

CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 16

A man with a beard and mustache, wearing a black polo shirt, stands with his arms crossed in front of a blurred bookshelf. He is wearing a black watch on his left wrist.

Malleham Devasane Sir

Recap of Previous Lecture



Topic

What is FA?

Topic

FA representations: Graph, Table, and Set

Topic

DFA, NFA without epsilon, NFA with epsilon

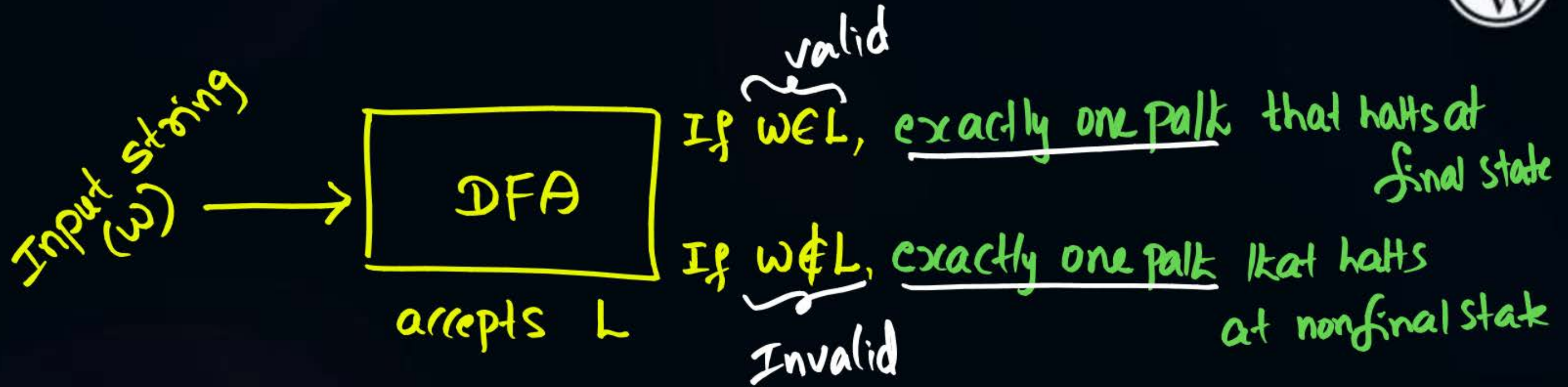
