Automata Formal Languages & Logic

Unit 1 - Finite State Machines

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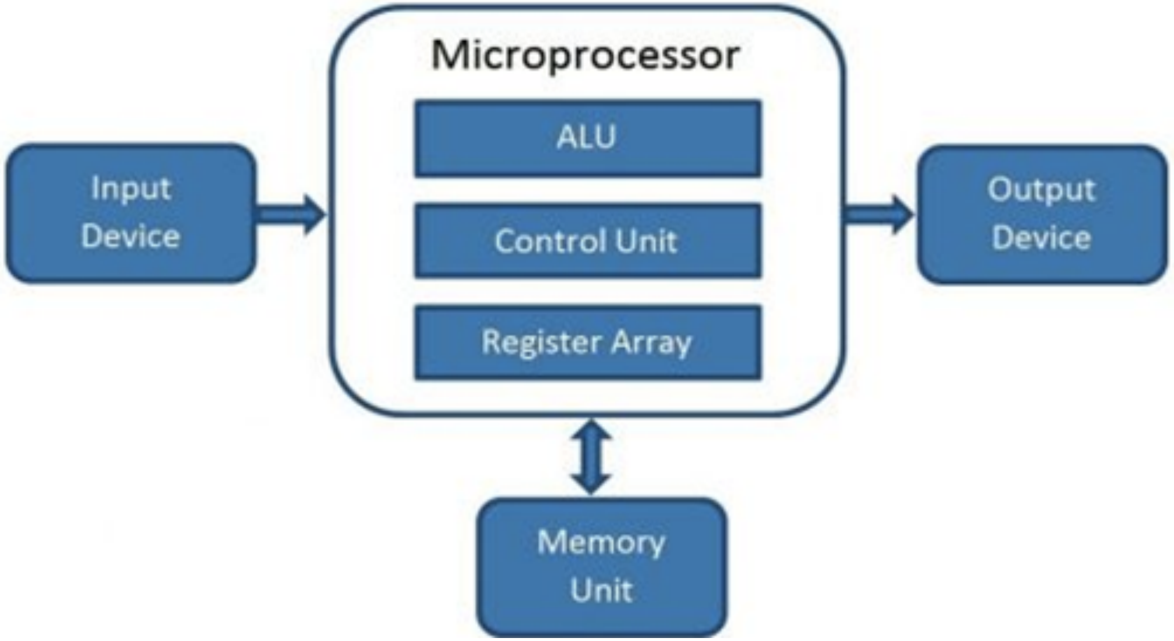
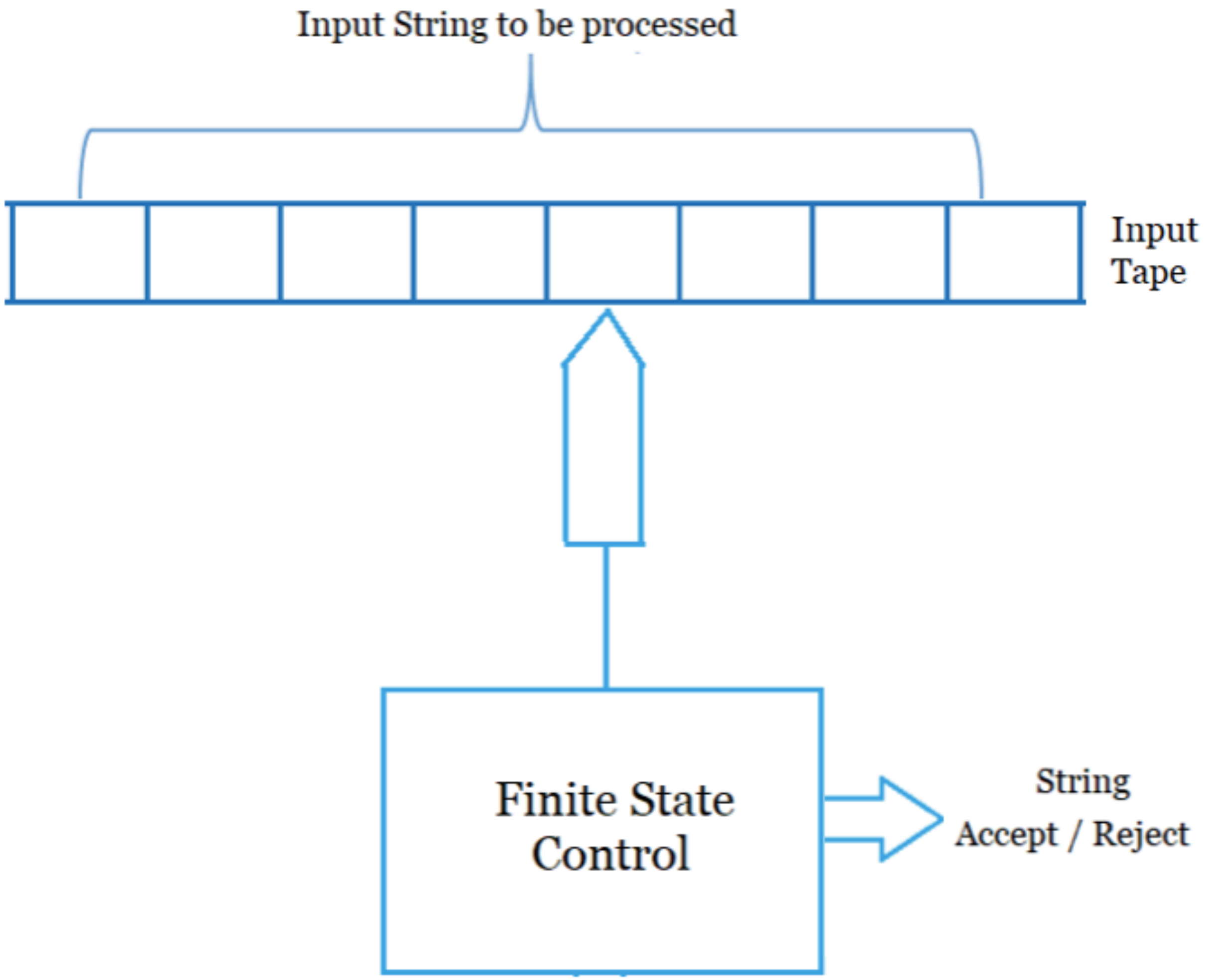
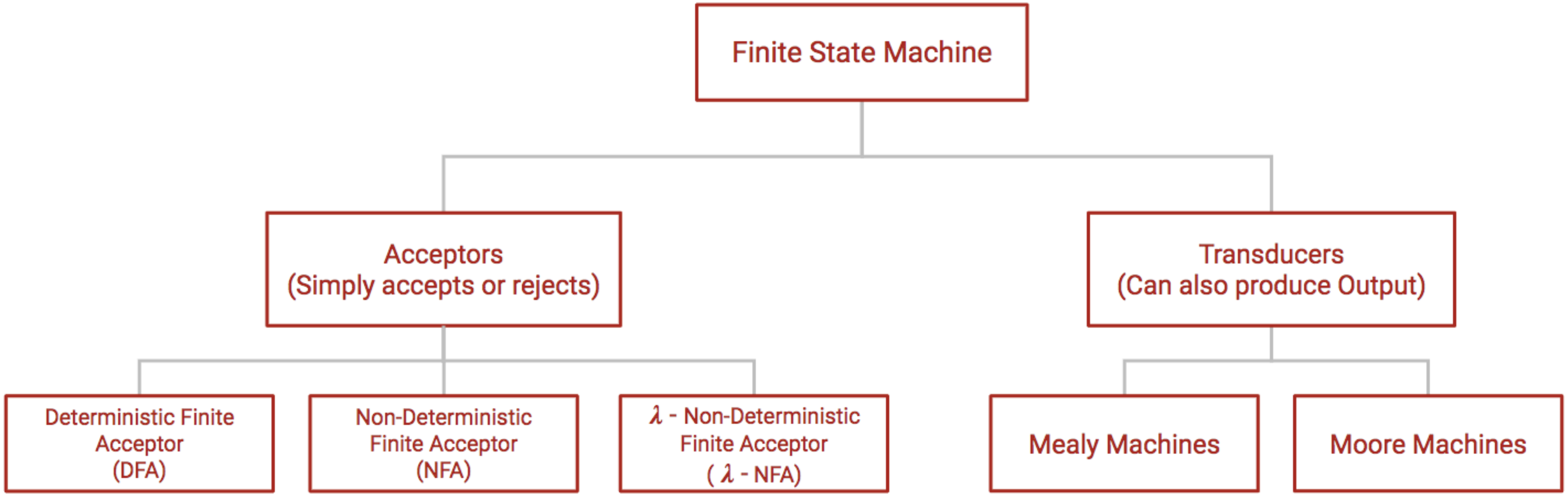


