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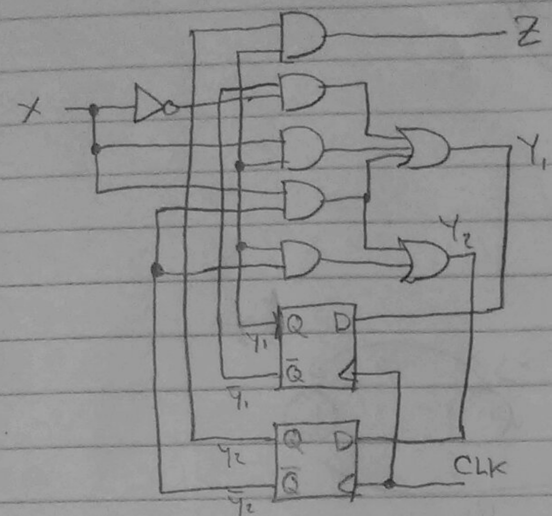
CMPE 212
HW 5

1



Find the state diagram w/ the following state code assignment:

	y_1	y_2
A	0	0
B	0	1
C	1	1
D	1	0

* $Y_1 = \bar{x}\bar{y}_1 + xy_1 + x\bar{y}_2 = D_1$

$Y_2 = y_1\bar{y}_2 + x\bar{y}_2 = D_2$

$Z = y_1 y_2$

* K-maps for inputs and states:

D_1:

y_1y_2 \ x	0	1
00	1	1
01	1	0
11	0	1
10	0	1

$\bar{x}\bar{y}_1 + x\bar{y}_2 + xy_1$

$\equiv 00d + 1d0 + 11d$

D_2:

y_1y_2 \ x	0	1
00	0	1
01	0	0
11	0	0
10	1	1

$y_1\bar{y}_2 + x\bar{y}_2$

$\equiv d10 + 1d0$

Z:

y_1y_2 \ x	0	1
00	0	0
01	0	0
11	1	1
10	0	0

y_1y_2

$\equiv d11$

Y_1Y_2:

y_1y_2 \ x	0	1
00	10	11
01	10	00
11	00	10
10	01	11

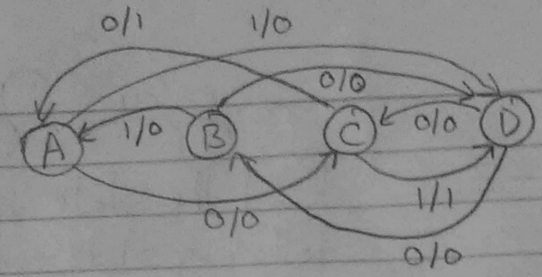
Y_1Y_2/Z:

y_1y_2 \ x	0	1
00	10/0	11/0
01	10/0	00/0
11	00/1	10/1
10	01/0	11/0

$\Rightarrow$

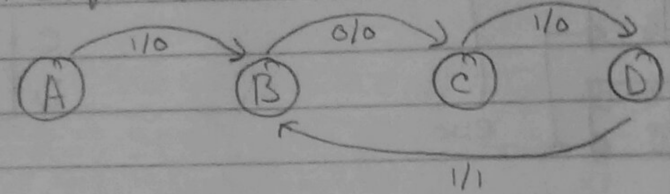
state/output:

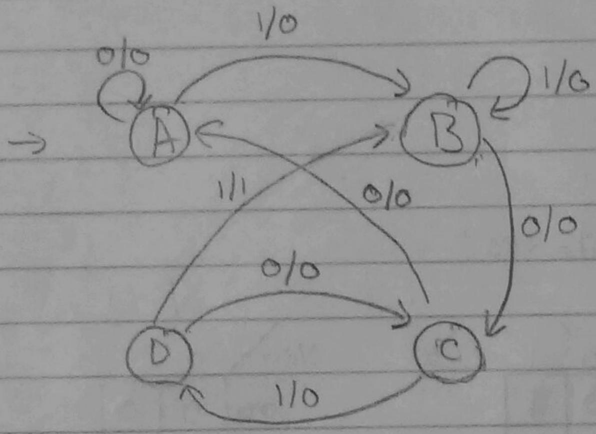
y_1y_2 \ x	0	1
A	D/0	C/0
B	D/0	A/0
C	A/1	D/1
D	B/0	C/0



