Lecture 37 + 38

$q_0 x \vdash^* \alpha p \beta$

where p is an accepting (halting) state

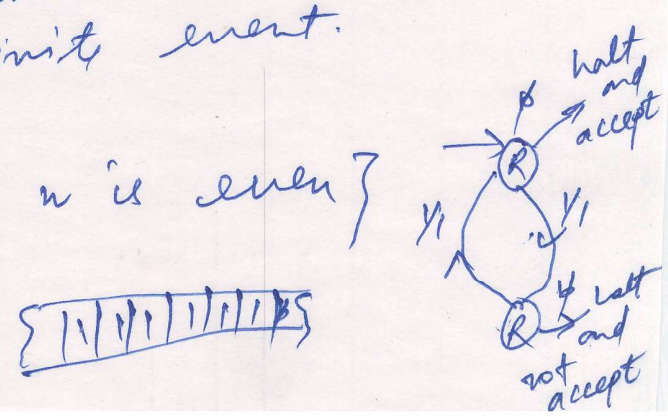
Then x is said to be accepted by the TM

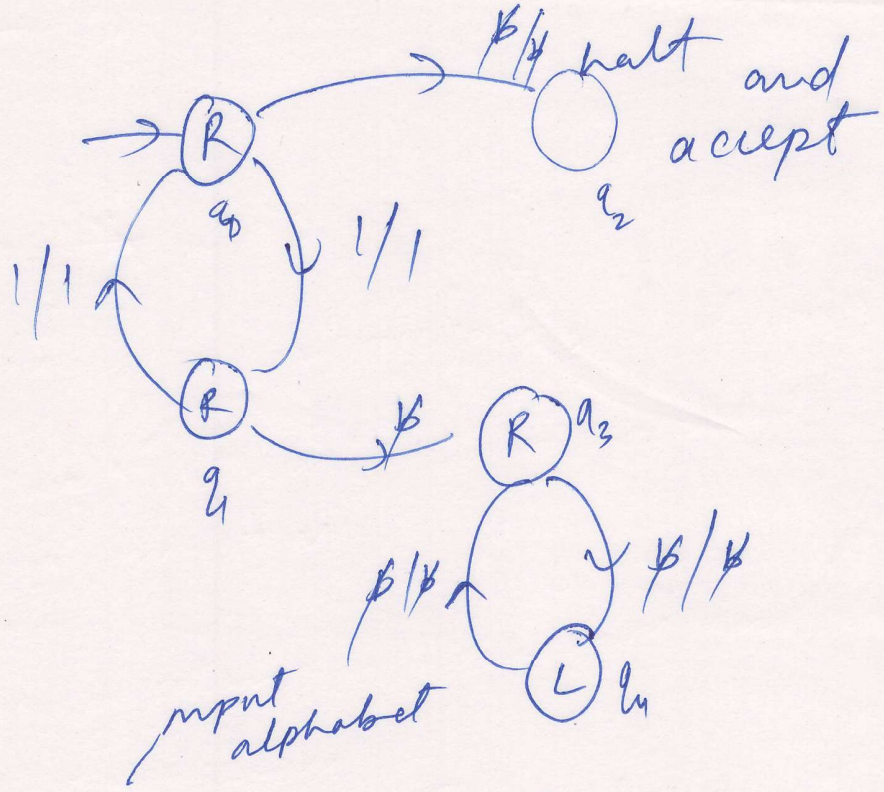
non-acceptance or rejection can happen in two ways:

1. TM enters a non-accepting halting state.
2. TM involes a non-terminating compatation.

Δ acceptance is a definite event whereas non-acceptance need not be a definite event.

$L = \{1^n \mid n \geq 0 \text{ and } n \text{ is even}\}$





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

set of states — tape alphabet — δ

$Q = \{ q_0, q_1, q_2, q_3, q_4 \}$

$\Gamma = \{ 1, b \}$

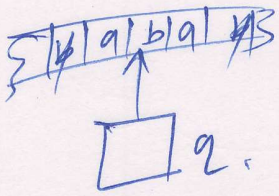
$\Sigma = \{ 1 \}$

present state	present symbol	next state	Symbol written	move
q_0	1	q_1	1	R
q_0	b	q_2	b	R
⋮	⋮	⋮	⋮	

Recursively Enumerable Language

r.e.

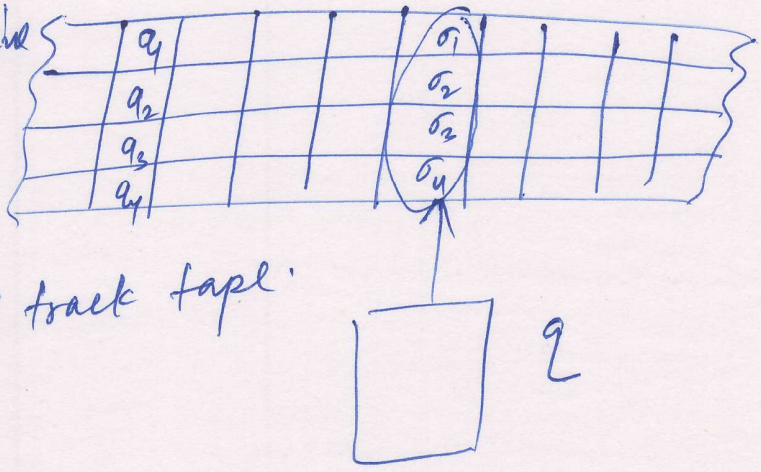
TM



Robustness of the basic TM model.

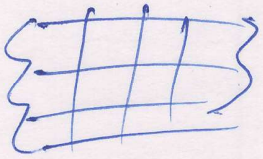
Basic TM { · add extra capabilities.
· Restrict some capabilities

multi track Turing Machine



present state	Symbols read.	next state	Symbols written	move
q	$\sigma_1, \sigma_2, \sigma_3, \sigma_3$	p	$\sigma_1', \sigma_2', \sigma_3', \sigma_4'$	R.

$\Gamma = \{0, 1, \not b\}$



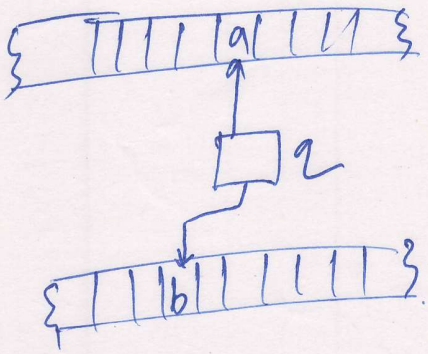
A	B	C	D	E	F	G
0	0	1	1	0	$\not b$	$\not b$
0	1	0	1	$\not b$	0	$\not b$

M	Σ
1	$\not b$
$\not b$	1

$(q_0, 0, p, \not b, R)$ MTTM

(q, E, p, G, R) STTM

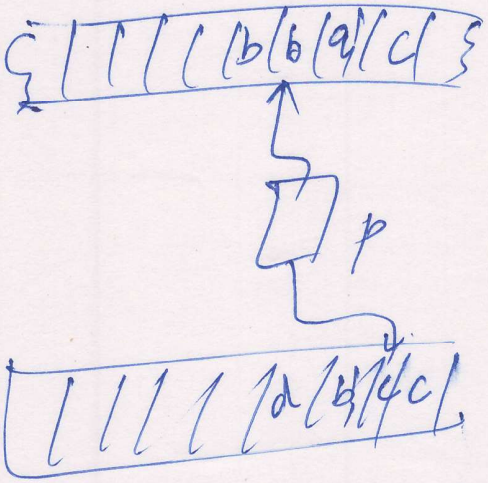
Multi tape TMs.



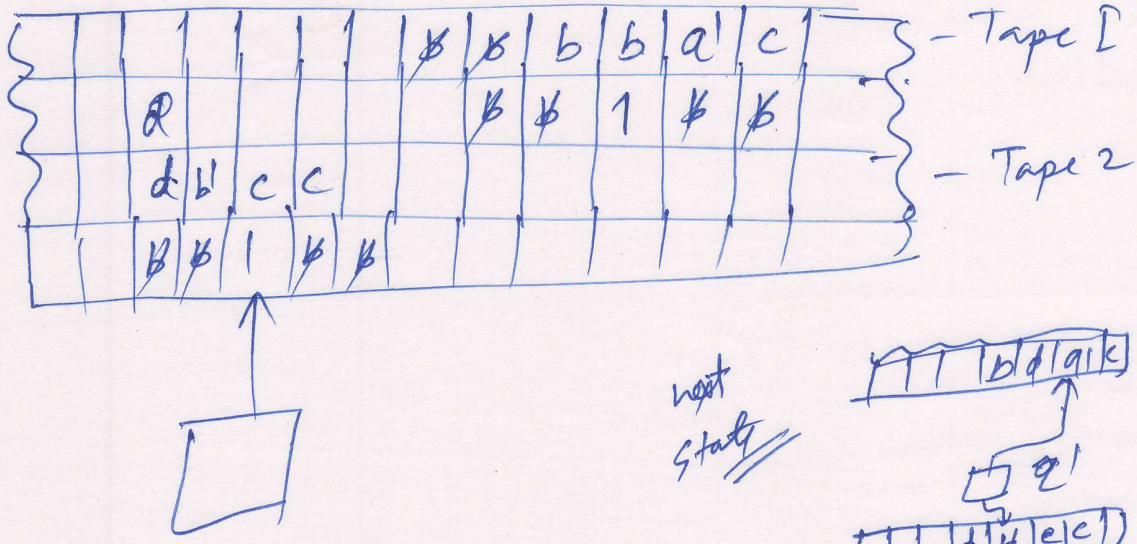
Q. Can a multi tape TM recognize a language which no single tape TM can recognize?

