Theory of Automata and Formal Language

Lecture-13

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Mealy and Moore Machines(Finite Automata with Outputs)

Moore Machine

Moore machine is a six-tuple $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$, where

$Q \rightarrow$ Finite set of states

$\Sigma \rightarrow$ Finite set of input symbols

$\Delta \rightarrow$ Finite set of output symbols

$q_0 \in Q \rightarrow$ Initial state

$\delta \rightarrow$ Transition function

It is defined as following:-

$$\delta : Q \times \Sigma \rightarrow Q$$

$\lambda \rightarrow$ Output function

It is defined as following:-

$$\lambda : Q \rightarrow \Delta$$

Mealy Machine

Mealy machine is a six-tuple $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$, where

$Q \rightarrow$ Finite set of states

$\Sigma \rightarrow$ Finite set of input symbols

$\Delta \rightarrow$ Finite set of output symbols

$q_0 \in Q \rightarrow$ Initial state

$\delta \rightarrow$ Transition function

It is defined as following:-

$$\delta : Q{\times}\Sigma \rightarrow Q$$

$\lambda \rightarrow$ Output function

It is defined as following:-

$$\lambda : Q{\times}\Sigma \rightarrow \Delta$$
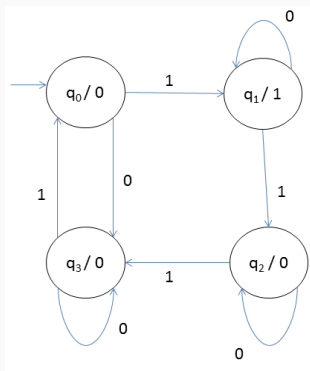
Representation of Moore machine

Moore machine is represented by the following two ways:-

(1) By transition table

Present State	Next State δ		Output λ
	0	1	
→q_0	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

(2) By transition diagram

Example: Find the output string corresponding to the input string 0111 in the above Moore machine.

$q_0 \rightarrow q_3 \rightarrow q_0 \rightarrow q_1 \rightarrow q_2$

The output string is 00010.
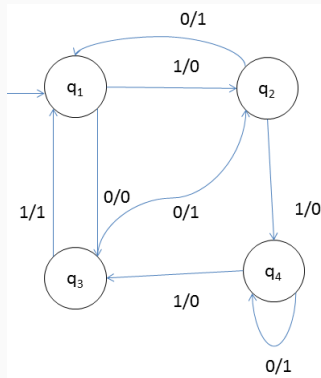
Representation of Mealy machine

Mealy machine is represented by the following two ways:-

(1) By transition table

Present State	0		1	
	δ	λ	δ	λ
→q_1	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

(2) By transition diagram

Example: Find the output string corresponding to the input string 0011 in the above Moore machine.

$q_1 \rightarrow q_3 \rightarrow q_2 \rightarrow q_4 \rightarrow q_3$

The output string is 0100.

Procedure for transforming a Moore machine into a Mealy machine

(1) The output function λ' for the Mealy machine is determined as following:-

$\lambda'(q, a) = \lambda(\delta(q, a)), \, \forall q \in Q, \, a \in \Sigma$

(2) The transition function is the same as that of the given Moore machine.

Finite Automata (FA)

Example: Construct a Mealy machine which is equivalent to the following Moore Machine

Present State	Next State δ		Output λ
	0	1	
$\rightarrow q_0$	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

Finite Automata (FA)

Solution: Mealy machine for the above Moore machine is the following:-

Present State	0		1	
	δ	λ	δ	λ
→q_0	q_3	0	q_1	1
q_1	q_1	1	q_2	0
q_2	q_2	0	q_3	0
q_3	q_3	0	q_0	0