

Lecture 18

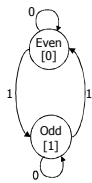
- More Moore/Mealy machines

Example: Parity checker

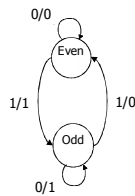
- Serial input string
 - OUT=1 if odd # of 1s in input
 - OUT=0 if even # of 1s in input
- Let's do this for Moore and Mealy

1. State diagram

Moore



Mealy



2. State transition table

Present State	Input	Next State	Present Output
Even	0	Even	0
Even	1	Odd	0
Odd	0	Odd	1
Odd	1	Even	1

Moore

Present State	Input	Next State	Present Output
Even	0	Even	0
Even	1	Odd	1
Odd	0	Odd	1
Odd	1	Even	0

Mealy

3. State minimization

- Already minimized
 - Need both states (even and odd)
 - Use one flip-flop

4. State encoding

Present State	Input	Next State	Present Output
0	0	0	0
0	1	1	0
1	0	1	1
1	1	0	1

Moore

Assignment
Even 0
Odd 1

Present State	Input	Next State	Present Output
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

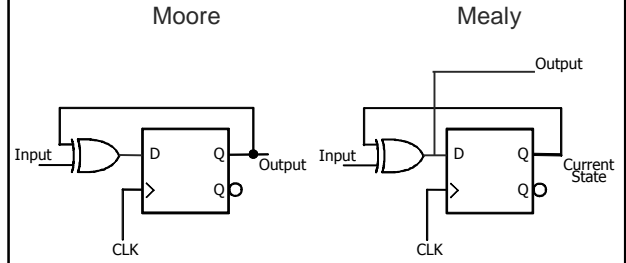
Mealy

5. Next-state logic minimization

- Assume D flip-flops
- Next state = (present state) XOR (present input)

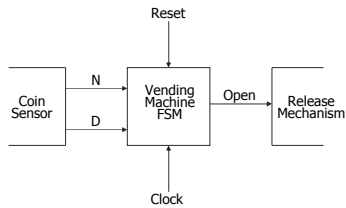
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6. Implement the design



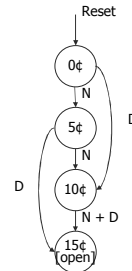
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Example: Vending machine



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Moore machine

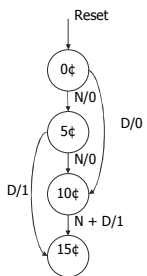


present state	inputs		next state	present output
	D	N		
0¢	0	0	0¢	0
	0	1	5¢	0
	1	0	10¢	0
	1	1	-	-
5¢	0	0	5¢	0
	0	1	10¢	0
	1	0	15¢	0
	1	1	-	-
10¢	0	0	10¢	0
	0	1	15¢	0
	1	0	15¢	0
	1	1	-	-
15¢	-	-	15¢	1

symbolic state table

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Mealy machine



present state	inputs		next state	present output
	D	N		
0¢	0	0	0¢	0
	0	1	5¢	0
	1	0	10¢	0
	1	1	-	-
5¢	0	0	5¢	0
	0	1	10¢	0
	1	0	15¢	1
	1	1	-	-
10¢	0	0	10¢	0
	0	1	15¢	1
	1	0	15¢	1
	1	1	-	-
15¢	-	-	15¢	1

symbolic state table

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Moore machine: State encoding

present state	inputs		next state	present output	present state	inputs		next state	present output		
	D	N			Q1	Q0	D	N	D1	D0	
0¢	0	0	0¢	0	0	0	0	0	0	0	0
	0	1	5¢	0	0	1	0	1	0	1	0
	1	0	10¢	0	1	0	1	0	1	0	0
	1	1	-	-	1	1	-	-	-	-	-
5¢	0	0	5¢	0	0	1	0	0	0	1	0
	0	1	10¢	0	0	1	1	0	1	1	0
	1	0	15¢	0	1	1	1	0	1	1	0
	1	1	-	-	1	1	-	-	-	-	-
10¢	0	0	10¢	0	1	0	0	0	1	0	0
	0	1	15¢	0	0	1	1	1	1	1	0
	1	0	15¢	0	1	0	1	1	1	1	0
	1	1	-	-	1	1	-	-	-	-	-
15¢	-	-	15¢	1	1	1	-	-	1	1	1

symbolic state table

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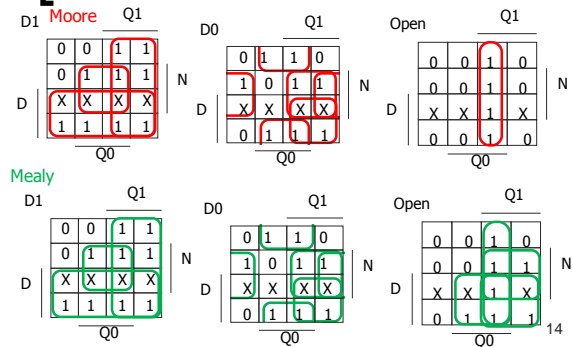
Mealy machine: State encoding

present state	inputs		next state	present output	present state	inputs		next state	present output
0¢	D	N	0¢	0	Q1 Q0	D	N	D1 D0	
	0	0	0¢	0	0	0	0	0	0
	0	1	5¢	0		0	1	0	0
	1	0	10¢	0		1	0	1	0
	1	1	-	-		1	1	-	-
5¢	0	0	5¢	0	0	1	0	0	1
	0	1	10¢	0		0	1	1	0
	1	0	15¢	1		1	0	1	1
	1	1	-	-		1	1	-	-
10¢	0	0	10¢	0	1	0	0	1	0
	0	1	15¢	1		0	1	1	1
	1	0	15¢	1		1	0	1	1
	1	1	-	-		1	1	-	-
15¢	-	-	15¢	1	1	1	-	1	1

symbolic state table

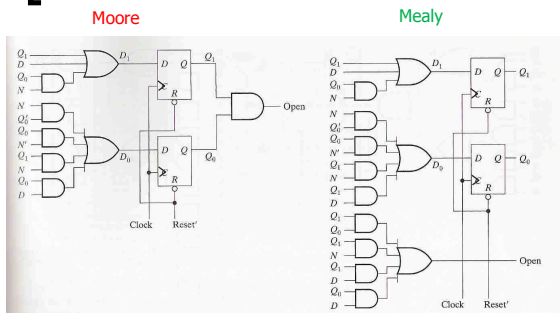
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Logic minimization



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Implementation



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7.24

- A Moore machine has two inputs (X1, X2) and one output (Z). The output remains a constant value unless one of the following input sequence occurs:
 - The input sequence 00,11 causes the output to become 0.
 - The input sequence 01,11 causes the output to become 1.
 - The input sequence 10,11 causes the output to toggle value.

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7.23

- A Mealy machine has one input (X) and two outputs (Z1 and Z2). An output Z1 = 1 occurs every time the input sequence 101 is observed, provided the sequence 011 has never been seen. An output Z2 = 1 occurs every time the input 011 is observed.

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