Topics to be Covered



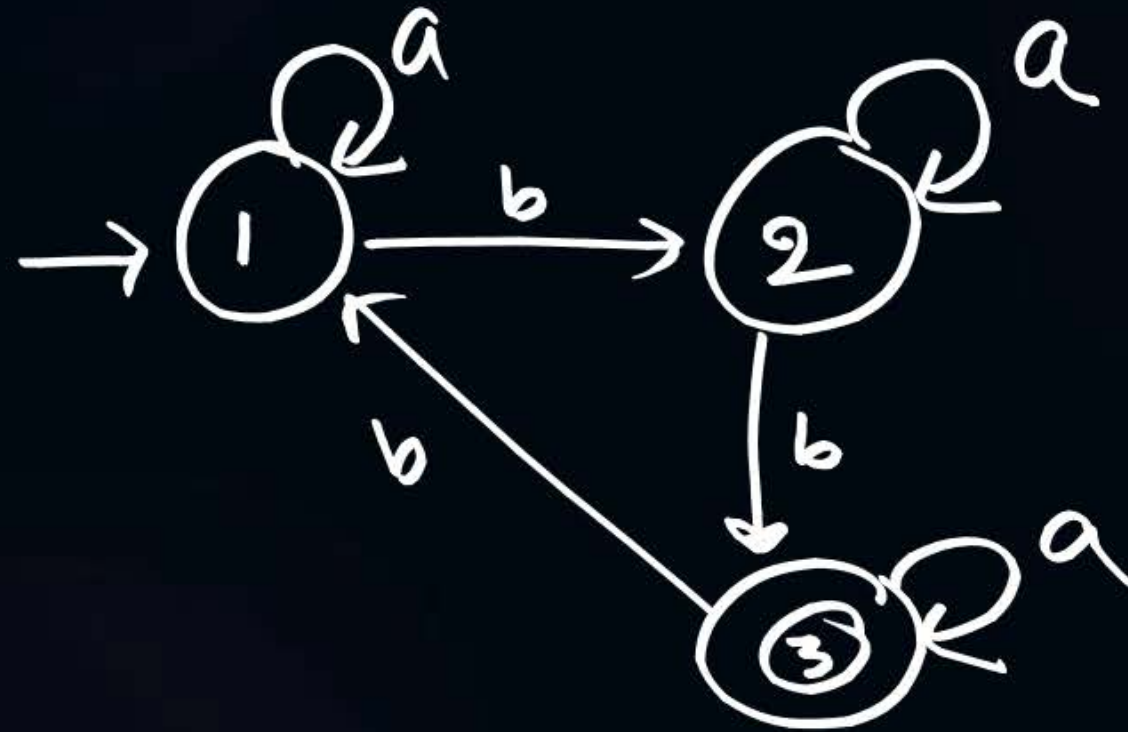
Topic

Construction of DFA and NFA



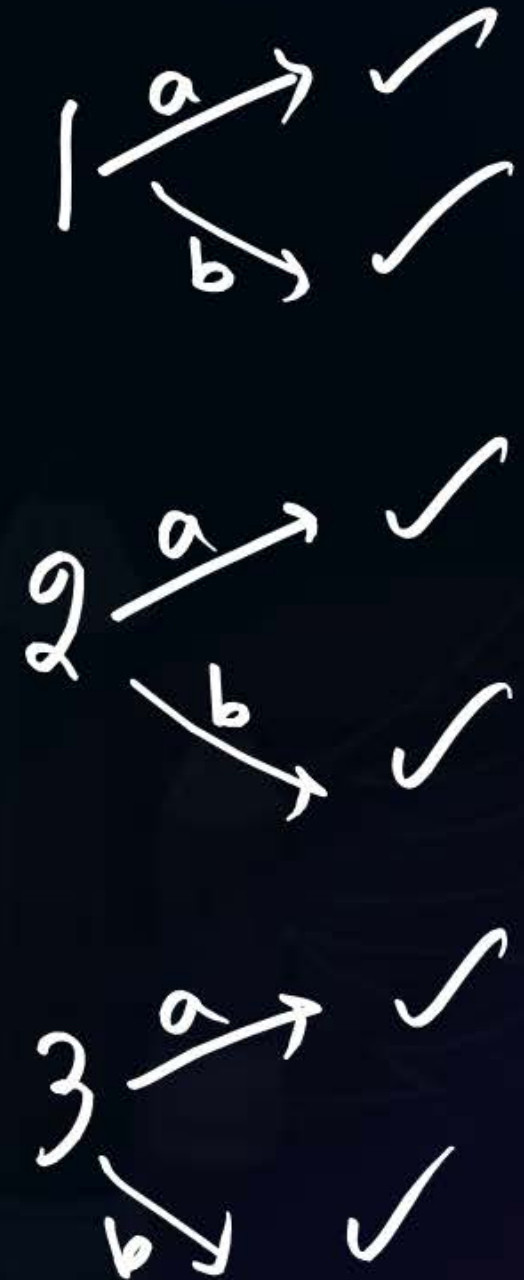


$$\delta: Q \times \Sigma \rightarrow Q$$



IS it DFA ?

$\epsilon \Rightarrow$ 1 path : 1
 $a \Rightarrow$ 1 path : 1 \rightarrow 1
 $b \Rightarrow$ 1 path : 1 \rightarrow 2
 $aa \Rightarrow$ 1 path : 1 \rightarrow 1 \rightarrow 1
 $bb \Rightarrow$ 1 path : 1 \rightarrow 2 \rightarrow 3



Model-I [Easy]:



① $L = \phi$ over $\Sigma = \{a, b\}$

$= \{ \}$

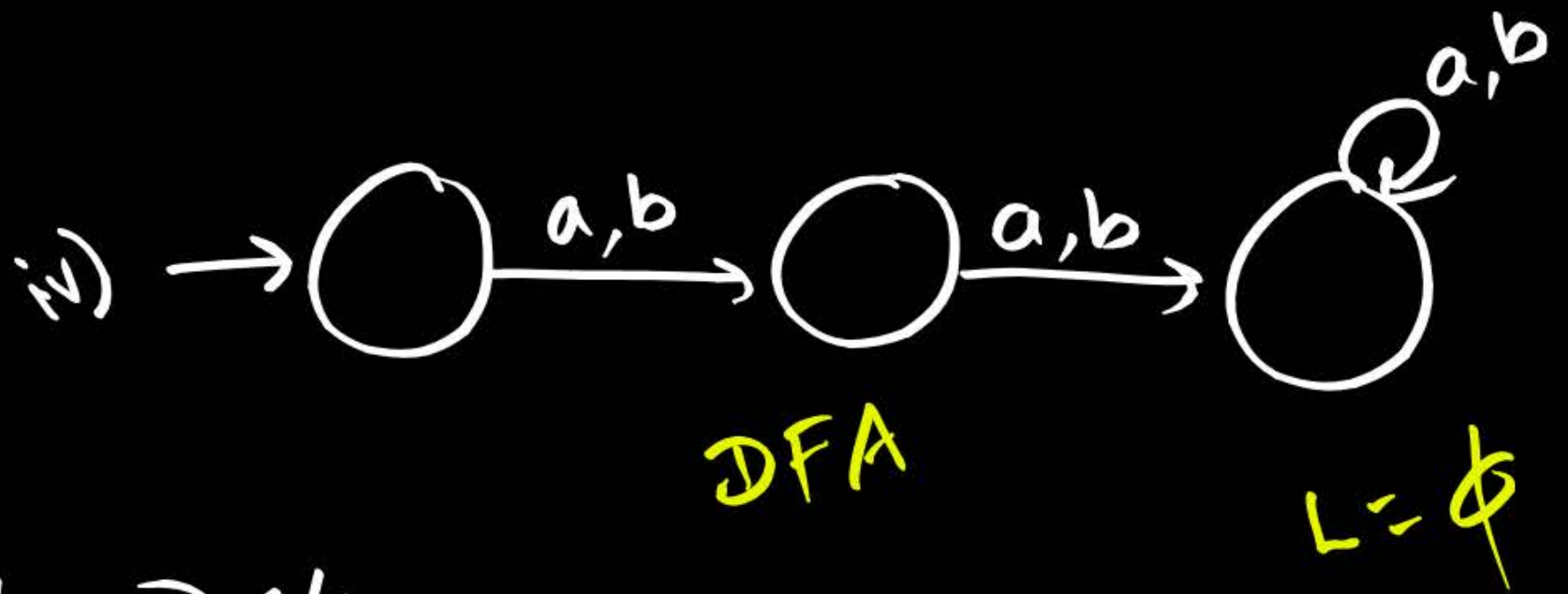
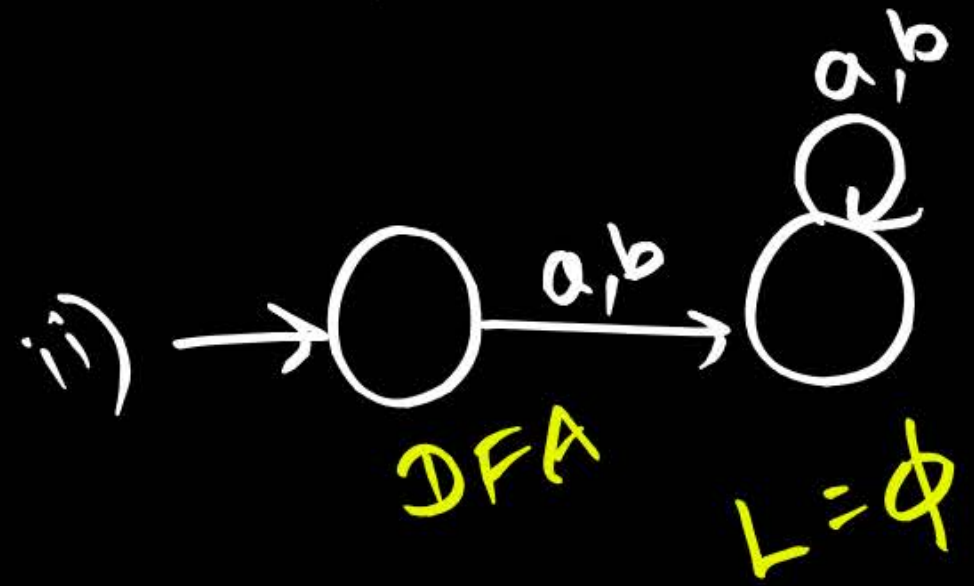
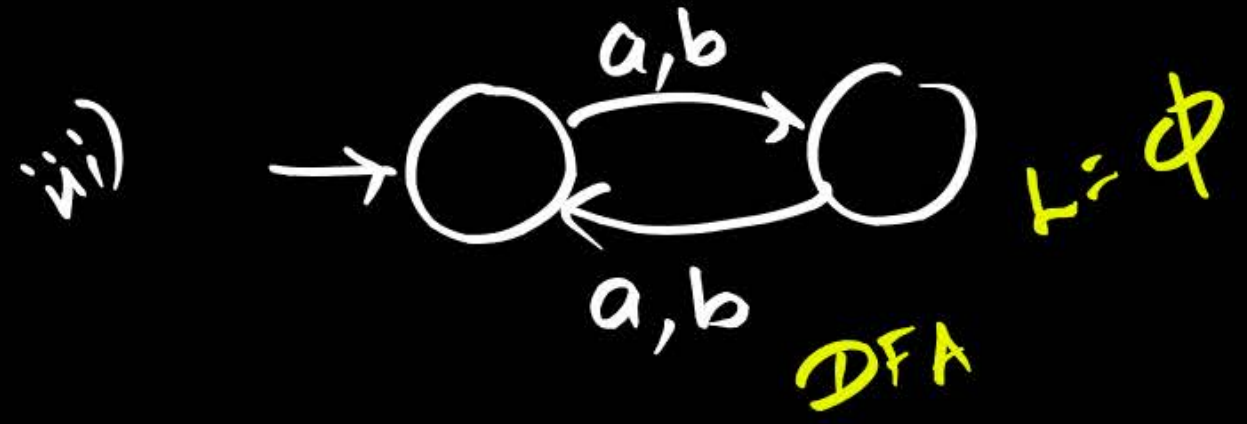
= Empty Language

