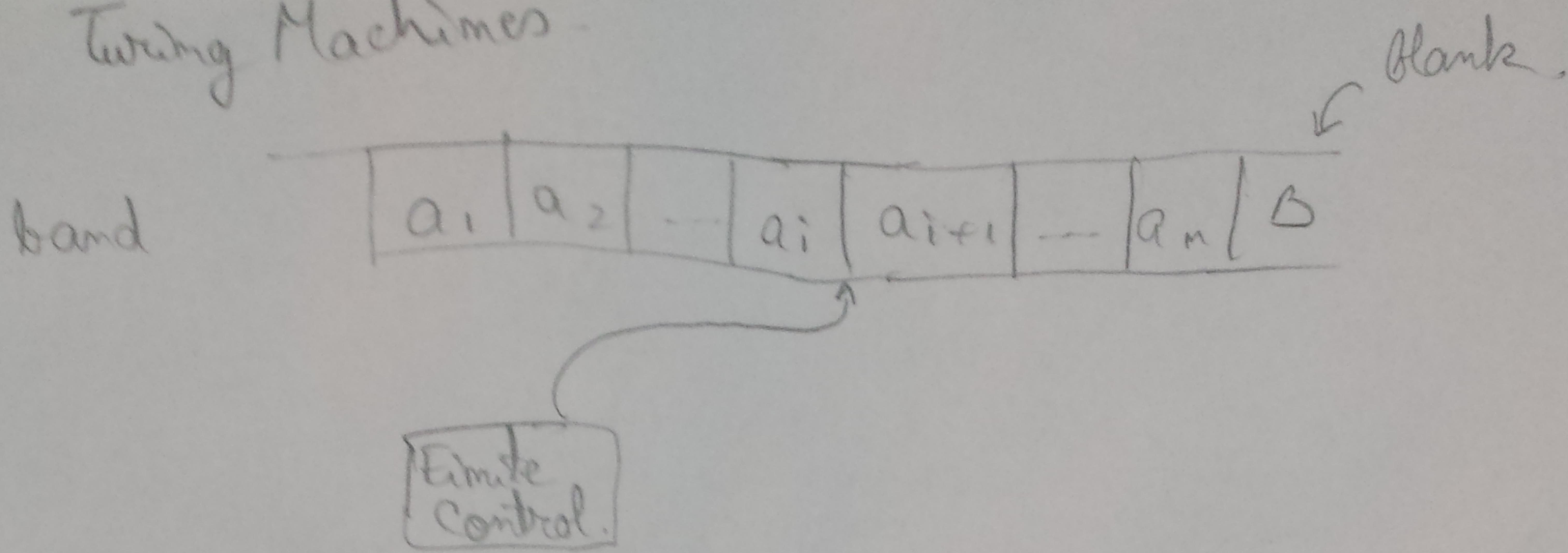


Turing Machines -



- move → change state
- reads a symbol AND writes a symbol on the band
- move reading head ^{left (L)}_{right (R)}

Def. A turing machine is a 7 tuple $\text{TM} = (\mathcal{Q}, \Sigma, \Gamma, \delta, q_0, B, F)$, where.

\mathcal{Q} - finite set of states.

Γ - finite alphabet of the band.

$\Sigma \subseteq \Gamma$ - input alphabet

δ - next move function: $\delta: \mathcal{Q} \times \Gamma \rightarrow \mathcal{Q} \times \Gamma \times \{R, L\}$.

q_0 - starting state., $B \in \Gamma$ - denotes blank..

$F \subseteq \mathcal{Q}$ set of final states.

Config → instantaneous description (ID)

$\alpha_1 q \alpha_2$.

$x, x \in \Gamma^*$.
 $q \in \mathcal{Q}$

$\alpha_1 \alpha_2$ - Band,

before
reading
head after
reading
head

$x_1 \dots x_{i-1} x_i q x_{i+1} \dots x_m \xrightarrow{\quad} x_1 \dots x_i Y p x_{i+2} \dots x_m$

$\delta(q, x_{i+1}) = (p, Y, R)$. state changes to p

x_{i+1} is replaced by Y and reading head moves to right (R).

$\delta(q, x_{i+1}) = (p, Y, L)$.

$\xrightarrow{\quad} x_1 \dots x_i p x_i Y \dots x_m$.

$L(\text{TM}) = \{w \in \Sigma^* \mid q_0 w \in \alpha_1 f \alpha_2, \alpha_1, \alpha_2 \in \Gamma^*, f \in F\}$.

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

$$\Sigma = \{0, 1\}$$

$$\Gamma = \{0, 1, X, Y, B\}$$

$$F = \{q_4\}$$

	0	1	X	Y	B
q_0	(q_1, X, R)			(q_3, Y, R)	
q_1	$(q_1, 0, R)$	(q_2, Y, L)		(q_1, Y, R)	
q_2	$(q_2, 0, L)$		(q_0, X, R)	q_2, X, L	
q_3				q_3, Y, R	(q_4, B, R)
q_4					

Examples:

$$1) q_0 0L \vdash X q_1 1 \vdash q_2 XY \vdash X q_0 Y \vdash XY q_3 B \vdash XYB \underline{q_4} B$$

$$2) q_0 011 \vdash X q_1 11 \vdash q_2 XY \vdash X q_0 Y \vdash XY q_3 1 \vdash 011 \text{ not acc}$$

$$3) q_0 01 \vdash X q_1 01 \vdash X q_2 1 \vdash X q_2 0Y \vdash q_2 X 0Y \vdash X q_0 0Y \vdash \\ \vdash XX q_1 Y \vdash XX Y q_2 B \vdash \text{not accepted}$$

$$4) q_0 0011 \vdash \vdash XX q_1 Y 1 \vdash XX Y q_2 1 \vdash XX q_2 YY \vdash X q_2 XXX \vdash \\ \vdash XX q_0 YY \vdash XX Y q_3 Y \vdash XXX Y q_3 \vdash XXXYYB \underline{q_4} B.$$

$$L = \{0^n, 1^m \mid n > 0\}$$

	0	1	B.
q_0	$(q_0, 0, L)$	$(q_0, 1, L)$	(q_1, B, R)
q_1	$(q_2, 1, R)$	$(q_1, 0, R)$	$(q_2, 1, L)$
q_2	$(q_2, 0, L)$	$(q_2, 1, L)$	(q_3, B, R)
q_3			

$$q_0 101 \vdash q_0 B 101 \vdash B q_1 101 \vdash B q_2 01 \vdash B q_2 01 \vdash q_2 B 01 \vdash$$

$$\vdash B q_3 01$$