

CS & IT ENGINEERING

Theory of Computation

Finite Automata



Lecture No. 10



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TOPICS TO BE COVERED

H.V.

01 Position based - Model 12

02 Special problems [Model-13]

03 Minimization of DFA

04 Revision on DFA

05

$$b^* a^* = \epsilon + a^+ + b^+ + \boxed{b^+ a^+}$$

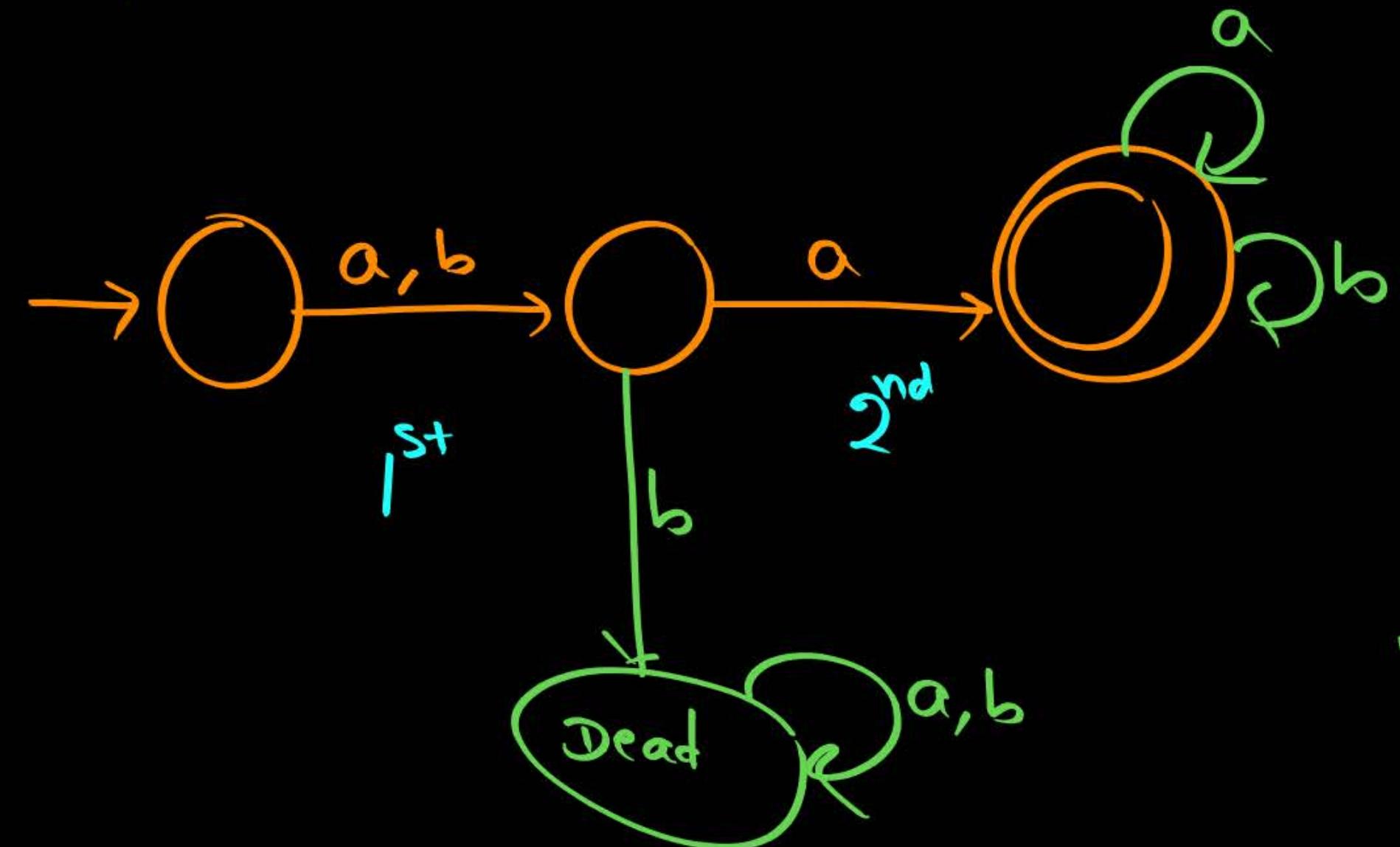
Diagram illustrating the decomposition of $b^* a^*$ into ϵ , a^+ , b^+ , and $b^+ a^+$. Three arrows point from the terms a^+ , b^+ , and $b^+ a^+$ to the term $b^* a^*$.

$$a^* b^* = \epsilon + a^+ + b^+ + a^+ b^+$$

Model 1-12 :

$$\textcircled{1} \quad \frac{(a+b)}{\text{1st}} \underline{a} \quad \underline{\frac{(a+b)^*}{\text{2nd}}}$$

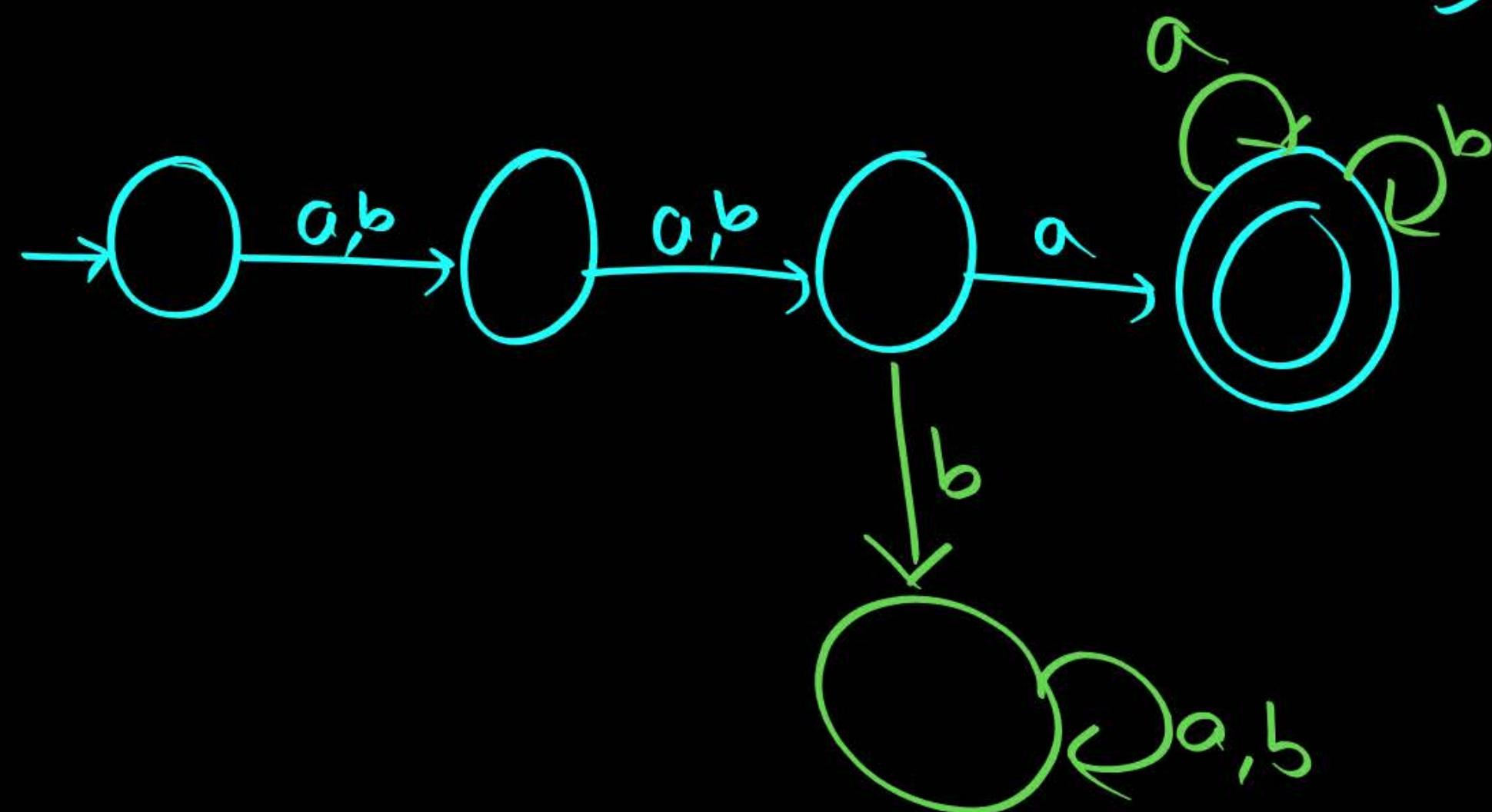
2nd symbol is 'a'



$$M_{in} = \frac{aa}{ay} \\ b^a =$$

Kth symbol is 'a'
 → K+2 states

② $L = (a+b)(a+b) \cup (a+b)^*$



3rd symbol from begin
is a'

$\Rightarrow 3+2$
 $= 5$ states

*** ③

2nd symbol from end is 'a' :

$$L = (a+b)^* \underbrace{a}_{\text{2nd last}} \underbrace{(a+b)}_{\text{Last}}$$

