WELCOME
Theory of Computation
Lecture 02

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Operation of Language

1) *Union*: Let L1 and L2 are language over an alphabet ∑. The union of L1 and L2 denoted by L1U L2 is {x|x is in L1 or L2}.
2) *Intersection*: Let L1 and L2 are language over an alphabet ∑. The union of L1 and L2 denoted by L1∩ L2 is {x|x is in L1 and L2}.
3) *Concatenation*: Let L1 and L2 are language over an alphabet ∑. The concatenation of L1 and L2 denoted by L1.L2 is { w1.w2|w1 is in L1 and w2 is in L2}.
4) *Reversal*: Let L be a language over an alphabet ∑. The reversal of L denoted by L^r / $L^/$ is {w^r | $w^/$ is in L}.
5) *Complementation:* Let L be a language over an alphabet ∑. The complementation of L denoted by L‘= ∑* - L.

Finite Automata

- Finite automata are used to recognize patterns.
- It takes the string of symbol as input and changes its state accordingly. When the desired symbol is found, then the transition occurs.
- At the time of transition, the automata can either move to the next state or stay in the same state.
- Finite automata have two states, **Accept state** or **Reject state**. When the input string is processed successfully, and the automata reached its final state, then it will accept.

Representation

- ✓ *It is mathematical model of a systems with discrete inputs, outputs, states and set of transitions from state to state that occurs on input symbols from alphabet* $\sum$.

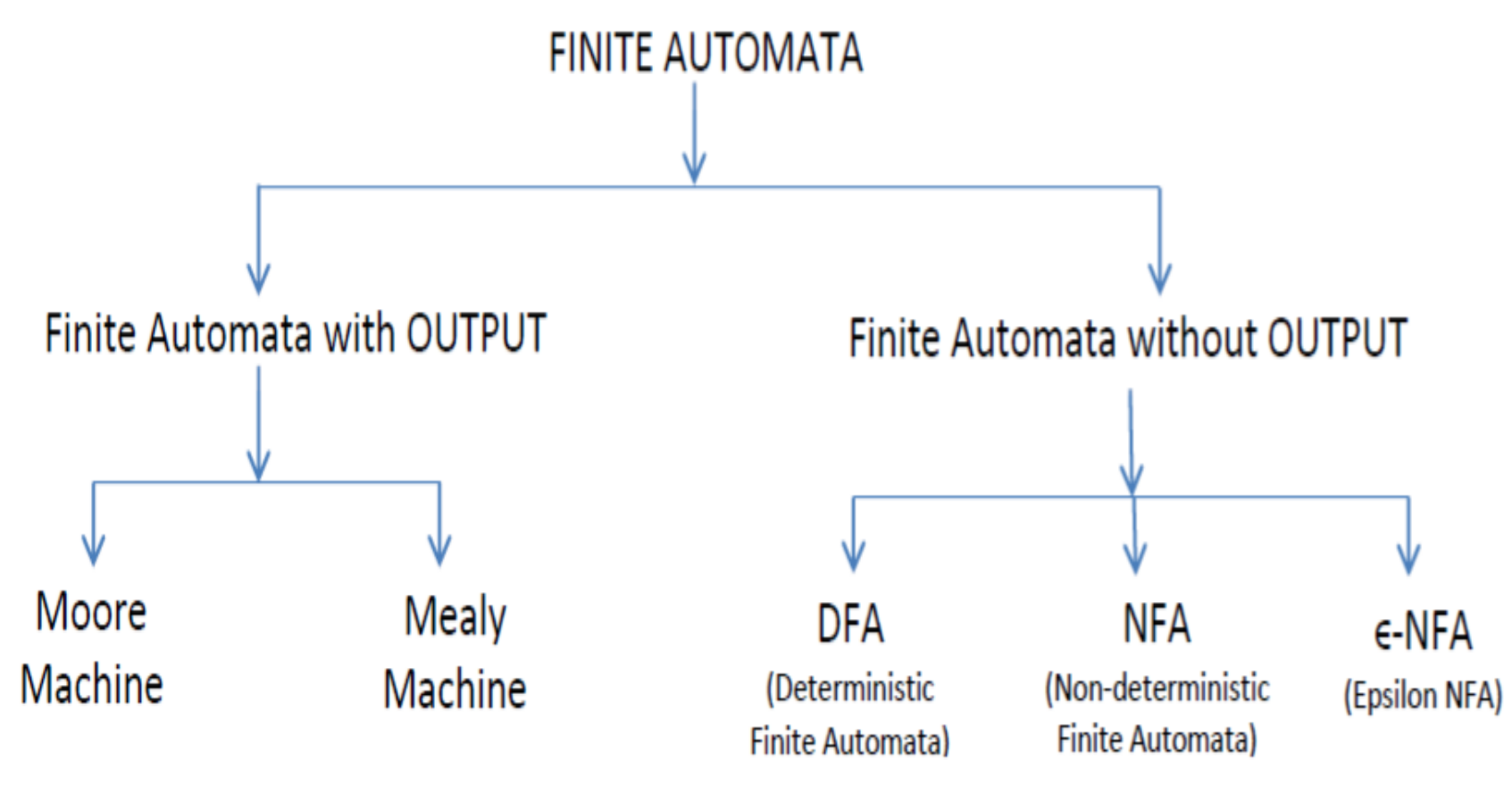
- ➢ Graphical (Transition Diagram)
- ➢ Tabular (Transition Table)
- ➢ Mathematical (Transition function or mapping function)

