

CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 21



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Recap of Previous Lecture



Topic

Model-I (Easy: Φ , Σ^* , only epsilon, Σ^+)

Topic

Construction of DFA Model II (Length)

Topic

Construction of DFA Model III (No. of symbols)

Topic

Construction of DFA Model IV (Over 1 symbol)

Topic

Construction of DFA Model V (Sequence based)

Topic

Construction of DFA Model VI (Length & Remainder)

Topic

Construction of DFA Model VII (Symbols & Remainder)

Topic

Construction of DFA Model VIII (Multiple Conditions on symbols)

Topics to be Covered



Topic

Construction of DFA Model IX (Start, End , Contain)

Topic

Construction of DFA Model X (Position based)

Model-IX [start, end, contain]

- (62) $L = a(a+b)^*$ $\text{Min} = a$
 (63) $L = aaa(a+b)^*$ $\text{Min} = aaa$
- (64) $L = (a+b)^*a$ $\text{Min} = a$
 (65) $L = (a+b)^*aaa$ $\text{Min} = aaa$
 (66) $L = (a+b)^*a(a+b)^*$ $\text{Min} = a$
 (67) $L = (a+b)^*aaa(a+b)^*$ $\text{Min} = aaa$
- } Trap state needed
 } No trap state

Construction of DFA



(62)

Set of all strings starting with 'a'

