MEALY AND MOORE MODELS

Finite Automata with outputs

The FA which we considered in the earlier sections have binary output, i.e, either they accept the string or they do not accept the string. This acceptability was decided on the basis of reachability of the final state by the initial state. Now, we remove this restriction and consider the model where the output can be chosen from some other alphabet. The value of the output function $Z(t)$ in the most general case is a function of present state $q(t)$ and present input $x(t)$ i.e,

$$Z(t) = \lambda(q(t), x(t))$$

where λ is called the output function. This generalized model is usually called the mealy Machine.

If the output function $Z(t)$ depends only on the present state and is independent of the current input, the o/p fn may be written as

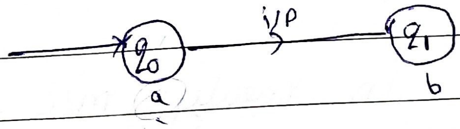
$$Z(t) = \lambda(q(t))$$

This restricted model is called the Moore Machine.

finite automata with output :-

↳(i) Mealy Machine

↳(ii) Moore Machine



FA with O/P

formal Definition : It consist 6 tuple

$M = \{ Q, \Sigma, \Delta, \delta, \lambda, q_0 \}$ where (Delta) (Del) (lambda)

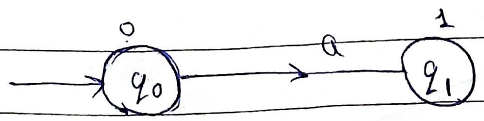
- Q = Non-empty set of all the state.
- Σ = non-empty set of input symbol.
- Δ = non-empty set of output symbol.
- δ = input transition function. $\Sigma \times Q$ into Q ;
- λ = output transition function.
- q_0 = Default initial state.

— × —

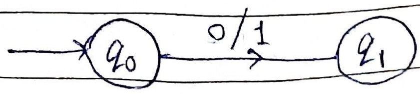
Difference between both machines :-

① In moore machine $\lambda = (Q \times \Delta) \vdash \Delta$,
In mealy machine $\lambda = (Q \times \Sigma) \vdash \Delta$

moore machine



Mealy m/c

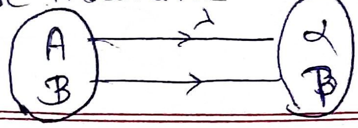


$\lambda = (q_0 \times 0) \vdash 0$

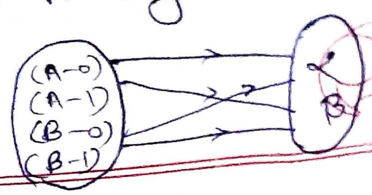
$\lambda(q_0 \times 0) \vdash 1$

O/P function

for moore machine



for mealy M/C

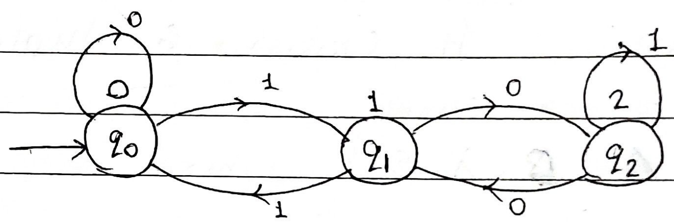


② In moore M/C if length of I/P string is n then the length of O/P string will be (n+1).

③ In mealy M/C if length of I/P string is n then length of O/P string will also n.

——— × ———

Que :-



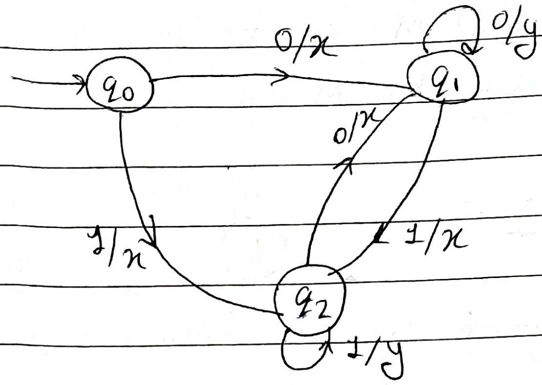
Moore M/C

Present state	Next state		Output
	a = 0	a = 1	λ
→ q_0	q_0	q_1	0
q_1	q_2	q_0	1
q_2	q_1	q_2	2

for the input string 1001, the transition of states is given by

$q_0 \rightarrow q_1 \rightarrow q_2 \rightarrow q_1 \rightarrow q_0$. The output string is 0 1 2 1 0 .

