SNS COLLEGE OF TECHNOLOGY

Coimbatore-36.

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

COURSE CODE& NAME : *19CSB301* &AUTOMATA THEORY AND COMPILER DESIGN

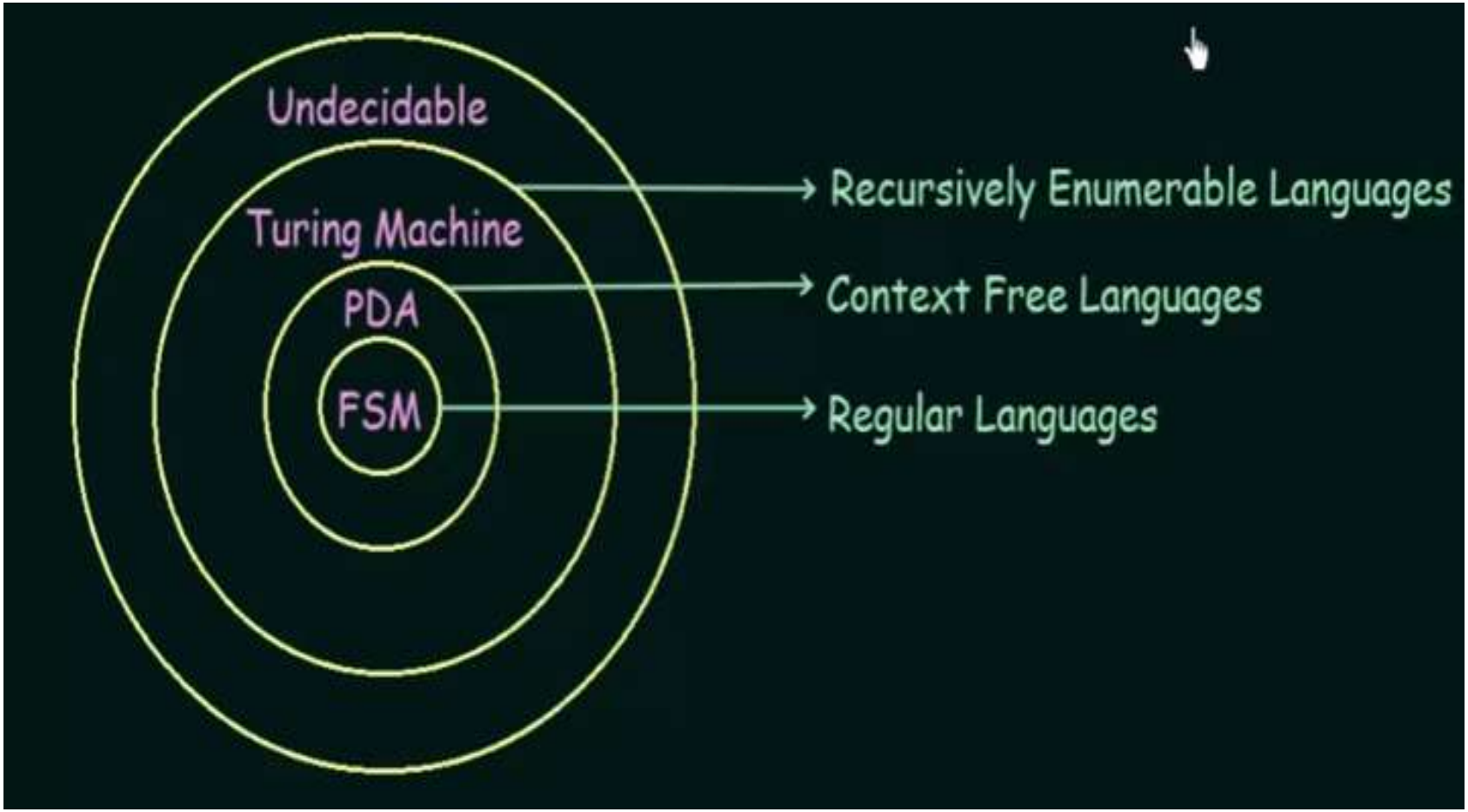
III YEAR/ V SEMESTER

UNIT – I FINITE AUTOMATA AND REGULAR LANGUAGES

Topic: Turing Machines- Languages of Turing Machine

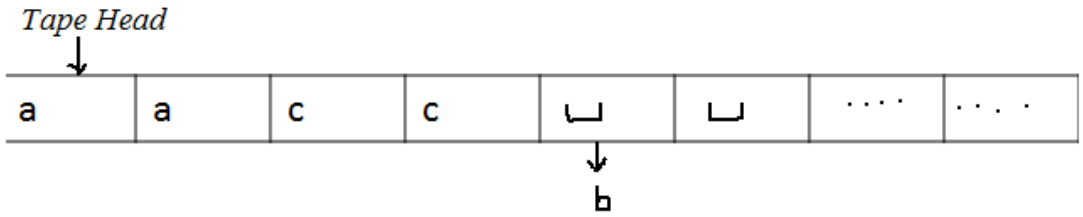
Dr.B.Vinodhini
Assistant Professor
Department of Computer Science and Engineering