Computer



Finite State Machines
or
Finite State Automata
or
Finite Automata

Classification of Finite State Machines



Basic Notations :

Alphabet (Σ)

String (w)

Empty String (ϵ or λ)

Length of a String ($|w|$)

Power of an Alphabet (Σ^i)

Kleens Closure or Kleens Star (Σ^*)

Kleens Plus (Σ^+)

Language (L)

Basic Notations :

Alphabet - Finite Set of Symbols, denoted by Σ

Example :

- Binary Alphabet - {0, 1}
- English Alphabet - {a, b, c, …. z}
- ASCII

Basic Notations :

String - Denoted by w is a finite sequence of symbols from the alphabet Σ.

Example :

- Empty String - $\{\epsilon\}$ or $\{\lambda\}$

Lets say, $\Sigma = \{0, 1\}$ then, various strings that can be generated are :

ϵ, 0, 1, 01, 10, 11, 00, 101,111, 110, 011, 010, and so on

Basic Notations :

Length of a String - It is the number of symbols in a String w. Denoted as |w|.

Example :

- Empty String - $\{\epsilon\}$ or $\{\lambda\}$ has length 0
- If w = 0100 then, |w| = 4

Basic Notations :

Power of an Alphabet - Denoted by Σ^i is the set of strings of length i.

Example :

if $\Sigma = \{0, 1\}$ then,

$\Sigma^0 = \{\lambda\}$ set of strings of length 0

$\Sigma^1 = \{0,1\}$ set of strings of length 1

$\Sigma^2 = \{00, 01, 10, 11\}$ set of strings of length 2

.....

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Basic Notations :

Kleene Closure(Kleene Star) - Denoted by Σ^* is the set of strings of length >=0

i.e. $\Sigma^* = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \ldots\ldots\ldots$

Kleene Plus - Denoted by Σ^+ is the set of strings of length > 0

i.e. $\Sigma^+ = \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \ldots\ldots\ldots$

Basic Notations :

Language - Denoted by L is the set of strings obtained from Σ^*.

Language L is a subset of Σ^*,

$$L \subseteq \Sigma^*$$

Example :

Language over $\Sigma = \{0, 1\}$ containing strings that contain equal number of 0's and 1's.

L = { λ , 01, 10, 1100, 0101, 1010, 1100, ... }

Basic Notations :

Language - Finite or Infinite

Example :

