Al-Mustaqbal University
College of Science
Artificial Intelligence Sciences Department

The Karnauph Map

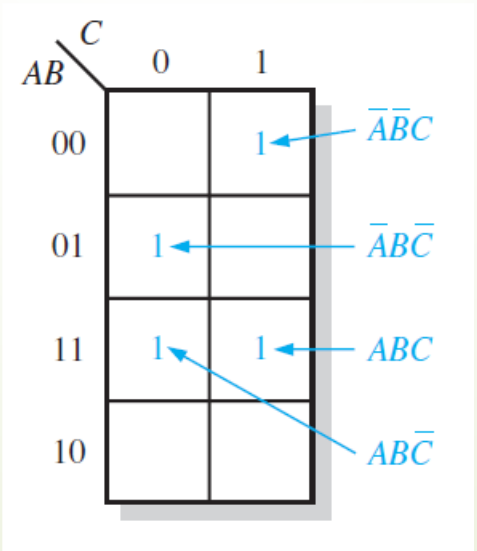
Lec.9

Ass.Lec. Fatima Ayad

The Karnaugh Map (K-Map)

A Karnaugh 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**.

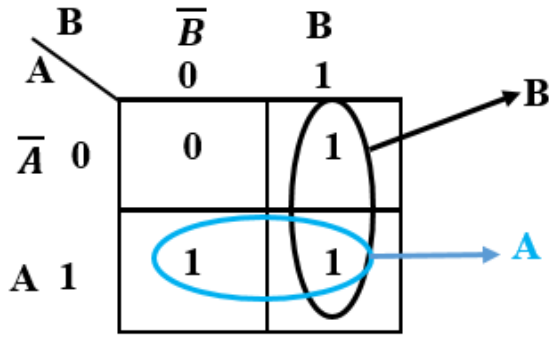
- The number of cells in a Karnaugh map, as well as the number of rows in a truth table, is equal to the total number of possible input variable combinations. For three variables, the number of cells is $2^3 = 8$. For four variables, the number of cells is $2^4 = 16$.



- **EXAMPLE :** Using the Karnauph Map, find the simplified Boolean expression for the truth table given below?

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Solution: $Y = \overline{A}\,B + A\,\overline{B} + A\,B$, The K-Map:



The simplified Boolean expression: **Y=A+B**

- **EXAMPLE :** Map the following SOP expression on a Karnaugh map:

$$\overline{A} + A\overline{B} + AB\overline{C}.$$

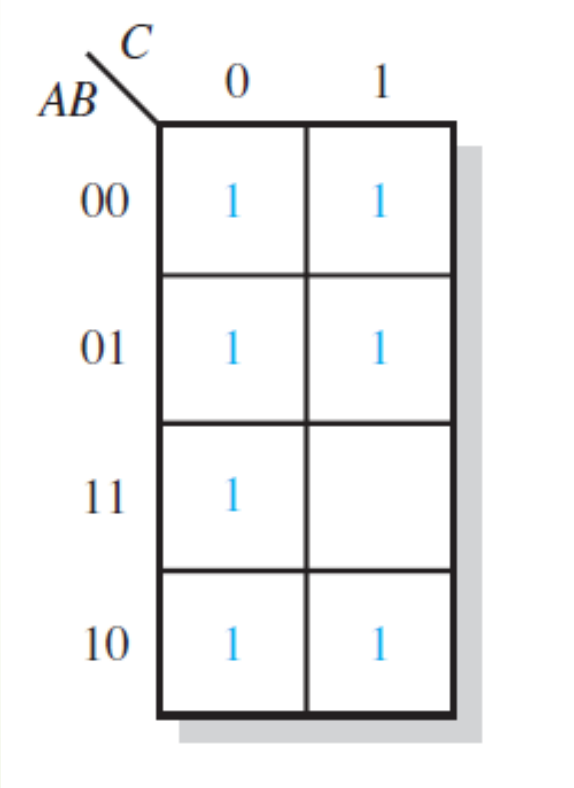
- **Solution:** $\overline{A} + A\overline{B} + AB\overline{C}$

000 **100** **110**

001 **101**

010

011

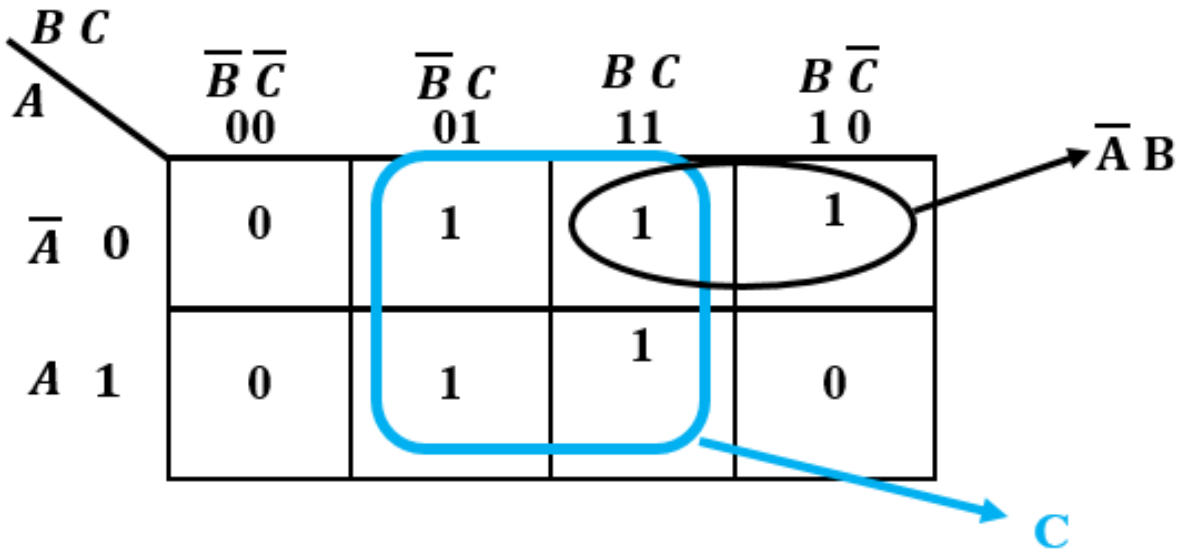


- **EXAMPLE :** Using the Karnauph Map, find the simplified Boolean expression for the logic expression: $\mathbf{Y = \sum(1, 2, 3, 5, 7)}$

Solution: $\mathbf{Y = \overline{A}\,\overline{B}\,C + \overline{A}\,B\,\overline{C} + \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,C}$

001 010 011 101 111

The K-Map:



The simplified Boolean expression: $\mathbf{Y = C + \overline{A}\,B}$

- **EXAMPLE :** Simplify the following Boolean expression using K-Map:

$$Y = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A}\,\overline{B}\,C\,D + \overline{A}\,\overline{B}\,C\,\overline{D} + \overline{A}\,B\,\overline{C}\,\overline{D} + \overline{A}\,B\,C\,D + \overline{A}\,B\,C\,\overline{D} + A\,B\,\overline{C}\,\overline{D} + A\,B\,C\,\overline{D}$$

$$+ A\,\overline{B}\,\overline{C}\,\overline{D} + A\,\overline{B}\,C\,D + A\,\overline{B}\,C\,\overline{D}$$

Solution: The K-Map: