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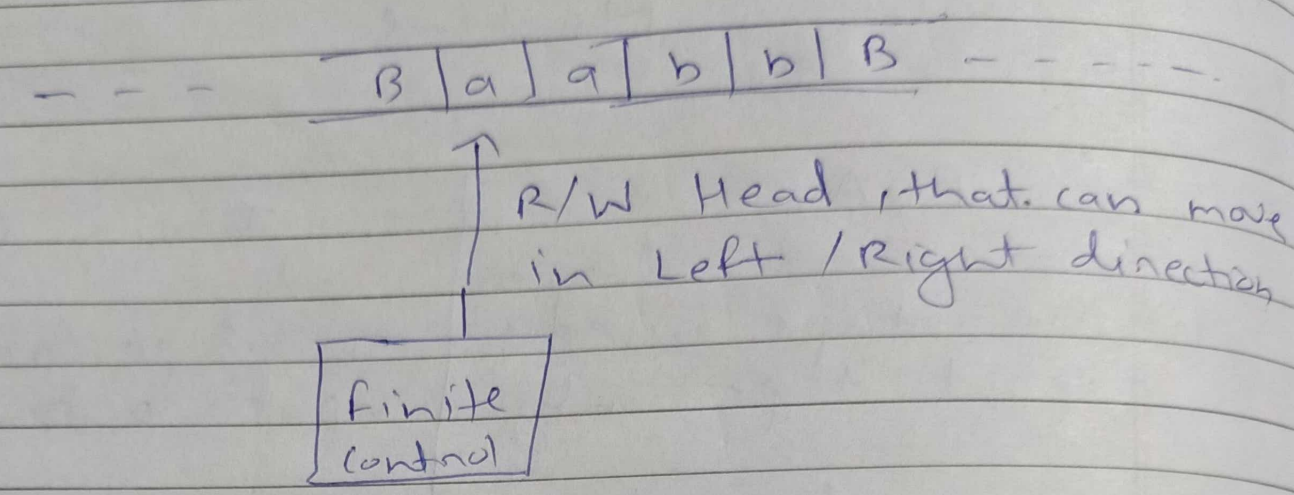
Unit 6

Turing Machine

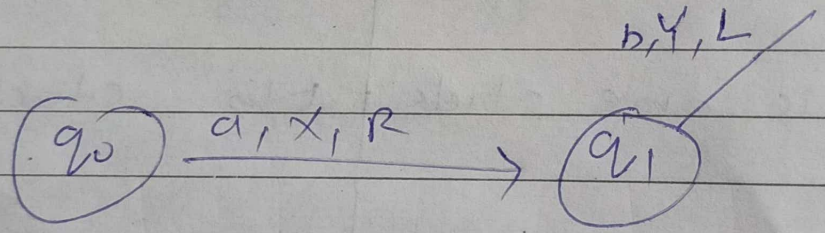
	PDA	Turing Maching
(i)	The tape used is input tape only	The tape used is input output tape
(ii)	The head used is read head only	The head is read write head
(iii)	The head can move only in one direction, i.e. right	The head can move in left or right both
(iv)	There is one stack used	No stack
(v)	$\delta: (Q \times \Sigma \times \Gamma) \to (Q \times \Gamma^*)$ (DPDA)	$\delta: (Q \times \Gamma) \to (Q \times \Gamma \times (L/R)$ (D Turing Maching)
(vi)	The 7 tupple of PDA are : $Q, \Sigma, \delta, q_0, F, Z_0, \Gamma$	The 7 tupples of turing machine are : $Q, \Sigma, \delta, q_0, F, B, \Gamma$
(vii)	Γ is set of stack symbols	Γ is set of input output tape symbols

* Turing Machine :-



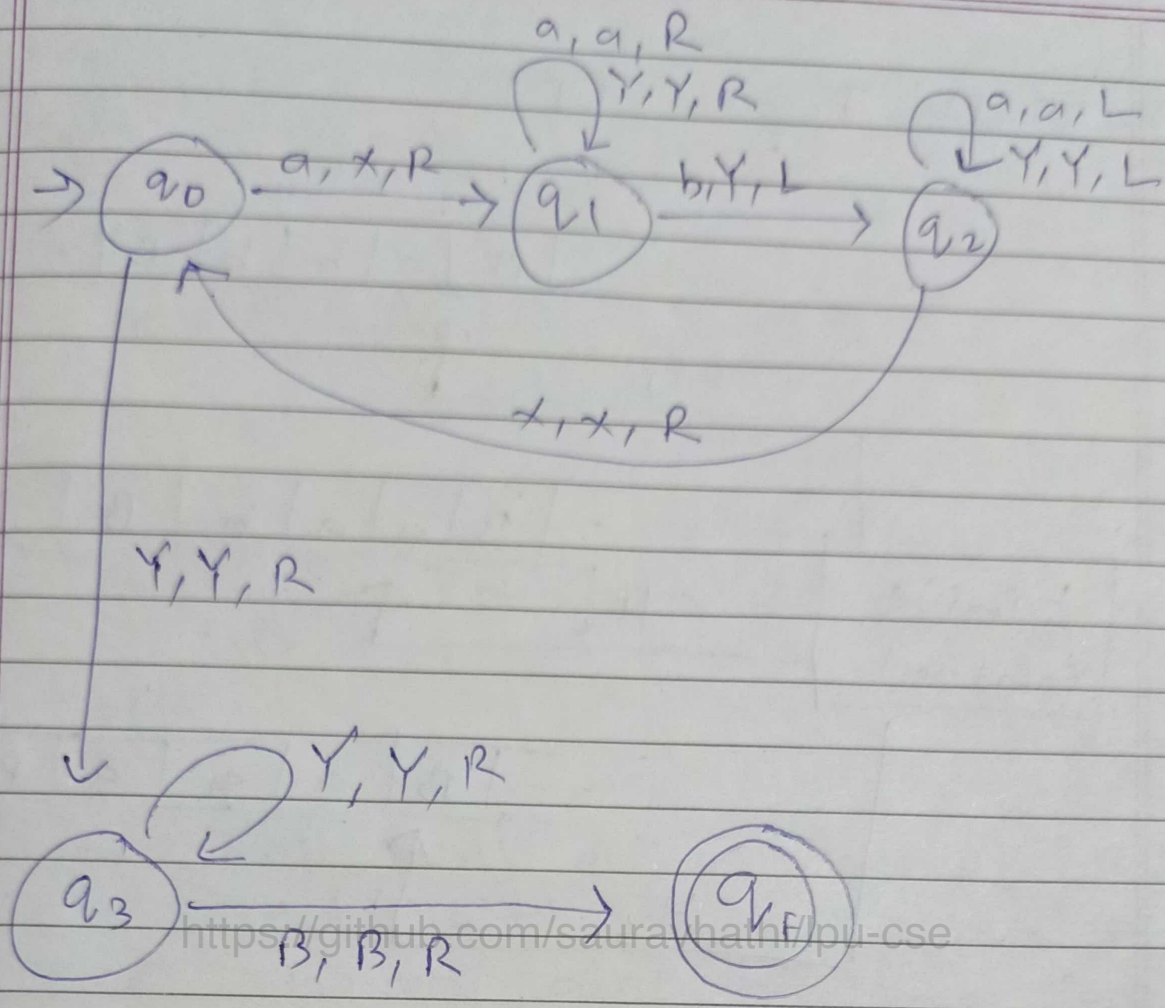
$\Gamma = \{a, b, X, Y, B\}$

X Y
a a a b b b



Q) Construct turing machine

$L = a^n b^n \quad ; \quad n \geq 1$



Variants of Turing machine :-

1) Multitape turing machine
2) Multitrack turing machine
3) Non-deterministic turing machine
4) Two way infinite turing machine

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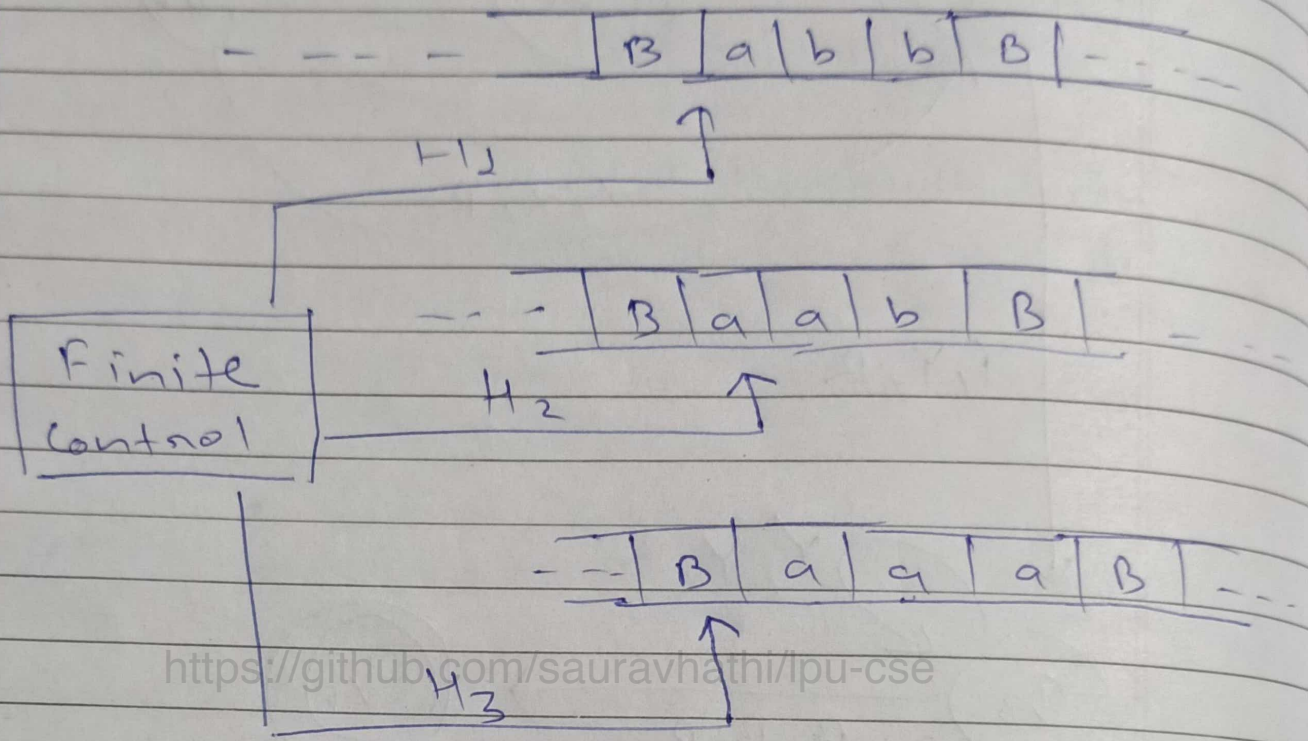
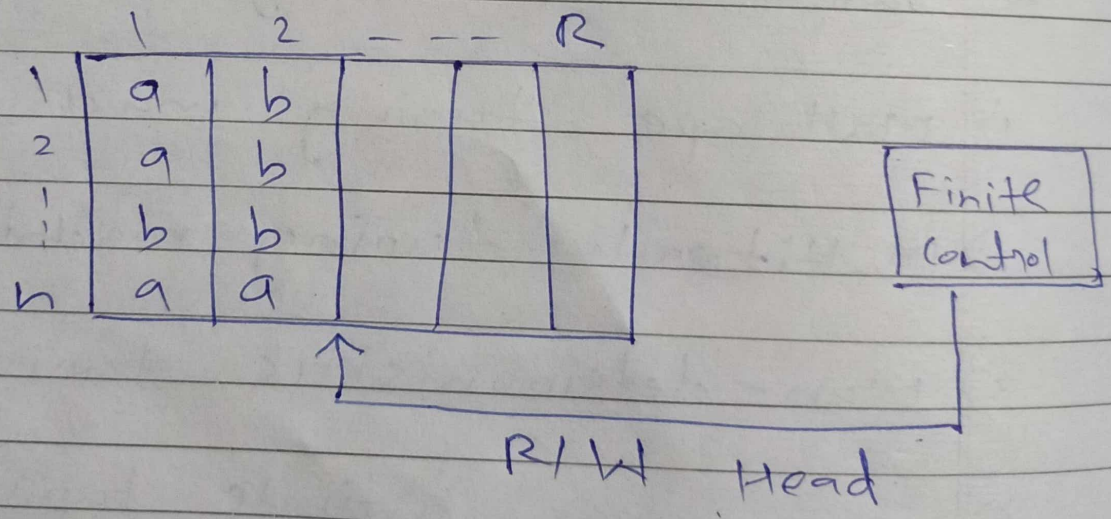
1) Multi Tape TM



2) Multi-track TM



Transition function of non-deterministic turing machine

$$Q \times \Gamma \rightarrow 2^{Q \times \Gamma \times L/R}$$

* Halting Problem :-

Halt

The TM will either accept (Halt) or reject (Halt) for a given string but never goes to any loop.

When machine goes to infinite loop that is Halting problem.

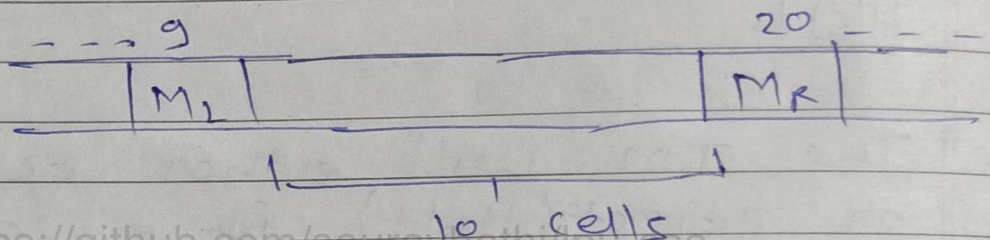
* Linear Bounded Automata

When the TM is restricted by restricting the input output tape with ~~ML and~~ M_L and M_R

There are 9 tupples of LBA namely

Q
q_0
F
Σ
δ
B
Γ

M_L - Left end marker
M_R - Right end markers



* Post correspondence problem :-

The aim of pcp is to arrange two sets of tiles in such order that string made by numerators is same as the string made by denominators

Lets assume 2 set of tiles

$A = \{\overset{x_1}{abb}, \overset{x_2}{aa}, \overset{x_3}{aaa}\}$

$B = \{\underset{y_1}{bba}, \underset{y_2}{aaa}, \underset{y_3}{aa}\}$

$x_1 x_2 x_3$ = abbaaaaa

$y_1 y_2 y_3$ = bbaaaa aa

$x_2 x_1 x_3$ = aaabbaaa

$y_2 y_1 y_3$ = aaabbaaa

Answer = 2,1,3

(d) $A = \{aa, bb, abb\}$

$B = \{aab, ba, b\}$

(i) 1, 2, 3, 1

✓ (ii) 1, 2, 1, 3

(iii) 1, 3, 2, 1

$x_1 x_2 x_1 x_3$ = aabbaaabb

$y_1 y_2 y_1 y_3$ = aabb aaabb

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* Recursive Language :-

(i) A TM accepts all strings in L and rejects all string not in L

(ii) It always halts to give answer for every string as accepted or rejected

* Recursive Enumerable Language :-

(i) A TM accepts and halts for all string which are in L.

(ii) It may or may not halt for input string which are not in L.

* Decidable Language :-

(i) If L is recursive of vice-versa.
(recursive $\rightleftharpoons$ Decidable)

* Partially decidable Language :-

If L is recursively enumerable language.

* Undecidable language :-

(i) If it is not decidable

(ii) May sometimes be partially decidable but not decidable language.

(iii) If not partially decidable then no turing machine is possible.