$$\Sigma = \{a, b\}$$

$$= \{ \underline{a}, \underline{a}a, \underline{a}b, \dots \}$$

$$= a\Sigma^*$$

$$\text{Min} = a$$

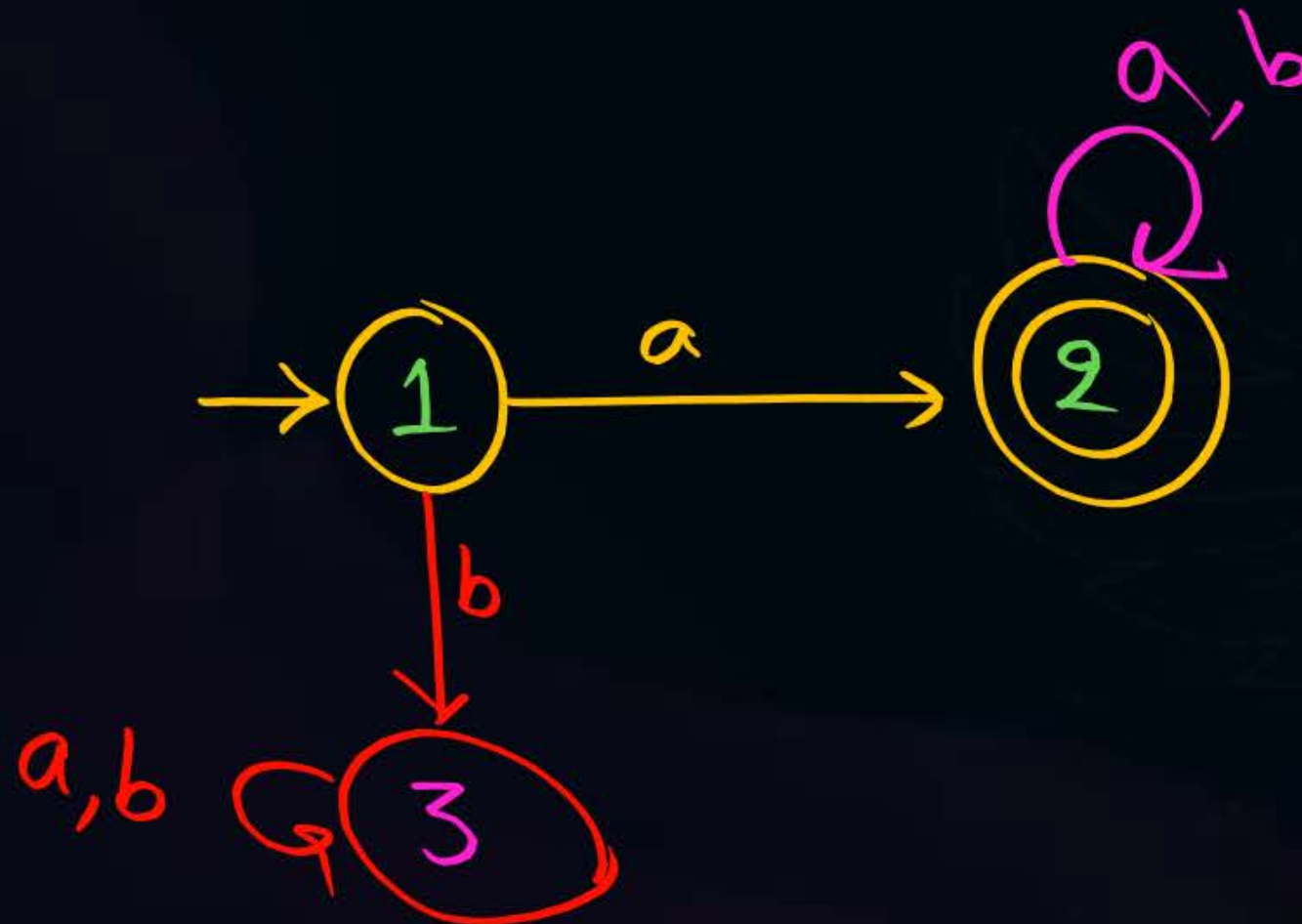
Σx

bx

$ba x$

$bb x$

$b \dots x$



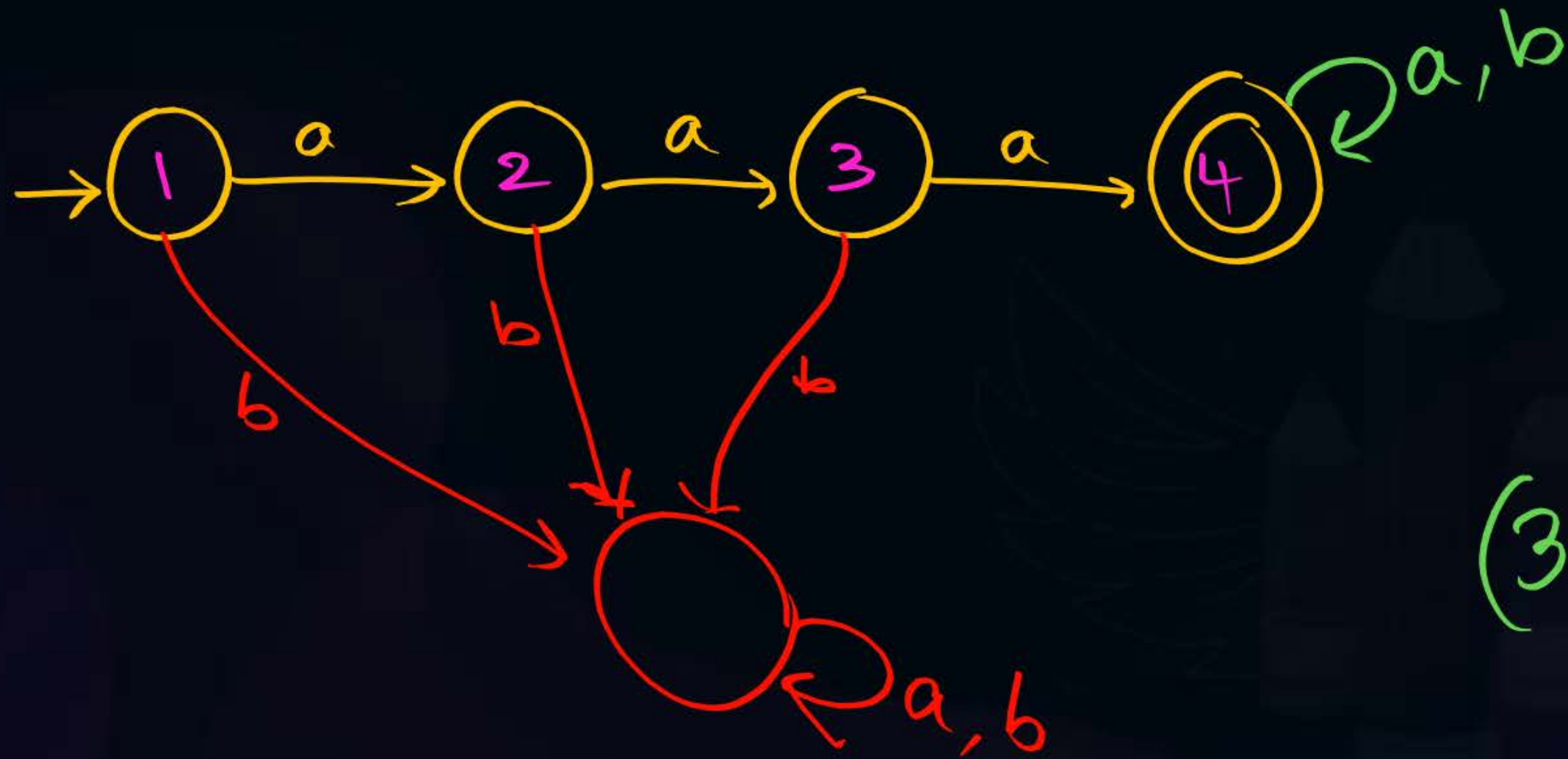
$$1 \xrightarrow{b} ?$$

$$2 \xrightarrow{a} ?$$

