SYSC2310 - LAB 5 : SEQUENTIAL LOGIC CIRCUITS

Exercise 1: Design a binary counter

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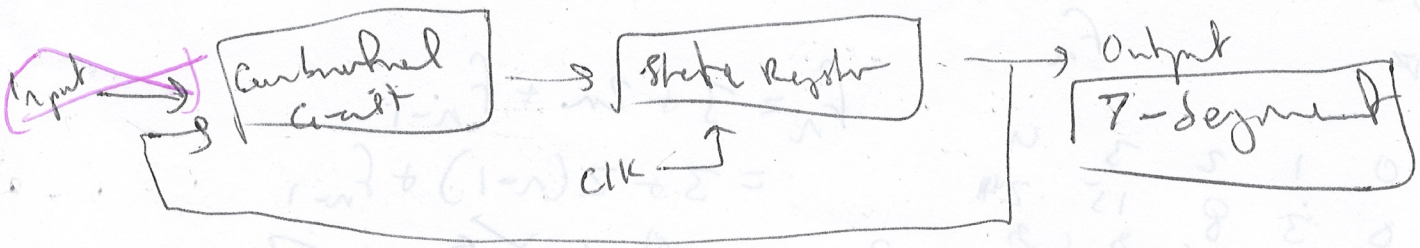
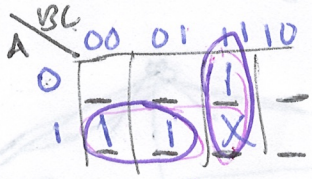


State table:

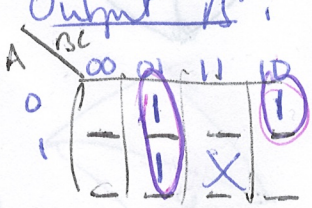
Present state A B C	Next state A' B' C'
0 0 0	0 0 1
0 0 1	0 1 0
0 1 0	0 1 1
0 1 1	1 0 0
1 0 0	1 0 1
1 0 1	1 1 0
1 1 0	0 0 0
1 1 1	X X X

Output A':



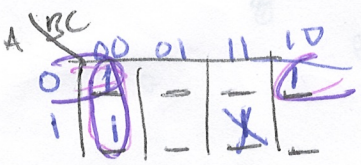
$D_A = AB' + BC$

Output B':



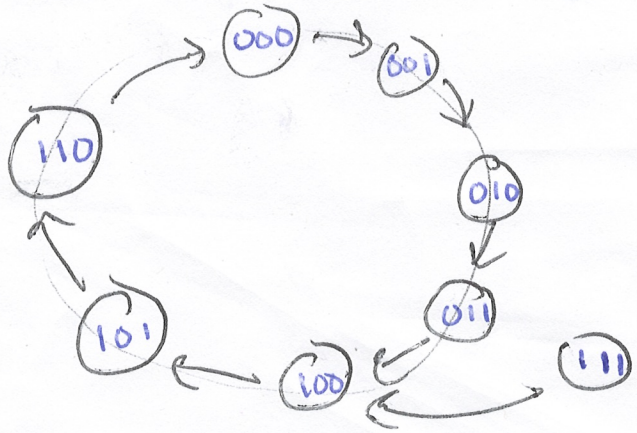
$D_B = B'C + A'BC'$

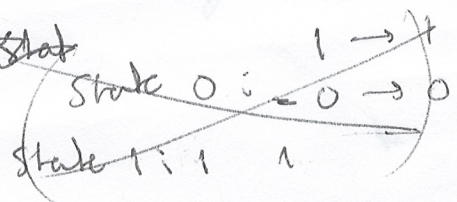
Output C':



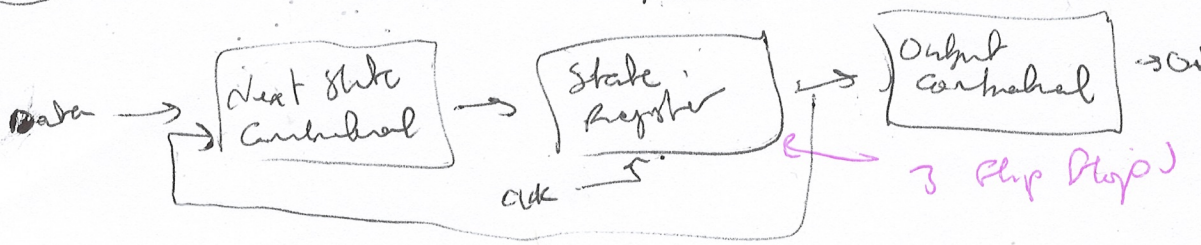
$D_C = B'C' + A'C'$

State Diagram:





Exercise 2: Design a Binary Sequence Detector



States:

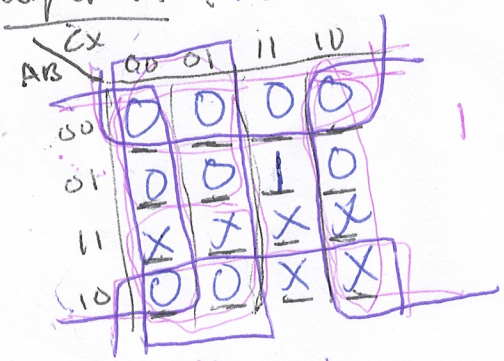
State 000: done
001: 1 detected
010: 11 detected
011: 110 detected
100: 1101 detected

Detect 1101

Present State			Input	Next State			Output
A	B	C	x	A'	B'	C'	y
0	0	0	0	0	0	0	0
0	0	0	1	0	0	1	0
0	0	1	0	0	0	0	0
0	0	1	1	0	1	0	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	0	0
0	1	1	0	0	0	0	0
0	1	1	1	1	0	0	1
1	0	0	0	0	0	0	0
1	0	0	1	0	1	0	0
1	0	1	0	X	X	X	0
1	0	1	1	X	X	X	0
1	1	0	0	X	X	X	0
1	1	0	1	X	X	X	0
1	1	1	0	X	X	X	0
1	1	1	1				

Don't care or sparing ???

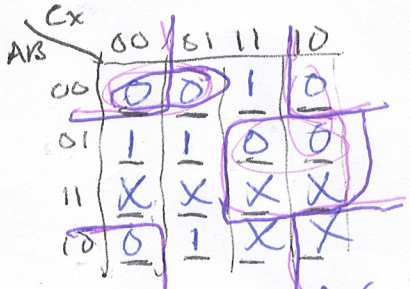
Output A': POS



$D_A = (C)(x)(B)$

$= BCx$

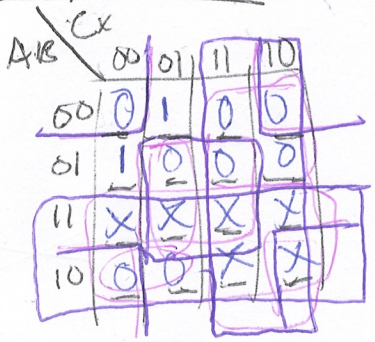
Output B': POS



$D_B = (A+B+C)(B'+C')(x+B)$

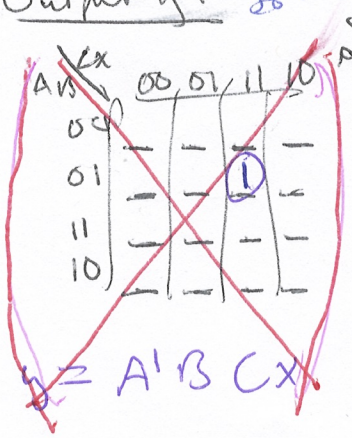
Exercise 2: Design a binary sequence detector (CONT)