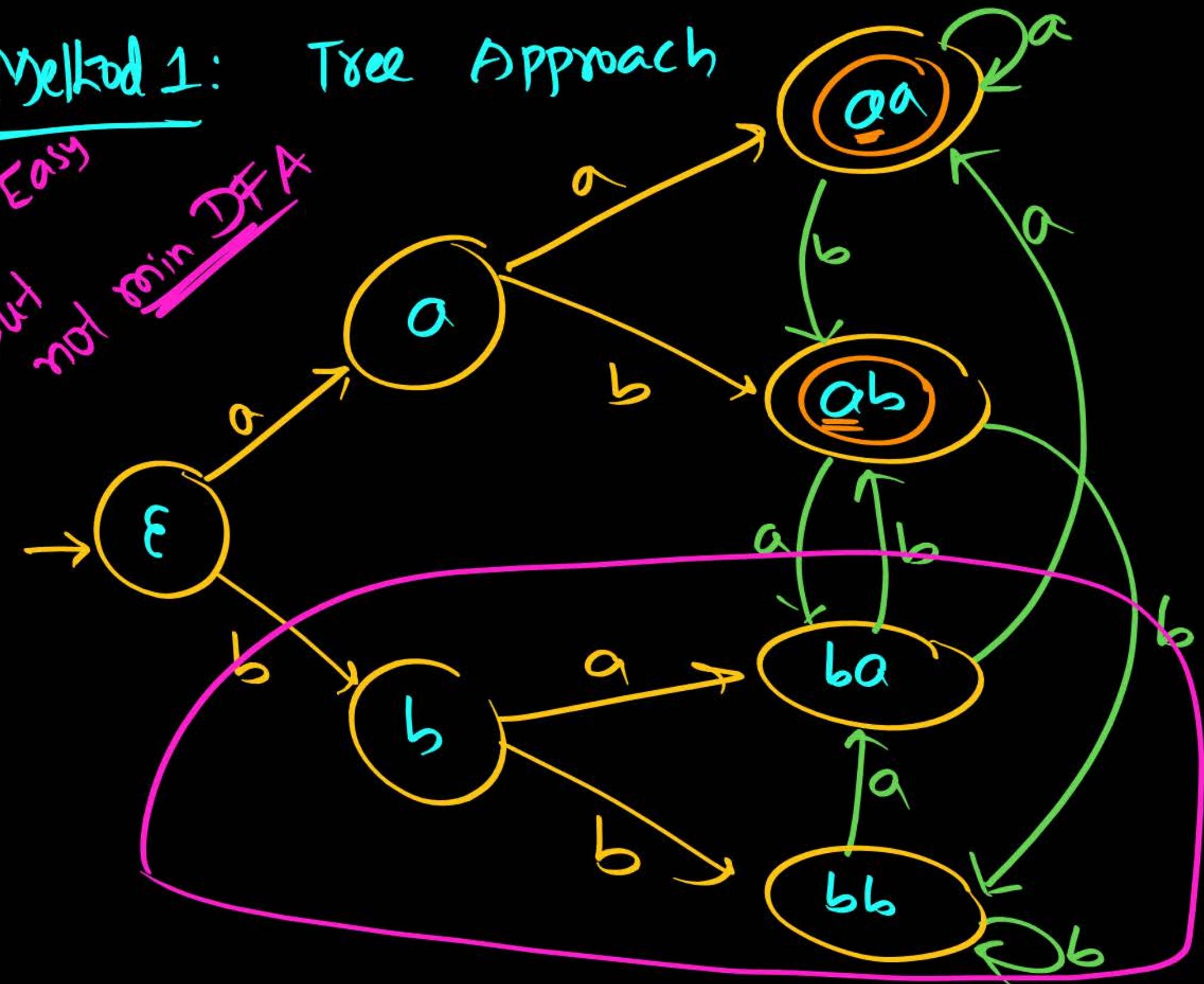
ends with aa or ab

10^kSymbol from end is 'a' \Rightarrow 1024 states

$$= 2^{10}$$

Methode 1: Tree Approach

Easy
But
not min DFA



$$aa \xrightarrow{a} aa$$

$$aa \xrightarrow{b} ab$$

$$ab \xrightarrow{a} ba$$

$$ab \xrightarrow{b} bb$$

$$ba \xrightarrow{a} aa$$

$$ba \xrightarrow{b} ab$$

$$bb \xrightarrow{a} ba$$

$$bb \xrightarrow{b} bb$$

symbo/
2

aa ✓
ab ✓

ba ✓
bb ✗

... ba ✗
... bb ✗

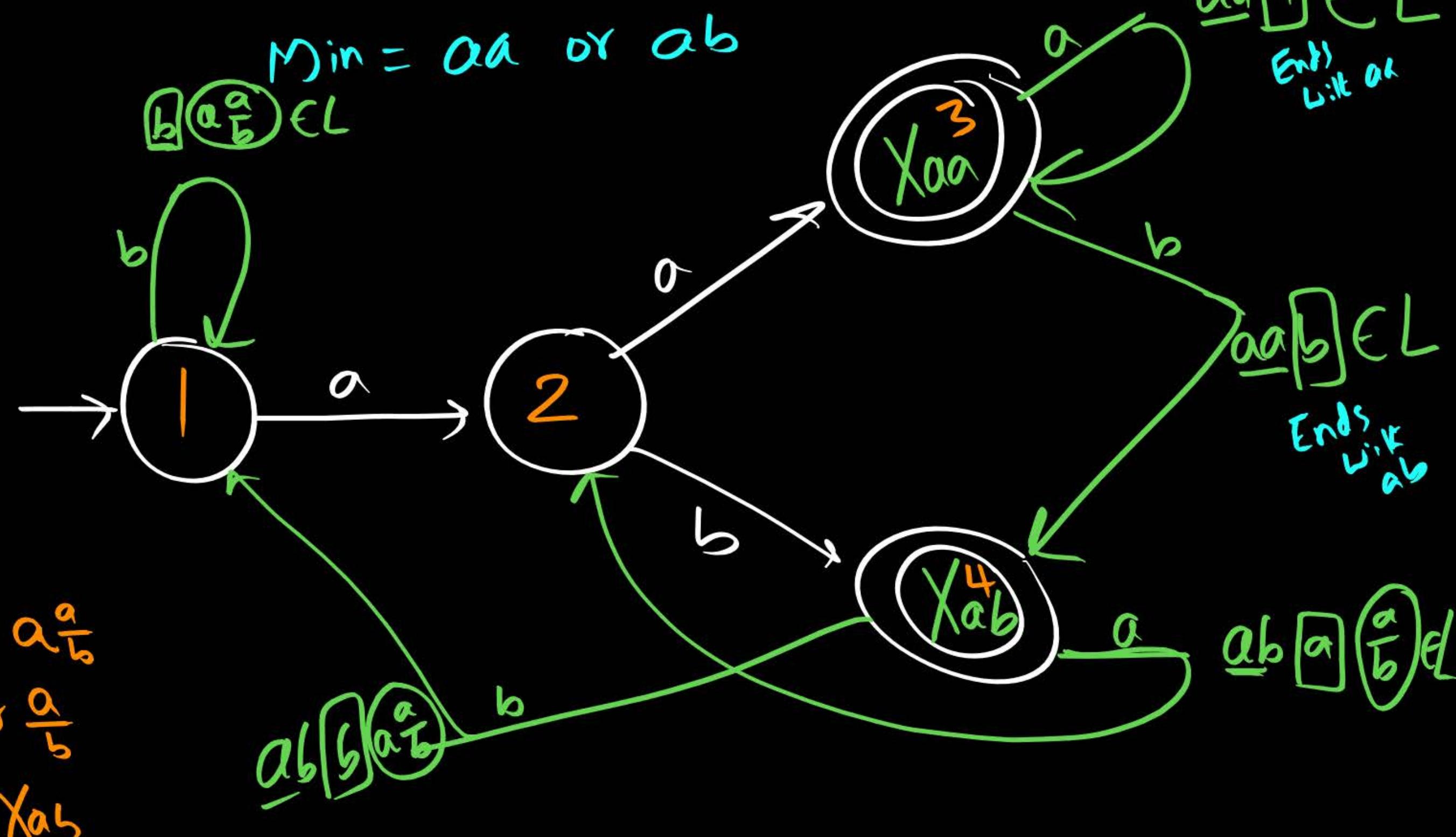
$\stackrel{ab}{=}$ 




 \times_{ab}^{ba}

Melkod 2: Direct Approach

$$M_{in} = aa \text{ OR } ab$$



1: waits for $a\frac{a}{b}$

2: waits for $\frac{a}{b}$

3: X_{aa}

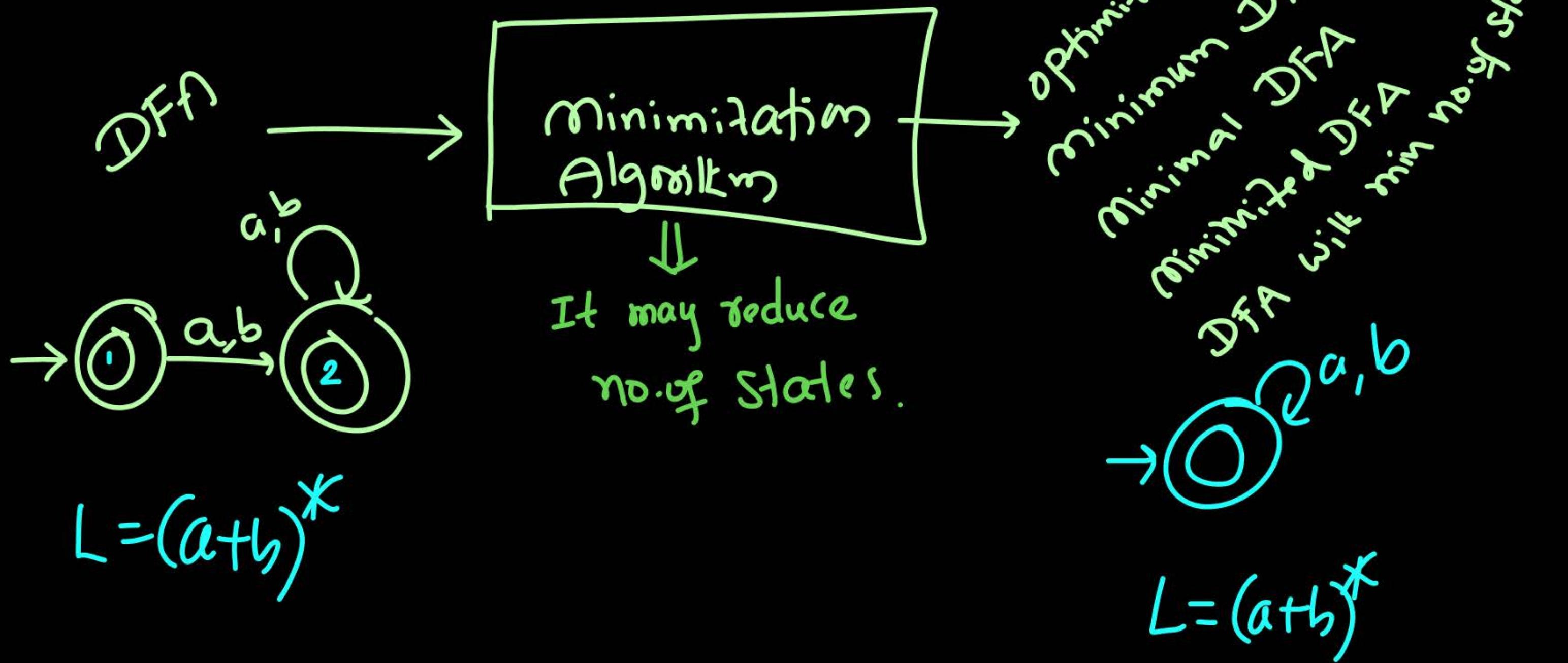
4: X_{ab}

Note:

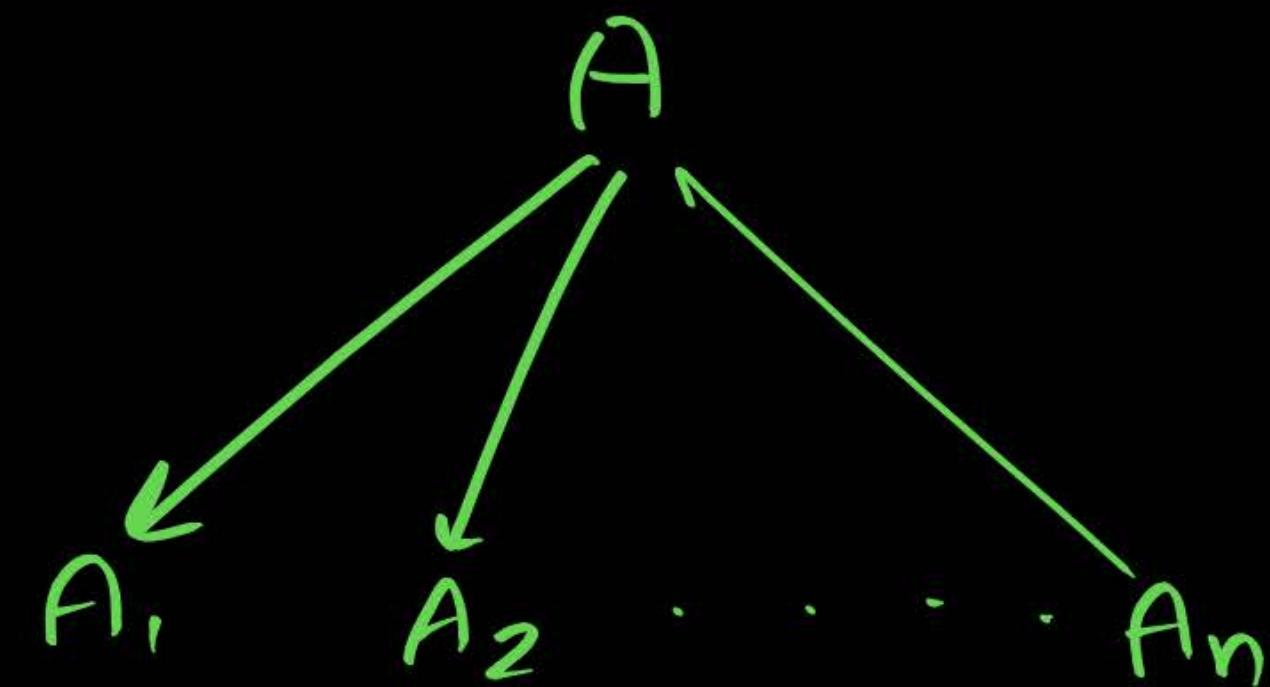
I) K^k symbol from end is 'a' $\Rightarrow 2^K$ states in DFA
 $\Sigma = \{a, b\}$

II) K^k symbol from begin is 'a' $\Rightarrow (K+2)$ States
in DFA

Minimization of DFA:



Partition on Set A



- I) Every A_i is nonempty subset of A
- II) $A_1 \cup A_2 \cup \dots \cup A_n = A$
- III) $\forall i, j \quad A_i \cap A_j = \emptyset$ [Disjoint]

PW

$$A = \{1, 2, 3\}$$



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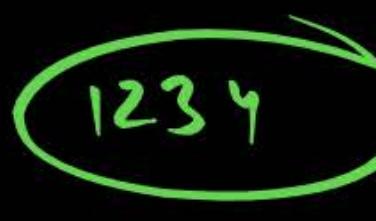
2
13