$$2 \xrightarrow{b} ?$$

(63) $L = a^3(a+b)^*$

Min = aaa



$|aaa| = 3$

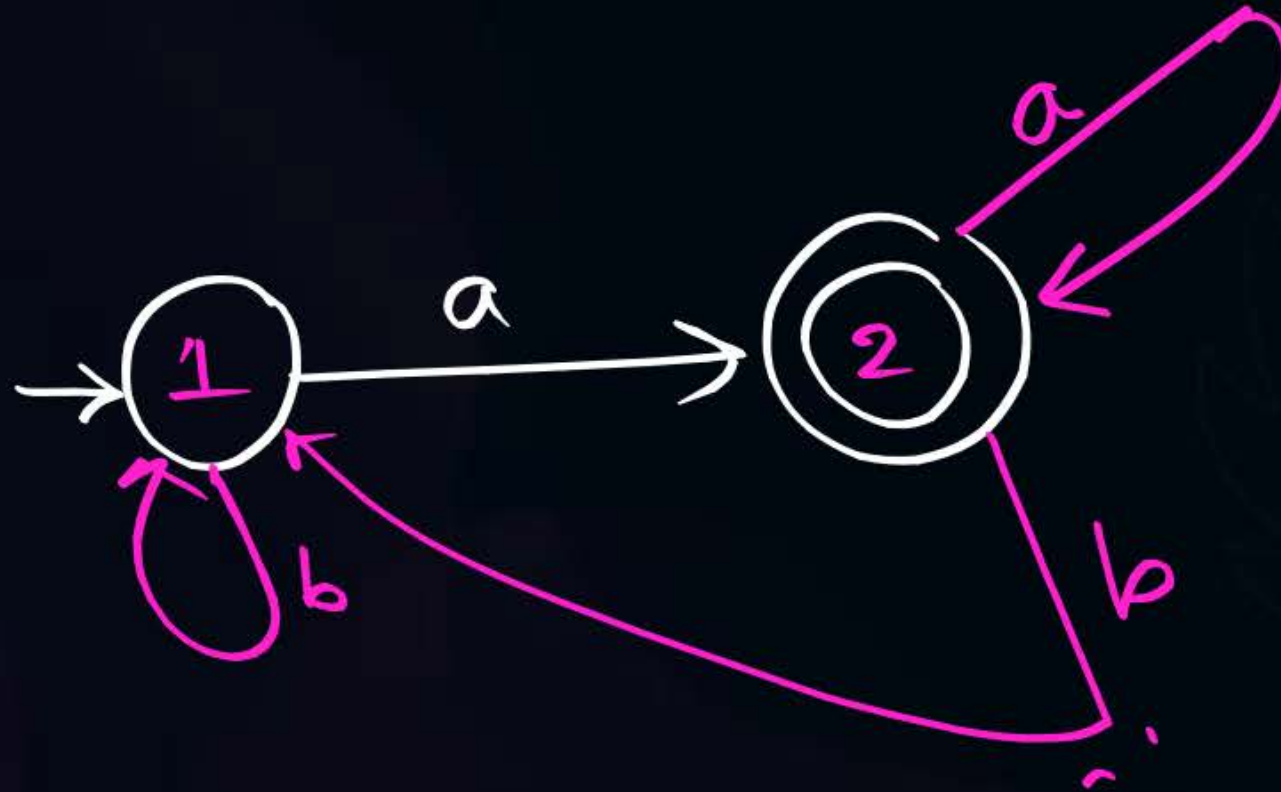
$(3+1)+1 = 5$
states

(64) $L = \{w \mid w \in \{a, b\}^*, w \text{ ends with 'a'}\}$
 $= (a+b)^*a$

Min = a

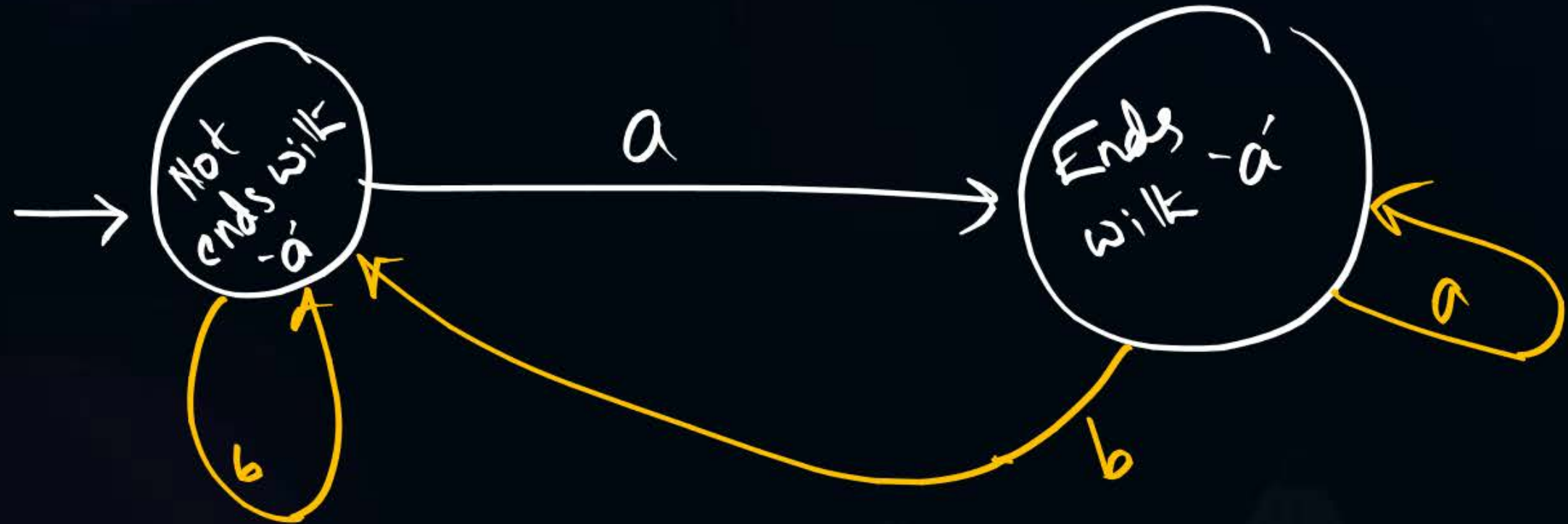
$[1] = \epsilon + \Sigma^*b$

$[2] = \Sigma^*a$



$1 \xrightarrow{b} ?$
 $2 \xrightarrow{a} ?$
 $2 \xrightarrow{b} ?$

Construction of DFA



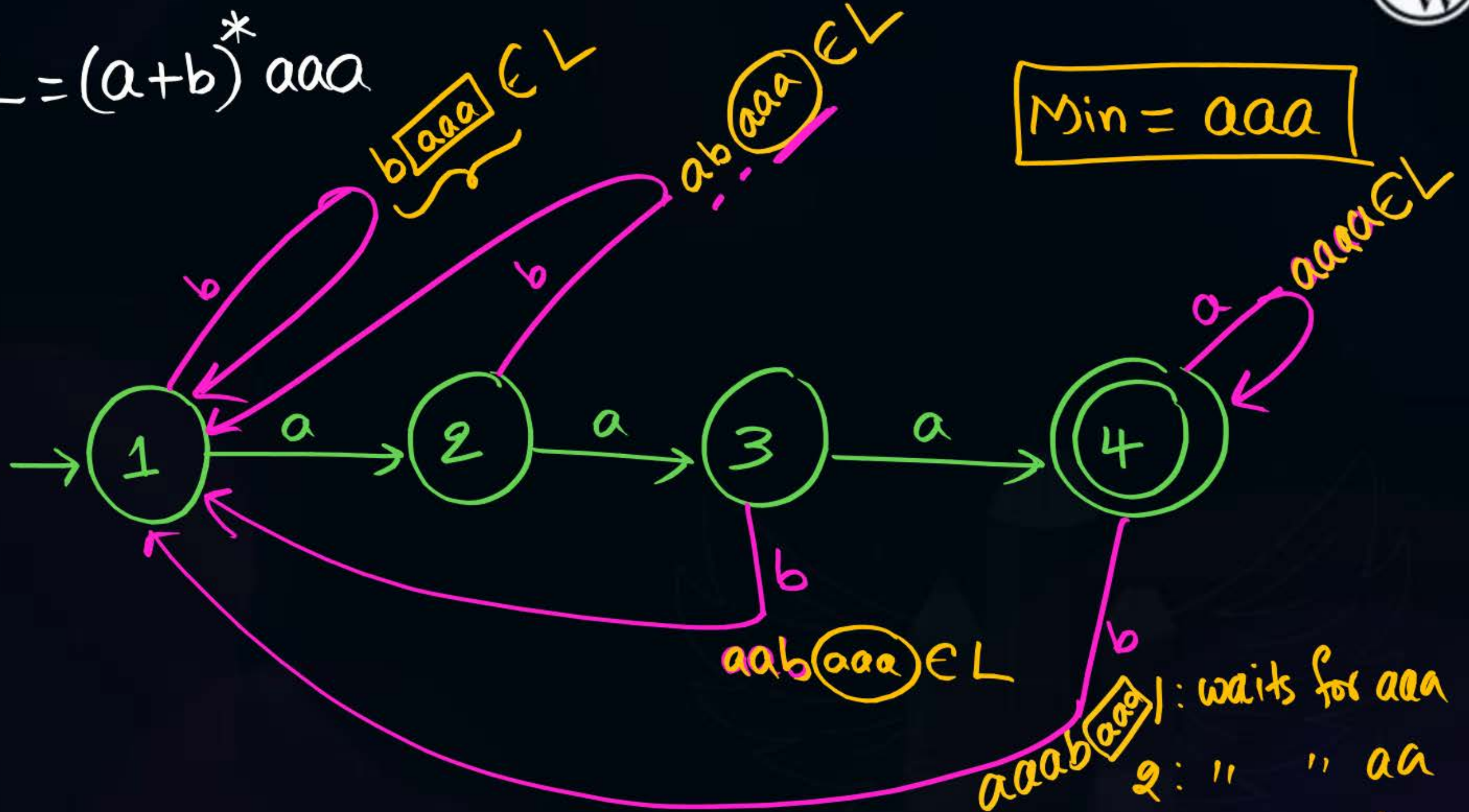
Construction of DFA



65

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

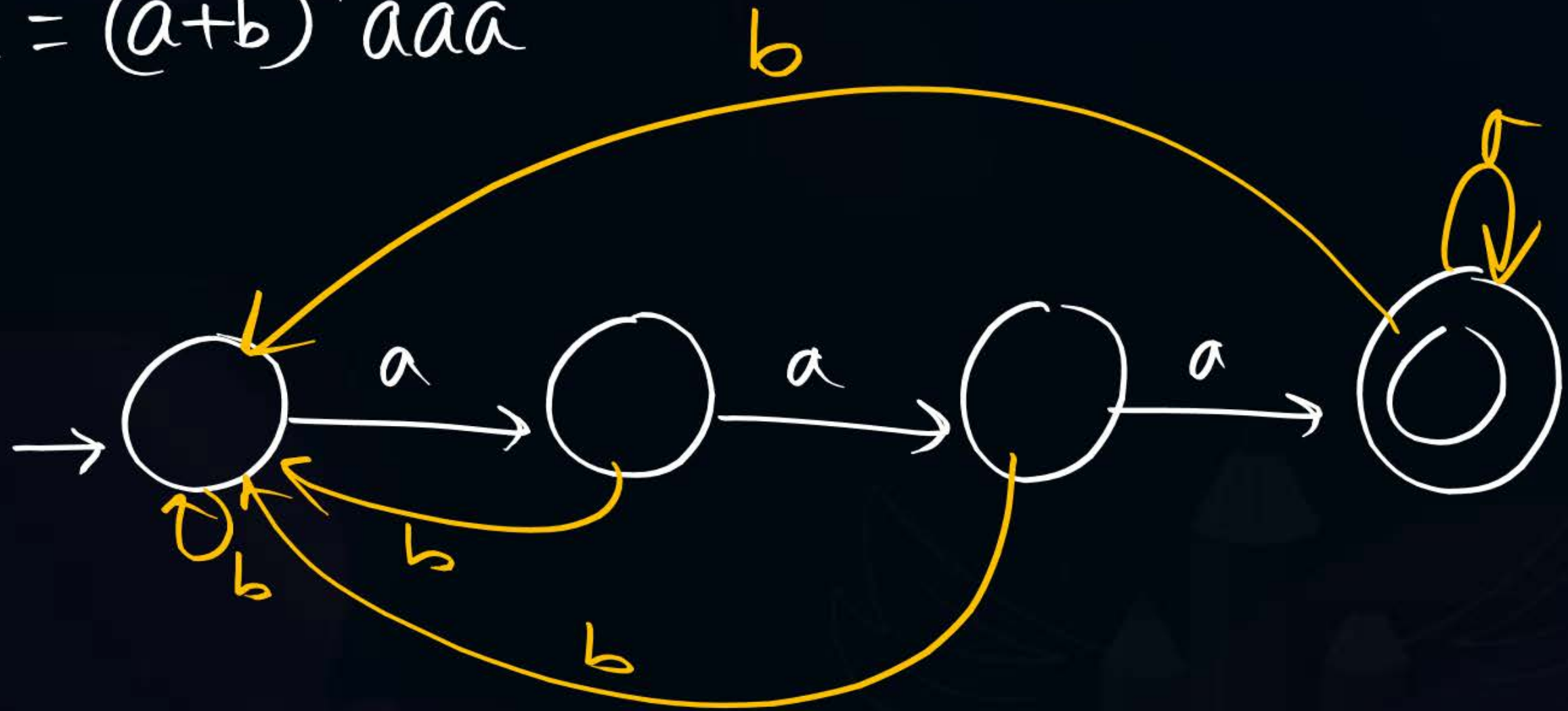
Min = aaa



1 → ? ✓
2 → ?
3 → ?
4 → ?
4 → ?