State diagram

② Input sequence 1011:





	x = 0	x = 1
A	A/0	B/0
B	C/0	B/0
C	A/0	D/0
D	C/0	B/1

③ Implement the following sequential circuit:

Y_1	Y_2	Y_3
0	0	0
0	0	1
0	1	1
0	1	0
1	0	0
1	0	1

→

	x = 0	x = 1
A	D/0	C/0
B	E/0	A/1
C	F/1	B/0
D	A/1	F/1
E	C/0	E/1
F	B/0	D/1

$Y_1Y_2Y_3$	$x = 0$	$x = 1$
000	010/0	011/0
001	100/0	000/1
011	101/1	001/0
010	000/1	101/1
100	011/0	100/1
101	001/0	010/1

(1) Using D-flipflops:

$Y_1Y_2Y_3$	D_1, $x=0$	D_1, $x=1$	D_2, $x=0$	D_2, $x=1$	D_3, $x=0$	D_3, $x=1$	Output = Z, $x=0$	Output = Z, $x=1$
000	0	0	1	1	0	1	0	0
001	1	0	0	0	0	0	0	1
011	1	0	0	0	1	1	1	0
010	0	1	0	0	0	1	1	1
100	0	1	1	0	1	0	0	1
101	0	0	0	1	1	0	0	1

D_1 k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00			1	
01	1			
11	1			
10				1

$$D_1 = \bar{x}\bar{Y}_1Y_3 + xY_1\bar{Y}_2\bar{Y}_3 + x\bar{Y}_1Y_2\bar{Y}_3$$

D_2 k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00	1	1		1
01			1	
11				
10				

$$D_2 = \bar{x}\bar{Y}_2\bar{Y}_3 + \bar{Y}_1\bar{Y}_2\bar{Y}_3 + xY_1\bar{Y}_2Y_3$$

D_3 k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00		1		1
01		1		
11				1
10				1

z k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00			1	
01			1	1
11	1			
10	1			1

$$D_3 = \bar{x}\bar{Y}_1\bar{Y}_2 + x\bar{Y}_1\bar{Y}_3 + \bar{Y}_1Y_2Y_3$$

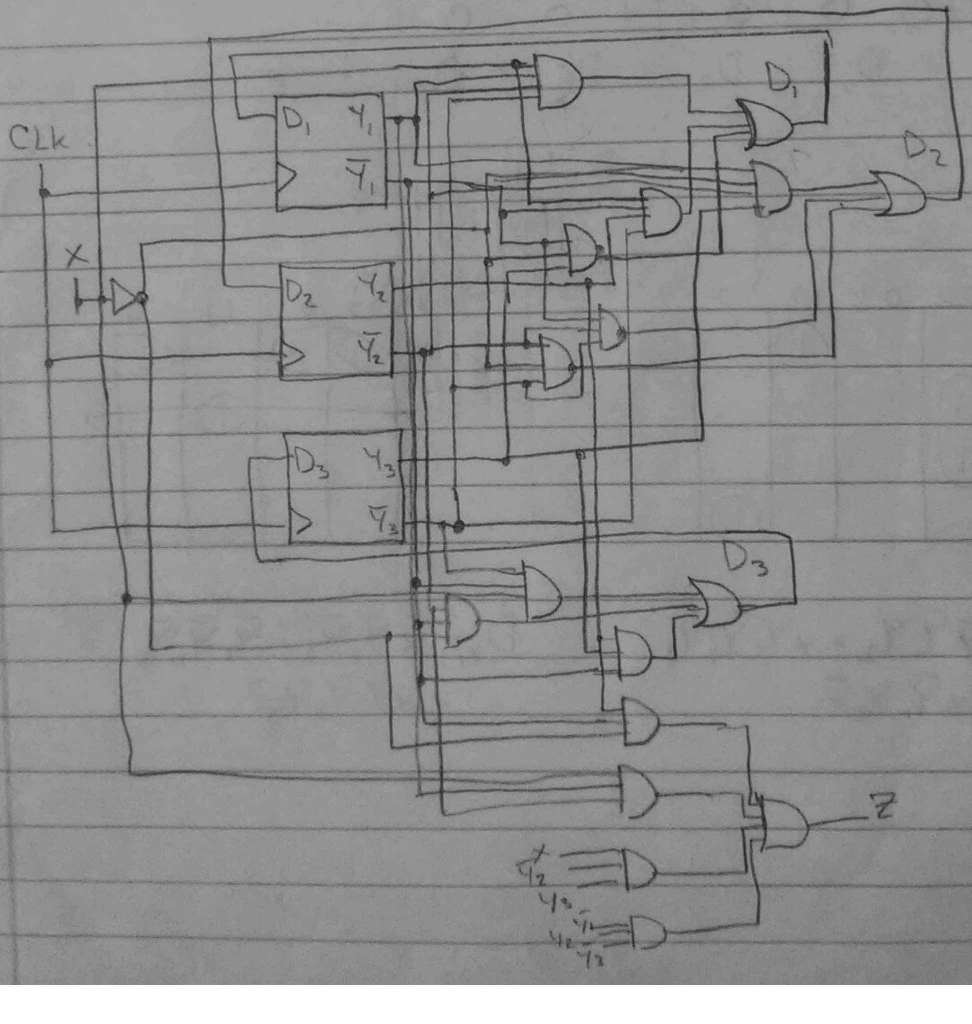
$$z = \bar{x}\bar{Y}_1Y_2 + xY_1\bar{Y}_2 + x\bar{Y}_2Y_3 + \bar{Y}_1Y_2\bar{Y}_3$$

