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ONLINE LEARNING

Digital Electronics (SKEE1223)

Karnaugh Maps

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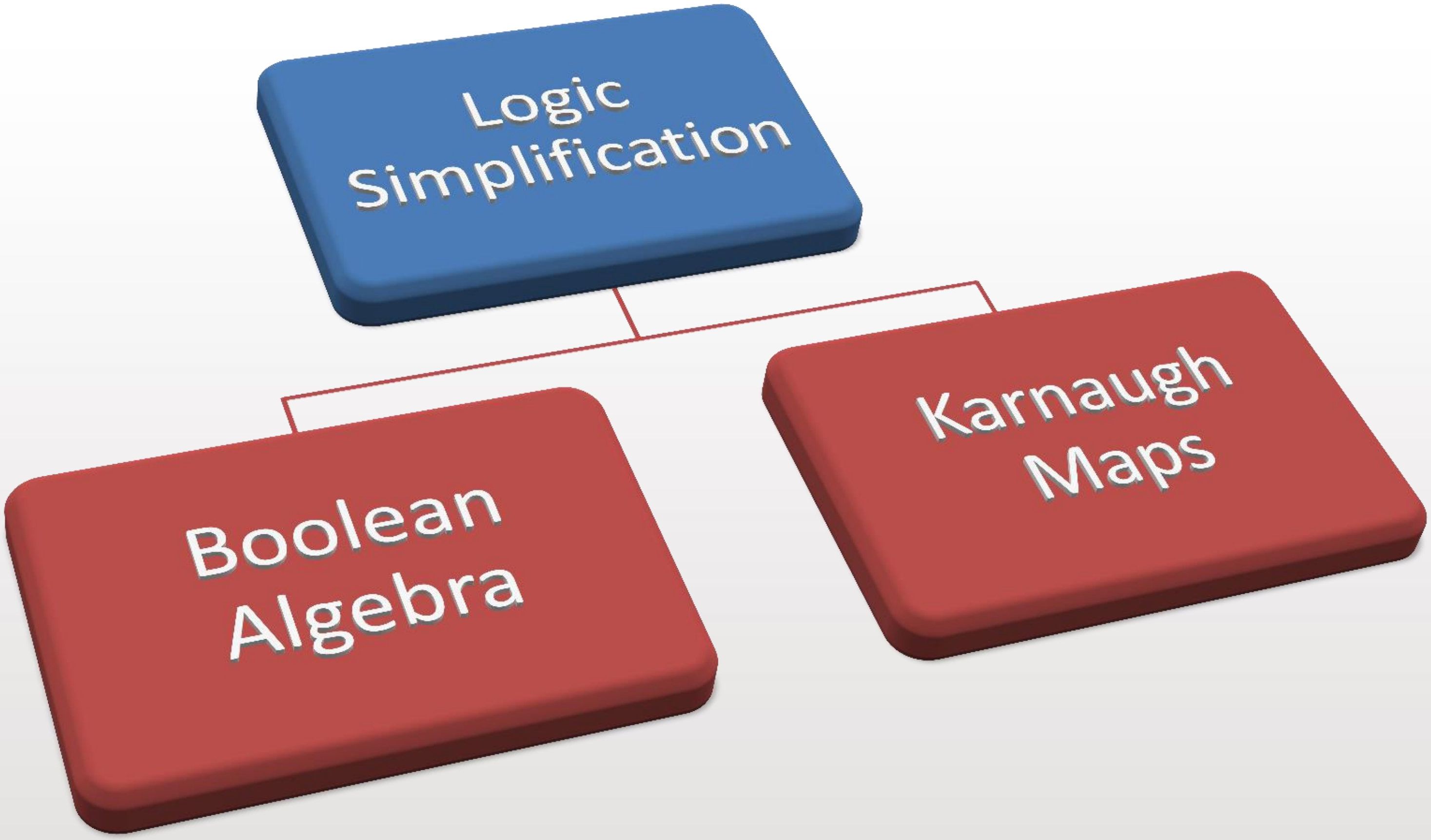
Introduction

- A logic circuit can be built using logic gates connected according to its Boolean function.
- This type of circuit is known as combinational logic circuit.
- The best design is the simplest circuit derived from the simplest Boolean expression.
- Simplifying a Boolean function allows us to remove redundant gates.

