CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 23

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Recap of Previous Lecture

Topic	Model-I (Easy: Phi, Sigma*, only epsilon, Sigma$^+$)
Topic	Model II (Length)
Topic	Model III (No. of symbols), Model IV (Over 1 symbol)
Topic	Model V (Sequence based), Model VI (Length & Remainder)
Topic	Model VII (Symbols & Remainder)
Topic	Model VIII (Multiple Conditions on symbols)
Topic	Model IX (Start, End , Contain), Model X (Position based)
Topic	Model XI (Multiple Conditions-Remainder)
Topic	Model XII (Multiple Conditions-Simple)

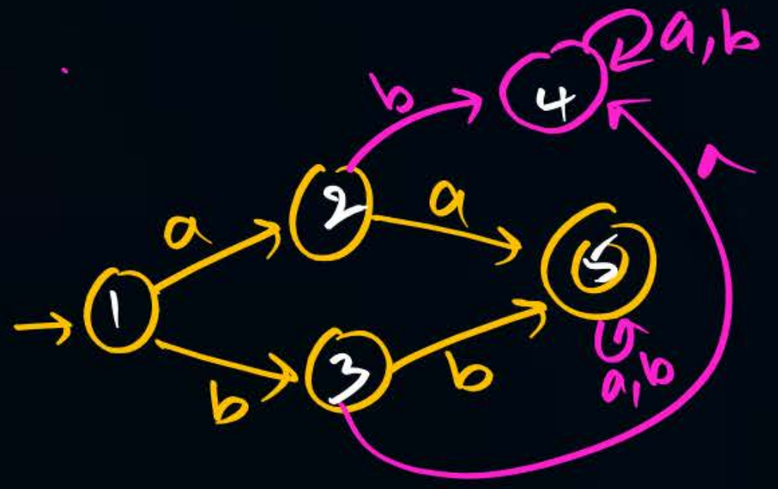
Topics to be Covered

Topic Model XIII (Multiple Conditions-start/end/contain)

Topic Minimization of DFA

Construction of DFA

aa . . . . .
bb . . . . .



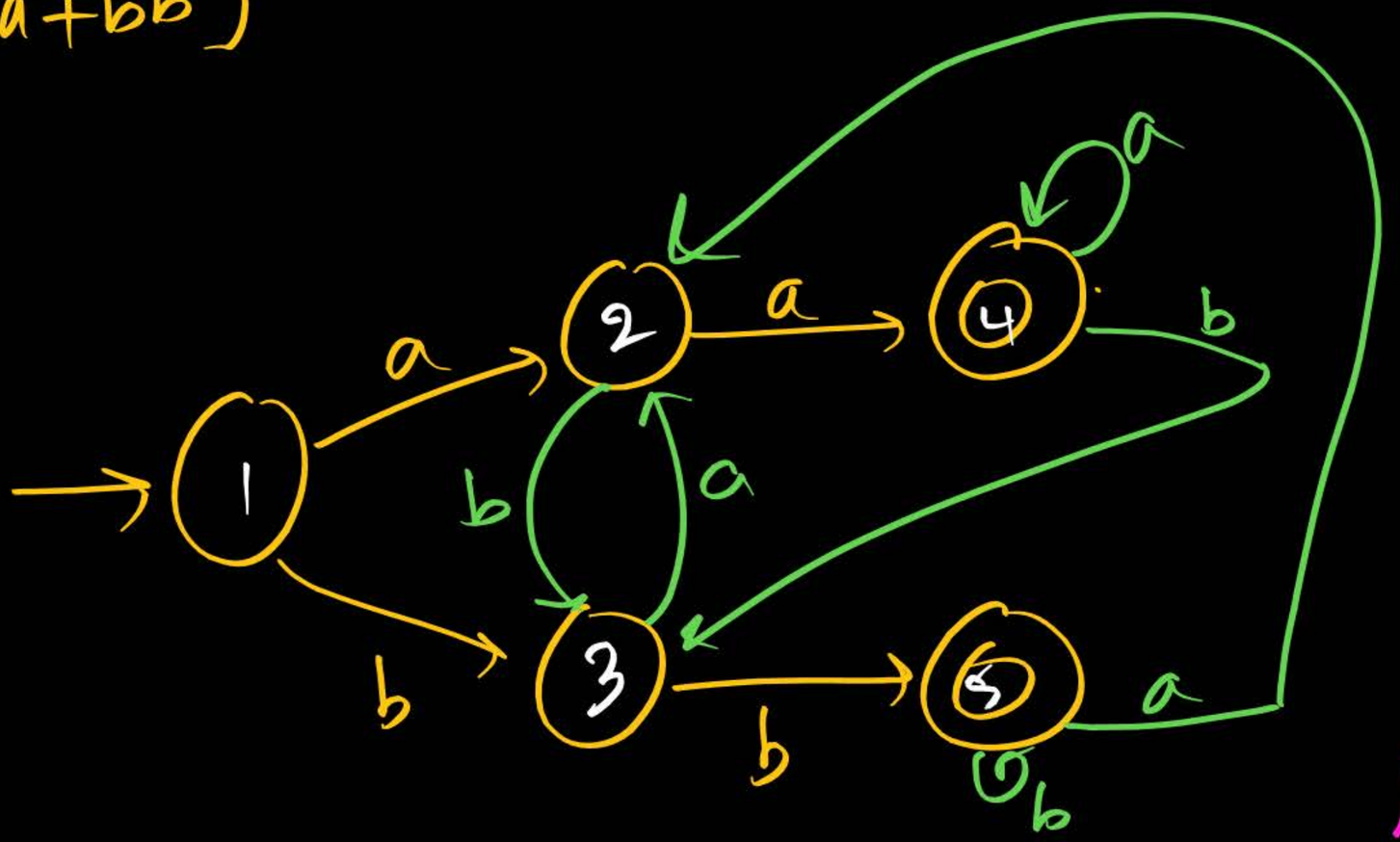
(85) $L = (aa + bb)(a+b)^*$
↳ starts with aa or bb

