CS & IT ENGINEERING

THEORY OF COMPUTATION

REGULAR EXPRESSION

Lecture No.- 03

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Recap of Previous Lecture

Topic ?????

Regular Expression Construction

Topics to be Covered

- Topic — Properties of Regular Expression
- Topic — ??
- Topic — ?? Finite Automata Regular Expression
- Topic — ??

Topic : Properties of regular expression

① Associative Property $\Rightarrow (r_1 + r_2) + r_3 = r_1 + (r_2 + r_3)$

② Commutative Property $\Rightarrow (r_1 + r_2 = r_2 + r_1)$ $\left[\left[r_1 \cdot r_2 \neq r_2 \cdot r_1 \right]\right]$

③ Distributive Property $\Rightarrow r_1 \cdot (r_2 + r_3) = r_1 \cdot r_2 + r_1 \cdot r_3$

$$\underline{\underline{a}}^* + \underline{\underline{a}}^* = \underline{\underline{a}}^*$$

$$a^* = (a^*)^* \Rightarrow a^*$$

$$(a^*)^+ \Rightarrow a^*$$

$$(a^+)^* = a^*$$

$$a \cdot a^* = a^+ = a^* \cdot a$$

$$a \cdot \{e, a, a^2, a^3, a^4 \cdots\}$$

$$\{a, a^2, a^3 \cdots\}$$

2*0 = 0

R = Reg Expr

0* = 0*0*0*... = ϵ

(1) $R + \phi = \phi + R = R$

(2) $R \cdot \phi = \phi \cdot R = \phi$

(3) $R + \epsilon = \epsilon + R \neq R$

(4) $R \cdot \epsilon = \epsilon \cdot R = R$

(5) $(R^*)^* = (R^*)^+ = (R^+)^* = R^*$

(6) $R \cdot R^* = R^+ = R^* R$

(7) $\epsilon^* = \epsilon$

1*n*1 = 1

(8) $\epsilon^+ = \epsilon$

(9) $\phi^* = \epsilon$; $\{\}^0 = \epsilon + \phi + \phi \cdots$

(10) $\phi^+ = \phi$

(11) $(a + b)^* \neq a^* b^*$ (ba, ba)

(12) $(a + b)^* \neq (a\ b)^*$ {ab, abab ...}

(13) $(a+b)^* \neq a^* + b^*$

ab, ab

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

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

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

$= \boxed{(a^* b^*)^*}$

(15) $a^* + a^* = a^* = a^* a^*$

(16) $a + b = b + a$ (Commitative)

(17) $a \cdot b \neq ba$

$(a+b)^* = (a+b)^0 + (a+b)^1 + (a+b)^2 + (a+b)^3 + \cdots$

$= \{\epsilon, a, b, aa, ab, ba, bb \cdots\}$

$(r_1 + r_2)^* = (r_1^* \cdot r_2^*)^*$

[MCQ]

#Q. Identify language accepted by following regular expression

$b^*(a^*.\phi\ .\ b + ab + a\phi^*b^*)(b + \phi)^*$

$b^*(\phi + ab^+ + ab^*)\,b^*$

A. Exactly one a

B. At least one a

C. At most one a

D. None

$b^*(ab + ab^*)\,b^*$

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

$b^*(a\cdot b^*)\cdot b^*$

b^*ab^* ✓

$b^* + b^* = b^*$

$b^* \cdot b^* = b^*$

$b^* + b = b^*$

[MCQ]

#Q. Which of the following regular expressions are equivalent?

I. $(00)^*.(\varepsilon+0)$

II. $(00)^*$

III. 0^*

IV. $0(00)^*$

A (I) And (II)

B (ii) and (iii)

C (i) And (iii)

D (iii) and (iv)

[MCQ]