1: waits for aaa
2: " " aa
3: " " a
4: I am final

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

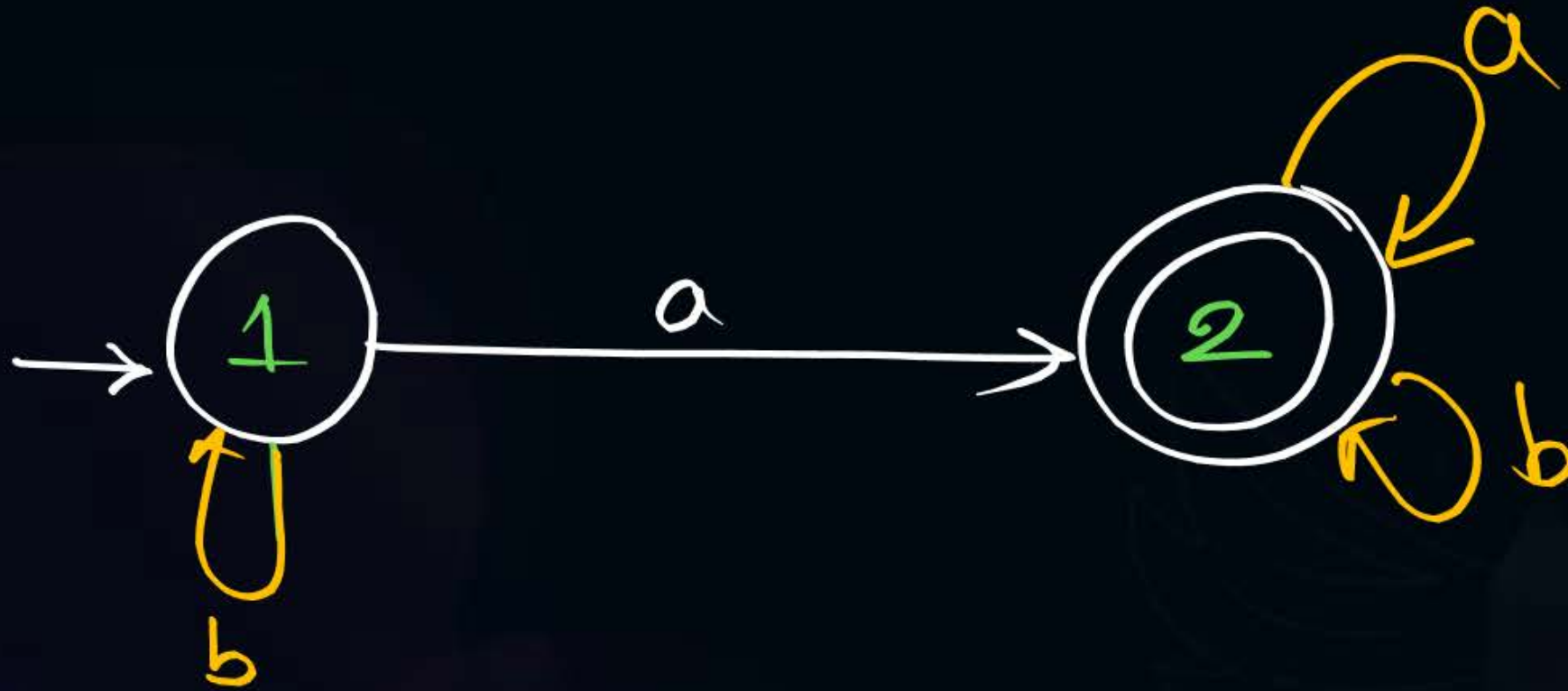


(66)

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

$$= \{w \mid w \in \{a,b\}^*, n_a(w) \geq 1\}$$

min = a

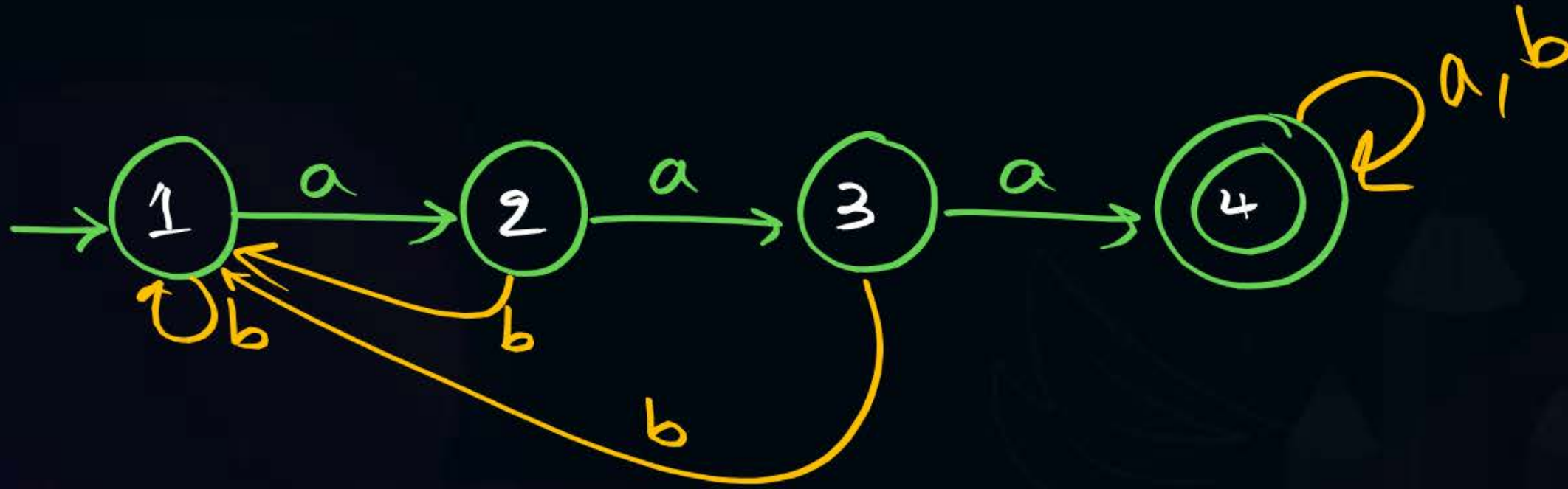


$$L = b^* a (a+b)^*$$

(67)