3
12

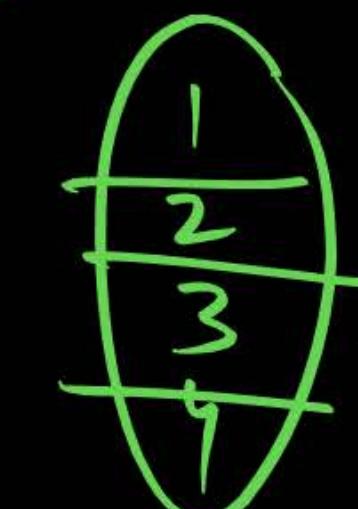
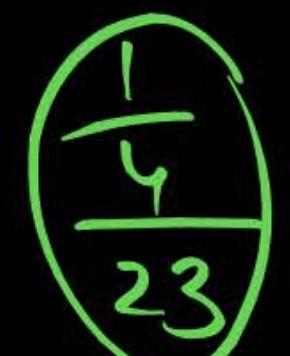
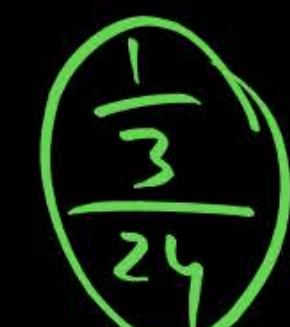
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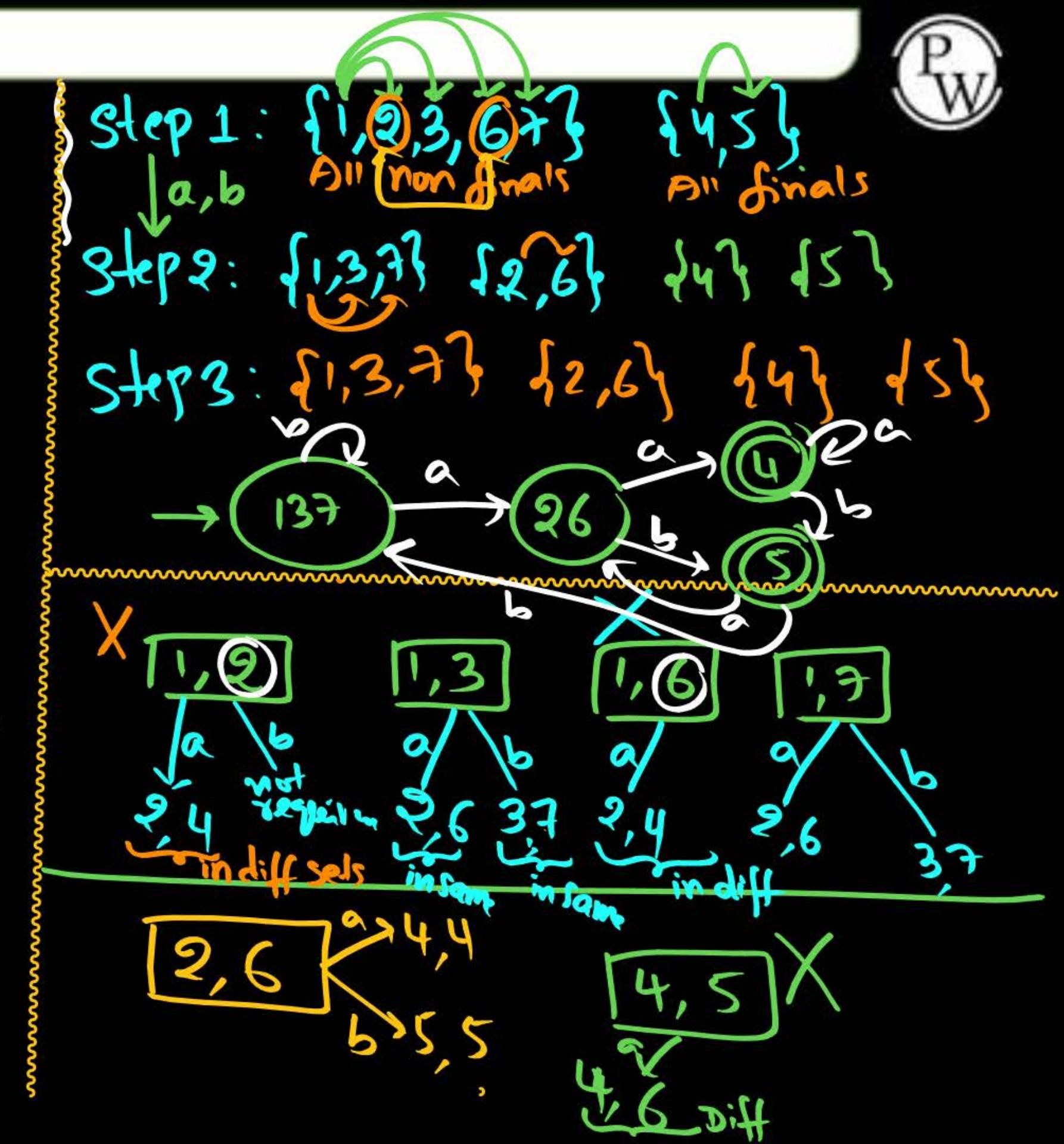