#Q. Which of the following pair of regular expressions are not equal

A (r*)* and (r+)*

B (r+ε)* and r*

C (rr + ε)* and r*

D None of the above

(Q) $\boxed{(a^*b^*)^* a^*b^*}$ is equivalent to

$(a+b)^* a^*b^* = (a+b)^* + (a+b)^* a^2b^2 + (a+b)^* a^3b = (a+b)^*$

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

(b) a^*b^*

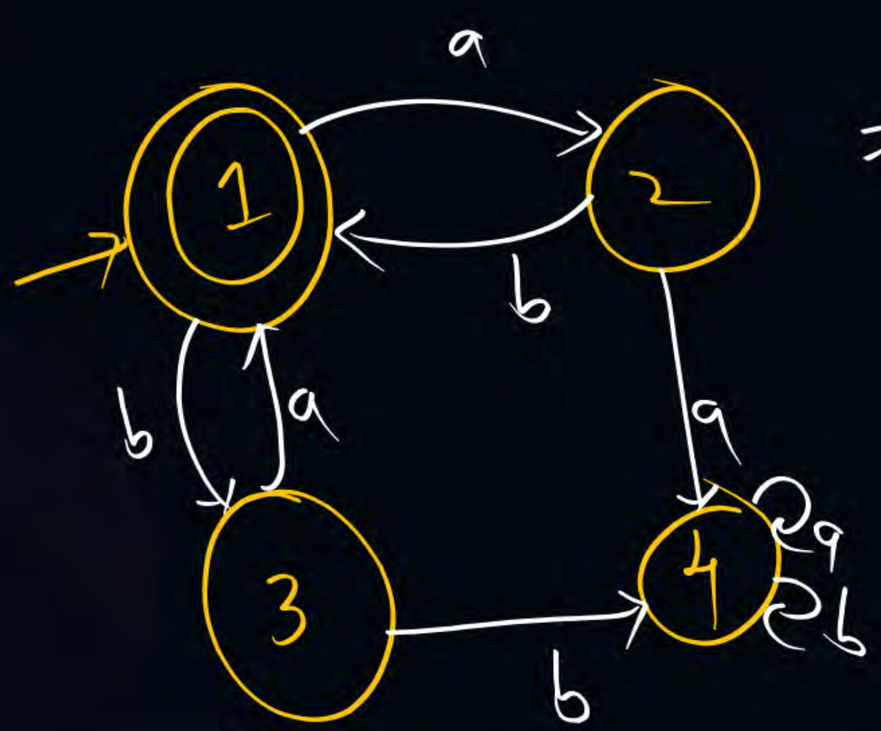
(c) $(a+b)^* ab$

(d) none

