SIMPLIFICATION OF LOGICAL FUNCTION USING KARNAUGH MAP (K-MAP):

Karnaugh Map (k-map) Introduction

- A Boolean expression may have many different forms.
- With the use of K-map, the complexity of reducing expression becomes easy and Boolean expression obtained is simplified.
- K-map also be said as **pictorial form** of truth table.
- K-map is alternative way of simplifying logic circuits.
- Instead of using Boolean algebra simplification techniques, you can transfer logic values from a Boolean statement or a truth table into a Karnaugh map (k-map)
- Tool for representing Boolean functions of up to six variables.
- K-maps are tables of rows and columns with entries represent 1's or 0's of SOP and POS representations.

- K-map cells are arranged such that adjacent cells correspond to truth rows that differ in only one bit position (*logical adjacency*)
- K-Map are often used to simplify logic problems with up to 6 variables
- ***No. of Cells = 2^n, where n is a number of variables.***

- The Karnaugh map is completed by entering a '1' (or '0') in each of the appropriate cells.
- Within the map, adjacent cells containing 1's (or 0's) are grouped together in twos, fours, or eights and so on.

2 variable k-map

- For 2 variable k-map, there are $2^2 = 4$ input combinations.
- If A & B are two variables then;

SOP → Minterms → A'B' (m_0, 00) ; A'B (m_1, 01) ; AB' (m_2, 10) ; AB (m_3, 11)
POS → Maxterms → A + B (M_0, 00) ; A + B' (M_1, 01) ; A' + B (M_2, 10) ; A' + B' (M_3, 11)

➢ ***Mapping of SOP Expression:***

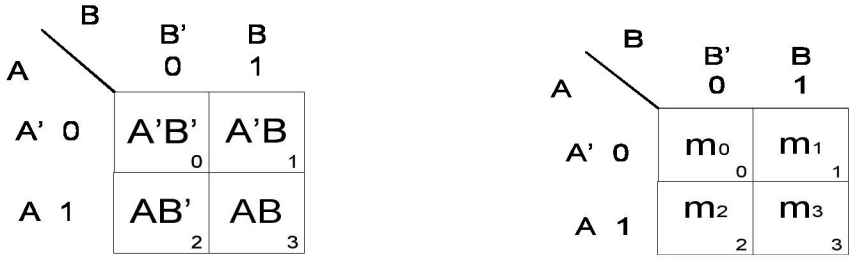
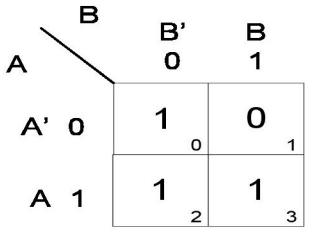
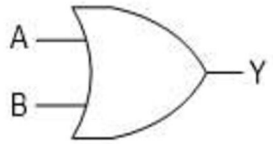


Fig.: Mapping of SOP form for two variable K-Map

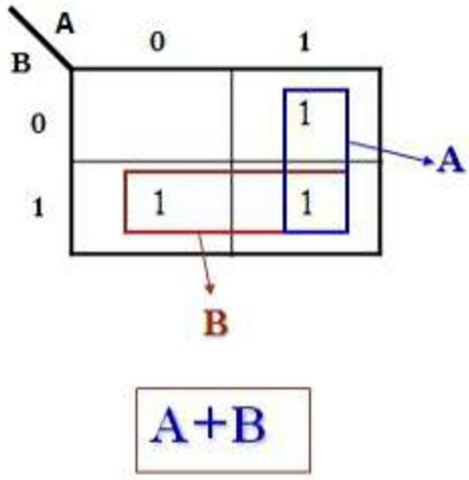
- 1 in a cell indicates that the minterm is included in Boolean expression.
- For e.g. if F = ∑m (0, 2, 3), then 1 is put in cell no. 0, 2, 3 as shown below.



Ex. : Map for a 2-input OR gate.

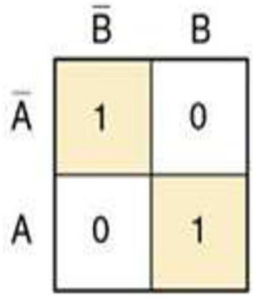


A	B	X
0	0	0
0	1	1
1	0	1
1	1	1



Ex. : Map for a 2-input EX-OR gate.

A	B	X
0	0	1 → $\bar{A}\bar{B}$
0	1	0
1	0	0
1	1	1 → AB

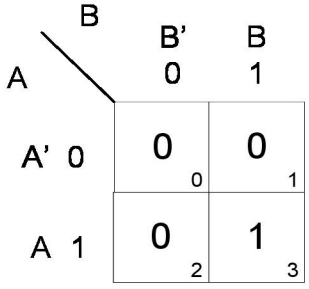


F = A'B' + AB

➢ ***Map following SOP expressions:***

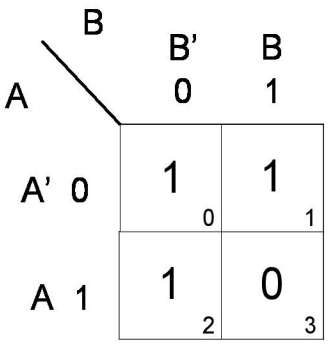
Ex. : F = AB

Solution:



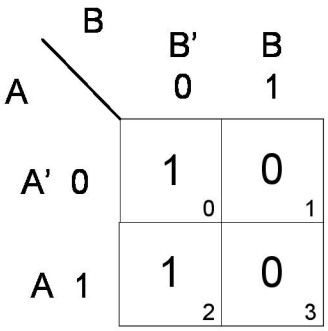
Ex. : F = AB' + A'B +A'B'

Solution:



Ex. : F (A, B) = ∑ (0, 2)

Solution:



Ex. : F = m_0 + m_1

Solution: