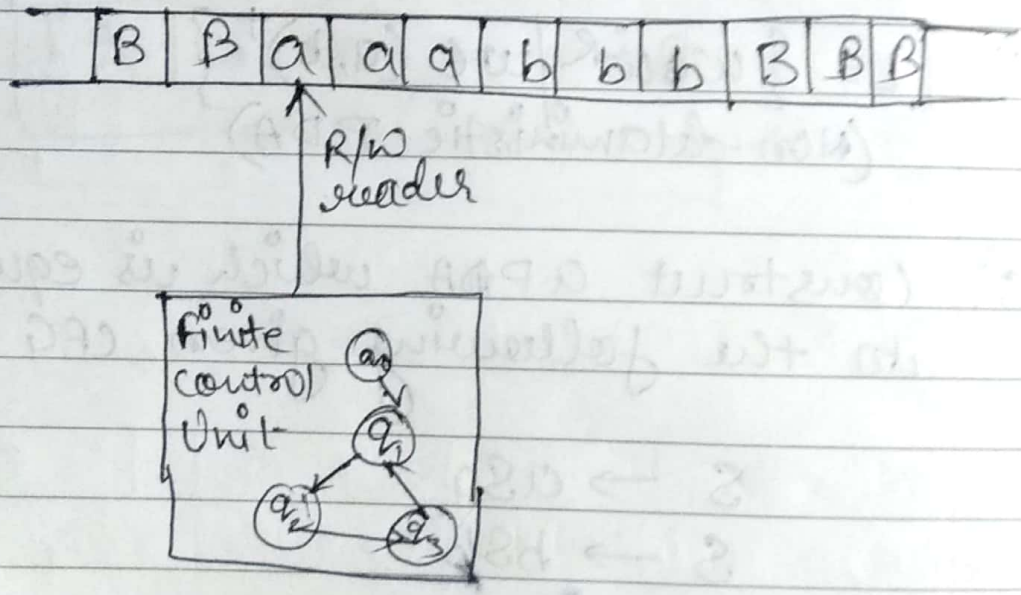
Turing Machine (TM)

Introduction

- A Turing m/c is capable of performing computations on input & producing new results.

- TM has infinite size tape and it is used to accept recursive enumerable languages.



- Input to TM is provided through long tape
- It has R/W header
- Tape :- each cell is capable to hold single symbol
- Blank Square holds 'B'

Reader :-
- can read a symbol
- can modify symbol
- shifting Left/Right
- If the string is not in language, m/c will halt

* Mathematical Representation of TM

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

where,

Q = finite set of states
Σ = Finite set of i/p alphabets not containing B
Γ = Finite set of tape symbols includes B
q_0 = initial state
B = represents all empty cells
F = final state

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

- After reading an i/p symbol, it is replaced with another symbol, its internal state is changed & it moves from one cell to the right or left.
- If TM reaches final state the i/p string accepted otherwise rejected.

Q1 Design a TM which recognizes the language $L = \{a^n b^n \mid n \geq 1\}$

(a) ~~Definition~~

Step (1) Definition of TM :-

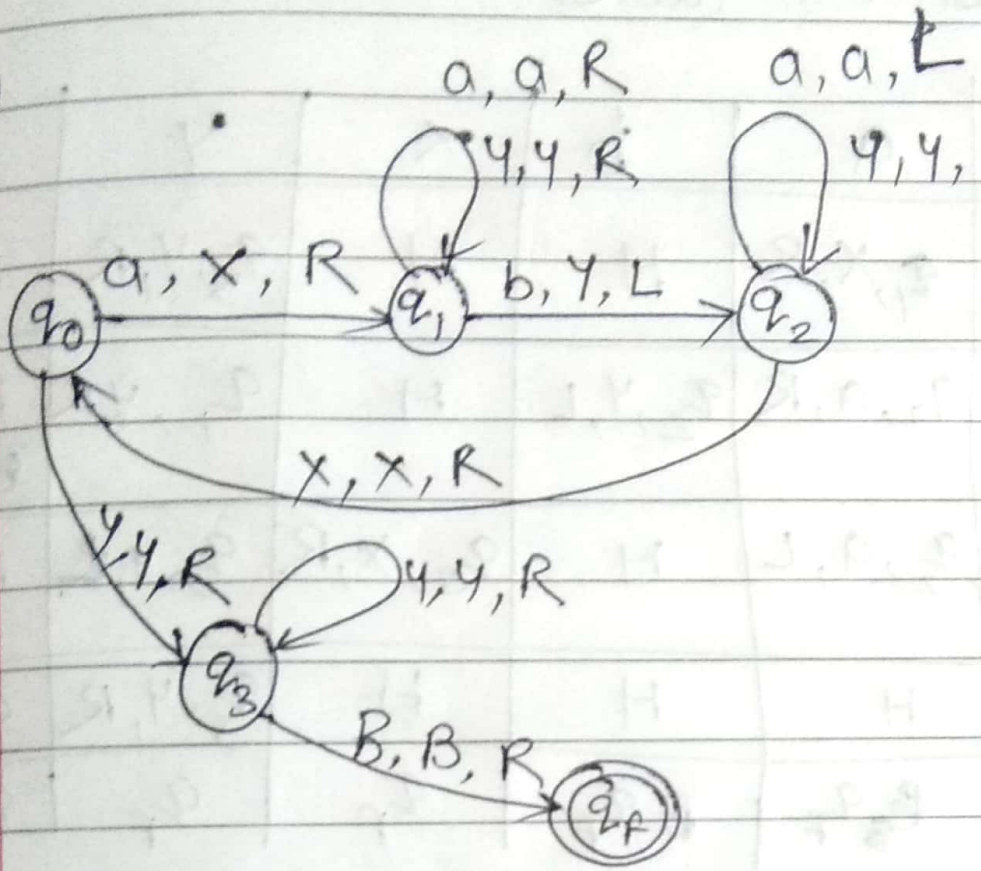
A TM is capable of performing computations on input & producing new results.

10 Mathematical Representation :-

Refer previous page

B	B	a	a	a	b	b	b	B

Step (3)



Step (2) Logic :-

q_0 → for replacing a with X
q_1 → for replacing b with Y
q_2 → come back
q_3 → check if any b is left or blank (B) is there.

$M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$

$Q = \{q_0, q_1, q_2, q_3, q_F\}$

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

$\Gamma = \{B, a, b, X, Y\}$

Step (4) Transition Table

Q/Γ	a	b	X	Y	B
q_0	q_1, X, R	H	H	q_3, Y, R	H
q_1	q_1, a, R	q_2, Y, L	H	q_1, Y, R	H
q_2	q_2, a, L	H	q_0, X, R	q_2, Y, L	H
q_3	H	H	H	q_3, Y, R	q_f, B, S
q_f	q_f	q_f	q_f	q_f	q_f

Step 5 Testing → a a b b