{ F. A ⇒ Regular Expression }

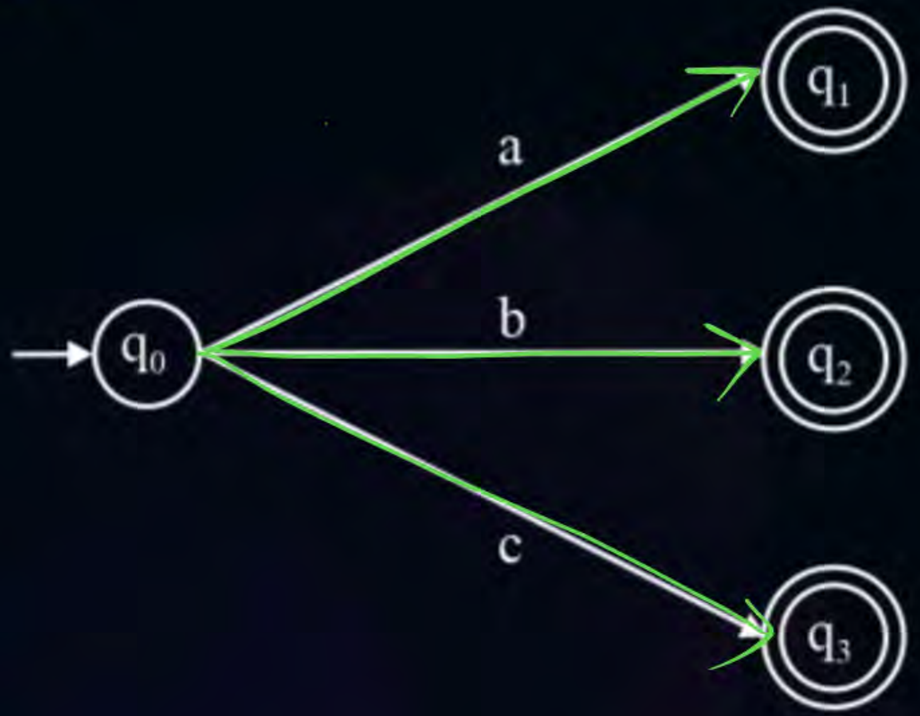
FINITE AUTOMATA TO REGULAR EXPRESSION

1. State elimination method
2. Ardens method

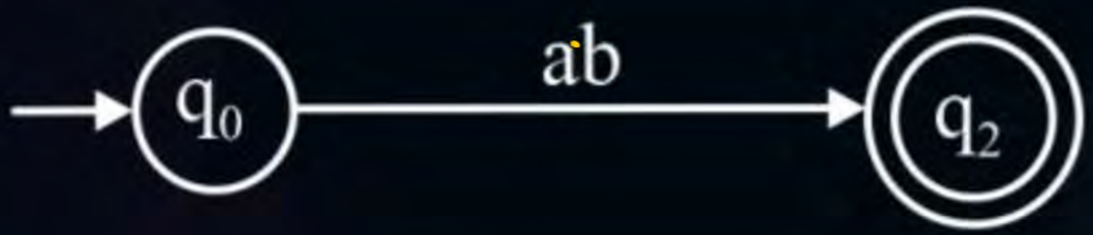


$= (ab+ba)^*$

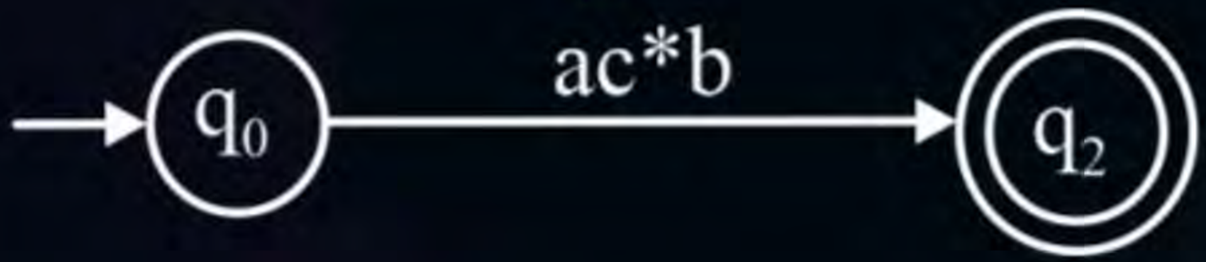
1. multiple final states ⇒ one final state



3.



4.



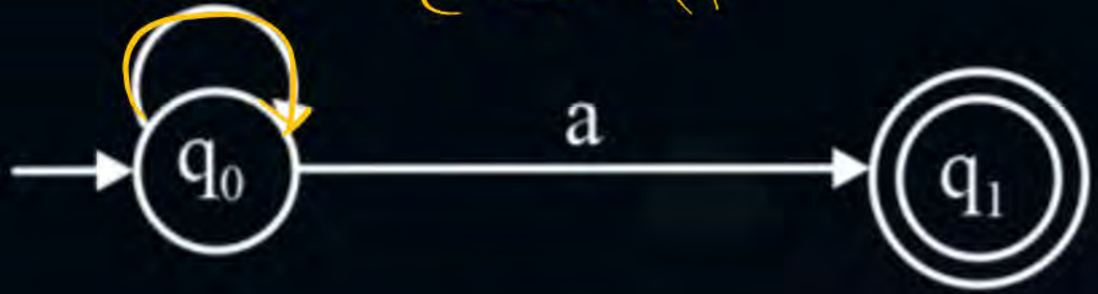
$r_1 + r_2 = (r_1 + r_2)$

$(a+b)^*$

5.