Turing Machine



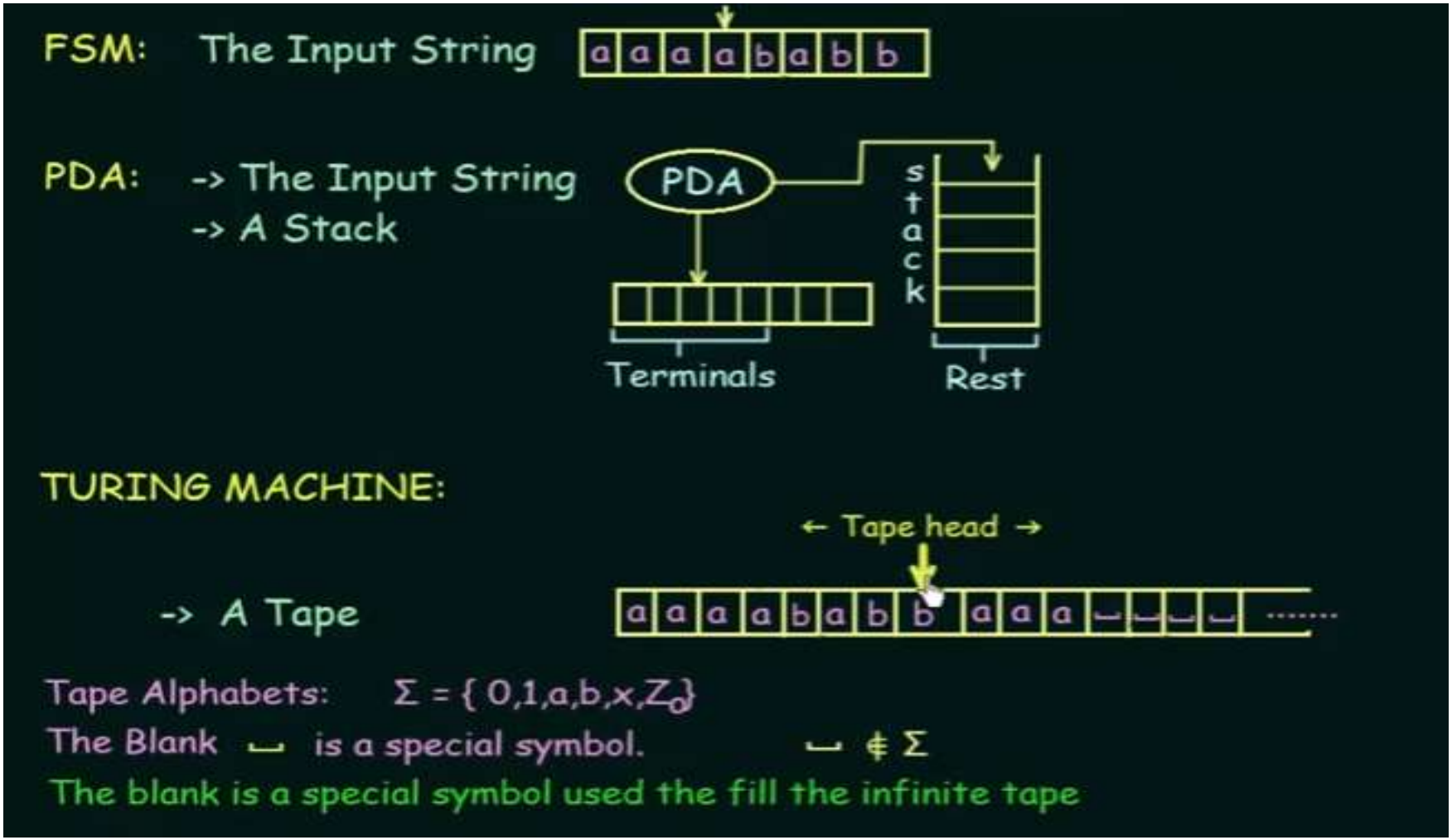
Turing Machine

- FSA → Regular language
- PDA → CFG → Context Free language → Stack
- Turing Machine → recursively enumerable language
  - Alan Turing (1936)
  - Unrestricted Grammar
  - ***Tape***