$\epsilon: 1$

$a: 1 \xrightarrow{a} 1$

$b: 1 \xrightarrow{b} 1$

$aa: 1 \xrightarrow{a} 1 \xrightarrow{a} 1$



Minimum DFA :

→ It is DFA with less no. of states

Note: I) If initial state is final state in DFA,
then empty string (ϵ) is accepted

II) If initial state is nonfinal in DFA,
then empty string (ϵ) is not accepted.

Note:

III) If all states in DFA are non finals then

$L(\text{DFA})$ is empty language.
(\emptyset)

IV) For every regular language,

i) No. of DFAs = Infinite

ii) No. of Minimum DFAs = 1

V) If every state is final in DFA then

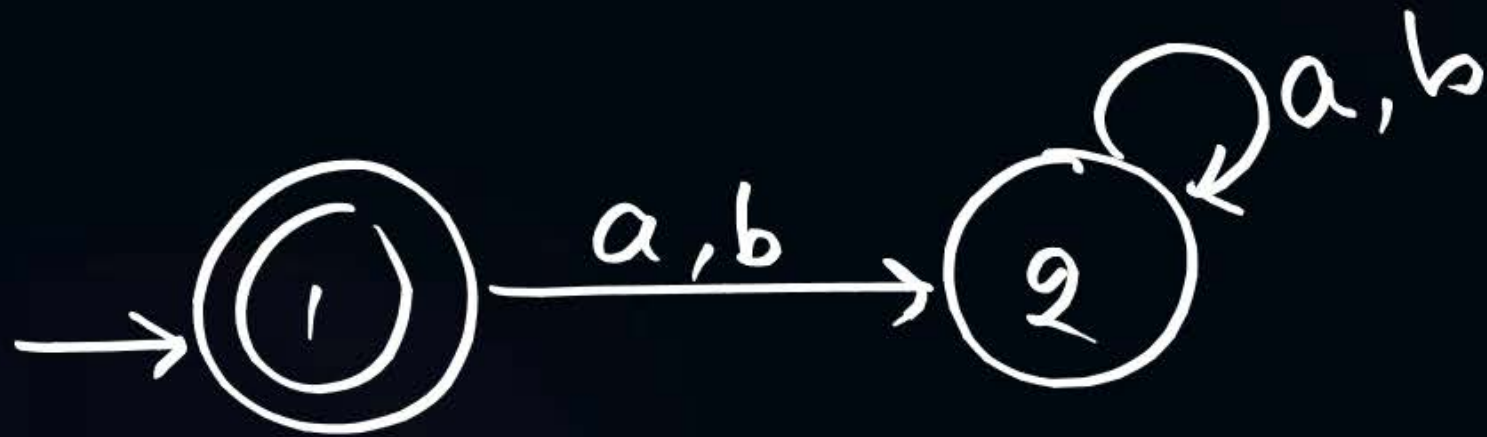
$L(\text{DFA})$ is Σ^* .