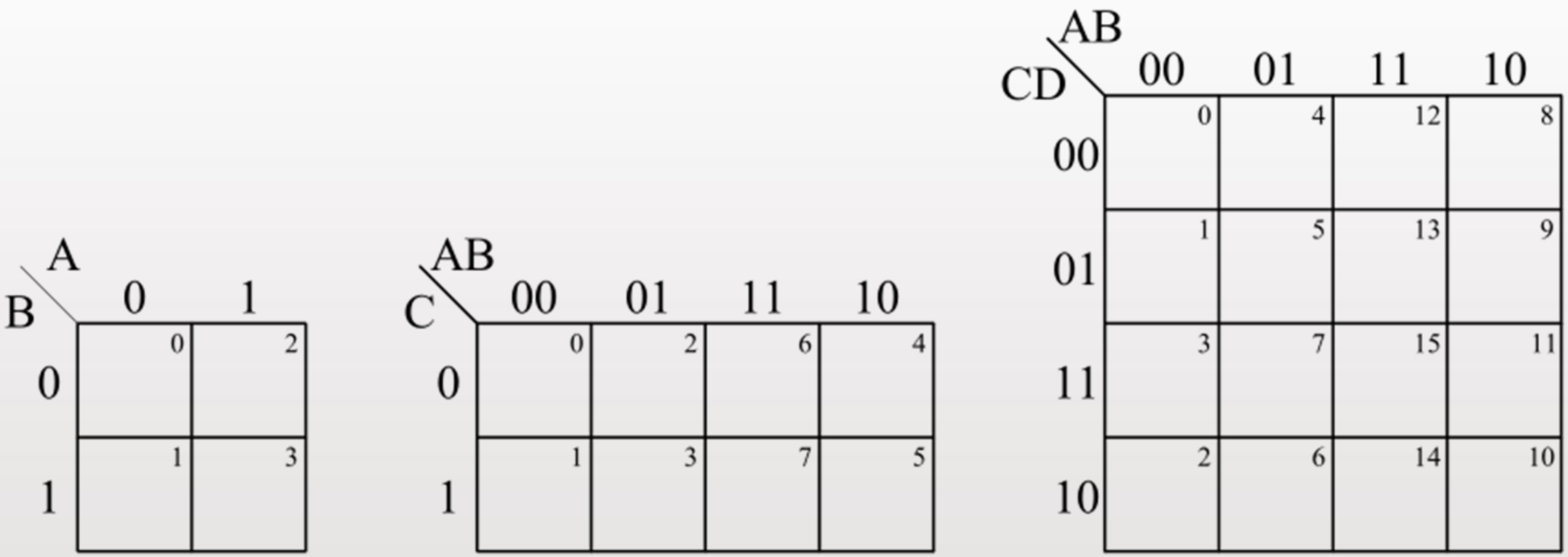

Logic Simplification
Boolean Algebra
Karnaugh Maps

Logic Simplification

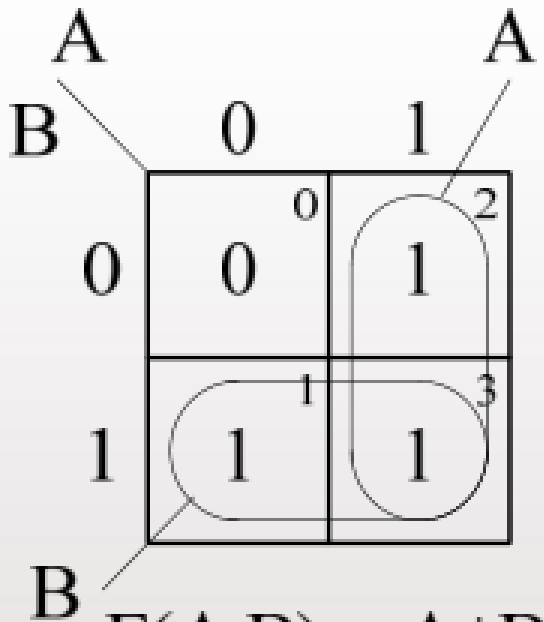
- Boolean Algebra
  - Not guaranteed to obtain simplest solution
- Karnaugh Maps
  - Introduced by Maurice Karnaugh
  - A graphical method of writing the truth table
  - Quickly simplify Boolean functions up to 6 variables