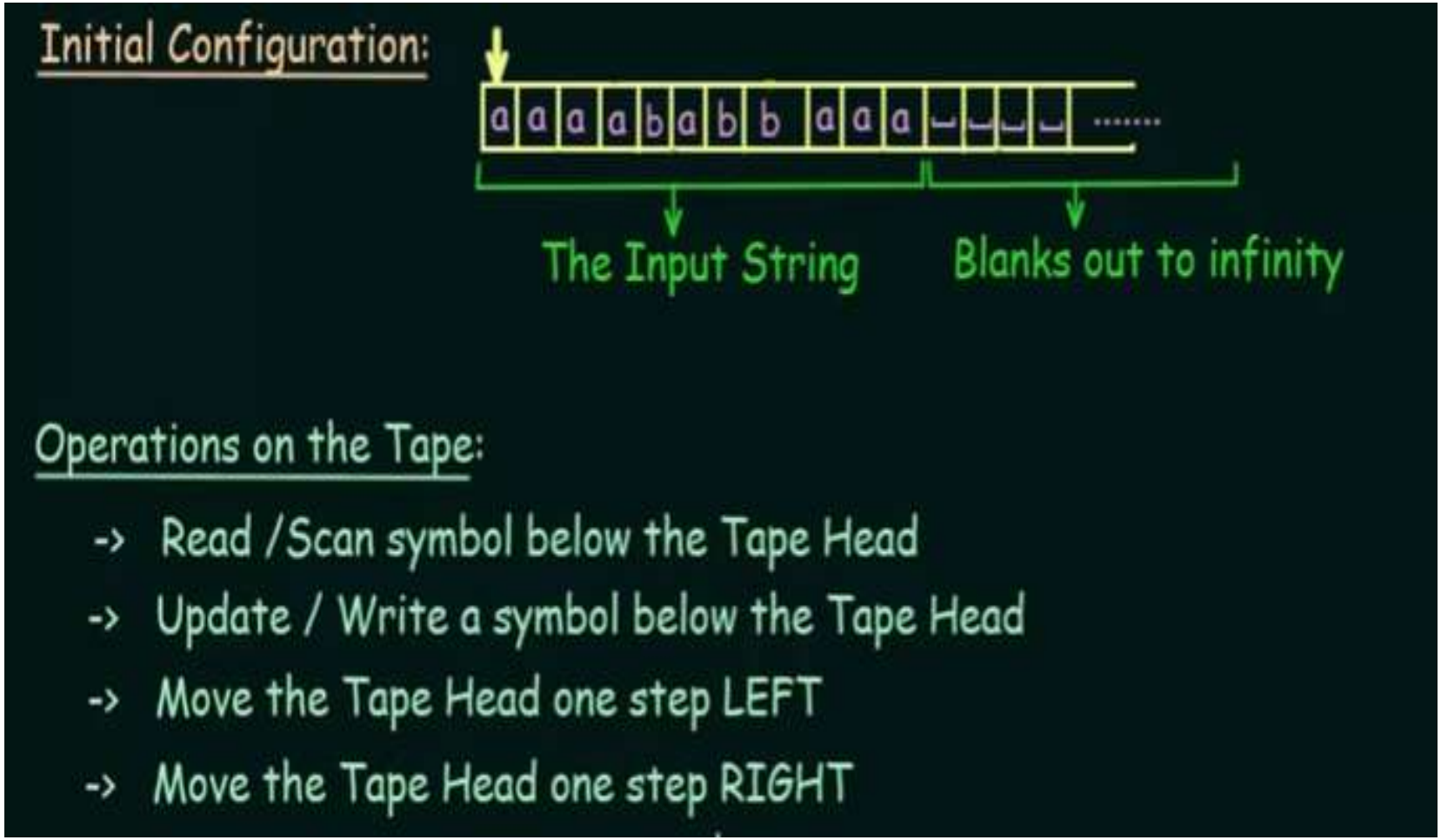


  - TM → what can be computed
  - ***Model for Computer***
  - Algorithm → TM can do its computation
  - (Simulation)

