Automata – What is it?

The term "Automata" is derived from the Greek word "αὐτόματα" which means "self-acting". An automaton (Automata in plural) is an abstract self-propelled computing device which follows a predetermined sequence of operations automatically.

An automaton with a finite number of states is called a **Finite Automaton** (FA) or **Finite State Machine** (FSM).

Formal definition of a Finite Automaton

An automaton can be represented by a 5-tuple (Q, ∑, δ, q0, F), where −

* **Q** is a finite set of states.
* **∑** is a finite set of symbols, called the **alphabet** of the automaton.
* **δ** is the transition function.
* **q0** is the initial state from where any input is processed (q0 ∈ Q).
* **F** is a set of final state/states of Q (F ⊆ Q).

Related Terminologies

Alphabet

* **Definition** − An **alphabet** is any finite set of symbols.
* **Example** − ∑ = {a, b, c, d} is an **alphabet set** where ‘a’, ‘b’, ‘c’, and ‘d’ are **symbols**.

String

* **Definition** − A **string** is a finite sequence of symbols taken from ∑.
* **Example** − ‘cabcad’ is a valid string on the alphabet set ∑ = {a, b, c, d}

Length of a String

* **Definition** − It is the number of symbols present in a string. (Denoted by **|S|**).
* **Examples** −
  + If S = ‘cabcad’, |S|= 6
  + If |S|= 0, it is called an **empty string** (Denoted by **λ** or **ε**)

Kleene Star

* **Definition** − The Kleene star, **∑\***, is a unary operator on a set of symbols or strings, **∑**, that gives the infinite set of all possible strings of all possible lengths over **∑** including **λ**.
* **Representation** − ∑\* = ∑0 ∪ ∑1 ∪ ∑2 ∪……. where ∑p is the set of all possible strings of length p.
* **Example** − If ∑ = {a, b}, ∑\* = {λ, a, b, aa, ab, ba, bb,………..}

Kleene Closure / Plus

* **Definition** − The set **∑+** is the infinite set of all possible strings of all possible lengths over ∑ excluding λ.
* **Representation** − ∑+ = ∑1 ∪ ∑2 ∪ ∑3 ∪…….

∑+ = ∑\* − { λ }

* **Example** − If ∑ = { a, b } , ∑+ = { a, b, aa, ab, ba, bb,………..}

Language

* **Definition** − A language is a subset of ∑\* for some alphabet ∑. It can be finite or infinite.
* **Example** − If the language takes all possible strings of length 2 over ∑ = {a, b}, then L = { ab, aa, ba, bb }