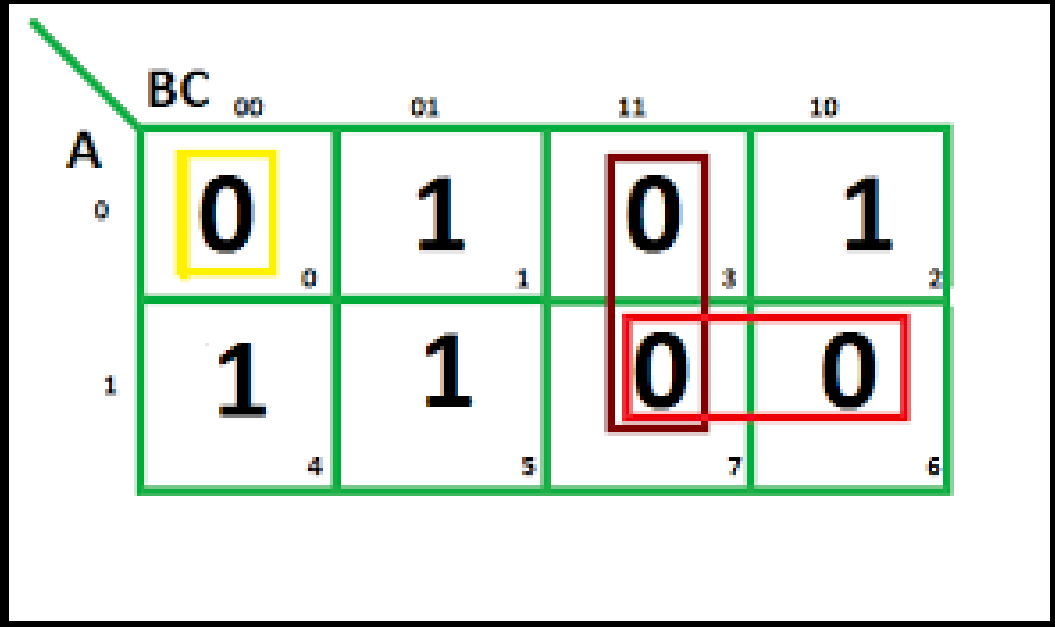
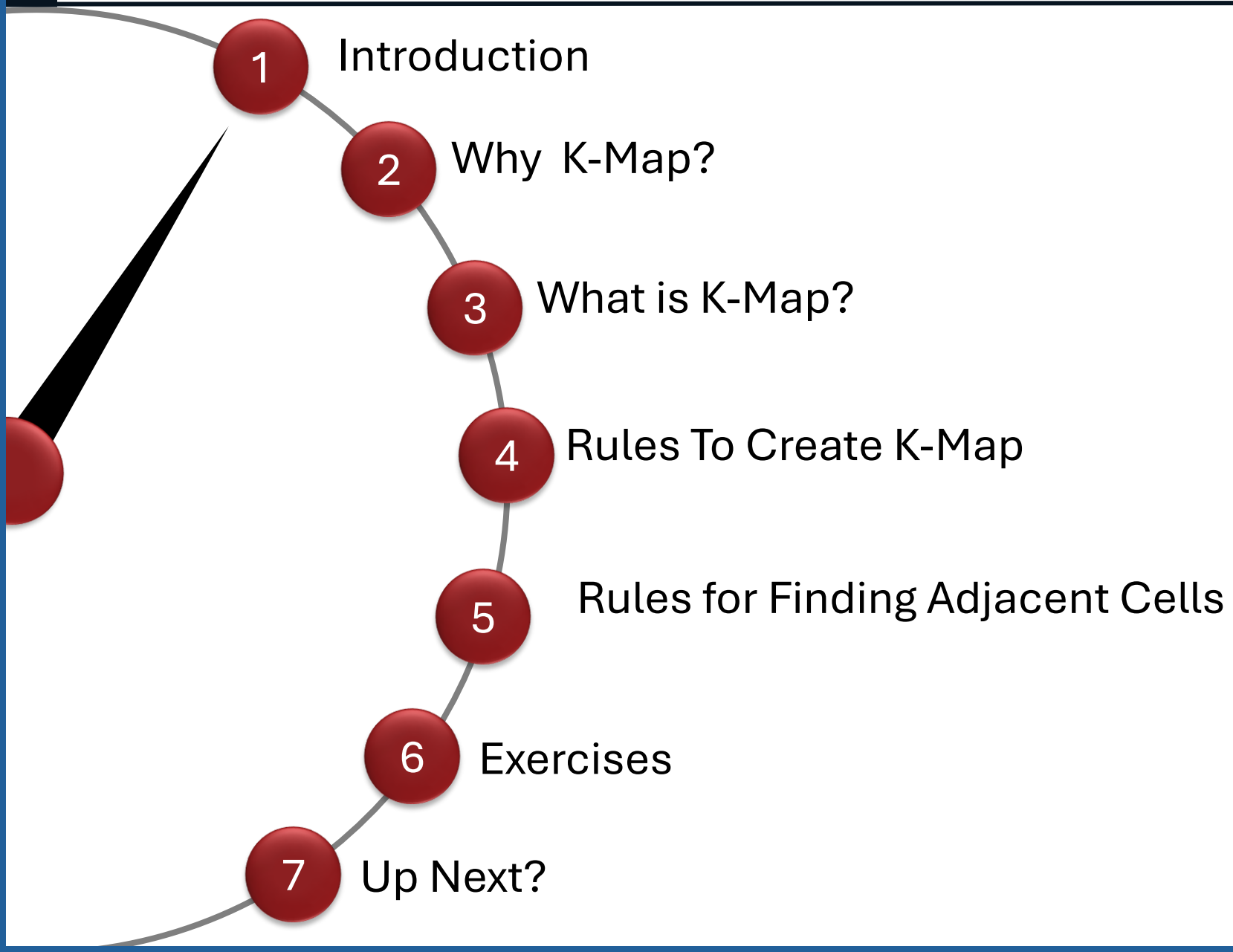
Dr. Kundan Kumar

