

Assignment 2

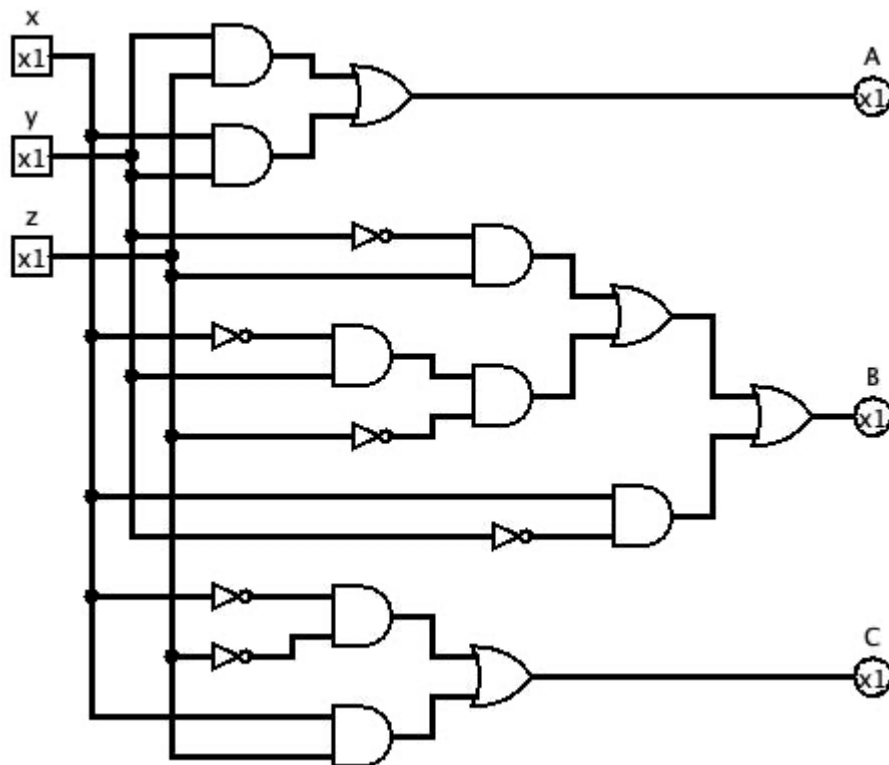
Question1

a)

Truth table

Decimal	x	y	z	A	B	C
0	0	0	0	0	0	1
1	0	0	1	0	1	0
2	0	1	0	0	1	1
3	0	1	1	1	0	0
4	1	0	0	0	1	0
5	1	0	1	0	1	1
6	1	1	0	1	0	0
7	1	1	1	1	0	1

b) logic circuit(Logisim .circ file submitted)



c)

Using minterms, the Boolean function is:

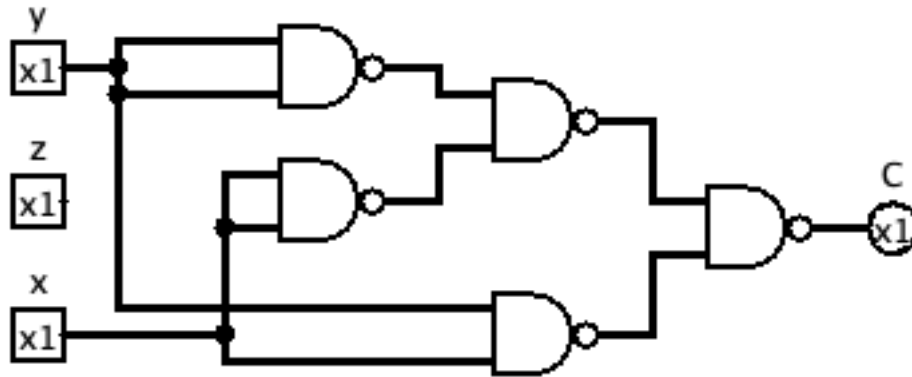
$$A(x, y, z) = \sum m(3, 6, 7) = \bar{x}yz + xy\bar{z} + xyz = xy + yz$$

d)

Using maxterms, the Boolean function is:

$$A(x, y, z) = \prod M(0, 3, 6, 7) = (x + y + z)(x + \bar{y} + \bar{z})(\bar{x} + \bar{y} + z)(\bar{x} + \bar{y} + \bar{z})$$

e) the Boolean function of $\overline{\overline{\bar{x}\bar{y}\bar{z}} + \overline{\bar{x}y\bar{z}} + \overline{xyz}} = \overline{\bar{x}\bar{y}} + \overline{\bar{x}y} + \overline{xy}$
the circuit is as follow using NAND gates



