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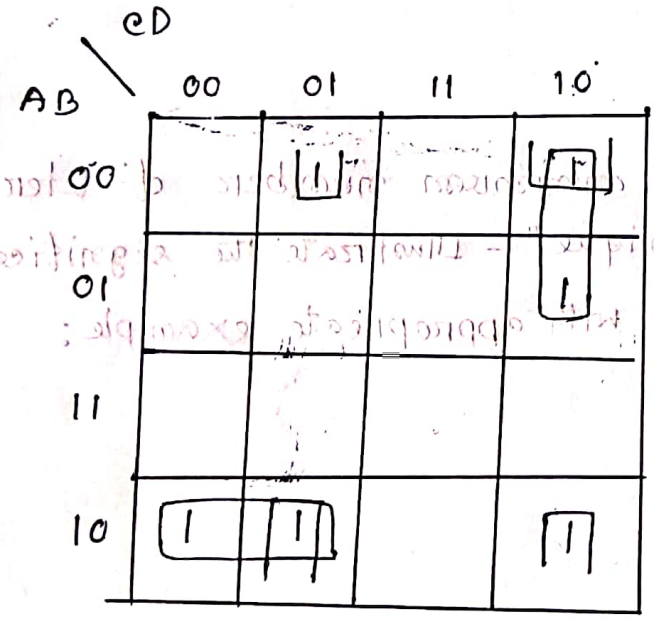
Digital logic Design (CSE).
Question Analysis

July-December- 2019

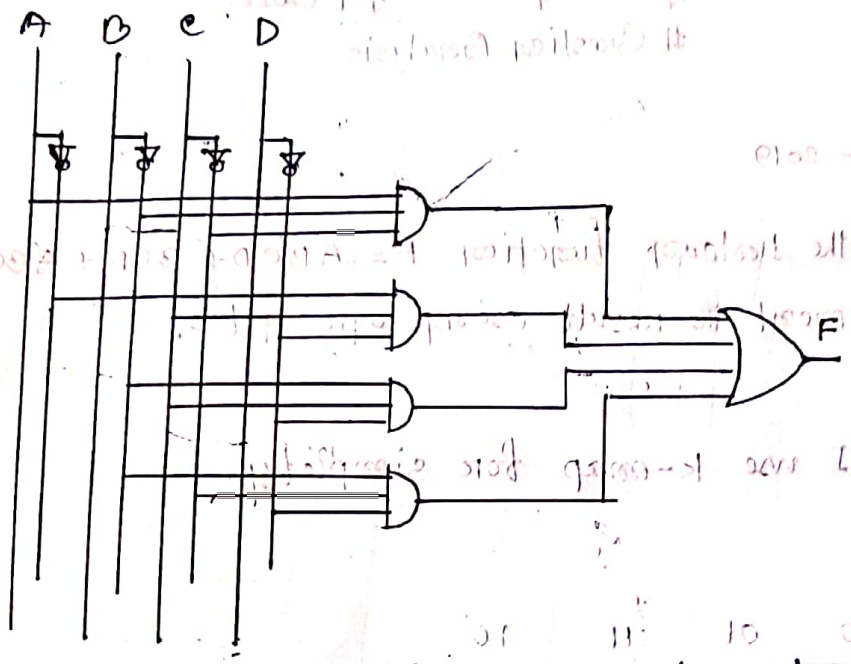
* Simplify the boolean function $F = A'B'C'D + B'CD' + A'BCD' + AB'C'$ and implement the result using logic gates.

At First I use k-map for simplify.