(86) $L = (a+b)^*(aa+bb)$
↳ ends with aa or bb

(87) $L = (a+b)^*(aa+bb)(a+b)^*$
↳ contains aa or bb

(88) $L = (a+b)^* aa (a+b)^* bb (a+b)^* + (a+b)^* bb (a+b)^* aa (a+b)^*$
↳ contains both aa and bb

(86) $L = \Sigma^*(aa+bb)$



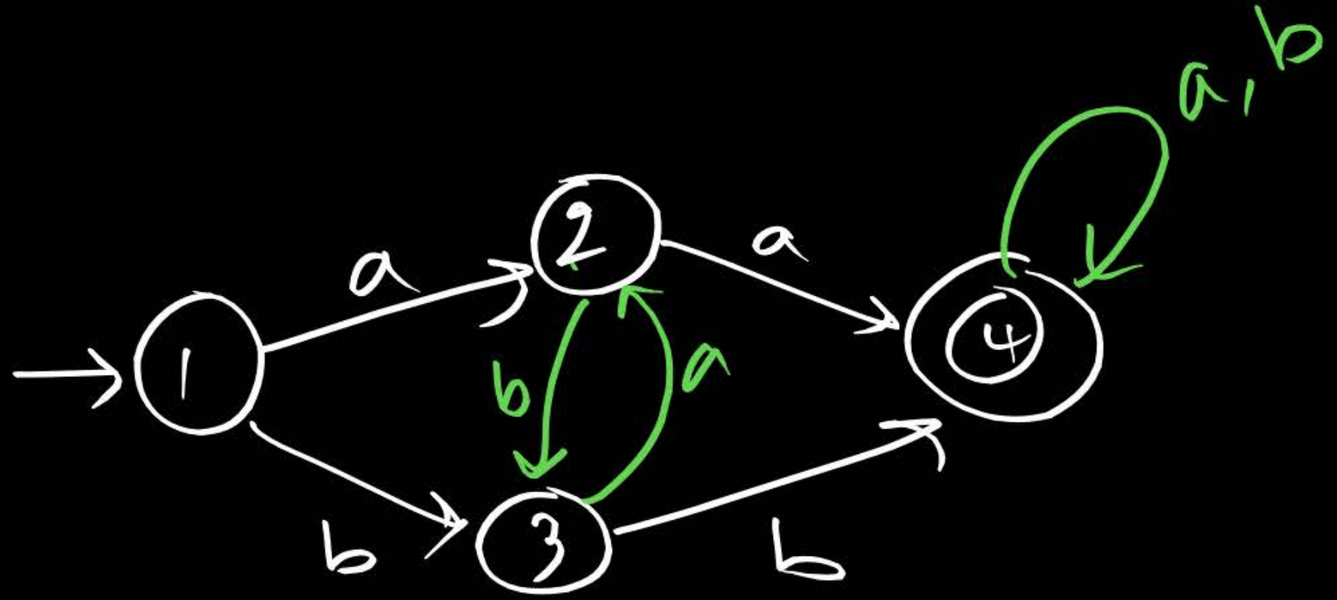
1: $\overline{aa/bb}$

2: (a)

3: (b)