Output C': POS

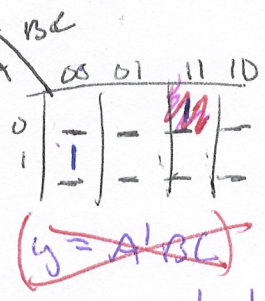


$D_C = (A')(C')(B+X)(B'+X')$

Output y: SOP



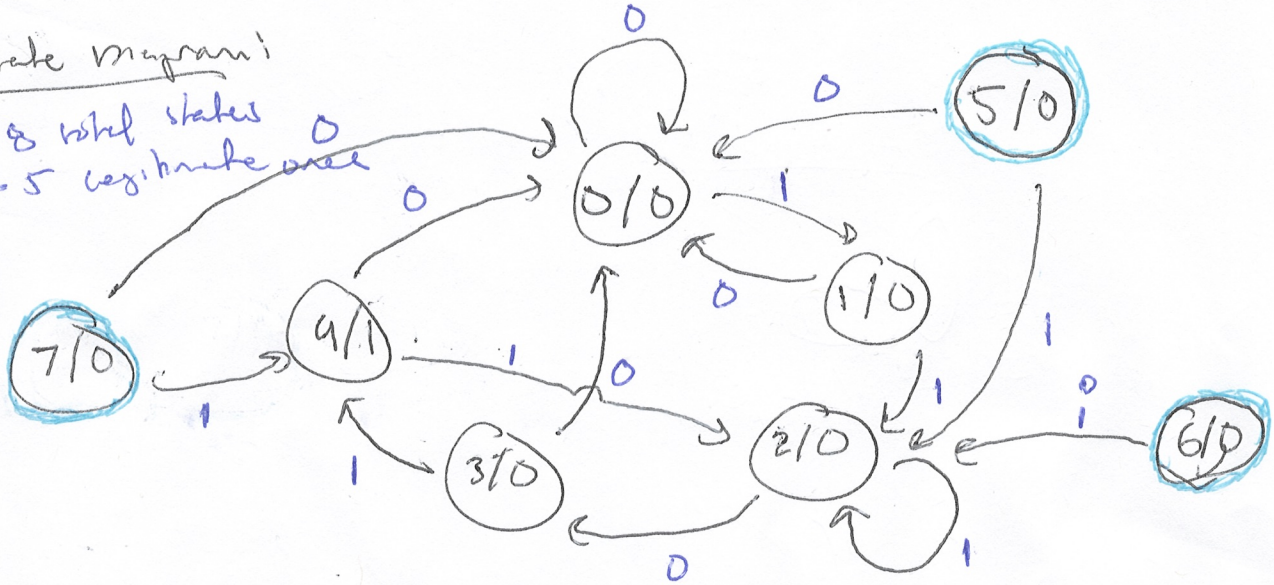
$y = A'BCX$



$y = AB'C'$

State Diagram:

- 8 total states
- 5 legitimate ones



→ Note: the highlighted states should be impossible to enter and the only time they ever could is if the flip flops were manually adjusted to any of these states at startup.

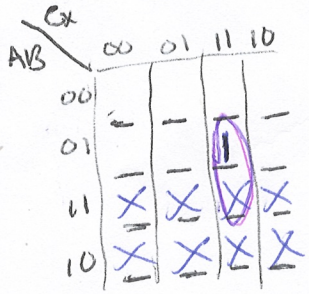
Exercise 3: Design using a JK Flip Flop

JK Flip Flop 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

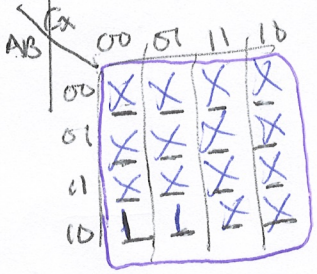
Present State			Input	Next state			Flip Flop Inputs						Output
A	B	C	x	A'	B'	C'	J_A	K_A	J_B	K_B	J_C	K_C	y
0	0	0	0	0	0	0	0	X	0	X	0	X	0
0	0	0	1	0	0	1	0	X	0	X	1	X	0
0	0	1	0	0	0	0	0	X	0	X	X	1	0
0	0	1	1	0	1	0	0	X	1	X	X	1	0
0	1	0	0	0	1	1	0	X	X	0	1	X	0
0	1	0	1	0	1	0	0	X	X	0	0	X	0
0	1	1	0	0	0	0	0	X	X	1	X	1	0
0	1	1	1	1	0	0	1	X	X	1	X	1	1
1	0	0	0	0	0	0	X	1	0	X	0	X	0
1	0	0	1	0	1	0	X	1	1	X	0	X	0
1	0	1	0	X	X	X	X	X	X	X	X	X	0
1	0	1	1	X	X	X	X	X	X	X	X	X	0
1	1	0	0	X	X	X	X	X	X	X	X	X	0
1	1	0	1	X	X	X	X	X	X	X	X	X	0
1	1	1	0	X	X	X	X	X	X	X	X	X	0
1	1	1	1	X	X	X	X	X	X	X	X	X	0

Output J_A:



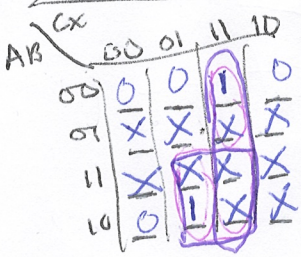
$J_A = BCx$

Output K_A:



$K_A = 1$

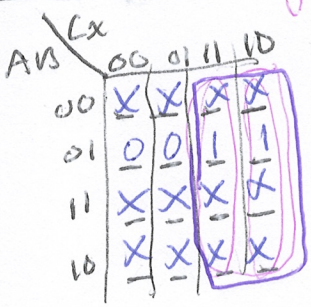
Output J_B:



$J_B = Ax + Cx$

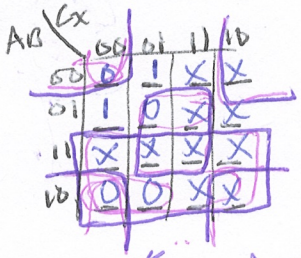
Exercise 3 (CONT):

Output K_B:



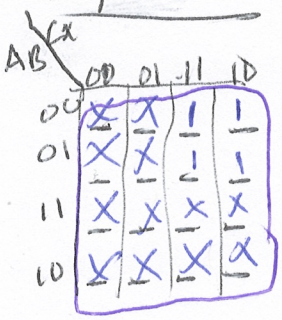
$K_B = C$

Output J_C:



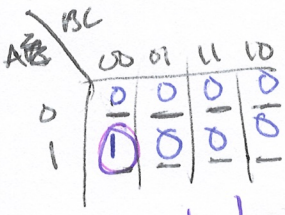
$J_C = (B^{\text{don't care}} + x)(B' + x')(A')$

Output K_C:



$K_C = 1$

Output y:



$y = AB'C'$

COUNTING THE GATES:

D-Flip Flops:

- 9 Gates used

JK Flip Flops:

- 9 Gates Used

Same number of gates used for both.