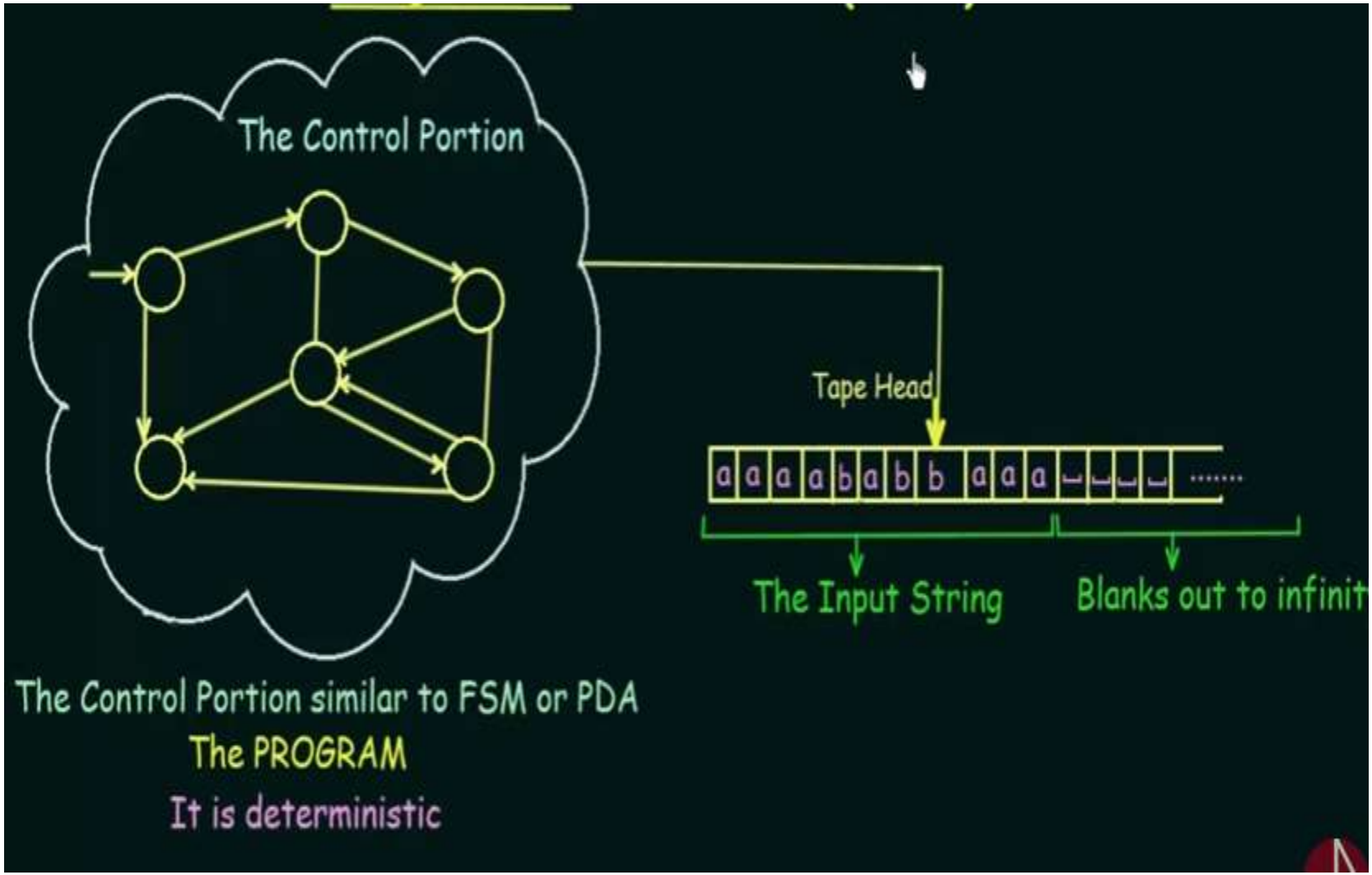
Turing Machine



Turing Machine



Turing Machine



Turing Machine

A Turing Machine can be defined as a set of 7 tuples

$$(Q, \Sigma, \Gamma, \delta, q_0, b, F)$$

$Q \rightarrow$ Non empty set of States

$\Sigma \rightarrow$ Non empty set of Symbols

$\Gamma \rightarrow$ Non empty set of Tape Symbols

$\delta \rightarrow$ Transition function defined as

$$Q \times \Sigma \rightarrow \Gamma \times (R/L) \times Q$$

$q_0 \rightarrow$ Initial State

$b \rightarrow$ Blank Symbol