Finite Language

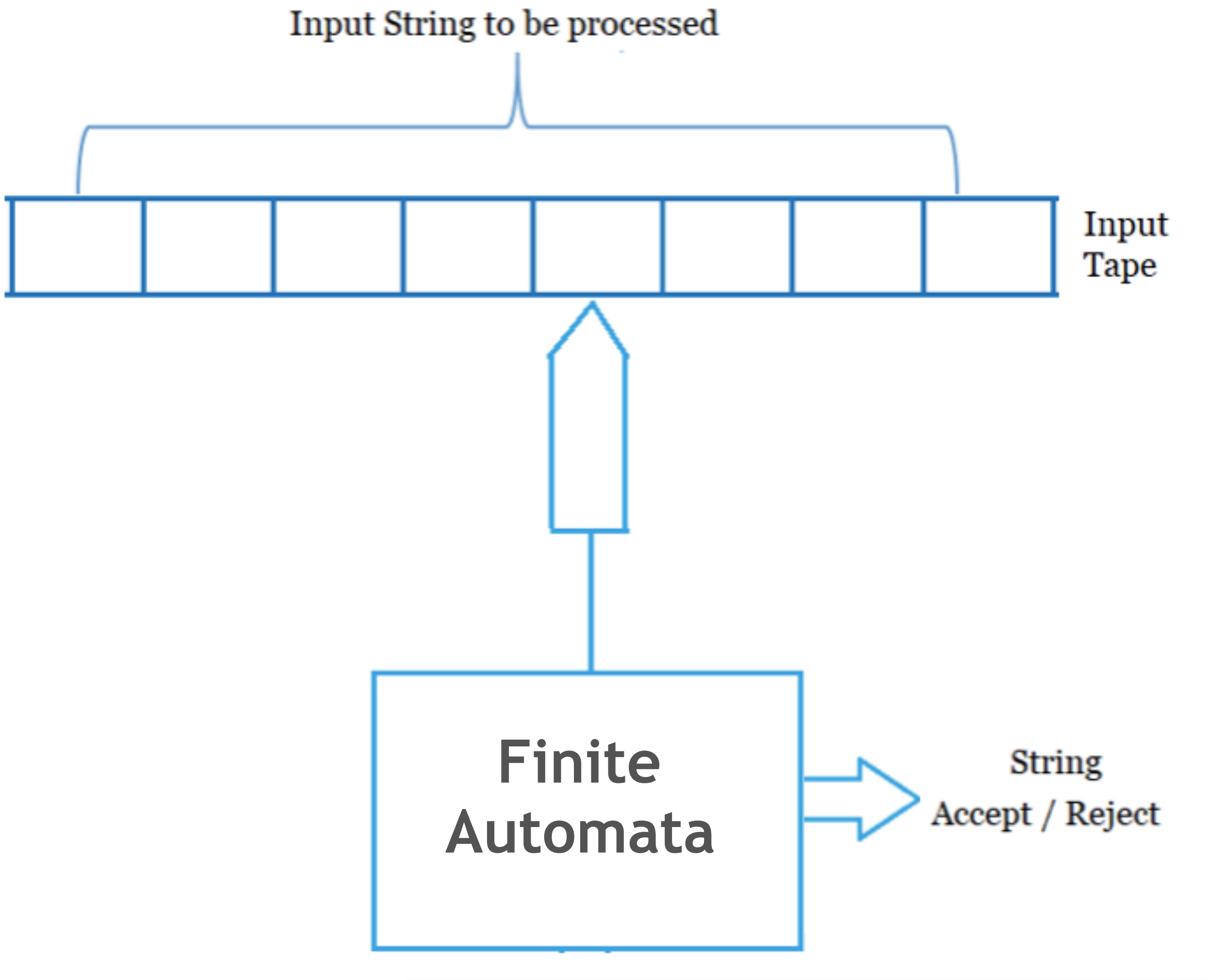
L = set of string over $\Sigma = \{0, 1\}$ such that $|w| = 2$

L = {00, 01, 10, 11}

Infinite Language

L = set of string over $\Sigma = \{0, 1\}$ such that $|w| > 2$

L = {00, 101, 010, 011, 100, 110, 001, 111, 1100, ... }



For Infinite languages we need a finite representation which we can store in memory and is able to do the same kind of check

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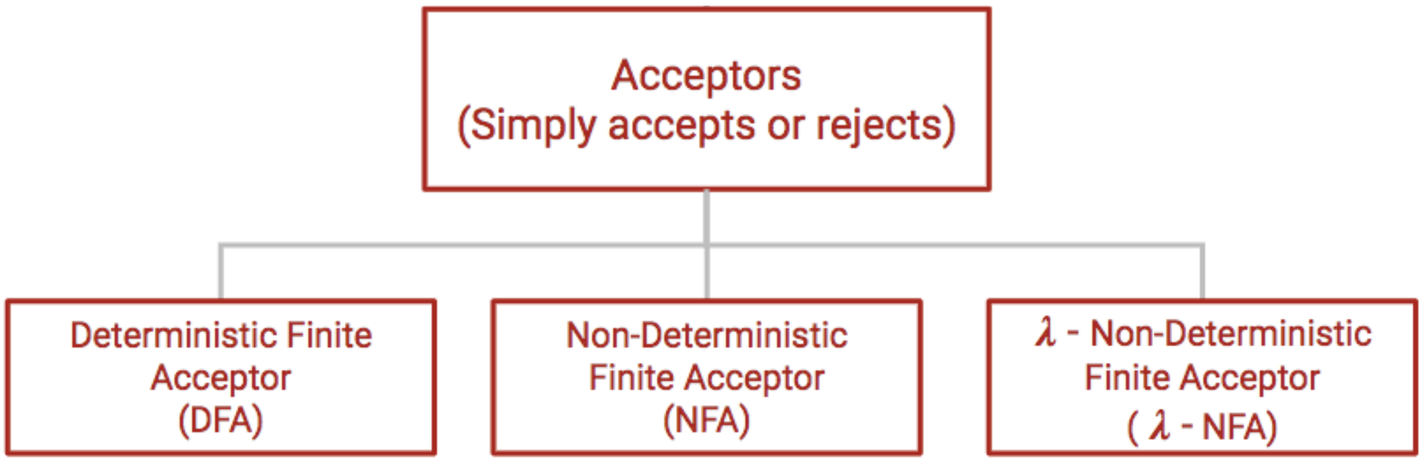