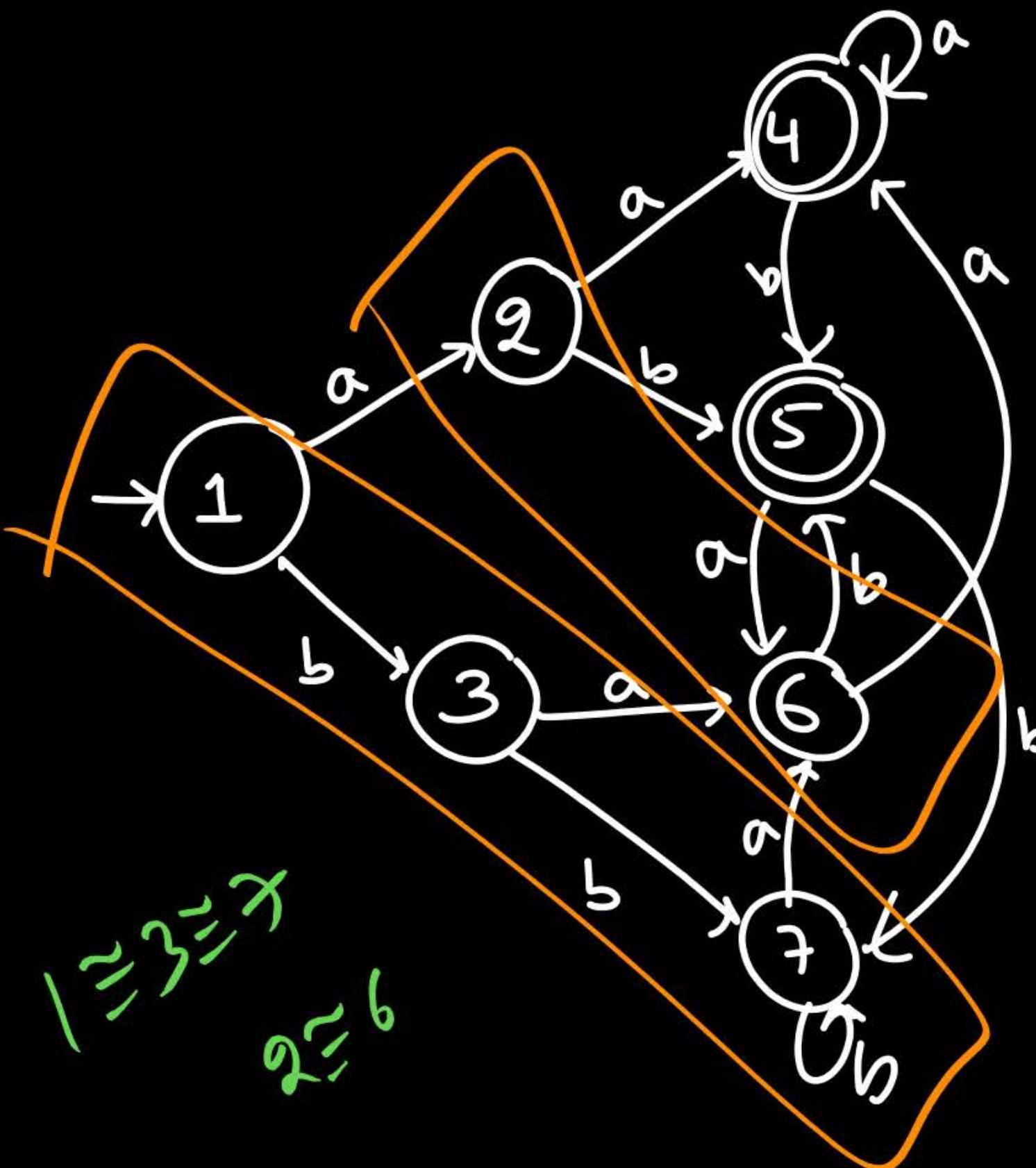
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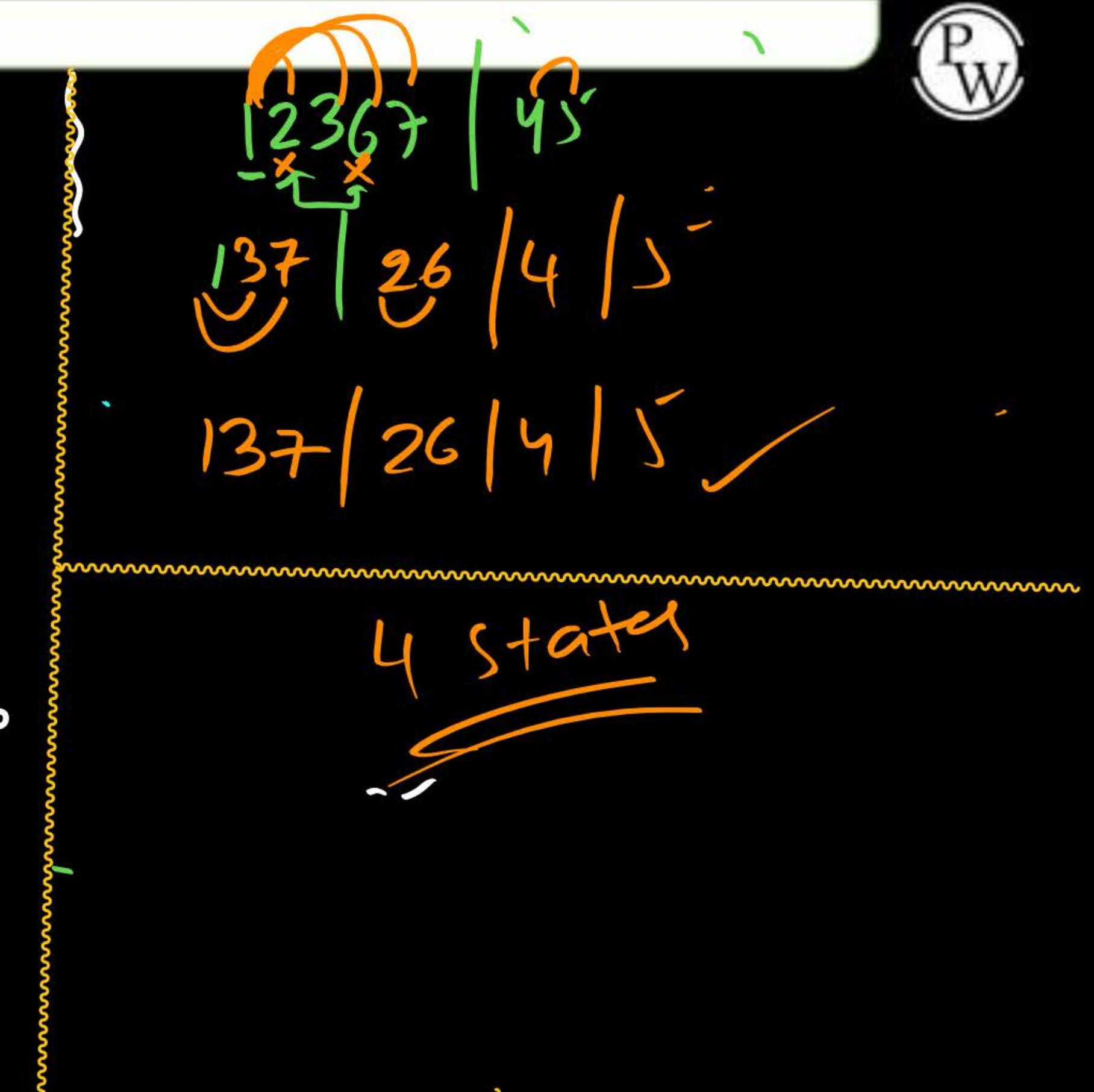
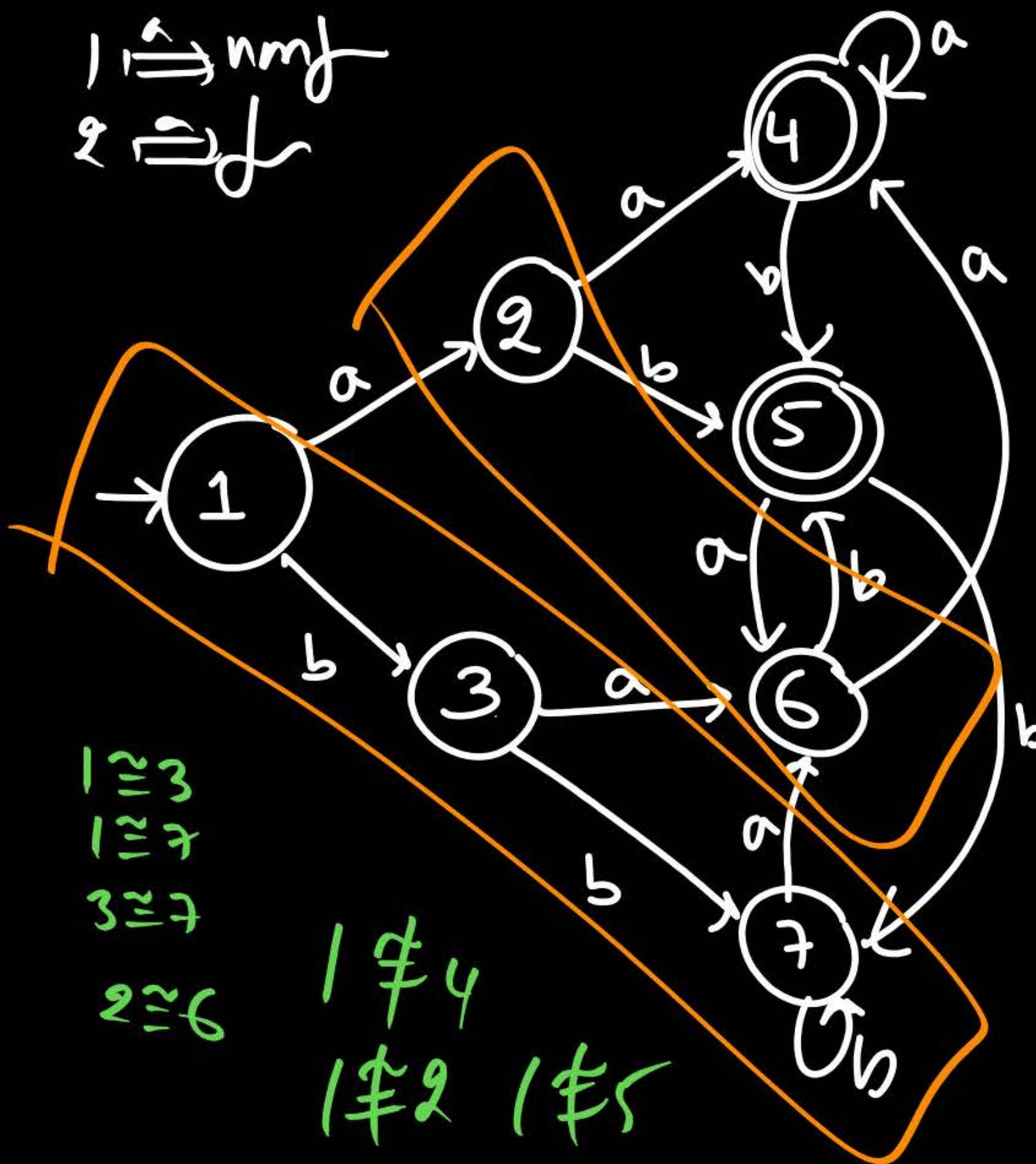
$$A = \{1, 2, 3, 4\}$$