$F \rightarrow$ Set of Final states (Accept state & Reject State)

Thus, the Production rule of Turing Machine will be written as

$$\delta (q_0, a) \rightarrow (q_1, y, R)$$

Turing Machine

Rules of Operation - 1

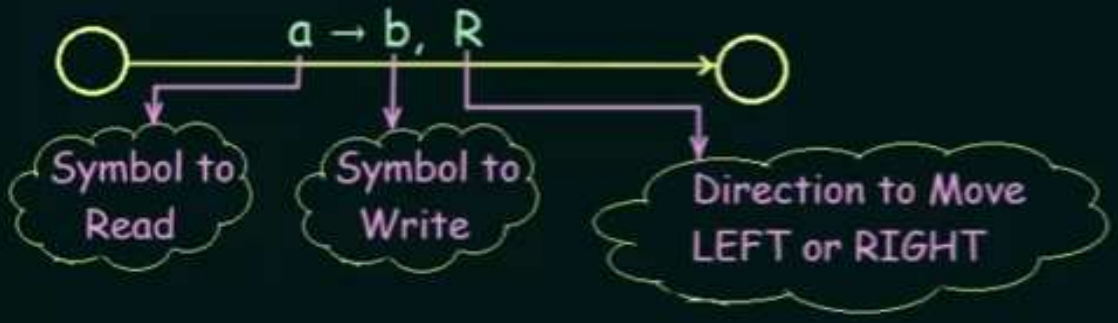
At each step of the computation:

-> Read the currect symbol

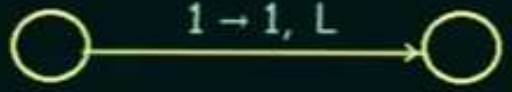
-> Update (i.e. write) the same cell

-> Move exactly one cell either LEFT or RIGHT

If we are at the left end of the tape, and trying to move LEFT, then do not move. Stay at the left end