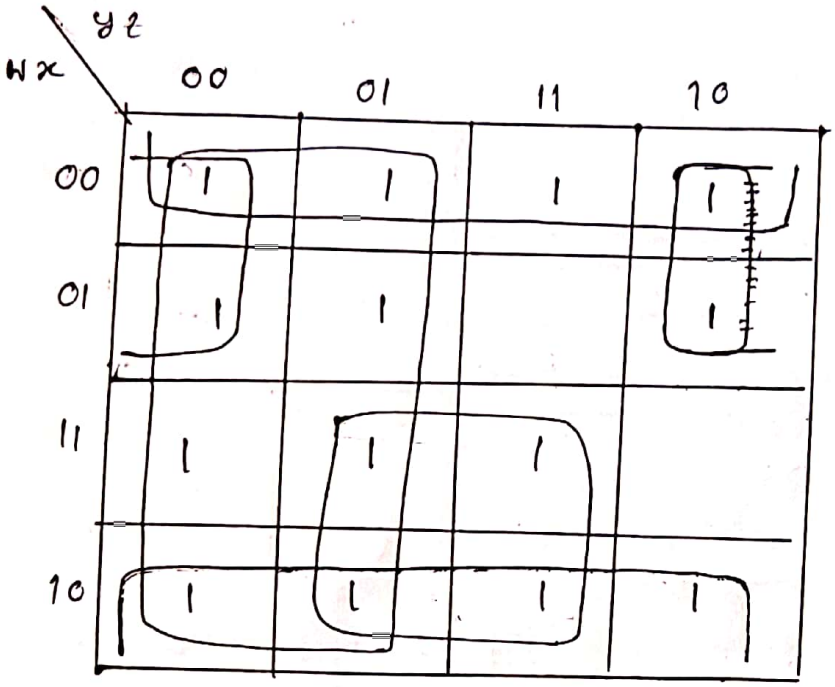
$F = A\bar{B}\bar{C} + \bar{A}C\bar{D} + \bar{B}C\bar{D} + \bar{B}\bar{C}D$

resulting logic gates.



* "An Expression with the minimum number of literals is not necessarily unique" – Illustrate the significance of the above statement with appropriate example:

* Simplify the boolean function $f(w, x, y, z) = \Sigma(0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 15)$



$$F = \bar{y} + wz + \bar{x} + \bar{w}\bar{y}\bar{z}$$

এখানে চারটি ভ্যারিয়েবল আছে তাই চার ভ্যারিয়েবল ম্যাপ ব্যবহার করতে হবে (K-map ব্যবহার করা হয়েছে)

Since the function has four variable, a four variable map must be used. The minterm listed in the sum are marked by 1, in the map.

* Find the complement of the function $F_1 = xy\bar{z} + \bar{x}\bar{y}\bar{z}$ and $F_2 = x(y\bar{z} + yz)$ applying De Morgan's theorem.

* Given

$$F_1 = xy\bar{z} + \bar{x}\bar{y}\bar{z}$$

complements of $\bar{F}_1 = \overline{xy\bar{z} + \bar{x}\bar{y}\bar{z}}$

$$= \overline{xy\bar{z}} \cdot \overline{\bar{x}\bar{y}\bar{z}}$$

$$= (\bar{x} + \bar{y} + z)(x + y + z)$$

distribution

$$= (xy + z) \cdot (\bar{x}\bar{y} + z)$$

$$= xy \cdot \bar{x}\bar{y} \cdot z$$

$$= (x + \bar{y})(x + y) \cdot z = (x\bar{y} + \bar{x}y)z$$

$\bar{x}(x+y+z) + \bar{y}(x+y+z) + z(x+y+z)$

$\bar{x}x + \bar{x}y + \bar{x}z + \bar{y}x + \bar{y}y + \bar{y}z + zx + yz + zz$

$= \boxed{\bar{x}y} + \bar{x}z + \boxed{\bar{y}x} + \bar{y}z + xz + yz + z$

$A + AB = A$ — Absorption

$= \bar{x}y + \bar{y}x + z$

x \ yz	00	01	11	10
0	1			
1				1

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

$A + AB$

$= 1 + 1.0$

$= 0 + 0.0$

$\bar{y} + z + x$

* Given:

$F_2 = x(xy\bar{z} + yz)$

$F_2' = \overline{x(y\bar{z} + yz)}$

$= \overline{xy\bar{z} + xyz}$

$= \overline{xy\bar{z}} \cdot \overline{xyz}$

$= (\bar{x} + \bar{y} + z)(\bar{x} + \bar{y} + \bar{z})$

$= \bar{x}\bar{x} + x\bar{y} + \bar{x}z + \bar{y}\bar{x} + \bar{y}\bar{y} + xz\bar{y} + \bar{x}\bar{z} + \bar{y}\bar{z} + z\bar{z}$

