Karnaugh map

Lecture 5

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Introduction

- A **Karnaugh Map (K-map)** is a graphical method used to **simplify Boolean functions** by organizing all possible combinations of variables in a visual grid.
  It helps to **minimize logic expressions** without using complex algebraic steps, making digital circuit design more efficient.
  Each cell in the map represents a **minterm** (for SOP) or **maxterm** (for POS),.
- **In short:**
  K-maps make it easier to find simplified logic equations by grouping 1s or 0s in patterns of

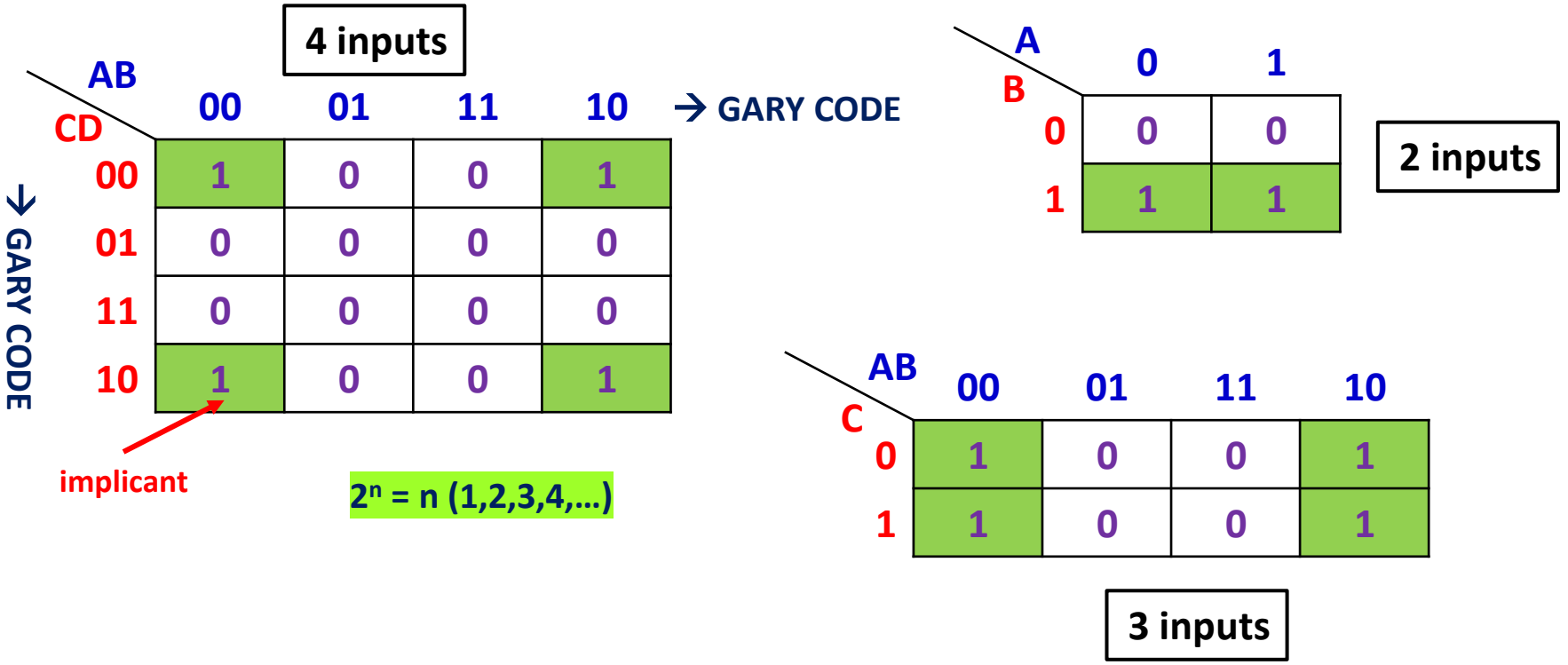
Why Simplification

- - To reduce the number of logic gates.
- - To simplify circuit design.
- - To save cost and power

K-map Layouts

- - 2-variable: 4 cells
- - 3-variable: 8 cells
- - 4-variable: 16 cells

Karnaugh map



Simplification Steps

- 1. Draw K-map
- 2. Fill cells with 1’s or 0
- 3. Group adjacent 1’s (1,2,4,8,…)
- 4. Write the simplified equation

Two Variables

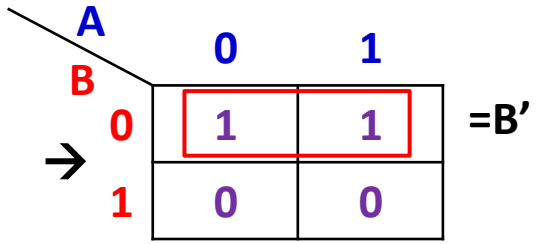
- Apply the Karnaugh map to the following table:

A.

