CS & IT ENGINEERING

Theory of Computation

Finite Automata:

FA with output

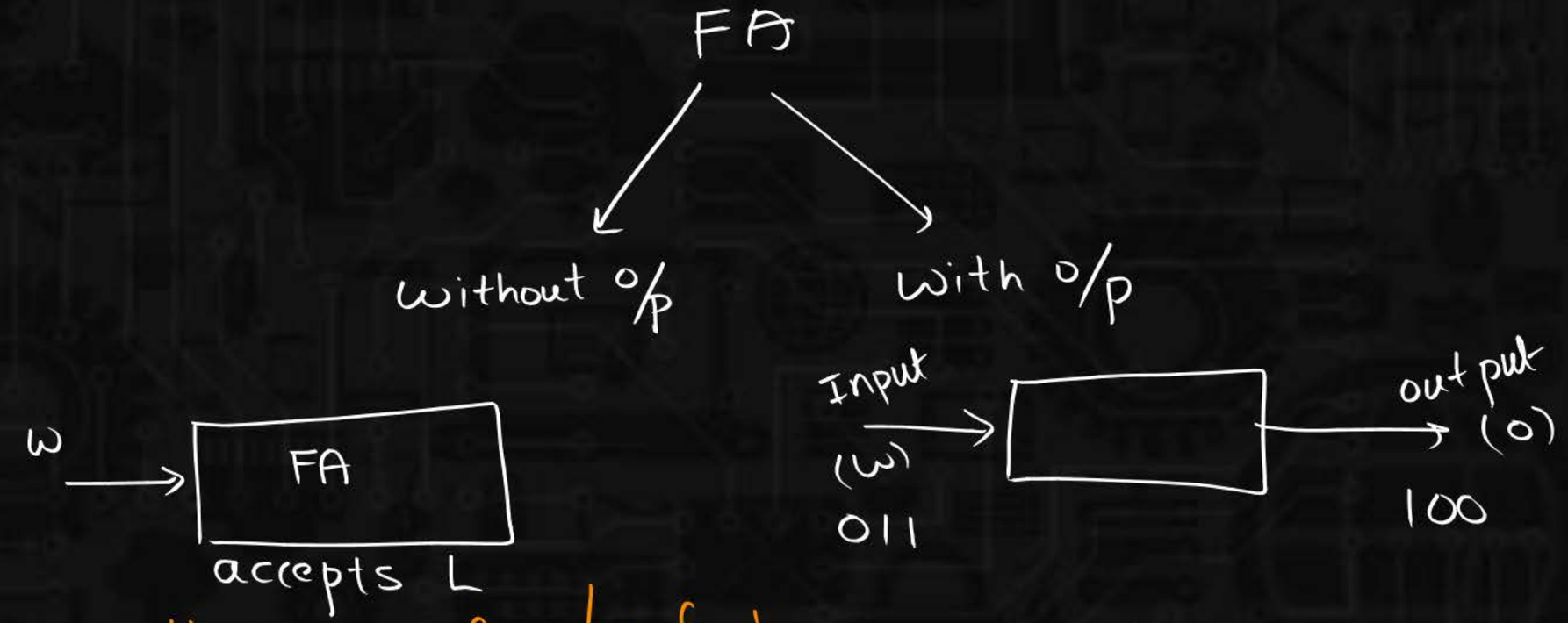
Lecture No. 13

Mallesham Devasane Sir

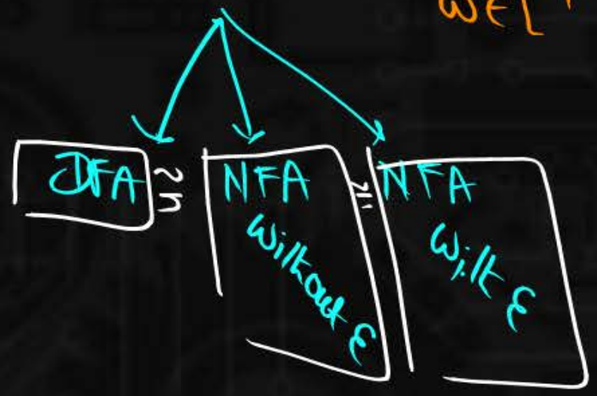
