

23ITT201 – DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

UNIT -1 COMBINATIONAL LOGIC

		CD			
		00	01	11	10
AB	00				
	01			0	0
	11	X	X	X	X
	10	0	0	X	X

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



Guess today's topic???





Karnaugh Map



- Feel a little difficult using Boolean algebra laws, rules, and theorems to simplify logic?
- A K-map provides a systematic method for simplifying Boolean expressions and, if properly used, will produce the simplest SOP or POS expression possible, known as the minimum expression.





What is K-map?



- It's similar to truth table; instead of being organized (i/p and o/p) into columns and rows, the K-map is an array of cells in which each cell represents a binary value of the input variables.
- The cells are arranged in a way so that simplification of a given expression is simply a matter of properly grouping the cells.
- K-maps can be used for expressions with 2, 3, 4, and 5 variables.
 - 3 and 4 variables will be discussed to illustrate the principles.



3 variable K-Map

- There are 8 cells as shown:

		C	
		0	1
AB	00	$\bar{A}\bar{B}\bar{C}$	$\bar{A}\bar{B}C$
	01	$\bar{A}B\bar{C}$	$\bar{A}BC$
11	$AB\bar{C}$	ABC	
10	$A\bar{B}\bar{C}$	$A\bar{B}C$	

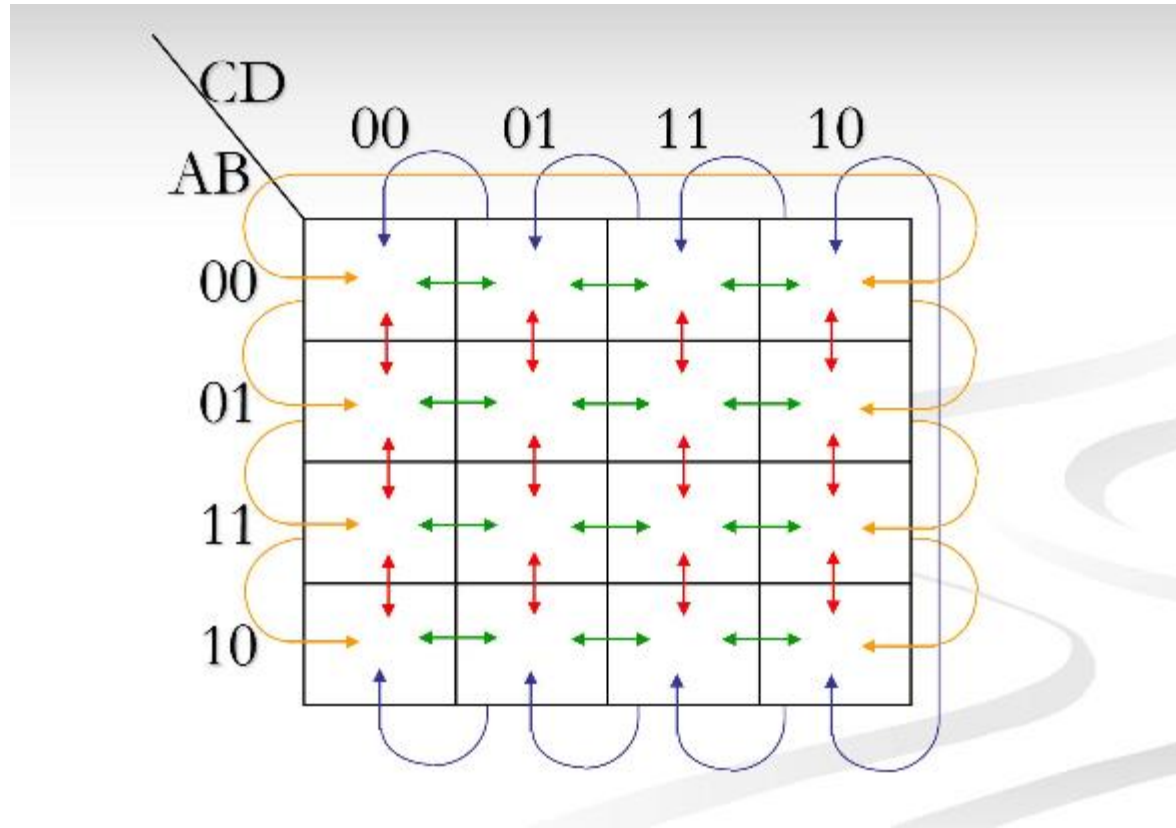


4 variable K-Map

		CD			
		00	01	11	10
AB	00	$\bar{A}\bar{B}\bar{C}\bar{D}$	$\bar{A}\bar{B}\bar{C}D$	$\bar{A}\bar{B}CD$	$\bar{A}\bar{B}C\bar{D}$
	01	$\bar{A}B\bar{C}\bar{D}$	$\bar{A}B\bar{C}D$	$\bar{A}BCD$	$\bar{A}BC\bar{D}$
	11	$AB\bar{C}\bar{D}$	$AB\bar{C}D$	$ABCD$	$ABC\bar{D}$
	10	$A\bar{B}\bar{C}\bar{D}$	$A\bar{B}\bar{C}D$	$A\bar{B}CD$	$A\bar{B}C\bar{D}$