$= \bar{x} + x\bar{y} + \bar{x}z + \bar{y}\bar{x} + \bar{y} + z\bar{y} + \bar{x}\bar{z} + \bar{y}\bar{z} + 0$

$= \bar{x} + \bar{y} + x\bar{y} + z\bar{y} + \bar{x}\bar{z} + \bar{y}\bar{z}$

$= \bar{x} + \bar{y} + x\bar{y} + z\bar{y}$

$= \bar{x} + \bar{y}$

For Demorgans law:

$A \cdot \bar{A} = 0$ complement

$\bar{A} \cdot \bar{A} = \bar{A}$ $\bar{A} \cdot A = A$

$\bar{A} + \bar{A} = \bar{A}$ $A + A = A$

$A + AB = A$ Absorption

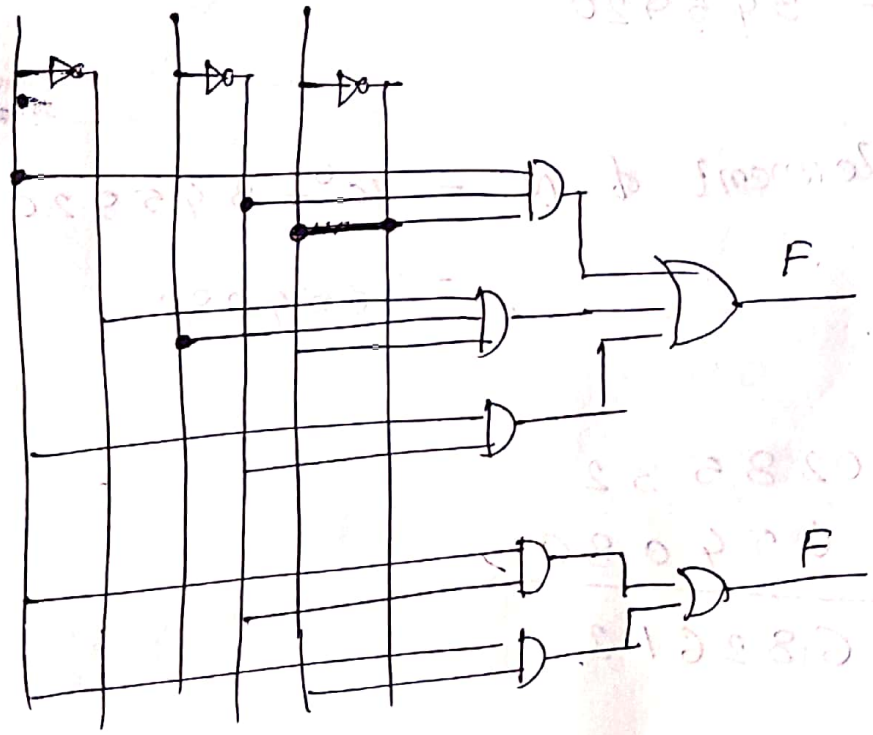
July - December 2017

* Implement the following equations using logic gates. $F = x\bar{y}\bar{z} + \bar{x}\bar{y}z + x\bar{y}$

$$F = x\bar{y} + xz$$

Logic diagram for $F = x\bar{y}\bar{z} + \bar{x}\bar{y}z + x\bar{y}$

x y z



For this logic circuit we use 5 and (AND gate and two OR gate. Finaly we find the output of function of F.

* Substract $(28532 - 345920)_{10}$ using 10's complement and $(11010010 - 10001100)_2$ using 1's complement.

$M = 28532$

$N = 345920$

10's complement of $N = 10^6 - 345920$

$= 654080$

```
  028532
  654080
--------
| 682612
```

No carry

-317388

answer : -682612 = $-$ (10's complement of 682612)

M = 11010010

N = 10001100

1's complement of N = 01110011

```
    11010010
    01110011
  ------------
1 | 01000101
  ------------
  +        1
  ------------
    01000110
```

answer: 01000110

* Convert $(511.4)_{10}$ to base 5 number

Given number $(511.4)_{10}$

$\therefore$

$5 \mid 511$

$5 \mid 102 \rightarrow 1$

$5 \mid 20 \rightarrow 2$

$5 \mid 4 \rightarrow 0$

$0 \leftarrow 4$

$(511)_{10} = (4021)_5$

$.4$

$\times 5$

2.0

$(.4)_{10} = (.2)_5$

$\therefore (511.4)_{10} = (4021.2)_5$

* Prove that $f_1 = m_0 + m_1 + m_5 + m_7 = M_2 \cdot M_3 M_4 M_6$

minterm				maxterm	
x	y	z	term	Designation	term	Designation
0	0	0	$\bar{x}\bar{y}\bar{z}$	m_0	$(x+y+z)$	M_0
0	0	1	$\bar{x}\bar{y}z$	m_1	$(x+y+\bar{z})$	M_1
0	1	0	$\bar{x}y\bar{z}$	m_2	$(x+\bar{y}+z)$	M_2
0	1	1	$\bar{x}yz$	m_3	$(x+\bar{y}+\bar{z})$	M_3
1	0	0	$x\bar{y}\bar{z}$	m_4	$(\bar{x}+y+z)$	M_4
1	0	1	$x\bar{y}z$	m_5	$(\bar{x}+y+\bar{z})$	M_5
1	1	0	$xy\bar{z}$	m_6	$(\bar{x}+\bar{y}+z)$	M_6
1	1	1	xyz	m_7		M_7

$f_1 = m_0 + m_1 + m_5 + m_7$

$= \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + x\bar{y}z + xyz$

x	y	z	f_1	f_1'
0	0	0	1	0
0	0	1	1	0
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	1	0

complement $f' = \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + xy\bar{z}$

$= (x+\bar{y}+z)(x+\bar{y}+\bar{z})(\bar{x}+y+z)(\bar{x}+\bar{y}+z)$

$= M_2 M_3 M_4 M_6$

* What are the advantages and disadvantages of digital technique over analog technique.

Advantages of digital technique

1. ~~Digital circuit~~ are more reliable
2. Easy to design
3. cheaper than analog circuit
4. Information stored is easy
5. Accuracy and ~~perfe~~ precision are greater
6.

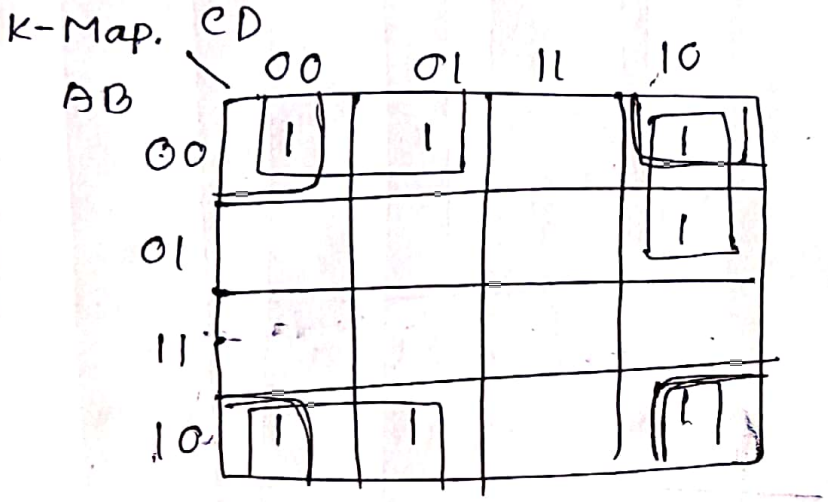
disadvantages of digital technique

1. less data security
2. more complexity
3. Work overload
4. plagiarism and copyright
5. Digital Media Manipulation

* Simplify the boolean function and implement the result using logic gates. $F = \bar{A}\bar{B}\bar{C} + \bar{B}C\bar{D} + \bar{A}BC\bar{D} + A\bar{B}\bar{C}$.

