

Turing Machine

→ invented by Alan Turing in 1936.

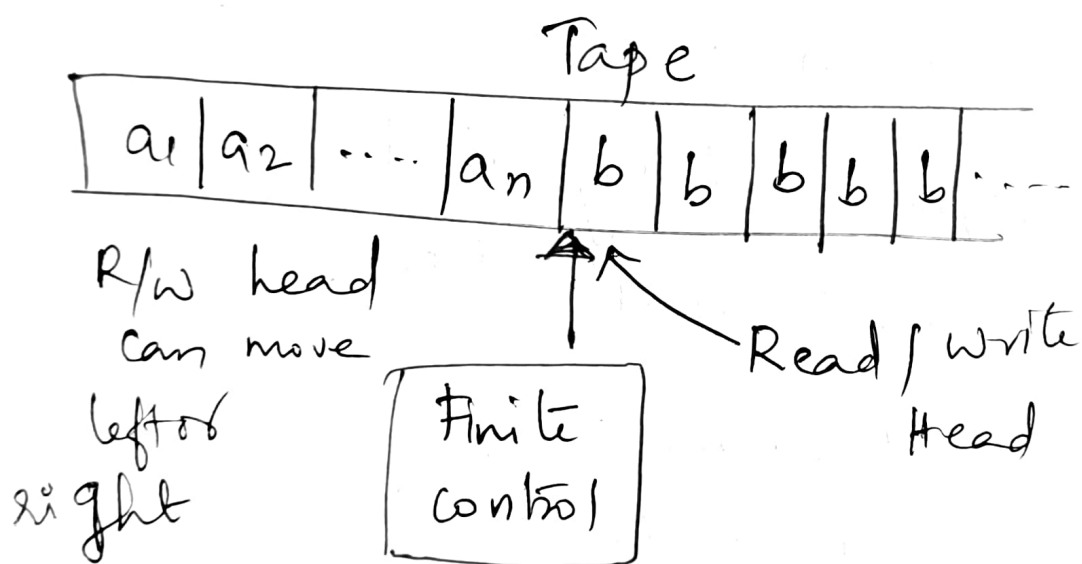
Turing Machine's behavior is determined by a finite state machine, which consists of a finite set of states, a transition function that defines the actions to be taken based on current state and the symbol being read and a set of start and accept states.

Turing Machine begins in the start state and performs the actions specified by the transition function until it reaches an accept or reject state.

Turing Machine consists of a tape of infinite length on which R/W operation can be performed.

The tape consists of infinite cells on which each cell contains input symbol or a special symbol called blank.

It also consists of a head pointer, which points to cell currently being read and can move in both directions.



Turing Machine (TM) is expressed as a 7-tuple $(Q, T, B, \Gamma, \delta, q_0, F)$ where

Q = Finite set of states

T = Tape alphabet (symbol which can write on tape)

B - blank symbol (every cell is filled with b , except input alphabet initially)

Σ - input alphabet (symbols which are part of input)

δ - transition function

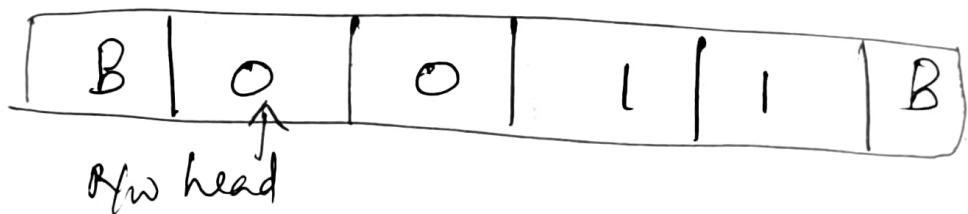
q_0 - initial state

F - set of final states

Construct a Turing machine for
 $L = \{0^n 1^n, n \geq 1\}$

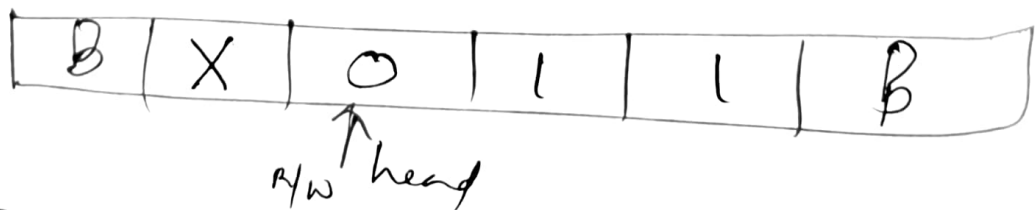
Solution ~~A~~ Example input string:- 0011