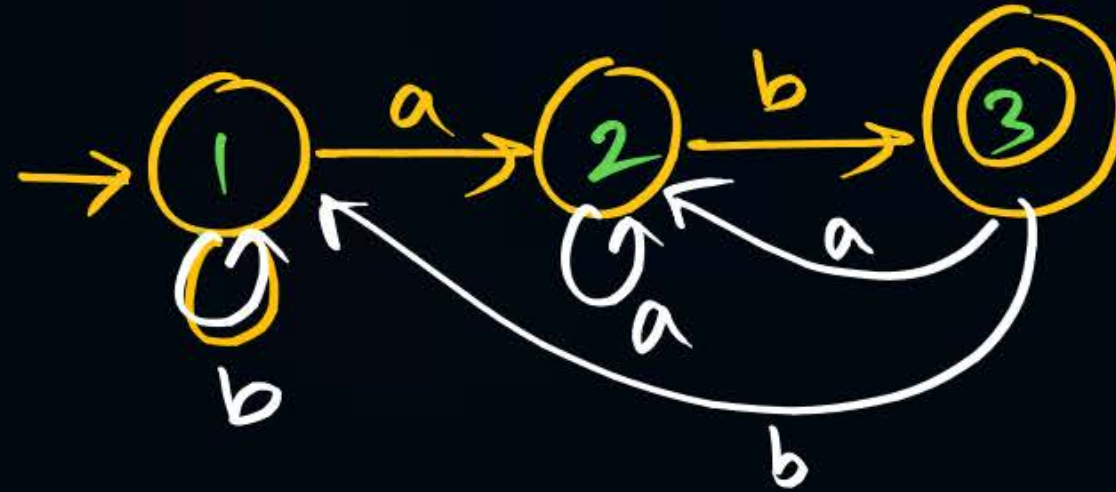
$$L = (a+b)^* aaa (a+b)^*$$

Min = aaa



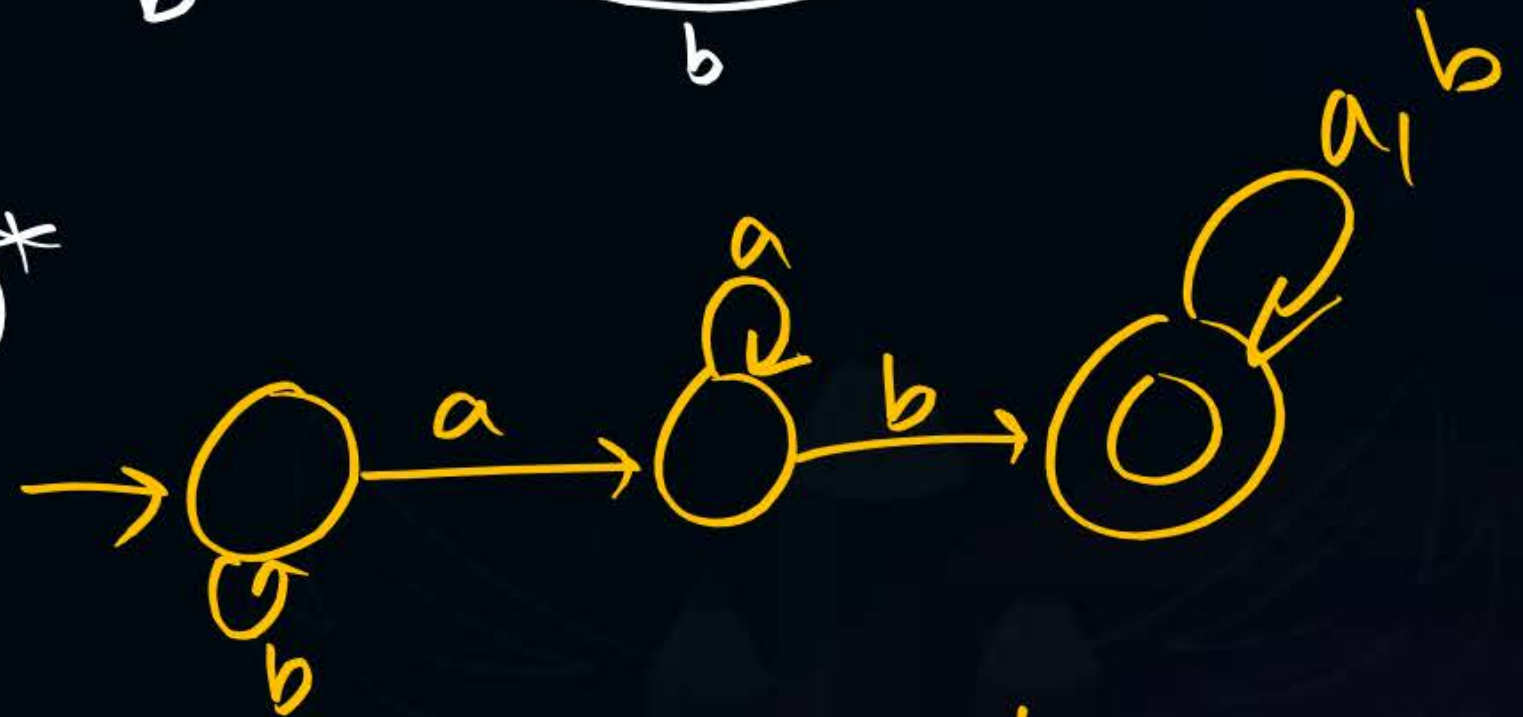
68
 $|ab|=2$
 $2+1=3$ states

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



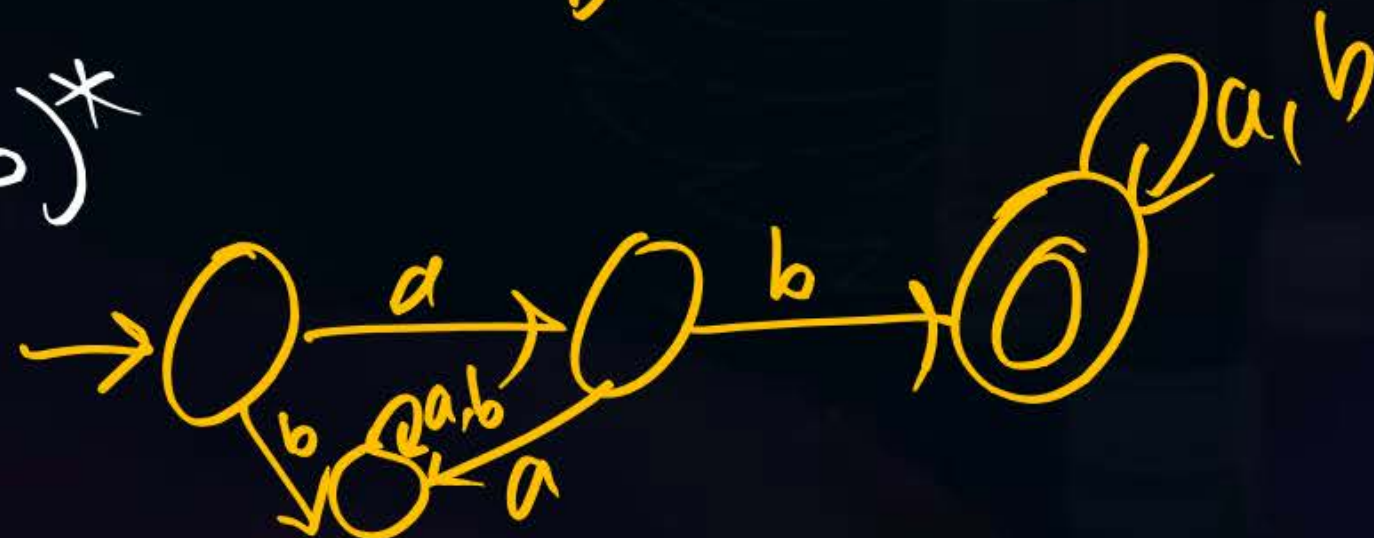
69
 $|ab|=2$
 $2+1=3$ states

