UNIT-II

Combinational Logic System

Lecture 15

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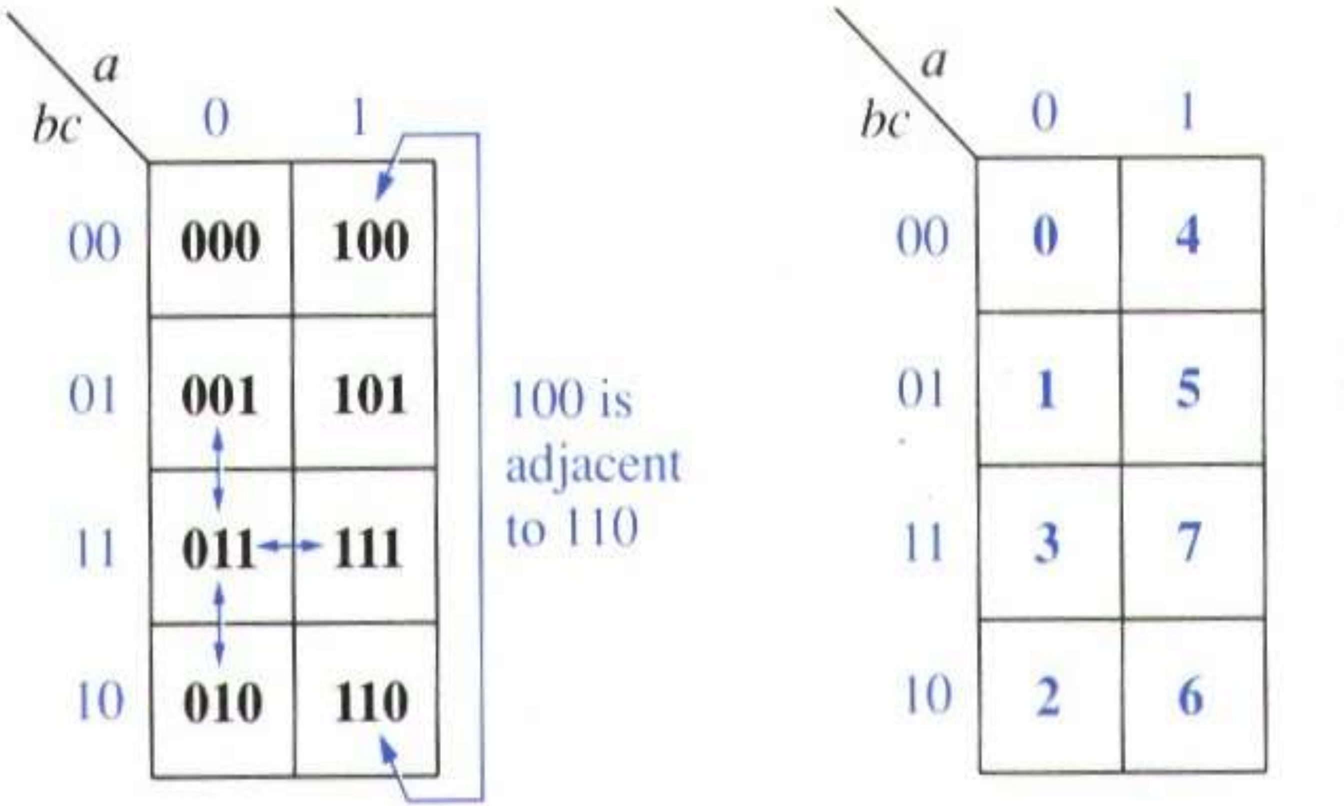
Location of Minterms

- Adjacent terms in 3-variable K map.



(a) Binary notation (b) Decimal notation

Three Variable Maps

- **A three variable Karnaugh Map is shown below:**

	yz=00	yz=01	yz=11	yz=10
x=0	m_0	m_1	m_3	m_2
x=1	m_4	m_5	m_7	m_6

- **Where each minterm corresponds to the product terms below:**

	yz=00	yz=01	yz=11	yz=10
x=0	$\overline{x}\,\overline{y}\,\overline{z}$	$\overline{x}\,\overline{y}\,z$	$\overline{x}\,y\,z$	$\overline{x}\,y\,\overline{z}$
x=1	$x\,\overline{y}\,\overline{z}$	$x\,\overline{y}\,z$	$x\,y\,z$	$x\,y\,\overline{z}$

- **Note that if the binary value for an index differs in one bit position, the minterms are adjacent on the Karnaugh Map**