FA with o/p

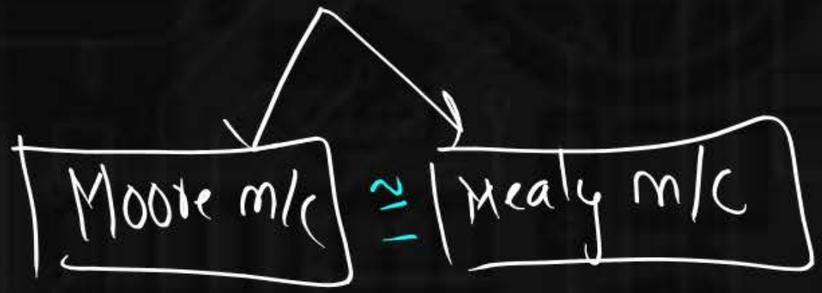
- Moore M/c
- Mealy M/c

FA with Output



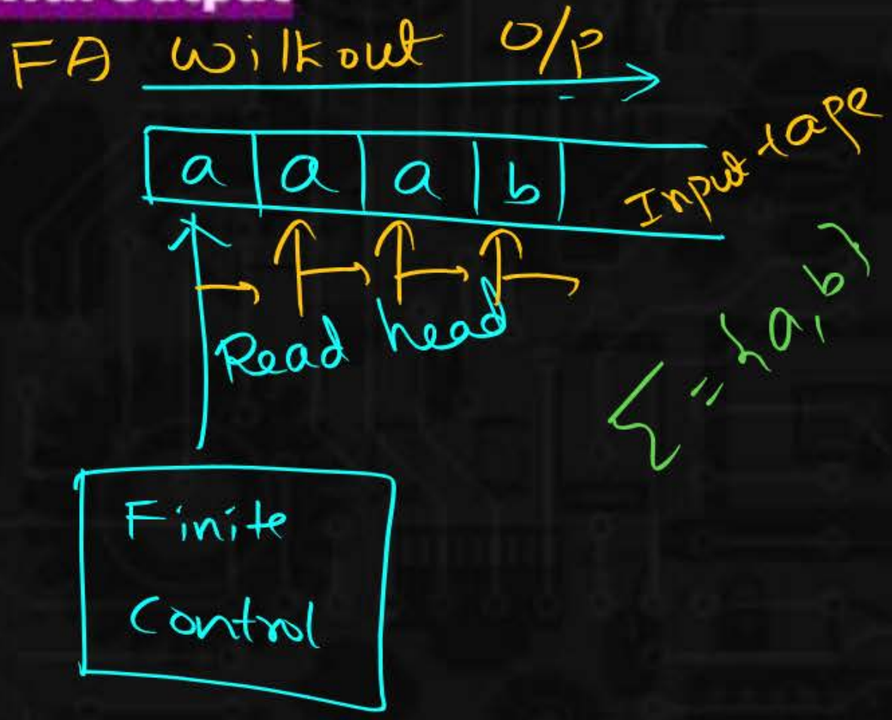
Halts at final / non-final
$w \in L$ $w \notin L$