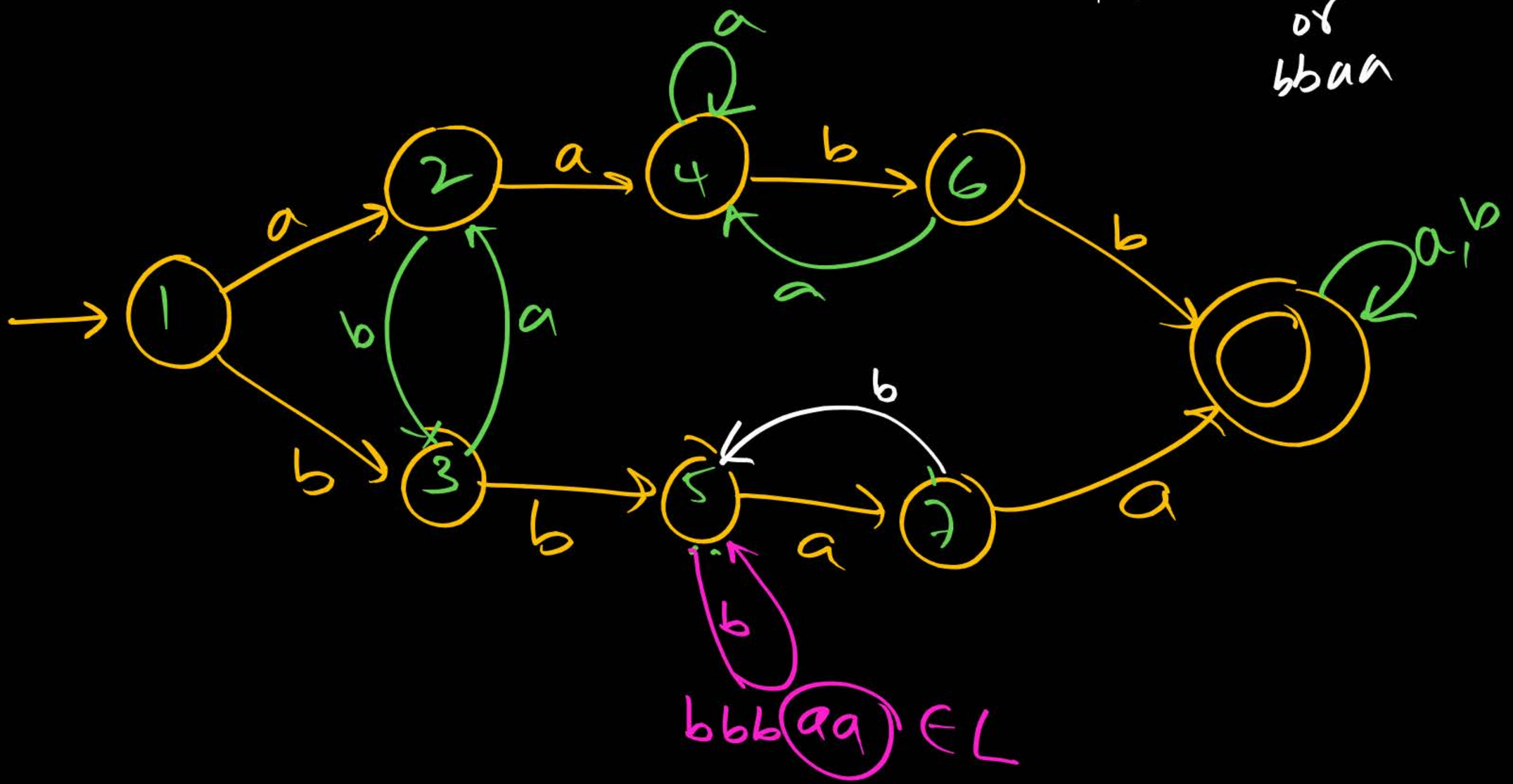
4 & 5 finals

87) $\Sigma^*(aa+bb)\Sigma^*$



88) $\Sigma^* aa\, \Sigma^* bb\, \Sigma^* + \Sigma^* bb\, \Sigma^* aa\, \Sigma^*$

$|xy|_{min}$ = aabb or bbaa



Minimization of DFA

Construction of DFA

Partition on set

$A = \{1\}$

⇓

Partition : $\{1\}$

$A = \{1,2\}$

⇓

Partition 1 : $\{1\}$ $\{2\}$

Partition 2 : $\{1,2\}$

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

