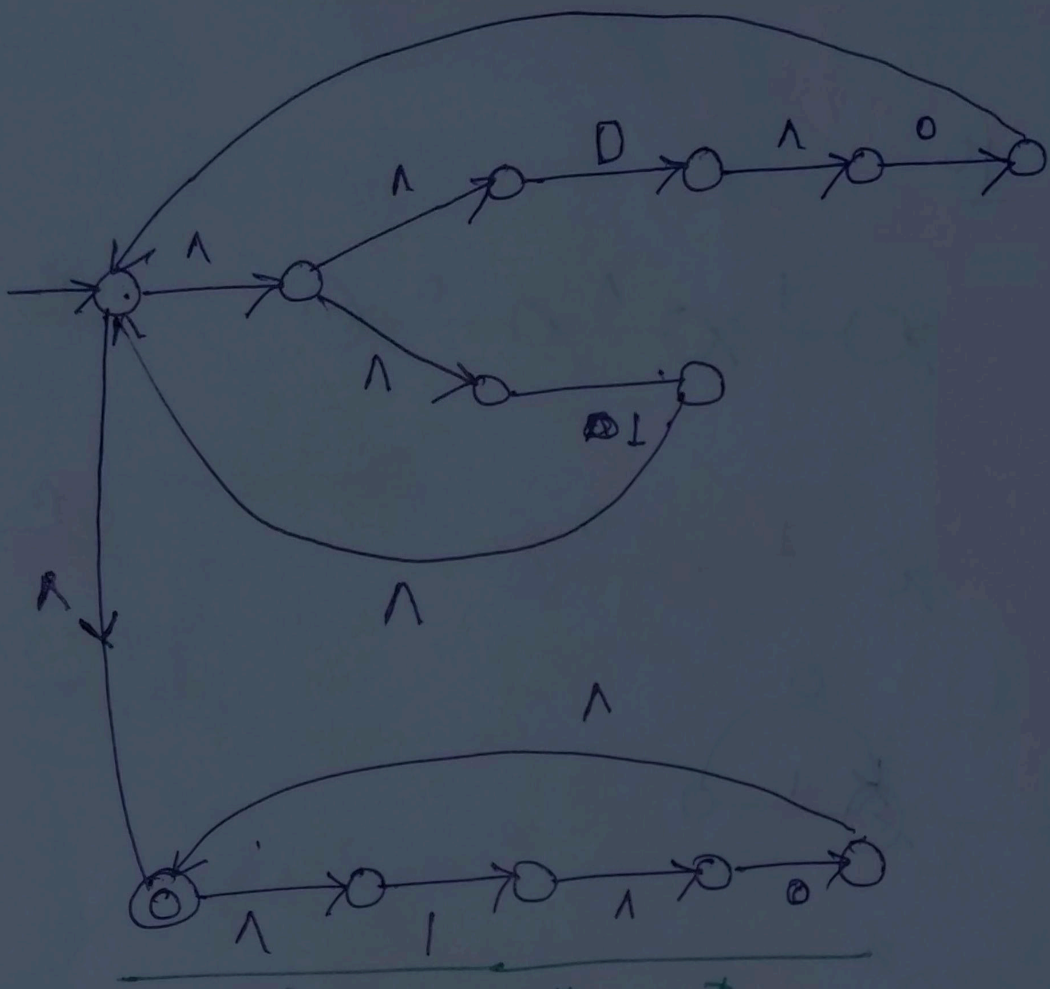


NFA-Λ for $(10)^*$

Now As we ~~to~~ having 2 NFA-Λ we have to Concatnate each other

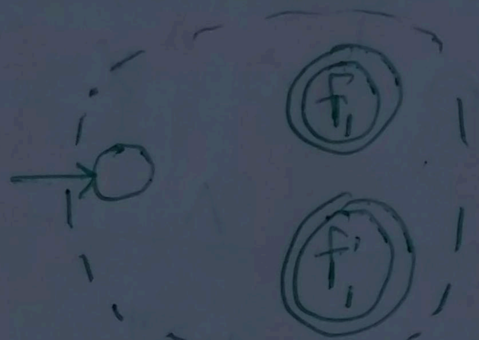
$$\boxed{(00+1)^* \cdot (10)^* \neq (10)^* \cdot (00+1)^*}$$