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



70
 $|ab|=2$
 $(2+1)+1=4$ states

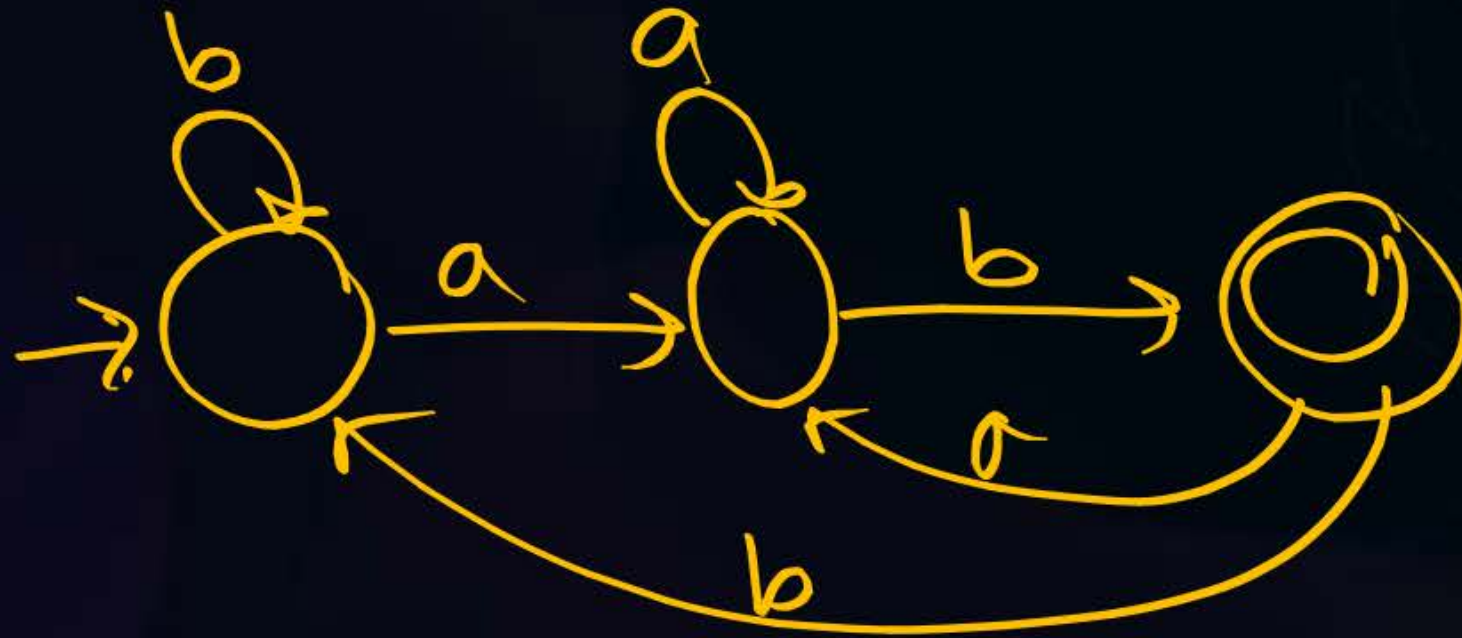
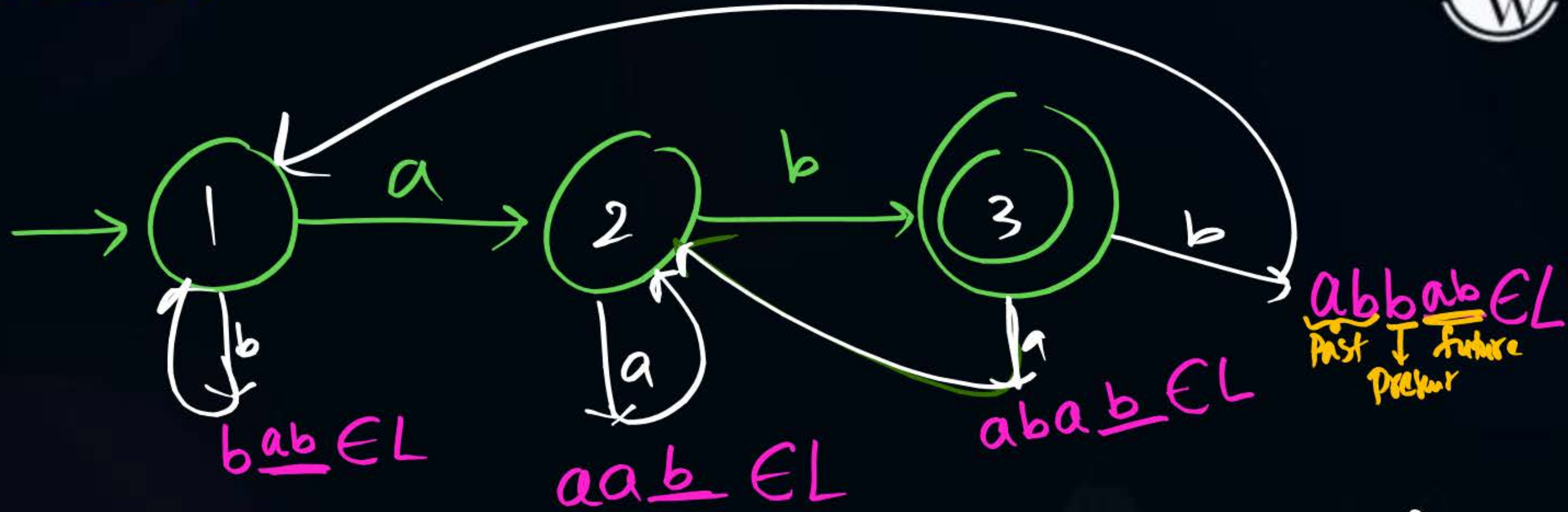
$$L = ab (a+b)^*$$



Construction of DFA



Σ^*ab
(68)



- 1: waits for ab
- 2: " " b
- 3: I am fine!