Read ϵ

Read no symbol

1
Start
Halt

② $L = \{\epsilon\}$ over $\Sigma = \{a, b\}$



ϵ ✓

ax

bx

$aa x$

$ab x$

$ba x$

$bb x$

Is there any path from 2 to final state?

Trap or Dead state:

→ It is non final and no path to final!

= 2 states
in min DFA

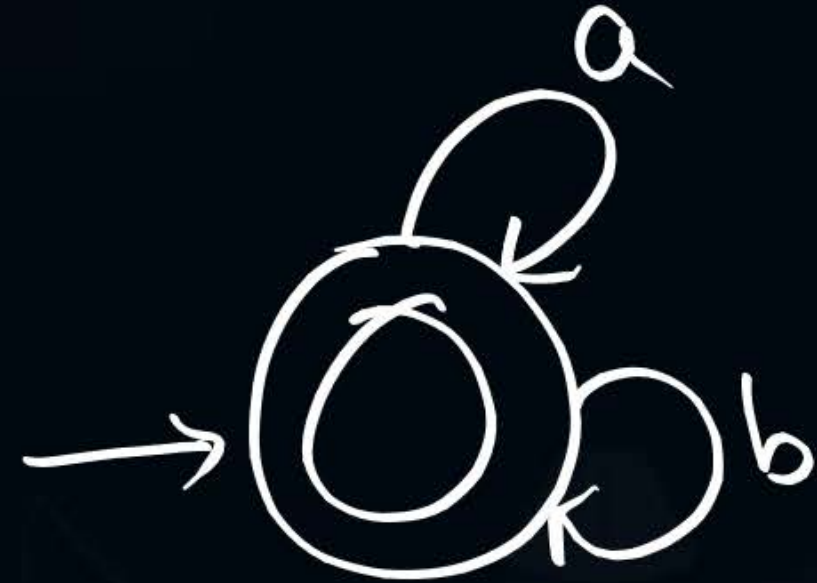
3) $L = (a+b)^*$ over $\Sigma = \{a, b\}$