* Initially head points to 0 and initial state q_0



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

Means it will go to state q_1 , replace 0 by X and head will move right

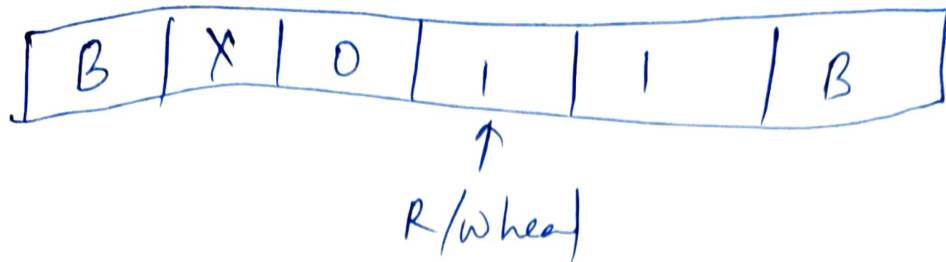


$$\delta(q_1, 0) = (q_1, 0, R)$$

Remain in same state, don't change symbol, move right

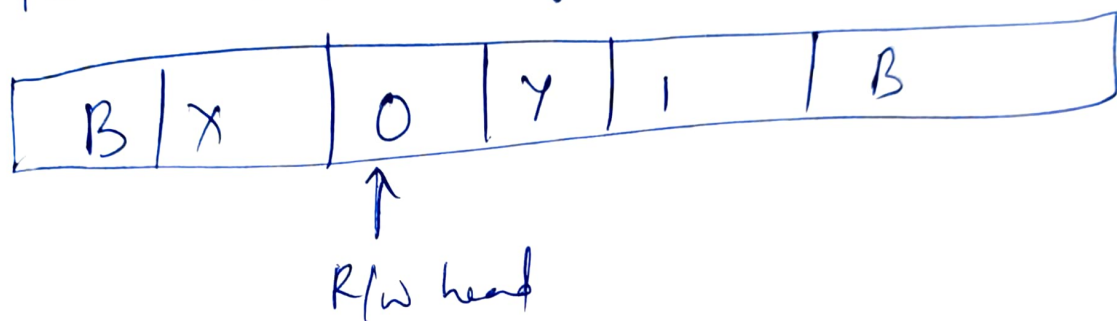
Transition fn

	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, Y, L)	
q_3				q_3, Y, R	halt



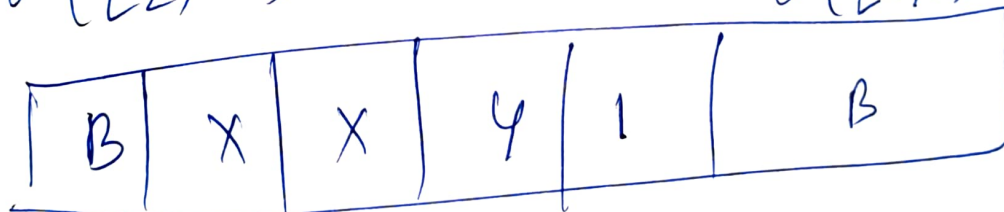
$$\delta(q_1, 1) = q_2, Y, L$$

move to q_2 , change 1 to Y, move left.



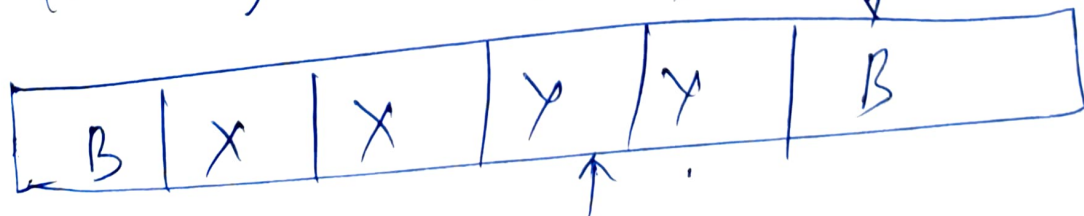
$$\delta(q_2, 0) = q_2, 0, L \quad ; \quad \delta(q_2, 0) = q_0, X, R$$

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



$$\delta(q_1, Y) = \cancel{q_2, Y, R} \quad q_1, Y, R$$

$$\delta(q_1, 1) = q_2, Y, L \quad \downarrow$$



$$\delta(q_0, Y) = q_3, Y, R$$

$$\delta(q_3, B) = \text{halt (accept the input)}$$