Question 2

Implement the following Boolean function with a multiplexer. (Just logic circuit)

a) $F(A, B, C, D) = \sum(0, 2, 5, 8, 10, 14) = A'B'C'D' + A'B'CD' + A'BC'D + AB'C'D' + AB'CD' + ABCD'$

A	B	C	D	F		
0	0	0	0	1	D'	A'B'C'D'
0	0	0	1	0		
0	0	1	0	1	D'	A'B'CD'
0	0	1	1	0		
0	1	0	0	0	D	
0	1	0	1	1		A'BC'D
0	1	1	0	0	0	
0	1	1	1	0		
1	0	0	0	1	D'	AB'C'D'
1	0	0	1	0		
1	0	1	0	1	D'	AB'CD'
1	0	1	1	0		
1	1	0	0	0	0	
1	1	0	1	0		
1	1	1	0	1	D'	ABCD'
1	1	1	1	0		

b) $F(A, B, C, D) = \prod(2, 6, 11) = (A+B+C+D)(A+B'+C'+D')(A'+B+C'+D')$

A	B	C	D	F		
0	0	0	0	1	1	
0	0	0	1	1		
0	0	1	0	0	D	A+B+C'+D
0	0	1	1	1		
0	1	0	0	1	1	
0	1	0	1	1		
0	1	1	0	0	D	A+B'+C'+D
0	1	1	1	1		
1	0	0	0	1	1	
1	0	0	1	1		
1	0	1	0	1	D'	
1	0	1	1	0		A'+B+C'+D'
1	1	0	0	1	1	
1	1	0	1	1		
1	1	1	0	1	1	
1	1	1	1	1		

Question3

a)

Simplify the Boolean function $F(A, B, C, D) = \prod(3,4,6,7,11,12,13,14,15)$.

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0

1	1	1	0	0
1	1	1	1	0

Karnaugh map for F

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	1
11	0	0	0	0
10	1	0	0	1

b) Simplification using sum-of-products form of F:

$$F = B'C' + B'D' + A'C'D$$

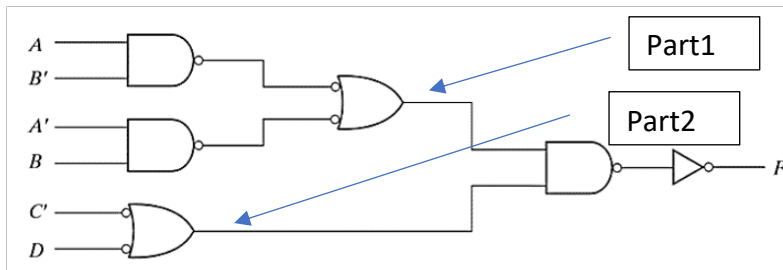
AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	1
11	0	0	0	0
10	1	0	0	1

c) Obtain simplified product-of-sums form of F

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	1
11	0	0	0	0
10	1	0	0	1

$$F = (C' + D')(B' + D)(A' + B')$$

Question 4



From the circuit

Lest's get the Boolean expression from the circuit.

Part 1

$$((AB')') + ((A'B)') = AB' + A'B$$

Part 2

$$(C'' + D') = C + D'$$

So, the final expression is : $F = (((AB' + A'B)(C + D'))')' = (AB' + A'B)(C + D')$

Truth table for the circuit

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

a)

K-Map of F

From truth table

b) the sum of the product is

$$A'BD' + A'BC + AB'D' + AB'C$$

CD \ AB	00	01	11	10
00	0	0	0	0
01	1	0	1	1
11	0	0	0	0
10	1	0	1	1

c) the sum of the product is

CD \ AB	00	01	11	10
00	0	0	0	0
01	1	0	1	1
11	0	0	0	0
10	1	0	1	1

The product of sum is $(A+B)(C+D')(A'+B')$

Question5

a)

K-Maps for the outputs a

D1d0 \ D3d2	00	01	11	10
00	1	0	1	1
01	0	1	1	1
11	1	0	1	1
10	1	1	0	1

K-Maps for the outputs b

D1d2 \ D3d2	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	0	1	0	0
10	1	1	0	1

K-Maps for the outputs c

D1d0 \ D3d2	00	01	11	10
00	1	1	1	0
01	1	1	1	1
11	0	1	0	0
10	1	1	1	1

K-Maps for the outputs d

D2d3 \ D0d1	00	01	11	10
00	1	0	1	1
01	0	1	0	1
11	1	1	0	1
10	1	1	1	0

K-Maps for the outputs e

D1d0 \ D3d2	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	1	1	1	1
10	1	0	1	1

K-Maps for the outputs f

D1d0 \ D3d2	00	01	11	10
00	1	0	0	0
01	1	1	1	1
11	1	0	1	1
10	1	1	1	1

K-Maps for the outputs g

D1d0 \ D3d2	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	0	1	1	1
10	1	1	1	1

b) logic equations (sum-of-products form)

- 1) logic equation for a: $d_2' d_0' + d_3' d_1 + d_3' d_2 d_0 + d_2 d_1 + d_3 d_2' d_1' + d_3 d_0'$
- 2) logic equation for b: $d_3' d_2' + d_3' d_1' d_0' + d_2' d_0' + d_3' d_1 d_0 + d_3 d_1' d_0$
- 3) logic equation for c: $d_3' d_1' + d_3' d_0 + d_1' d_0 + d_3' d_2 + d_3 d_2'$
- 4) logic equation for d: $d_3' d_2' d_0' + d_2' d_1 d_0 + d_2 d_1' d_0 + d_2 d_1 d_0' + d_3 d_1'$
- 5) logic equation for e: $d_2' d_0' + d_1 d_0' + d_3 d_1 + d_3 d_2$
- 6) logic equation for f: $d_1' d_0' + d_3' d_2 + d_3 d_2' + d_3 d_1 + d_3 d_1'$
- 7) logic equation for d: $d_2' d_1 + d_1 d_0' + d_3' d_2 d_1' + d_3 d_2' + d_3 d_0$

c) Logisim circ file submitted.

