

# CS & IT ENGINEERING

Theory of Computation

Finite Automata:

DFA-4

Lecture No. 9 (no DPP)



By- DEVA Sir



# TOPICS TO BE COVERED

01 DFA model - VIII

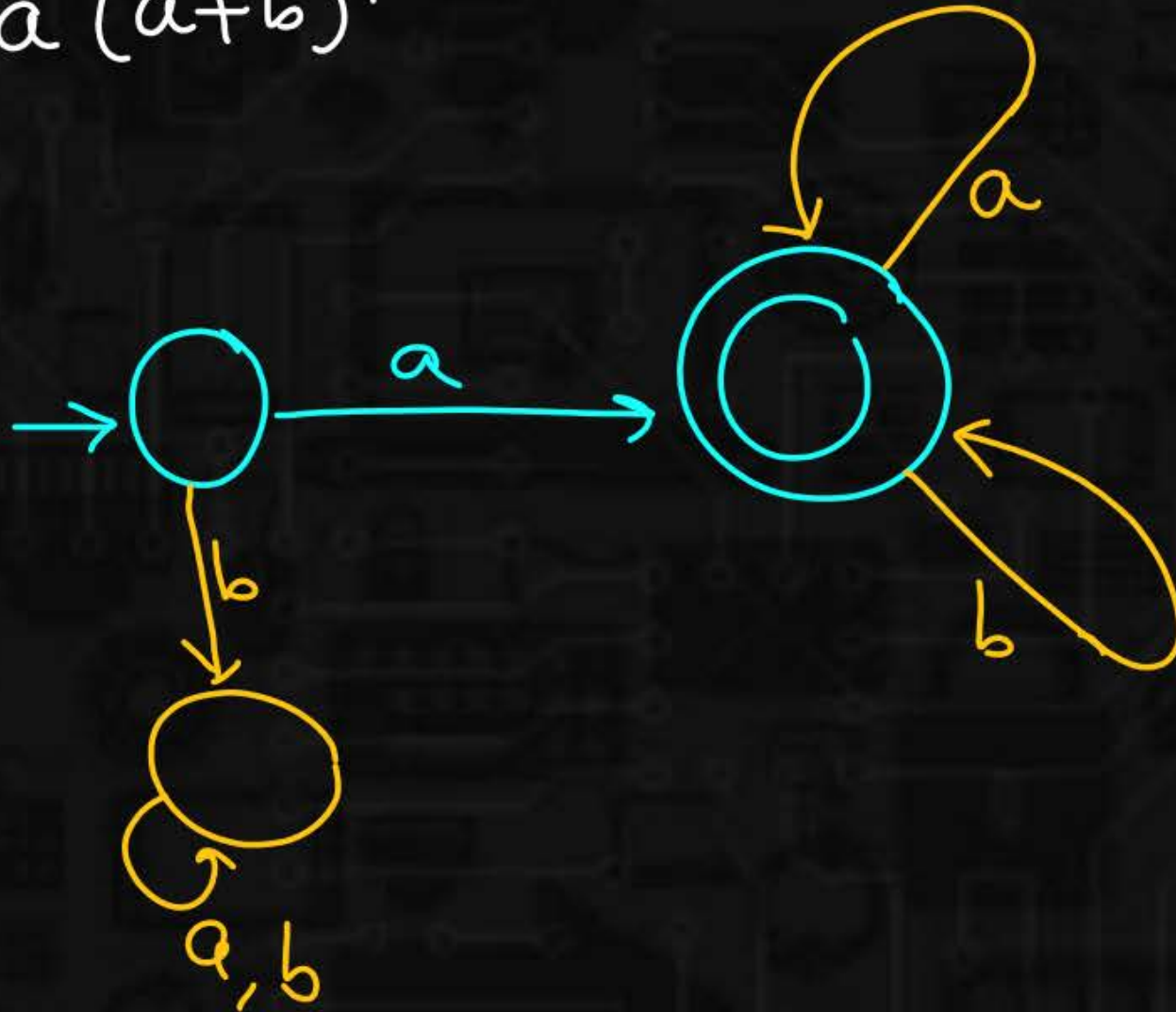
02 - IX

03 - X

04 - XI

05 - XII

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



$aa \in L$   
 $ab \in L$

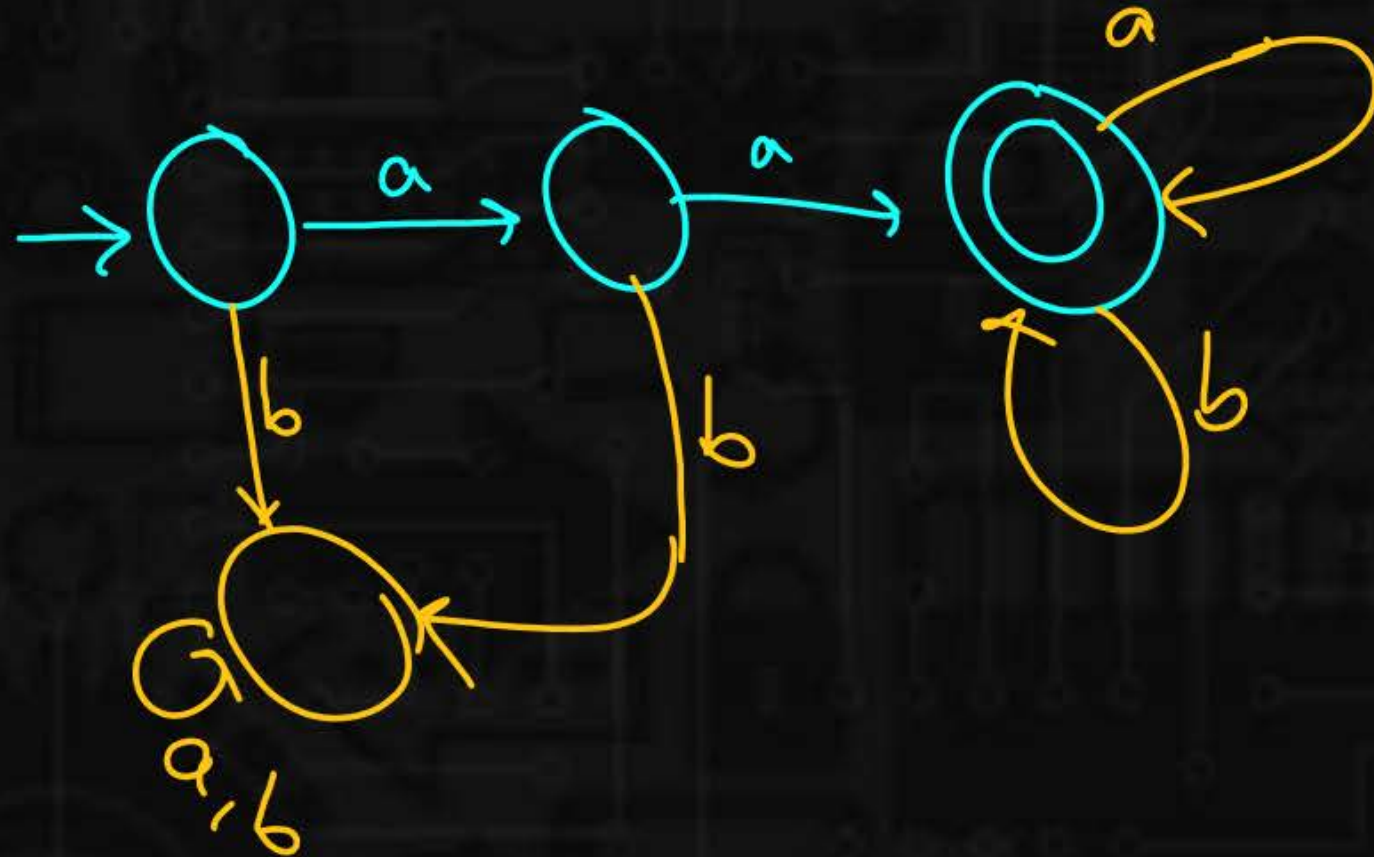
Shortcut:  