Concatnation

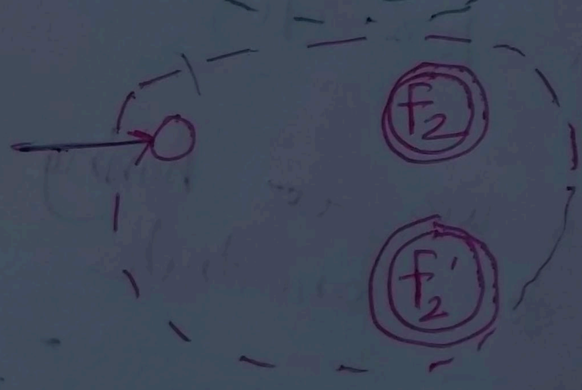


NFA-Λ for $(00+1)^*(10)^*$

F_1 / M_1



F_2 / M_2



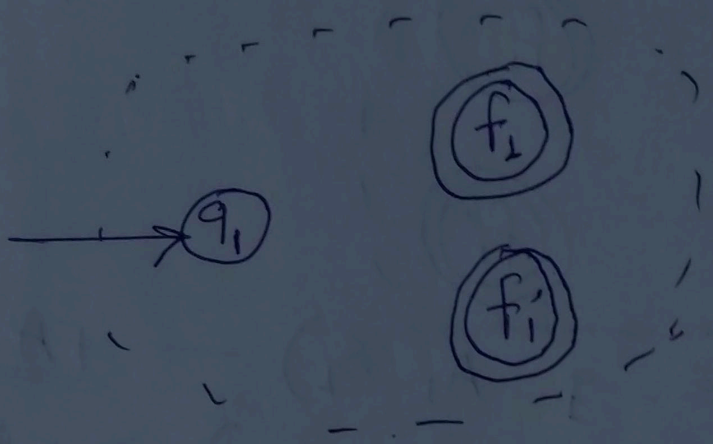
Concatnate M_1 & M_2

$$\boxed{M_1 \cdot M_2 \neq M_2 \cdot M_1}$$

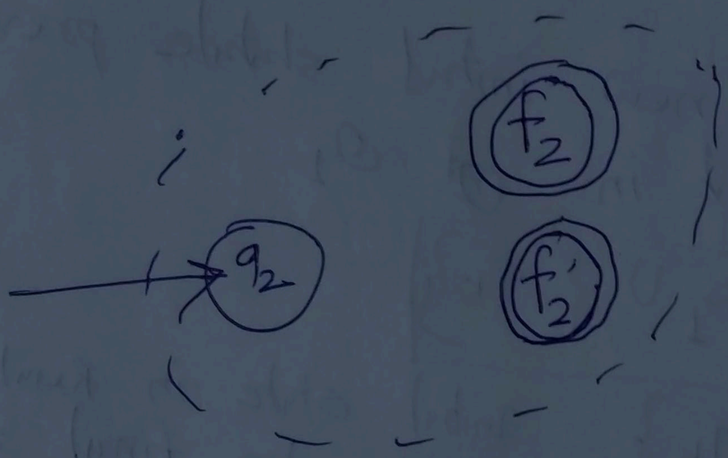
$M_1 = (Q_1, \Sigma, q_1, A_1, \delta_1)$ **Concatnation**