$a(ba)^*$

$\equiv (ab)^* a$



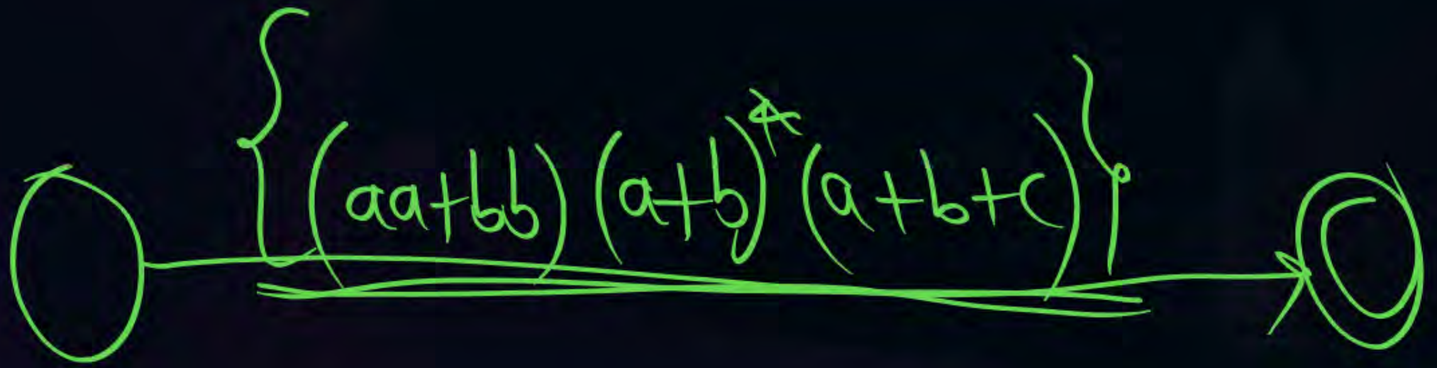
$\Downarrow$

$(ab)^* a$

[NAT]

