

CSARCH1 LE2 Reviewer Series

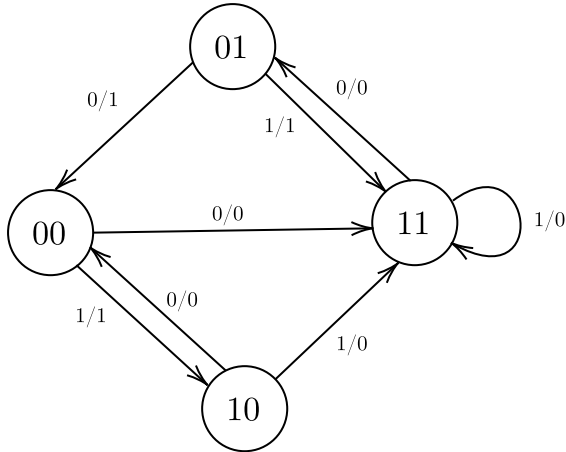
Sequential Circuit Design

Version: 0.0

When designing a circuit diagram,

Example 1:

Design the following state diagram with two JK flip-flops.



Input	Present State		Next State		Output
X	A	B	A	B	Y
0	0	0	1	1	0
0	0	1	0	0	1
0	1	0	0	0	0
0	1	1	0	1	0
1	0	0	1	0	1
1	0	1	1	1	1
1	1	0	1	1	0
1	1	1	1	1	0

Input	Present State		Next State		Flip Flop Input				Output
X	A	B	A	B	JA	KA	JB	KB	Y
0	0	0	1	1	1	X	1	X	0
0	0	1	0	0	0	X	X	1	1
0	1	0	0	0	X	1	0	X	0
0	1	1	0	1	X	1	X	0	0
1	0	0	1	0	1	X	0	X	1
1	0	1	1	1	1	X	X	0	1
1	1	0	1	1	X	0	X	1	0
1	1	1	1	1	X	0	X	0	0

Excitation Table

$Q(t)$	$Q(t+1)$	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

For each state A and B , we use the excitation table for JK flip-flop to know which inputs to feed to each flip-flop to represent going from one state to the next.

JA

AB	00	01	11	10
$X=0$	1		X	X
$X=1$	1	1	X	X

KA

AB	00	01	11	10
$X=0$	X	X	1	1
$X=1$	X	X		

JB

AB	00	01	11	10
$X=0$	1	X	X	
$X=1$		X	X	X

KB

AB	00	01	11	10
$X=0$	X	1		X
$X=1$	X		1	

Y

AB	00	01	11	10
$X=0$		1		
$X=1$	1	1		

From this, we can also generate a boolean equation for each input as well as the output.

$$\begin{aligned}
 JA &= \overline{B} \\
 JB &= \overline{A}\overline{X} \\
 KA &= \overline{X} \\
 KB &= \overline{A}\overline{X} + ABX \\
 Y &= \overline{A}X + \overline{A}B
 \end{aligned}$$