 $a \times$   
 $\min = \underline{a}$   
 $|a| = 1$   
 $|a| + 2 = 3 \text{ States}$



$$(72) \quad L = aa(a+b)^*$$

Min string = aa

$$\text{States} = |aa| + 2 = 4$$



$ab \notin L$

$ab \dots \notin L$

$aaa \in L$

$aaab \in L$

$$L = \underline{abb}(a+b)^*$$

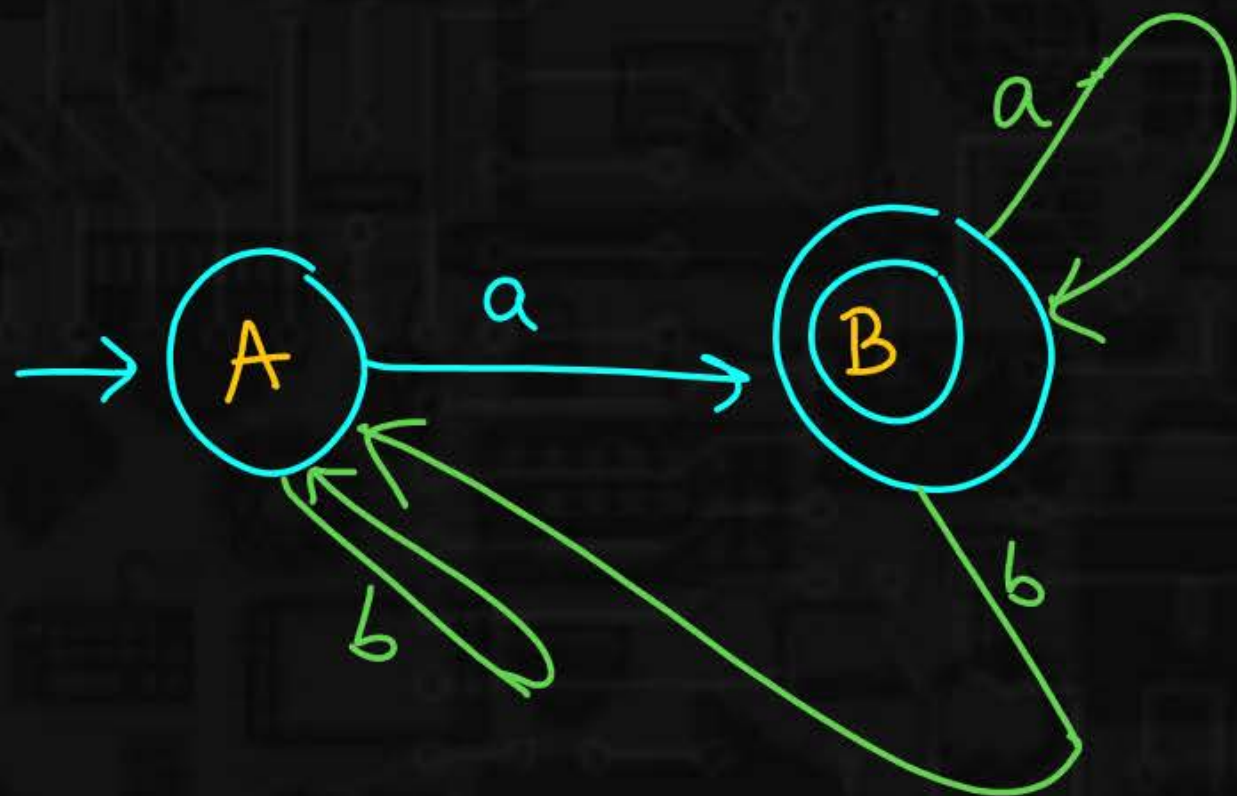
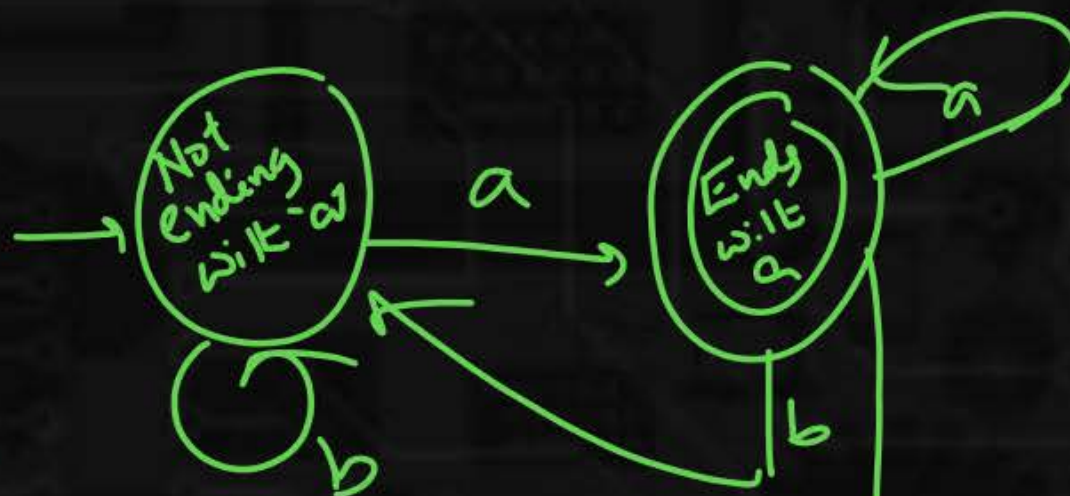
Min string =  $abb$

