

'Boolean Algebra'

K-map :- pairing - 1, 1, 2, 4, 8, 16

Two variable

	A	B
0	0	0
1	0	1
2	1	0
3	1	1

A \ B'	0	1
0	00 $\bar{A}\bar{B}$	01 $\bar{A}B$
1	10 $A\bar{B}$	11 AB

three variable map

A \ BC	00	01	11	10
0	00	01	11	32
1	4	5	7	6

4 variable

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

Ex:- $AB + \bar{A}B$ find K-map

A \ B	0	1
\bar{A}	0	1
A	1	0

$AB + \bar{A}B$

② $AB + \bar{A}\bar{B}$

	A	B	B	\bar{B}
	A	0		1
	\bar{A}	1		1

$$f = \bar{B}$$

③

	A	B	B	\bar{B}
A			1	
\bar{A}	1		1	

$$f \rightarrow AB + \bar{A}B + \bar{A}\bar{B} \quad f = A + \bar{B}$$

Ex: 3- variable

① $X = AB\bar{C} + ABC$

	A	B	C	$B\bar{C}$	$B\bar{C}$	$\bar{B}\bar{C}$	$\bar{B}C$
A		1	1				
\bar{A}							

$$X = AB$$

② $X = A'B'C' + AB'C'$

	A	B	C	$B\bar{C}$	$B\bar{C}$	$\bar{B}\bar{C}$	$\bar{B}C$
A						1	
\bar{A}						1	

$$X = B'C'$$

③ $X = A'C' + BC' + ABC'$

	A	B	C	$B\bar{C}$	$B\bar{C}$	$\bar{B}\bar{C}$	$\bar{B}C$
A						1	
\bar{A}						1	1

$$X = B'C' + A'C'$$

(d) $X = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C + A\bar{B}C' + ABC + ABC$

		BC			
A	B	BC	BC'	B'C'	B'C
	B	1	*	.	1
A'	B	1	1	1	1

$$X = A' + AC$$

4 Variable

		CD			
AB	C	CD	CD'	C'D'	C'D
	C	0	1	2	3
AB'	C	4	5	6	7
	C	12	13	14	15
A'B'	C	8	9	10	11
	C	16	17	18	19

$$X = \bar{A}\bar{B}CD + \bar{A}\bar{B}C\bar{D} + A\bar{B}C\bar{D} + A\bar{B}CD$$

$$\text{Min } X = B'CD' + A'B'D$$

Q1 - Express the Boolean funⁿ.

$$f(x, y, z) = x + y'z \text{ in a Sum of minterms}$$

Solⁿ: Here we have 3 variables x, y, z .
as we know $a + a' = 1$

1st term missing two variables y & z

Now

$$x = x(y + y') = xy + xy'$$

$$x = xy(z + z') + xy'(z + z')$$

$$= xyz + xy'z + xy'z' + xy'z'$$

The Second term

$$y'z(x+x') = xy'z + x'y'z$$

$$f(x,y,z) = x + y'z$$

$$= xyz + xy'z + xy'z' + xy'z'$$

Ex: $f(a,b,c) = ab + a'c$ as a product of maxterm

1st term ab

$$\begin{aligned} f(a,b,c) &= ab + a'c \\ &= (ab + a')(ab + c) \\ &= (a + a')(b + a')(a + c)(b + c) \\ &= (b + a')(a + c)(b + c) \end{aligned}$$

Since each term missing one variable.

$$\begin{aligned} \text{Now } a + a' &= 1 \\ a \cdot a' &= 0 \end{aligned}$$

$$\begin{aligned} a' + b &= a' + b + cc' \\ &= (a' + b + c)(a' + b + c') \end{aligned}$$

$$\begin{aligned} a + c &= a + c + bb' \\ &= (a + c + b)(a + c + b') \end{aligned}$$

$$\begin{aligned} (b + c) &= b + c + aa' \\ &= (b + c + a)(b + c + a') \end{aligned}$$

$$f(a,b,c) = (a'+b+c)(a'+b+c')(a+c+b')(a+b+c)$$

Q1. Simplify the Boolean Expⁿ and given that $C+CB=C$ and $B \in B$

$$\begin{aligned} \textcircled{a} \quad & f(a,b,c) = (a'+b+c)(a'+b+c')(a+c+b')(a+b+c) \\ & = (C+CB+CC)(A+B+C) \\ & = (CB+C)(A+B+C) \quad \because C+C=C \\ & = C(A+B+C) \quad \because CC=C \\ & = CA+CB+CC \quad \because CC=C \\ & \Rightarrow CA+CB+C \quad \because CB+C=C \\ & \Rightarrow CA+C \quad \because CA+C=C \\ & \Rightarrow C \end{aligned}$$

$$\begin{aligned} \textcircled{b} \quad & A+B(A+B)+A(A'+B) \\ & = A+BA+BB+AA'+AB \quad \because AA'=0 \\ & = A+AB+B+0+AB \quad \because A+1=1 \\ & = A+B(A+1) \quad \because BB=B \\ & = A+B \quad \because A+1=1 \\ & = A+B \end{aligned}$$

Q1. Simplify the Boolean Expⁿ.

$$F(A,B,C,D) = \overline{\Sigma(0,1,2,3,4,5,6,7,8,9,11)}$$

funⁿ is of 4-variable

$$\Sigma(0,1,2,3,4,5,6,7,8,9,11)$$

AB \ CD	CD	CD'	C'D	C'D'
AB	1	1	1	1
AB'	1	1	1	1
A'B	1	1	1	1
A'B'	1	1	1	1

$$f(A,B,C,D) = AB + AB' + A'B + A'B'$$

or

	CD	CD'	C'D'	C'D
AB	1	1	1	1
AB'	4	1	1	1
A'B'				
A'B	8	4	1	1

Diagram showing a 4x4 Karnaugh map for variables A, B, C, and D. The map is divided into four 2x2 quadrants by dashed lines. The top-left quadrant (AB) contains cells 1, 2, 3, 4. The top-right quadrant (AB') contains cells 5, 6, 7, 8. The bottom-left quadrant (A'B') contains cells 9, 10, 11, 12. The bottom-right quadrant (A'B) contains cells 13, 14, 15, 16. The map is labeled with AB, AB', A'B', A'B on the left and CD, CD', C'D', C'D on the top. A handwritten 'or' is next to the first row. A handwritten 'CD' is written above the first column.

$$F(A, B, C, D) = AB + AB' + A'B CD + A'B D'$$