

Introduction K-MAP

THE KARNAUGH MAP METHOD

- The algebraic procedure of combining various terms and applying to them the rule $Xx + Xx1 = X$
- A Karnaugh map is, actually, a modified form of truth table in which the arrangement of the combinations is very much convenient .
- Each n-variable map consists of 2^n cells (squares) representing all possible combination of these variables.

	a	0	1
b	0		
		0	2
	1		
		1	3

Location of min terms in 2 variable map

	a	0	1
b	0	1	
	1	1	

Map for the functions
 $f(a,b) = \sum(0,1) = a'$

	ab	00	01	11	10
c	0				
		0	2	6	4
	1				
		1	3	7	5

Location of min terms in 3 var map

	ab	00	01	11	10
c	0	1		1	1
	1			1	

$f(a,b,c) = \sum(0,4,6) = ac' + b'c'$

	ab			
cd	00	01	11	10
00	m_0	m_4	m_{12}	m_8
01	m_1	m_5	m_{13}	m_9
11	m_3	m_7	m_{15}	m_{11}
10	m_2	m_6	m_{14}	m_{10}

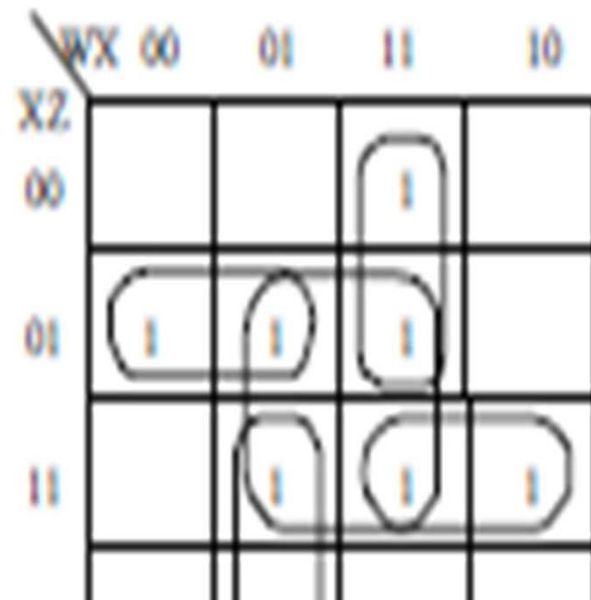
Location of min terms in 4 variable map

Example (1) : Simplify $f(a, b, c, d) = \Sigma(0, 4, 5, 7, 8, 9, 13, 15)$

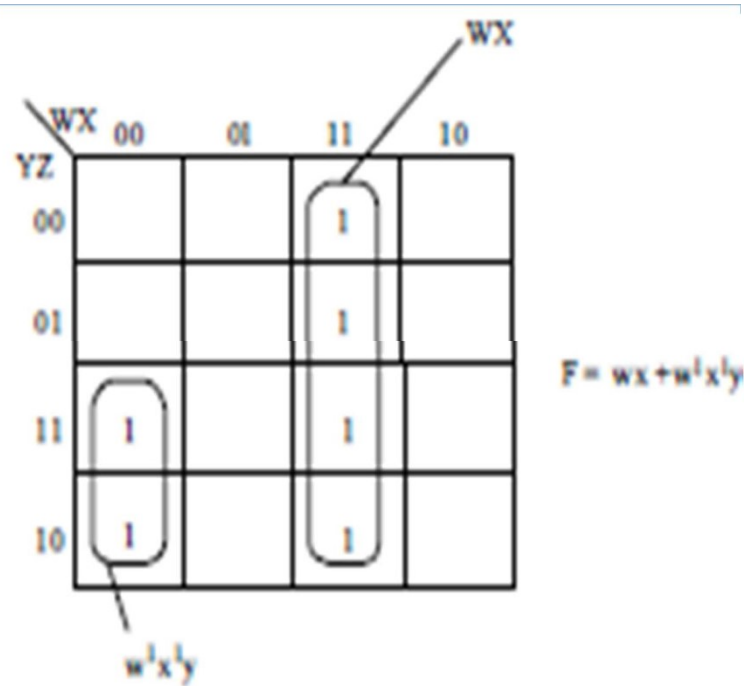
		ab			
	cd	00	01	11	10
00		1	1		1
01			1	1	1
11			1	1	
10					

$$f(a,b,c,d) = a'c'd' + ab'c' + ad$$

Example (2) : The function $f(w, x, y, z) = \Sigma (0, 5, 6, 7, 11, 12, 13, 15)$ has only one irredundant form, as opposed to the preceding example. This unique minimal expressions is derived from below figure and is found to be $f = wxy1 + wyz + w1xy + w1y1z$

