CS & IT ENGINEERING

Theory of Computation

Finite Automata

Lecture No. 15

By- DEVA Sir

TOPICS TO BE COVERED

01 FA with O/P

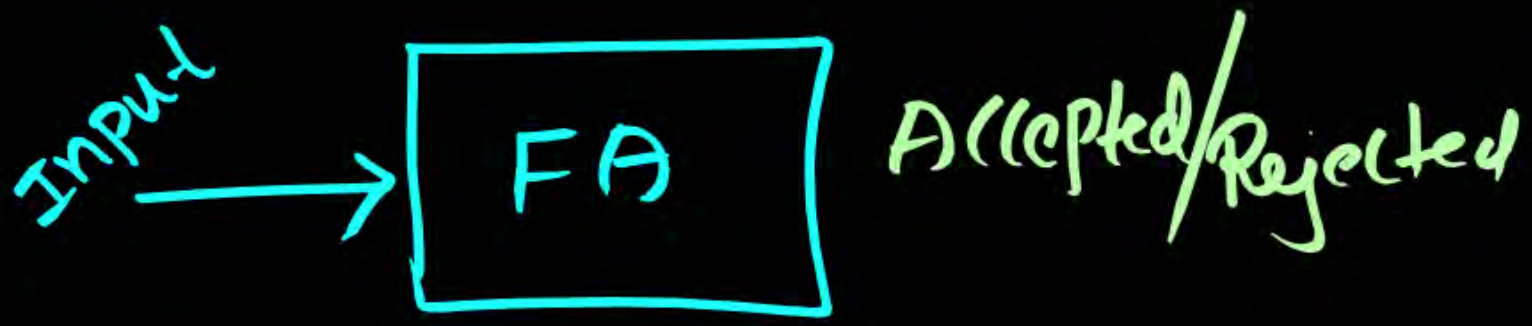
02 Moore M/C

03 Mealy M/C

04

05

Acceptor



FA without O/P

- NFA
- DFA

Applications:
Token Recognizer
Spell checker

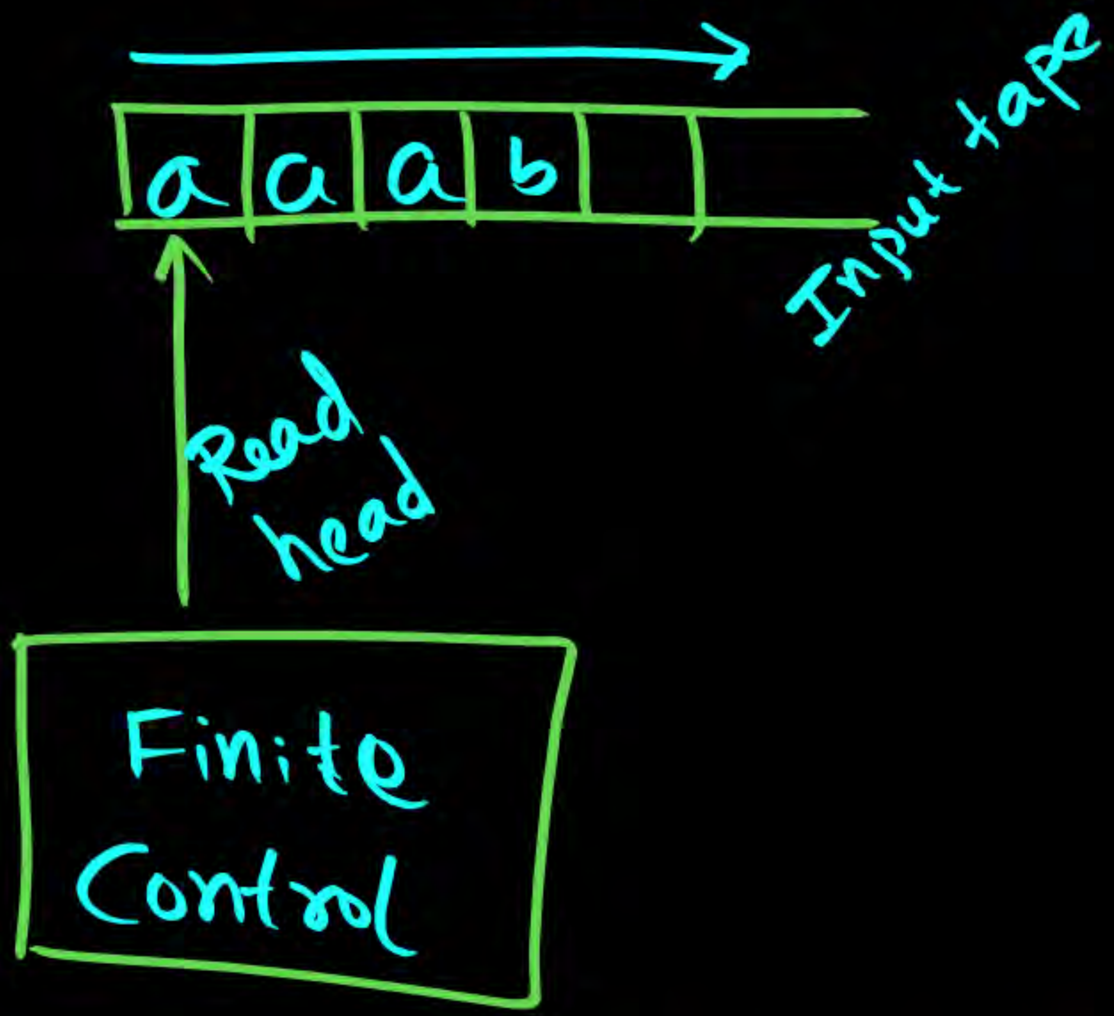
Transducer

FA with O/P

- Moore M/C
- Mealy M/C

Applications:
Sequence Detector, Generator,
Inc/Dec, Addition, Subtraction, etc.