$$\text{No. of States} = |abb| + 2 = 5$$



73  $(a+b)^*a$

Min = a



A: waiting for a  
B: Final (Ending in a)

$b \notin L$  future  
 $\boxed{a} \in L$   
 previous min seq

$aa \in L$

$\underbrace{a}_{\text{Past}} \underbrace{b}_{\text{Present}} \underbrace{a}_{\text{Future}} \in L$

Shortcut:

~~Xa~~

Min = a

States:

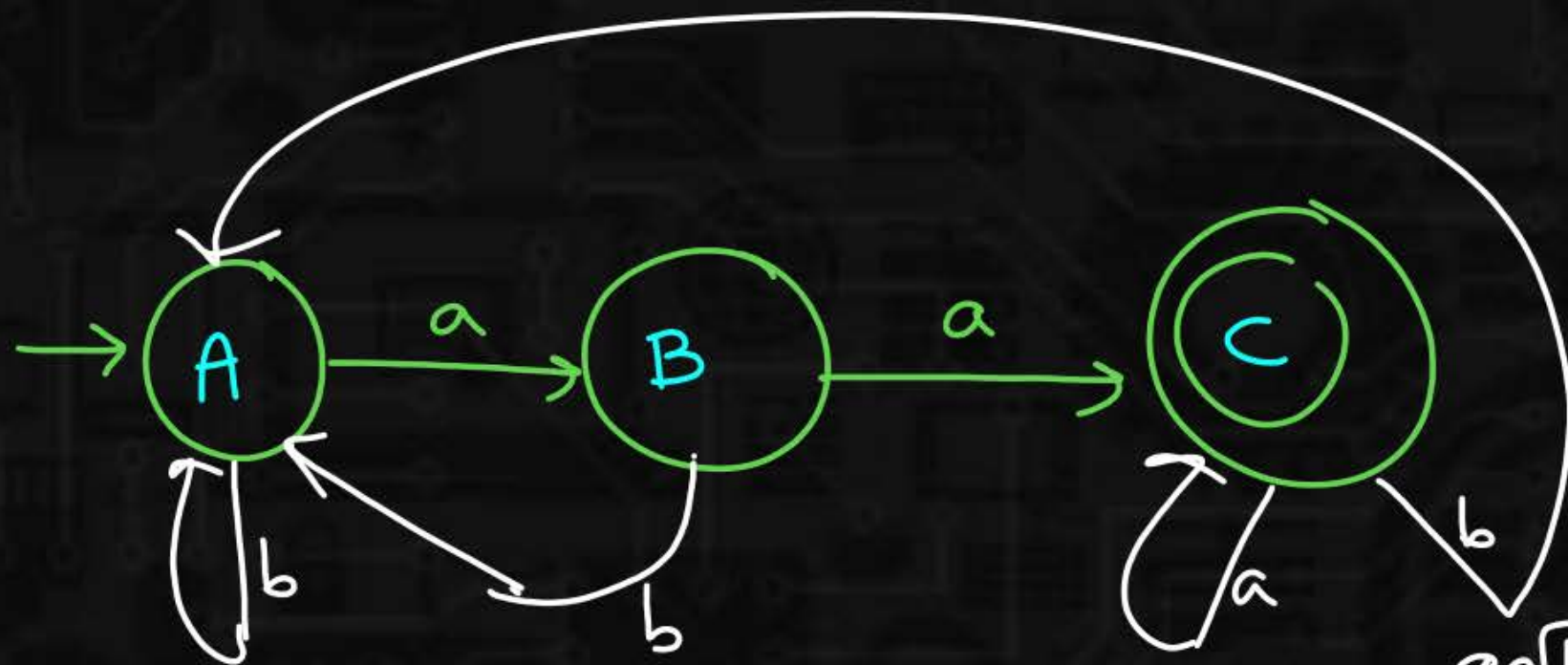
$|a| + 1 = 2$



# DFA Construction



74  $(a+b)^*aa$



min = aa

$|aa| + 1 = 2 + 1$   
= 3 states  
        

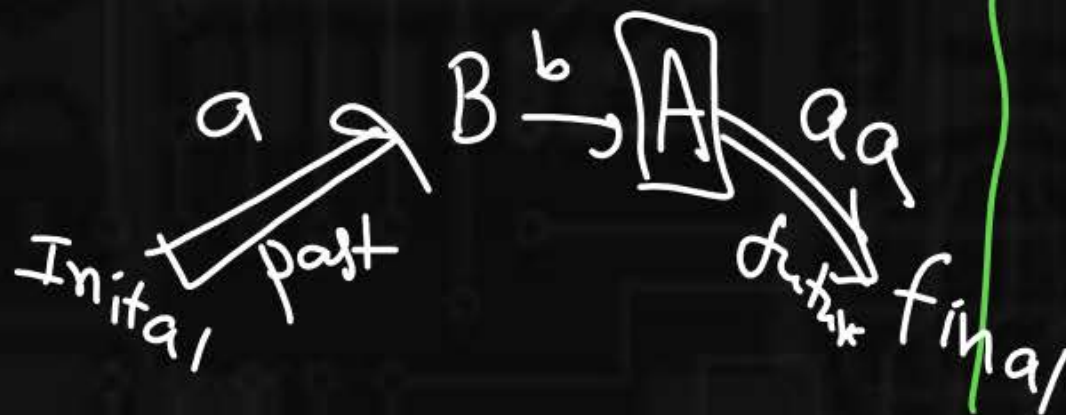
