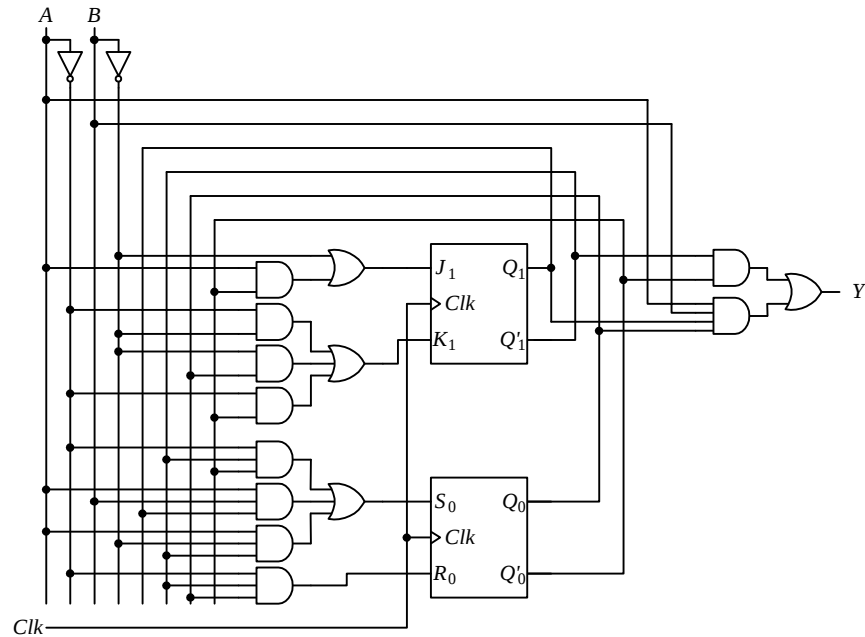


CS120B – Homework #1

Given October 10, 2001. Due October 16, 2001

- Derive the next-state/output table and state diagram for the following sequential circuit. (6)



Answer

Excitation equations:

$$\begin{aligned} J_1 &= B' + AQ_0' \\ K_1 &= A'B' + B'Q_0 + A'Q_0' \\ S_0 &= A'Q_1'Q_0' + ABQ_1 + AB'Q_1' \\ R_0 &= A'Q_1'Q_0 \end{aligned}$$

Output equation:

$$Y = Q_1'Q_0' + ABQ_1Q_0$$

Characteristic and next-state equations:

$$\begin{aligned} Q_{1next} &= K'Q + JQ' \\ &= K_1'Q_1 + J_1Q_1' \\ &= (A'B' + B'Q_0 + A'Q_0')'Q_1 + (B' + AQ_0')Q_1' \\ &= (A'B)'(B'Q_0)'(A'Q_0')'Q_1 + B'Q_1' + AQ_0'Q_1' \\ &= (A+B)(B+Q_0')(A+Q_0)Q_1 + B'Q_1' + AQ_0'Q_1' \\ &= (ABQ_1) + (ABQ_0Q_1) + (AQ_0'Q_1) + (AQ_0'Q_0Q_1) + \\ &\quad (ABQ_1) + (BQ_0Q_1) + (BAQ_0'Q_1) + (BQ_0'Q_0Q_1) + B'Q_1' + AQ_0'Q_1' \\ &= (ABQ_1) + (ABQ_1) + (AQ_0') + (BQ_0Q_1) + (B'Q_1') \end{aligned}$$

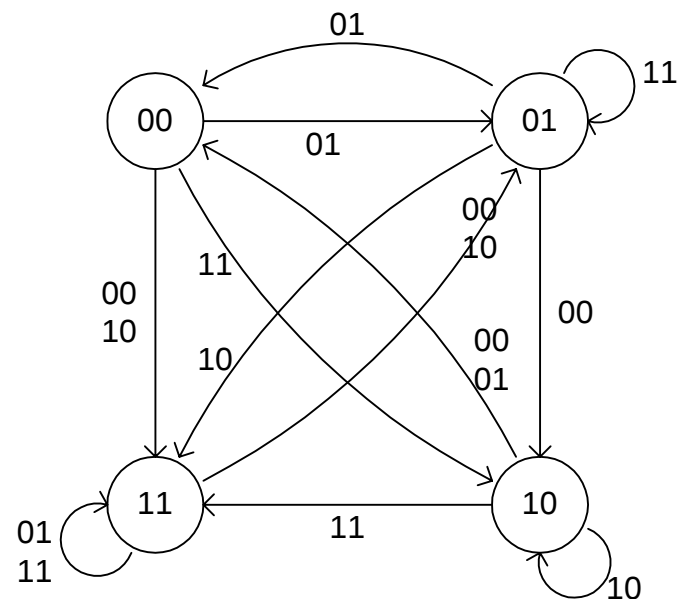
$$\begin{aligned} Q_{0next} &= S + R'Q \\ &= S_0 + R_0'Q_0 \end{aligned}$$

$$\begin{aligned}
 &= A'Q_1'Q_0' + ABQ_1 + AB'Q_1' + (A'Q_1'Q_0)'Q_0 \\
 &= A'Q_1'Q_0' + ABQ_1 + AB'Q_1' + (A+Q_1+Q_0')Q_0 \\
 &= A'Q_1'Q_0' + ABQ_1 + AB'Q_1' + AQ_0 + Q_1Q_0 + Q_0'Q_0
 \end{aligned}$$

Next-state table:

Current State $Q_1 Q_0$	Next State / Output $Q_{1next} Q_{0next}$			
	AB			
	00	01	10	11
0 0	11/1	01/1	11/1	10/1
0 1	10/0	00/0	11/0	01/0
1 0	00/0	00/0	10/0	11/0
1 1	01/0	11/0	01/0	11/1

State diagram:



2. Synthesize the sequential circuit for the following next-state/output table using a *SR* flip-flop for Q_0 and a *JK* flip-flop for Q_1 . (6)

Current State $Q_1 Q_0$	Next State / Output $Q_{1next} Q_{0next}$			
	AB			
	00	01	10	11
0 0	11/1	01/1	11/1	10/1
0 1	10/0	00/0	11/0	01/0
1 0	00/0	00/0	11/0	10/0
1 1	01/0	11/0	11/0	01/1

Answer

Implementation table

Current State $Q_1 Q_0$	Implementation $J_1 K_1 S_0 R_0$			
	AB			
	00	01	10	11
0 0	1×10	0×10	1×10	1×0×
0 1	1×01	0×01	1××0	0××0
1 0	×10×	×10×	×010	×00×
1 1	×1×0	×0×0	×0×0	×1×0

K-Map

Current State $Q_1 Q_0$	K-Map $J_1 K_1 S_0 R_0$			
	AB			
	00	01	11	10
0 0	1×10	0×10	1×0×	1×10
0 1	1×01	0×01	0××0	1××0
1 1	×1×0	×0×0	×1×0	×0×0
1 0	×10×	×10×	×00×	×010

Excitation equations:

$$\begin{aligned}
 J_1 &= B' + AQ_0' \\
 K_1 &= A'B' + A'Q_0' + ABQ_0 \\
 S_0 &= AB' + A'Q_1'Q_0' \\
 R_0 &= A'Q_1'Q_0
 \end{aligned}$$

Output equation:

$$Y = Q_1'Q_0' + ABQ_1Q_0$$

Circuit:

