

# CS & IT ENGINEERING

Theory of Computation

Turing Machine : Recursively Enumerable

**Turing Machine (Part 1)**



**Lecture No. 1**



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# TOPICS TO BE COVERED

01 Turing Machine

02 Configuration of TM

03 Types of TM

04 Recursive Language Vs REL

CSL Vs ~~REL~~ Vs REL  
05 LBA Vs HTM Vs TM

FA

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

PDA

$(Q, \Sigma, \delta, q_0, F, Z_0, \Gamma)$

TM

$(Q, \Sigma, \delta, q_0, F, B, \tau)$

Blank Symbol

Tape Alphabet

Tape

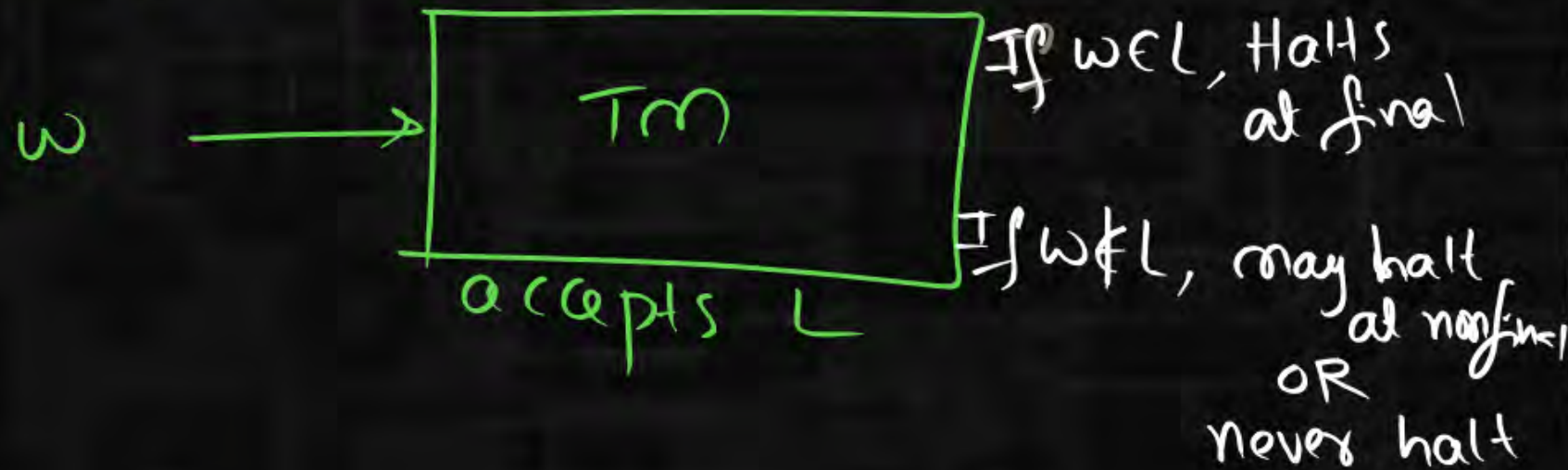


# Turing Machine



→ It represents a Recursively Enumerable Language

## I) Acceptor



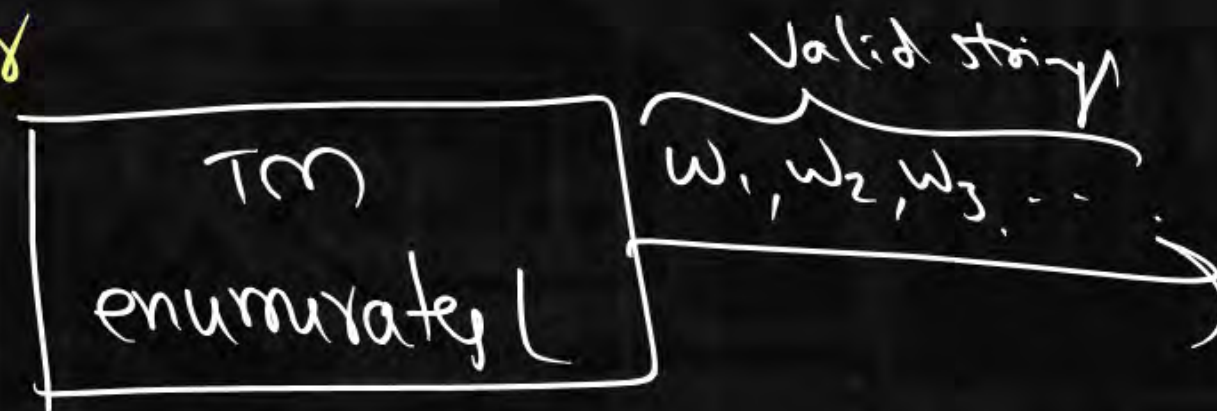
(REL)

