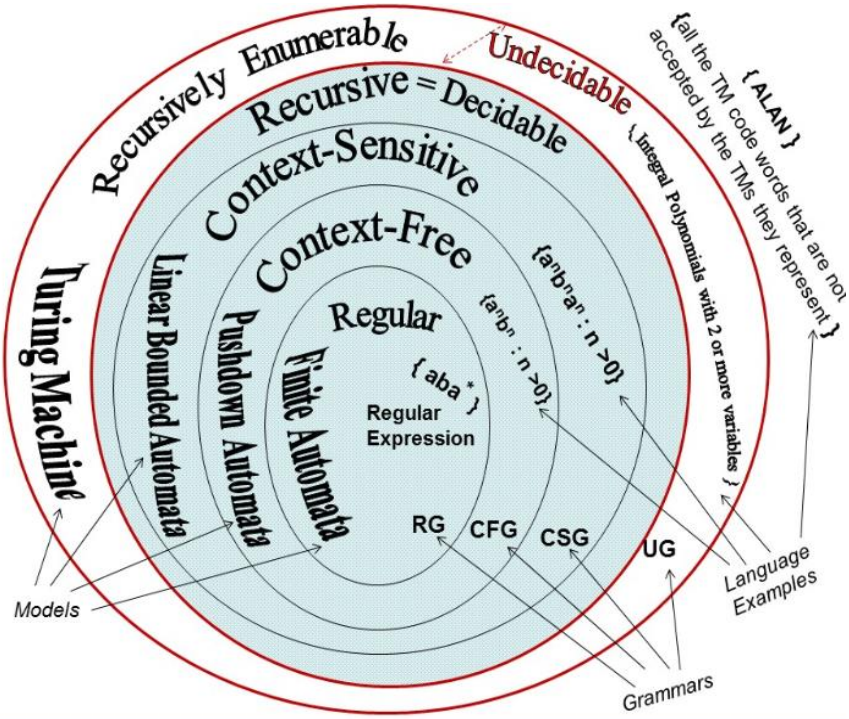
Al-Hamdaniya University

College of Education

Computer Science

Stage: 2nd



Turing Machine TM

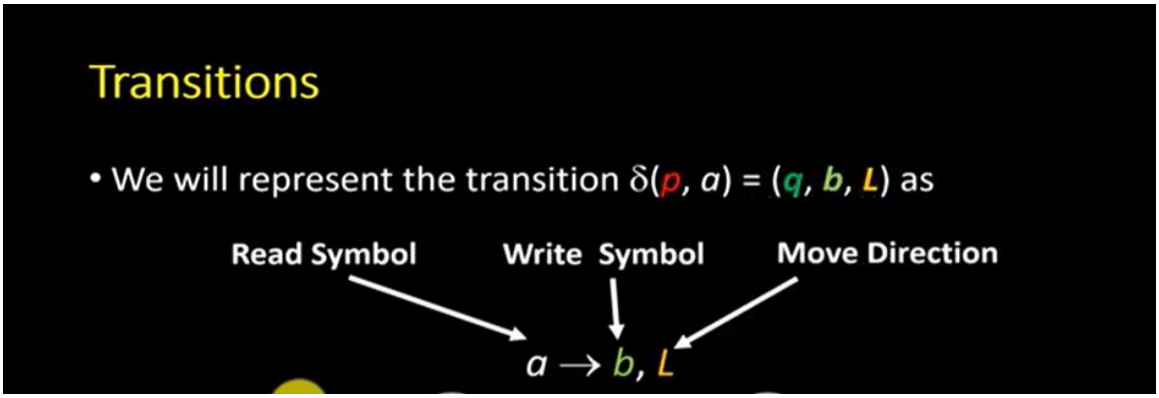
It is a mathematical representation of computer which developed by Alan Mathison Turing. The importance of TM is that it has an output which conveys people of the operation results.

TM has the following items:

- An alphabet Σ of input letters .
- The input string will be stored in a TAPE that consists of a sequence of cells. Each cell contains a single character of the input string. The initial values of the TAPE are blanks Δ.