A	B	F
0	0	1
0	1	0
1	0	1
1	1	0

→ 1. F= A'B' + AB'

→ $F(A,B) = \sum(0,2)$



F= B'

Two Variables

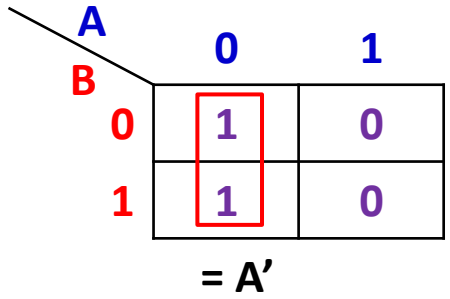
- Apply the Karnaugh map to the following table:

B.

A	B	F
0	0	1
0	1	1
1	0	0
1	1	0

→ 1. F= A'B' + A'B

$F(A,B) = \sum(0,1)$



= A'

F= A'

Three Variables

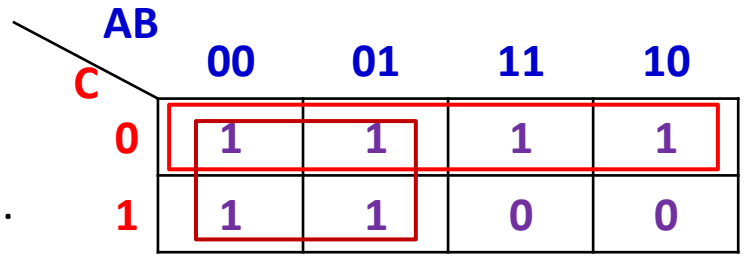
- Apply the Karnaugh map to the following table:

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

→ 1.F=A'B'C'+A'B'C+A'BC'+A'BC+AB'C'+ABC' →

2. $F(A,B,C) = \sum(0,1,2,3,4,6)$

3.



F= A' +C'

four Variables

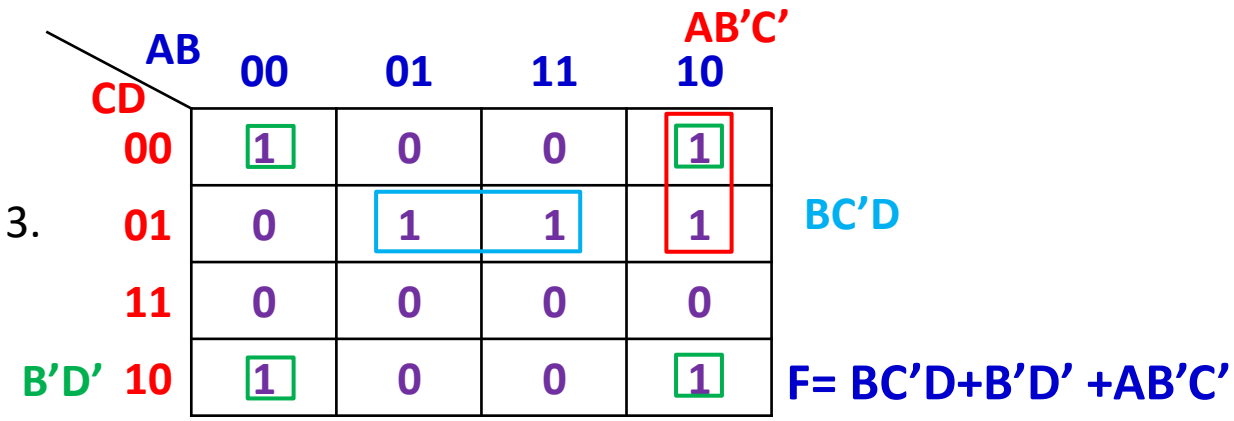
Apply the Karnaugh map to the following table: ➢

A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

1.F=A'B'C'D'+A'B'CD'+A'BC'D+AB'C'D' +AB'C'D
+AB'CD' + ABC'D

→ 2. $F(A,B,C,D) = \sum m(0,2,5,8,9,10,13)$

3.



Exercise

- Apply the Karnaugh map to the following table:

A	B	F
0	0	1
0	1	0
1	0	1
1	1	1

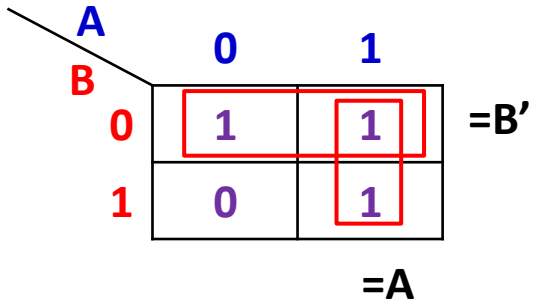
Answer

- Apply the Karnaugh map to the following table:

A	B	F
0	0	1
0	1	0
1	0	1
1	1	1

1. F= A'B' + AB' + AB

$$F(A,B) = \sum(0,2,3)$$



F= A'B' + AB' + AB= >A+B'

So F = A+B`