$M_2 = (Q_2, \Sigma, q_2, A_2, \delta_2)$

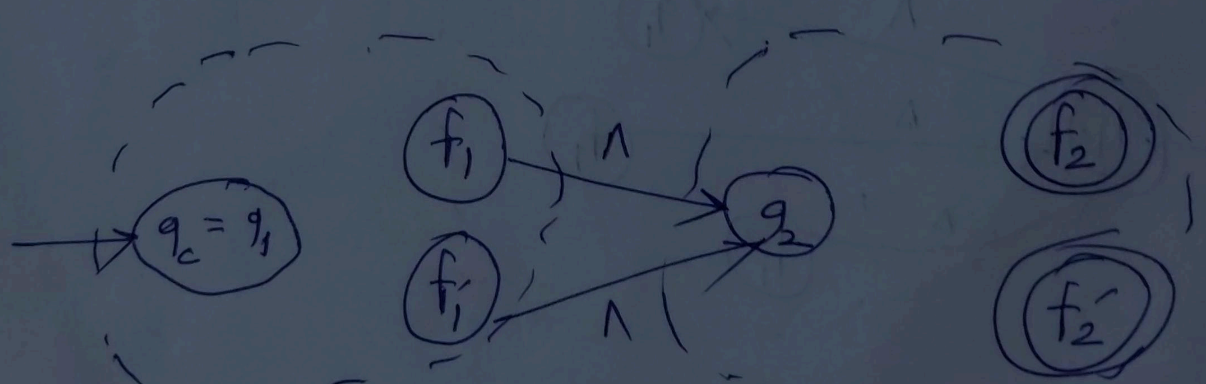
M_1



M_2

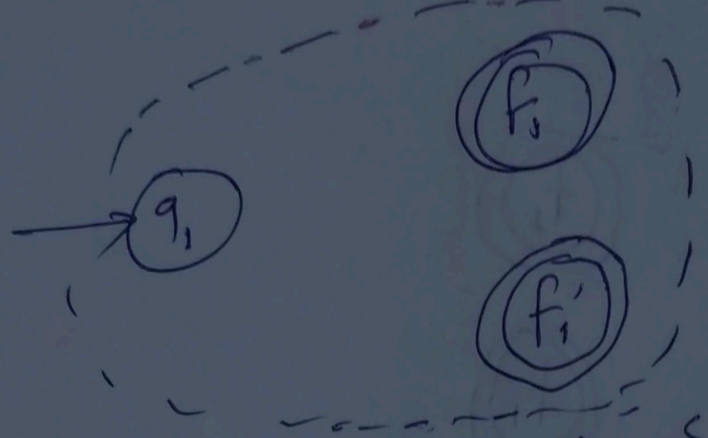


$M_1 \cdot M_2 = M_c = (Q_c, \Sigma, q_c, A_c, \delta_c)$



Kleene*

L_1 Accepted by M_1 then we can perform $\underline{L(M_1)}$



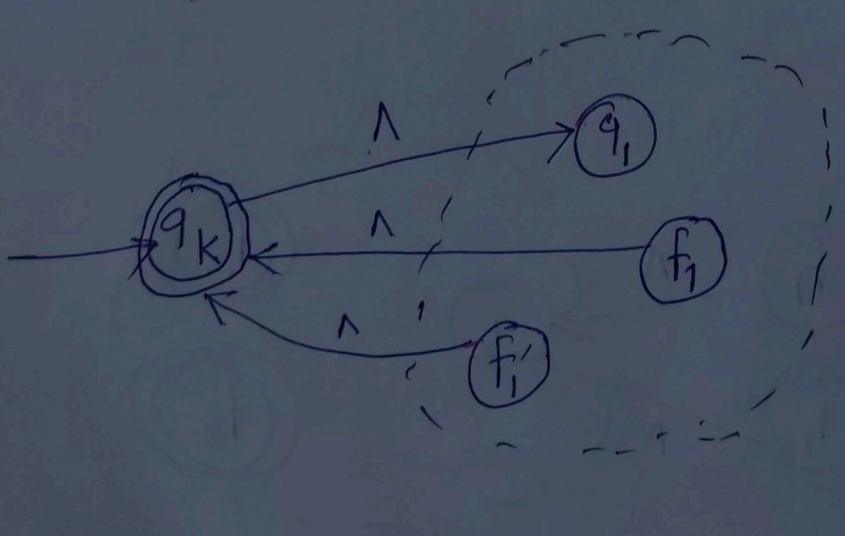
$M_1 = (Q_1, \Sigma, q_1, A_1, \delta_1)$ — FA