K-Map



Session Agenda



Why K-Map?

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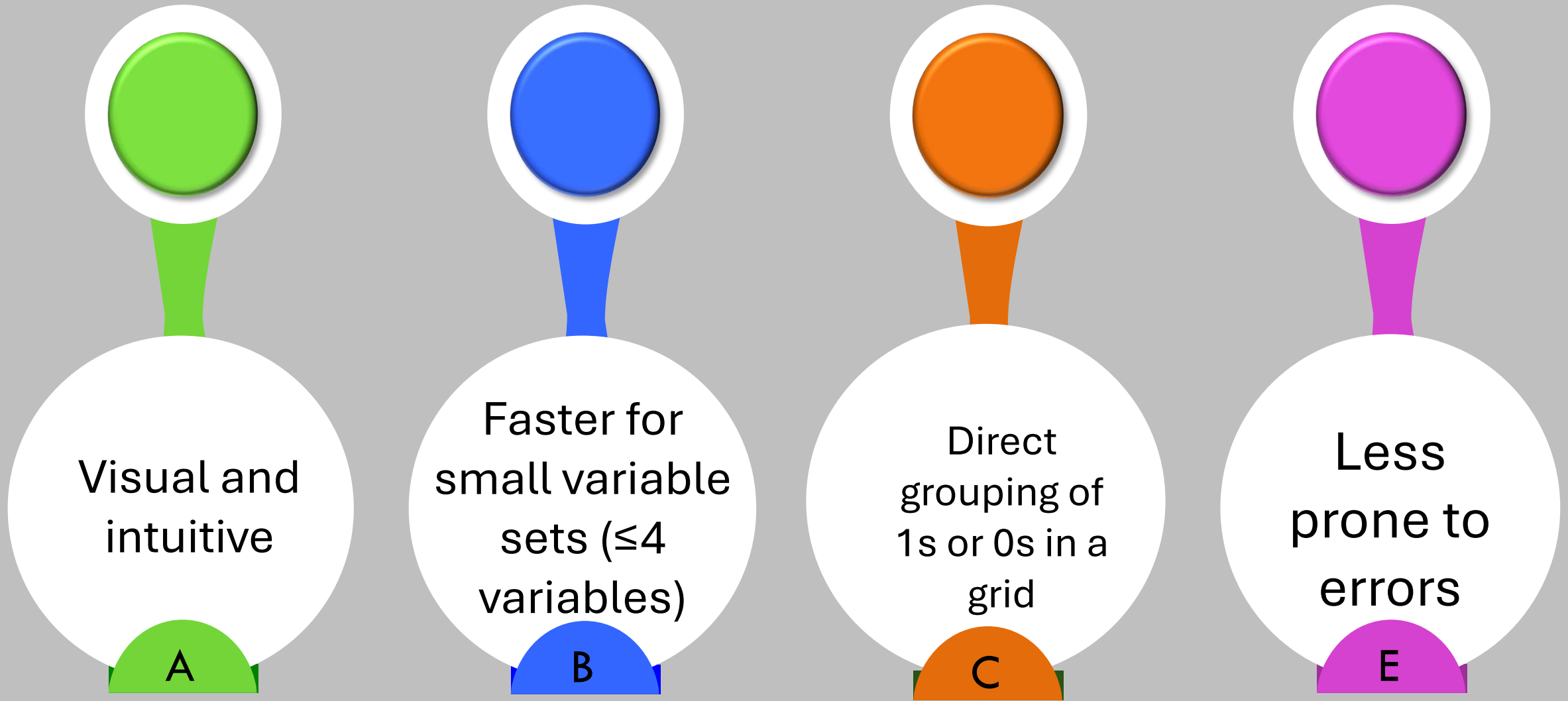
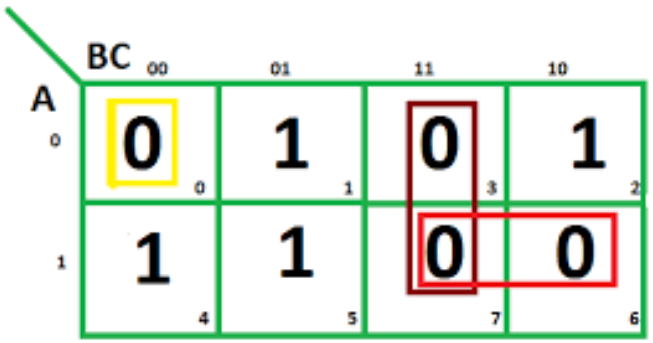

