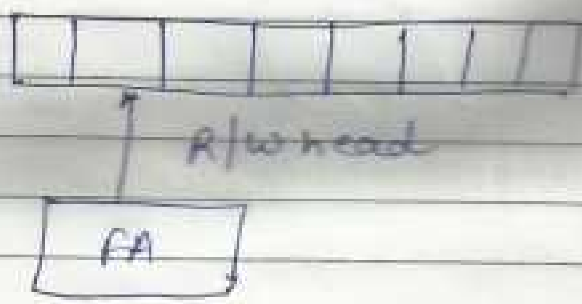
Date :
Page No.

Turning Machine : It is a simple Mathematical method of general purpose computer. It is capable of performing any calculation which can be perform by any calculating Machine or and computing Machine



(Two - way FA) R/w head move in both direc.

In one transition Machine exam present symbol under Read-write head and present state of an automaton to deter nine the foll

→ Next state
→ A New symbol to be written on the table under R/W head
→ movement of R/w head the along the tape i-e either Left or right.

$Q \times \Sigma \vdash Q \times \Gamma \times LR$

$Q \times (\Sigma \cup \Gamma) \vdash$ input tape symbol

Date :
Page No.

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$Q \times \Sigma \vdash Q \times \Gamma \times LR$
↓ ↓
$Q \times (\Sigma \cup \Gamma) \vdash$ Subset tape symb

Date :
Page No.

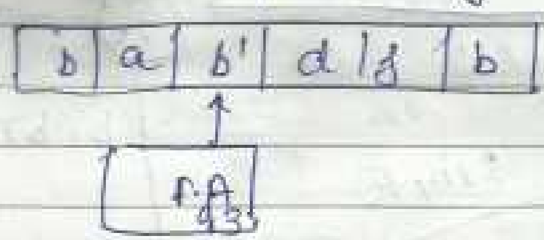
formal defination -{ Q, Σ, Γ, δ, Q_0, b, F}
where
Q → set of states
Σ → set of input
Γ → set of to be written on tape
Q_0 → initial state
b → blank symbol ∈ Γ
F → set of final state

Representation of TM

1) By using ID'S

q β γ
↓ ↳ present input
current state

bq₂ a cdf b



$b a q_3 b' d f b$

$q_1 b a' b' d f b$

Left movement & right movement

$(q, x_i) \vdash (P, y, L)$

$x_1 x_2 x_3 \cdots x_{i-1} q x_i x_{i+1} \cdots x_n \vdash$

$x_1 x_2 x_3 \cdots P x_{i-1} y x_{i+1} \cdots$

$(q, x_i) \vdash (P, y, R)$

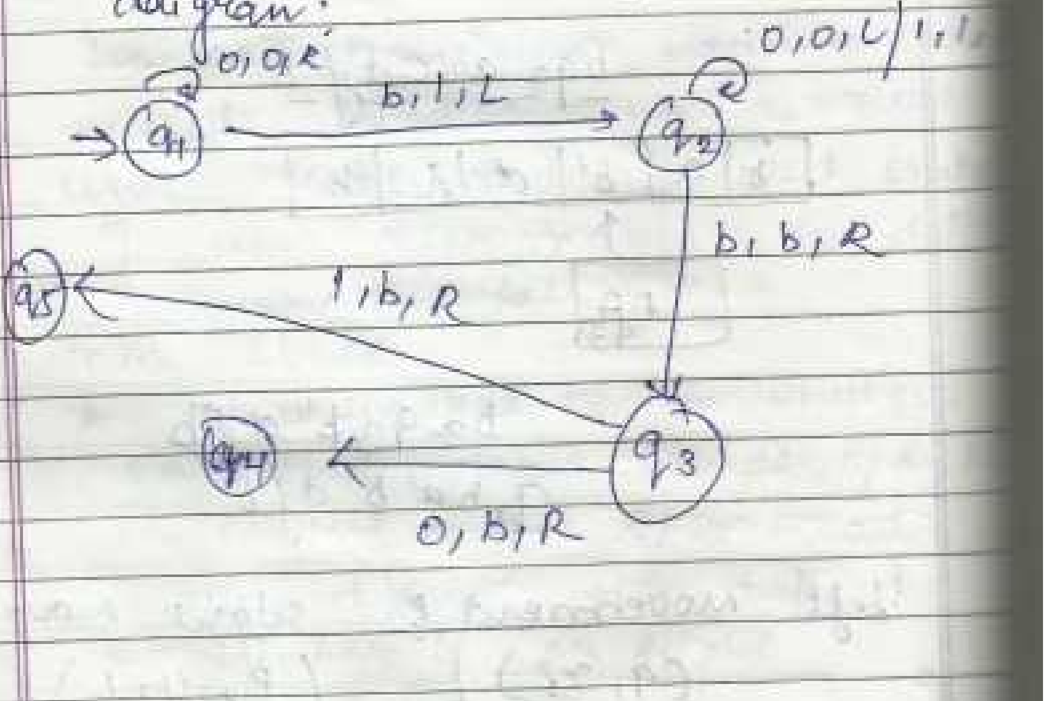
Date :
Page No.

Representation using transition table

γ β γ → Input Movement State

	b	0	1
→ q_1	1Lq_2	0Rq_1	—
q_2	bRq_3	0Lq_2	1Lq_2
q_3	—	bRq_4	bRq_5
q_4	0Rq_5	0Rq_4	1Rq_4
* q_5	0Lq_1	—	—

Representation using transition daigram:



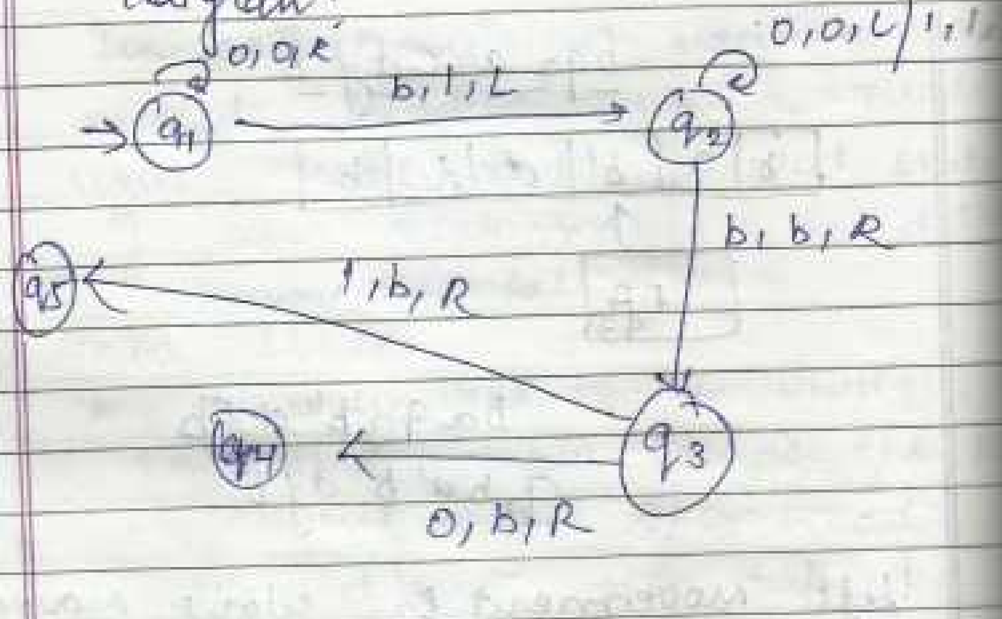
Date :
Page No.

Representation using transition table

	b	0	1
$\rightarrow q_1$	$1Lq_2$	$0Rq_1$	—
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3	-	bRq_4	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
$*q_5$	$0Lq$	—	—

$\gamma\ \beta\ \gamma$
↓ ↓ ↓
Input Movement State

Representation using transition daigram:



Langage acceptability by T.M

Let M is equals $\{q, \Sigma, \Gamma, \delta, Q_0, b, F\}$ be a T.M.

A string w in Σ^* is said to be accepted by M if $q_0 w b \vdash^* \alpha_1 p \alpha_2$

$P \in F, \alpha_1, \alpha_2 \in (\Sigma \cup \Gamma)^*$.

M doesnot accept w, if machine M either haults in non-accepting state or doesnot hault.

Haulting problem of T.M – The Haulting prob of a T.M over the input alpa Σ is unsolveable i.e the problem of deciding weather or Not a T.M M halts an arbitary input w in Σ^* or not.

Unsolvaeble problem: A class of problem with two output i.e yes/No is said to be solvable or decideable if there exist some definate algorithm which always teminate with two output i.e yes or No, than that prob is decideable or solvaeble Otherwise problem is Undecida

Date :
Page No.

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Date :
Page No.

Types of T.M

/ \

Deterministic   Non - Determinis-
tic.

ID1 ⊢ ID2 ⊢ ID3 ⊢ .. IDn   ID1 →

⇒ multiple head T.M
= K- dimensional
We can have 2D or 3D input
⇒ Universal TM - A general purpose T.M is called a Universal T.M. It is a Machine that accept two things I input data, and description of computation i.e algorithm. eg. computer.

check weather string w = 0... will be accepted by g... TM or Not.

$q_1 00b \vdash 0 q_1 0b \vdash 00 q_1 ...$
$0 q_2 0b \vdash$

Clear

We can add b on starting and End.

[b | b | 0 | 1]

Date :

Page No.

$q_2 b 001 \vdash b q_3 001 \vdash bb q_4 01 \vdash$

$bb0 q_4 1 \vdash bb01 q_4 b \vdash$

$bb01 q_5 b \vdash bb01 q_2 001 \vdash$

$bb0 q_2 100 \vdash bb q_2 0100$

$\vdash b q_2 b0100 \vdash bb q_3 0100 \vdash$

$bbb q_4 100 \vdash bbb1 q_4 000 \vdash bbb10 q_4 0$

$\vdash bbb100 q_4 b \vdash bbb100 q_5 b$

$\vdash bbb100 q_2 00 \vdash bbb10 q_2 000 \vdash$

$bbb q_2 10000 \vdash bb q_2 b10000 \vdash$

$bbb q_3 1000 \vdash bbb b q_5 0000$

modify post correspondence problem

Imp- PCP / MPCP

↓

Post correspondence problem

Consider two lists $X = x_1, x_2, x_3 \dots x_n$

and $Y = y_1, y_2, y_3 \dots y_n$ of non empty string over the input alphabet Σ, the PCP is to determine weather or not $i_1, i_2 \dots i_n$ where $1 \le i_j \le n$ such that $x_{i_1} \dots x_{i_n}$

$= y_{i_1} \dots y_n$

Date :
Page No.

If their exist a soln to PCP then their exist infinitly many solutions

Example:
check weather that the PCP with two list has soln or not.

$x = \{ b, bab^3, ba \}$

$y \{ b^3, ba, a \}$

2 b b a = 2 1 1 2

= bab^3 b b ba

= bab^3bbba

= (bab^6a)

= $(bab^6a)^2$

= $(bab^6a)^3$

= $(bab^6a)^4$

= $(bab^6a)^5$

=

Modify PCP: If the first sub-st... use in PCP is x, and y then that PCP is known as MPCP

[1011111110]
[1011111110]

Example: check weather gi... PCP has soln or not.

1011
1011

x	y
① 1	111
10111	10
10	0

= 2 1 1 3

10111
10111

most have ans 2113

Date :
Page No.

$= X \{01, 1, 1\}$
$= Y \{01^2, 10, 11\}$

cub
ava

soln can not exist

$X = \{01, 10, 11\}$
$Y = \{10, 01, 01\}$ No soln exist.

$X = \{10, 011, 101\}$
$Y = \{101, 11, 10\}$ 10110
10110

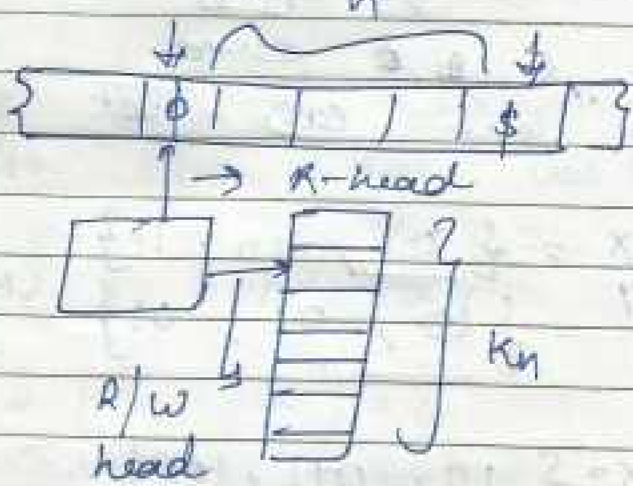
= 13

Church's Thesis :
Statement No computational procedure will be consider algo unless it can be represented as TM. This statement is Analzo church in 1936.

Linear Bounded Automata : It is type-1 (context. sensitive lang.) LBA is non-deterministic TM which has a single Input Tape whose length is not ∞ and by bounded by a linear function.

Date :
Page No.

LBA is formally define as
$\{Q, \Sigma, \Gamma, \delta, q_0, b, ¢, \$, F\}$



n = 10
Input $\Sigma = 8$

K is constant specifeid by programmer

$Q \times (\Sigma \cup *) \times \Gamma \vdash Q \times (L/R) \times \Gamma$

$\Gamma \rightarrow$ storage tape
$b \rightarrow$ blank
$¢ \rightarrow$ Start - Marker
$\$ \rightarrow$ End marker

$Q \times (\Sigma \cup i) \times \Gamma \vdash Q \times (L/R) \times \Gamma$

Date :

Page No.

Design of TM :-

The state will be changed only when there is a change in the written symbol or there is change in the movement of R/W head.

Q. Design a TM to recognize all the strings consisting equal all the string of 1 = Σ(1)

	1	b
→ q_0	q_1bR	–
q_1	bRq_0	~~bq_0R~~

Q. Design a TM which accept odd no of 1. – Σ = 1,

→ q_0	bq_1R	
* q_1	–	bq_0R

Q. Design TM for even no of 1, Σ = {0, 1}

Date :
Page No.

	1	b	0
→*q_0	bq_1R	-	0q_1
q_1		bq_0R	0Rq_1

Design a TM for odd no. of 1 = Σ(0,1) (q_1 will ... state

Q. Design a TM compute w... the first compliment ...

	1	0	b
→*q_0	0q_1R	1q_1R	accept
→* q_1	0q_0R	1q_1R	accept

Q. Design TM which con... contacation function Σ = 1

	1	E	b
→ q_0	1q_0R	1q_1R	-
q_1	1q_1R	-	1q_2R
* q_2	bLq_2	-	bLq_2

q_2 - 1

Date :
Page No.

Q = $a^n b^n$

$a^n b^n c^n$

equal No a and equal No b's

Q. Palidrome

q0	a	b	X	Y	Δ
→ q_0	XRq_1	YRq_2	–	–	
q_1	aRq_1	b	~~XRq_1~~ XLq_1	YRq_1	

(q_0) x ~~a~~ a a b b b

$a^n b^n$

Q.

	a	b	x	y	Δ
q_0	xRq_1	–	–	yRq_0	$\Delta L q_3$
q_1	aRq_1	yLq_2	–	yRq_2	
q_2	aLq_2	–	xRq_0	yLq_0	
* q_3	–	–	xLq_3	yLq_3	accept

Q. equal no of a's and b's

	a	b	x	y	Δ
→ q_0	XRq_1	YRq_3	XRq_0	YRq_0	$\phi L q_4$
q_1	aRq_1	YLq_3	XRq_1	YRq_1 ~~XRq_1~~	~~$\Delta R q_1$~~
q_2	aLq_2	bLq_2	XLq_2	YLq_2	$\phi R q_0$

q_3	XLq2	bRq5	XRq3	YR[illegible]
* q_4	H	H	XLq4	XLq[illegible]

Q. $a^n b^n c^n$

	a	b	c	X	Y	Z
→ q_0	XRq1	–	–	–	YRq0	ZRq0
q_1	aRq1	YRq2	–	–	YRq1	–
q_2	–	bRq2	ZLq3	–	–	ZRq2
q_3	aLq3	bLq3	–	XRq0	YLq3	ZLq3
q_4*	H	H	H	XLq4	YLq4	ZLq4

Q. For Palidrome.

0 1 0
0 1 1 1
L 0 [illegible]

	1	0	b

Date :
Page No.

q_3	XLq2	bRq5	XRq3	YR…
* q_4	H	H	XLq4	XLq…

Q. $a^n b^n c^n$

	a	b	c	X	Y	Z
→ q_0	XRq1	–	–	–	YRq0	ZRq0
q_1	aRq1	yRq2	–	–	yRq1	–
q_2	–	bRq2	ZLq3	–	–	ZRq2
q_3	aLq3	bLq3	–	XRq0	yLq3	ZLq3
q_4*	H	H	H	XLq4	YLq4	ZLq4

Q. for Palidrome.

0 1 0
0 1 1
L 0 …

1	0	b