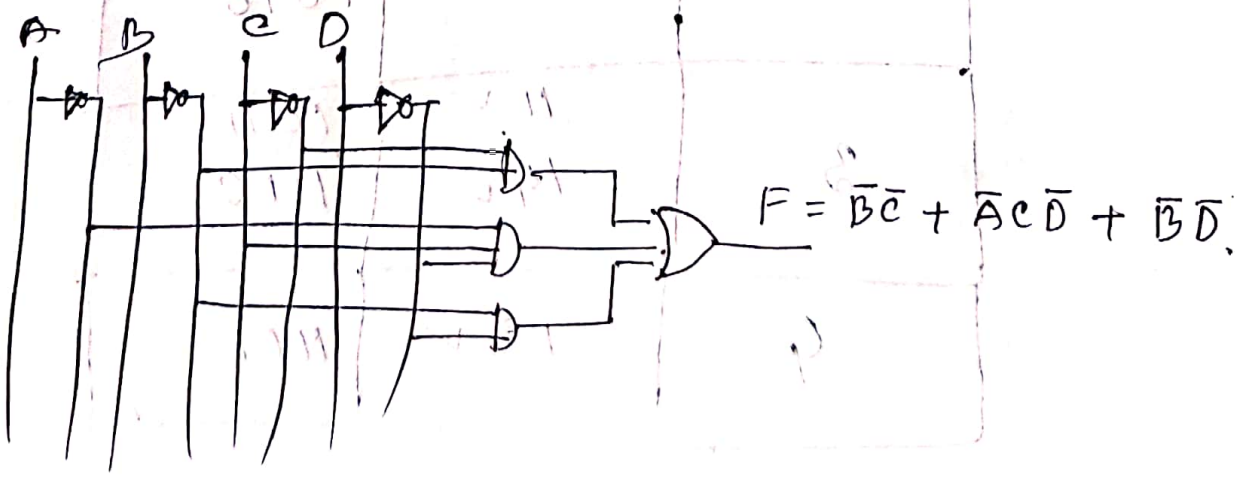
The function have four variable. so we use a four variable karnaugh map where the minterm listed in the sum by are marked by 1.

K-Map.



$$F = \bar{B}\bar{C} + \bar{A}C\bar{D} + \bar{B}\bar{D}$$

Now Implement the Function $F = \bar{B}\bar{C} + \bar{A}C\bar{D} + \bar{B}\bar{D}$ using logic gates.



* Mc-cluskey method (Tabulation Form).

$f = (a, b, c, d) = \Sigma(0, 5, 8, 9, 10, 11, 14, 15)$

0 = 0000

5 = 0101

8 = ~~0110~~ 1000

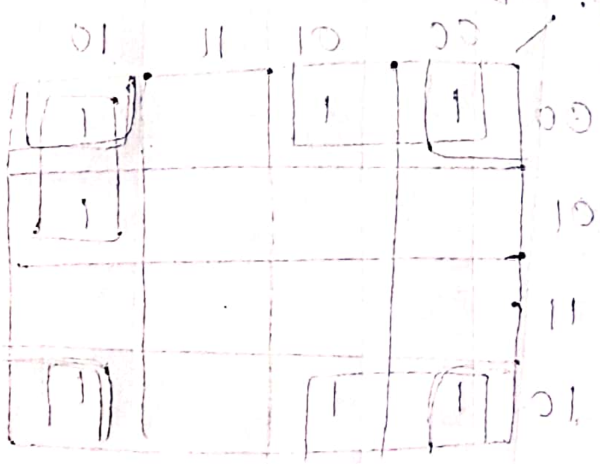
9 = 1001

10 = 1010

11 = 1011

14 = 1110

15 = 1111



Step – 01

Group	minterm	Variable A B C D
0	0 ✓	0 0 0 0
1	8 ✓	1 0 0 0
2	5 9 ✓ 10 ✓	0 1 0 1 1 0 0 1 1 0 1 0
3	11 ✓ 14 ✓	1 0 1 1 1 1 1 0
4	15 ✓	1 1 1 1

