CPSC 359 Final Exam Question 2

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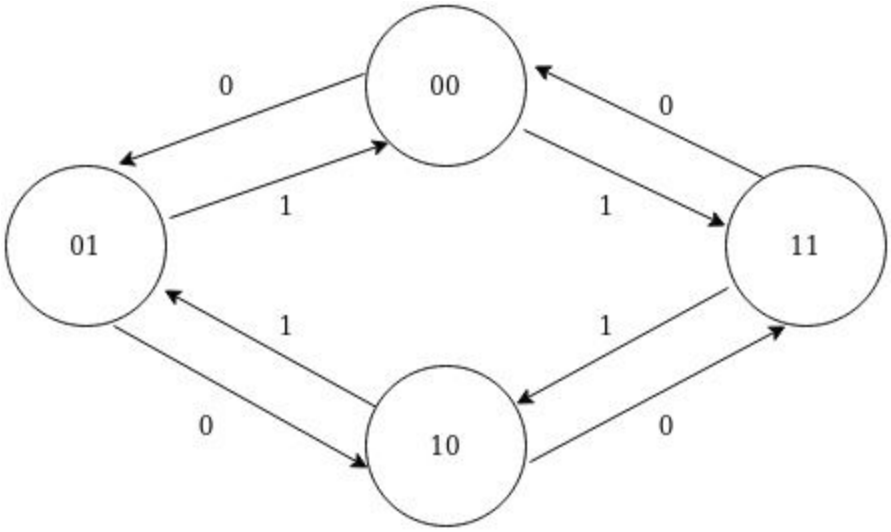
a) State diagram of the design:



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

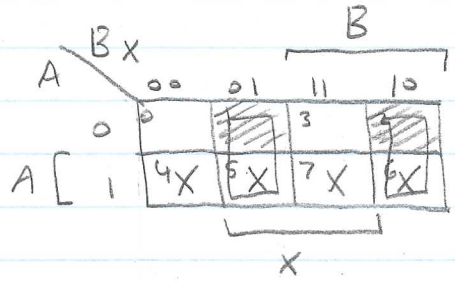
Present State A	Present State B	Circuit Input Direction	Next State A	Next State B	J_A	K_A	J_B	K_B	
0	0	0	0	1	0	X	1	X	0
0	0	1	1	1	1	X	1	X	1
0	1	0	1	0	1	X	X	1	2
0	1	1	0	0	0	X	X	1	3
1	0	0	1	1	X	0	1	X	4
1	0	1	0	1	X	1	1	X	5
1	1	0	0	0	X	1	X	1	6
1	1	1	1	0	X	0	X	1	7

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.

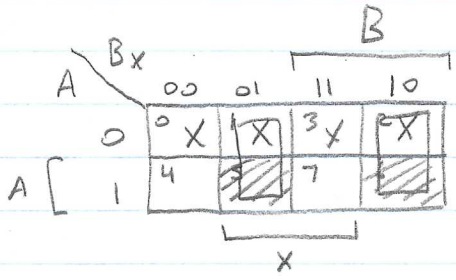
Derive the function for J_A:

$J_A = B'x + Bx'$



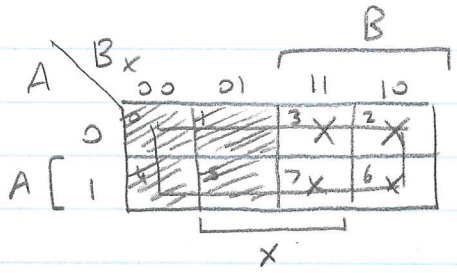
Derive the function for K_A:

$K_A = B'x + Bx'$



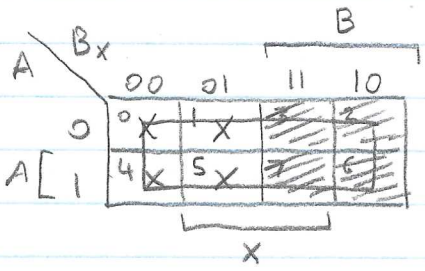
Derive the function for J_B:

$J_B = 1$



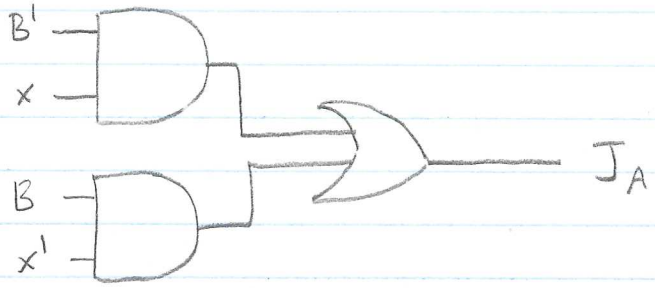
Derive the function for K_B:

$K_B = 1$

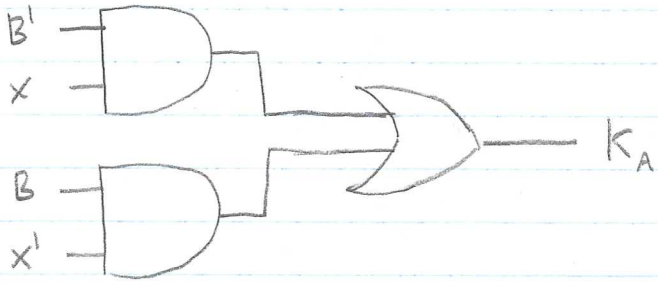


e) Draw the logic diagram of the circuit

Logic implementation of J_A:



Logic implementation of K_A:



Logic implementation of J_B:

Logic implementation of K_B:

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