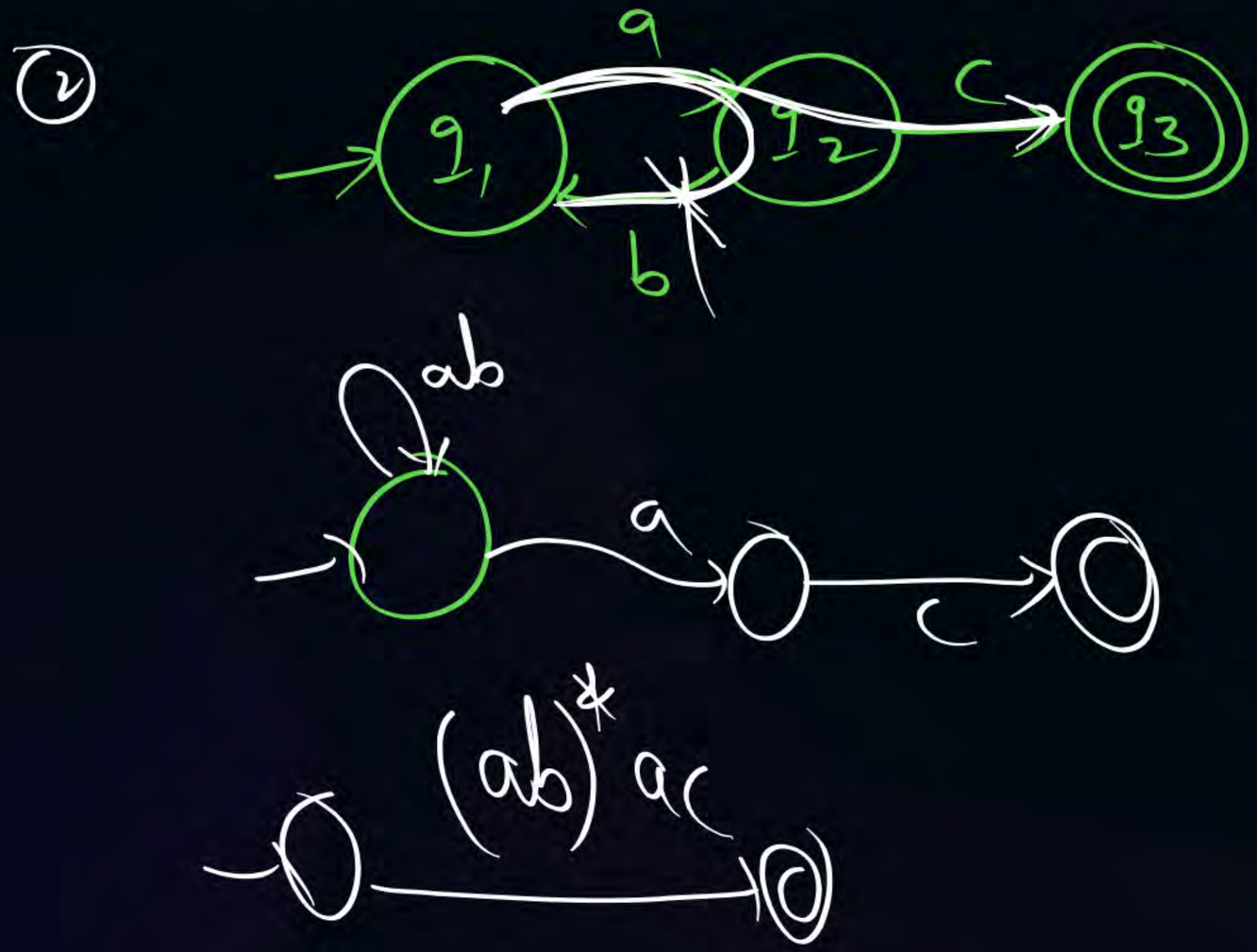
$(a+b)^*$

#Q. Construct Regular Expression for the following Finite Automata.



[NAT]

#Q. Construct Regular Expression for the following Finite Automata.

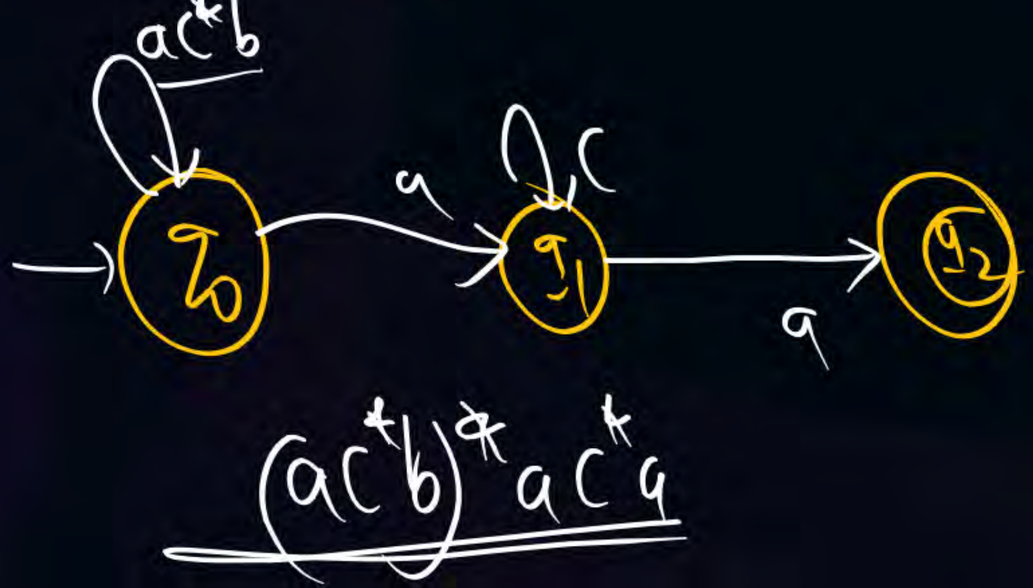


[NAT]

$(ab)^*$ a c c c b

#Q. Construct Regular Expression for the following Finite Automata.

(3)