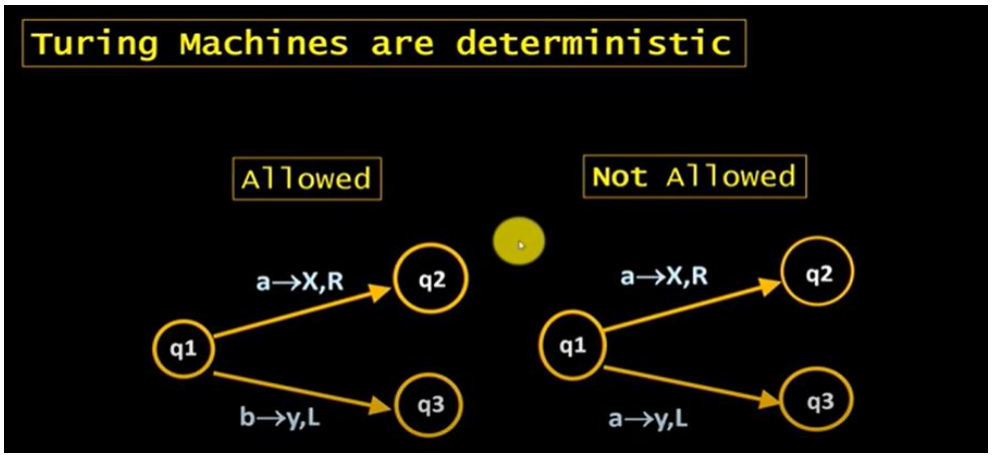
- A HAED read the content of the TAPE cells and can be moved to the left or right. The initial location of the HEAD is the first cell and the HEAD has to be relocated to the right or the machine will be crashed.

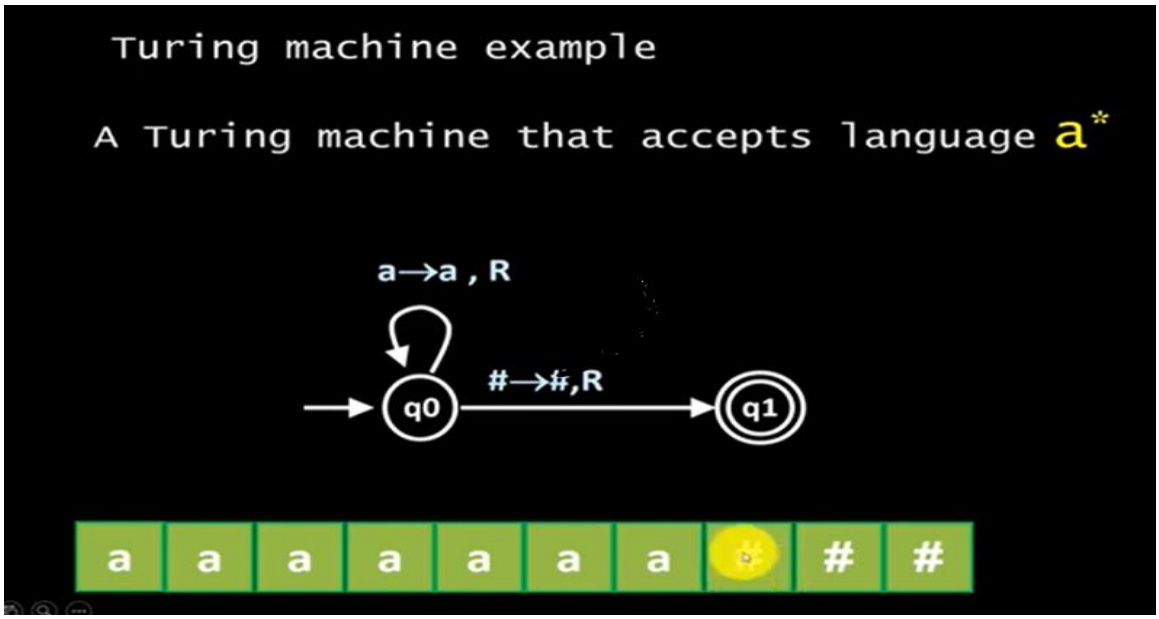
- A machine which consists of a set of states; one START state where the execution begins and HALT states where the execution is finished, a number of states which do not have a function it has only names.
- A program which is a set of rules that labels the machine edges by three sections: (Letteri, Lettero, direction).
- Letteri, the input character is read by the HEAD.
- Lettero, the character which is written by the HEAD.
- Direction, move the HEAD to a specific direction.
- Turing Machine is deterministic, nor more than one leaving edge have the same Letteri.



