

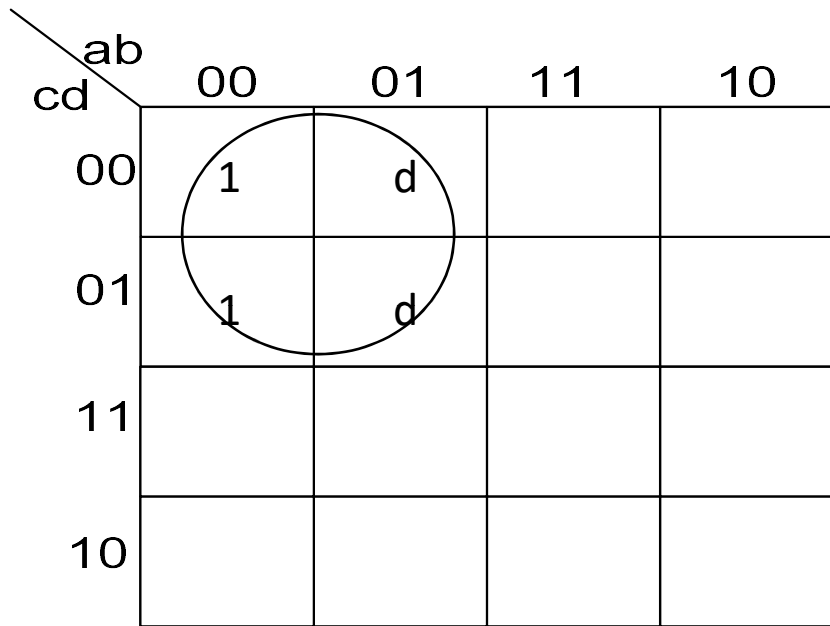
# **K-MAP(Don't Care Combinations)**

**DON'T CARE COMBINATIONS**

## DON'T CARE COMBINATIONS

- So far the functions considered have been completely specified for every combination of the variables. There exist situations, however, where, while a function is to assume the value 1 for some combinations and the value 0 for others, it may assume either value for a number of combinations. Combinations for which the value of the function is not specified are called don't care combinations. The value of the function for such combinations is denoted by a  $\phi$  (or d).

For example in figure shown below the d's can be used as 1's to form a subcube consisting of four 1's.



Where in the below figure the d's need not be used

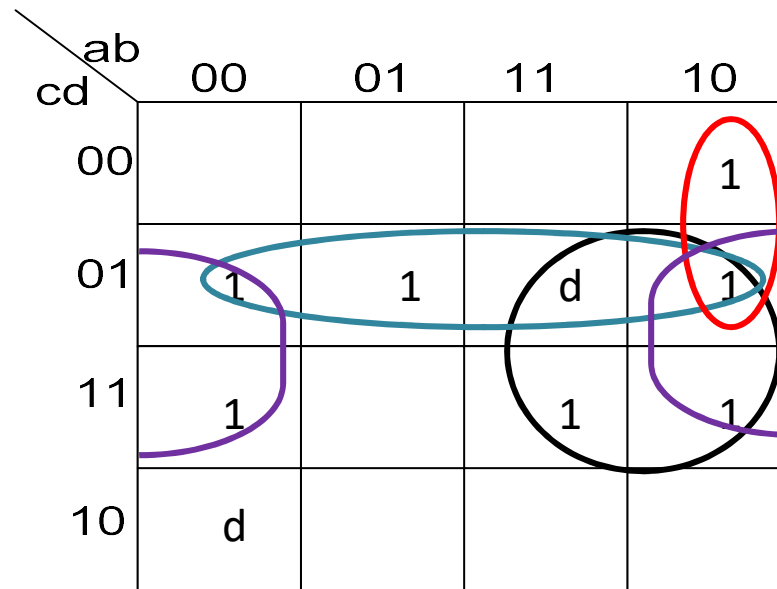
cd \ ab	00	01	11	10
00	1	d		1
01	1	d		1
11				
10				