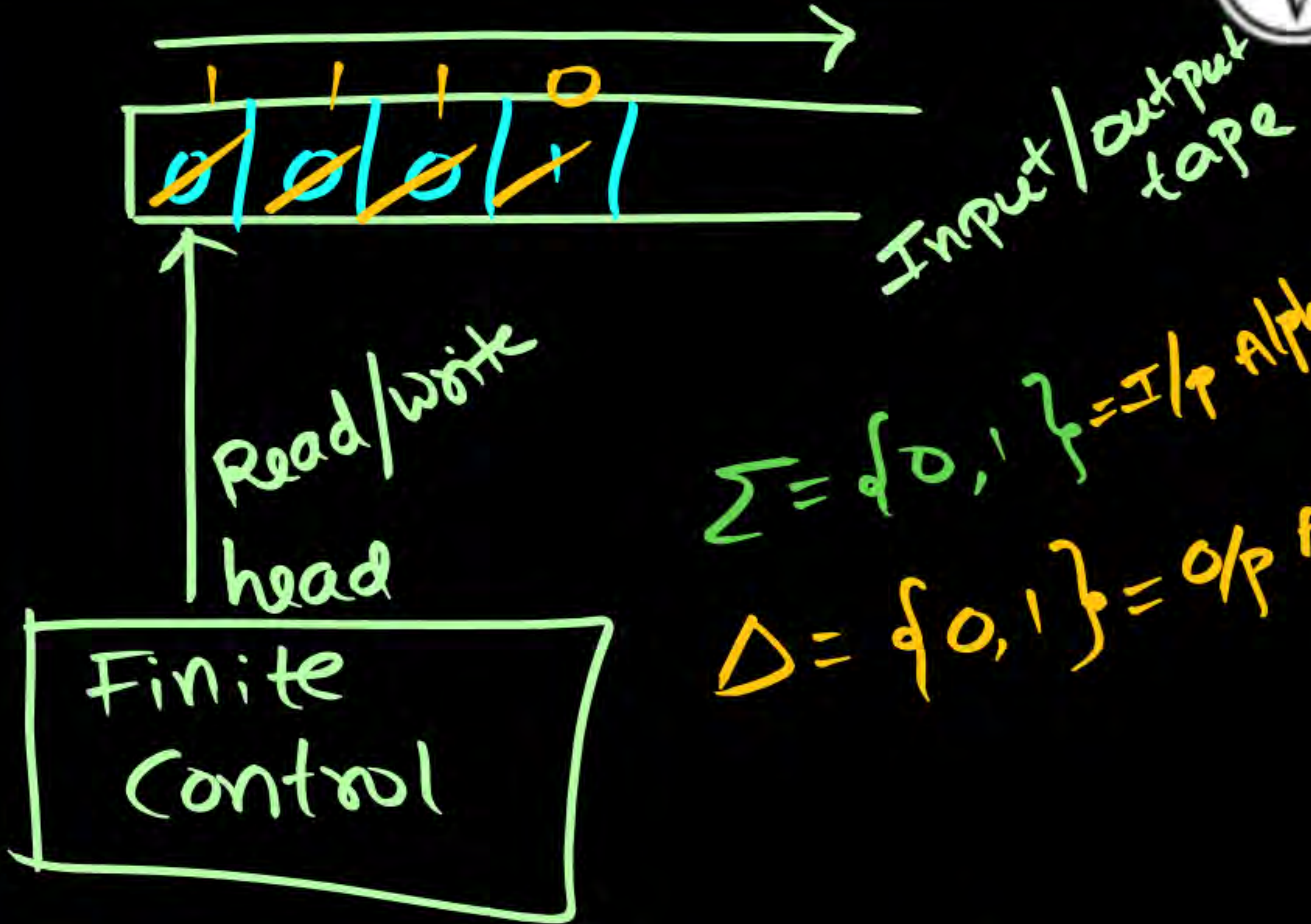
FA Configuration :