Combining Squares Example

- **Example: Let F = $\sum m(2,3,6,7)$**

F	yz=00	yz=01	yz=11	yz=10
x=0			1	1
x=1			1	1

- **Applying the Minimization Theorem three times:**

$$\begin{aligned} F(x, y, z) &= \overline{x}\,y\,z + x\,y\,z + \overline{x}\,y\,\overline{z} + x\,y\,\overline{z} \\ &= yz + yz \\ &= y \end{aligned}$$

- **Thus the four terms that form a 2 × 2 square correspond to the term "y".**

K Map Example

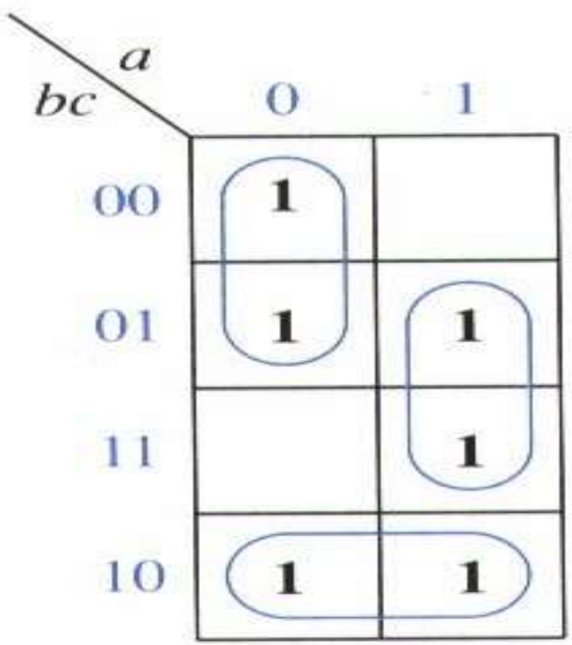
K-map of $F(a,b,c) = \sum m(1,3,5) = \prod M(0,2,4,6,7)$

bc \ a	0	1
00	0 ($_0$)	0 ($_4$)
01	1 ($_1$)	1 ($_5$)
11	1 ($_3$)	0 ($_7$)
10	0 ($_2$)	0 ($_6$)

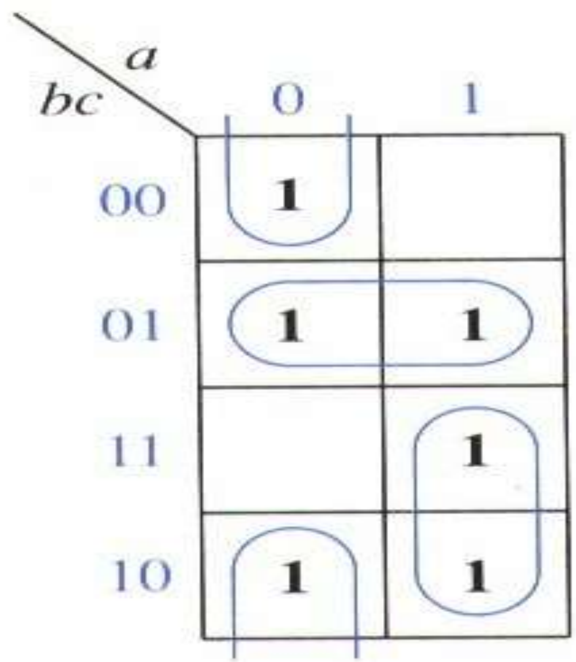
Karnaugh Map of
$F(a, b, c) = \sum m(1, 3, 5) = \prod M(0, 2, 4, 6, 7)$

More Than Two Minimum Solutions

- F = $\sum$ m(0,1,2,5,6,7)



$F = a'b' + bc' + ac$



$F = a'c' + b'c + ab$

4-Variable K Map

- Each minterm is adjacent to 4 terms with which it can combine.
  - 0, 8 are adjacent squares
  - 0, 2 are adjacent squares, etc.
  - 1, 4, 13, 7 are adjacent to 5.