Formal Definition of FA

A finite automaton is a collection of 5-tuple (Q, ∑, δ, q0, F), where:

- Q: finite set of states
- ∑: finite set of the input symbol
- q0: initial state
- F: final state
- δ: Transition function

Classification of FA



Transition Diagram

- A transition diagram or state transition diagram is a directed graph which can be constructed as follows:
- There is a node for each state in Q, which is represented by the circle.
- There is a directed edge from node q to node p labeled a if δ(q, a) = p.
- In the start state, there is an arrow with no source.
- Accepting states or final states are indicating by a double circle.
- Some Notations that are used in the transition diagram:

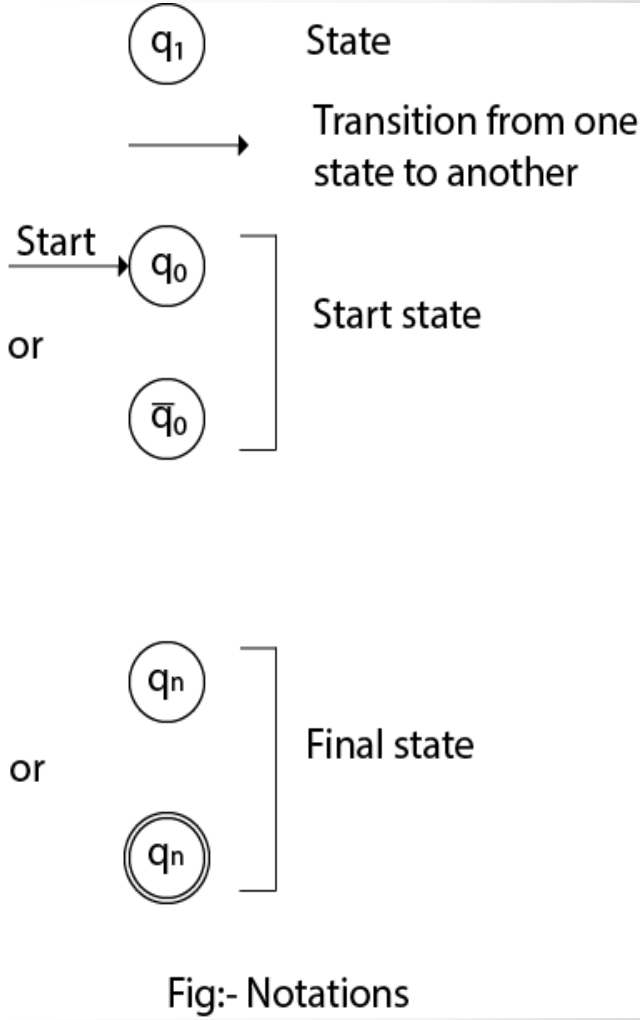


Fig:- Notations

Example

- ∑ = {0, 1} accepts all strings starting with 1.
- **Solution:**

  L={1, 10,11,110,101,111……}

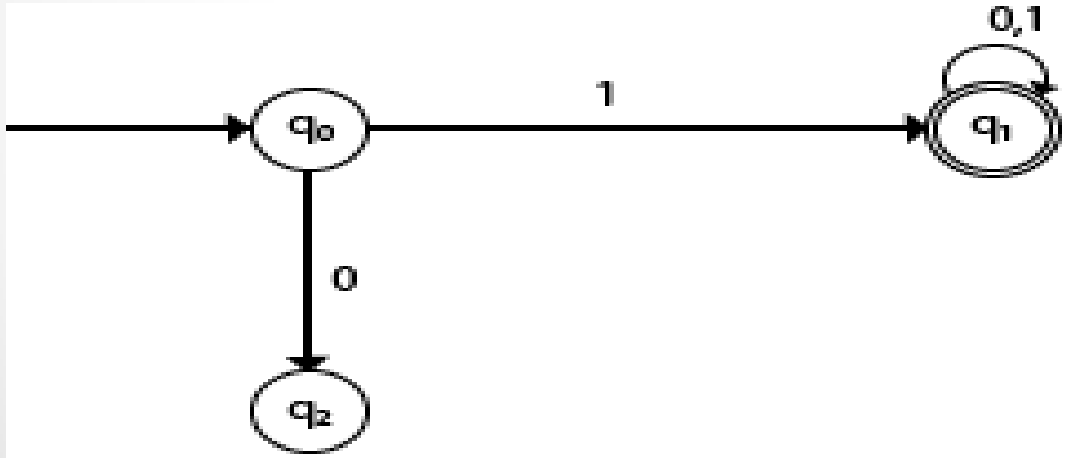
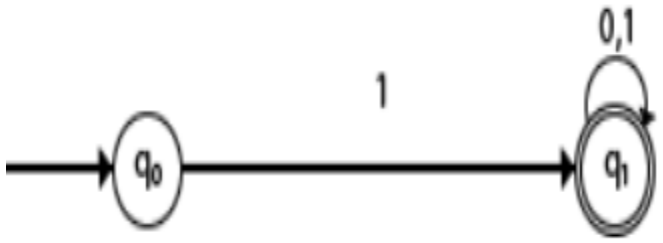
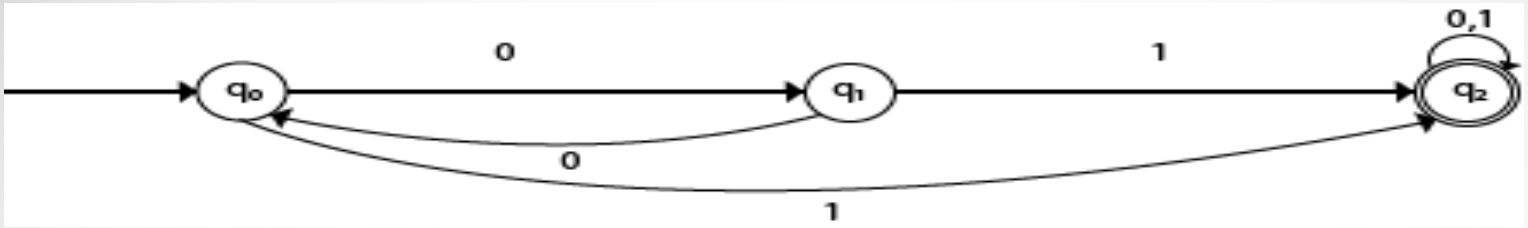


Fig: Transition diagram



Transition Table

- The transition table is basically a tabular representation of the transition function. It takes two arguments (a state and a symbol) and returns a state (the "next state").
- A transition table is represented by the following things:
- Columns correspond to input symbols.
- Rows correspond to states.
