Turing Machines

material

Chapters 14.3, $\underbrace{\text{8.1 and 8.3}}_{\text{recap}}$

Definition

T. M.

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

Q is a finite set of states

Γ is a finite set of symbols, which we call the Tape alphabet.

$\Sigma \subseteq \Gamma \setminus B$

the input alphabet

δ is a partial function

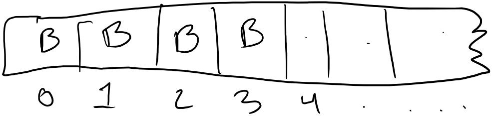
$\delta : Q \times \Gamma \xrightarrow{p} Q \times \Gamma \times \{L, R\}$

transition function

$q_0 \in Q$ start state of M.

Properties of TMs.

Every machine has something called a tape

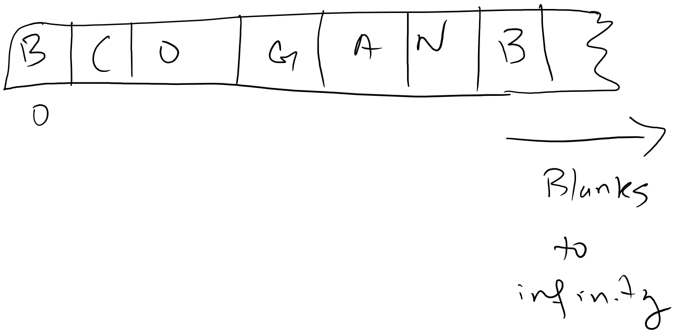


left boundary

first input starts

q_0 at position 0

infinitely to the right


B
C
O
G
A
N
B
0
Blanks
to
infinity

Transition in a Turing Machine

- Change to the appropriate state of turing machine (which is based the transition function)
- write a new symbol at the current position

  a/a

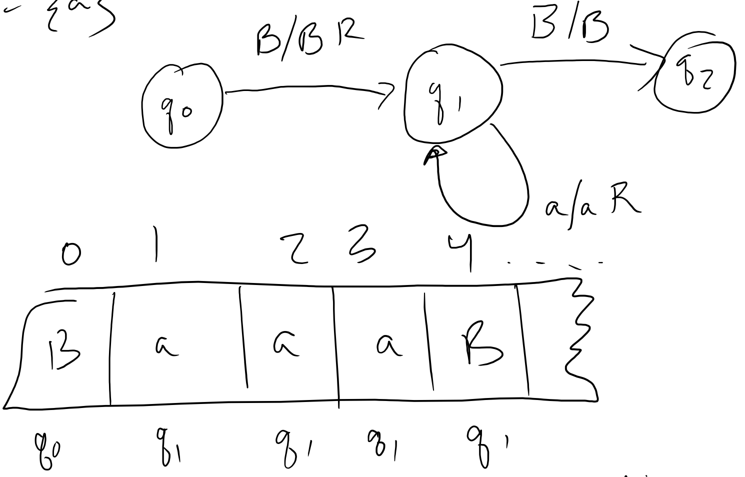
  read "a"
  write "a"
- move the tape head to the next position

Computation halts if there is no transition defined for the current state and input.

Computation halt *abnormally* if the tape head moves to the left of $\emptyset$.

Turing Machines can be represented as state diagrams.

$\Sigma = \{a\}$



computation halts in q_1

$x/y\ D$

$x, y \in \Gamma$, $D \in \{L, R\}$

a	a
b	a
B	B

Replace all "~~b~~'s" with "a's".

$\vdash q_0 B\, a\, a\, a\, a\, a$

$\vdash q_0 B\, a\, b\, a\, b\, B$

more blanks

$\vdash B q_1 a\, b\, a\, b\, B$

$\vdash B\, b\, a\, q_2 b\, a\, B$