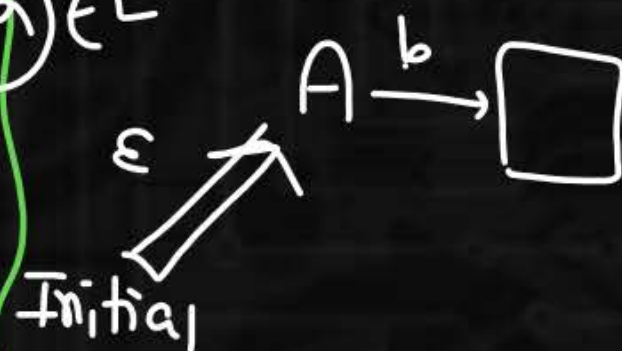
A: waiting for aa

B: " " a

C: final

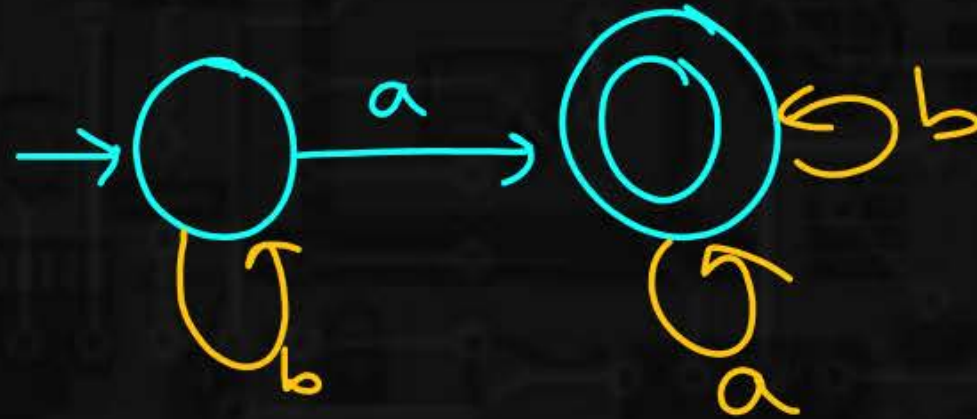
$\underbrace{aa}_{\text{past}} \boxed{a} \in L$

$aa \boxed{b} aa \in L$



$\underbrace{b}_{\text{future}} \boxed{aa} \in L$

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



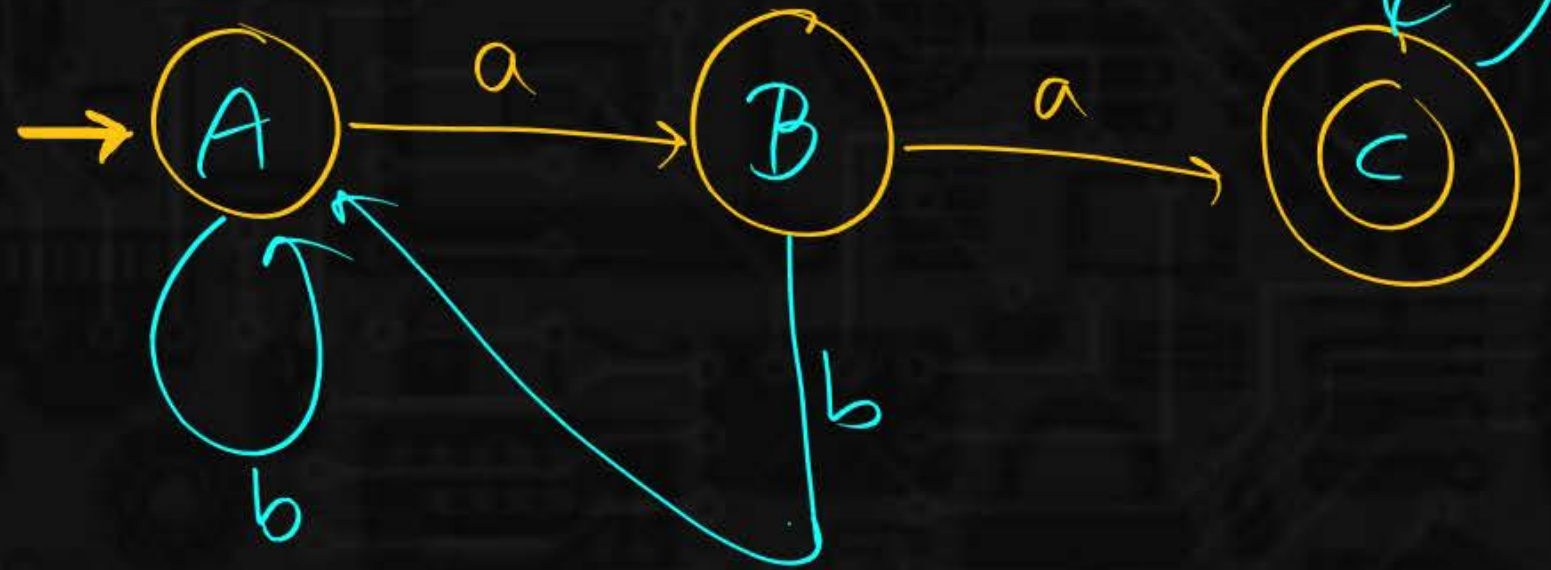
~~$XaX$~~

$\min = a$

$|a| + 1 = 1 + 1 = 2 \text{ states}$



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



$|aa| + 1 = 2 + 1 = 3 \text{ states}$

H.W.