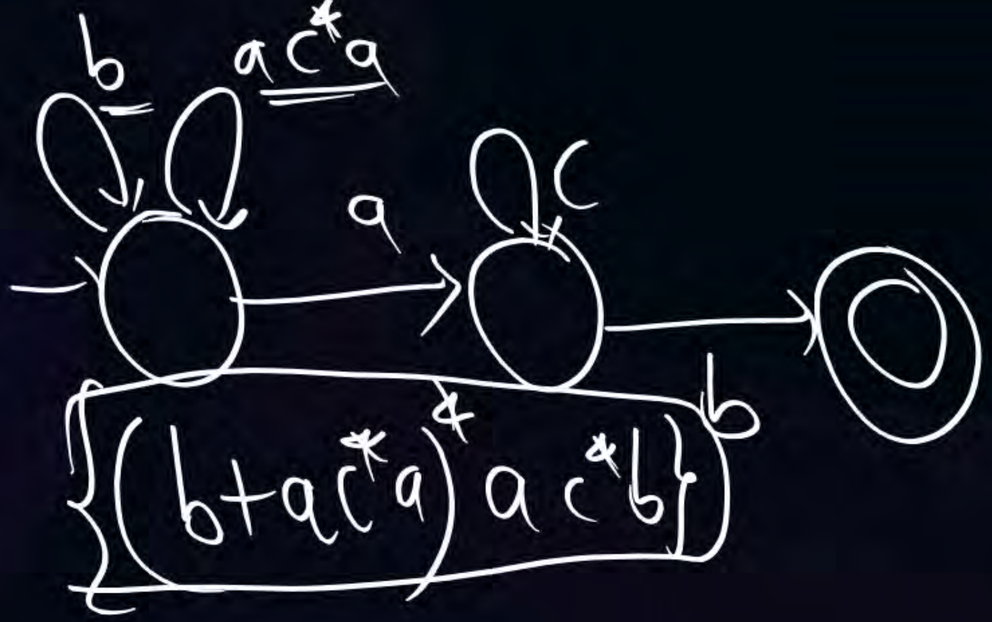


$(ac^*b)^*ac^*q$

[NAT]

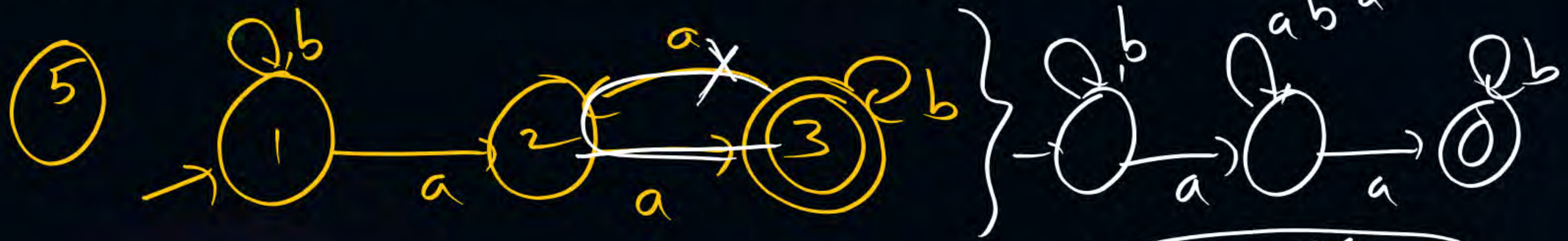
#Q. Construct Regular Expression for the following Finite Automata.

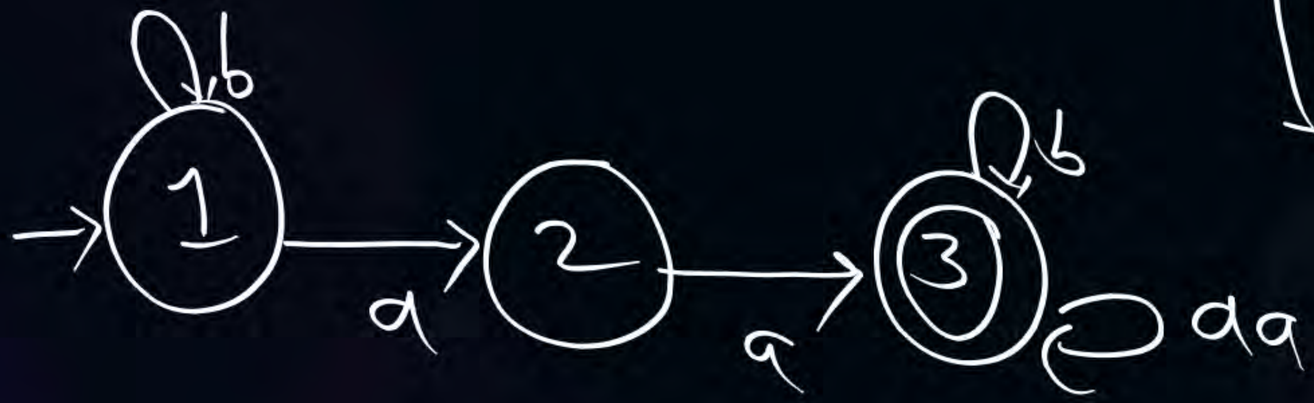
(4)



[NAT]

#Q. Construct Regular Expression for the following Finite Automata.