5-tuple or quintuple

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

M - Machine/Automata

Q - Set of States (finite)

Σ - Set of Input Symbols

δ - Transition Function

q_0 - Start State

F - Set of Final States

$F \subseteq Q$

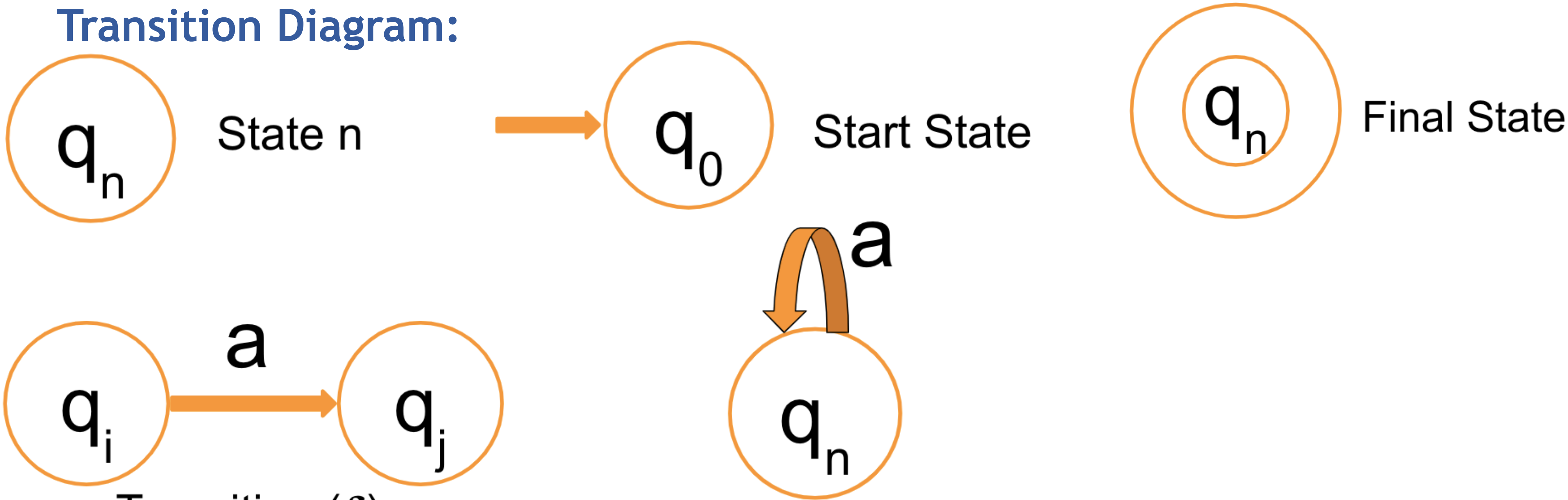
Summary :

- An *automaton* is an idealized mathematical computing machine.
- A *language* is a set of strings.
- The automata we study will accept as input a string and (attempt to) determine whether that string is contained in a particular language.
- A *finite automaton* is a simple type of mathematical machine for determining whether a string is contained within some language.

Machine M can be defined in 3 different ways :

1) Transition Diagram
2) Transition Table
3) Transition Function

Each finite automaton consists of a set of *states* connected by *transitions*. Symbols used in Constructing a Finite Automata as Transition Diagram:



Transition (δ)
$\delta(q_i\ ,\ a) = q_j$

Self-loop or Jolly ride
$\delta(q_n\ ,\ a) = q_n$

THANK YOU

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