*Block diagram of Turing Machine:-

It consists of 3 components -

1) Infinite tape
2) R/W Header
3) Finite control Unit.

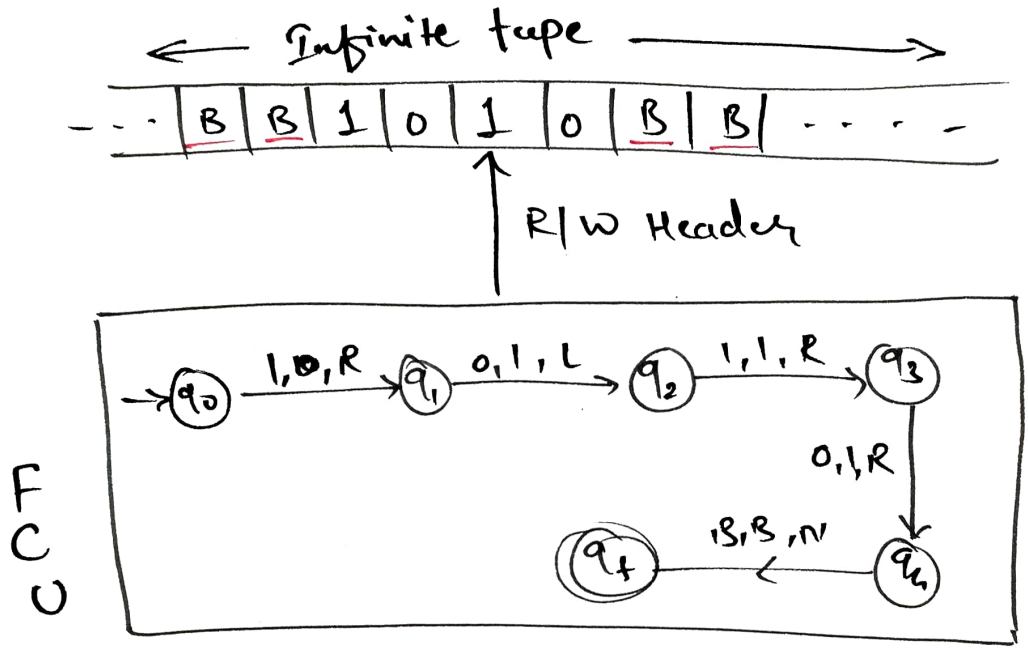


fig. Block dia. of TM.

① Infinite Tape:-

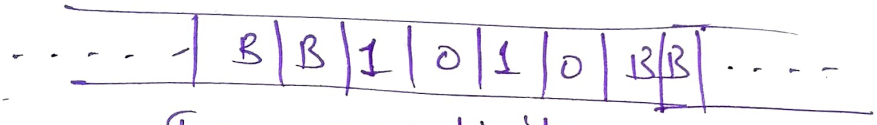
⇒ It is divided into cells where each cell can hold only one input symbol.

⇒ At any point of time only finite no. of cells will be occupied, hence the tape is divided into two region i.e. non blank region & Blank region. where non-blank region is always finite

⇒ All the empty cells in the Blank portion are filled with Blank symbol 'B'

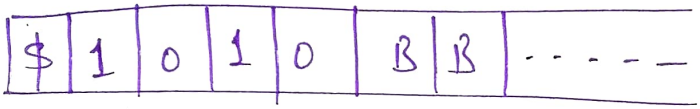
⇒ The tape can be two way infinite (or) one way infinite.

Ex:- ①



Two way infinite.

②



one-way Infinite

② Read/write Header:-

⇒ The header can read the symbol from the tape (or) modify Symbols over the tape.

⇒ And It will point to only one cell.

⇒ R/w header can move to only one cell in both right & left directions along with infinite tape.

⇒ The movement of R/w header is bidirectional.

③ Finite Control Unit:- (FCU)

⇒ FCU is control system where we can implement the buisness logic.

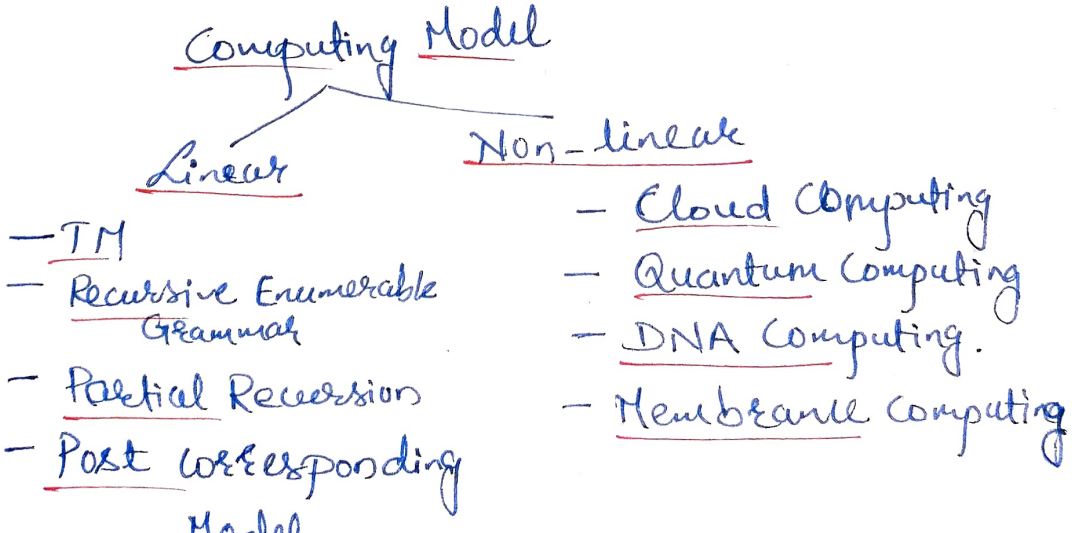
⇒ To compute any transition function, the state movements are defined by instantaneous description & controlled by FCU i.e. transitions of TM is implemented by FCU.

Note:-

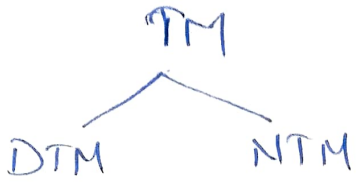
1) TM is a abstract model of real computer system

2) The capabilities of TM equal to capabilities of computer.

3) TM is a linear computing model and powerful among all the models of the same type.



⇒ TM can also be defined in both deterministic & non-deterministic mode.



⇒ DTM is more efficient than NTM.

⇒ The language which is accepted by TM is called as recursive enumerable language (RE) TM recognizable language.

⇒ As a language acceptor (LA) TM is more powerful than FA & PDA.

Halt:- The state where transition is not defined is called as Halt.

$$\delta(q_i, a) = (q_j, x, R)$$

q_j → Halt State

Halt State → Final State, Non-final State.

* Behaviour of TM:-

TM works as -

1) Language Acceptor

2) Language Generator

3) Input/output Device [or] Computing Model (or) Transducer.

* TM as a Language Acceptor:-

⇒ The language accepted by TM is called as RES (RS - Recursive set)

⇒ TM accepts all the RL, CFL & also some of the NON CFL.

⇒ E(TM) = E(FA + 2Stack) = E(FA + n Stack),

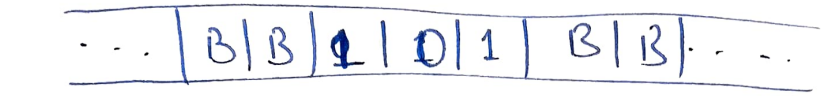
n >, 2

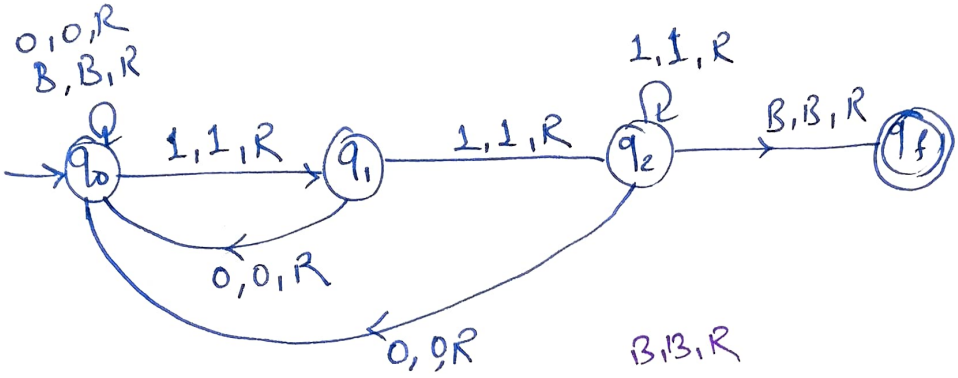
↳ Diff^n types of TM

E(TM) > E(PDA) > E(FA)

*Acceptance by TM :-

1) $L = (0+1)^* 11$

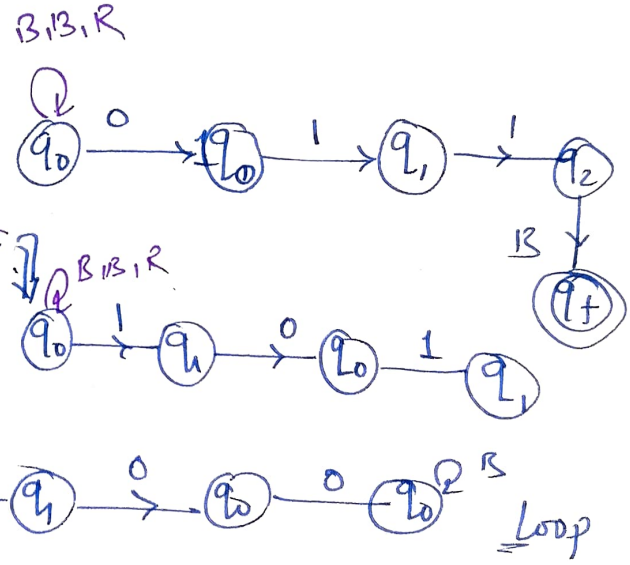




011 ⇒ Final Halt

101 ⇒ Non final Halt

100 ⇒ Loop



There are three possibilities for the TM after taking the input string.

① May go to Final Halt. ⇒ String is accepted by TM

② May go to non-final Halt. ⇒ I/p string is rejected by TM.

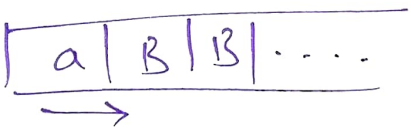
③ May go to loop. ⇒ String is neither accepted nor rejected

Note:-

No algorithm exist to decide the nature of TM for input string w i.e. the TM halt (or) doesnot halt can not be decided, Hence halting problem of TM is undecidable.

* Construction of Turing Machine:-

1) $L = \{a, ab\}$



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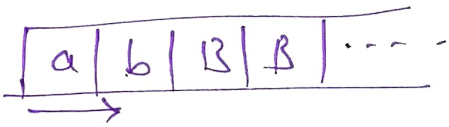
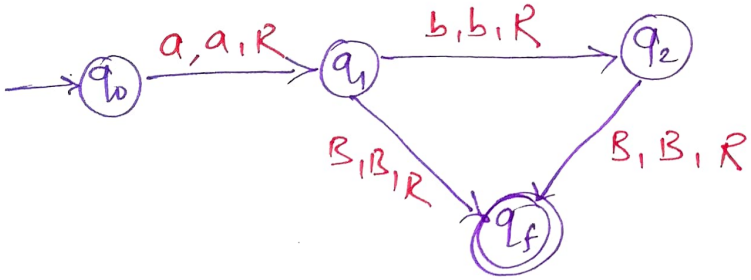
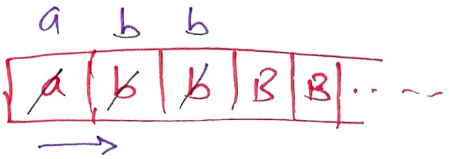
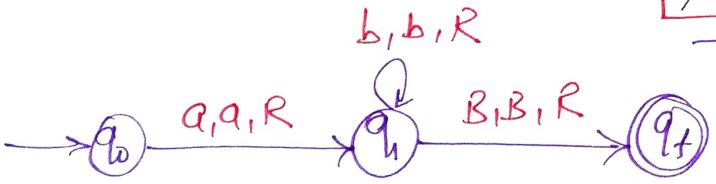


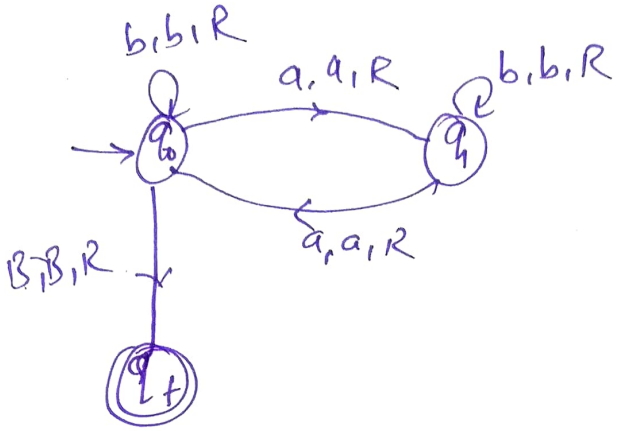


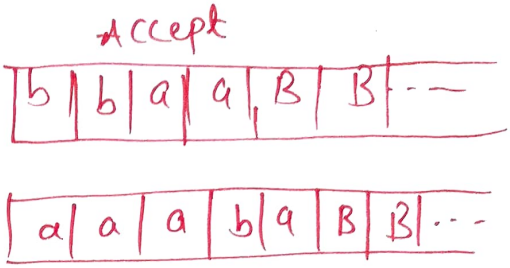
2) $L = ab^*$





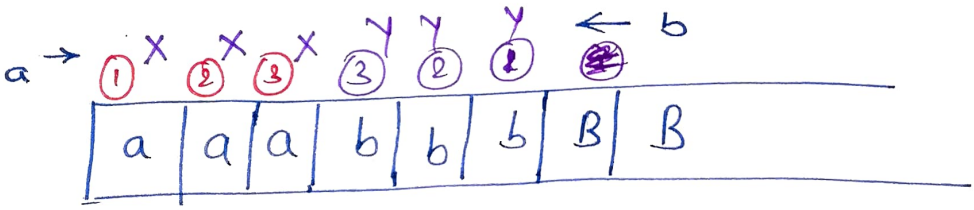
(3) $L = \{ w \in (a+b)^* \mid |w|_a = \text{even} \}$

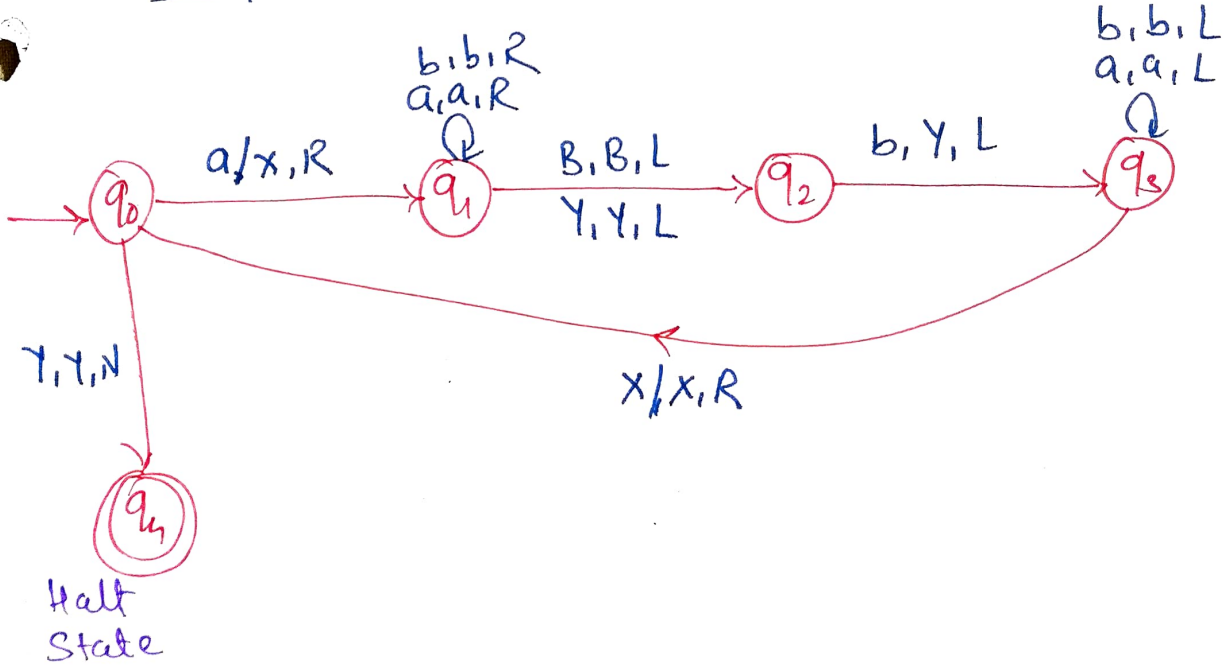




(4) $L = \{ a^n b^n \mid n \geq 1 \}$

$\Rightarrow$ Let, $a^3 b^3$





$\Rightarrow$ a a b b B $\Rightarrow q_0$

X a b b B $- q_1$

X a b b B $- q_1$

X a b b B $- q_1$

X a b b B $- q_4$

X a b Y B $- q_2$

X a b Y B $- q_3$

X a b Y B $- q_3$

X a b Y B $- q_3$

X X b Y B $- q_0$

X X b Y B $- q_1$

X X b Y B $- q_1$

X X Y Y B $- q_2$

X X Y Y B $- q_3$

X X Y Y B $- q_0$

X X Y Y B $- q_4$

δ	a	b	x	Y	B
$\rightarrow q_0$	(q, X, R)	—	—	(q_4, Y, N)	—
q_1	(q_1, a, R)	(q_1, b, R)	—	(q_2, Y, L)	(q_2, B, L)
q_2	—	(q_3, Y, L)	—	—	—
q_3	(q_3, a, L)	(q_3, b, L)	(q_0, X, R)	—	—
$*q_4$	q_4	q_4	q_4	q_4	q_4 Halt State

OR