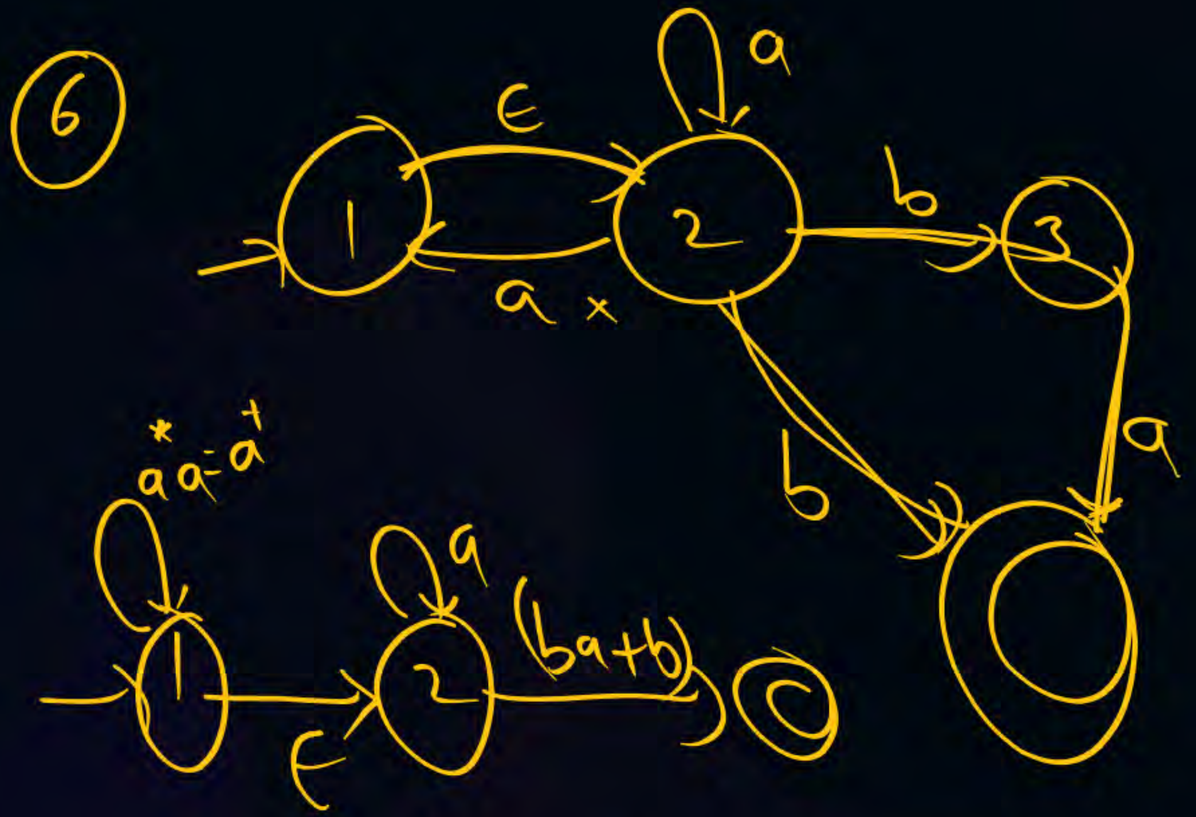




$b^* aa(b+aa)^*$

[NAT]

#Q. Construct Regular Expression for the following Finite Automata.