- Entries correspond to the next state.
- The start state is denoted by an arrow with no source.
- The accept state is denoted by a star.



Present State	Next State for Input 0	Next State of Input 1
→q0	q1	q2
q1	q0	q2
*q2	q2	q2

Explanation:

In the above table, the first column indicates all the current states. Under column 0 and 1, the next states are shown.

The first row of the transition table can be read as, when the current state is q0, on input 0 the next state will be q1 and on input 1 the next state will be q2.

In the second row, when the current state is q1, on input 0, the next state will be q0, and on 1 input the next state will be q2.

In the third row, when the current state is q2 on input 0, the next state will be q2, and on 1 input the next state will be q2.

The arrow marked to q0 indicates that it is a start state and circle marked to q2 indicates that it is a final state.

Transition Function

- ✓ The mapping function or transition function denoted by δ (Delta).
- ✓ Two parameters are passed to this transition function
  - 1) Current state
  - 2) Input symbol
- ✓ The transition return a state, which can be called as next state.

δ(current_state, current_input_symbol)=next_state.

- State table

δ	0	1
q_0	q_0	q_1
q_1	q_1	q_0

- State transition function

$\delta(q_0, 0) = q_0, \delta(q_0, 1) = q_1$

$\delta(q_1, 0) = q_1, \delta(q_1, 1) = q_0$