⇓

Partition 1 : $\{1\}$ $\{2\}$ $\{3\}$

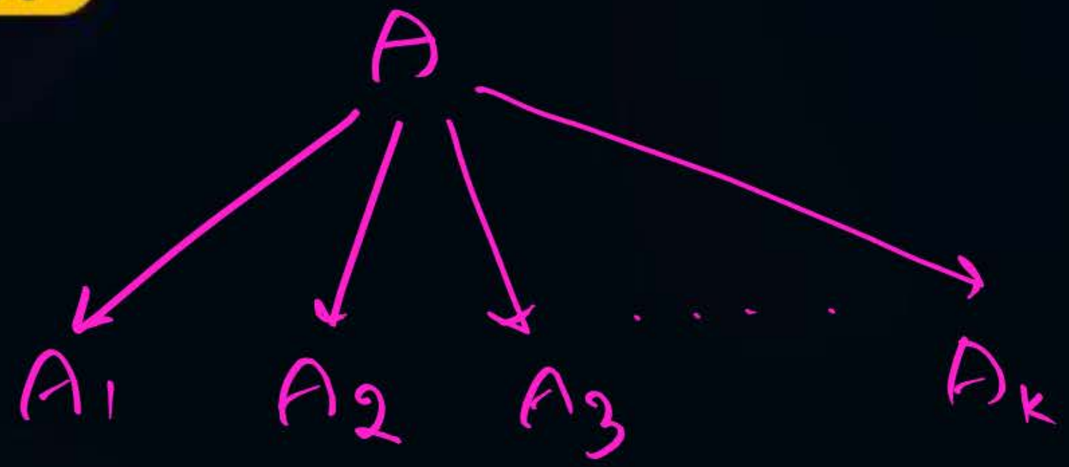
Partition 2 : $\{1,2\}$ $\{3\}$

Partition 3 : $\{1,3\}$ $\{2\}$

Partition 4 : $\{2,3\}$ $\{1\}$

Partition 5 : $\{1,2,3\}$

Construction of DFA



$\{A_1, A_2, A_3, \ldots A_k\}$ is partition on A

iff

I) $A_i \subseteq A$ for every i

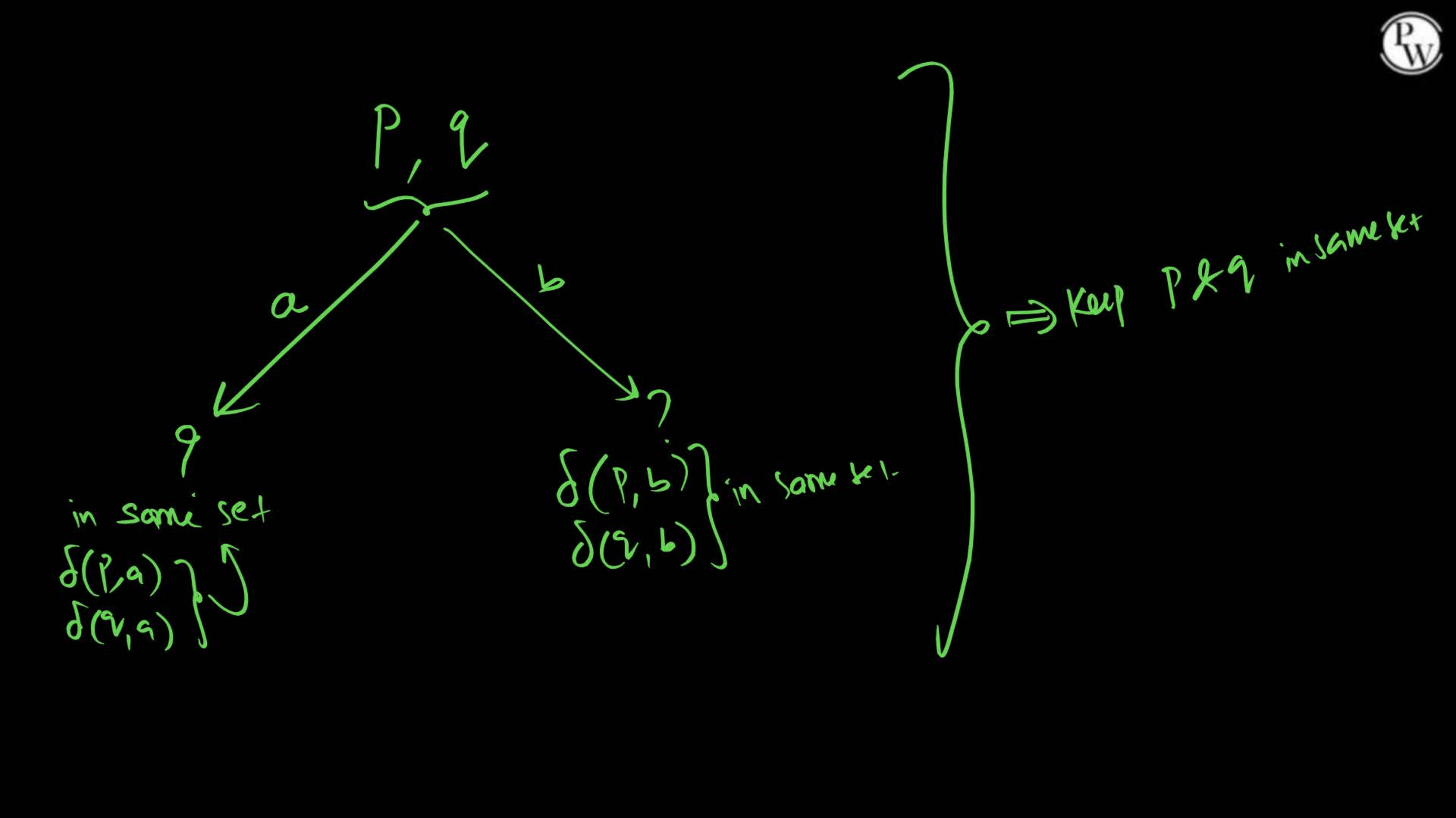
II) $A_1 \cup A_2 \cup \ldots \cup A_k = A$