(77)  $aaaX \Rightarrow |aaa| + 2 = 3 + 2 = 5 \text{ states}$

(78)  $Xaaa \Rightarrow 3 + 1 = 4 \text{ states}$

(79)  $XaaaX \Rightarrow 3 + 1 = 4 \text{ states}$

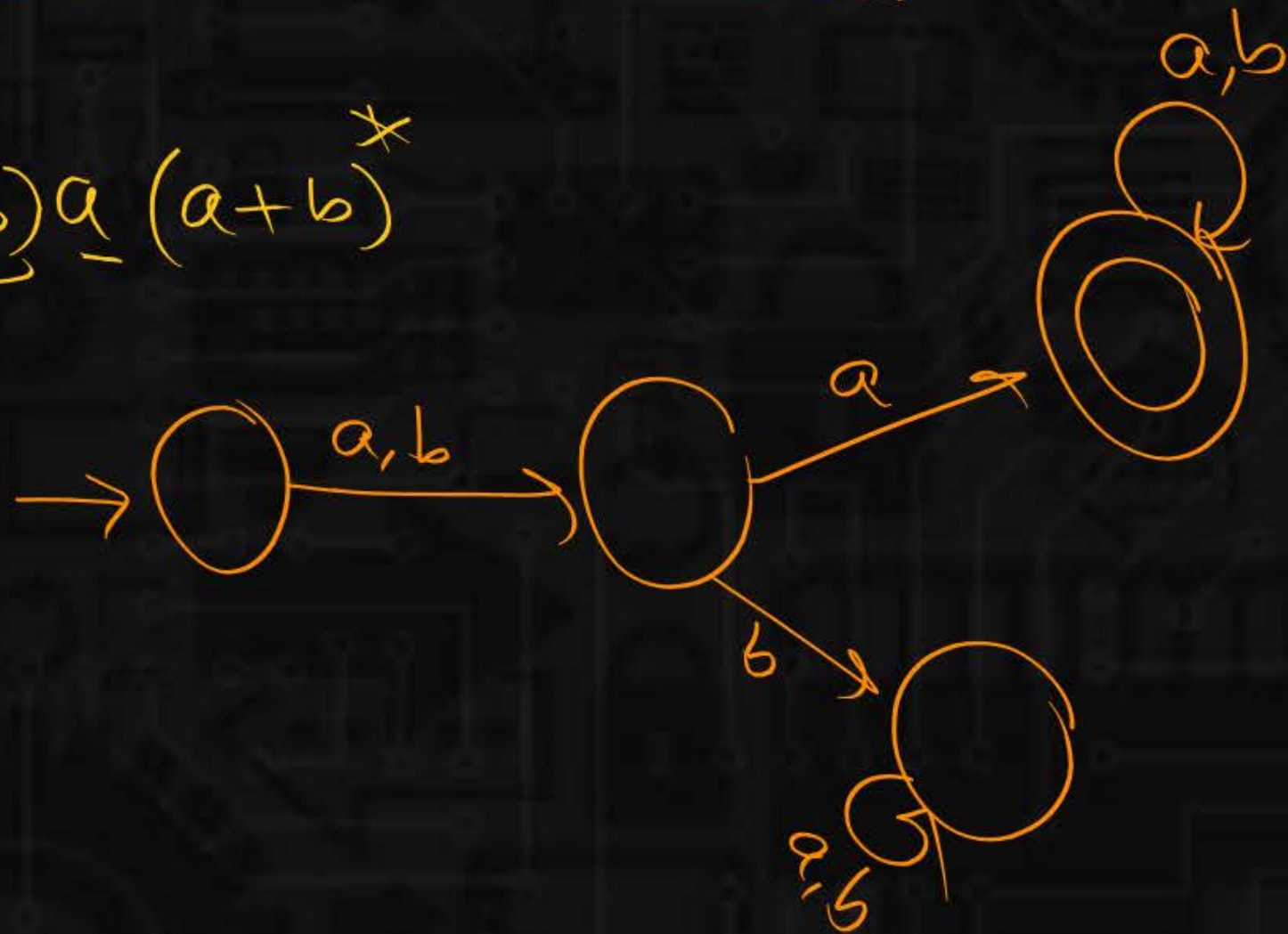
(80)  $Xab \Rightarrow 2 + 1 = 3 \text{ states}$



$$(81) \{ xaw \mid x \in \{a,b\}, w \in \{a,b\}^* \}$$

2<sup>nd</sup> Symbol from begin is 'a'

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



$K^{\text{th}}$  symbol from begin is 'a'