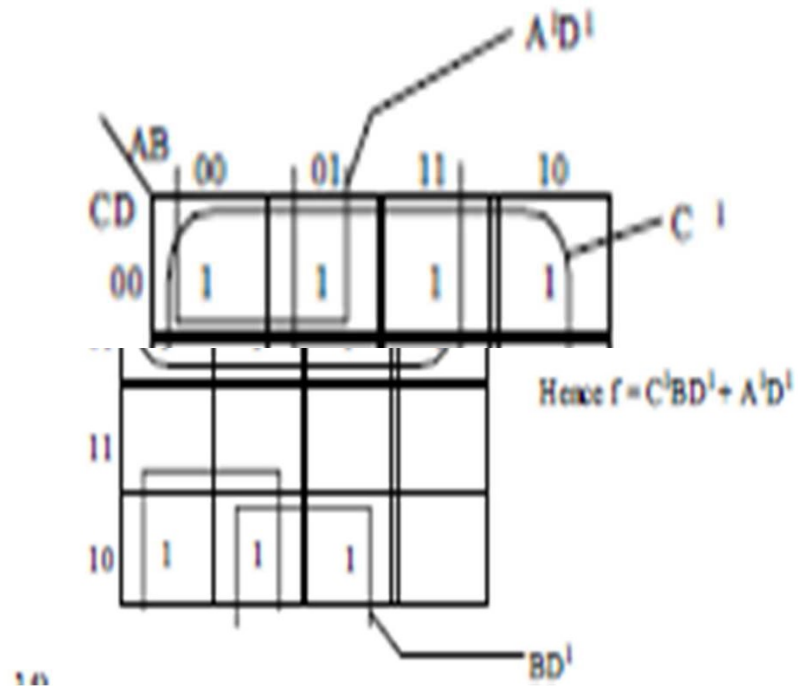


Example (3) : Simplify $f(w, x, y, z) = \Sigma (2, 3, 12, 13, 14, 15)$

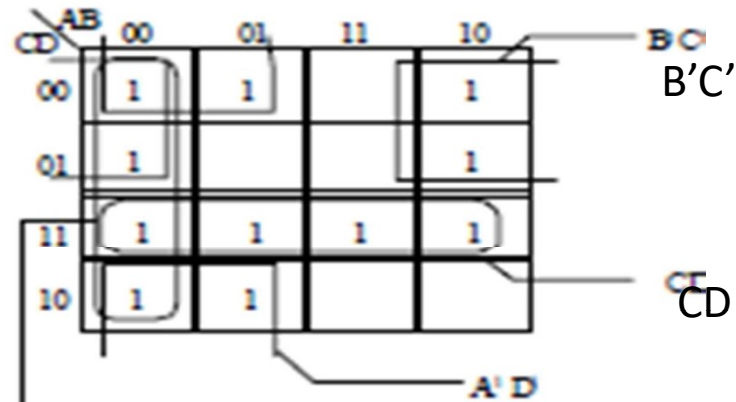


$$f(w,x,y,z) = wx + w'x'y$$

Example(4) : Simplify $f(A, B, C, D) = \Sigma(0, 1, 2, 3, 4, 5, 6, 8, 9, 12, 13)$.



Example(5) : $f(A, B, C, D) = \Sigma(0, 1, 2, 3, 4, 6, 7, 8, 9, 11, 15)$
 $f(ABCD) = B'C' + CD + A'D$



In this quad, since all min terms are already covered by remaining sub cubes, it is redundant.

Example : Minimize by using Karnaugh map

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

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

$$Y(A,B,C,D) = A'B + BC'D'$$

THE FIVE – VARIABLE MAP

- 32 minterms require 32 squares in the k-map.
- Minterms 0-15 belong to the squares with variable $V=0$, and minterms 16-32 belong to the squares with variable $V=1$
- Each square in V' is also adjacent to a square in V (one is above the other)
- Minterm 4 is adjacent to 20, and minterm 15 is to 31

A=0 map

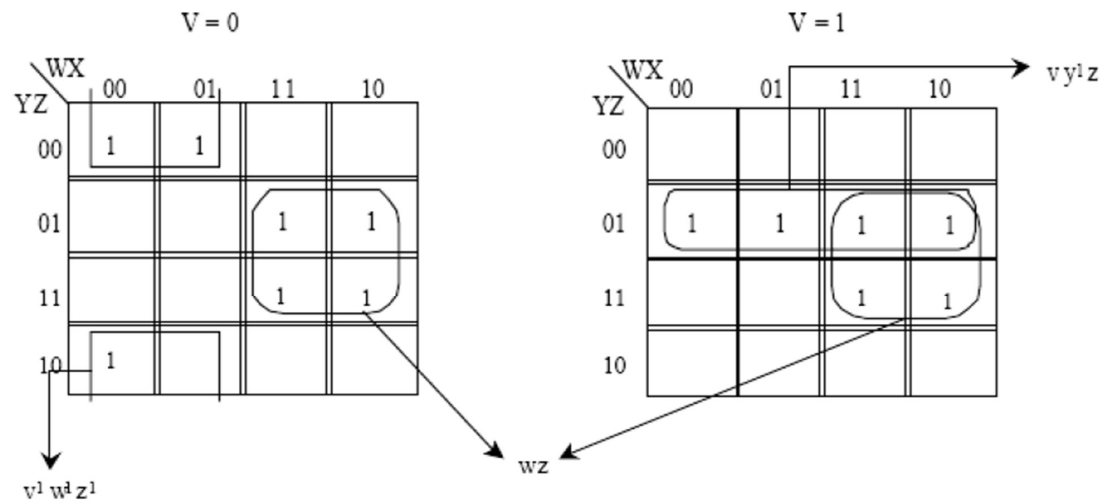
bc \ de	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

A=1 map

bc \ de	00	01	11	10
00	16	20	28	24
01	17	21	29	25
11	19	23	31	27
10	18	22	30	26

Location of minterms in a 5-variable k-map

Example : With the aid of the map, minimise the function. $f(v, w, x, y, z) = \Sigma (0, 2, 4, 6, 9, 11, 13, 15, 17, 21, 25, 27, 29, 31)$

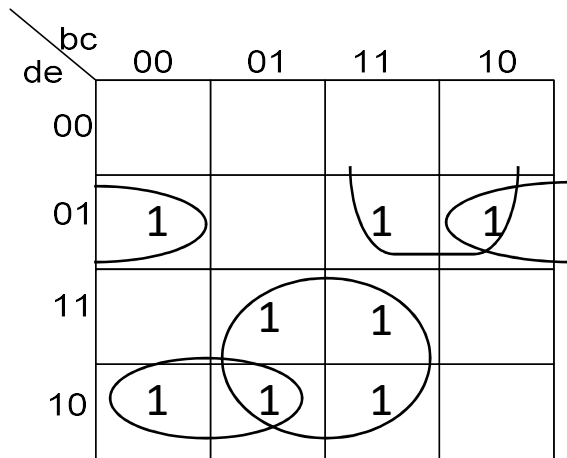


$$f = (v, w, x, y, z) = wz + vy^1z + v^1w^1z^1$$

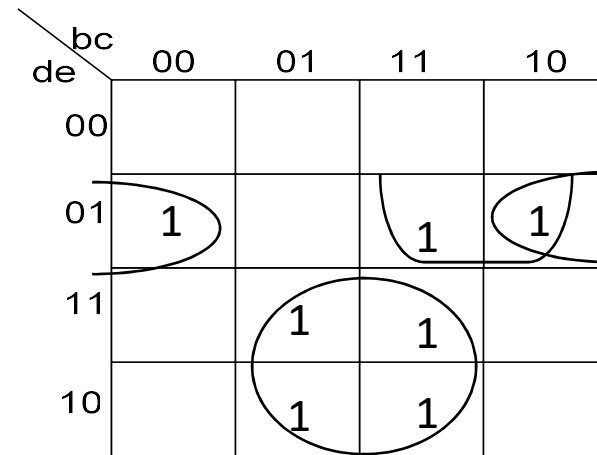
$$f(v, w, x, y, z) = wz + vy'z + v'w'z'$$