(Enumerable Set)

(Turing Acceptable set)

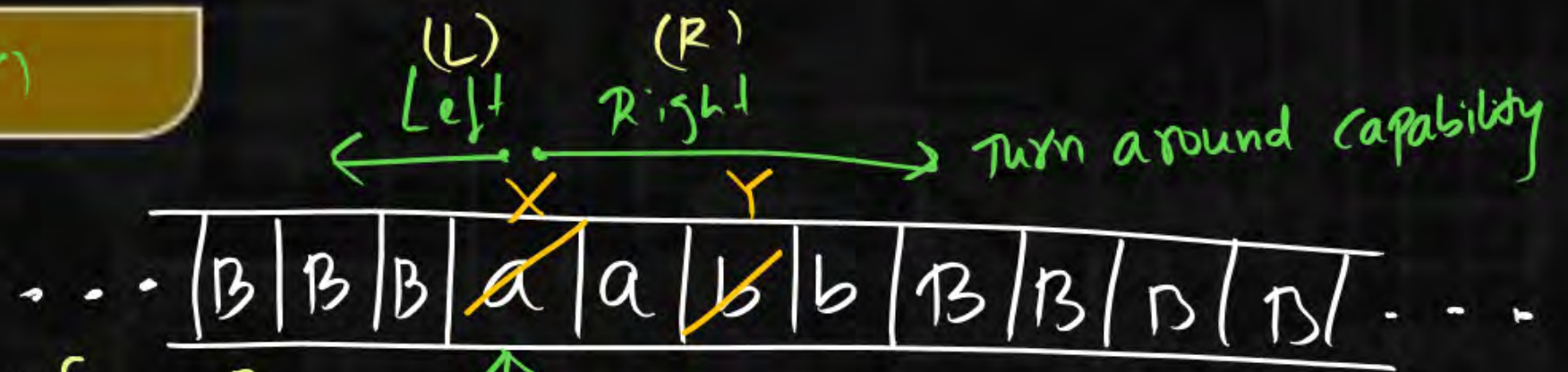
(Turing Recognizable set)

## II) Enumerator





# Configuration of TM



$$\delta_{DTM}: Q \times T \rightarrow Q \times T \times \{L, R\}$$

$$\delta_{NTM}: Q \times T \rightarrow 2^{Q \times T \times \{L, R\}}$$

$$\Sigma = \{a, b\}$$

$$\tau = \{\underline{B}, a, b, x, \bar{x}\}$$

Finite Control

Note:

I)  $TM \cong FA + R/W \text{ tape} + \text{Bidirectional head}$

II)  $TM \cong 2 \text{ stack PDA}$

$$TM = (Q, \Sigma, \delta, q_0, F, B, \tau)$$



# Types of TM

equivalent

- TM
- ≡
- Single tape TM
- ≡
- One way infinite tape TM
- ≡
- Two " " " " " "
- ≡
- Multi tape TM
- ≡
- Multi dimensional tape TM
- ≡
- Multi head TM

- multi head, multitape TM
- ≡
- Universal TM
- ≡
- 2 stack PDA
- ≡
- FA + 2 stack
- ≡
- TM + any



FA + 100 stacks

FA  $\cong$  2 stacks

$\cong$   
PDA with 2 stacks

$\cong$   
PDA with 100 stacks

2 stack PDA

$\cong$   
3 stack PDA

$\cong$   
4 stack PDA

$\cong$   
TM

↳ What is TM?