$K+2$  states in minDFA

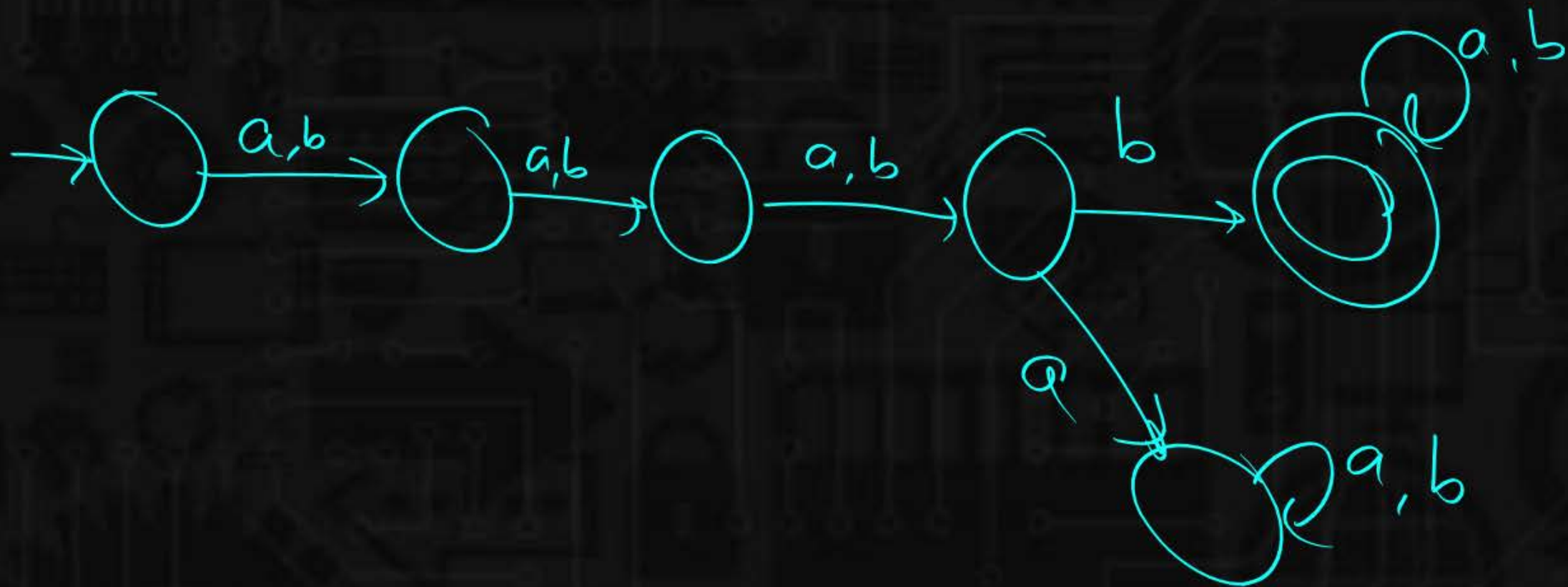
$$= 2+2 = 4 \text{ states}$$

(82)

$$L = \underbrace{(a+b)^3}_4 b (a+b)^*$$

4<sup>th</sup> Symbol from begin is 'b'

$\Rightarrow 4 + 2 = 6$  states





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(83)  $(a+b)^* a (a+b)$   $\Rightarrow$  4 states  
 2<sup>nd</sup> symbol from end is 'a'

(84)  $(a+b)^* a (a+b)^2$   $\Rightarrow$  8 states  