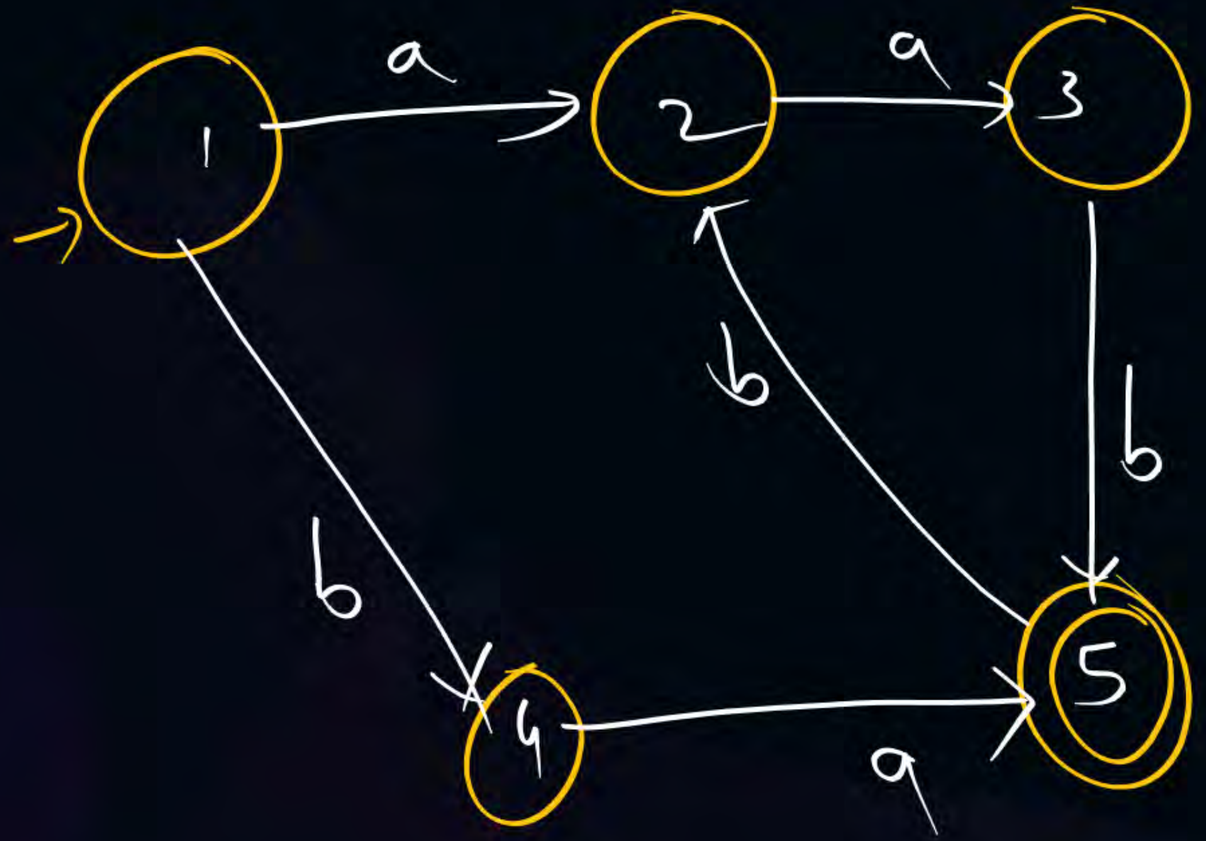
$(a+)^* a^* (ba+b) = a^* (ba+b)$

$a^* \cdot a^* (ba+b)$

[NAT]

#Q. Construct Regular Expression for the following Finite Automata.

7



Regular Expr ?

Home Work

Question

#Q. Consider the following regular expressions:

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

(II) $(\epsilon + aa^*)(bb^* + \epsilon)$

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

(IV) $aa^+ + bb^+$

Which the following is equivalent to a^*b^*?

A (I) and (II) only

B (I) only

C (II) and (III) only

D (I) and (IV) only

Question

#Q. Which of the following is not correct?

A $a^* bb^* = a^* b^+$

B $a^* a^+ = a^+$

C $a^+ a^+ = a^+$

D $\phi^* = \in$

Question

#Q. Consider following regular expressions:

[I] $(ab)^*a = a(ab)^*$

[II] $(bb)^*b^* = b^*$

[III] $(b + \epsilon)^+ = b^*$

Which of the following is correct?

(A) II and III only

(B) I and II only

(C) All are correct

(D) None of these are correct

Question

#Q. Let $L_1 = \phi$, $L_2 = \{\varepsilon\}$, $L_3 = \{a, \varepsilon\}$.

L_1, L_2, L_3 are languages defined over $\Sigma = \{a\}$ then,

$$L_1 \cdot L_2^* + L_3 \cdot L_1 + L_1^* \cdot L_2 \cdot L_3 = ?$$

$$\phi \cdot \epsilon + \{a, \epsilon\} \cdot \phi + \phi^* \cdot \epsilon \cdot \{a, \epsilon\}$$

$$\phi + \phi + \epsilon \cdot \epsilon \cdot \{a, \epsilon\} = \{a, \epsilon\}$$

(A) ϕ

(B) $\{a\}$

(C) $\{a, \varepsilon\}$ ✓

(D) $\{a^n \mid n \geq 2\}$

THANK - YOU