III) $A_i \cap A_j = \phi$ for all i and j $i \neq j$

Construction of DFA

Note: Every partition induces an equivalence relation.

No. of partitions = No. of equivalence relations


p, q
a
b
q
?
in same set
δ(p,a)
δ(q,a)
δ(p,b)
δ(q,b)
in same set
⇒ Keep p & q in same set

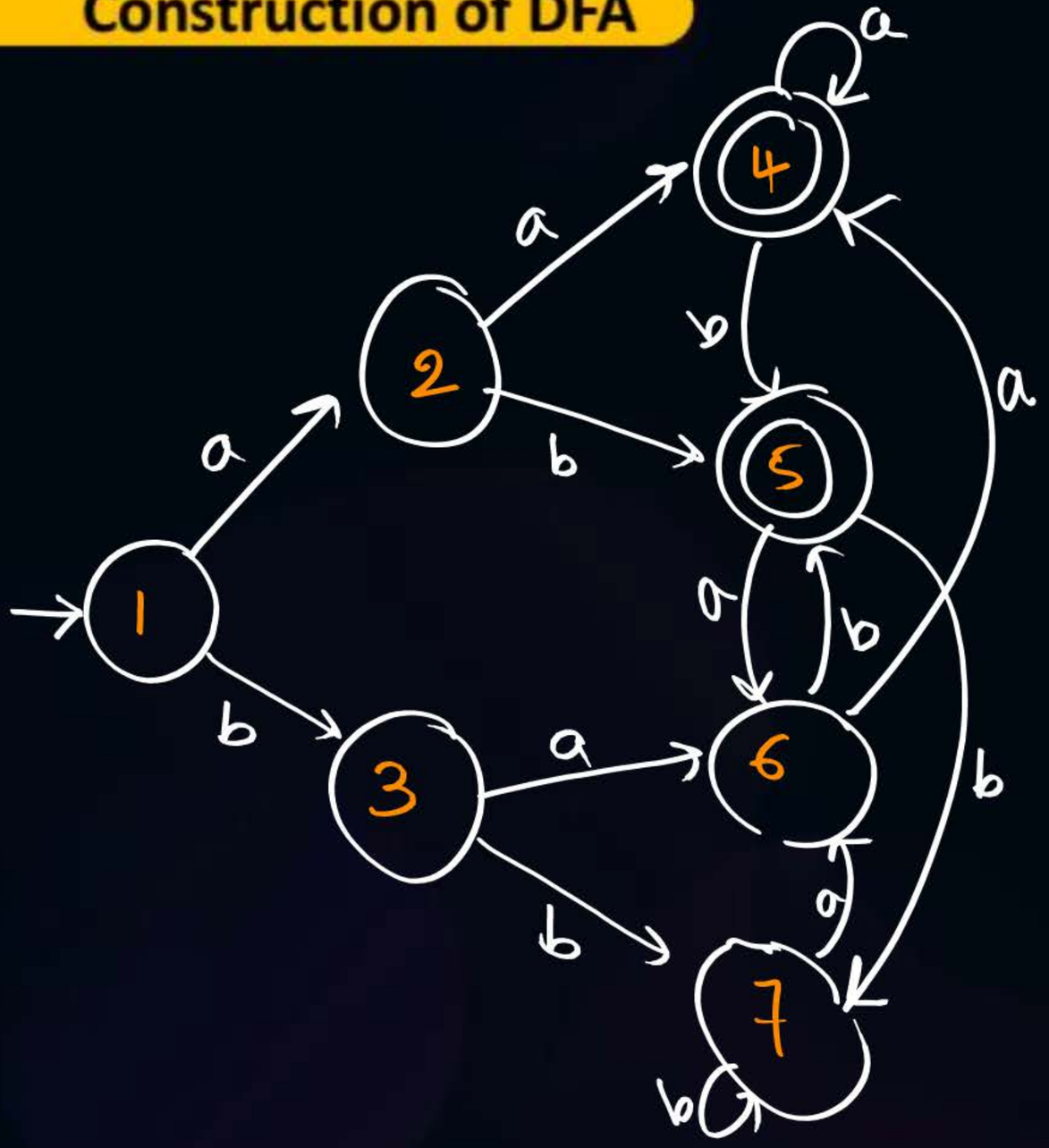
Construction of DFA

Step1: {1,2,3,6,7} {4,5}

All non finals in one set

All finals in one set

Construction of DFA



Step 1: {1,2,3,6,7} {4,5}

Step 2: {1,3,7} {2,6} {4} {5}

2 & 6
- a → 4, 4
- b → 5, 5

4 & 5
- a → 4, 6 ✗

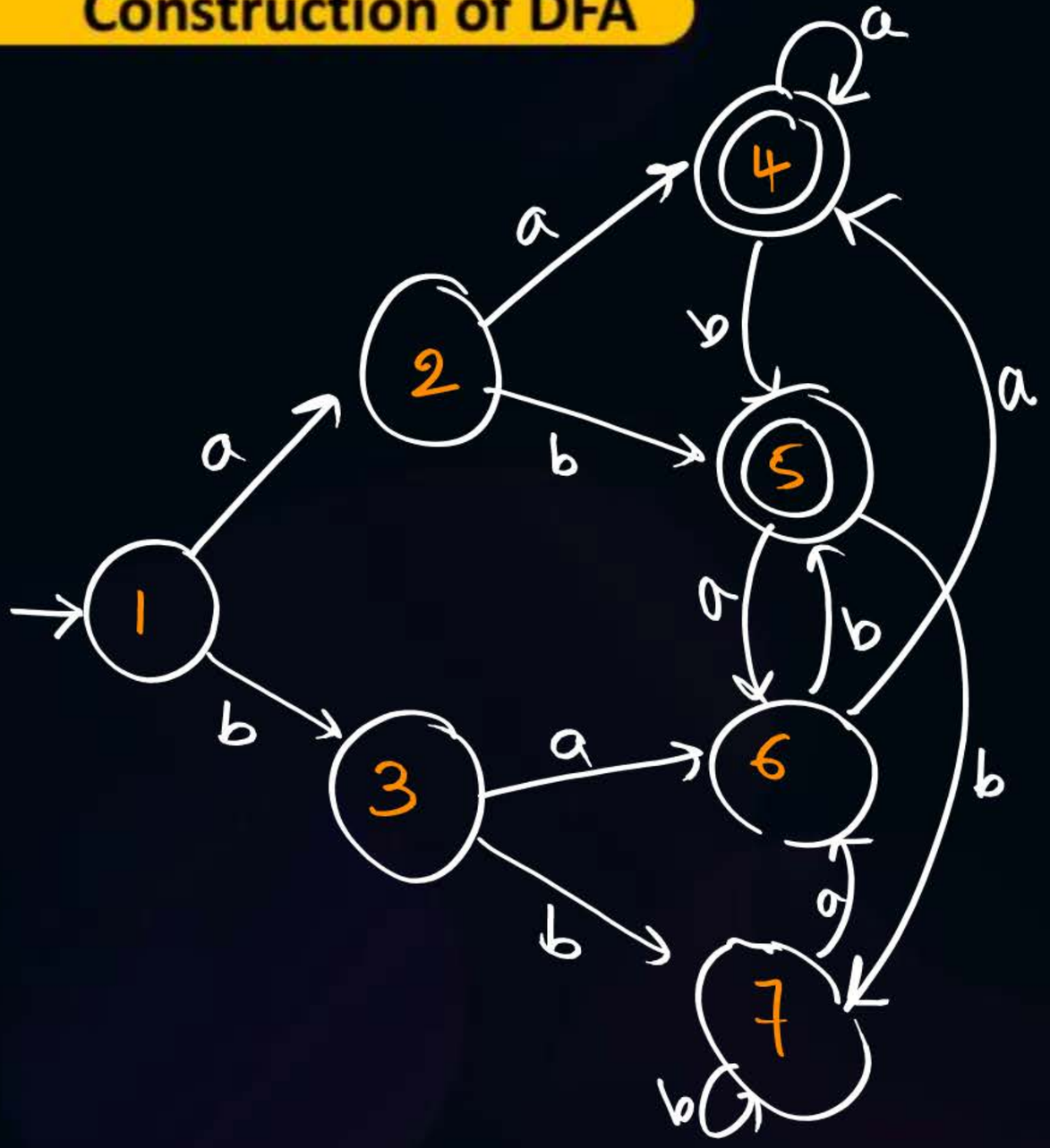
1 & 2
- a → 2, 4 ✗ (in diff sets, so, we separate)

