Karnaugh map (K-map)

Thursday, September 24, 2020 11:44 AM

$f(A,B) = \Sigma m(0,1,2,3)$

2 Variable $\Rightarrow 2^2$ minterm

2 Variable $\rightarrow$ K-map $\longrightarrow 2^2$ cells

$f(A,B,C) = \Sigma m(0,1,2,3,4,5,6,7)$

3 Variable $= 2^3$ minterms

3 Variable K-map $\longrightarrow 2^3$ cells (or) 2^3 Squares

2 Variable K-map

A \ B	0	1
0	00 m_0	01 m_1
1	10 m_2	11 m_3

2^2 cells

A	B	minterm
0	0	$\rightarrow m_0$
0	1	$\rightarrow m_1$
1	0	$\rightarrow m_2$
1	1	$\rightarrow m_3$

K-map $\longrightarrow$ 2 Variable $= 2^2$ cells

A \ B	0	1
0	$\bar{A}\bar{B}$ m_0	$\bar{A}B$ m_1
1	$A\bar{B}$ m_2	AB m_3

$f(A,B) = \Sigma m(1,2,3)$

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

$= B(\underbrace{A+\bar{A}}_{1}) + A\bar{B}$

$= B + A\bar{B}$

$B + \bar{B}A$

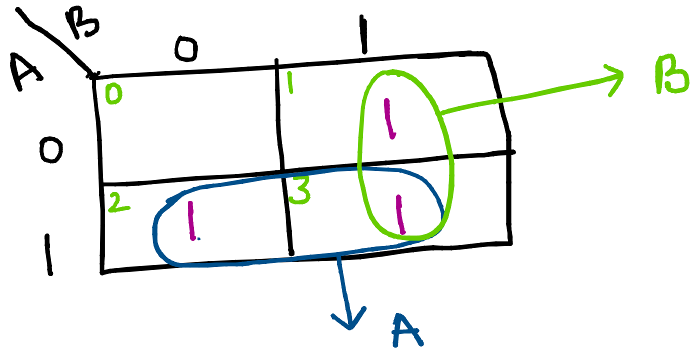
$= B + A\overline{B}$

$= A + B$ ✓

$B + \overline{B}A \rightarrow B + A$

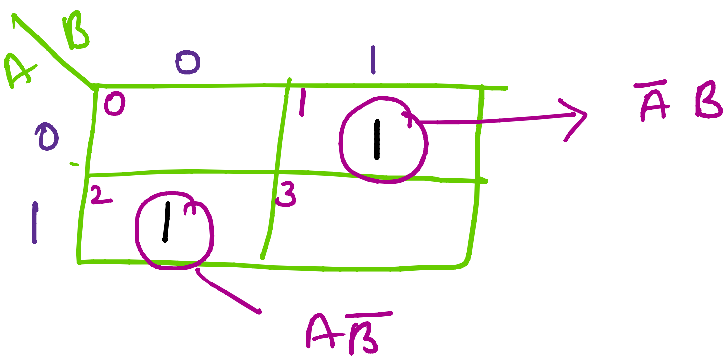
2-Variable K-map

$f(A,B,C) = \Sigma m(1,2,3)$



$\Rightarrow A + B$ ✓

$f(A,B) = \Sigma m(1,2)$



$f(A,B) = \overline{A}B + A\overline{B}$

$A \oplus B$ ✓

Note → Adjacent cells differ by 1 bit.

To maintain adjacency property gray code sequence is used in k-maps

2 Variable → 2^0, 2^1, 2^2 → groups

3 Variable → 2^0, 2^1, 2^2, 2^3

n Variables → - - - - 2^n.

n Variables → _ _ _ _ 2^n

$f(A,B) = \Sigma m(0,1,2,3)$

A \ B	0	1
0	1 (0)	1 (1)
1	1 (2)	1 (3)

→ 1

$f(A,B) = 1$ ✓

A	B	Maxterm
0	0	$A+B$
0	1	$A+\bar{B}$
1	0	$\bar{A}+B$
1	1	$(\bar{A}+\bar{B})$

$f(A,B) = \Pi M(0,1,3)$

$f(A,B) = \underbrace{(A+B)(A+\bar{B})}(\bar{A}+\bar{B})$

$(\underbrace{A\cdot A}_{A} + A\bar{B} + AB + \underbrace{B\cdot\bar{B}}_{0})(\bar{A}+\bar{B})$

$(A + A\bar{B} + AB + 0)(\bar{A}+\bar{B})$

$A(\underbrace{1+\bar{B}+B}_{1})(\bar{A}+\bar{B})$

$\boxed{\because 1+\bar{B}+B = 1}$

$A(\bar{A}+\bar{B})$

$A\cdot\bar{A} + A\bar{B}$

$0 + A\bar{B}$ ✓

K-map

A\B	0	1
0	0	0
1		0

A

$\bar{B}$

$A\bar{B}$

$f(A,B) = \pi m(0,1,2)$

A\B	0	1
0	0	0
1	0	

A

B

$\underline{\underline{AB}}$ ✓

How many bits are required to represent decimal ranging from +75 to −75

$(75)_{10} = (1001011)_2$

+ve

$(+75)_{10} = 01001011 \longrightarrow$ 8 bits

−75 (1's) 10110100

+1

2's complement for (−75)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
$\boxed{1}$	0	1	1	0	1	0	1

$\longrightarrow$ 8 bits

$-2^7\times 1 + 2^5\times 1 + 2^4\times 1 + 2^2\times 1 \times 1\times 2^0$

$-128 + 32 + 16 + 4 + 1 \Rightarrow -75$ ✓

$$\begin{array}{ccccccccccccc} -2^{12} & 2^{11} & 2^{10} & 2^{9} & 2^{8} & 2^{7} & 2^{6} & 2^{5} & 2^{4} & 2^{3} & 2^{2} & 2^{1} & 2^{0} \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \end{array} \Rightarrow \text{——} \quad -\text{ve true}$$