FA with Output

FA without o/p

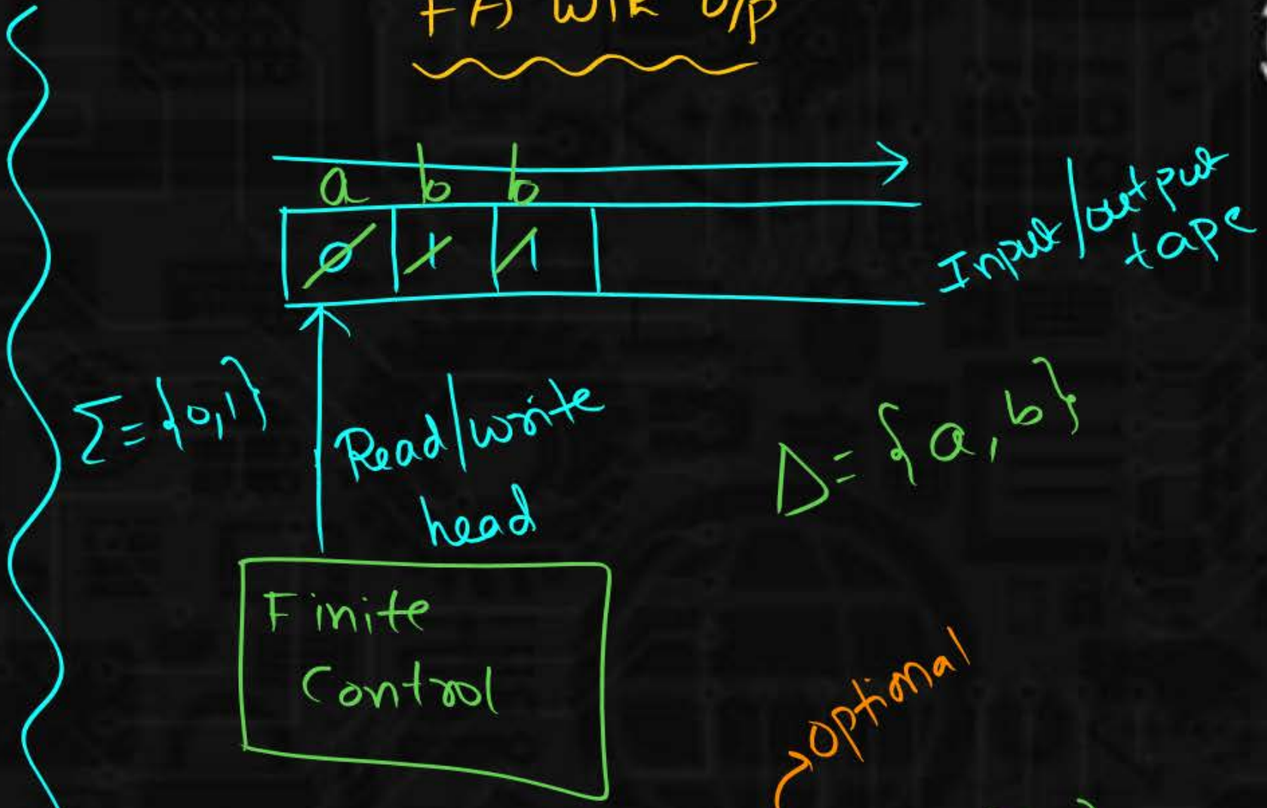


$FA = (Q, \Sigma, \delta, q_0, F)$

DFA $\delta : Q \times \Sigma \to Q$

NFA $\delta : Q \times \Sigma_\varepsilon \to 2^Q$

FA with o/p



$FA = (Q, \Sigma, \delta, q_0, F, \Delta, \lambda)$ (λ: optional)

- δ → DFA transition function: $Q \times \Sigma \to Q$
- Δ → o/p Alphabet
- λ → o/p function

Moore M/c $[\lambda : Q \to \Delta]$

Mealy M/c $[\lambda : Q \times \Sigma \to \Delta]$

FA with Output

Moore M/C

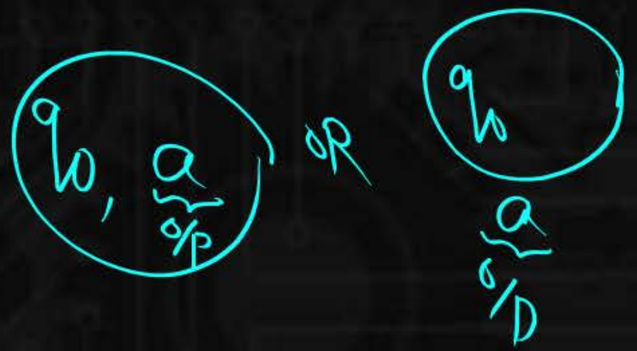
① It is DFA along with o/p's (no final state)

$$\delta : Q \times \Sigma \to Q$$

② output function (λ)

$$\lambda : Q \to \Delta$$

o/p is associated with a state



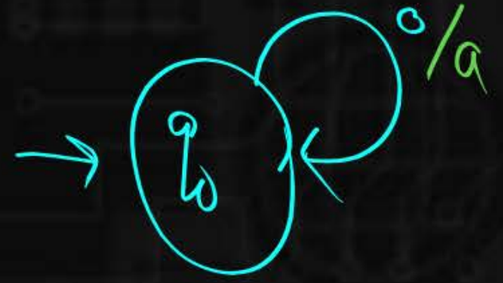
Mealy M/C

① It is DFA along with o/p's (no final state)

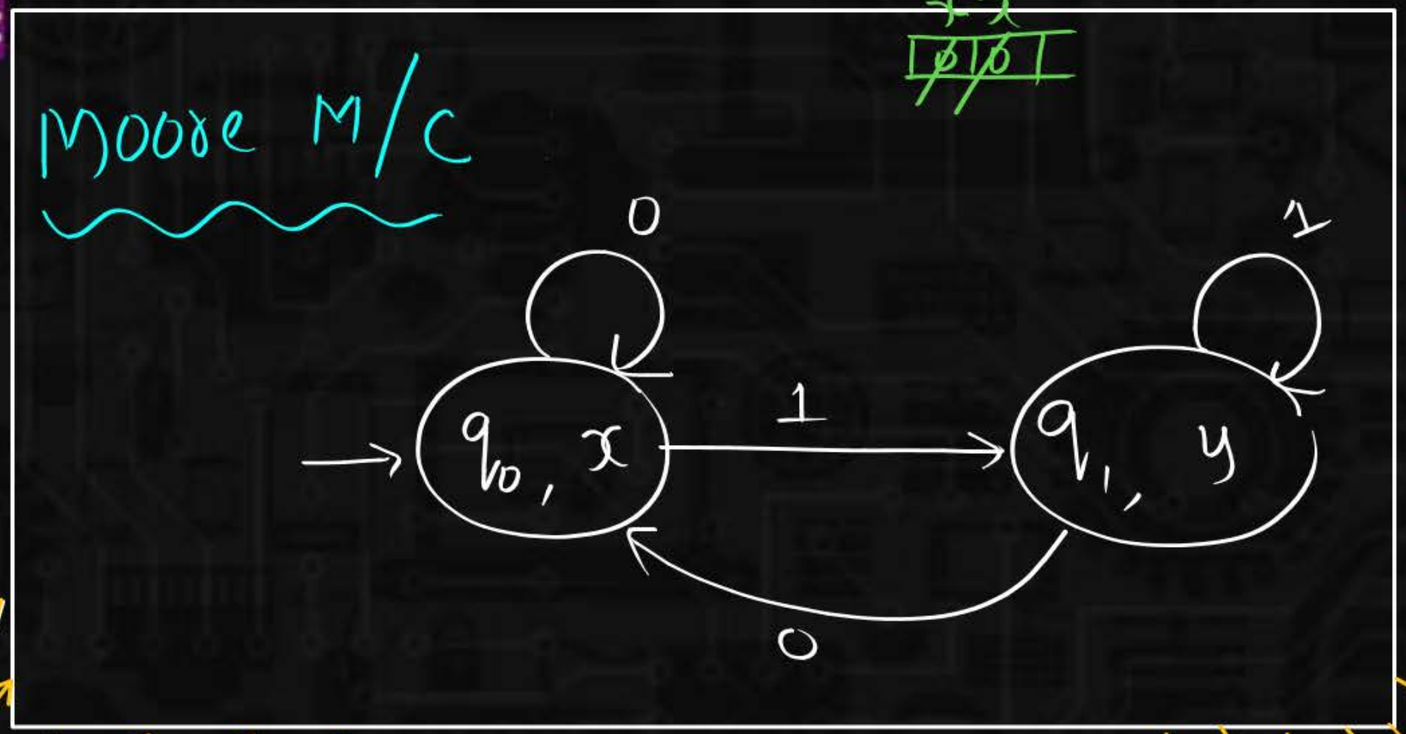
$$\delta : Q \times \Sigma \to Q$$

② output function (λ)

$$\lambda : Q \times \Sigma \longrightarrow \Delta$$



FA with Output



$w = 00$

$q_0 \xrightarrow{0} q_0 \xrightarrow{0} q_0$

x x x

(w)

Input:

0

1

00

01

10

11

$w = 0$ $q_0 \xrightarrow{0} q_0$ x

x ignore

$w = 1$: $q_0 \xrightarrow{1} q_1$ (x, y)

Output:

ignore it always

x x

x y

x x x

x x y

x y x

x y y

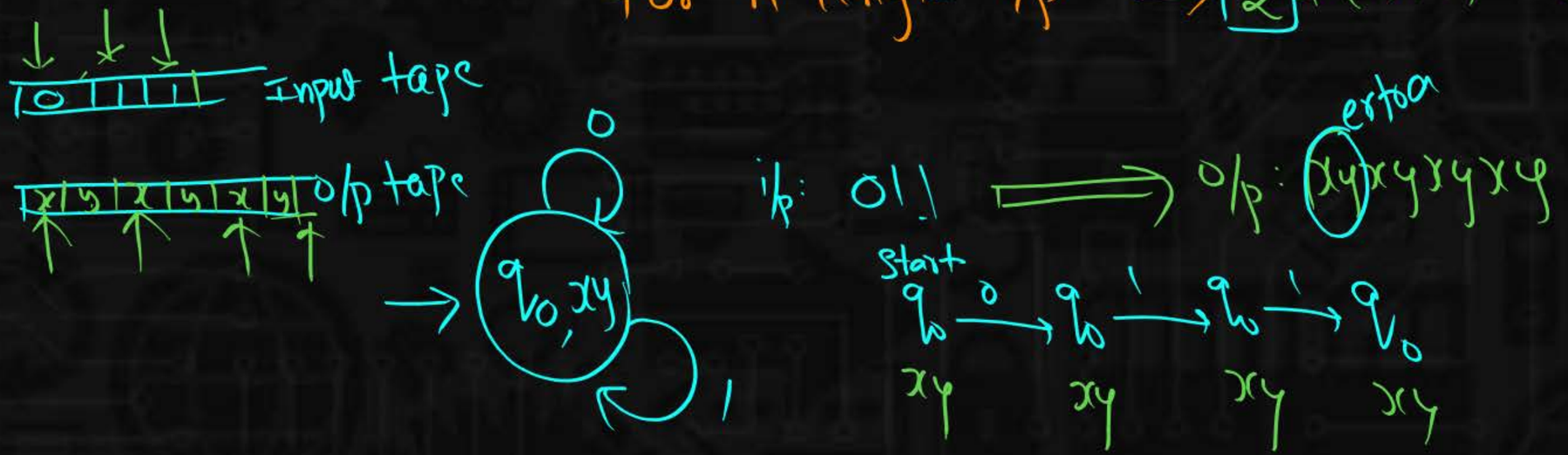
FA with Output

I) If every state has 1 length output symbol :