 3<sup>rd</sup> symbol from end is 'a'

(85)  $(a+b)^* a (a+b)^3$   $\Rightarrow$  16 states  
 4<sup>th</sup> symbol from end is 'a'

(86)  $(a+b)^* a (a+b)^9$   $\Rightarrow$   $2^{10} = 1024$  states  
 10<sup>th</sup> symbol from end is 'a'

$K^{\text{th}}$  Symbol from begin is 'a'

$\Rightarrow K+2$  states

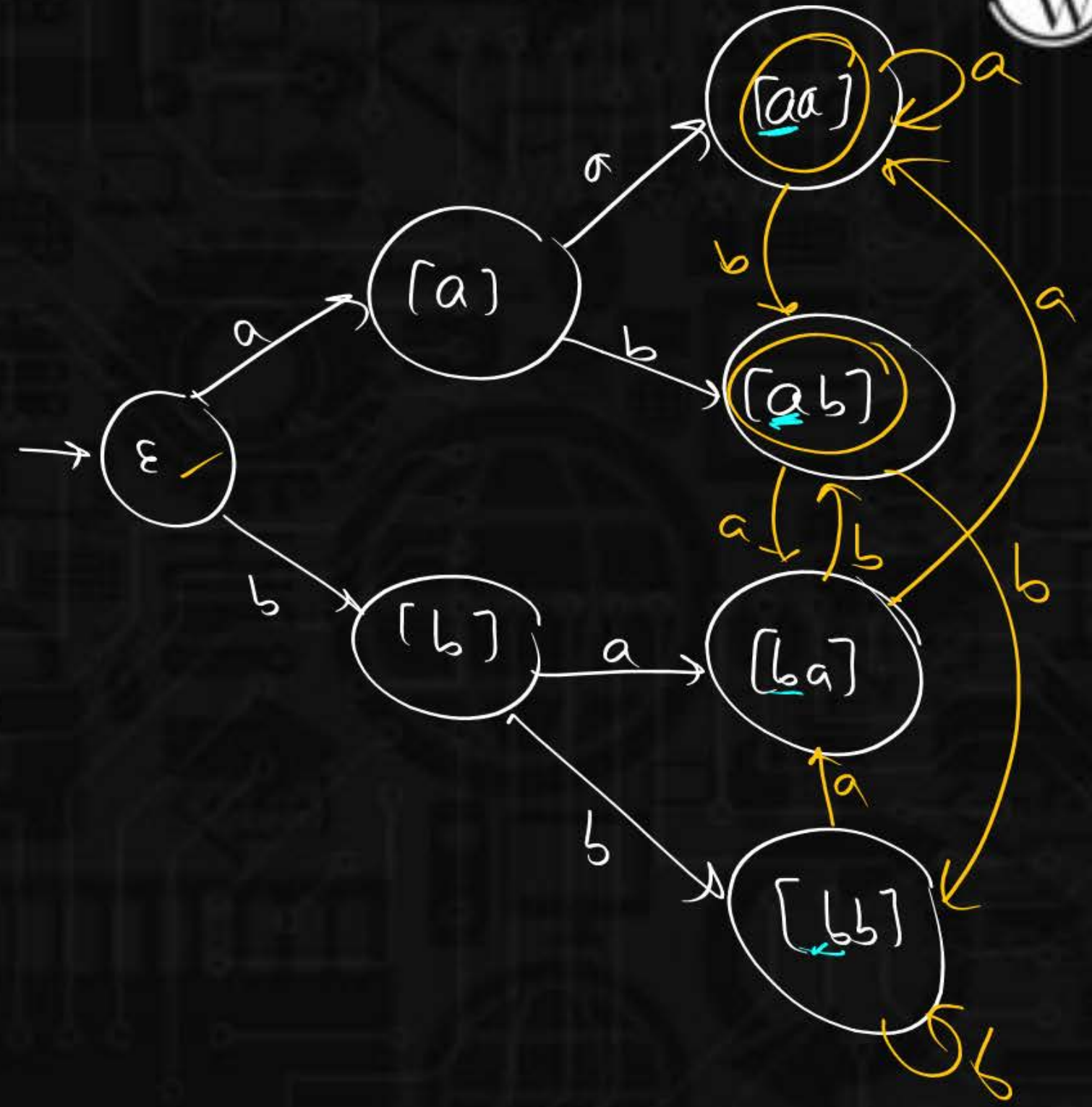
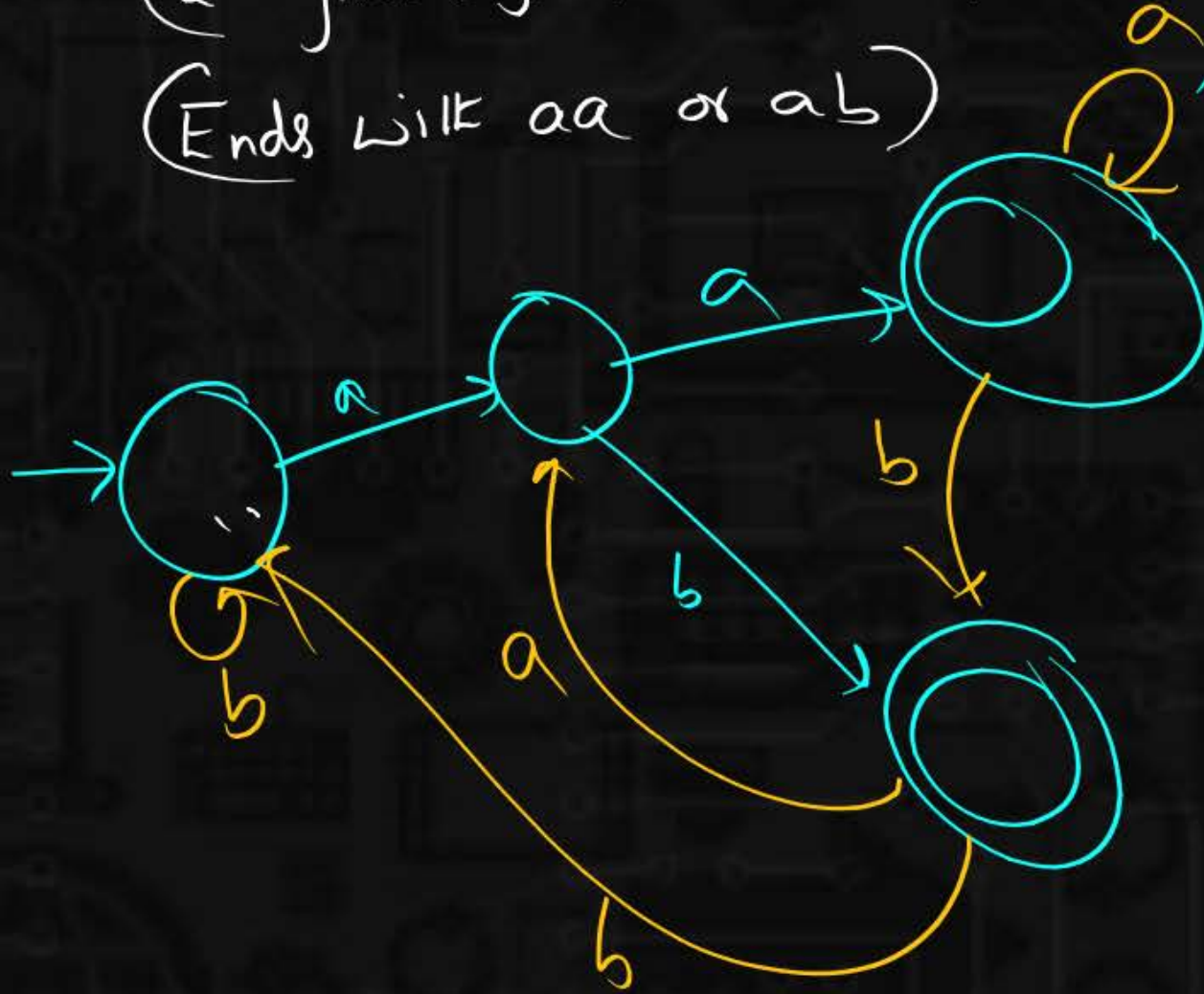
$K^{\text{th}}$  symbol from end is 'a'

