Karnaugh Maps

It is pictorial representation of truth table of the Boolean fn. It is used for minimization of Boolean functions. It is useful when Boolean fn. has six or fewer variables.

I Case of Two Variables

When 'f' has two variables, say 'x' & 'y'. We shall construct (2×2) matrix of squares with each square containing one possible input combination of x & y. The K-map of the fn. is the (2×2) matrix obtained by placing 0's & 1's in the square according to whether the functional value is '0' or '1'. For the input combination associated with that square.

Exn. Consider Boolean fn.—

$$f = xy + x'y$$. ~~Minimize using K-map~~ form K-map.

Solⁿ K-map →

$$\begin{array}{c|c|c|} & x & x' \\ \hline y & xy & x'y \\ \hline y' & xy' & x'y' \\ \hline \end{array} \qquad \begin{array}{c|c|c|} & x & x' \\ \hline y & 1 & 1 \\ \hline y' & 0 & 0 \\ \hline \end{array}$$

Now we cover 1's with rectangles & squares called groups with following properties—

(i) The no. of squares in a group must be equal to 2^n s.t. 1, 2, 4, 8 . . .

(ii) A square containing 1 can be included in as many groups as desired

(iii) Grp must be as large as possible

Considers—

Ex1). $f(x,y) = xy + xy'$

	x	x'
y	1	0
y'	1	0

Here $f = x$

Ex2). $f(x,y) = xy + x'y + x'y'$

	x	x'
y	1	1
y'	0	1

$f = y + x'$

Ex3). $f = xy' + x'y + x'y'$

	x	x'
y	0	1
y'	1	1

$f = x' + y'$

(II.) Case of three variables x, y, z

K-map is formulated as

	xy	xy'	$x'y'$	$x'y$
z				
z'				

which is like —

	00	01	11	10
0				
1				

Total squares $= 2^3 = 8$

Ex. $f(x,y,z) = xyz + xyz' + x'yz' + x'y'z$

K-map →

	xy	xy'	$x'y'$	$x'y$
z	1	0	1	0
z'	1	0	0	1

$$f = xy + x'y'z + yz'$$

Ex. $f(x,y,z) = xyz + xyz' + xy'z + x'yz + x'y'z$

To find minimal form using K-map.

	xy	xy'	$x'y'$	$x'y$
z	1	1	1	1
z'	1			

$f = z + xy$

Ex: $f(x,y,z) = xyz + xyz' + x'yz' + x'y'z' + x'y'z$

	xy	xy'	$x'y'$	$x'y$
z	1	0	1	0
z'	1	0	1	1

$f = xy + x'y' + yz'$