TM will be crashed when:

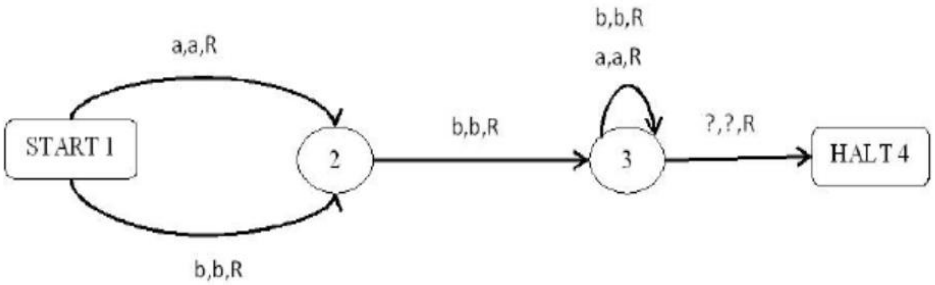
1. The HEAD is moved to the right while it is in the first cell.
2. The path of the input string will not arrive at the HALT state.


Turing Machines are deterministic
Allowed
Not Allowed
a→X,R
q2
q1
b→y,L
q3
a→X,R
q2
q1
a→y,L
q3


Turing machine example
A Turing machine that accepts language a*
a→a , R
#→#,R
q0
q1
a a a a a a a # # #

Example:

Let us trace the input string *aba* on the following TM:



STATE	TAPE & TAPE HEAD
START1	<u>a</u>ba
2	a<u>b</u>a
3	ab<u>a</u>
3	aba<u>Δ</u>
HALT 4	aba<u>ΔΔ</u>

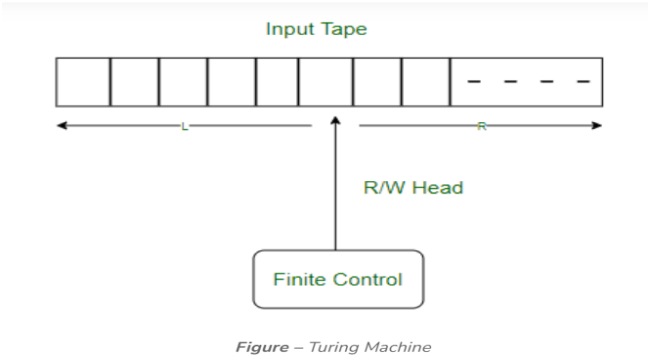
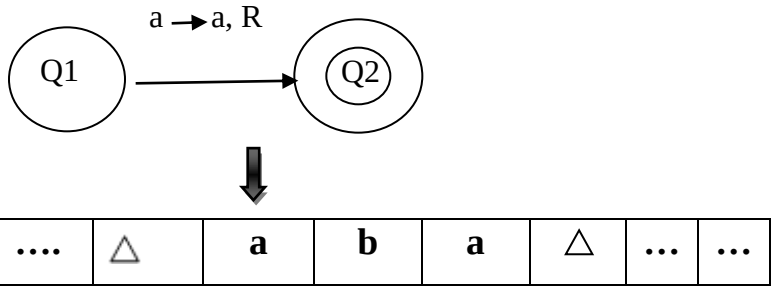


Figure – Turing Machine

Example : L= { w |w starts with a } is it accept?



Example : L= { w |w ends with a } is it accept?

a → a, R b → b, R