For n length i/p $\Longrightarrow$ n+1 length o/p

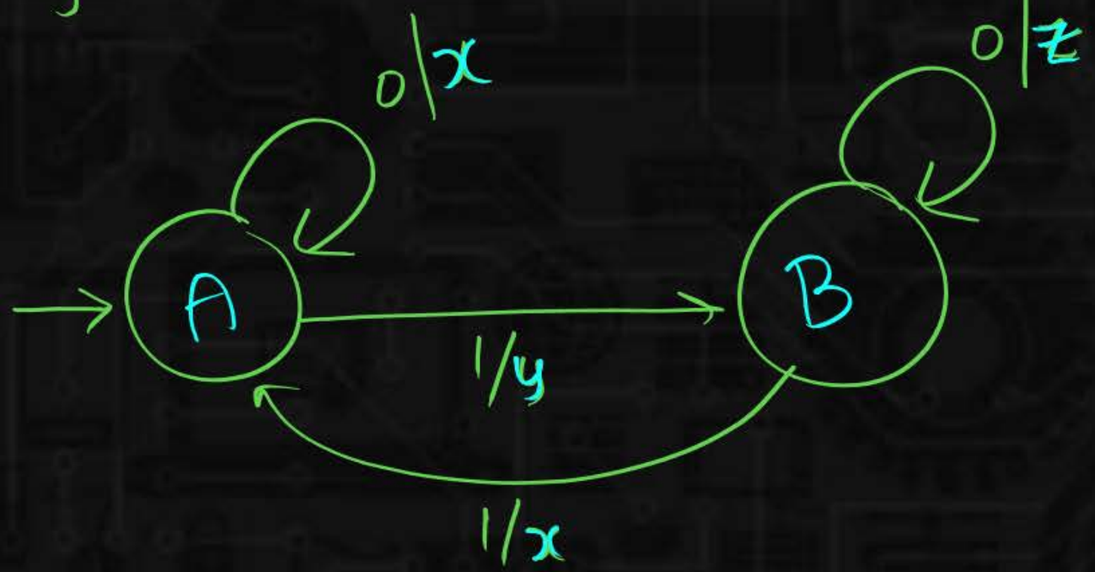
II) If every state has 2 length o/p :

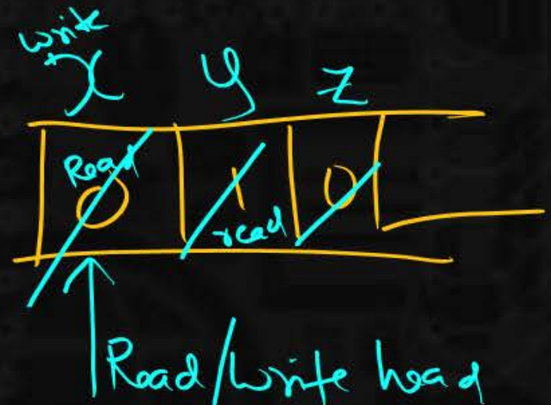
For n length i/p $\Longrightarrow$ 2*(n+1) length o/p $= 2n + 2$ (2 = Initial state o/p)



FA with Output

Mealy M/c :



