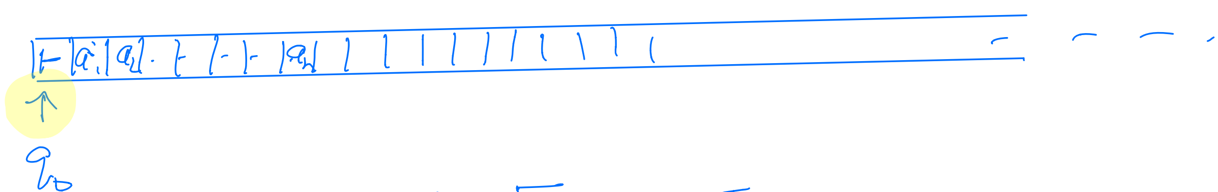
Turing Machines

$(Q, \Sigma, \Gamma, \delta, q_0, t, r)$

$q_0, t, r \in Q$

initial, accepting, rejecting states.

$w = a_1 a_2 \dots a_n$



$\Sigma \subseteq \Gamma$ $\quad \Gamma$

$\vdash$ - left end marker

$\sqcup$ - blank tape cell

$\vdash, \sqcup \in \Gamma \setminus \Sigma$

$$\delta \subseteq (Q \times \Gamma) \times (Q \times \Gamma \times \{L, R\})$$

uqv ← configuration.

$a^n b^n c^n$

$\vdash w \sqcup^{\infty}$

⊢	a	a	a	a	b	b	b	c	c	c	c	⊔	⊔	⊔
↑ q_0														

$\Gamma = \{a, b, c, \vdash, \sqcup, X \ldots\}$

$Q = \{q_0, q_a, q_b, q_c, t, r, \ldots\}$

$\delta(q_0, \vdash) = (q_a, \vdash, R)$

⊢	$\cancel{a}$	a	a	a	$\cancel{b}$	b	b	$\cancel{c}$	c	c	c	⊔	⊔	⊔
					↑ q_b									

$\delta(q_a, a) = (q_b, X, R)$

$\delta(q_a, X) = (q_a, X, R)$

$\delta(q_b, a) = (q_b, a, R)$

$\delta(q_b, b) = (q_c, X, R)$

$\delta(q_b, X) \quad (q_b, X, R)$

$$\delta(q_a, \sqcup) = (t, \sqcup, R)$$
$$\delta(q_a, b) = (r, b, R)$$
$$\delta(q_a, c) = (r, c, R)$$
$$\delta(q_b, c) = (r, c, R)$$
$$\delta(q_c, c) = (q_\ell, x, L)$$
$$\delta(q_\ell, -) = (q_\ell, -, L)$$
$$- \in \Gamma \setminus \{\vdash\}$$
$$\delta(q_\ell, \vdash) = (q_a, \vdash, R)$$

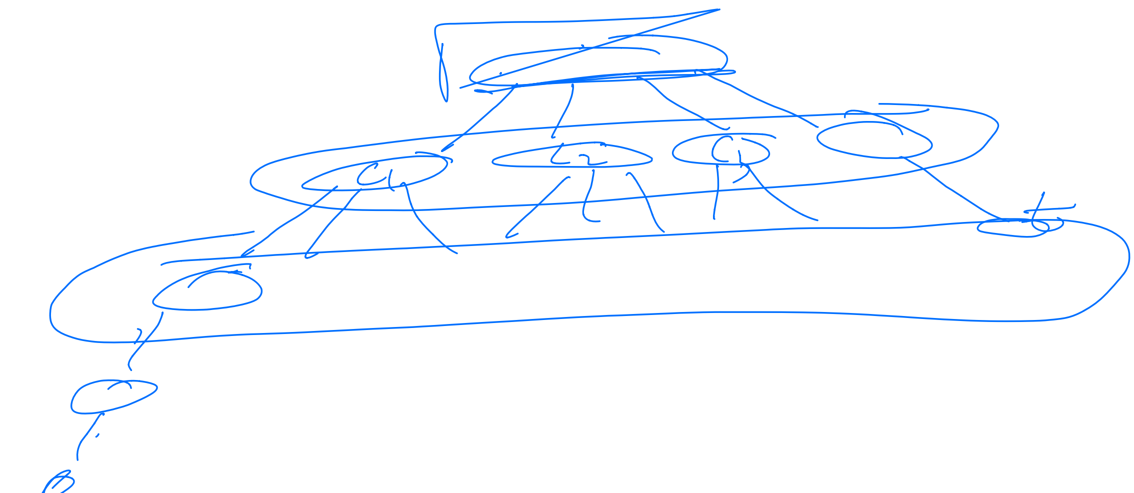
Turing machine. M

acceptance.

$L(M)$ – language of M

$$\{ w \mid q_0 \vdash w \sqcup^\omega \xrightarrow{*} \Gamma^* t \Gamma^\omega \}$$

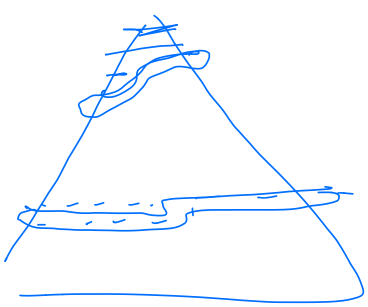
Turing machine is "total"



$\vdash \cancel{C_1} \# C_2 \# C_3 \# C_4 \# C_5 \# C_6$

$\vdash C_0$

$\cancel{C_0 \# C_1 \# C_2} \# C_3 \# C_4 \# C_5 \# C_6$



Simulate NTM with DTM

$L(M)$ - recursively enumerable