$$\therefore D_1 = \bar{x}\bar{Y}_1Y_3 + xY_1\bar{Y}_2\bar{Y}_3 + x\bar{Y}_1Y_2\bar{Y}_3$$

$$D_2 = \bar{x}\bar{Y}_2\bar{Y}_3 + \bar{Y}_1\bar{Y}_2\bar{Y}_3 + xY_1\bar{Y}_2Y_3$$

$$D_3 = \bar{x}\bar{Y}_1\bar{Y}_2 + x\bar{Y}_1\bar{Y}_3 + \bar{Y}_1Y_2Y_3$$

$$z = \bar{x}\bar{Y}_1Y_2 + xY_1\bar{Y}_2 + x\bar{Y}_2Y_3 + \bar{Y}_1Y_2\bar{Y}_3$$



(ii) Using T-flip flops:

$Y_1Y_2Y_3$	T_1 ($x=0$)	T_1 ($x=1$)	T_2 ($x=0$)	T_2 ($x=1$)	T_3 ($x=0$)	T_3 ($x=1$)	Z ($x=0$)	Z ($x=1$)
000	0	0	1	1	0	1	0	0
001	1	0	0	0	1	1	0	1
011	1	0	1	1	0	0	1	0
010	0	1	1	1	0	1	1	1
100	1	0	0	0	1	0	0	1
101	1	1	1	1	0	1	0	1

Z = output

T_1 k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00		1		
01	1	1	1	
11	1			
10				1

$T_1 = \bar{x}Y_1\bar{Y}_2 + \bar{x}\bar{Y}_1Y_3 + Y_1\bar{Y}_2Y_3 + x\bar{Y}_1Y_2\bar{Y}_3$

T_2 k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00	1			1
01		1	1	
11	1			1
10	1			1

$T_2 = \bar{Y}_1\bar{Y}_3 + \bar{Y}_1Y_2 + Y_1\bar{Y}_2Y_3$

T_3 - k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00		1		1
01	1		1	1
11				
10				1