If you dont want to update the cell, JUST WRITE THE SAME SYMBOL



Turing Machine

Rules of Operation - 2

-> Control is with a sort of FSM

-> Initial State

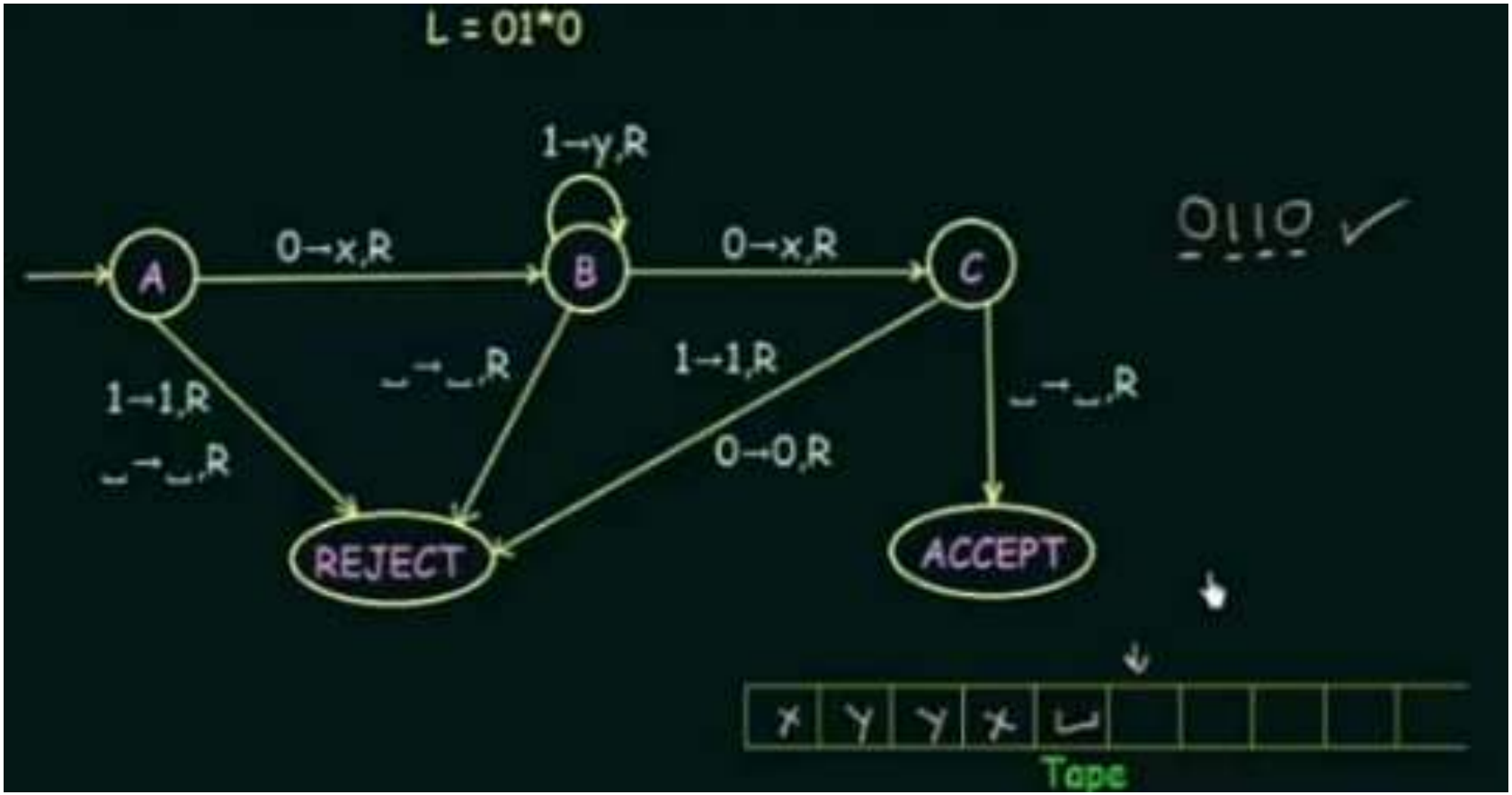
-> Final States: (there are two final states)