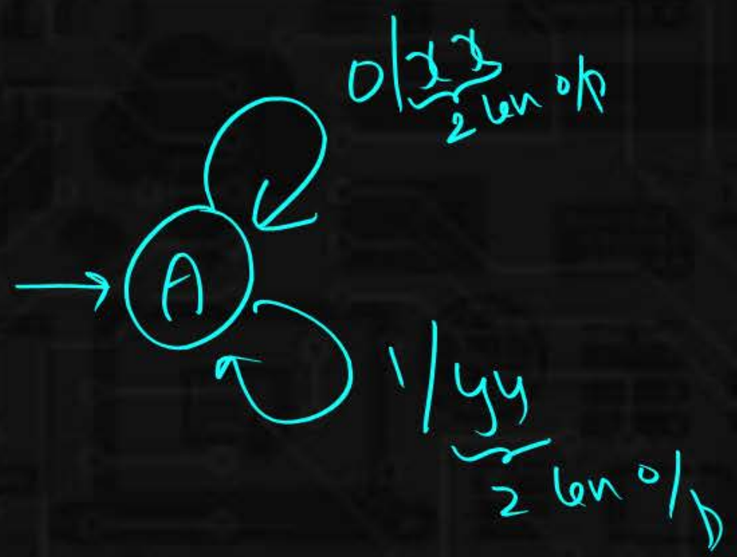


W = 010

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

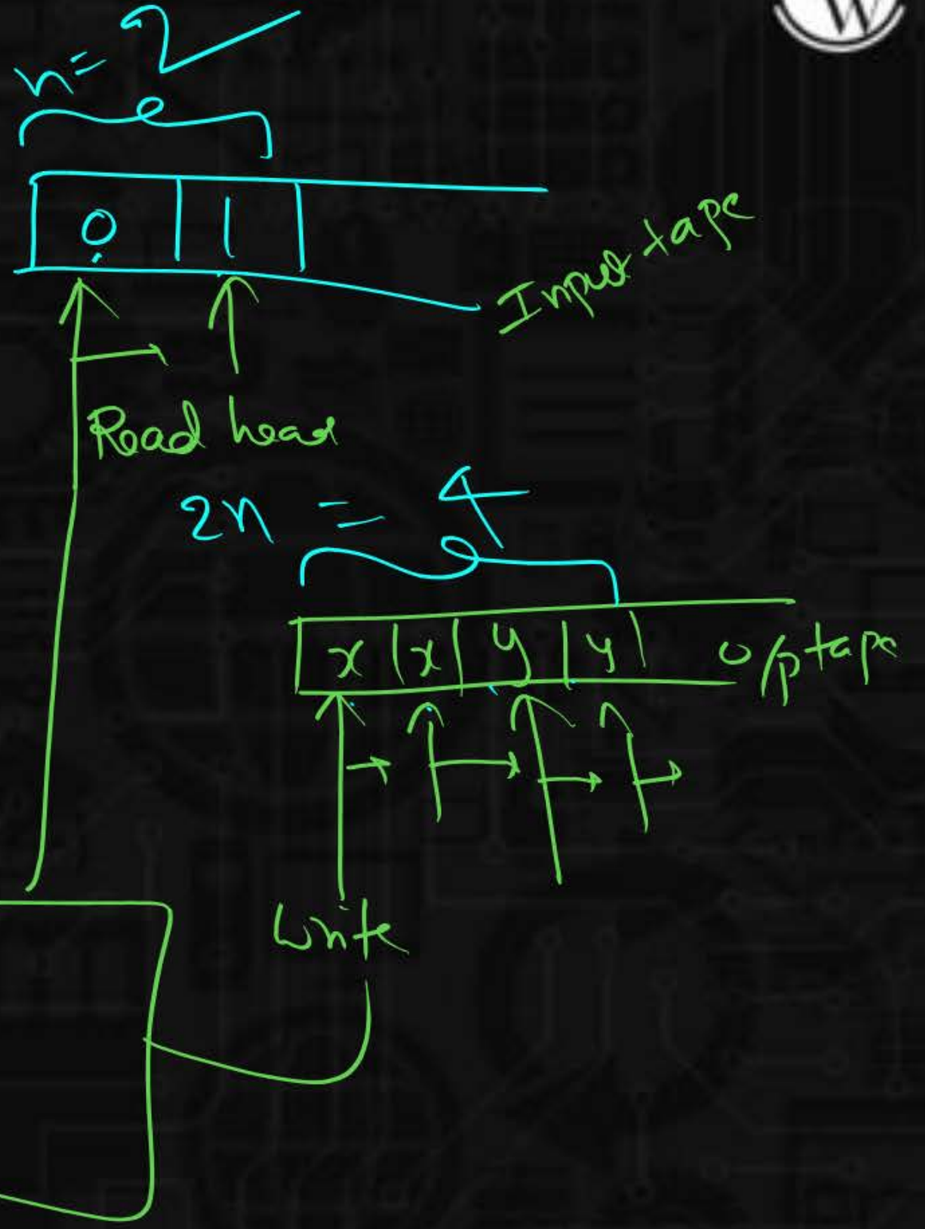
O/P : xyz

FA with Output



0 1 = 3

xx yy yy = 6 = 2*3



FA with Output

By default

I) If n length i/p is given in Mealy m/c

then n is o/p length.

II) If 2 length o/p is associated with every transition

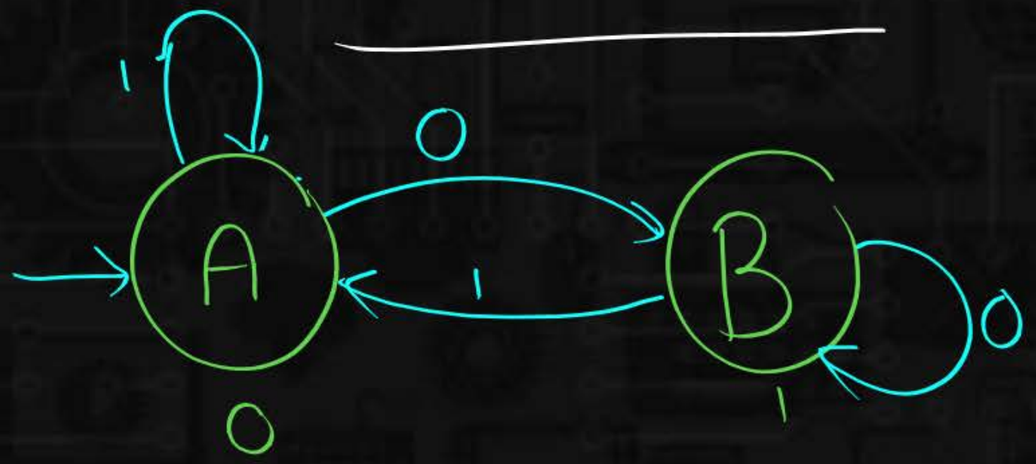
then for n length i/p, 2n is o/p length

FA with Output construction of FA with O/P :