$$FA = (Q, \Sigma, \delta, q_0, F)$$

$$\delta_{DFA} : Q \times \Sigma \rightarrow Q$$

$$\delta_{NFA} : Q \times \Sigma_\epsilon \rightarrow 2^Q$$



$\Sigma = \{0, 1\}$ = I/p Alphabet

$\Delta = \{0, 1\}$ = O/p Alphabet

$$FA = (Q, \Sigma, \delta, q_0, \Delta, \lambda)$$

Δ → O/p Alphabet

λ → O/p Function

$$\underbrace{\delta : Q \times \Sigma \rightarrow Q}_{DFA}$$

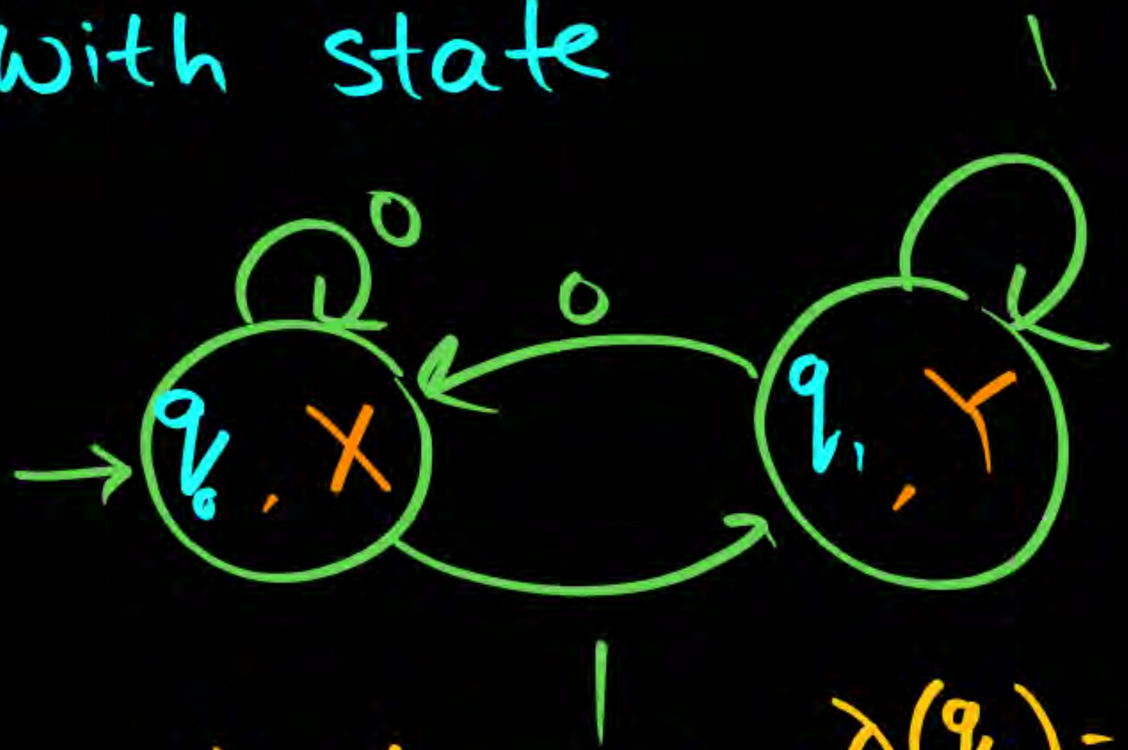
Moore M/C

① $\lambda : Q \rightarrow \Delta$

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

② O/p is associated with state

③



$\Delta = \{X, Y\}$

$\lambda(q_0) = X$

$\lambda(q_1) = Y$

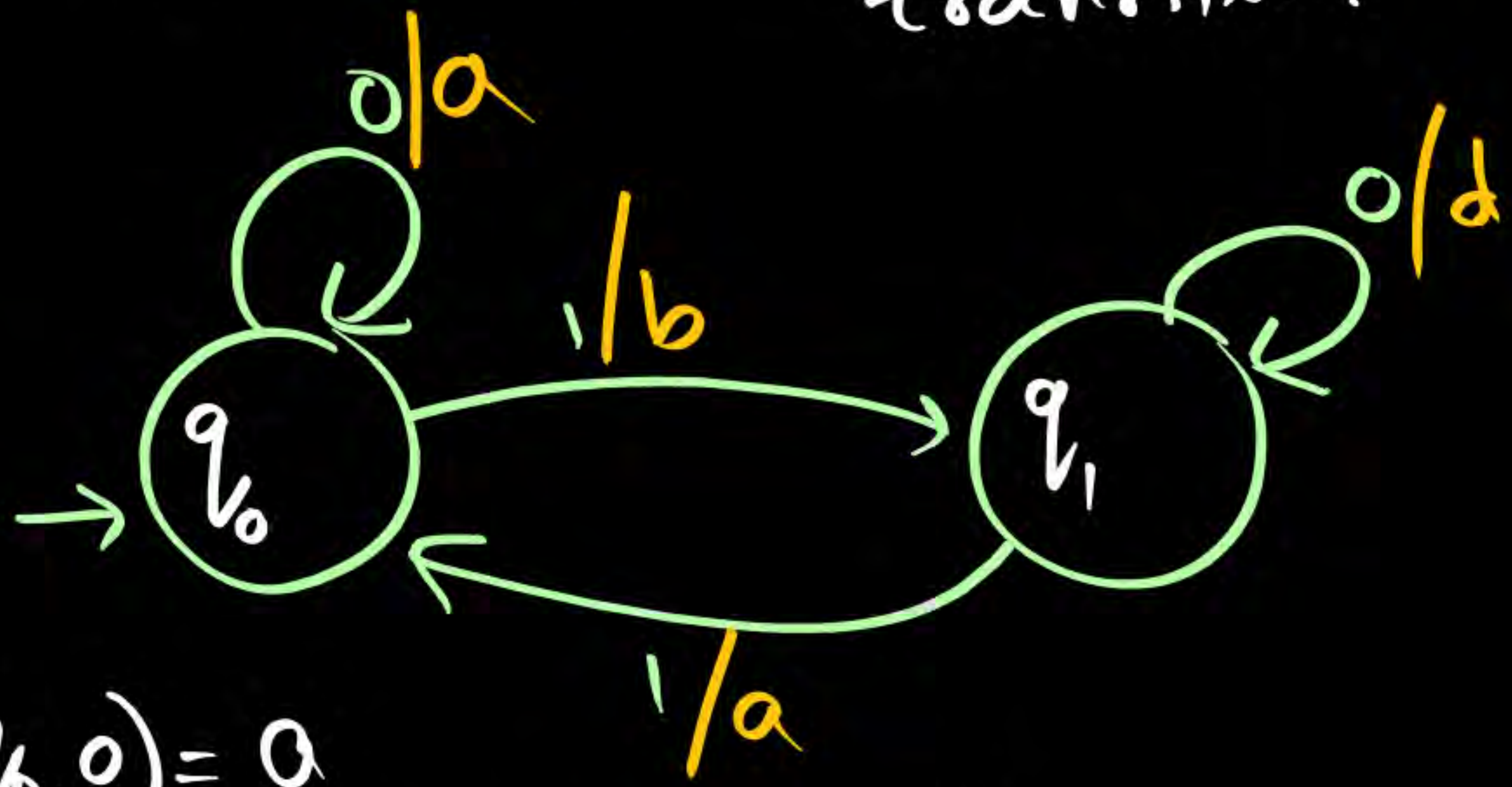
Mealy M/C