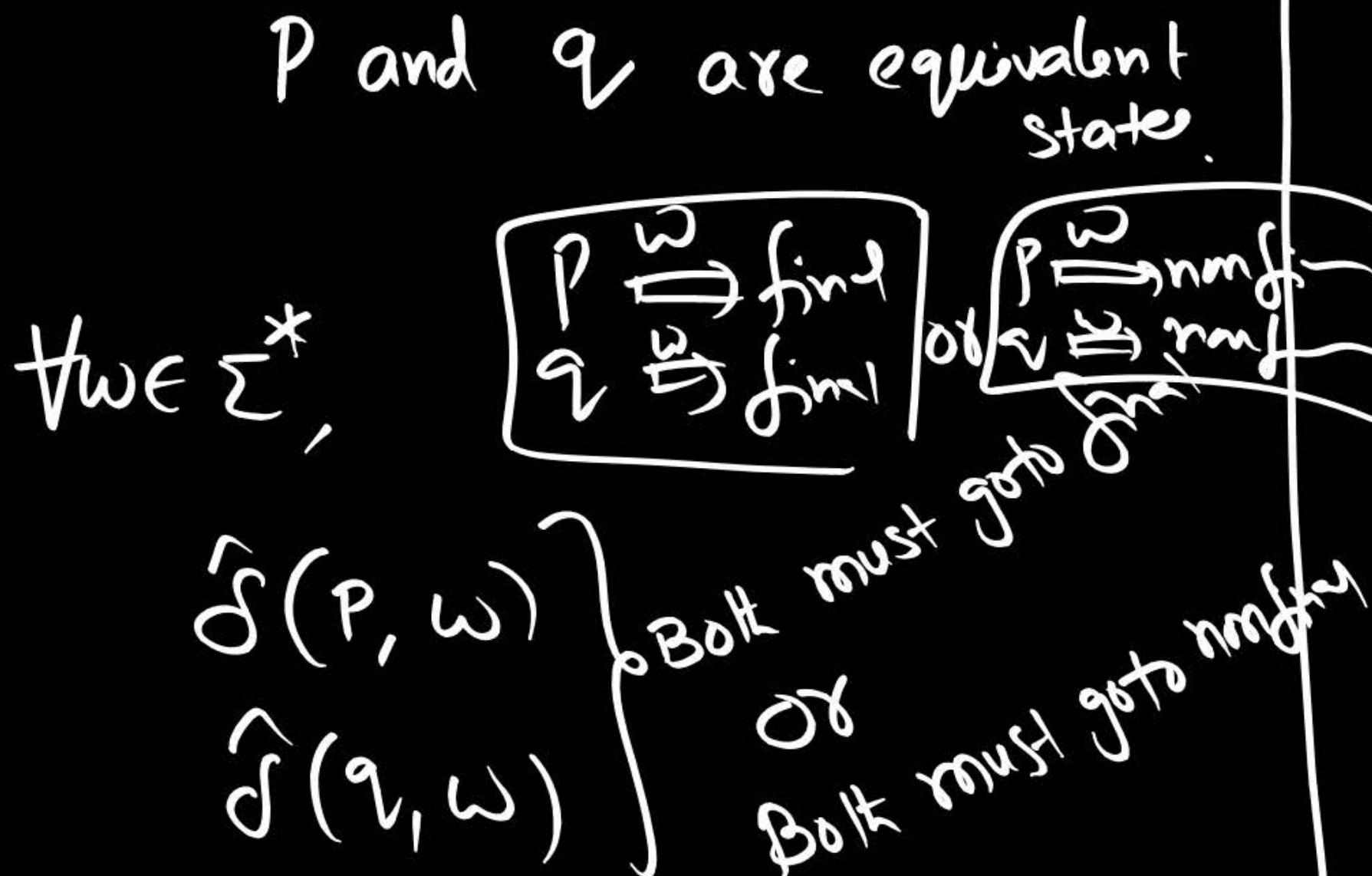
۱۵ پاسخ‌نامه
مکانیک مولکولی







Equivalent states (not distinguishable)



Distinguishable states (non equivalent)