Cell adjacency



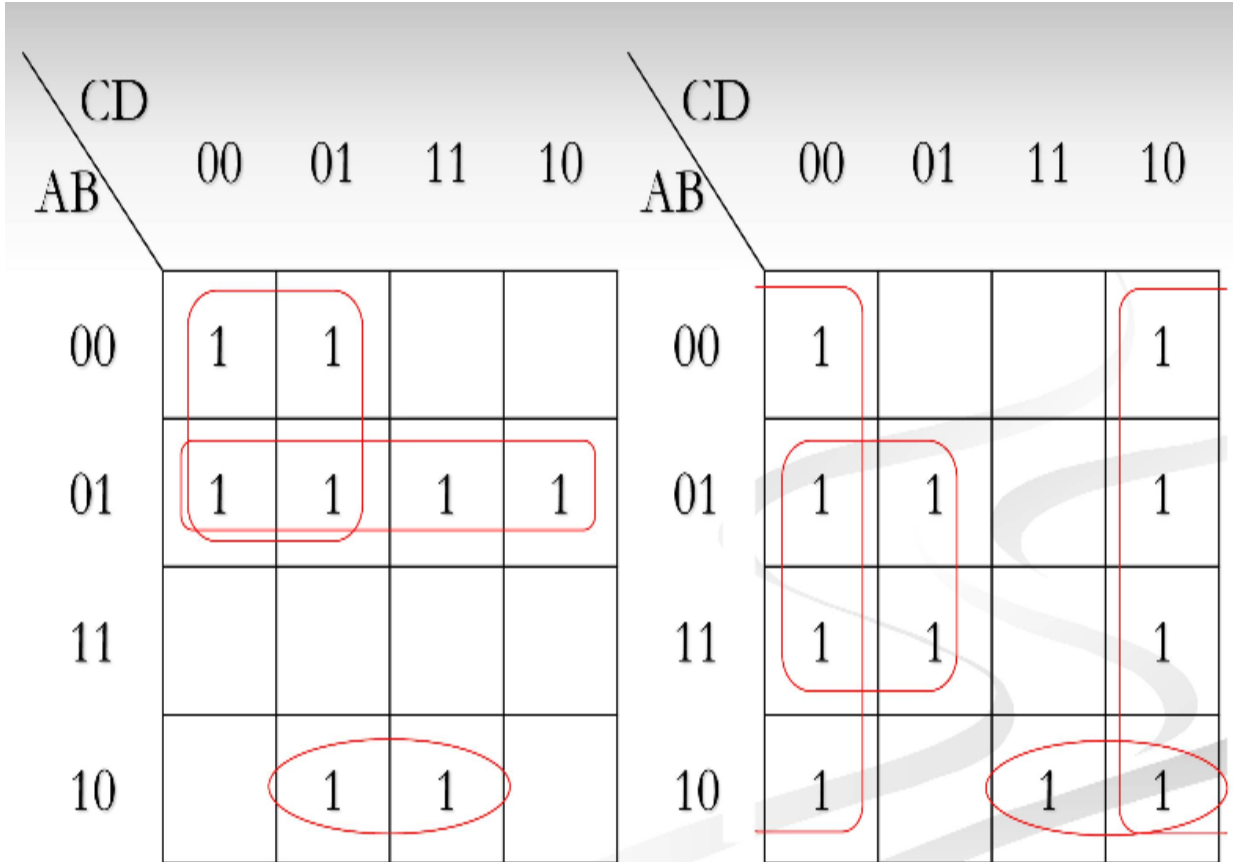
Grouping the 1's Example

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

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



Grouping the 1's Example