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

= Set of all strings

= Universal Set

$= \Sigma^*$



= 1 state

$$4) L = (a+b)^+ \text{ over } \Sigma = \{a, b\}$$


$$= \{w \mid w \in (a+b)^*, |w| > 0\}$$

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


$$= \text{Set of all non empty strings}$$



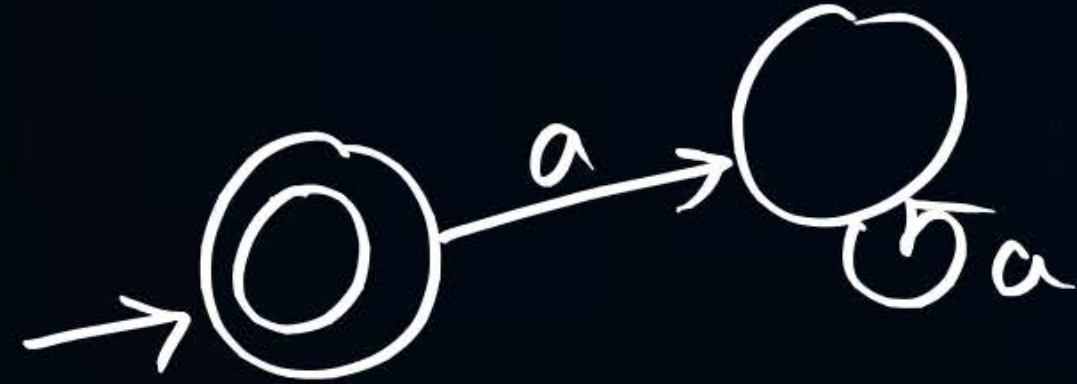
= 2 states
in min DFA

5) $L = \phi$ over $\Sigma = \{a\}$ \rightarrow 

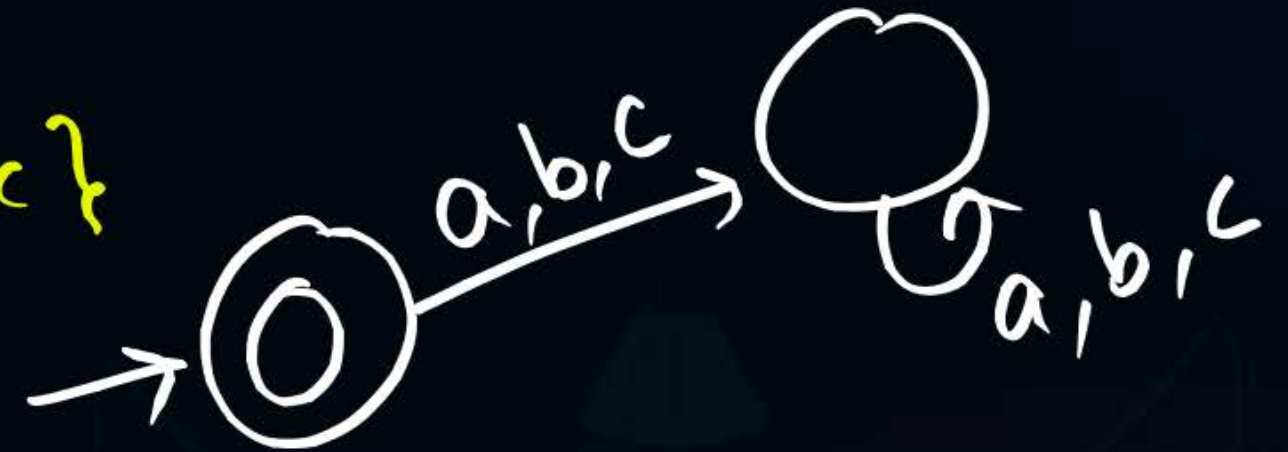
6) $L = \phi$ over $\Sigma = \{a, b, c\}$ \rightarrow 

7) $L = \phi$ over $\Sigma = \{+, *, -\}$ \rightarrow 

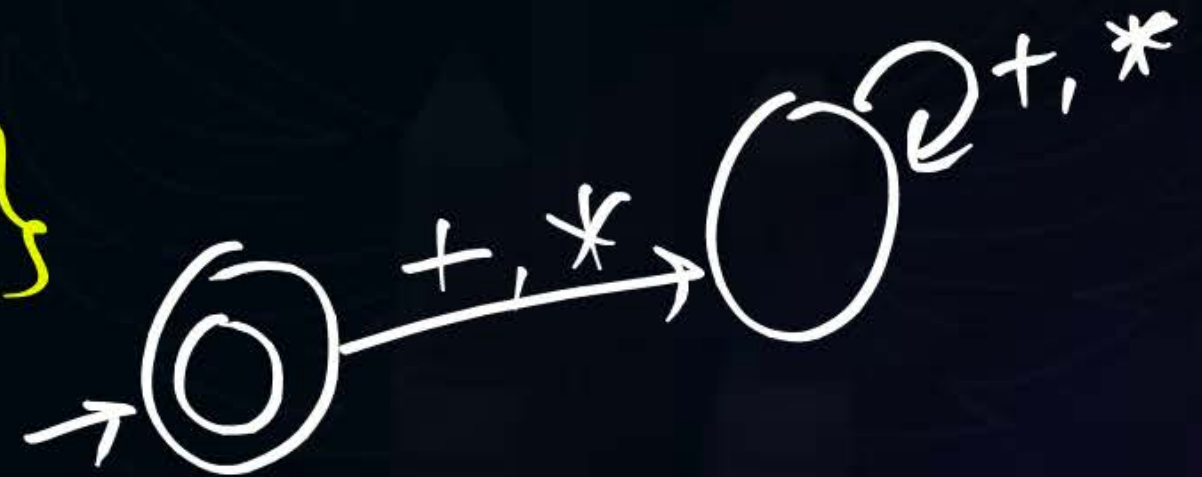
8) $L = \{\epsilon\}$ over $\Sigma = \{a\}$