1) The ACCEPT STATE
2) The REJECT STATE

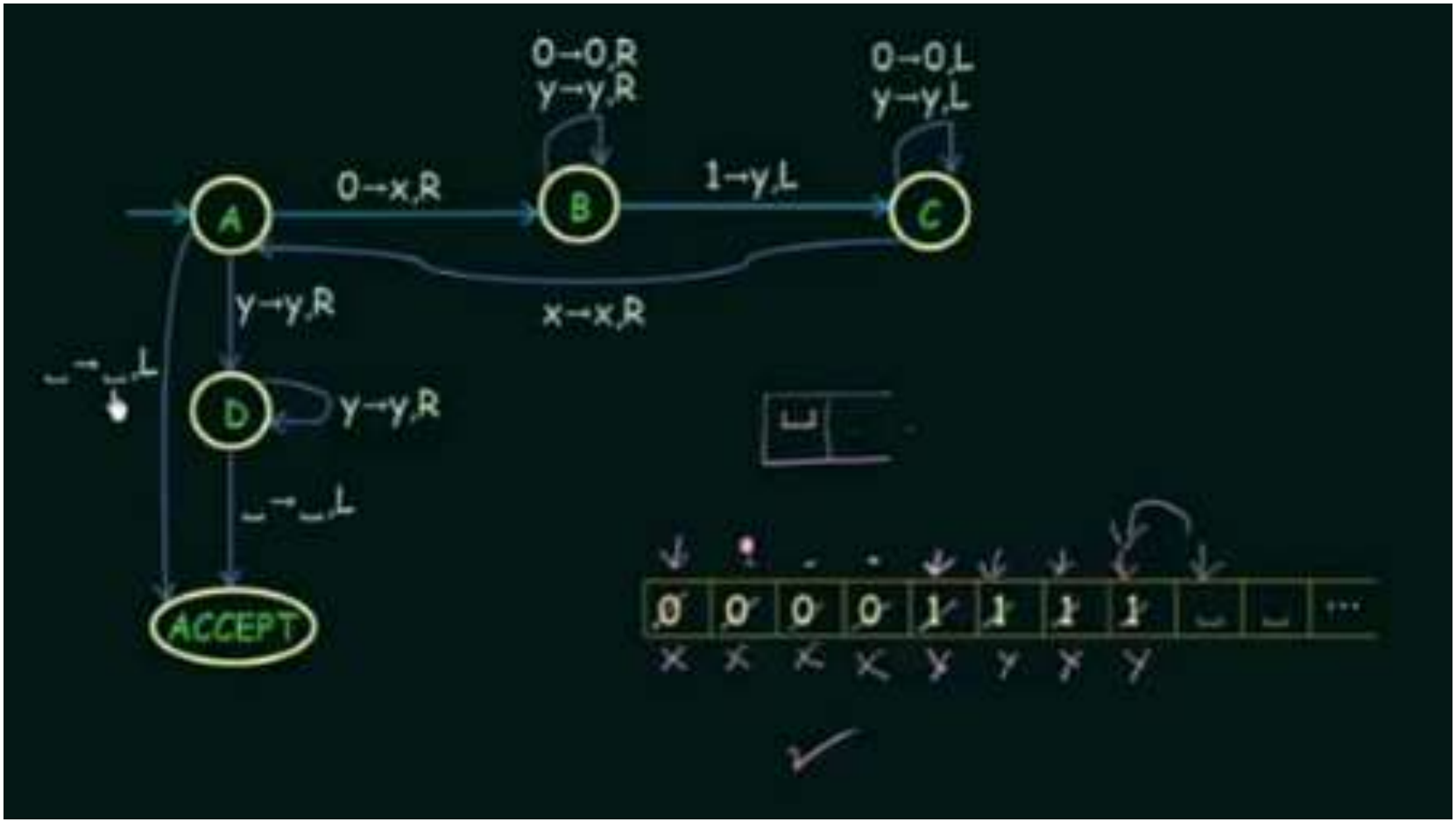
-> Computation can either

1) HALT and ACCEPT
2) HALT and REJECT
3) LOOP (the machine fails to HALT)

Turing Machine – Example1



Turing Machine – Example2 ($L=0^n1^n$)



Applications

- Applications
  - Computer Networks
  - Artificial Intelligence
  - Machine Learning
- Turing Machine was invented by
  - Alan Turing Turing taring Nickel Turing
- In one move the turing machine
  - May change the state
  - Move one tape position by Left or Right
  - Write the Symbol on the cell
  - All these
- Turing machine is more powerful than
  - PDA -FSA -Both these

References

- John E. Hopcroft and Rajeev Motwani and Jeffrey D. Ullman, “Introduction to Automata Theory, Languages and Computation”, Second Edition, Pearson Education, New Delhi, (2007) (UNIT-I)
- Linz P. An introduction to formal languages and automata. Sixth edition, Jones and Bartlett Publishers; 2016.(UNIT-I)
- Ramaiah k. Dasaradh “Introduction to Automata and Compiler Design “ First Edition ,Prentice Hall India Learning Private Limited(2011)(UNIT-I to V)