Introduction of K-Map

Karnaugh Map(K-Map) method

The **K-map** is a systematic way of simplifying Boolean expressions. With the help of the K-map method, we can find the simplest POS and SOP expression, which is known as the minimum expression. The K-map provides a cookbook for simplification.

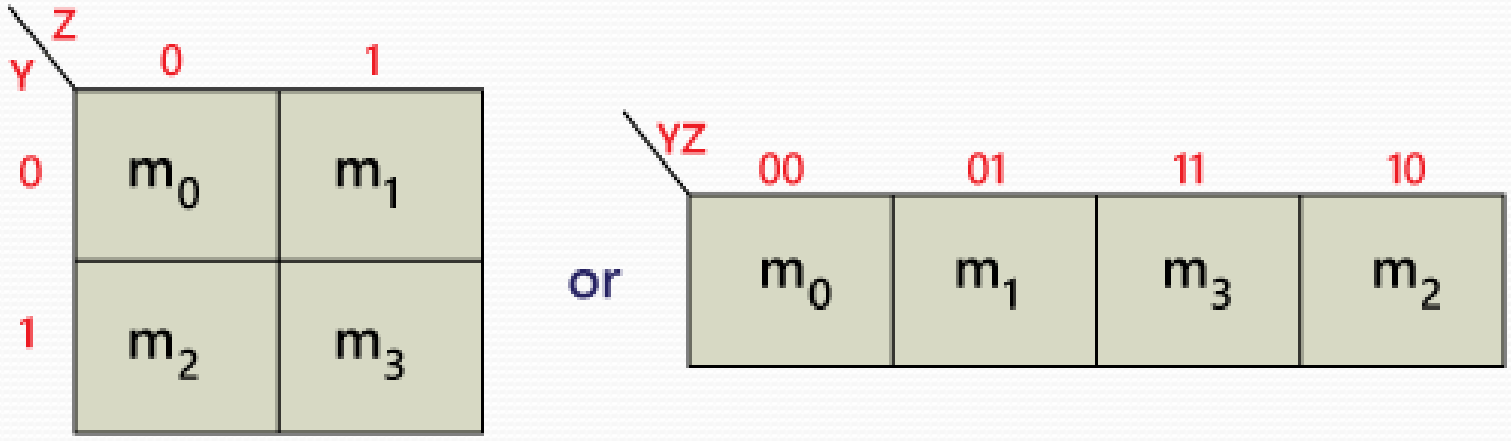
Just like the truth table, a K-map contains all the possible values of input variables and their corresponding output values. However, in K-map, the values are stored in cells of the array. In each cell, a binary value of each input variable is stored.

The K-map takes the SOP and POS forms. The K-map grid is filled using 0's and 1's. The K-map is solved by making groups. There are the following steps used to solve the expressions using K-map:

- First, we find the K-map as per the number of variables.
- Find the maxterm and minterm in the given expression.
- Fill cells of K-map for SOP with 1 respective to the minterms.
- Fill cells of the block for POS with 0 respective to the maxterm.
- Next, we create rectangular groups that contain total terms in the power of two like 2, 4, 8, ... and try to cover as many elements as we can in one group.
- With the help of these groups, we find the product terms and sum them up for the SOP form.

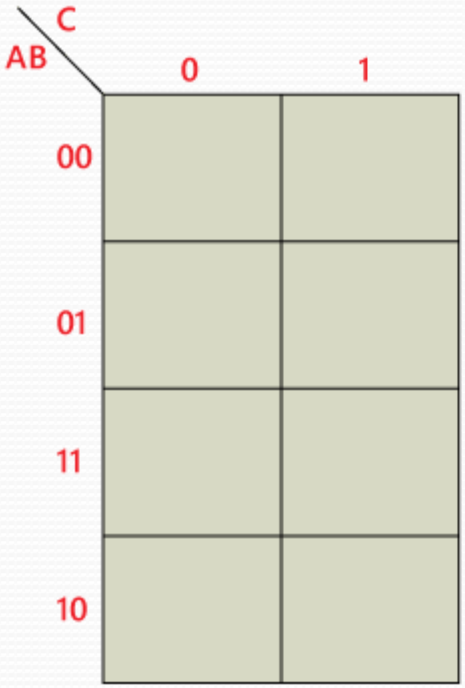
2 Variable K-map

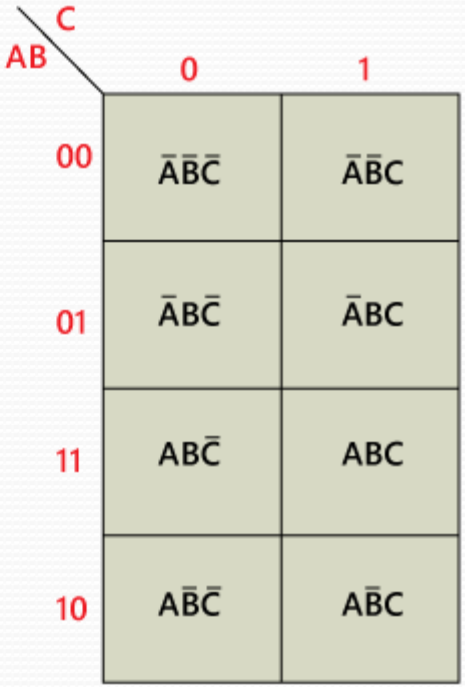
There is a total of 4 variables in a 2-variable K-map. There are two variables in the 2-variable K-map. The following figure shows the structure of the 2-variable K-map:



3-variable K-map

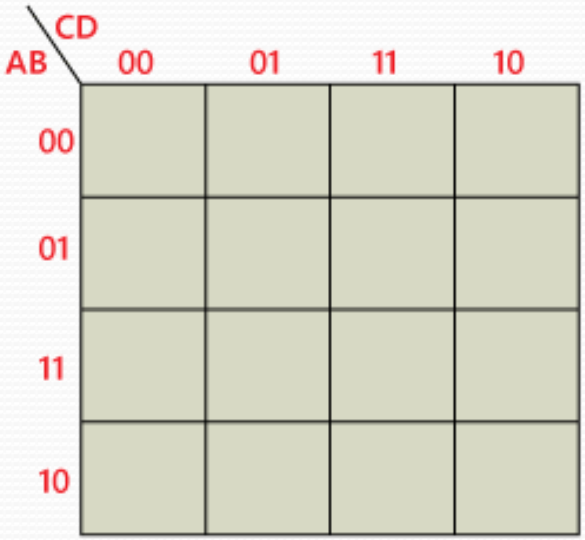
- The 3-variable K-map is represented as an array of eight cells. In this case, we used A, B, and C for the variable. We can use any letter for the names of the variables. The binary values of variables A and B are along the left side, and the values of C are across the top.

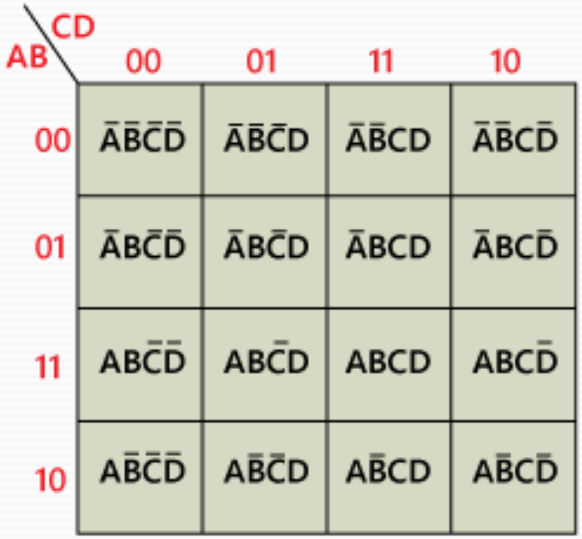




4-Variable Karnaugh Map

- The 4-variable K-map is represented as an array of 16 cells. Binary values of A and B are along the left side, and the values of C and D are across the top. The value of the given cell is the binary values of A and B at left side in the same row combined with the binary values of C and D at the top in the same column.





PROBLEMS BASED ON KARNAUGH MAP

- Minimize the following boolean function-
- $F(A, B, C, D) = \Sigma m(0, 1, 3, 5, 7, 8, 9, 11, 13, 15)$

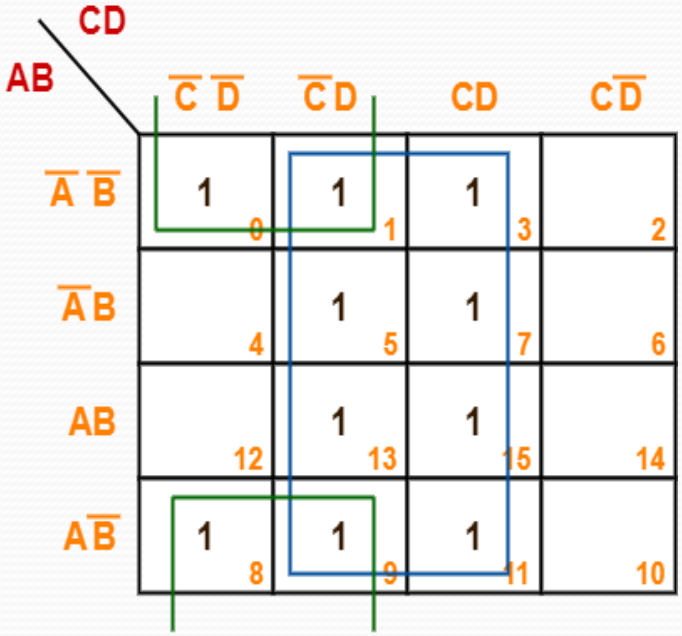
Solution-

- Since the given boolean expression has 4 variables, so we draw a 4 x 4 K Map.
- We fill the cells of K Map in accordance with the given boolean function.
- Then, we form the groups in accordance with the above rules.

F(A, B, C, D)

= (A'B' + A'B + AB + AB')(C'D + CD) + (A'B' + AB')(C'D' + C'D)

= D + B'C'



Thus, minimized boolean expression is-

F(A, B, C, D) = B'C' + D