Karnaugh Maps for 2-4 Variables

- Number of cells = 2^n, where n = number of inputs



2-variable K-map



F(A,B) = A+B

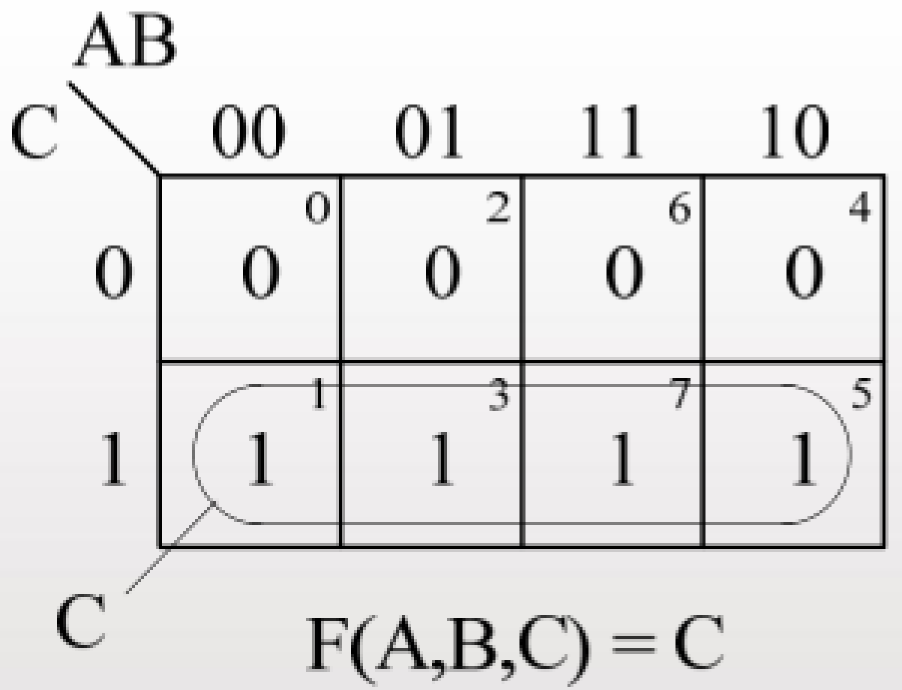
3-variable K-map

$B.\overline{C}$

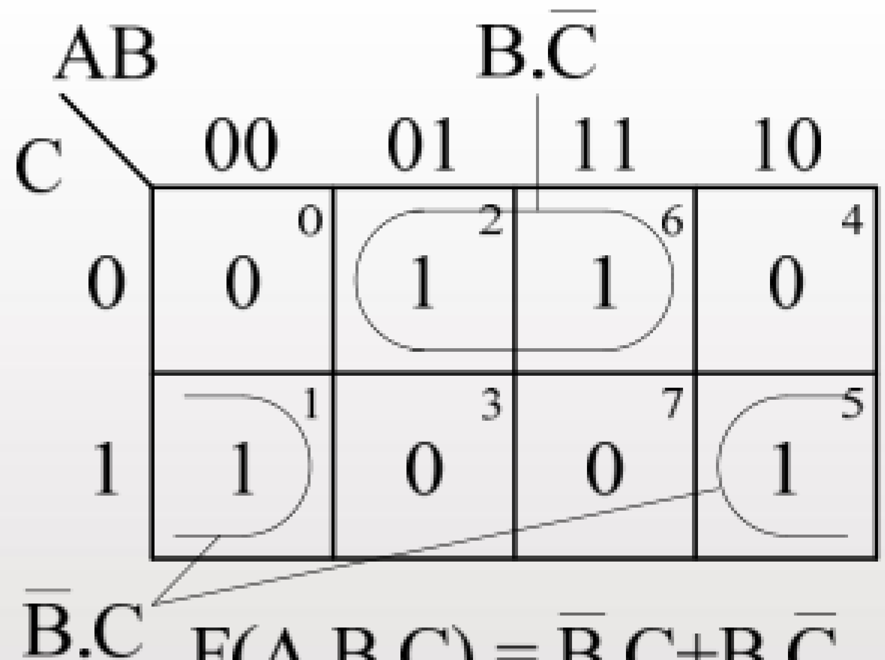
C \ AB	00	01	11	10
0	0 (0)	1 (2)	1 (6)	0 (4)
1	0 (1)	0 (3)	0 (7)	0 (5)

$$F(A,B,C) = B.\overline{C}$$

3-variable K-map

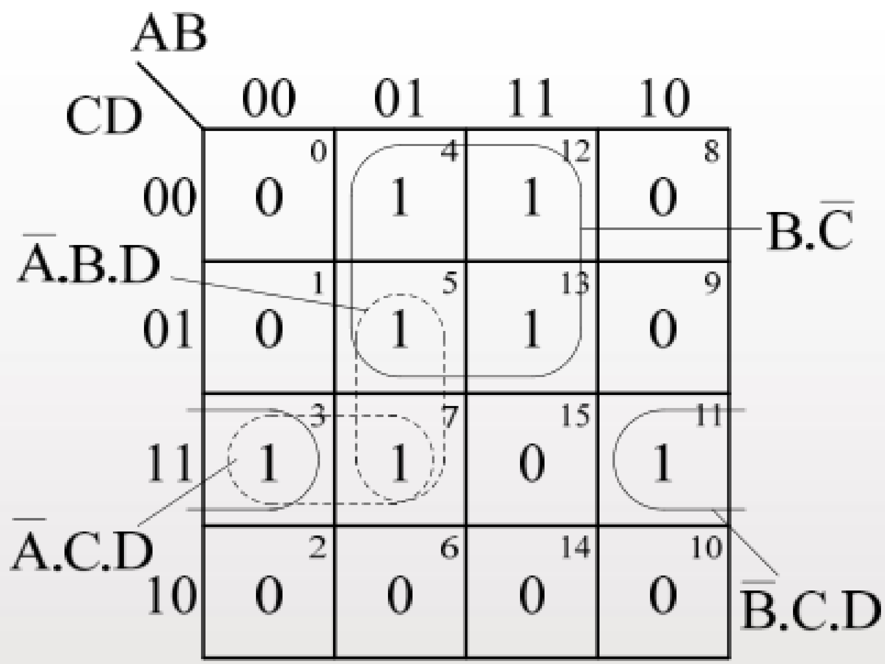


3-variable K-map



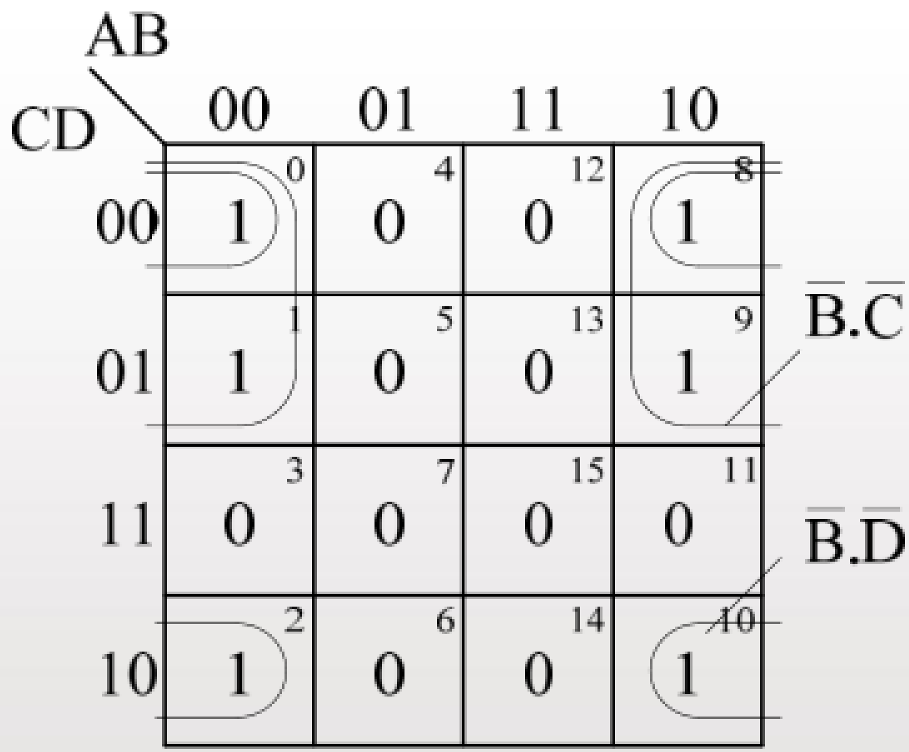
$$F(A,B,C) = \overline{B}.C + B.\overline{C}$$