1 & 3
- a → 2, 6
- b → 3, 7

1 & 6
- a → 2, 4 ✗

1 & 7
- a → 2, 6
- b → 3, 7

Construction of DFA



Step 1: {1,2,3,6,7} {4,5}

Step 2: {1,3,7} {2,6} {4} {5}

Step 3: {1,3,7} {2,6} {4} {5}

2 & 6
a → 4,4
b → 5,5

4 & 5
a → 4,6 ✗

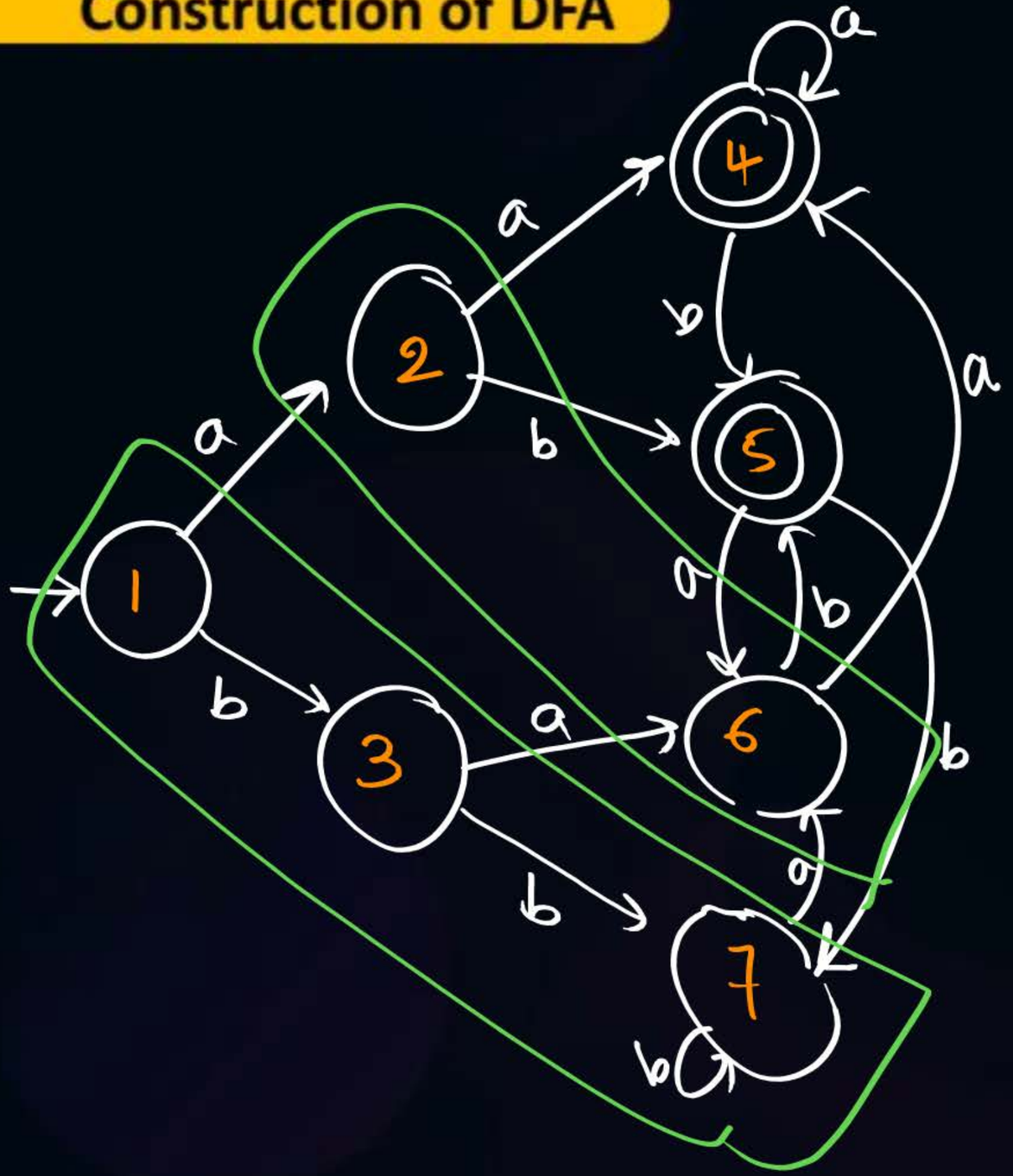
1 & 2
a → 2,4
✗ in diff sets
So, we separate