Example :  $f = \Sigma (0, 2, 4, 6, 8) + \Sigma d (10, 11, 12, 13, 14, 15)$

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

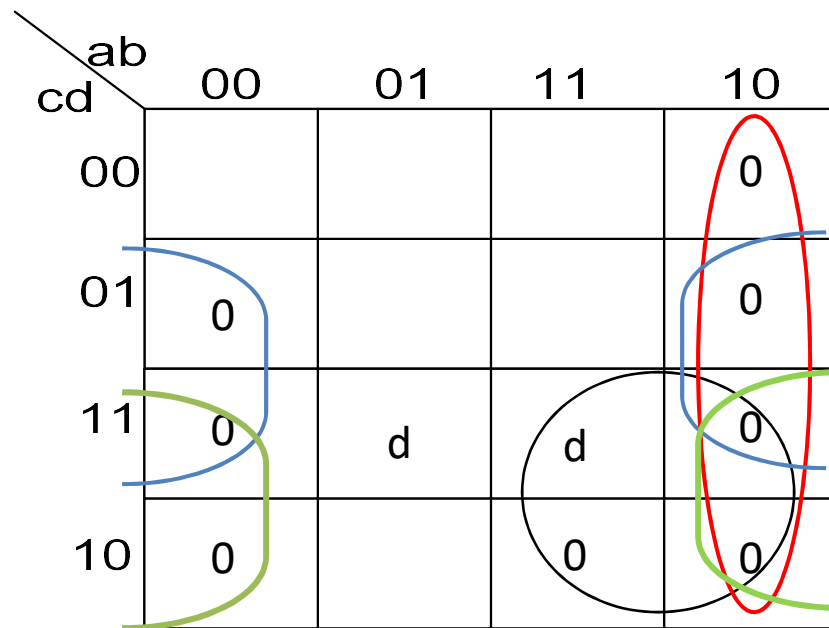
$$f = c'd' + cd$$

Example :  $f(A, B, C, D) = (1, 3, 5, 8, 9, 11, 15) + d(2,13)$



$$f = ab'c' + c'd + ad + b'd$$

Example :  $f(A, B, C, D) = \pi(1, 2, 3, 8, 9, 10, 11, 14) + d(7, 15)$



$$f = (A'+B)(A'+C')(B+C')(B+D')$$





Cont...

A switching function can be represented by a table as above, or by a switching expression as follows:

$$f_0(A,B) = 0, f_6(A,B) = AB' + A'B, f_{11}(A,B) = AB + A'B + A'B' = A' + B, \dots$$

Value of a function can be obtained by plugging in the values of all variables:

The value of  $f_6$  when  $A = 1$  and  $B = 0$  is:

$$= 0 + 1 = 1.$$

$$1 \cdot 0' + 1' \cdot 0$$

## Truth Tables

Shows the value of a function for all possible input combinations.

Truth tables for OR, AND, and NOT (Table 2.4):

ab	$f(a,b)=a+b$	ab	$F(a,b)=ab$	a	$F(a)=a'$
00	0	00	0	0	1
01	1	01	0	1	0
10	1	10	0		
11	1	11	1		

## Truth Tables (2)

Truth tables for  $f(A,B,C) = AB + A'C + AC'$  (Table 2.5)

ABC	f(A,B,C)	ABC	F(A,B,C)
000	0	FFF	F
001	1	FFT	T
010	0	FTF	F
011	1	FTT	T
100	1	TFF	T
101	0	TFT	F
110	1	TTF	T
111	1	TTT	T

## Algebraic Forms of Switching Functions

**Example:** Given  $f(A,B,Q,Z) = A'B'Q'Z' + A'B'Q'Z + A'BQZ' + A'BQZ$ ,

express  $f(A,B,Q,Z)$  and  $f'(A,B,Q,Z)$  in minterm list form.

$$\begin{aligned} f(A,B,Q,Z) &= A'B'Q'Z' + A'B'Q'Z + A'BQZ' + A'BQZ \\ &= m_0 + m_1 + m_6 + m_7 \\ &= \sum m(0, 1, 6, 7) \end{aligned}$$

$$\begin{aligned} f'(A,B,Q,Z) &= m_2 + m_3 + m_4 + m_5 + m_8 + m_9 + m_{10} + m_{11} \\ &\quad + m_{12} + m_{13} + m_{14} + m_{15} \\ &= \sum m(2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15) \quad (2.6) \end{aligned}$$

$AB + (AB)' = 1$  and  $AB + A' + B' = 1$ , but  $AB + A'B'$

## Algebraic Forms of Switching Functions

A maxterm is a sum term in which all the variables appear exactly once either complemented or uncomplemented.

### ***Canonical Product of Sums (canonical POS):***

Represented as a product of maxterms only.

***Example:  $f_2(A,B,C) =$***

$$(A+B+C)(A+B+C')(A'+B+C)(A'+B+C') \quad (2.7)$$

Maxterms of three variables:

Cont...

$$\begin{aligned} f_2(A,B,C) &= M_0 M_1 M_4 M_5 \\ &= \prod M(0,1,4,5) \text{ (maxterm list form)} \end{aligned}$$

The truth table for  $f_2(A,B,C)$ :

Truth tables of  $f_1(A,B,C)$  of Eq. (2.3) and  $f_2(A,B,C)$  of Eq. (2.7) are identical.

$$\begin{aligned} \text{Hence, } f_1(A,B,C) &= \sum m(2,3,6,7) \\ &= f_2(A,B,C) \\ &= \prod M(0,1,4,5) \quad (2.10) \end{aligned}$$

Cont...

**Example:** Given  $f(A,B,C) = (A+B+C')(A+B'+C')(A'+B+C')(A'+B'+C')$ , construct the truth table and express in both maxterm and minterm form.

$$f(A,B,C) = M_1M_3M_5M_7 = \prod M(1,3,5,7) = \sum m(0,2,4,6)$$

Relationship between minterm  $m_i$  and maxterm  $M_i$ :

$$\text{For } f(A,B,C), (m_1)' = (A'B'C)' = A + B + C' = M_1$$

$$\text{In general, } (m_i)' = M_i \quad (2.11)$$

$$(M_i)' = ((m_i)')' = m_i \quad (2.12)$$