The Karnaugh Map

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Karnaugh Maps are graphical representations of truth tables. They consist of a grid with one cell for each row of the truth table. The intersection of each row and column corresponds to a unique set of input values. The purpose of Karnaugh maps is to rearrange truth tables so that adjacent cells can be represented with a single product using the simplification previously described. Each square represents a minterm. Adjacent squares differ in the value of one variable. Alternative algebraic expressions for the same function are derived by recognizing patterns of squares

1-Two- Variable Karnaugh map

A	B	F
0	0	m_0
0	1	m_1
1	0	m_2
1	1	m_3

A \ B	0	1
0	m_0	m_1
1	m_2	m_3

For example the truth table for OR gate

X	Y	F
0	0	0
0	1	1
1	0	1
1	1	1

X \ Y	0	1
0	0	1
1	1	1

F= X+Y

Two pairs of adjacent cells containing 1's can be combined using the Minimization.

2-Three- Variable Karnaugh Map

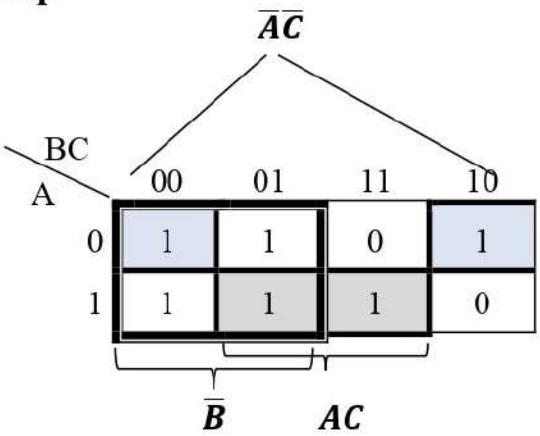
A	B	C	F
0	0	0	m0
0	0	1	m1
0	1	0	m2
0	1	1	m3
1	0	0	m4
1	0	1	m5
1	1	0	m6
1	1	1	m7

A \ BC	00	01	11	10
0	m0 0	m1 1	m3 3	m2 2
1	m4 4	m5 5	m7 7	m6 6

3-Variable K-Map, minterm and cell position

2-Three- Variable Karnaugh Map

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



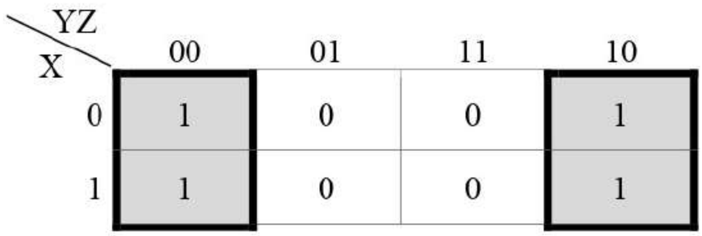
F(A,B,C)=∑(0,1,2,4,5,7)=$\overline{B}+\overline{A}\overline{C}+AC$

Note that: One square represents a minterm with three variables. Two adjacent squares represent a product term with two variables. Four "adjacent" terms represent a product term with one variable. Eight "adjacent" terms is the function of all ones (no variables) = 1.

<u>Example:</u> simplify the Boolean Function F(X,Y,Z)= ∑(0,2,4,6)

Solution: since the function has three variables, a three variable map must be used

X	Y	Z	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0



F=$\overline{Z}$