Scanned with CamScanner

Step 02

Group	matched pair	Variable A B C D
0	0, 8	- 0 0 0
1	8, 9 ✓	1 0 0 -
	8, 10 ✓	1 0 - 0
2	9, 11 ✓	1 0 - 1
	10, 11 ✓	1 0 1 -
	10, 14 ✓	1 - 1 0
3	11, 15 ✓	1 - 1 1
	14, 15 ✓	1 1 1 -

Step 03

Group	match pair	Variable A B C D	
0	8, 9, 10, 11	1 0 - -	$A\bar{B}$
	8, 10, 9, 11	1 0 - -	
1	10, 11, 14, 15	1 - 1 -	AC
	10, 14, 11, 15	1 - 1 -	
	0, 8	- 0 0 0	
	5	0 1 0 1	

Step 04

Prime. Imp.	0	5	8	9	10	11	14	15
8, 9, 10, 11			X	(X)	X	X		
10, 11, 14, 15					X	X	(X)	(X)
0, 8	(X)		X					
5		(X)						

$$= A\bar{B} + AC + \bar{B}\bar{C}\bar{D} + \bar{A}B\bar{C}D$$

* Find prime implecants.

$F = \Sigma(0, 1, 2, 8, 10, 11, 14, 15)$

0 = 0000

1 = 0001

2 = 0010

8 = 1000

10 = 1010

11 = 1011

14 = 1110

15 = 1111

Step 01

Group	minterm	Variable
		A B C D
0	0 ✓	0 0 0 0
1	1 ✓	0 0 0 1
	2 ✓	0 0 1 0
	8 ✓	1 0 0 0
2	10 ✓	1 0 1 0
3	11 ✓	1 0 1 1
	14 ✓	1 1 1 0
4	15 ✓	1 1 1 1

Step 02

Group	matched pair	Variable A B C D
0	0, 1	0 0 0 -
	0, 2 ✓	0 0 - 0
	0, 8 ✓	- 0 0 0
1	2, 10 ✓	- 0 1 0
	8, 10 ✓	1 0 - 0
2	10, 11 ✓	1 0 1 -
	10, 14 ✓	1 - 1 0
3	11, 15 ✓	1 - 1 1
	14, 15 ✓	1 1 1 -

Step 03

Group	match pair	variable A B C D	
0	0,2,8,10	- 0 - 0	$\bar{B}\bar{D}$
	0,8,2,10	- 0 - 0	
1	10,11,14,15	1 - 1 -	A C
	10,14,11,15	1 - 1 -	
	0, 1	0 0 0 -	

step 04

Prim Implicant	0	1	2	8	10	11	14	15
0, 2, 8, 10	X		(X)	(X)	X			
10, 11, 14, 15					X	(X)	(X)	(X)
0, 1	X	(X)						

$\bar{B}\bar{D} + AC + A\bar{B}\bar{C}$.

ডেসিমাল থেকে যে কোন নাম্বার সিস্টেমে নেওয়ার সময় দশমিক বামে সংখ্যা বামে যে সংখ্যা থাকে তাকে ভাগ দিতে হবে। ভাগ দিতে হবে ঐ যে সংখ্যায় কনভার্ট করব তার যেমন দিয়ে। দশমিক ডানে যে সংখ্যা থাকবে তাকে গুন দিতে হবে যেমন দিয়ে।

$$
\begin{array}{r|l}
0.375 & \\
\times\ 2 & \\
\hline
0 \mid 750 & \\
\times 2 & \\
\hline
1 \mid 500 & \\
\times 2 & \\
\hline
1 \mid 000 &
\end{array}
$$

$(0.375)_{10} = (.011)_2$

$$
\begin{aligned}
.011 &= 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3} \\
&= \frac{1}{2^2} + \frac{1}{2^3} \\
&= \frac{1}{4} + \frac{1}{8} \\
&= \frac{2+1}{8} \\
&= \frac{3}{8} \\
&= 0.375
\end{aligned}
$$

Reflected / Gray Code