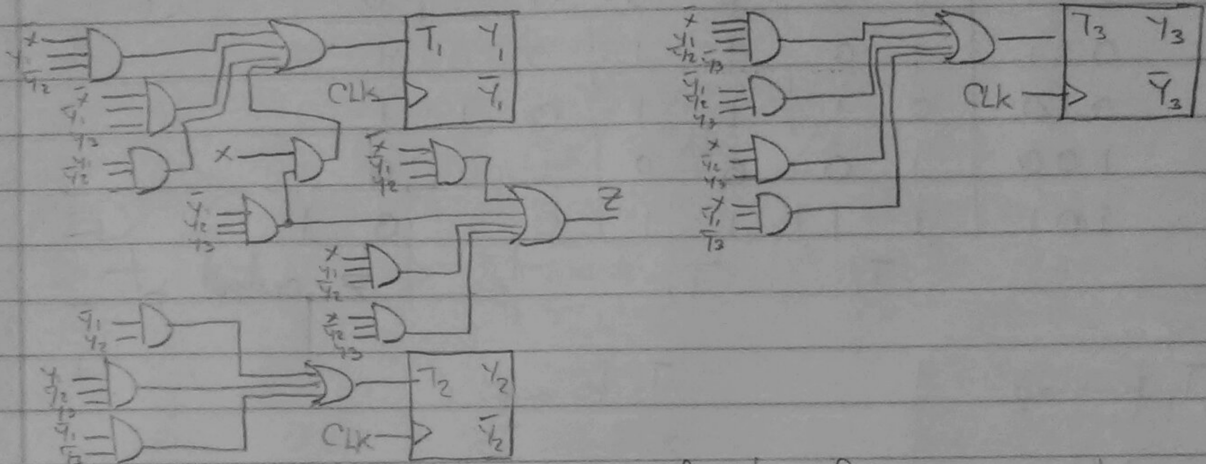
$T_3 = \bar{x}Y_1\bar{Y}_2\bar{Y}_3 + \bar{Y}_1\bar{Y}_2Y_3 + x\bar{Y}_2Y_3 + x\bar{Y}_1\bar{Y}_3$

Z k-map:

$Y_2Y_3 \backslash xY_1$	00	01	11	10
00			1	
01			1	1
11	1			
10	1			1

$Z = \bar{x}\bar{Y}_1Y_2 + xY_1\bar{Y}_2 + x\bar{Y}_2Y_3 + \bar{Y}_1Y_2\bar{Y}_3$

$$\therefore T_1 = \bar{x} Y_1 \bar{Y}_2 + \bar{x} \bar{Y}_1 Y_3 + Y_1 \bar{Y}_2 Y_3 + x \bar{Y}_1 Y_2 \bar{Y}_3$$
$$T_2 = \bar{Y}_1 \bar{Y}_3 + \bar{Y}_1 Y_2 + Y_1 \bar{Y}_2 Y_3$$
$$T_3 = \bar{x} Y_1 \bar{Y}_2 \bar{Y}_3 + \bar{Y}_1 \bar{Y}_2 Y_3 + x \bar{Y}_2 Y_3 + x \bar{Y}_1 \bar{Y}_3$$
$$z = \bar{x} \bar{Y}_1 Y_2 + x Y_1 \bar{Y}_2 + x \bar{Y}_2 Y_3 + \bar{Y}_1 Y_2 \bar{Y}_3$$



(4) Find a reduced state table for the following synchronous sequential circuit:

	0	1
A	B/0	C/0
B	D/0	E/0
C	F/0	G/0
D	A/1	B/1
E	C/0	D/0
F	F/0	G/0
G	B/0	F/0

(1) Using state partitioning:

$P_0 = (ABCDEFG)$

$P_1 \overset{0}{=} (ABCEFG)(D)$

$\quad \overset{1}{=} (ABCEFG)(D)$

$P_2 \overset{0}{=} (ACEFG) \to (BFCFB), (B) \to (D), (D) \to A$

$\quad \overset{1}{=} (ABCFG) \to (CEGGE), (E) \to (D), (D) \to B$

$\quad = (ACFG)(B)(D)(E)$

$P_3 \overset{0}{=} (ACFG) \rightarrow (B)(FF)(B), (B)(D)(E)$

$\overset{1}{=} (ACFG) \rightarrow (C)(GG)(B), (B)(D)(E)$

$= (AG)(CF)(B)(D)(E)$

	$x = 0$	$x = 1$
A'	B'/0	C'/0
B'	D'/0	E'/0
C'	C'/0	A'/0
D'	A'/1	B'/1
E'	C'/0	D'/0 ◻

(ii) Using implication table:

	A	B	C	D	E	F
B	BD CE					
C	~~BF CG~~	~~DF EG~~				
D	X	X	X			
E	~~BC CD~~	~~CD DE~~	~~CF DG~~	X		
F	BF CG	~~DF EG~~	✓	X	~~CF DG~~	
G	✓	~~BD EF~~	~~BF FG~~	X	BC DF	BF FG

$\therefore\ C \equiv F,\ A \equiv G$

	$x = 0$	$x = 1$
A'	B'/0	C'/0
B'	D'/0	E'/0
C'	C'/0	A'/0
D'	A'/1	B'/1
E'	C'/0	D'/0

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