

## Mealy and Moore machine and their conversions

(<http://smartclassacademy.blogspot.pt/2012/11/mealy-and-moore-machine-and-their.html>)

### Mealy and Moore machine

#### Mealy machine :

- In Mealy machine. the value of output function is depend on the present state and present input.
- Mealy machine is described by 6-tuples -  $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$

where

$Q$  = Finite non-empty set of states;

$\Sigma$  = Set of input alphabets.

$\Delta$  = Set of output alphabets.

$\delta$  = Transitional function mapping  $Q \times \Sigma \rightarrow Q$

$\lambda$  = Output function mapping  $Q \times \Sigma \rightarrow \Delta$

$q_0$  = Initial state.

#### Sample Transition table:

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
-> q0	q3	0	q1	1
q1	q0	1	q3	0
q2	q2	1	q2	0
q3	q1	0	q0	1

#### Moore machine :

- In Moore machine. the value of output function is depend on the present state only.
- Moore machine is described by 6-tuples -  $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$

where

$Q$  = Finite non-empty set of states;

$\Sigma$  = Set of input alphabets.

$\Delta$  = Set of output alphabets.

$\delta$  = Transition function mapping  $Q \times \Sigma \rightarrow Q$

$\lambda$  = Output function mapping  $Q \rightarrow \Delta$

$q_0$  = Initial state..

**Sample Transition Table:**

Present State	Next State		Output
	a = 0	a = 1	
-> q0	q3	q1	1
q1	q0	q3	0
q2	q2	q2	0
q3	q1	q0	1

## Conversion from Mealy machine to Moore machine:

### Steps:

- 1.> Determine the number of different output associated with  $q_i$  in the next state column.
- 2.> we split  $q_i$  into different states according to different output associated with it. for ex. suppose in the next state column of the above sample transition table of mealy machine, the output associated with  $q_1$  is "0" in the first next state column and "1" in the second next state column. so we split  $q_1$  into  $q_{10}$  and  $q_{11}$  states. similarly check others and split them.

**Example 1:** consider the above sample transition table of the mealy machine. convert it into corresponding Moore machine.

**Solution:** After applying the conversion steps, we get two states (  $q_1$  and  $q_2$ ) that are associated with different outputs (0 and 1). so we split both states into  $q_{10}$  ,  $q_{11}$  and  $q_{20}$ ,  $q_{21}$ .

Now the transition table becomes

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
-> $q_0$	$q_3$	0	$q_{11}$	1
$q_{10}$	$q_0$	1	$q_3$	0
$q_{11}$	$q_0$	1	$q_3$	0
$q_{20}$	$q_{21}$	1	$q_{20}$	0
$q_{21}$	$q_{21}$	1	$q_{20}$	0
$q_3$	$q_{10}$	0	$q_0$	1

Here

- whole row of  $q_1$  is copied to  $q_{10}$  ,  $q_{11}$  and whole row of  $q_2$  is copied to  $q_{20}$  and  $q_{21}$  of the sample transition table of mealy machine.
- The outputs of the next state columns of  $q_1$  and  $q_2$  are depend on the previous output. For ex. in the first row,  $q_1$  becomes  $q_{11}$  because the out of  $q_1$  is 1. in the fourth row,  $q_2$  becomes  $q_{21}$  because the output of the  $q_2$  is 1. and in the subsequent column  $q_2$  becomes  $q_{20}$  because the output of  $q_2$  in that column was 0. and so on

now in moore machine format, we copied all the states and common output because in moore machine. the outputs of the next state are common.

Present State	Next State		Output
	a = 0	a = 1	
-> q0	q3	q11	1
q10	q0	q3	0
q11	q0	q3	1
q20	q21	q20	0
q21	q21	q20	1
q3	q10	q0	0

This table is moore machine table corresponding to the sample mealy machine.

**Exercise : convert the following mealy machine to corresponding moore machine**

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
->q0	q1	0	q3	0
q1	q3	1	q2	0
q2	q4	1	q0	0
q3	q0	0	q4	1
q4	q2	0	q1	1

## Conversion from Moore machine to Mealy machine:

For understanding the conversion of moore to mealy machine, let us take an example:

**suppose the moore machine transition table is:**

Present State	Next State		Output
	a = 0	a = 1	
-> q0	q3	q1	1
q1	q0	q3	0
q2	q2	q2	0
q3	q1	q0	1

convert this transition table into mealy machine.

**Solution:** First of all take the mealy machine transition table format, i.e.,

resent State	Next State			
	a = 0		a = 1	
	State	Output	State	Output

next step is to copy all the moore machine transition table states into mealy machine transition table format

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
-> q0	q3		q1	
q1	q0		q3	
q2	q2		q2	
q3	q1		q0	

Now in the moore machine, the output of the q0 is 1. so make the output of q0 in the mealy machine next state column of the above table is 1. same process is repeated for q1, q2 and q3.

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
-> q0	q3		q1	
q1	q0	1	q3	
q2	q2		q2	
q3	q1		q0	1

After repeating the above process for q1,q2 and q3 states, the final mealy machine transition table is:

Present State	Next State			
	a = 0		a = 1	
	State	Output	State	Output
-> q0	q3	1	q1	0
q1	q0	1	q3	1
q2	q2	0	q2	0
q3	q1	0	q0	1

**Exercise : convert the following Moore machine into mealy machine:**

Present State	Next State		Output
	a = 0	a = 1	
-> q0	q1	q0	0
q1	q2	q3	1
q2	q3	q2	0
q3	q0	q1	1