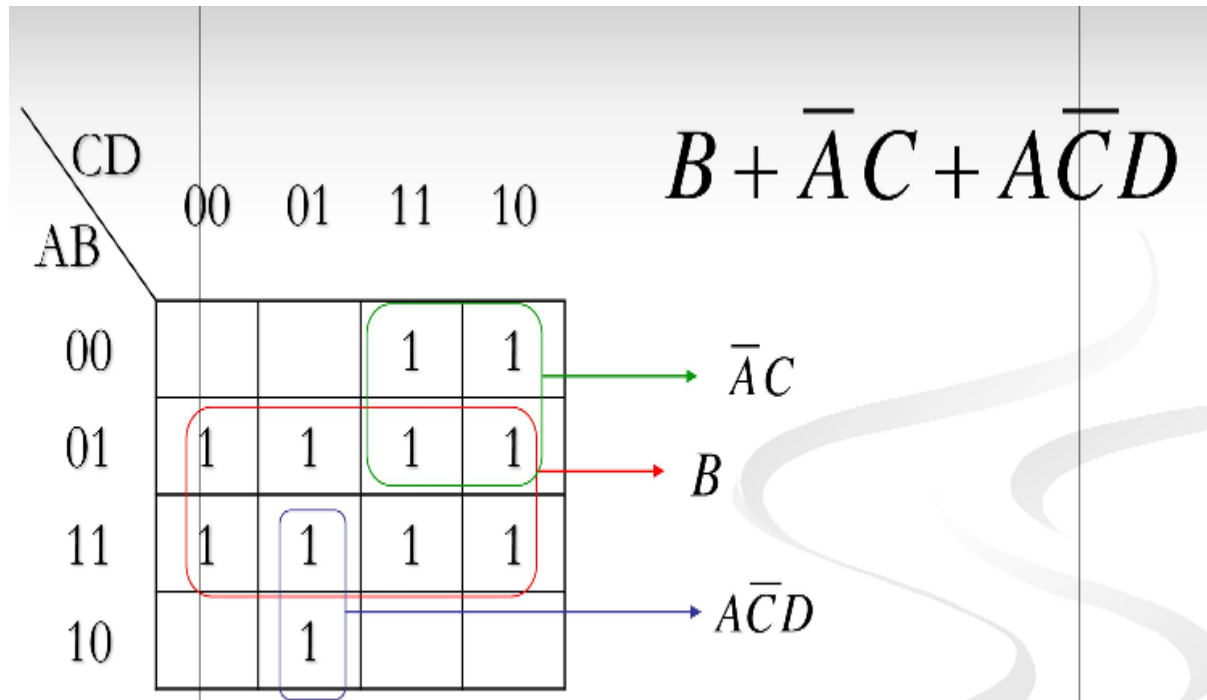
Determining the minimum SOP

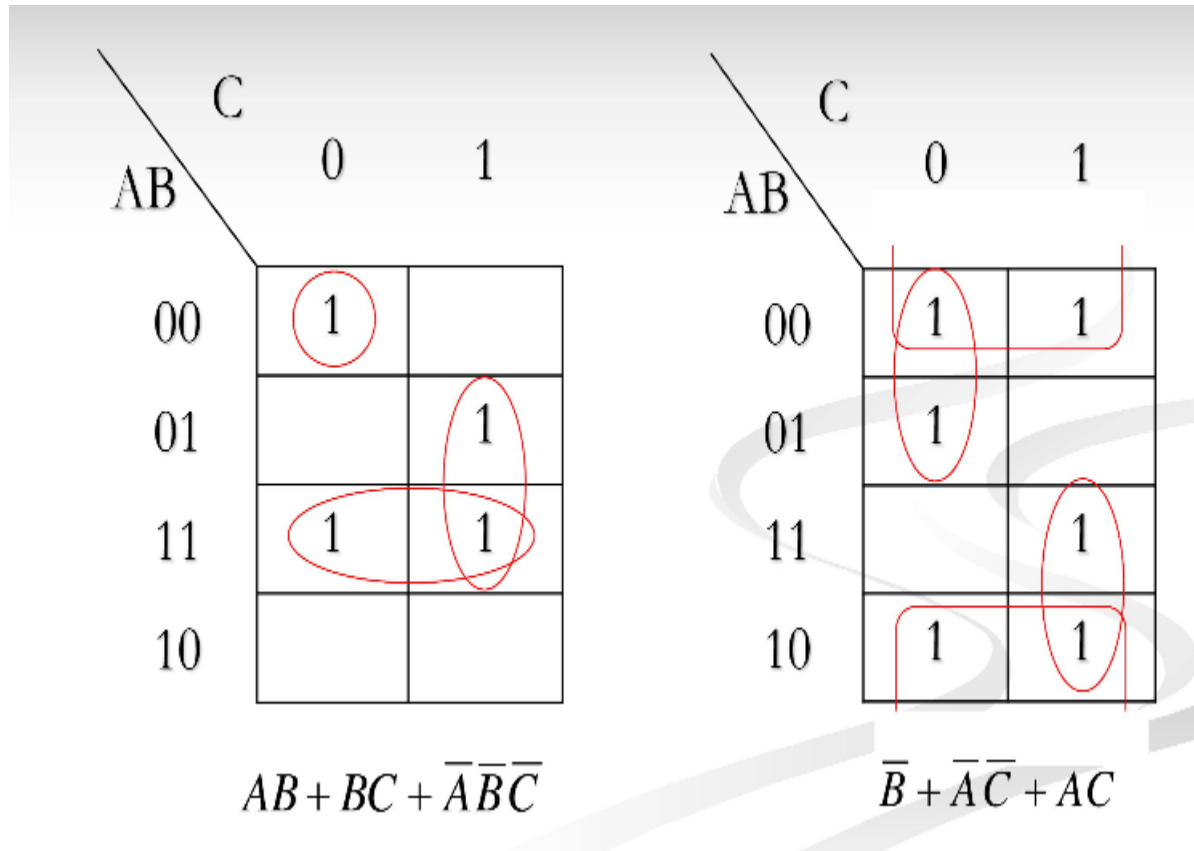


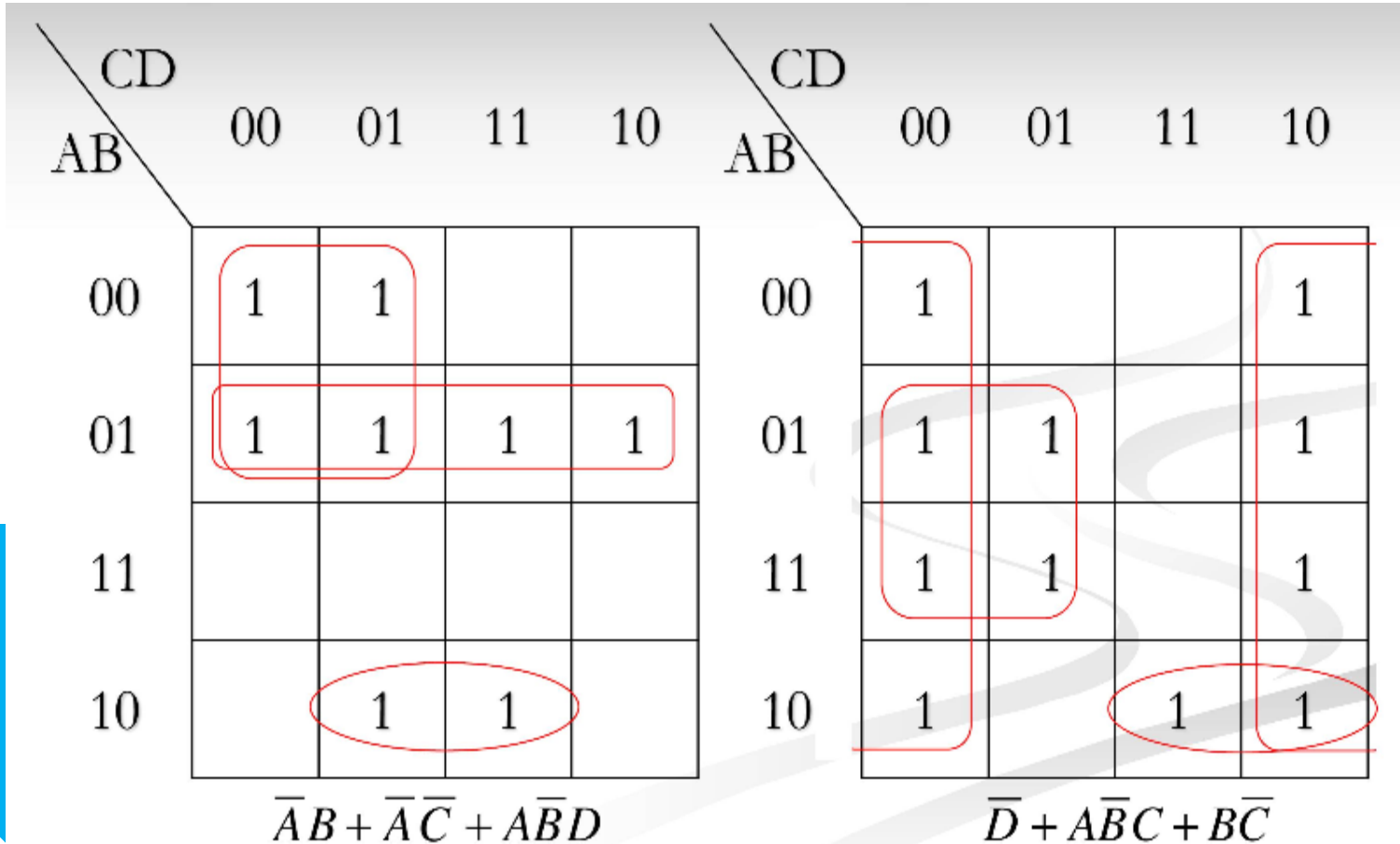
Determine the minimum product term for each group.

- For a 3-variable map:
 1. A 1-cell group yields a 3-variable product term
 2. A 2-cell group yields a 2-variable product term
 3. A 4-cell group yields a 1-variable product term
 4. An 8-cell group yields a value of 1 for the expression.
- For a 4-variable map:
 1. A 1-cell group yields a 4-variable product term
 2. A 2-cell group yields a 3-variable product term
 3. A 4-cell group yields a 2-variable product term
 4. An 8-cell group yields a a 1-variable product term
 5. A 16-cell group yields a value of 1 for the expression.

