

1. Automata Theory: Introduction & Theory of Formal Languages.

Introduction:

Automata (plural of automaton) theory is the basis for developing the theory of formal languages. The basic definition of a formal language can be described as:

- A **symbol** (a simple character, i.e. meaningless by itself).
- An **alphabet** (a finite set of symbols).
- A **word** (a finite string of symbols from a given alphabet).
- A **language** (a set of words formed from a given alphabet/word).

The set of words that form a language is usually **infinite**, but it may be **finite** or **empty**. Formal languages are treated like mathematical models which involves union and intersection of sets.

Since computers are mathematical models, so building the mathematical models means building the machines. Automata theory is used to analyze the machine by types of input on which that machine can operate successfully. The collection of these successful inputs is called the language of that specific machine. That is, an automata provides a method for accepting or rejecting a string(s) of a language by a machine.

The acceptance or rejection of a string is performed by defining a **grammar** for that specific machine. Grammars are termed as a set of rules. The machine performs the computations (as per rule) on an input by moving through a series of states. That's why an automata is also called as an abstract mathematical model for Finite State Machines (FSM).

What is a grammar?

A *grammar* is a powerful tool (a set of rules) for describing and analyzing a language. Using grammar, valid sentences in a language are constructed. A simple example of English grammar can be given as: (the symbol "|" stands for "or")

Example-1:

sentence	<div>F0 A1 E0</div>	subject verb-phrase object
subject	<div>F0 A1 E0</div>	This Computers I
verb-phrase	<div>F0 A1 E0</div>	adverb verb verb
adverb	<div>F0 A1 E0</div>	never
verb	<div>F0 A1 E0</div>	is run am tell
object	<div>F0 A1 E0</div>	the noun a noun noun
noun	<div>F0 A1 E0</div>	university world cheese lies

Using the above grammar (rules), some simple sentences can be constructed such as:

This is a university.