Turing machines

Turing machine consists of:

1 an infinite Length <u>tape</u>
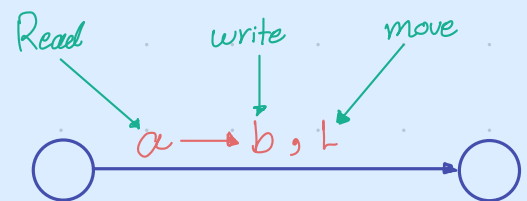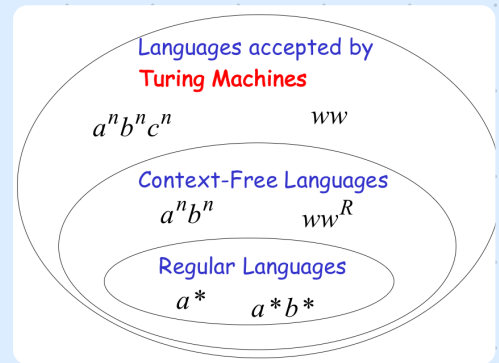
divid into cells on wich input is given.

2 a **head** wich reads the input tape

at each transition:
① Reads a symbol
② writes a symbol
③ Moves Left or Right

3 a Control Unit

Languages accepted by **Turing Machines**

$a^n b^n c^n$ ww

Context-Free Languages
$a^n b^n$ ww^R

Regular Languages
$a*$ $a*b*$

Read write move

$a \rightarrow b , L$

Turing Machines are Deterministic !

Deterministic

no multiple transition acceptable for one input

- no multiple transitions acceptabe fo one input No δ transaction

- no δ transition allowed

Partial, ممكن لكل input ما يكنش عندي آزاد رجعة با مث

- *Partial : input لكل transition عندي يبقي ي إجبار مبت

Halting..

the machine halt in a state if there is no transition to follow.

* يعني ماتلقي و ما input transition

Accepting States:

Allowed!

Not allowed!

no outgoing transitions.

Acceptance:

accept input string if :

if machain halt in an accept state.

reject Input string if :

① if machain halt in a non-accept state.

or

② if machain enters an infinite Loop
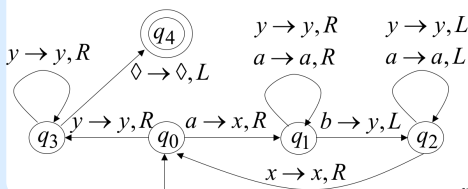
Because of the infint Loop:

1) The accepting state can not be reached!

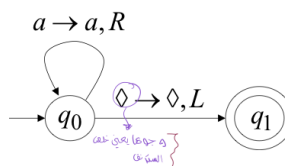2) The machin never halt

3) The input string is rejected.

Turing machine examples :

Turing machine for the language $\{a^n b^n\}$ $n \geq 1$

Input alphabet $\Sigma = \{a, b\}$

Accepts the language: a^* RL

Formal Definitions for TM

Transition Function:

$$\delta(q_1, a) = (q_2, b, R)$$

- q_1: The current state
- a: input we Readed
- q_2: new state
- b: input we writed
- R: move

Formal Definition:

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

$$\Gamma \subseteq \Sigma$$

- Q: set of States
- Σ: set of input alphabet
- Γ: set of Tape alphabet
- δ: transition function
- q_0: initial state
- $\Diamond$: blank
- F: accept states

Configuration:

- ❦ Instantaneous description:

$$c\,a\ \ q_1\ \ b\,a$$

- ca: قبل الhead
- q_1: واقف عند الhead
- ba: الhead وبعد

* ما أكتب البلانك بال config

- ❦ Initial configuration: $q_0\, w$

  - w: Input string.

- ❦ The accepted Language: For any TM M $\quad L(M) = \{ w : q_0 w \overset{*}{\vdash} x_1 q_f x_2 \}$

if a language L is accepted by
a TM then we say that L is:

- Turing Recognizable
- Turing Acceptable.
- Recursively Enumerable.

Computing Functions with Turing Machines جزء الـ

ما غطيته في هذا الملخص