① $\lambda : Q \times \Sigma \rightarrow \Delta$

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

② O/p is associated with transition.

③



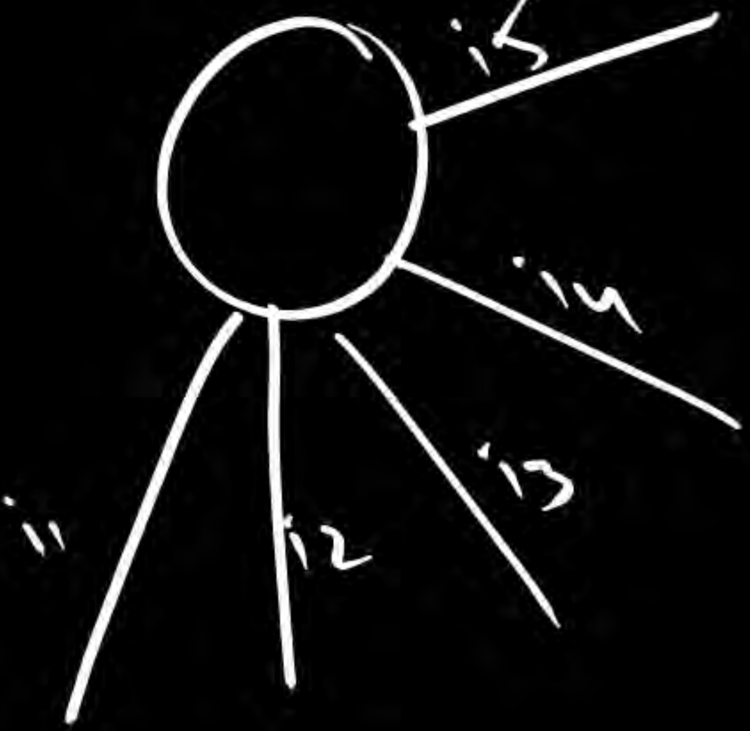
$\lambda(q_0, 0) = a$

$\lambda(q_0, 1) = b$

$\lambda(q_1, 0) = d$

$\lambda(q_1, 1) = a$

Mealy M/c:



$|Q| = 2$

$|\Sigma| = 5$

$\Downarrow$

max size of Δ ?