$\exists \omega \in \Sigma^*$

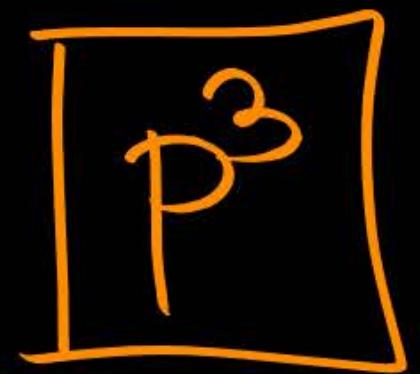
$P \xrightarrow{\omega} \text{find}$

$q \xrightarrow{\omega} \text{nmf}$

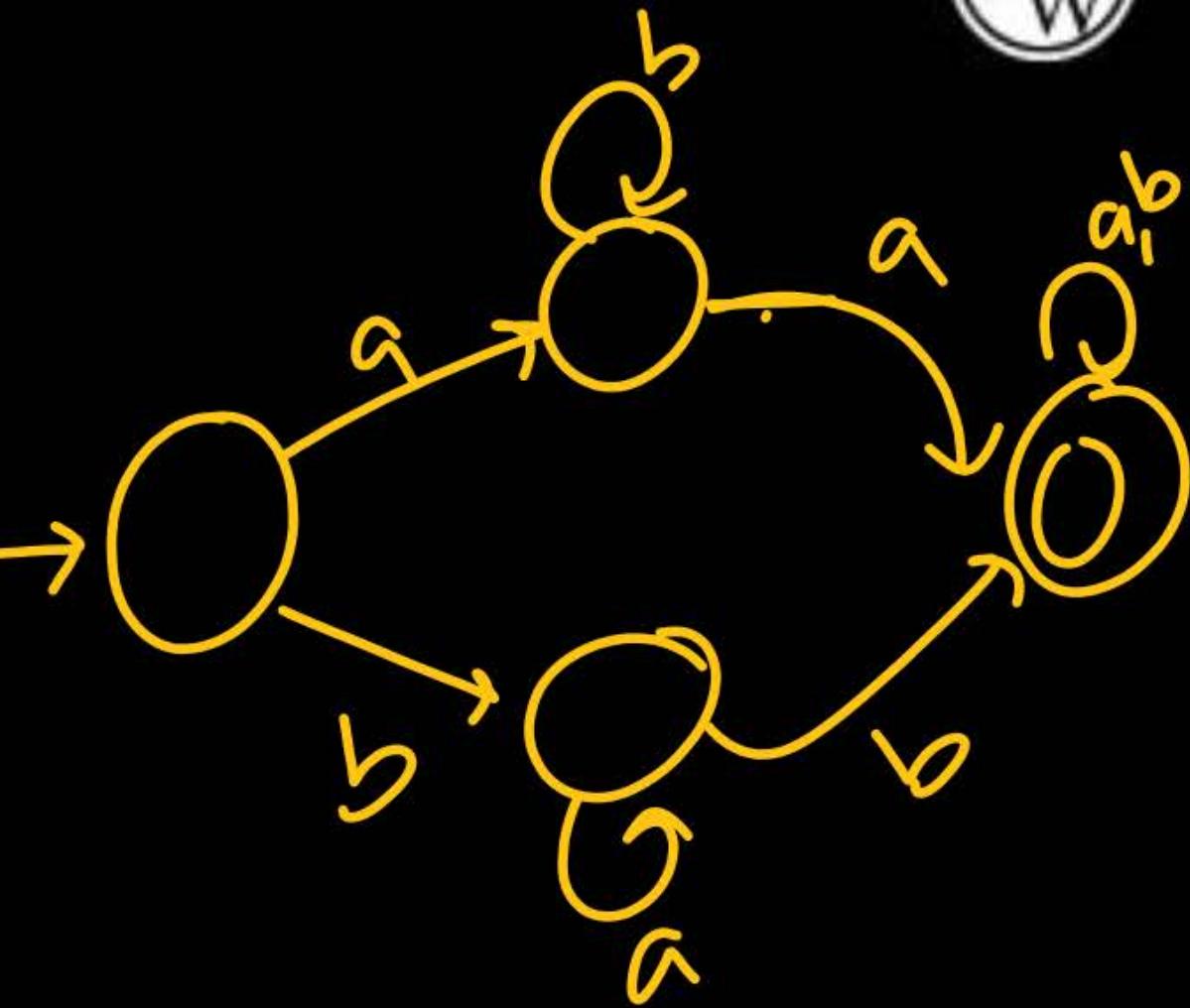
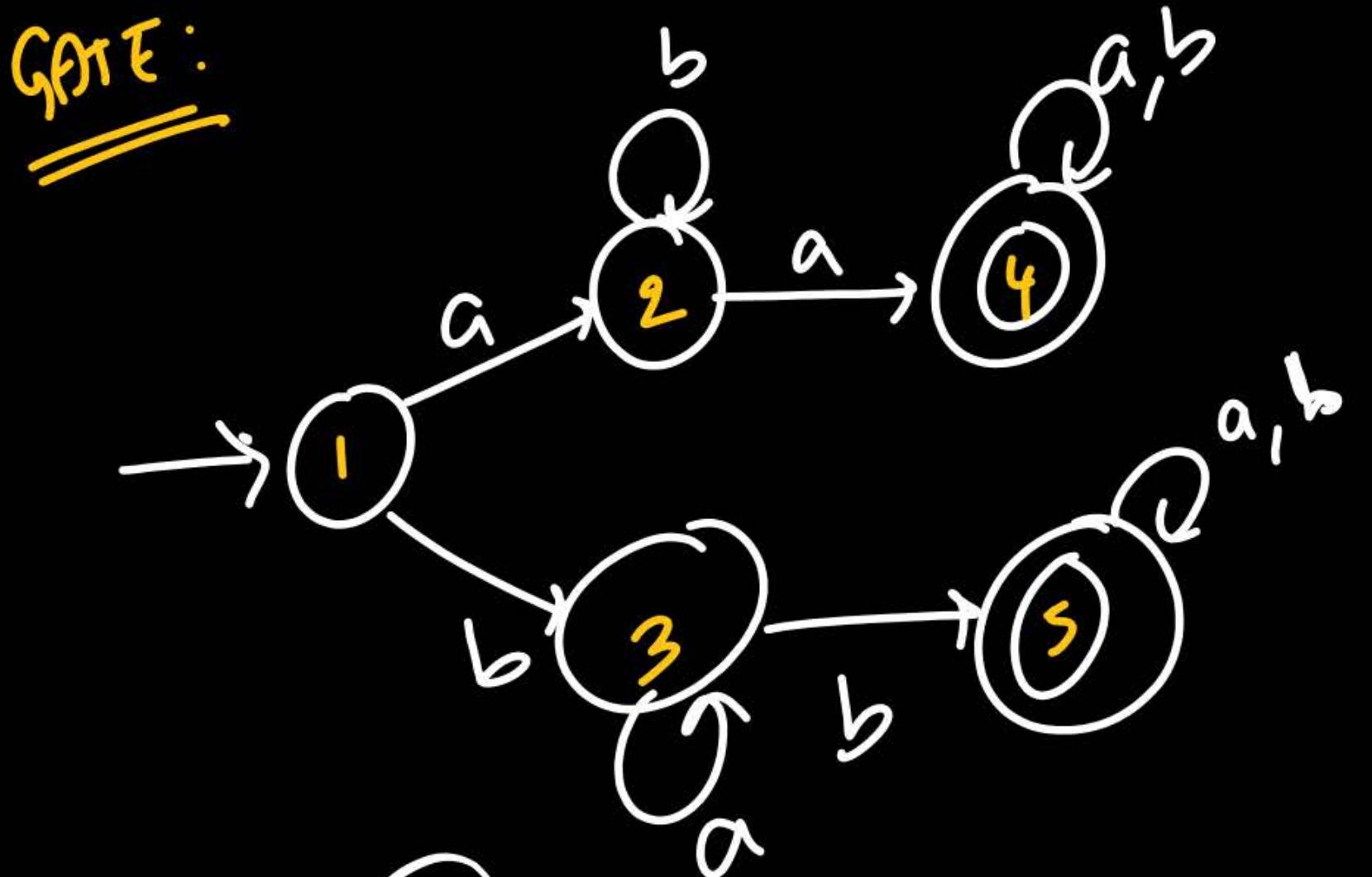
$P \xrightarrow{\omega} \text{nmf}$