1 & 3
a → 2,6
b → 3,7

1 & 6
a → 2,4
✗

1 & 7
a → 2,6
b → 3,7

Construction of DFA



Step 1: {1,2,3,6,7} {4,5}

Step 2: {1,3,7} {2,6} {4} {5}

Step 3: {1,3,7} {2,6} {4} {5}

2 & 6
a → 4,4
b → 5,5

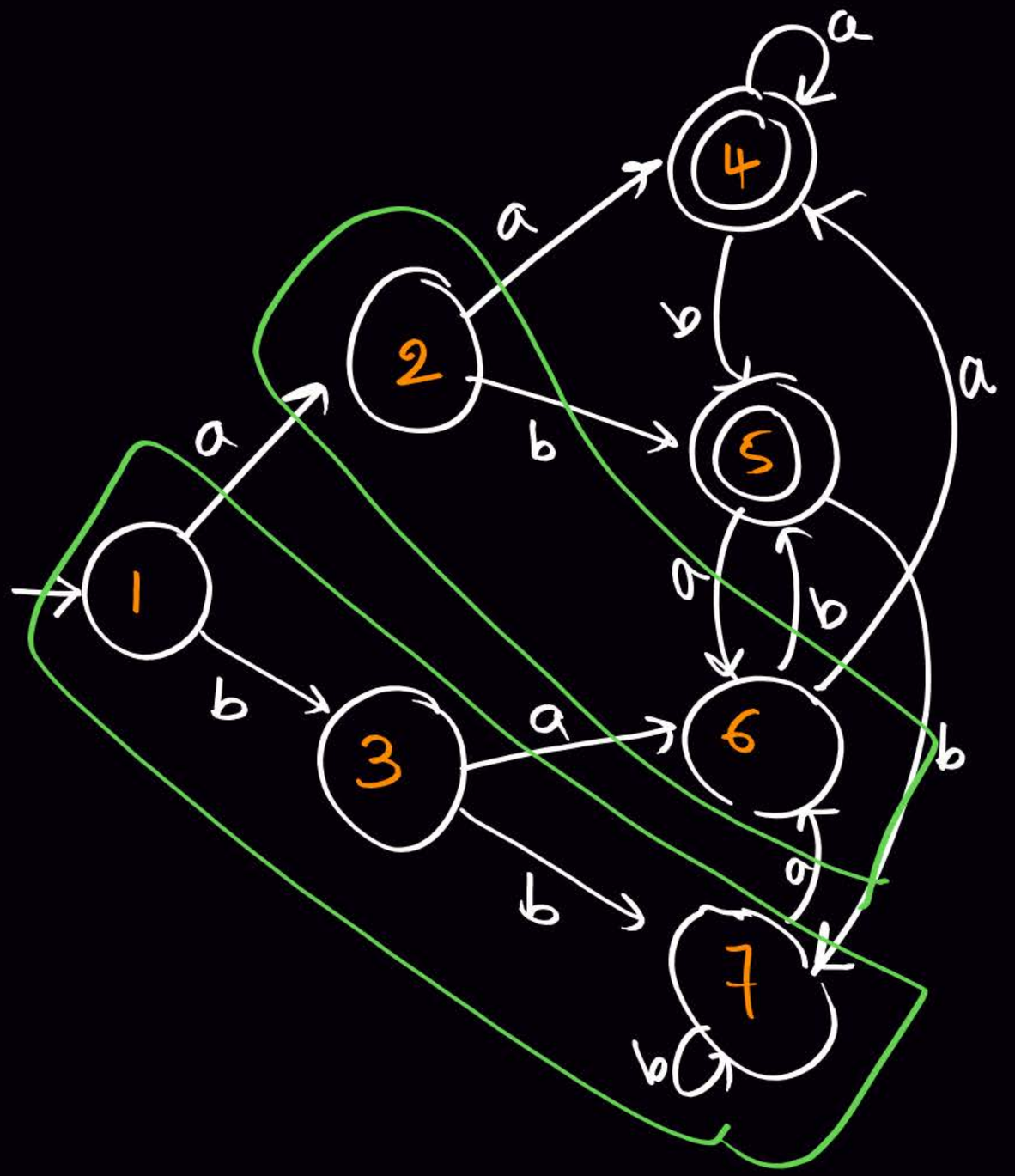
4 & 5
a → 4,6 ✗

1 & 2
a → 2,4
✗ in diff sets
So, we separate

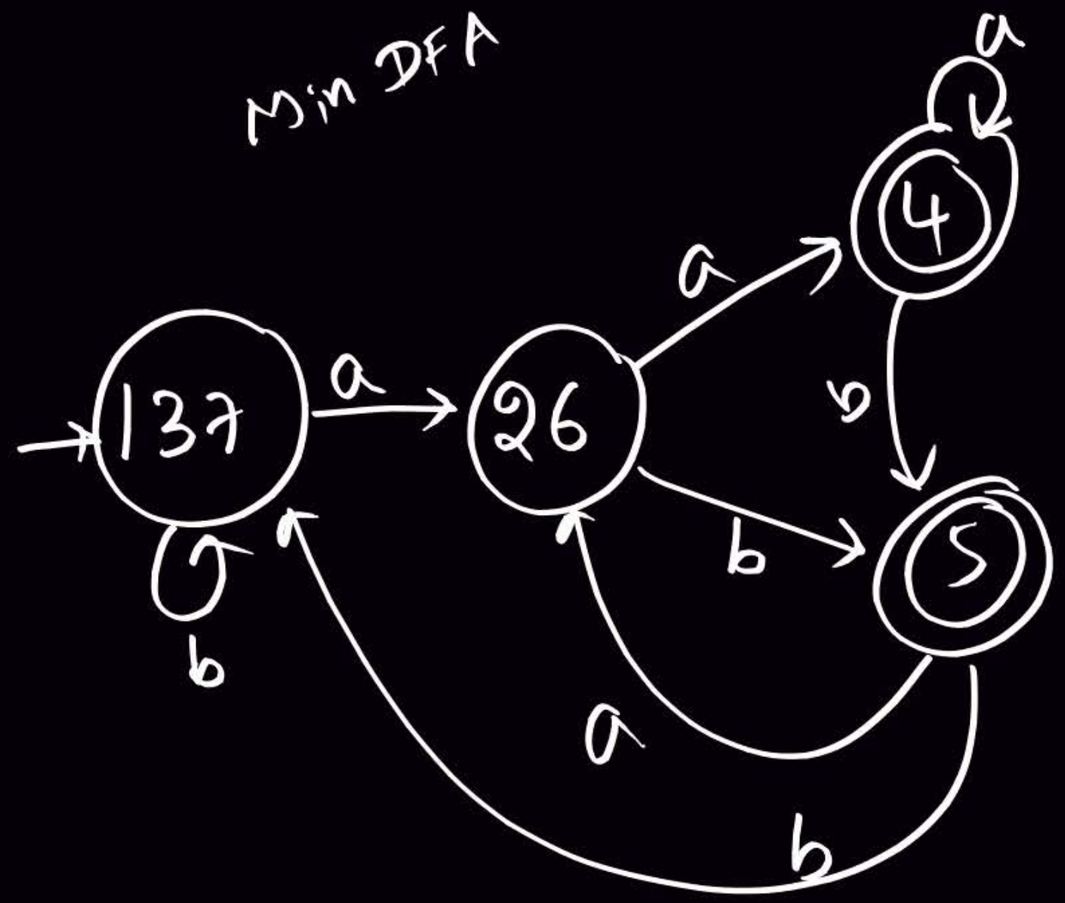
1 & 3
a → 2,6
b → 3,7

1 & 6
a → 2,4
✗

1 & 7
