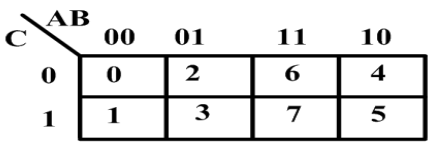
Boolean function simplification using k-map

• gray code is used to numbers the rows and columns of a k-map. Consider a 3-variable k-map.



C \ AB	00	01	11	10
0	0	2	6	4
1	1	3	7	5

Box numbers are entered in the boxes

• A box which can not be combined with any other box is circled as a single box combination

• 2-box combinations for box-0

i. 0-2 (physically touching horizontally)

ii. 0-1 (,, ,, vertically as well as mirror image)

iii. 0-4 (Mirror image)

For box -6

i. 6-4 (physically touching horizontally)

ii. 6-2 (,, ,, ,, as well as mirror image)

iii. 6-7 (,, ,, vertically)

• 4 box combination for box-0

i. 0-2-1-3 [1-3 is mirror image of 0-2]

ii. 0-2-6-4 [6-4 ,, ,, ,, ,,]

iii. 0-1-4-5 [4-5 ,, ,, ,, 0-1]

For box -6

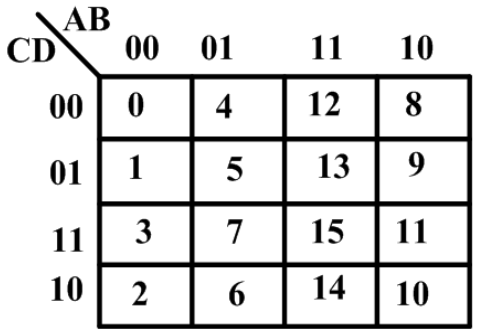
i. 6-4-7-5

ii. 6-2-3-7

iii. 6-4-2-0

- Only one 8-box combination 0-1-2-3-4-5-6-7

4- variable k-map



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

- A box which con not be combined with any other box is considered as single –box combination.
- 2-box combinations

	For box 0	For box-7
i.	0-4	7-15
ii.	0-1	7-5
iii.	0-8	7-6
iv.	0-2	7-3

4-box combinations

For box-0	for box-7
(1) 0-4-2-6	(1) 7-15-6-14
(2) 0-1-8-9	(2) 7-15-11-3
(3) 0-8-2-10	(3) 7-15-5-13
(4) 0-4-1-5	(4) 7-6-5-4
(5) 0-4-12-8	(5) 7-3-15-11
(6) 0-1-3-2	(6) 7-3-1-5

- 8-box combinations

For box-0	For box-7
(1) 0-4-12-8-1-5-13-9	(1) 7-3-15-11-2-6-14-10
(2) 0-4-12-8-2-6-14-10	(2) 7-5-6-4-0-1-2-3
(3) 0-4-1-5-3-7-2-6	(3) 7-3-15-11-1-5-13-9
(4) 0-1-3-2-8-9-11-10	(4) 7-4-5-6-12-13-14-15

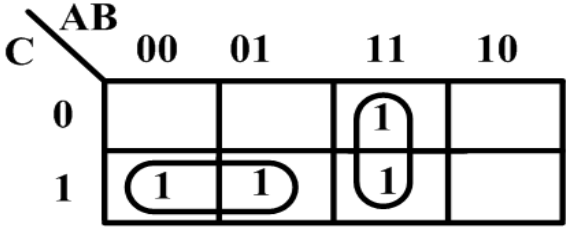
- only one 16-box combination

Ex:- Simplify the following Boolean function using k-map

F(A,B,C) $= AB + \bar{A}C + BC$

$= \sum m(1, 3, 6, 7)$

Sol:-



Grouping rules:

i. All single box combinations

ii. 2-box single way combination

iii. 4-box ,, ,, ,,

iv. 8-box ,, ,, ,,

v. 16-box ,, ,, ,,

vi. If any minterms are left, combine those minterms with max possible number of boxes.

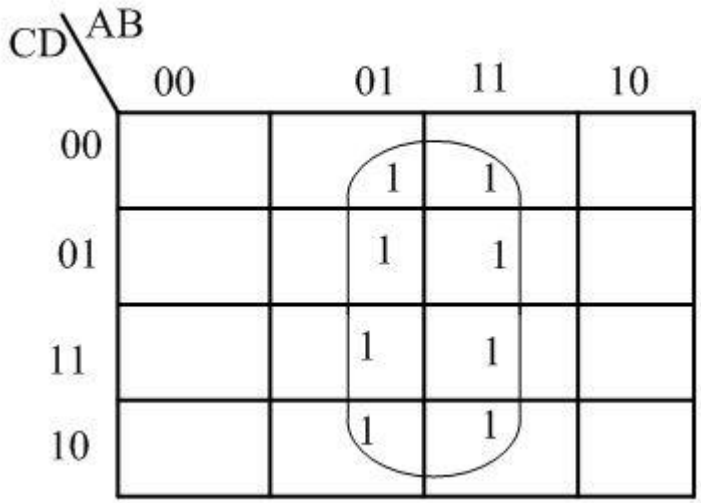
$\therefore$ The simplified Boolean expression $f(A, B, C) = AB + \bar{A}C$

Ex. : Simplify the following Boolean functions using k-map.

$f(A,B,C,D)=AB\overline{C}+BCD+B$

Sol. The given Boolean function can be expressed as sum of minterms as follows:

$$\therefore\ f(A,B,C,D)=\sum m(4,5,6,7,12,13,14,15)$$



$\therefore$ The simplified Boolean expression $f(A,B,C,D)=B$