26 | 11 | 19

Variants of Turing Machine

(i) Multitape TM

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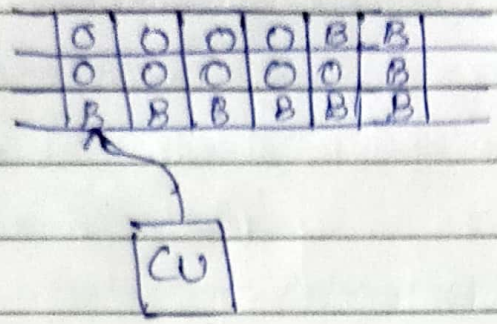


$(q_0, [0,0,B])$

$(q_0, [0,0,B], B)$

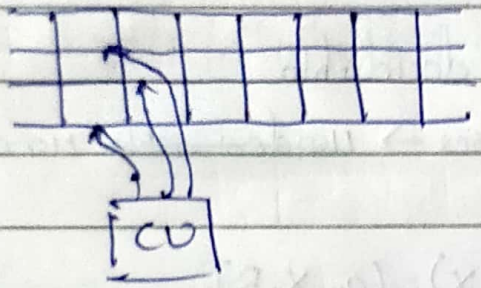
$q_0, [B,B,B]$

$(q_0, [B,B,B]) = (q_1, [B,B,0], R)$

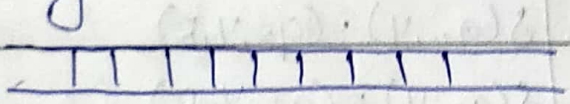
$\delta(q_0, [0,0,B]) = (q_0, [0,0,B], R)$

$\delta(q_0, [0,B,B]) = (q_0, [0,B,0],$

(ii) Multiple Tape TM



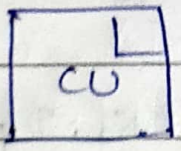
(iii) Storage in CU



$\delta([q_0, B], 0) = ([q_0, 0], 0, R)$

$\delta([q_0, 0], 1) = ([q_0, 0], 1, R)$

$\delta([q_0, 0], B) = ([q_1, B], B,$



TM as translucer $\rightarrow m+n \rightarrow 0^m 1 0^n$

$(q_0, 0) = (q_1, B, R)$

$(q_1, 0) = (q_1, 0, R)$

$(q_1, 1) = (q_2, 1, R)$

$(q_2, 0) = (q_2, 0, R)$

$(q_2, B) = (q_3, 0, L)$

$(q_3, 0) = (q_3, 0, L)$

$(q_3, 1) = (q_4, 1, L)$

$(q_4, 0) = (q_4, 0, L)$

$(q_4, B) = (q_0, B, R)$

$m \times n \rightarrow 0^m 1 0^n 1$

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$(q_0, 0) = (q_1, X, R)$

$(q_1, 0) =$

$(q_1, 1) = (q_2, 1, R)$

$(q_2, 0) = (q_3, 0, R)$

$(q_6, 0) = (q_6, 0, L)$

$(q_7, X) = q_0,$

$(q_8, X) = (q_8, 0, L)$

$(q_3, 1) = (q_4, 1, R)$

$(q_4, B) = (q_5, 0, L)$

$(q_5, 1) = (q_6, 1, L)$

$(q_6, 1) = (q_7, 1, L)$

$(q_7, 1) = (q_8, 1, L)$

$(q_8, B) = (q_0, B, R)$

m x n

$\delta(q_0, 0) = (q_1, X, R)$

$\delta(q_1, 0) = (q_1, 0, R)$

$\delta(q_1, 1) = (q_2, 1, R)$

$\delta(q_2, 0) = (q_3, Y, R)$

$\delta(q_3, 0) = (q_3, 0, R)$

$\delta(q_3, 1) = (q_4, 1, R)$

$\delta(q_2, Y) = (q_8, Y, R)$

$\delta(q_4, B) = (q_5, 0, L)$

$\delta(q_5, 1) = (q_6, 1, L)$

$\delta(q_6, 0) = (q_6, 0, L)$

$\delta(q_6, Y) = (q_6, Y, L)$

$\delta(q_6, 1) = (q_7, 1, L)$

$\delta(q_7, 0) = (q_7, 0, L)$

$\delta(q_7, X) = (q_0, X, R)$

Recursive Languages

Whenever we can design a TM with acceptance in final state & non-acceptance in non-final state.

TM — YES
— NO

For every storing Recursive lang has TM o/p YES/NO

Recursively Enumerable Lang

RE lang — YES (Accepting with final state)
— ∞ loop (Non-accepting with non-final state)

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∞ loop → Never halt → Undecidable

Halting problem of TM → Undecidable problem.

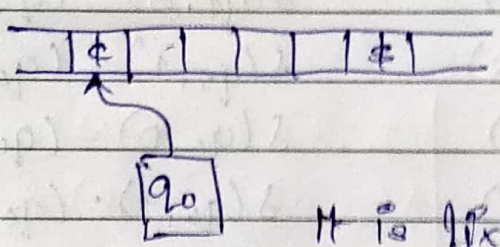
TM → Deterministic
↳ Non-deterministic

We always design DTM.

Linear Bounded Automata (LBA)

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

¢ → Left end marker $ → Right end marker



¢ & $ } Instead of B (Blank)

M is fixed size; No i/p symbol appears after $.

Context-Sensitive Lang

$\alpha A \beta \to \gamma$ (Done only when LHS format is as specified)

$\alpha \to \beta \Rightarrow$ RE lang (No restriction on no. of symbols in α & β)