Example : With the aid of the map, minimise the function. $f(a, b, c, d, e) = S(1, 2, 6, 7, 9, 13, 14, 15, 17, 22, 23, 25, 29, 30, 31)$

a=0 map



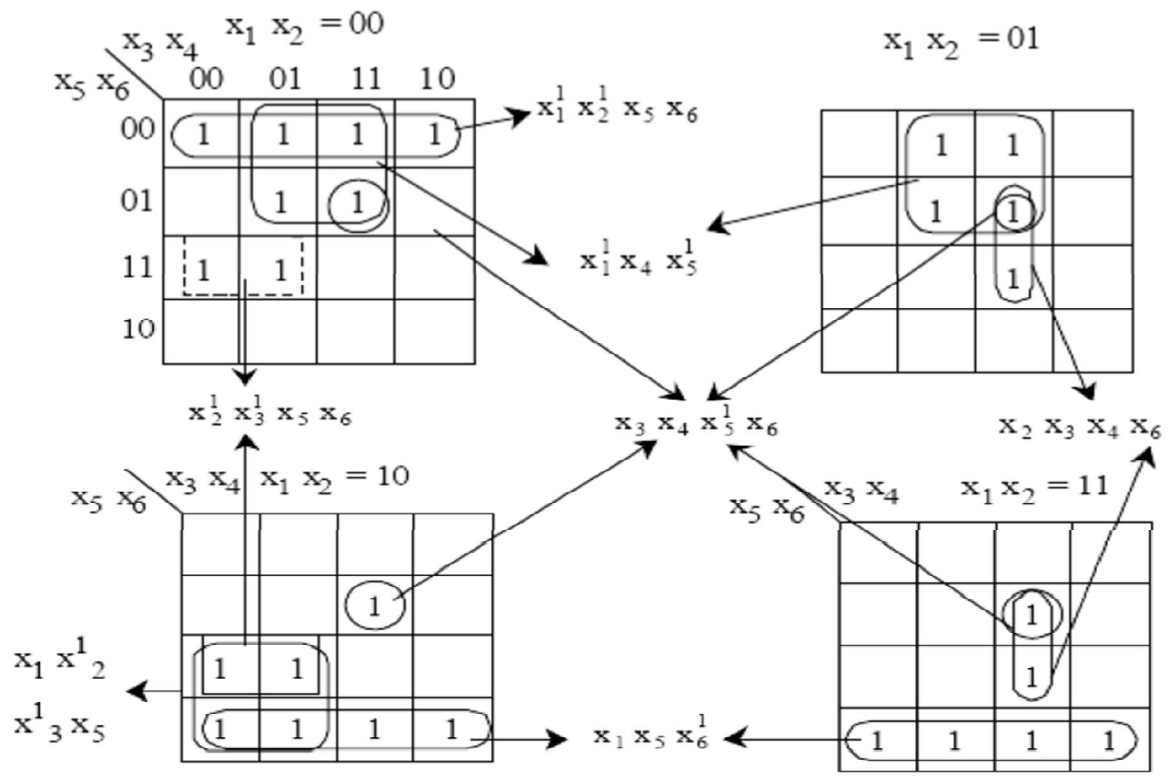
a=1 map



$$f(a,b,c,d,e) = cd + bd'e + c'd'e$$

6-VARIABLE MAP

- A six variable map contains $2^6 = 64$ cells.
- Below example x_1 --- x_6 are input variables.
- ***Example*** : Simplify $f(x_1, x_2, x_3, x_4, x_5, x_6) = \Sigma (0, 3, 4, 5, 7, 8, 12, 13, 20, 21, 28, 29, 31, 34, 35, 38, 39, 42, 45, 46, 50, 54, 58, 61, 62, 63)$.



THANK YOU

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