- H.2.
- (71) $L = aba(a+b)^*$
 - (72) $L = (a+b)^* aba$
 - (73) $L = (a+b)^* aba(a+b)^*$

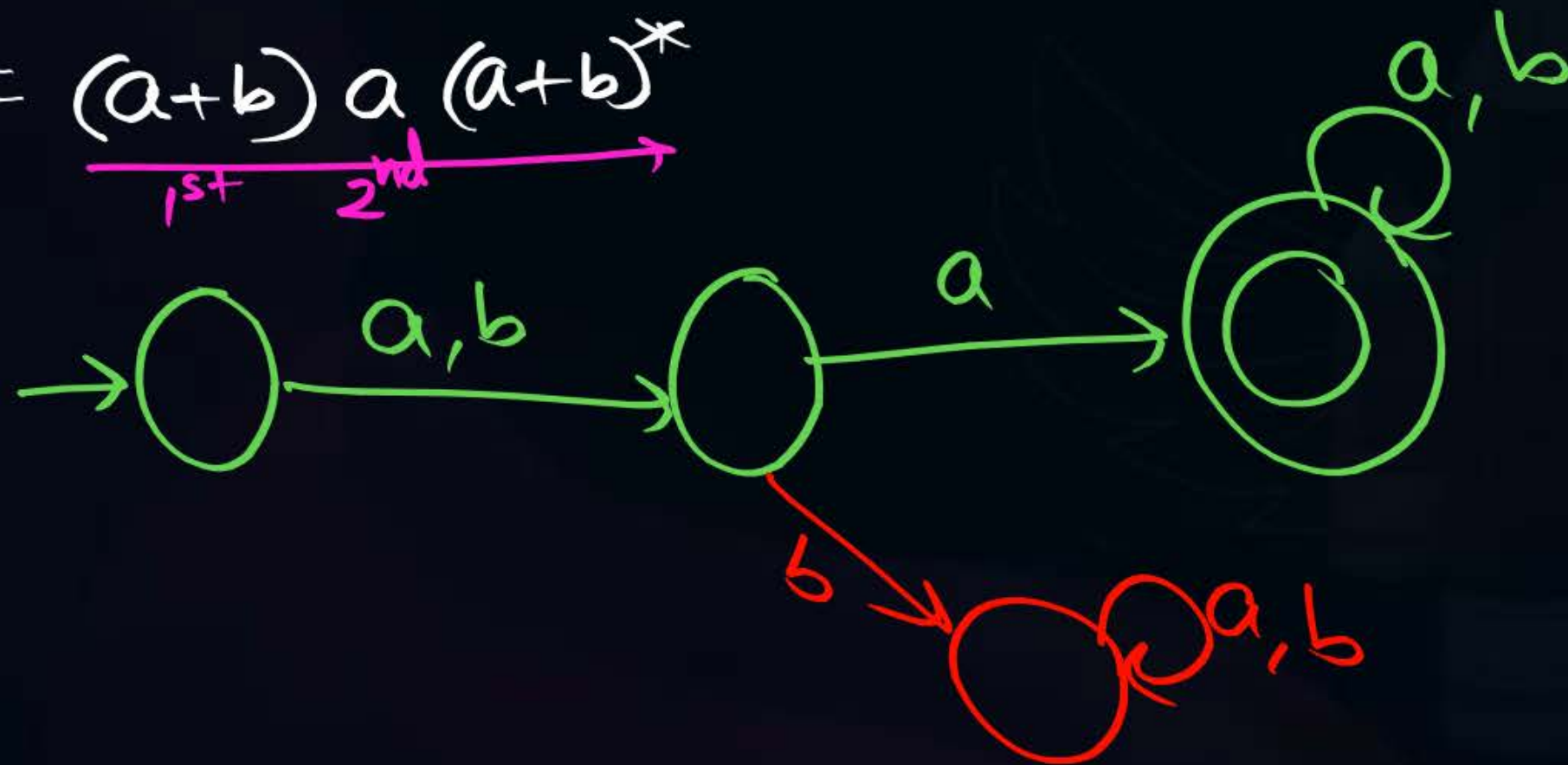


Model-X [Position based]:

(74) $\{w \mid w \in \{a,b\}^*, \text{ 2}^{\text{nd}} \text{ symbol of } w \text{ is 'a'}\}$

$= \{xay \mid x \in \{a,b\}, y \in \{a,b\}^*\}$

$= \underbrace{(a+b)}_{\text{1st}} \underbrace{a}_{\text{2nd}} (a+b)^*$



$***$ (75) $\{w \mid w \in \{a,b\}^*, \text{ 2}^{\text{nd}} \text{ symbol from end in } w \text{ is 'a'}\}$

$$= \{xay \mid x \in \{a,b\}^*, y \in \{a,b\}\}$$

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

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

Home work:



2 mins Summary



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Model-I (Easy: Φ , Σ^* , only epsilon, Σ^+) ✓

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Construction of DFA Model IV (Over 1 symbol) ✓

Topic

Construction of DFA Model V (Sequence based) ✓

Topic

Construction of DFA Model VI (Length & Remainder) ✓

Topic

Construction of DFA Model VII (Symbols & Remainder) ✓

Topic

Construction of DFA Model VIII (Multiple Conditions on symbols) ✓

Topic

Construction of DFA Model IX (Start, End, Contain) ✓

THANK - YOU