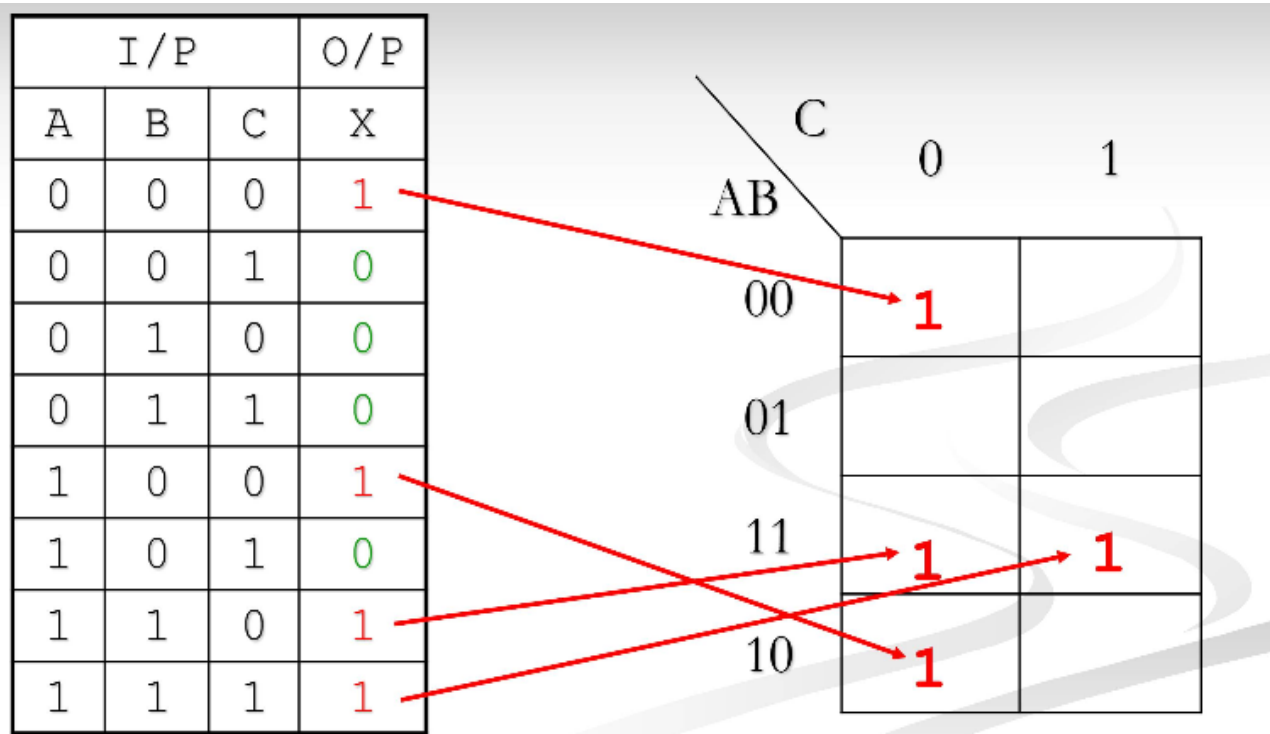








Mapping Directly from a Truth Table





Don't care condition



- Sometimes a situation arises in which some input variable combinations are not allowed, i.e. BCD code:
 - There are six invalid combinations: 1010, 1011, 1100, 1101, 1110, and 1111.
- Since these unallowed states will never occur in an application involving the BCD code → they can be treated as “don't care” terms with respect to their effect on the output.
- The “don't care” terms can be used to advantage on the K-map (how? see the next slide).



Don't care condition-Assessment

INPUTS				O/P
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	X
1	0	1	1	X
1	1	0	0	X
1	1	0	1	X
1	1	1	0	X
1	1	1	1	X

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

Without "don't care"
 $Y = \overline{A}B\overline{C} + \overline{A}BCD$

With "don't care"
 $Y = A + BCD$