Ans Yes

present state	Symbol in Tape 1	Symbol in Tape 2	next state	Tape 1 symbol written	Tape 2 symbol written	move Tape 1	move Tape 2
q	a	b	p	a'	b'	R	L

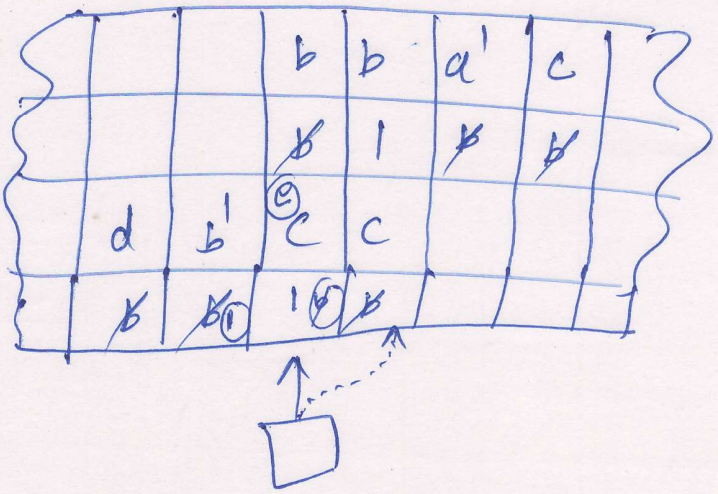


T



(q, c

/
state of M



(q, c ,2)

(q', — ,2)

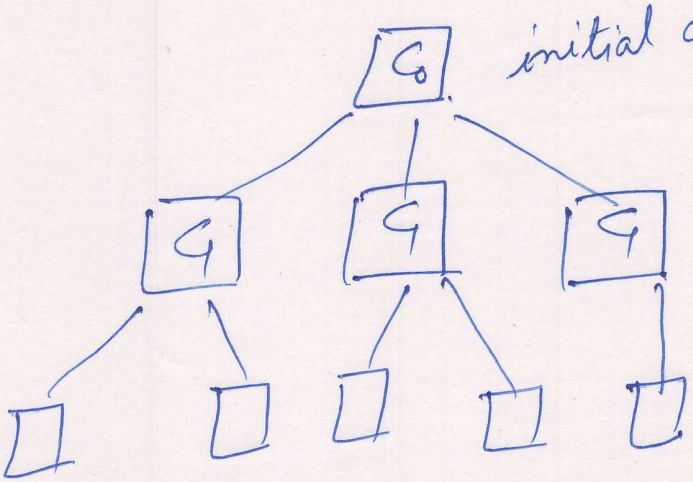
Non-deterministic TM.

(p, a, q_1, b_1, L)

(p, a, q_2, b_2, R) one of 3.

(p, a, q_3, b_3, L).

$q_0 x$



initial configuration.

$C_i \vdash C_j$

From configuration C_i in a single step, the non-deterministic machine can go to C_j

$C_i \vdash C_j^k$ $\quad 1 \le k \le m$

C_i — C_j^1, C_j^2, C_j^3, ..., C_j^m

$q_i \vdash^* q_j$

M is an NDTM

$$L(M) \triangleq \{ x \in \Sigma^* \mid q_0 x \vdash^* \alpha p \beta$$

for some α, β and p is an accepting state $\}$

Q. Is there a language L for which there is a NDTM M to accept it **but** there is no DTM to accept the same language L?

Ans