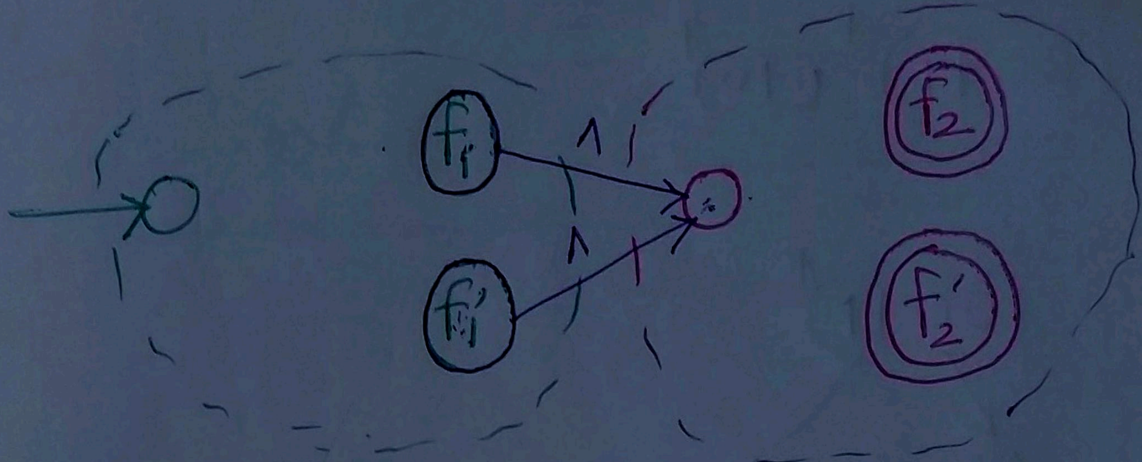
$M_k = (Q_k, \Sigma, q_k, A_k, \delta_k) \rightarrow$ FA*