4-variable K-map



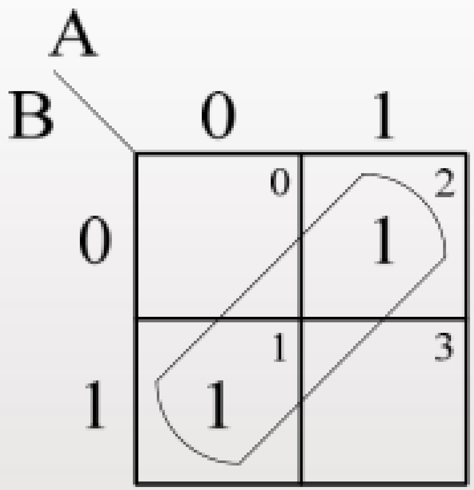
$$F(A,B,C,D) = B.\overline{C} + \overline{B}.C.D + \overline{A}.C.D$$
$$= B.\overline{C} + \overline{B}.C.D + \overline{A}.B.D$$

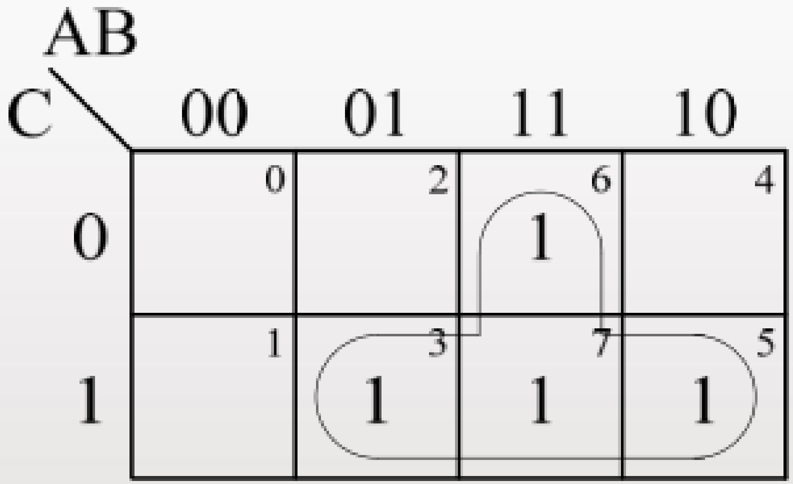
4-variable K-map



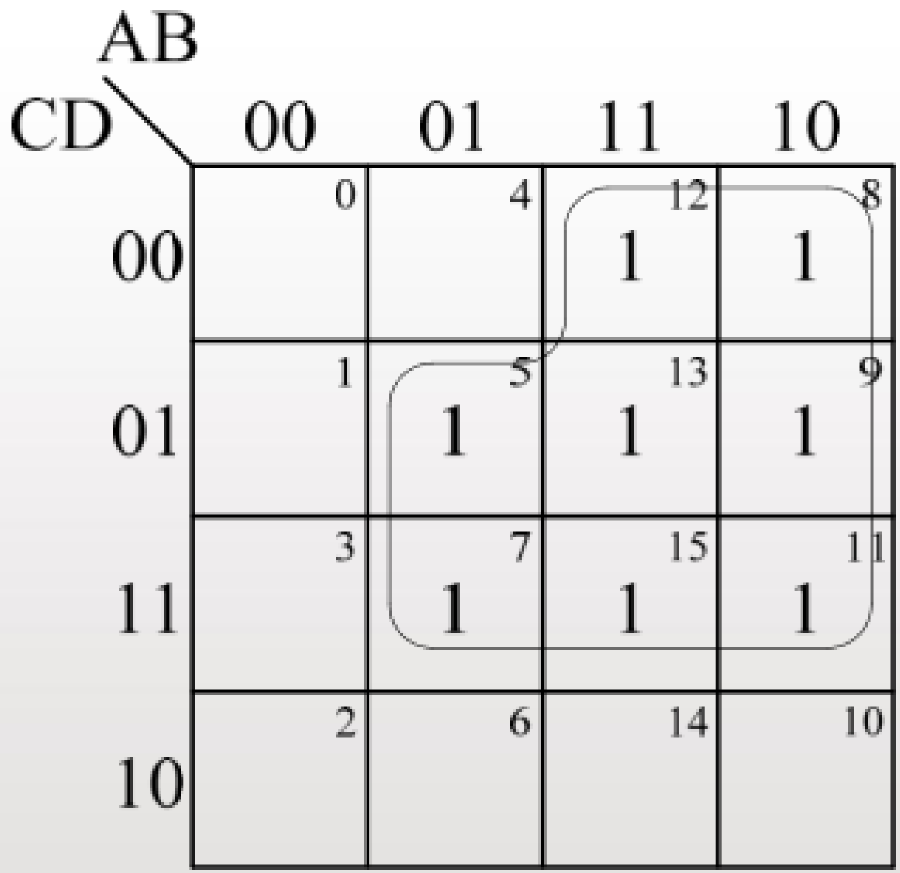
$$F(A,B,C,D) = \overline{B}.\overline{C} + \overline{B}.\overline{D}$$