$q \xrightarrow{\omega} \text{find}$

Patience }
Practice } H/W
Performance }



P
W



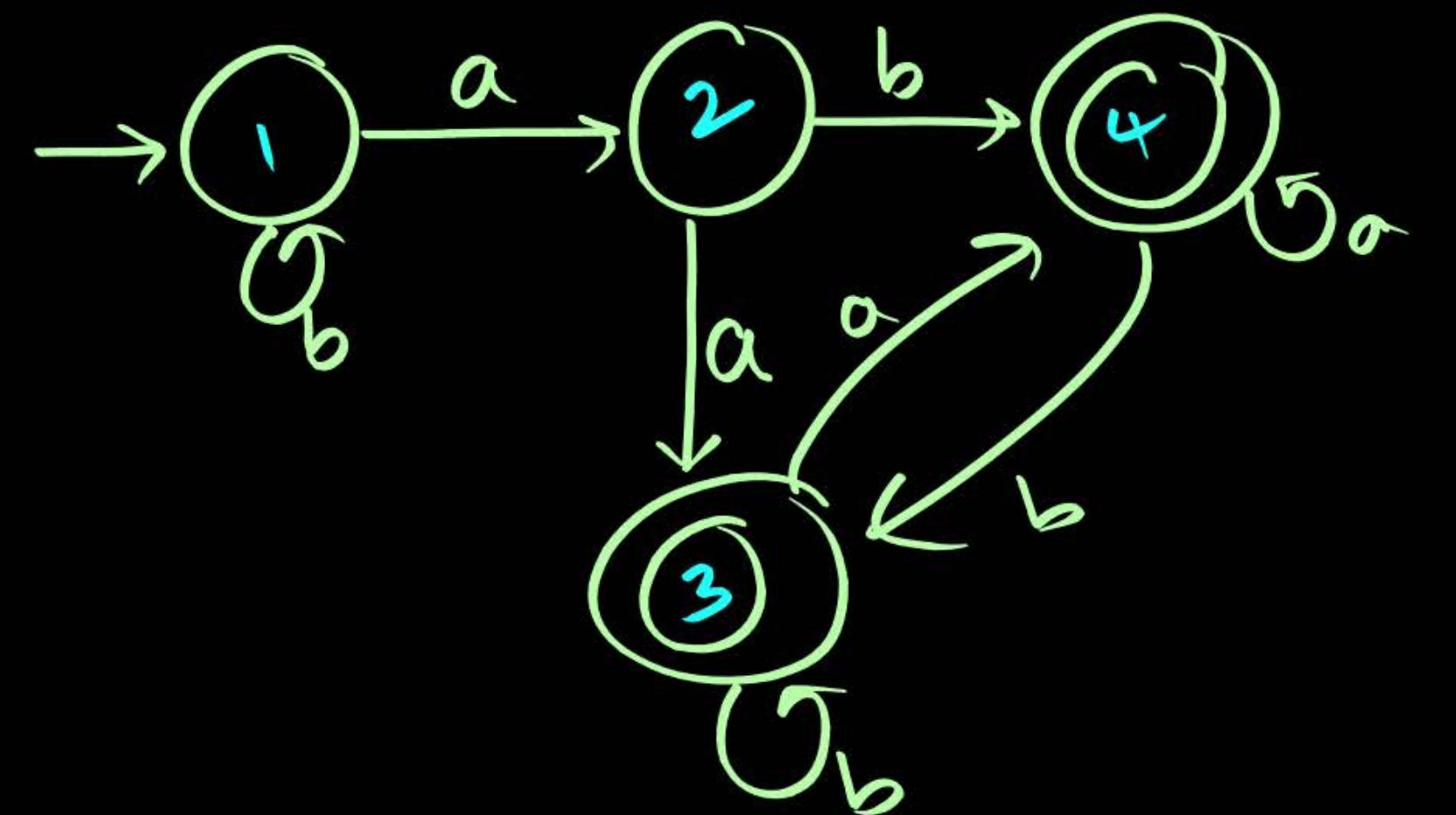
Step 1: $\overbrace{2 \ 3}^x \mid \overbrace{4 \ 5}^y$

Step 2: 1 | 2 | 3 | 4 | 5

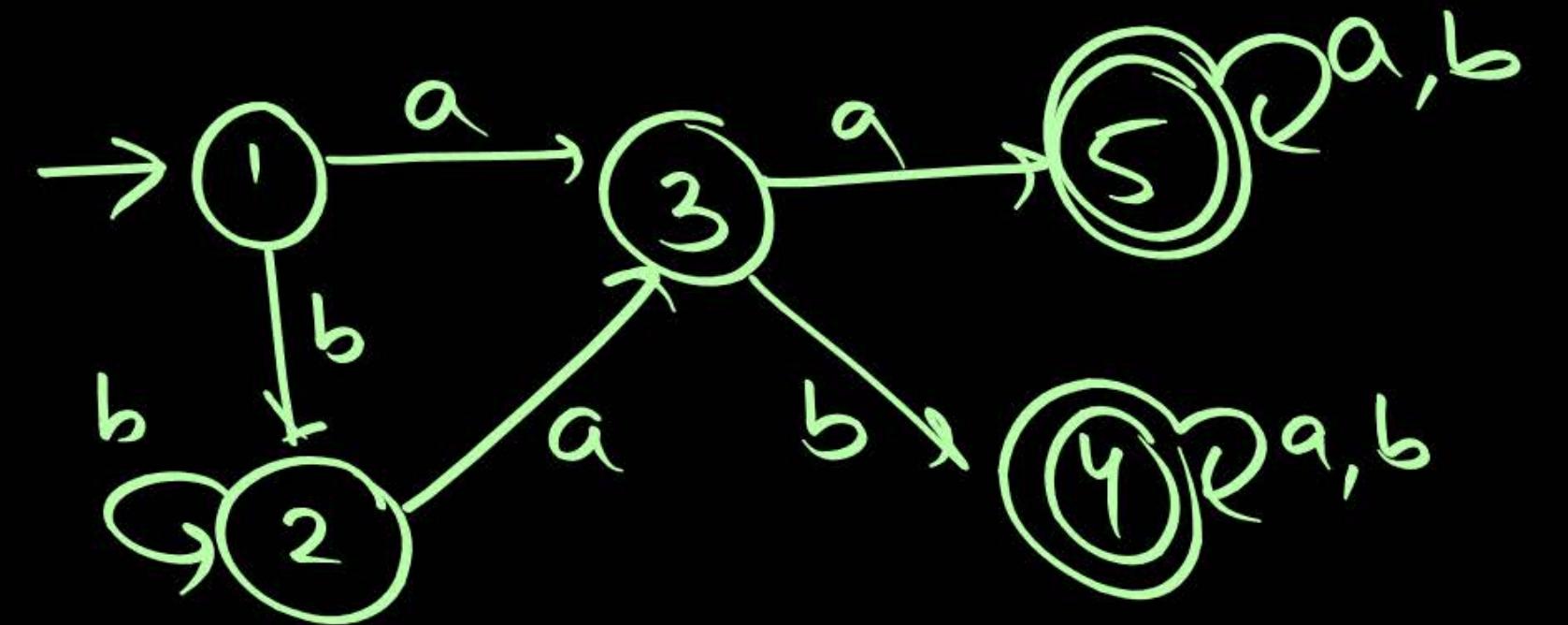
Step 3:

1 | 2 | 3 | 4 | 5

H.W. 1)



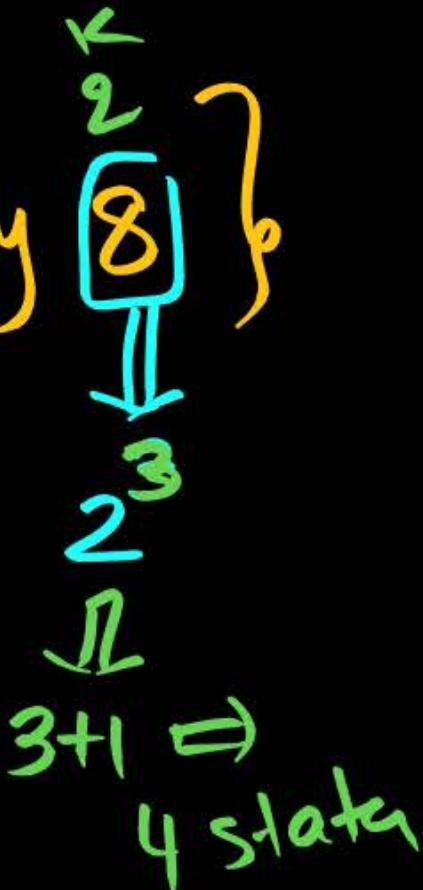
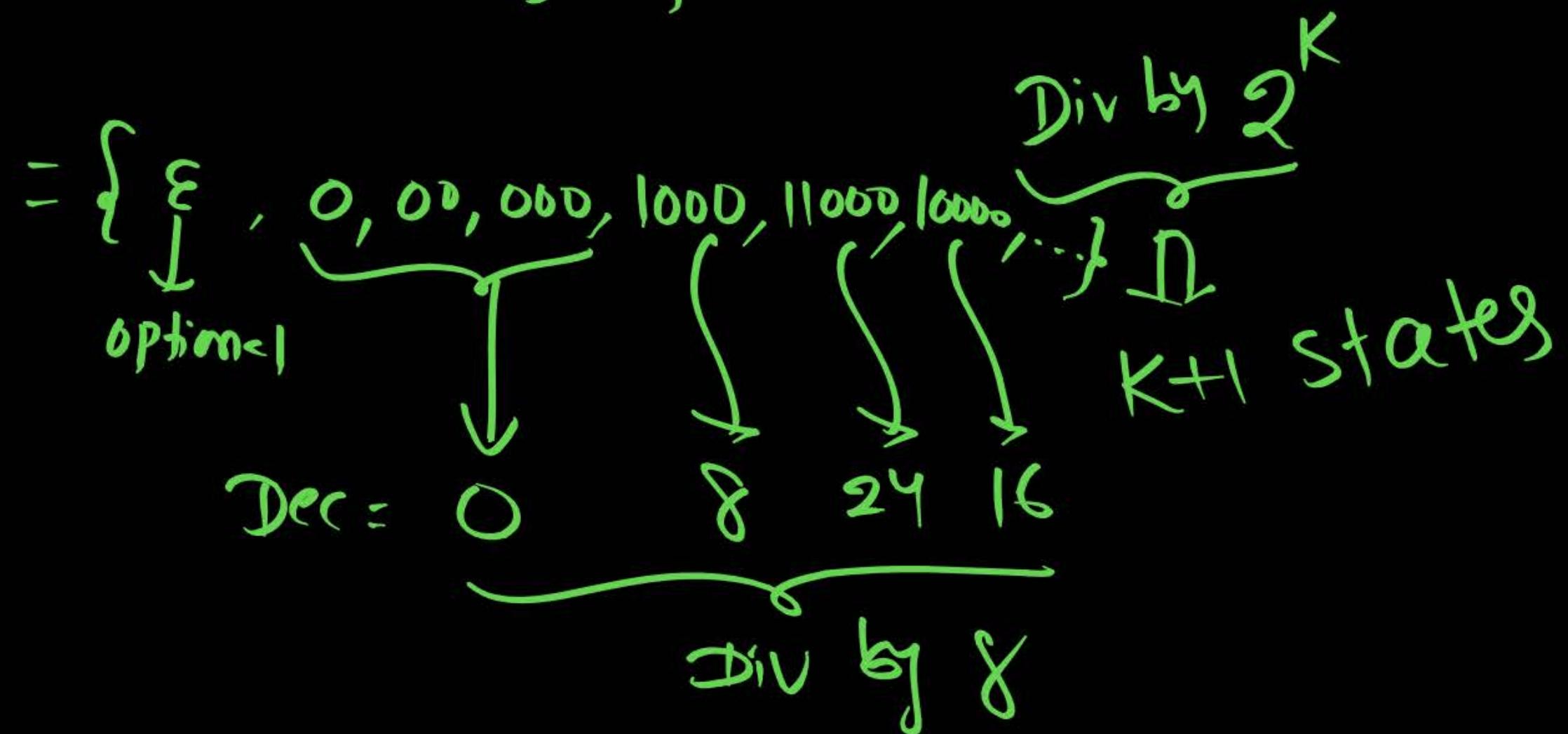
2)