$= |\delta| = |Q \times \Sigma| = 10$ = no. of transitions

If every transition has different o/p.

Moore M/C

$$|Q| = 2$$

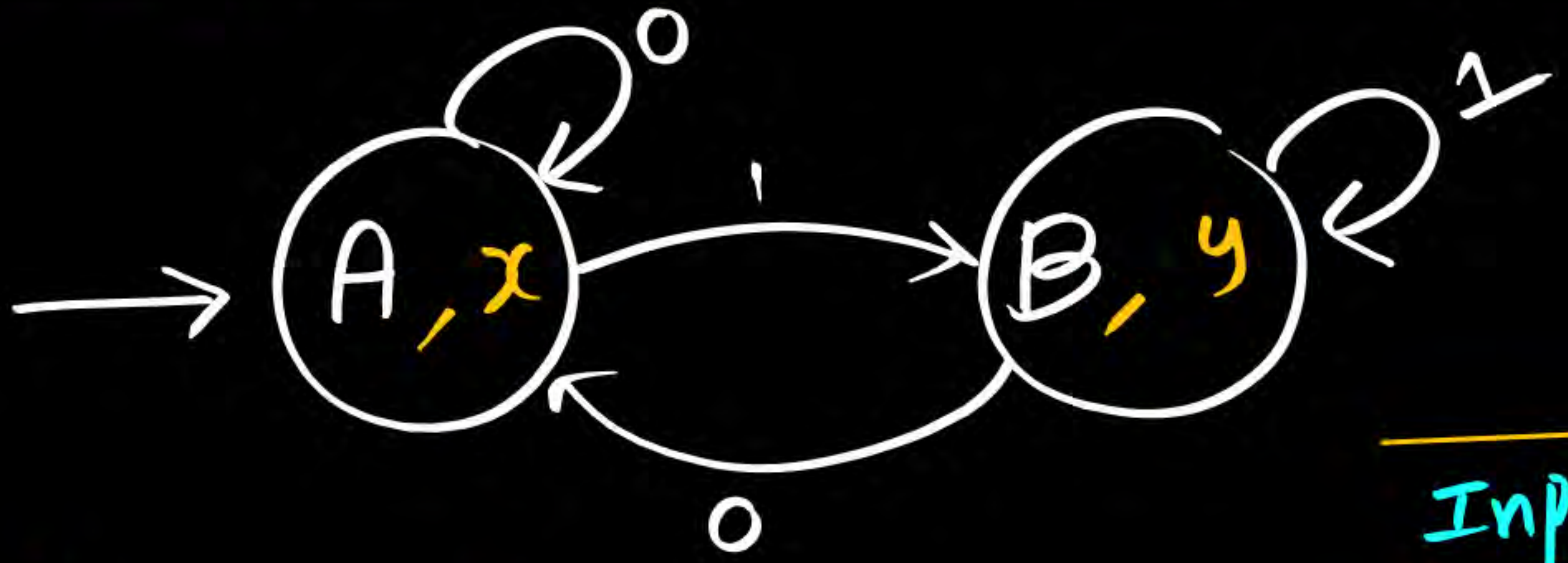
$$|\Sigma| = 5$$

No. of different o/ps ?

$$\underbrace{\max |\Delta|}_{} = ? = |Q| = 2 = \text{no. of states}$$

If every state has different o/p.