Examples of Illegal Loops

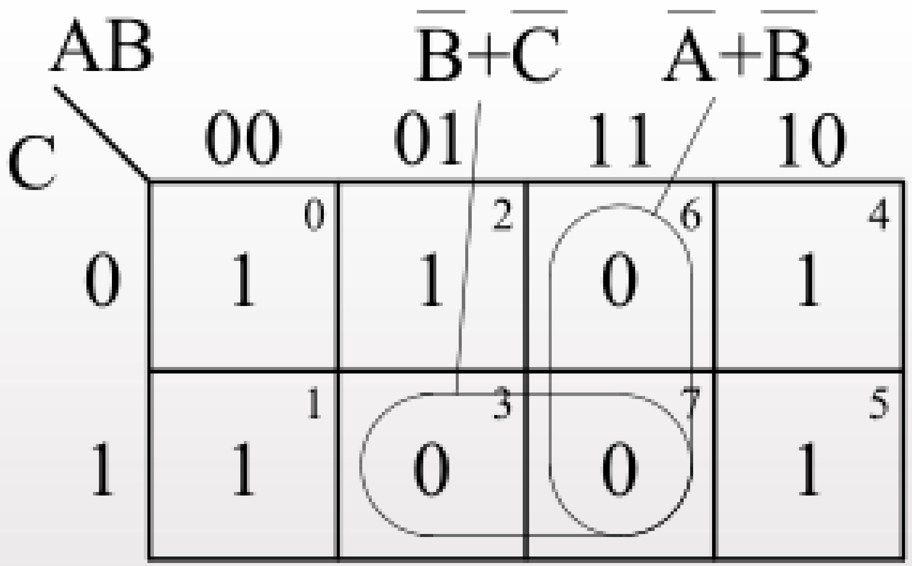




Examples of Illegal Loops

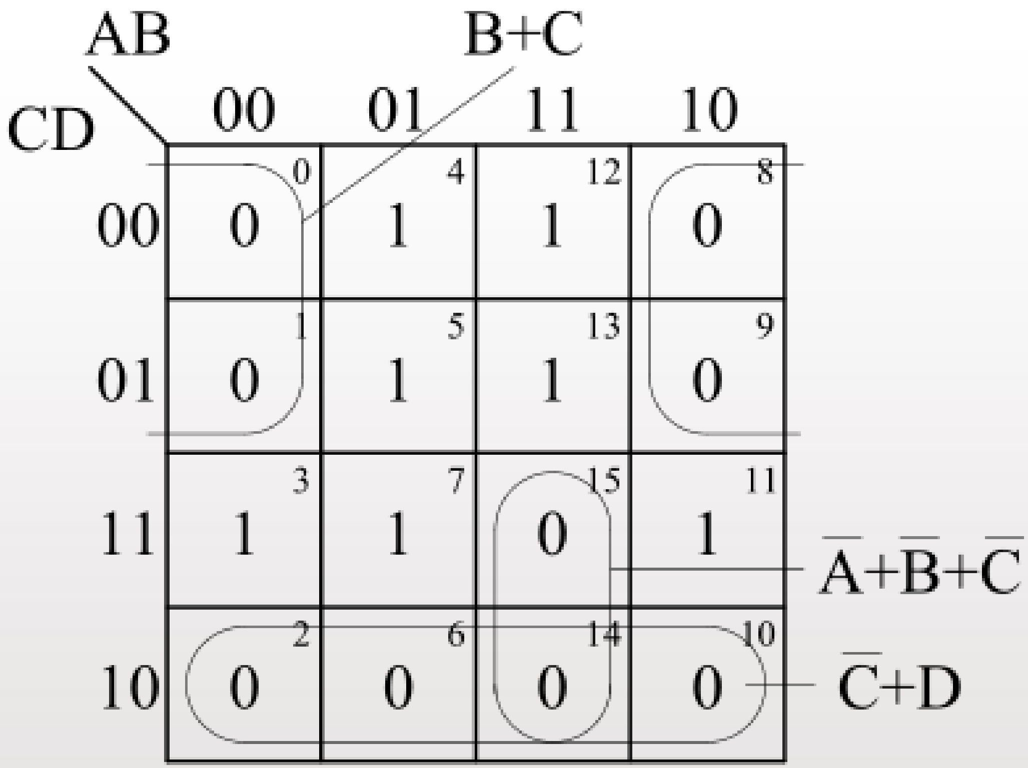


Looping 0's for POS Expressions



$$F(A,B,C) = (\overline{A}+\overline{B}).(\overline{B}+\overline{C})$$

Looping 0's for POS Expressions

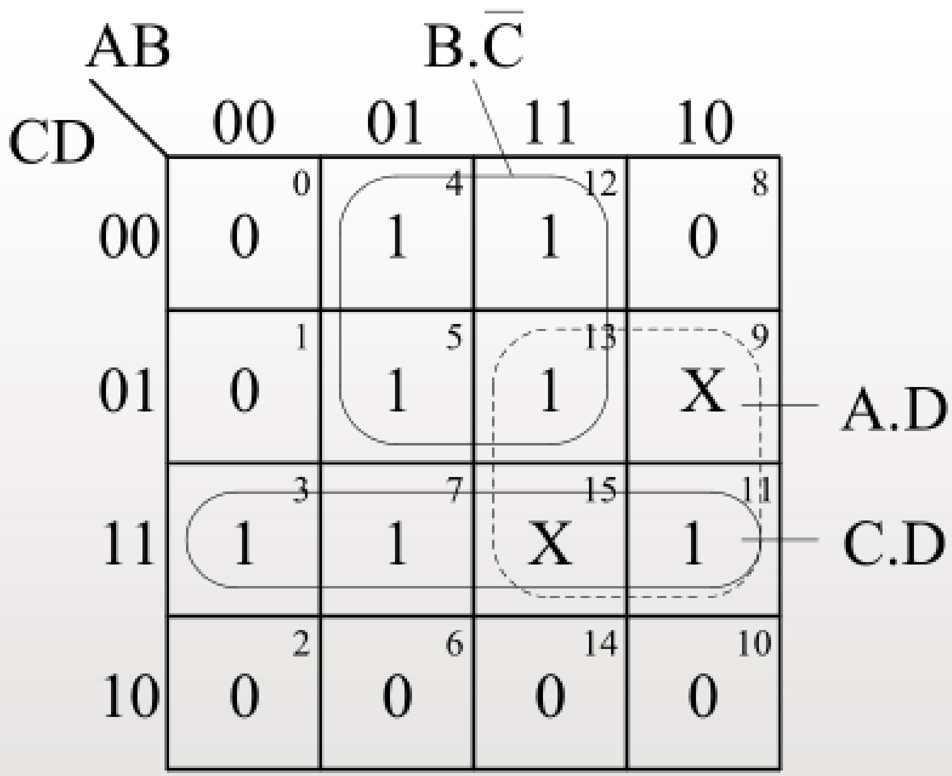


$$F(A,B,C,D) = (B+C).(\overline{C}+D).(\overline{A}+\overline{B}+\overline{C})$$

Don’t Care Conditions

- Certain input combinations do not exist or are not allowed.
- They are labelled as X in the K-map.
- X can be assumed to be either 0 or 1.
- Can be used to simplify Boolean function by forming larger loops of 1’s or 0’s.
- It is unnecessary to loop the unused “don't cares”

Don't Care Conditions



$$F(A,B,C,D) = B.\bar{C} + C.D$$