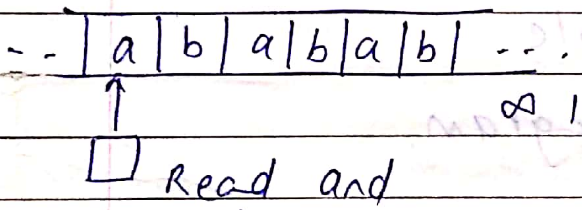
Turing machine

TM = $M = (Q\ \Sigma\ \Gamma\ \delta\ q_0\ F\ B)$ (7 tuple)

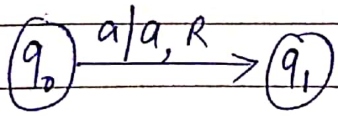
Q = set of states
Σ = input alphabet
Γ = tape alphabet (symbols)
δ: transition funn
$Q \times \Gamma \rightarrow Q \times \Gamma \times \{L, R, N\}$
q_0 = initial state

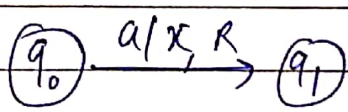
F = set of final states $\subseteq Q$
B = blank symbol.



① After reading a symbol read/write head reads symbol and writes a new symbol or same symbol
② it can move to left or right or no move
③ state may transited.

e.g.





$\delta(q_0, a) \rightarrow (q_1, a, R)$ $\delta(q_0, a) \rightarrow (q_1, x, R)$

(FA/PDA) don't have control over their input.

TM can change its own input
↳ writing m/c

- Tm is most powerful m/c
- Any problem that can have a algorithm and can be solved can also be solved by Tm.
- same power of digital comp.
- abstract / mathematical model of digital comp.
-
- comparision of power

FA < PDM < TM

-
- Representation of Tm

(1) Instantaneous Description (ID)

(2) Transition table

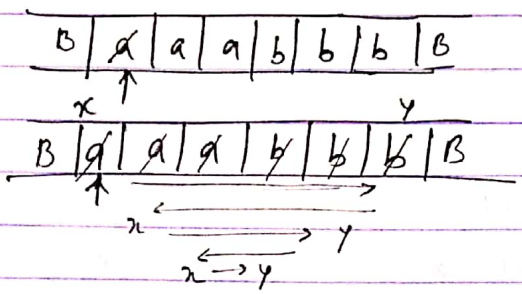
(3) Transition diagram.

After processing a^3b^3 m/c reaches to halt state

(2) Tm accepts strings of $a^n b^n$ $n \geq 1$ rejects other all.

Step I ie $a^3 b^3$

logic



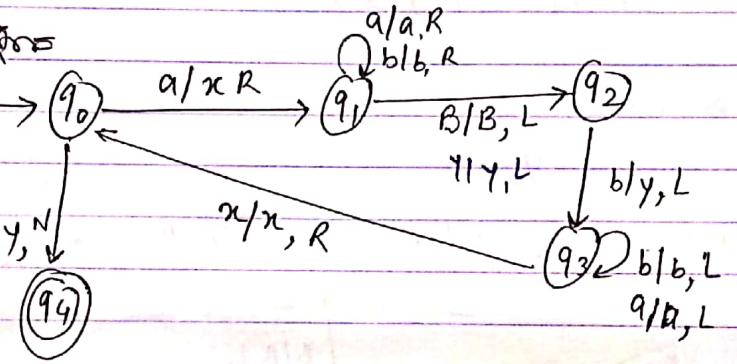
(1) steps - leftmost a → x
(2) rightmost b → y
(3) head comes back to first a.

Step II defn of Tm

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

Step III

Transition Diagram



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

$\Sigma = \{a, b\}$ B = Blank symbol.

$\Gamma = \{a, b, B\}$ $F = \{q_4\}$ Halt state

x, y

Step IV δ is as shown

Transition table →

	a	b	x	y	B
q_0	xRq_1	—	—	YNq_4	—
q_1	aRq_1	bRq_1	—	—	BLq_2
q_2	—	YLq_3	—	—	—
q_3	aLq_3	bLq_3	xRq_0	—	—
q_4	—	—	—	—	— Halting state

Step V

Instaneous Description

$q\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,b\,B$ (q_0, q_1, q_1)

$\vdash x\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,b\,B$ (q_1, q_1, q_1)

$\vdash x\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,b\,B \vdash x\,a\,a\,b\,b\,y\,B$ (q_1, q_2, q_3)

$\vdash x\,a\,a\,b\,b\,y\,B \vdash x\,a\,a\,b\,b\,y\,B \vdash x\,a\,a\,b\,b\,y\,B$ (q_3, q_3, q_3)

$\vdash x\,a\,a\,b\,b\,y\,B \vdash x\,a\,a\,b\,b\,y\,B \vdash x\,x\,b\,b\,y\,B$ (q_3, q_0, q_1)

$\vdash x\,x\,b\,b\,y\,B \vdash x\,x\,b\,b\,y\,B \vdash x\,x\,b\,b\,y\,B$ (q_1, q_1, q_2)

$\vdash x\,x\,b\,y\,y\,B \vdash x\,x\,y\,y\,B \vdash x\,x\,y\,y\,B$ (q_3, q_0, q_4)

[accept]

Step VI

Final Ans.

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

$Q = \{q_0, q_1, q_2, q_3, q_4\}$ $\Sigma = \{a, b\}$ $\Gamma = \{a, b, x, y, B\}$

δ: as per diagram $q_0 = q_0$ $F = \{q_4\}$

B = Blank symbol.