P
W

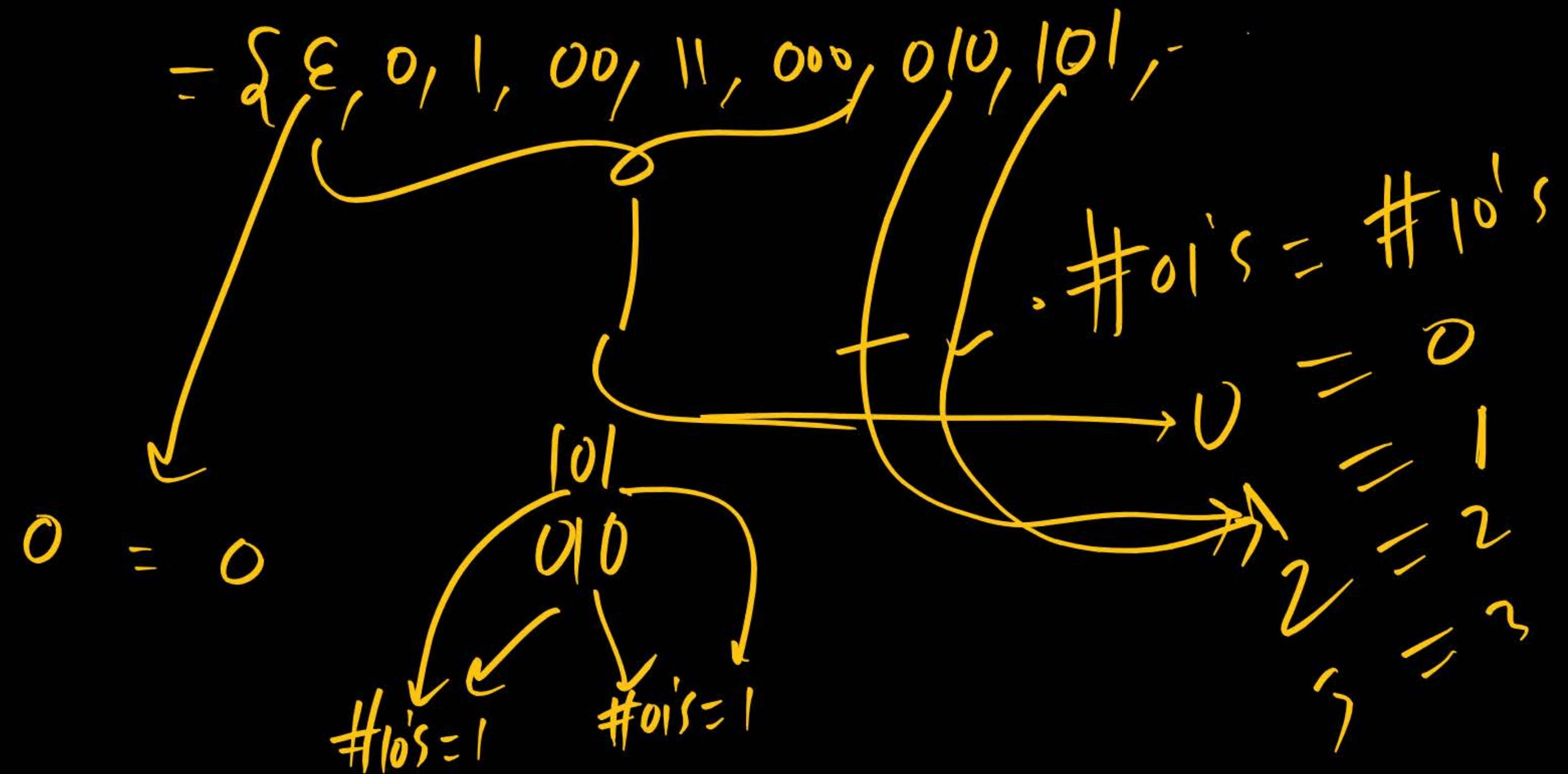
Model-13 [Advanced Special] → Construct DFA

Condition ① $\{ w \mid w \in \{0,1\}^*, \text{ Decimal}(w) \text{ is divisible by } 8 \}$



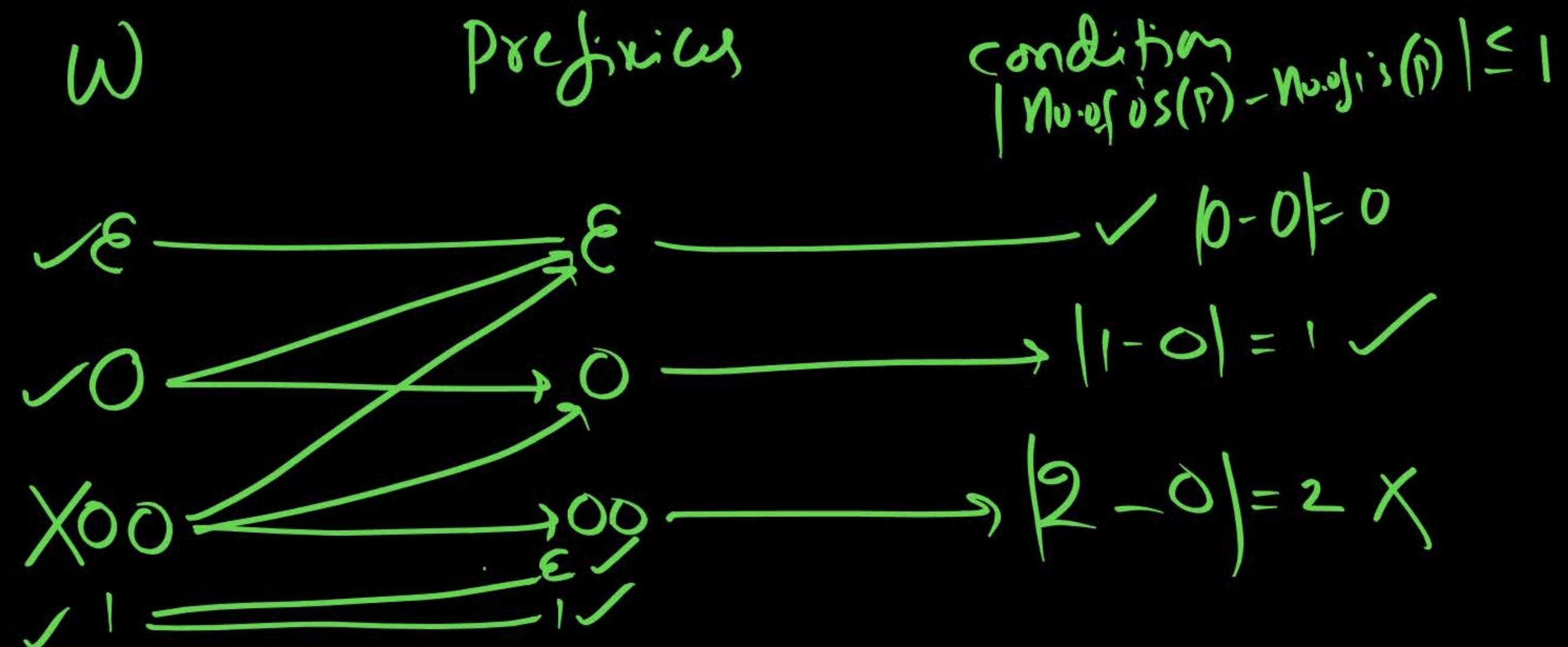
Path ②

$$\{ \omega \mid \omega \in \{0,1\}^*, \#_{01}(\omega) = \#_{10}(\omega) \}$$



pref ③

$\{w \mid w \in \{0,1\}^*, \text{ every prefix } P \text{ of } w \text{ satisfies}$

 $\{\epsilon, 0, 1, \cancel{00}, \cancel{01}, \cancel{10}, \cancel{11}; \dots\}, |n_0(P) - n_1(P)| \leq 1\}$


- position based ✓
- min DFA ✓
- H.W.: ←