Moore M/c :



ε : $\underset{x}{A}$

0 : $\underset{x}{A} \xrightarrow{0} \underset{x}{A}$

$\underset{\boxed{x}}{A} \xrightarrow{1} \underset{\boxed{y}}{B} \xrightarrow{1} \underset{\boxed{y}}{B}$

By default o/p associated with initial state will be produced

Input	Output
ε	x
0	xx
1	xy
00	xxx
01	xxy
10	xyx
11	xyy

In Moore M/C :

(By default every state associated with one o/p symbol)

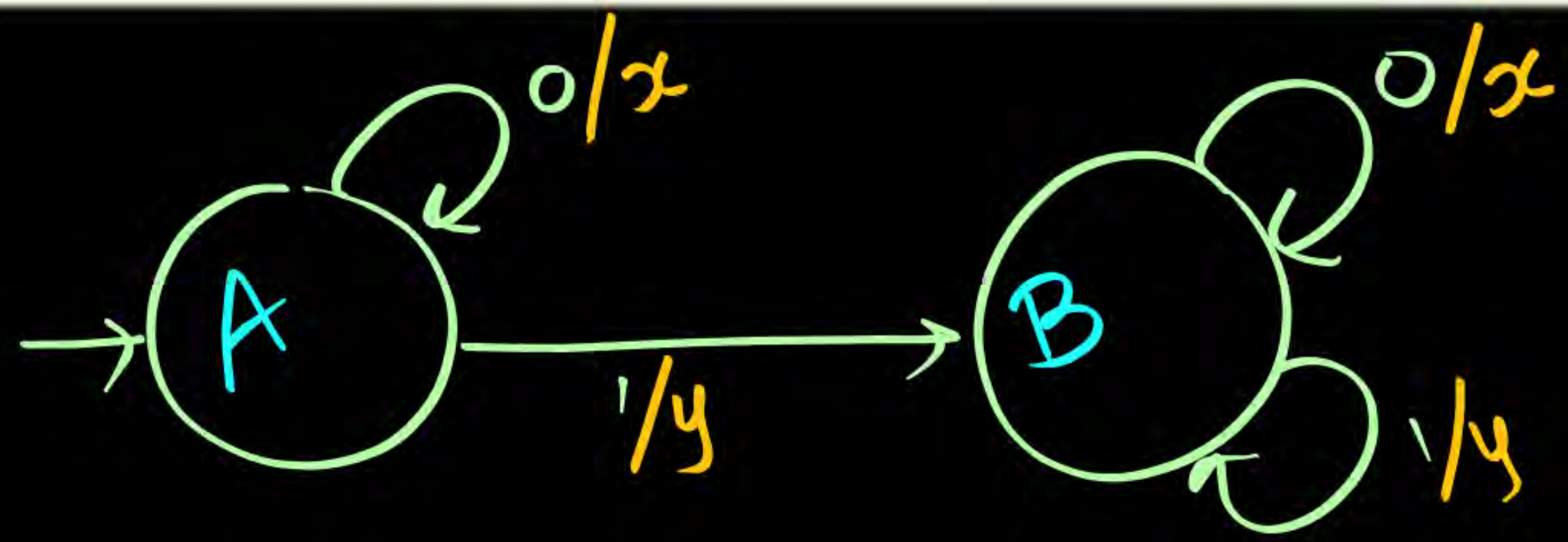
I) If n length i/p is given then

O/p length for given i/p $= n+1$

II) If n length i/p is given and every state is associated with 3 length o/p then

O/p length for given i/p $= 3*(n+1)$

Mealy M/C :



I/p : 0001

O/p : xxxy

$$A \xrightarrow[x]{0} A \xrightarrow[x]{0} A \xrightarrow[x]{0} A \xrightarrow[y]{1} B$$

I/P	O/P
ε →	nothing
0 →	x
1 →	y
00 →	xx
01 →	xy
10 →	yx
11 →	yy

Mealy M/C :

By default

I) If n length i/p given then

o/p length for given i/p = $\underline{n}$

II) If every transition is associated 3 length o/p

then o/p length for n length i/p = $\underline{3n}$

Moore m/c

Mealy m/c

@aba

char ch

ch

a

a

FA

n-length i/p

- Space : O(1) : constant
- Time : O(n) : Linear

- $\delta : Q \times \Sigma \to Q$
- Both are DFAs
- Final states are not there

Language ? accepted by FA

Whether given I/p is valid/Invalid ?