Q.2 :-



Mealy Machine

Sol:

Present State S	Next state			
	0		1	
	state	output	state	output
$\rightarrow q_0$	q_1	x	q_2	x
q_1	q_1	y	q_2	x
q_2	q_1	x	q_2	y

Q:- Generate o/p string with respect to i/p string 1001.

transition of states is given by

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

$$x\ x\ y\ x$$

The o/p string is

$M = \{Q, \Sigma, \Delta, \delta, \lambda, q_0\}$

$Q = \{q_0, q_1, q_2\}$

$\Sigma = \{0\ 1\}$

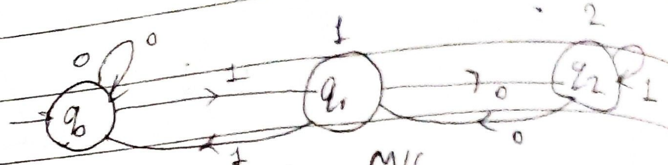
$\Delta = \{x, y\}$

$q_0 = \{q_0\}$

Conversion : 30% ① Moore to Mealy

70% ✡ ② Mealy to Moore

① Moore to Mealy :-

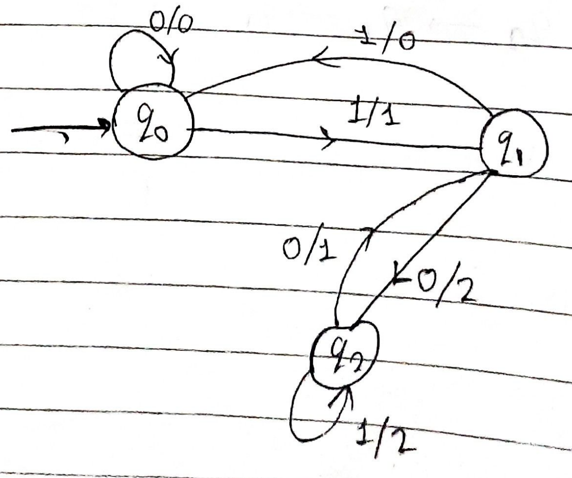


M/C

Que :- Change the given moore into mealy

Present state S	Next state 0	Next state 1	Output λ
→ q_0	q_0	q_1	0
q_1	q_2	q_0	1
q_2	q_1	q_2	2

S	0		1	
	State	O/P	State	O/P
→ q_0	q_0	0	q_1	1
q_1	q_2	2	q_0	0
q_2	q_1	1	q_2	2



② Mealy to Moore :-

Que :-

S	0		1	
	STATE	O/P	STATE	O/P
q_0	q_1	x	q_2	x
q_1	q_1	y	q_2	x
q_2	q_1	x	q_2	y

Step no 1>: Check output of every available state.

Step no. 2>: If any state having multiple O/P then we must brake or split such state into no. of partitioned state according to their available O/P.

Step no. 3>: Splited states consists some transition as a base state but O/P's are different.

Step no 4>: If any state does not have any o/p then we assume primary O/P as its O/P.

Step no 5>: If initial state contains secondary O/P we assume another initial state containing same transition as given in original initial state but O/P will be primary O/P.

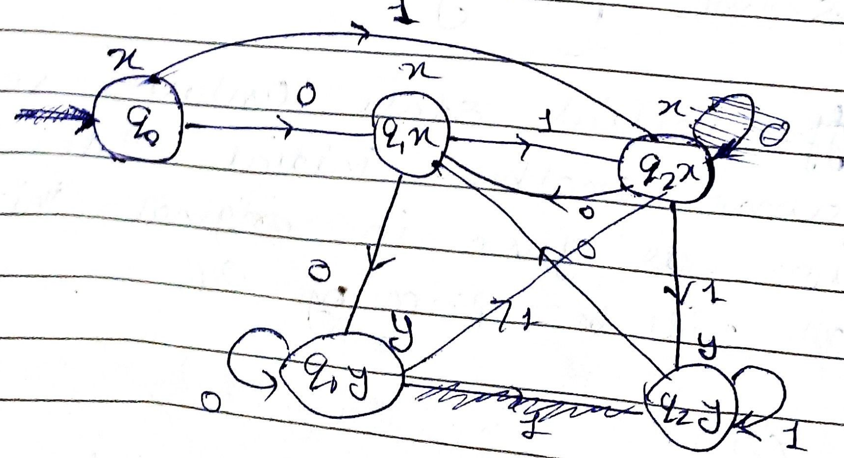
Primary (0), secondary (1)

Que: Mealy to moore conversion :-

δ	0		1	
	State	O/P	State	O/P
q_0	q_1	x	q_2	x
q_1	q_1	y	q_2	x
q_2	q_1	x	q_2	y

Sol:

δ	0	1	λ
$\rightarrow q_0$	q_1x	q_2x	x ← Primary O/P
q_1x	q_1y	q_2x	x
q_1y	q_1y	q_2x	y
q_2x	q_1x	q_2y	x
q_2y	q_1x	q_2y	y



Que :

S	0		1	
	State	output	State	output
→ 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

Sol :

S	0	1	λ
→ q_1	q_3	q_{20}	1
q_{20}	q_1	q_{40}	0
q_{21}	q_1	q_{40}	1
q_3	q_{21}	q_1	0
q_{40}	q_{41}	q_3	0
q_{41}	q_{41}	q_3	1

since initial state contains secondary O/P (i.e, 1) so we must add a new initial state containing the same transition but primary O/P.

δ	0	1	λ
→ q_0	q_3	q_{20}	0
q_1	q_3	q_{20}	1
q_{20}	q_1	q_{40}	0
q_{21}	q_1	q_{40}	1
q_3	q_{21}	q_1	0
q_{40}	q_{41}	q_3	0
q_{41}	q_{41}	q_3	1