$\Rightarrow 2^K$  states



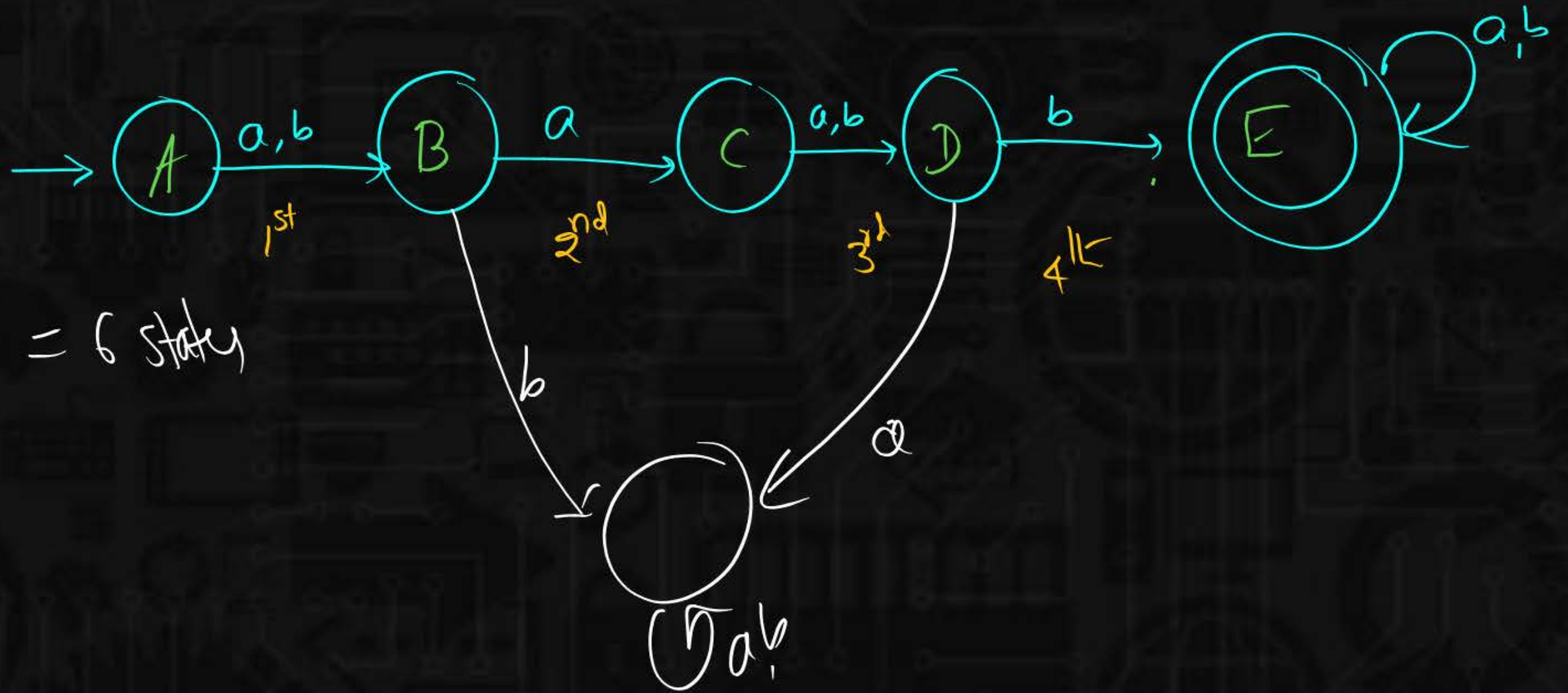
## DFA Construction

83)  $(a+b)^* a (a+b)$   
(2<sup>nd</sup> symbol from end is 'a')  
(Ends with aa or ab)

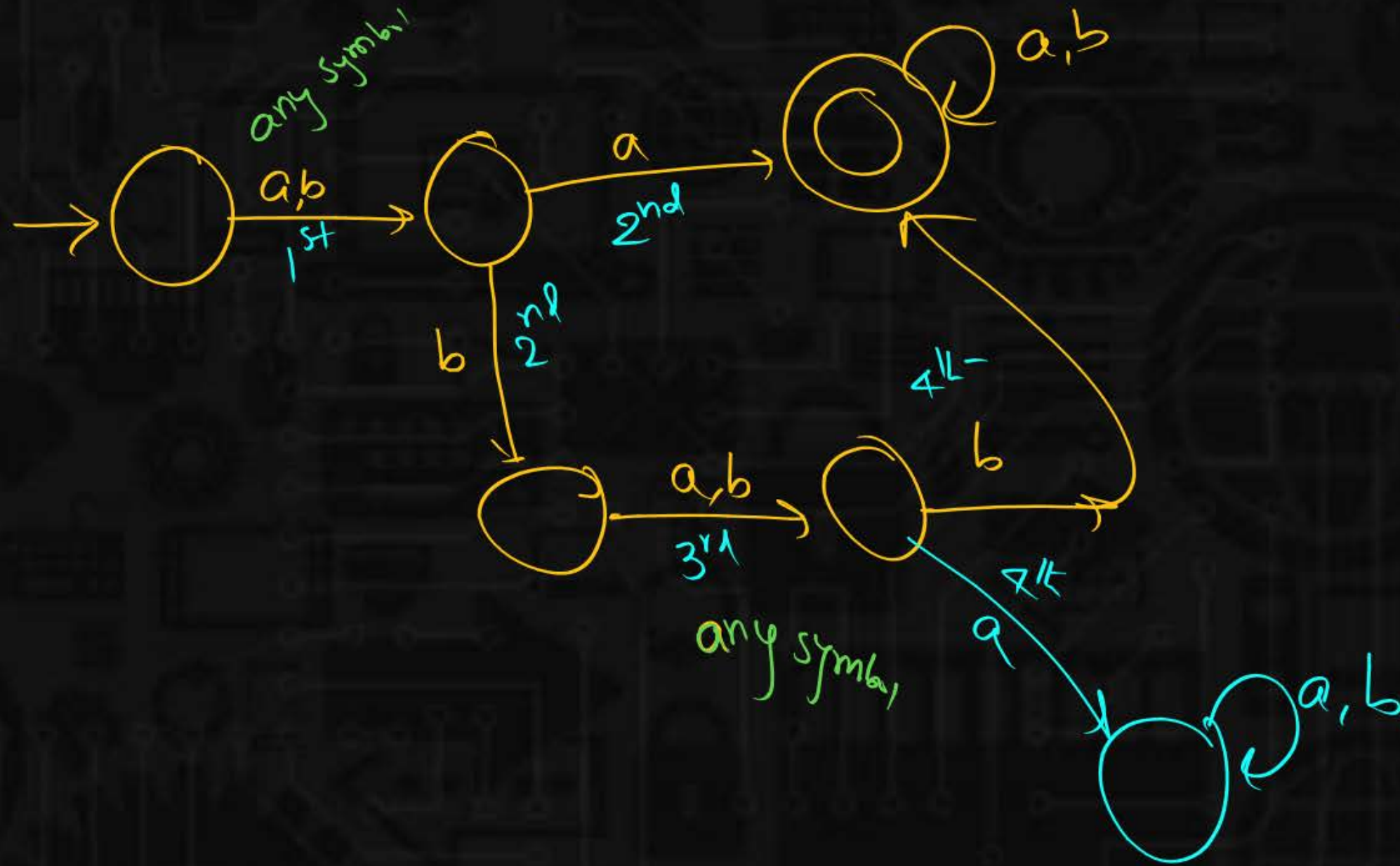




84  $\{w/w \in \{a,b\}^*, 2^{\text{nd}} \text{ symbol}(w) \text{ is 'a' and } 4^{\text{th}} \text{ symbol}(w) \text{ is 'b'}\}$



(85)

 $L = \{ w \mid w \in \{a,b\}^*, \text{ 2}^{\text{nd}} \text{ symbol is 'a' OR 4}^{\text{th}} \text{ symbol is 'b'} \}$ 


~~$xa$~~   
 ~~$xb$~~   
 ~~$xb$~~

= 6 states



$$(86) (aa+bb)(a+b)^*$$

H.W.

$$(87) (a+b)^*(aa+bb)(a+b)^*$$

11:30 AM

$$(88) (a+b)^*(aa+bb)$$

$$(89) a(a+b)^*b$$

$$(90) aa(a+b)^*bb$$

$$(91) \{w \mid w \in \{a,b\}^*, w \text{ starts with 'a' and } w \text{ contains 'a'}\}$$

$$(92) \{w \mid \text{"}, w \text{ ends with 'a' and "}\}$$

# Summary



$aX$

$Xa$

$XaX$

modul - ~~IIII~~

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$xax$

$Xax$