i/p $\longrightarrow \boxed{\quad}$

where it halts? Final/nonfinal

Functionality of FA

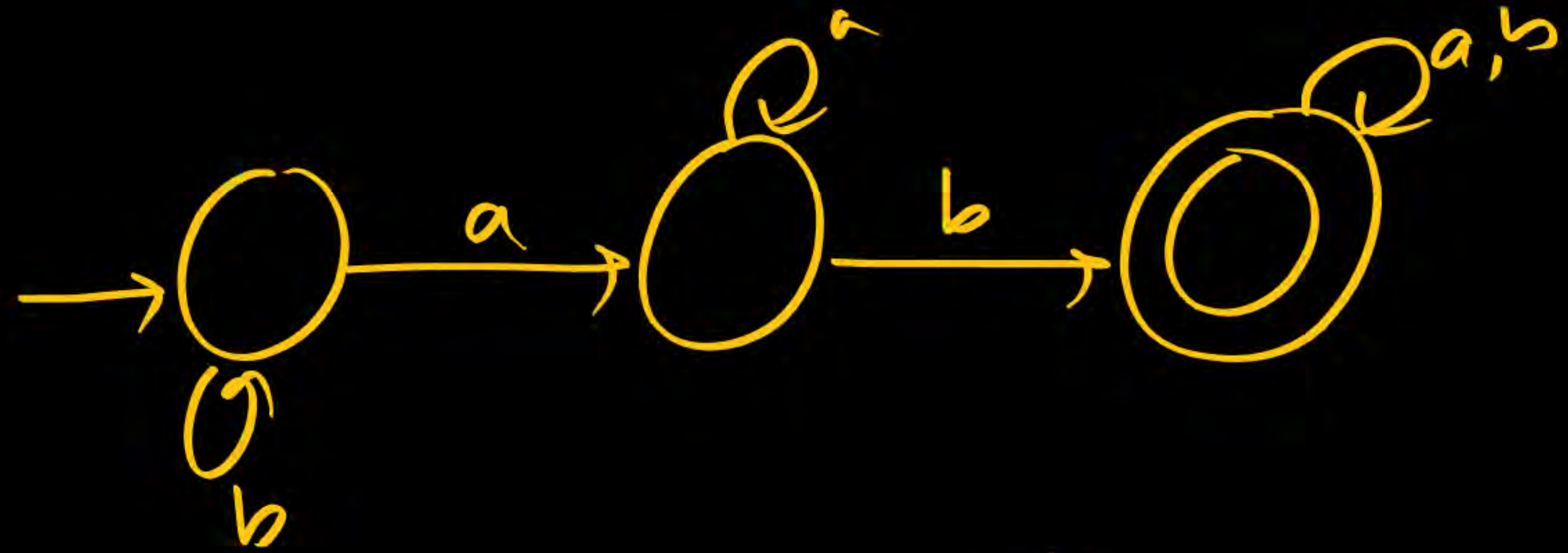
What is the o/p for given i/p ?

i/p $\longrightarrow \boxed{\quad} \longrightarrow$ o/p

$$
\begin{tikzcd}
\boxed{\text{Moore M/C}} \arrow[r, bend left, "\text{Algo 1}"] \arrow[r, phantom, "\cong"] & \boxed{\text{Mealy M/C}} \arrow[l, bend left, "\text{Algo 2}"]
\end{tikzcd}
$$

H.W.: Construct Moore & Mealy M/C

1. 1's complement of Binary i/p
2. 2's Complement " "
3. Increment of Binary i/p
4. Decrement of Binary i/p
5. Addition of 2 binary inputs
6. Subtraction of 2 Binary inputs.



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

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

Summary

→ Moore & Mealy M/C


THANK YOU
GW
SOLDIERS !