a → 2,6
b → 3,7



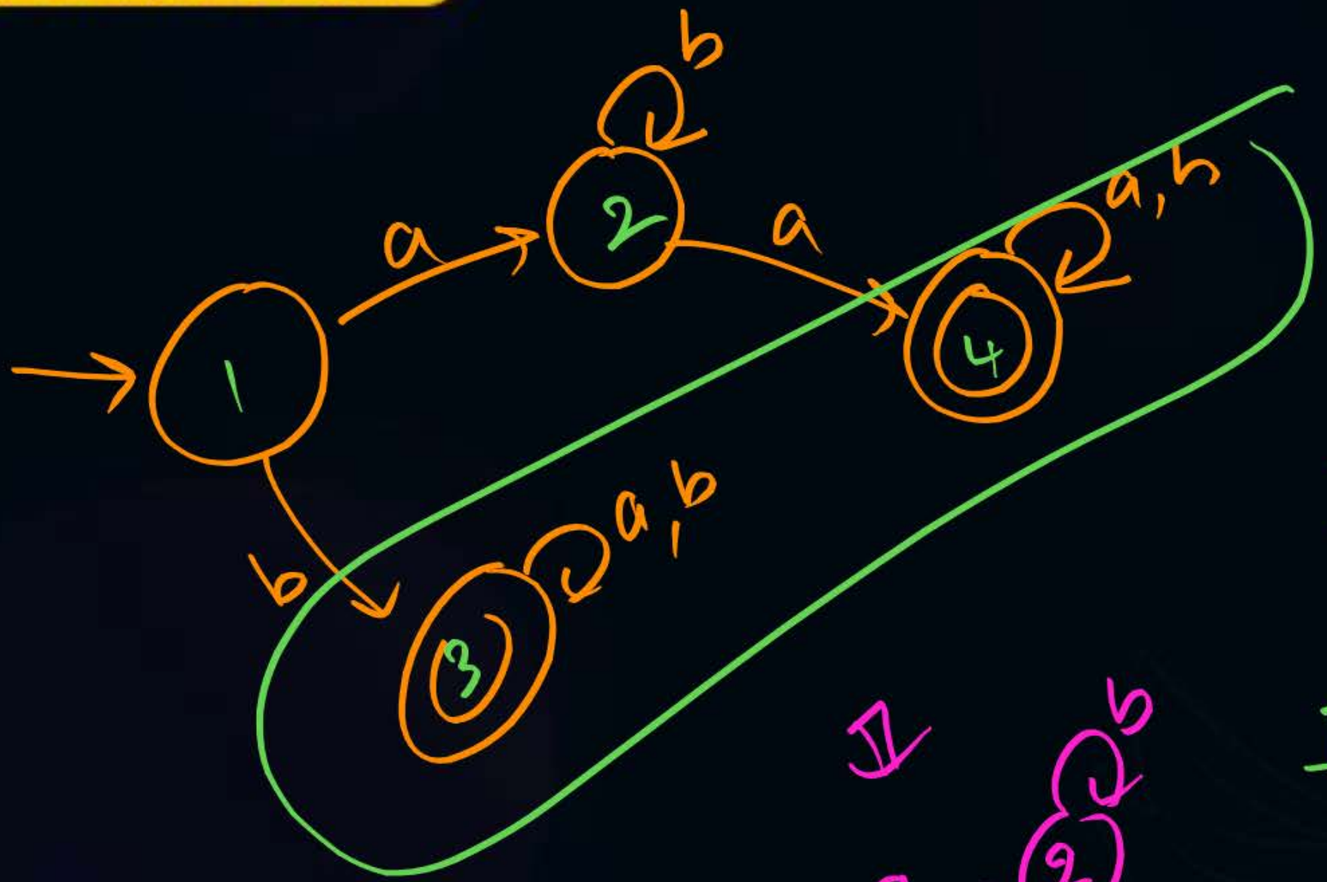
Min DFA



$1 \equiv 3 \equiv 7$

$2 \equiv 6$

Construction of DFA



I) {1,2} {3,4}

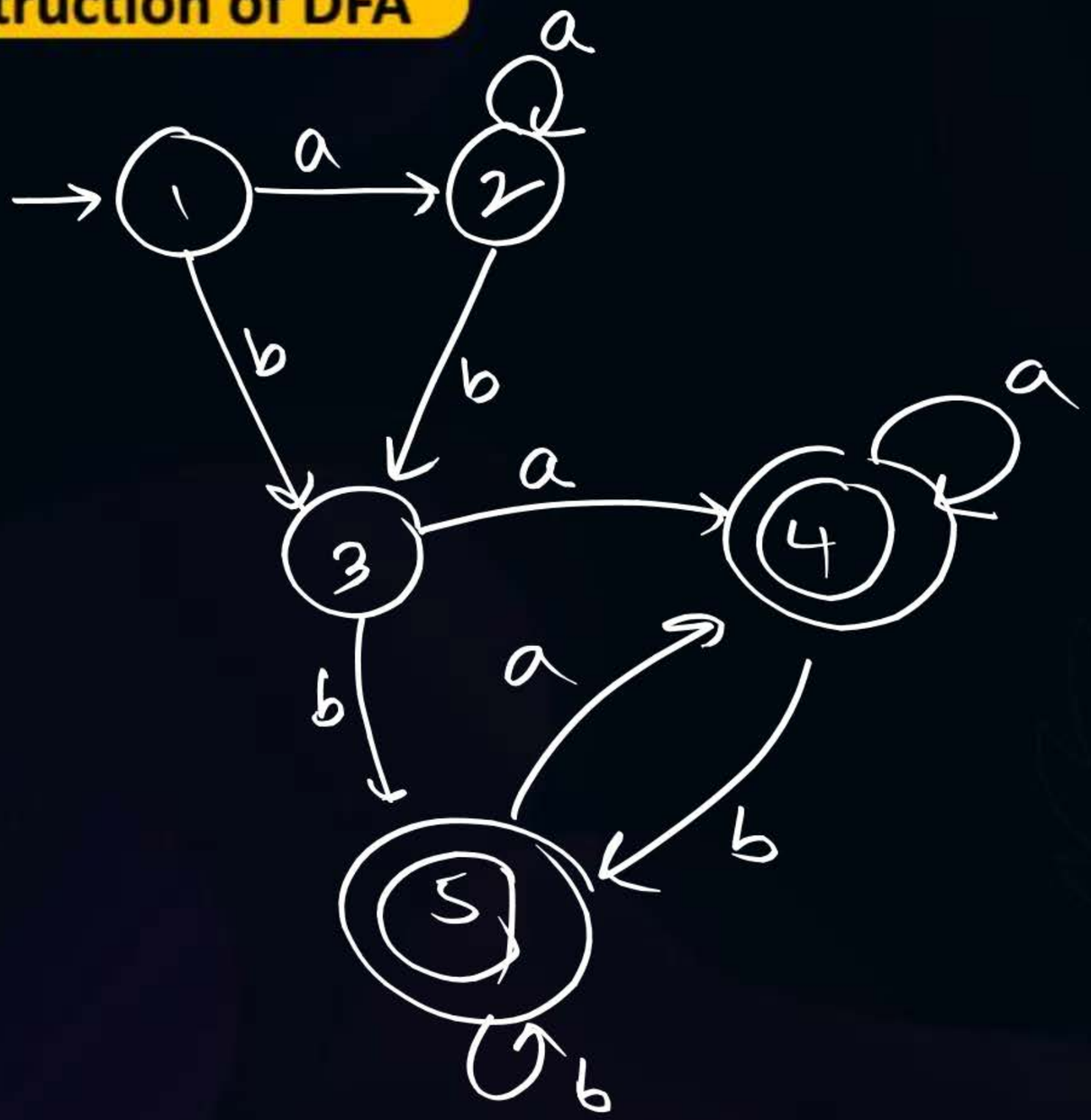
II) {1} {2} {3,4}

III) Same as II

3 States in min DFA

II

Construction of DFA



$\Rightarrow$ #states in min DFA = ?

2 mins Summary

Topic Minimization of DFA

Topic DFA Vs NFA ⇨ Next

THANK - YOU