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

$$f(A,B,C,D)=\sum m(0,1,3,4,5,7,12,13,15)$$

AB \ CD	00	01	11	10
00	1	1	1	0
01	1	1	1	0
11	1	1	1	0
10	0	0	0	0

$$\overline{A}\,\overline{C} + \overline{A}D + B\overline{C} + BD$$

$$f(A,B,C,D) = \prod M(2,6,8,9,10,11,14)$$

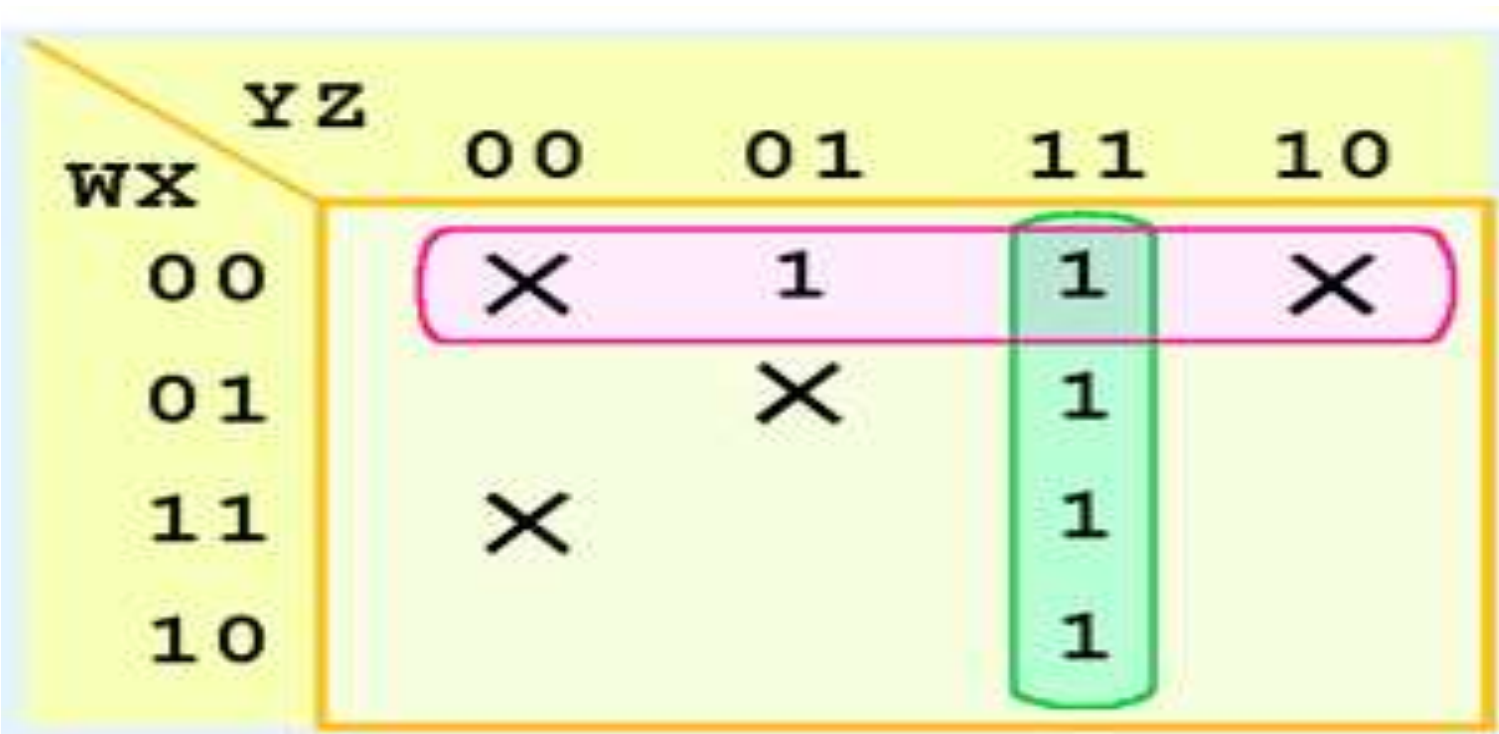
AB \ CD	00	01	11	10
00	1	1	1	0
01	1	1	1	0
11	1	1	1	0
10	0	0	0	0

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

Kmap with Don't Care

In a Kmap, a don't care condition is identified by an *X* in the cell of the minterm(s)

In simplification, we are free to include or ignore the *X*'s when creating our groups.



Simplification with Don’t Care

- Don’t care “x” is covered if it helps. Otherwise leave it along.

cd \ ab	00	01	11	10
00			x	
01	1	1	x	1
11	1	1		
10		x		

$$f = \Sigma m(1, 3, 5, 7, 9) + \Sigma d(6, 12, 13)$$
$$= a'd + c'd$$

$$F(A, B, C, D) = m(1, 2, 6, 7, 8, 13, 14, 15) + d(0, 3, 5, 12)$$

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