9) $L = \{\epsilon\}$ over $\Sigma = \{a, b, c\}$



10) $L = \{\epsilon\}$ over $\Sigma = \{+, *\}$



$$11) L = \Sigma^* \text{ over } \Sigma = \{a\} \\ = a^*$$



$$12) L = \Sigma^* \text{ over } \Sigma = \{a, b, c\} \\ = (a+b+c)^*$$



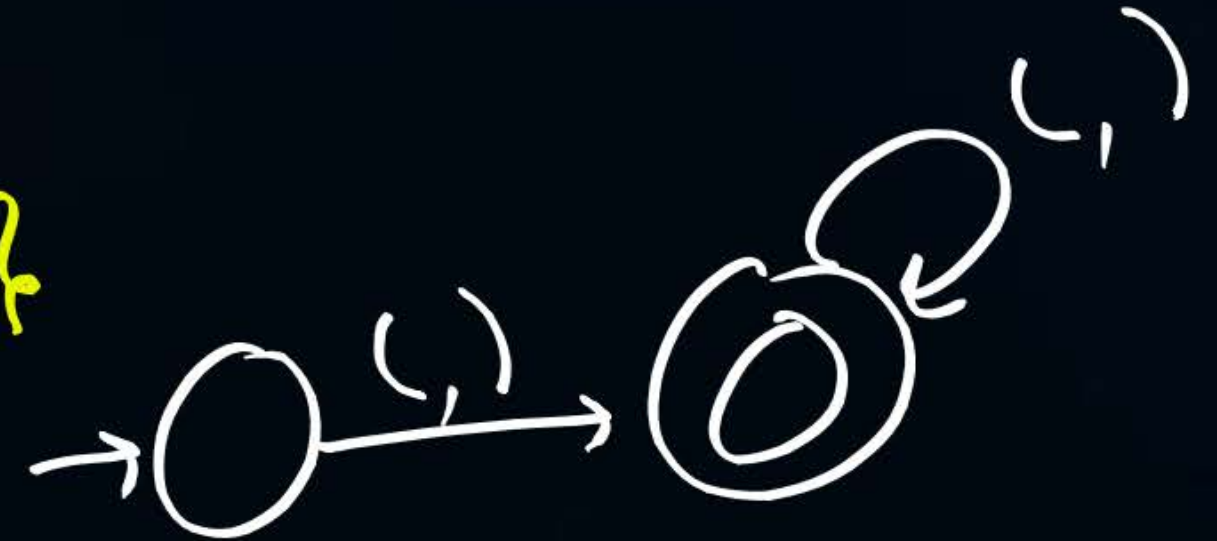
$$13) L = \Sigma^* \text{ over } \Sigma = \{+, *\}$$



14) $L = \Sigma^+$ over $\Sigma = \{a\}$



15) $L = \Sigma^+$ over $\Sigma = \{ (,) \}$



16) $L = \Sigma^+$ over $\Sigma = \{ a, b, c \}$



Model - II [Length based]

17) $L = \{w \mid w \in \{a, b\}^*, |w| = 2\}$

18) $L = \{w \mid w \in \{a, b\}^*, |w| \leq 2\}$

19) $L = \{w \mid w \in \{a, b\}^*, |w| \geq 2\}$

H.W.

Construct Min DFA.



2 mins Summary



Topic

Construction of FA

Topic

When do we need dead state?

Topic

Which state we need to make final state?

THANK - YOU