Visual and intuitive
A
Faster for small variable sets (≤4 variables)
B
Direct grouping of 1s or 0s in a grid
C
Less prone to errors
E

K-Map

K-Map

- A **Karnaugh Map (K-map)** is a visual method of simplifying Boolean expressions and logic circuits.
- It was introduced by Maurice Karnaugh in 1953 and is a more efficient way of minimizing expressions compared to Boolean algebra



Rules To Create K-Map

Rule to Create K-Map

1

Determine the number of variables (n):

- 2 variables → $2^2 = 4$ cells
- 3 variables → $2^3 = 8$ cells
- 4 variables → $2^4 = 16$ cells

2

Label rows and columns using Gray Code

Label rows and columns using **Gray Code** (only one-bit changes between adjacent cells). For example, 00, 01, 11, 10.

3

Fill in the values from the truth table.

Fill in the values from the truth table using the minterms (where the output is 1).

4

Group adjacent

- Group adjacent 1s into rectangles that follow the powers of 2 (1, 2, 4, 8…):
- Each group must contain 1, 2, 4, or 8 1s.
- The group must be rectangular (not diagonal).
- Groups can wrap around the edges (K-map is toroidal).

Rules for Finding Adjacent Cells

Rules for Finding Adjacent Cells

1) Cells are adjacent if their minterm numbers differ by only one bit.

2) Valid groups include:

    1) Single 1 (1-cell group)

    2) Pair (2-cell group)

    3) Quad (4-cell group)

    4) Octet (8-cell group, in a 4-variable map)

3) Wrapping around edges is allowed (top-to-bottom, left-to-right).

4) Corner cells are adjacent to each other diagonally if wrapping is applied.

Step-by-Step Process to Simplify a Boolean Expression Using K-Map (SOP Form)

Step-by-Step Process to Simplify a Boolean Expression Using K-Map (SOP)

STEP 1: Identify the Variables/Domain:

Determine the number of variables present in the given Boolean expression. These variables define the size of the K-Map (e.g., 2-variable, 3-variable, 4- variable).

STEP 2 : Draw and Label the K-Map:

Create the appropriate K-Map grid based on the number of variables and label the rows and columns using **Gray code** sequence to ensure adjacency.

STEP 3: Populate the K-Map with 1's:

Fill the K-Map cells with 1's based on the minterms present in the Boolean expression (for **Sum of Products (SOP)** form).

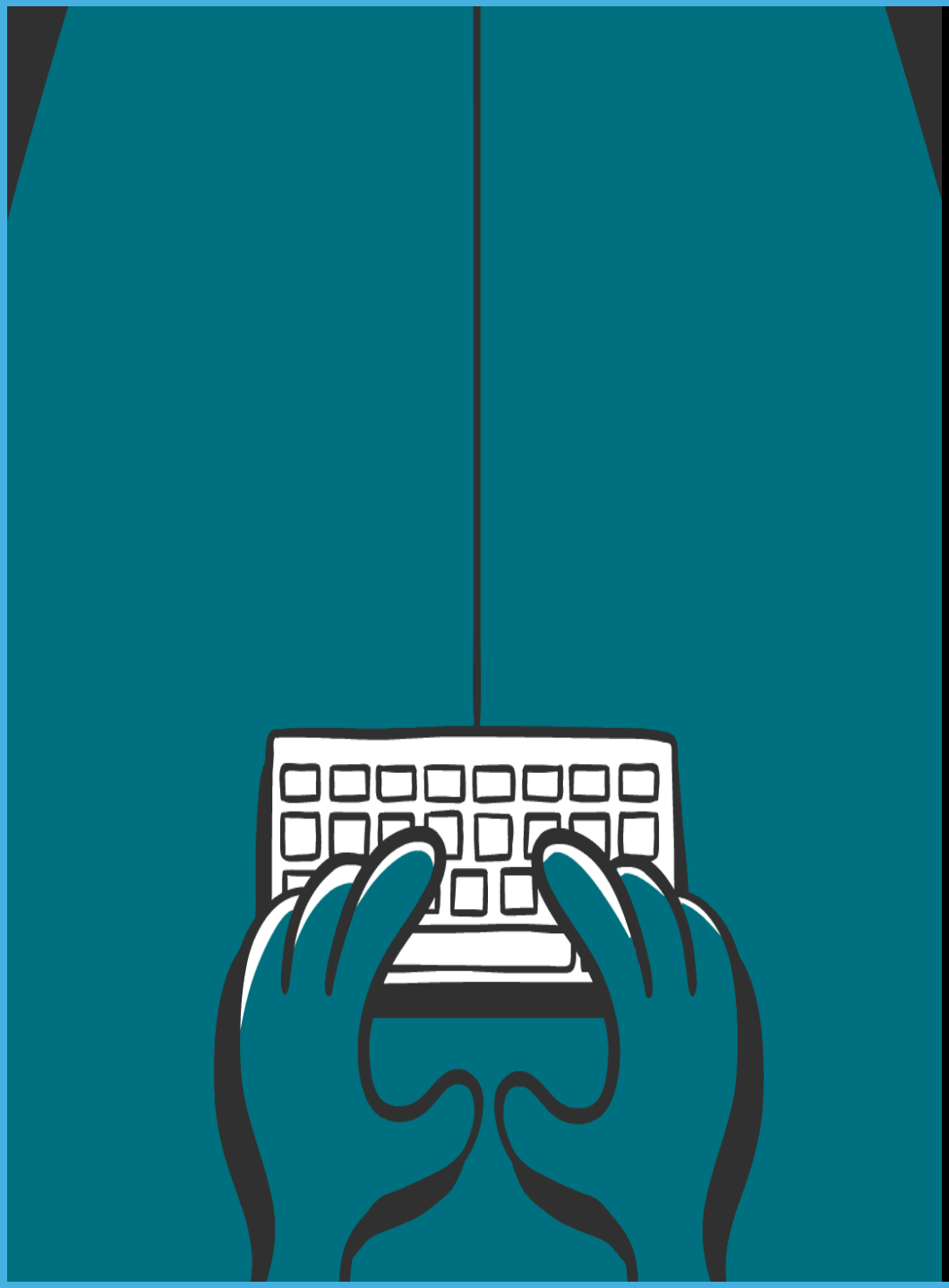
STEP 4: Group the Adjacent 1's:

Form groups of 1's in powers of two (1, 2, 4, 8, etc.). Groupings should be:

- As large as possible
- Rectangular
- Include only 1's
- Wrap around edges if necessary

Step 5: Derive the Simplified SOP Expression

For each group, write the simplified product term (minterm) by including only the variables that remain constant within the group. Finally, combine all simplified terms to form the **reduced SOP expression**.



Exercises

[Follow the exercises done during the live session]

Thank You