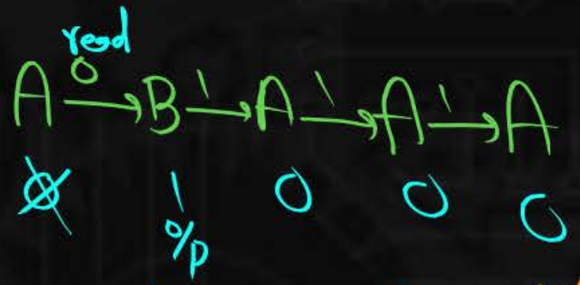
(1) One's complement of Binary number

$\Sigma = \{0,1\}$
$\Delta = \{0,1\}$

Moore M/c

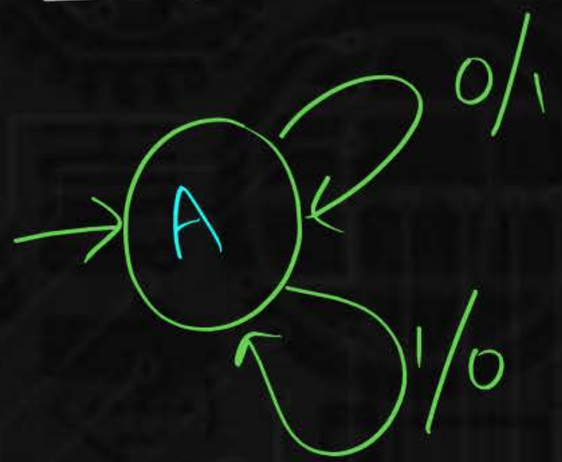


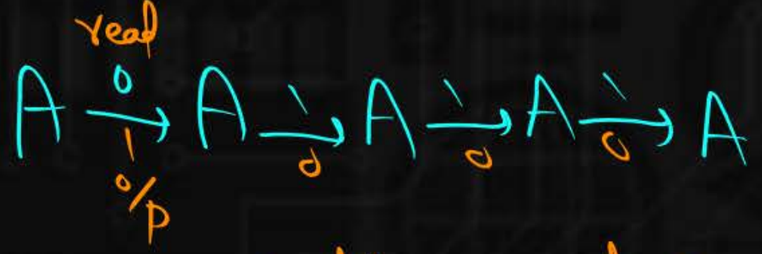
I/P : 0111



Delay in producing O/P

Mealy M/c





No delay in producing O/P

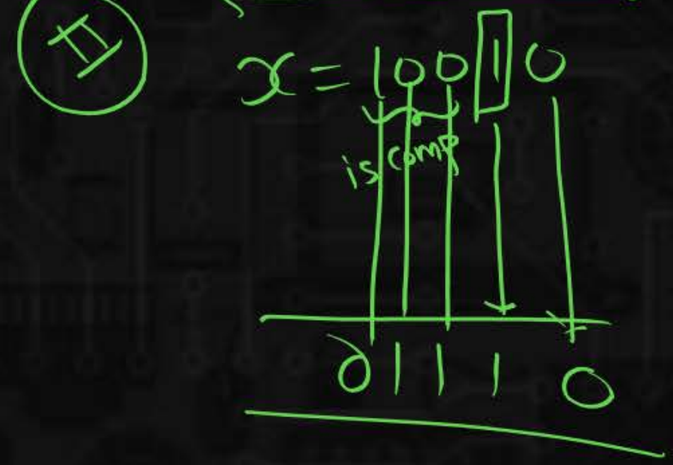
FA with Output

- Traffic signal
- Digital circuits
  - Increment of binary i/p $[x+1]$
  - Decrement of binary i/p $[x-1]$
  - 1's complement
  - 2's complement
  - Addition of any 2 binary i/p's $[x+y]$
  - multiplication of any binary i/p with constant
    - $2x$
    - $4y$
  - Subtraction of any 2 i/ps $[x-y]$
  - Counters
    - 000 → 001 → 010
  - Sequence detector
    - Detect 10 in sequence
    - 0 1 0 1 0 1 0 1 0

FA with Output

② 2's complement of binary i/p

(II) till 1st one, copy as it is

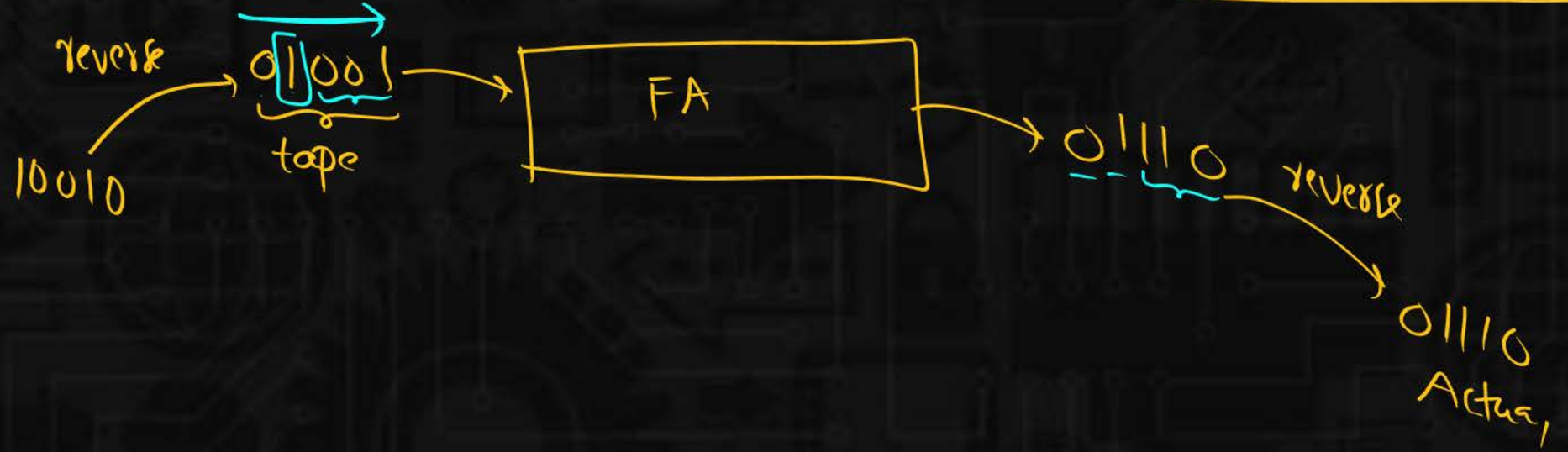


(I) x = 10010

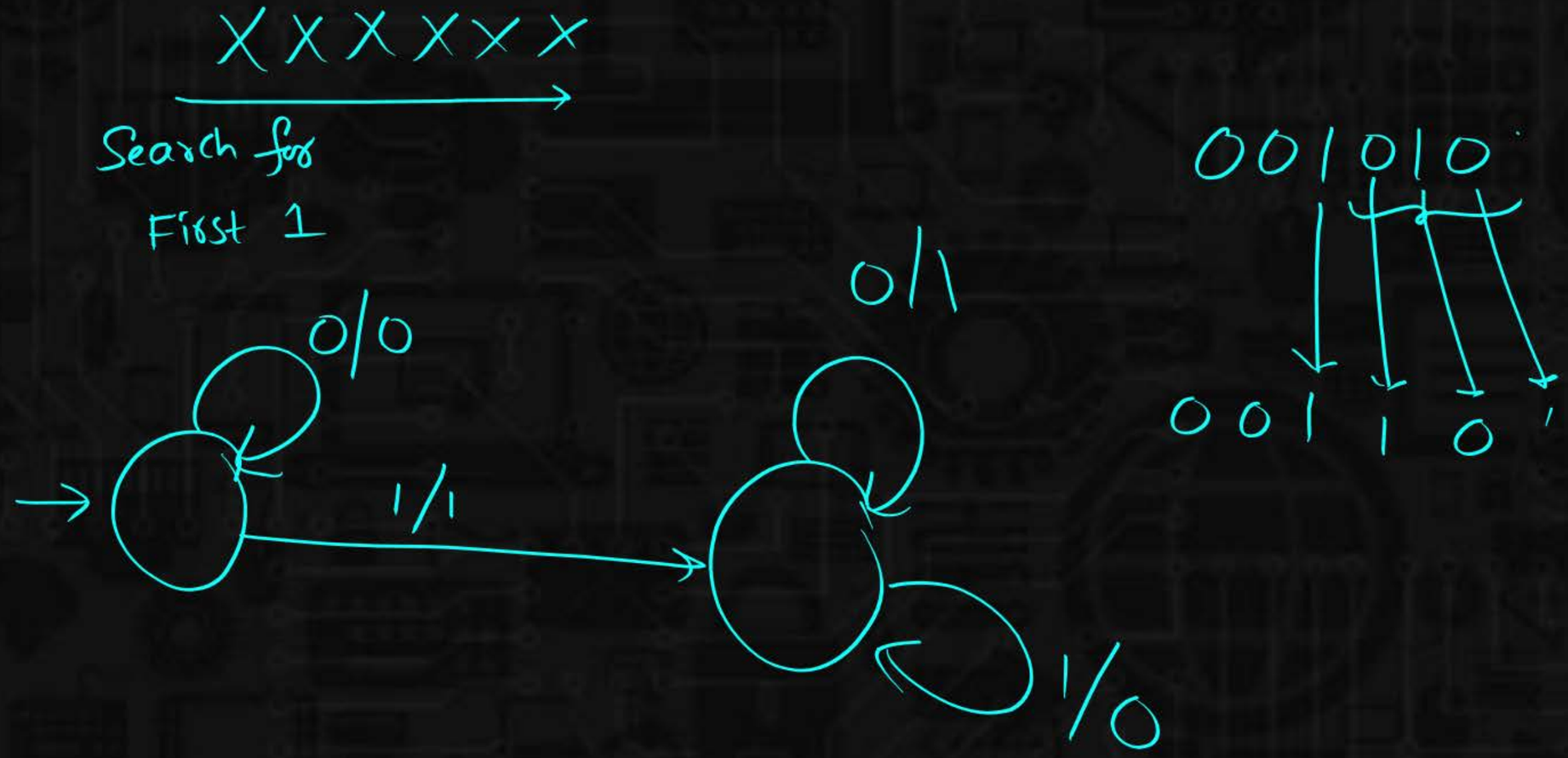
1's comp of x: 01101

+1

01110 ⇒ 2's comp of x



FA with Output



Applications

FA

- Digital logic problems
- compiler design

producing token

Recognize lexeme and produce token


THANK YOU GW
SOLDIERS !