q_k is new initial state previously not present in Q_1

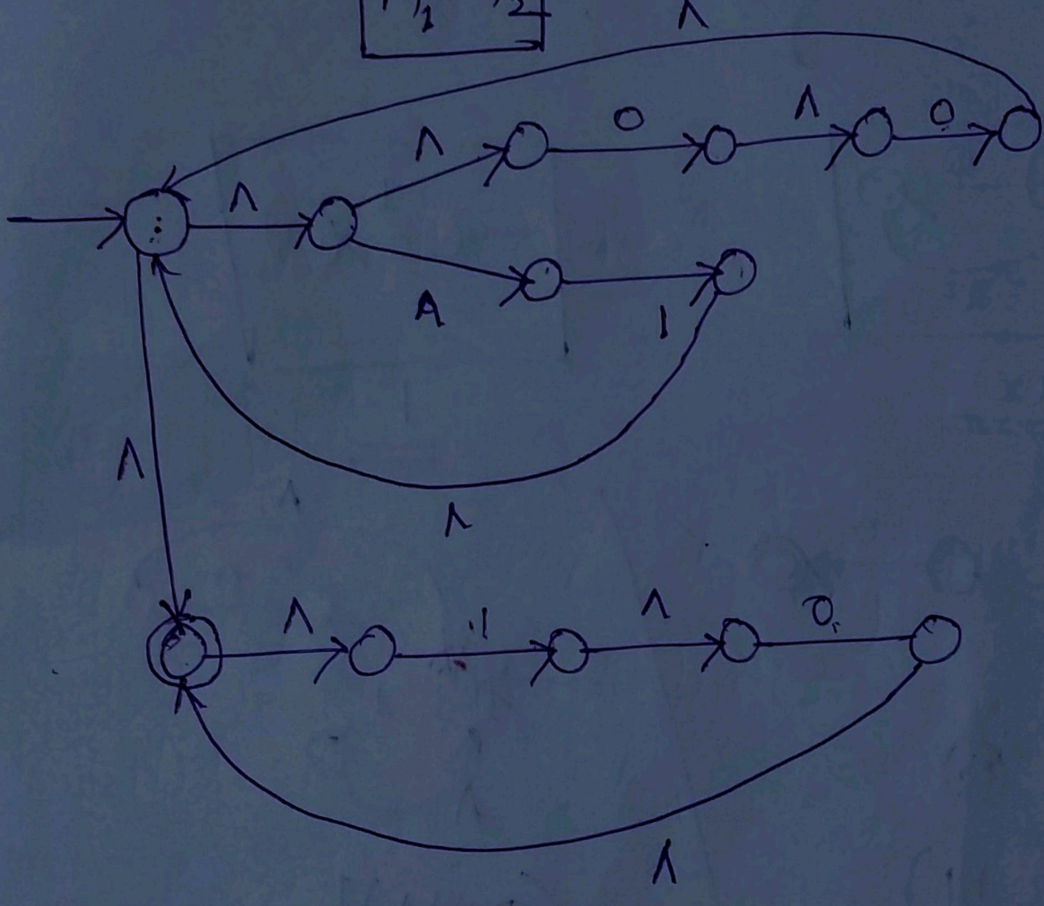
$$\boxed{Q_k = Q_1 \cup \{q_k\}}$$

$A_k = \{q_k\}$ Initial state in Resultant FA is also final state





$\boxed{M_1 \cdot M_2}$

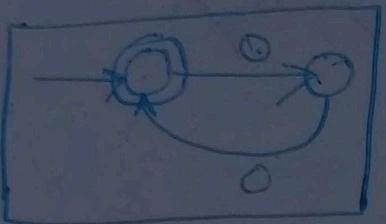


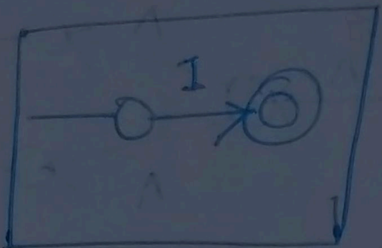
Result for $\boxed{(00+1)^* \cdot (10)^*}$

$(00+1)^* \cdot (10)^*$

(A) $(00+1)^*$

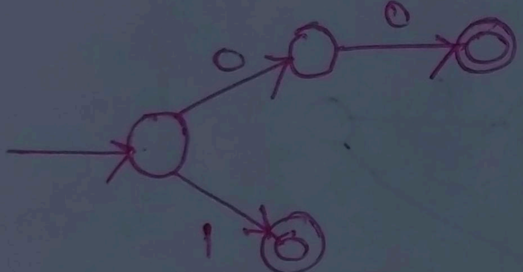
$00 + 1$ *



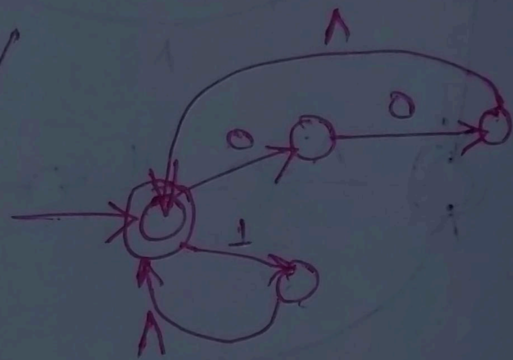


00

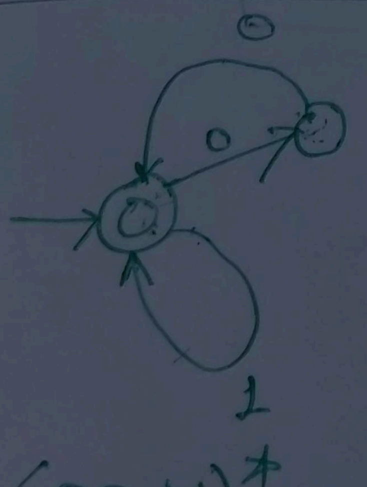
1



$(00+1)$



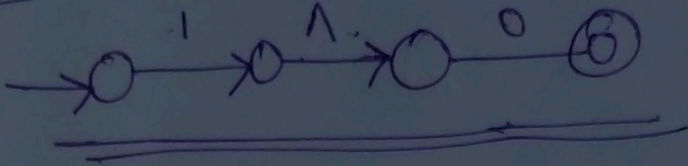
$(00+1)^*$



$(00+1)^*$

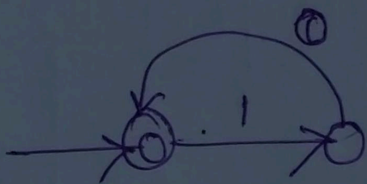
$(10)^*$

10



$(10)^*$

$(10)^*$



finally Resultant

$(00+1)^* \cdot (10)^*$