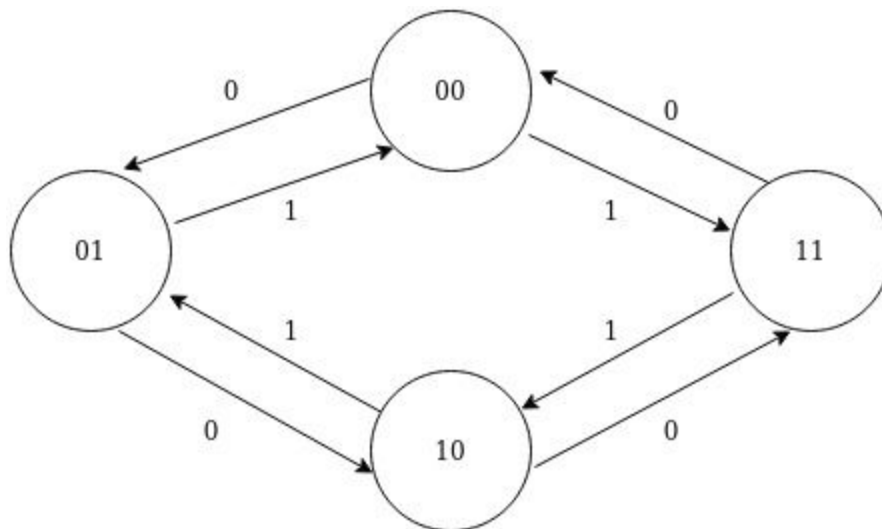


CPSC 359 Final Exam Question 2

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a) State diagram of the design:



b) Determine the inputs, outputs, number of flip-flops needed:

We need:

- One input called Direction
- 2 JK flip-flops (named A, B) to represent each bit in the 2-bit binary counter
- The outputs of the circuit will be the outputs (ie. states) of the two flip-flops

c) Derive the excitation table for the state machine

Present State		Circuit Input Direction	Next State		Flip-flop Inputs				
A	B		A	B	J _A	K _A	J _B	K _B	
0	0	0	0	1	0	X	1	X	0
0	0	1	1	1	1	X	1	X	1
0	1	0	1	0	1	X	X	1	2
0	1	1	0	0	0	X	X	1	3
1	0	0	1	1	X	0	1	X	4
1	0	1	0	1	X	1	1	X	5
1	1	0	0	0	X	1	X	1	6
1	1	1	1	0	X	0	X	1	7

d) Derive the circuit output functions and flip-flop input functions using the map method

Note: To make the maps more concise, let Direction be called x.

Derive the function for J_A:

$$J_A = B'x + Bx'$$

		B			
		00	01	11	10
A	0	0	X	3	X
	1	4X	5X	7X	6X

x

Derive the function for K_A:

$$K_A = B'x + Bx'$$

		B			
		00	01	11	10
A	0	0X	1X	3X	2X
	1	4	X	7	X

x

Derive the function for J_B :

$$J_B = 1$$

		B							
		00		01		11		10	
A	0	0	1	2	3	4	5	6	7
	1	8	9	10	11	12	13	14	15

Handwritten Karnaugh map for J_B . The map is a 4x4 grid with columns labeled 00, 01, 11, 10 and rows labeled 0, 1. The cells are numbered 0 through 15. The cells (0,0), (0,1), (0,2), (0,3), (1,0), (1,1), (1,2), (1,3) are shaded with diagonal lines. The cells (0,4), (0,5), (0,6), (0,7), (1,4), (1,5), (1,6), (1,7) are marked with an 'X'. A bracket under the bottom two rows (1,0) to (1,3) is labeled 'X'.

Derive the function for K_B :

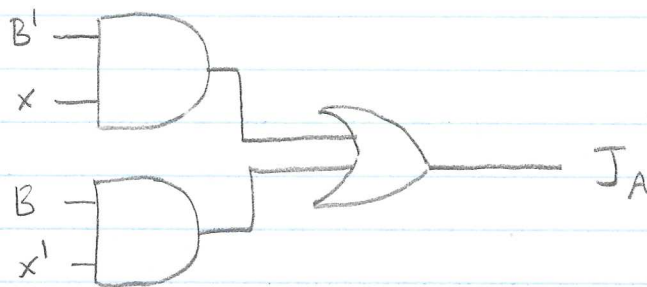
$$K_B = 1$$

		B			
		00	01	11	10
A	0	0 X	1 X	2	3
	1	4 X	5 X	6	7

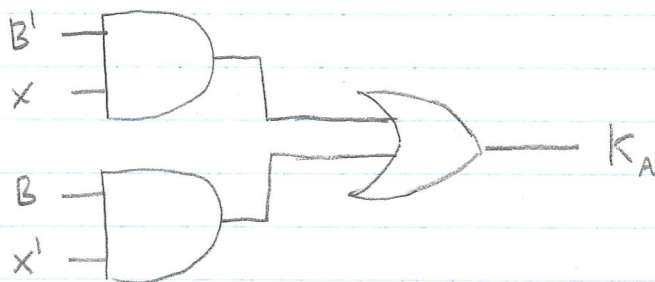
X

e) Draw the logic diagram of the circuit

Logic implementation of J_A :



Logic implementation of K_A :



Logic implementation of J_B :

1 ————— J_B

Logic implementation of K_B :

1 ————— K_B

f) The design has been implemented in the file question2.circ.