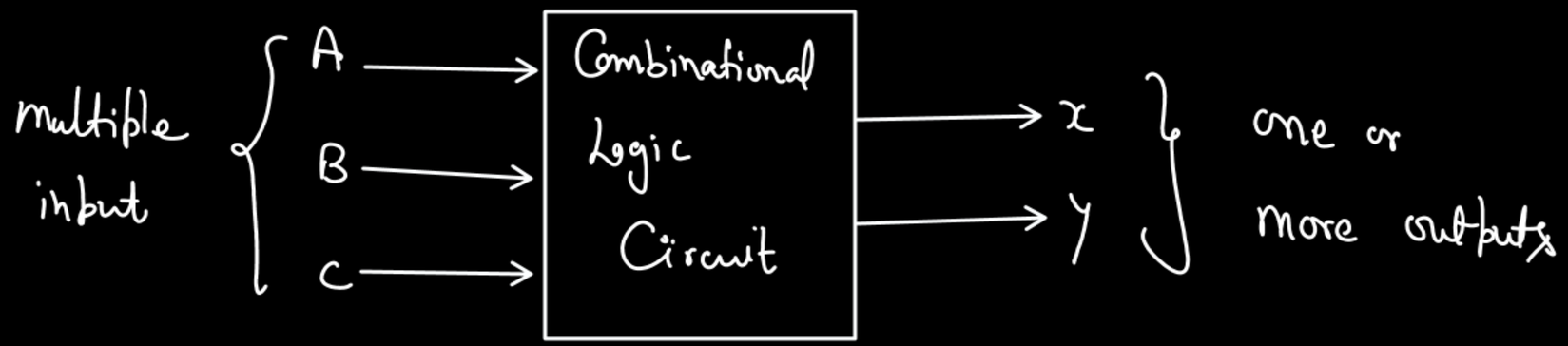
Combinational Circuit

→ Combinational Circuits designed by using logic gate

→ Operated on Binary Values

→ The output of the combinational Circuit is dependent on the combinations of input values.



'A Combinational Circuit implies that the output of the circuit depends upon combination of Inputs given to the Circuit'

$$O/P = f(input) + t_{pd}, \quad t_{pd} \geq 1 \text{ unit of time}$$

* Ideally, o/p instantly changes with the input, but practically, their is a propagation delay (t_{pd}).

Combination Logic / Circuit

- Boolean Algebra → Represent Boolean Variables
- Logic Diagram → Represent o/p, Graphical Representation
- Truth table → I/p & O/p Relationship.

Steps to design a Combinational Circuit

STEP 1: Identify Inputs & outputs

↳ कौन से I/P के Combination में कौन सा O/P चाहिए.

STEP 2: Based on problem statement, make / design the truth table.

STEP 3: Simplify the Expression using Boolean Rules / K-Maps.

Expression → minterm | maxterm

SOP (Σ) — minterm

maxterm — POS (Π)

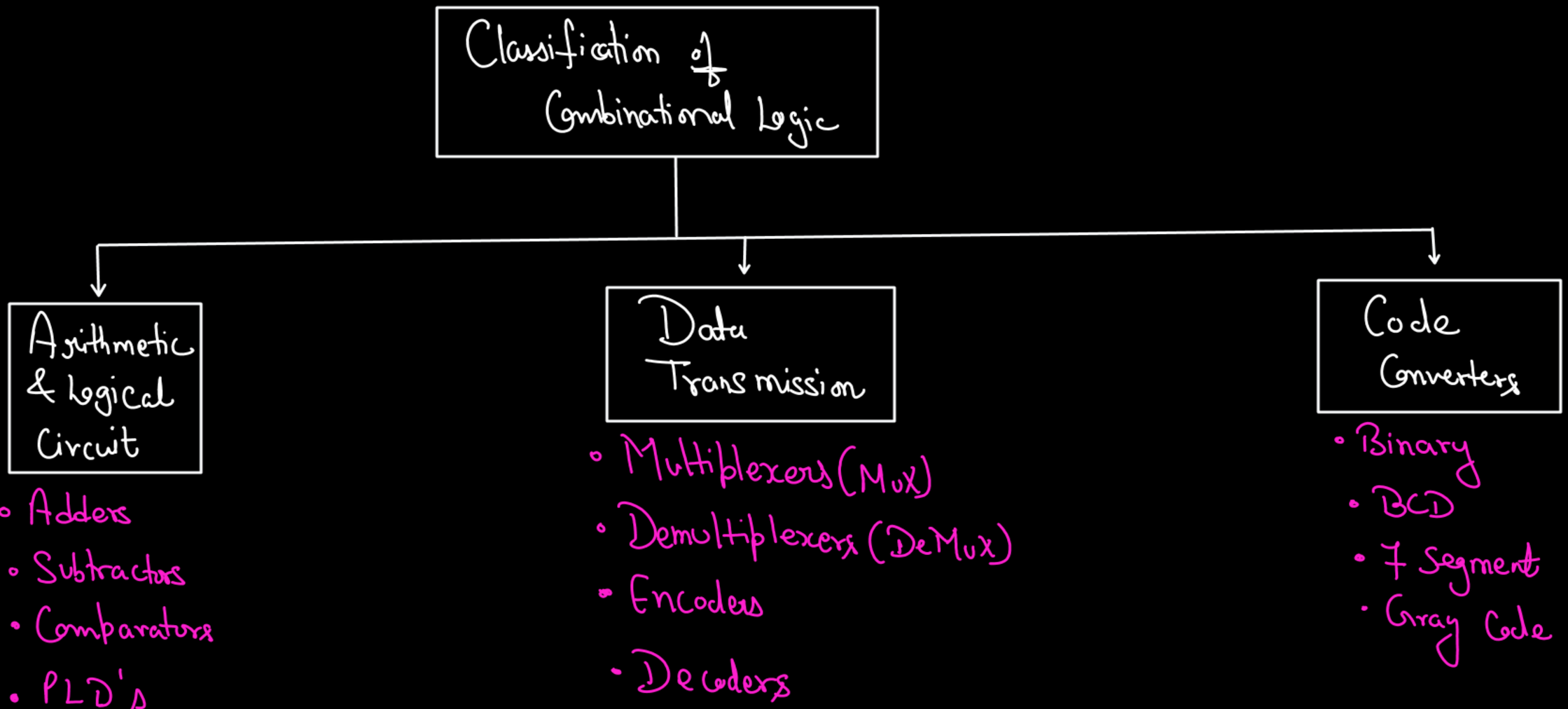
Best suitable for Simplification

Step 4: Based on simplified Expression Draw the logic Diagram

↓

Combinational Circuit

Classification of Combinational Logic



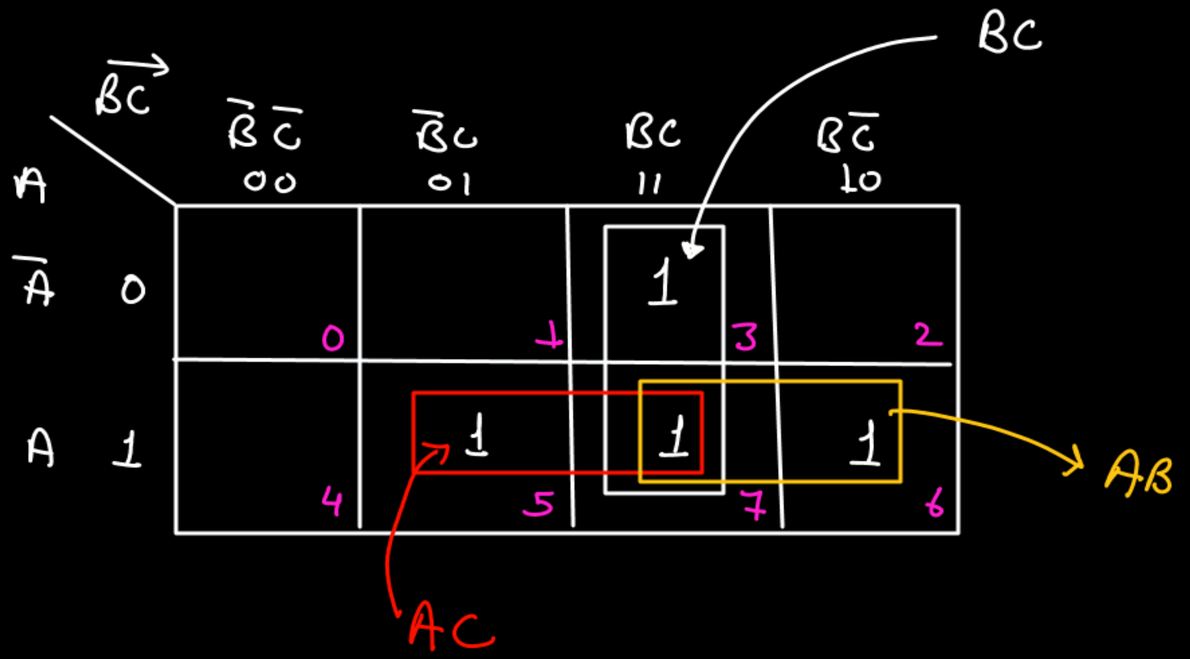
3-bit Majority Detector: It gives the output 1 when the input have more number of 1's

Inputs = A, B, C

	A	B	C	f(A,B,C)
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	1 ($\bar{A}BC$)
4	1	0	0	0
5	1	0	1	1 ($A\bar{B}C$)
6	1	1	0	1 ($AB\bar{C}$)
7	1	1	1	1 (ABC)

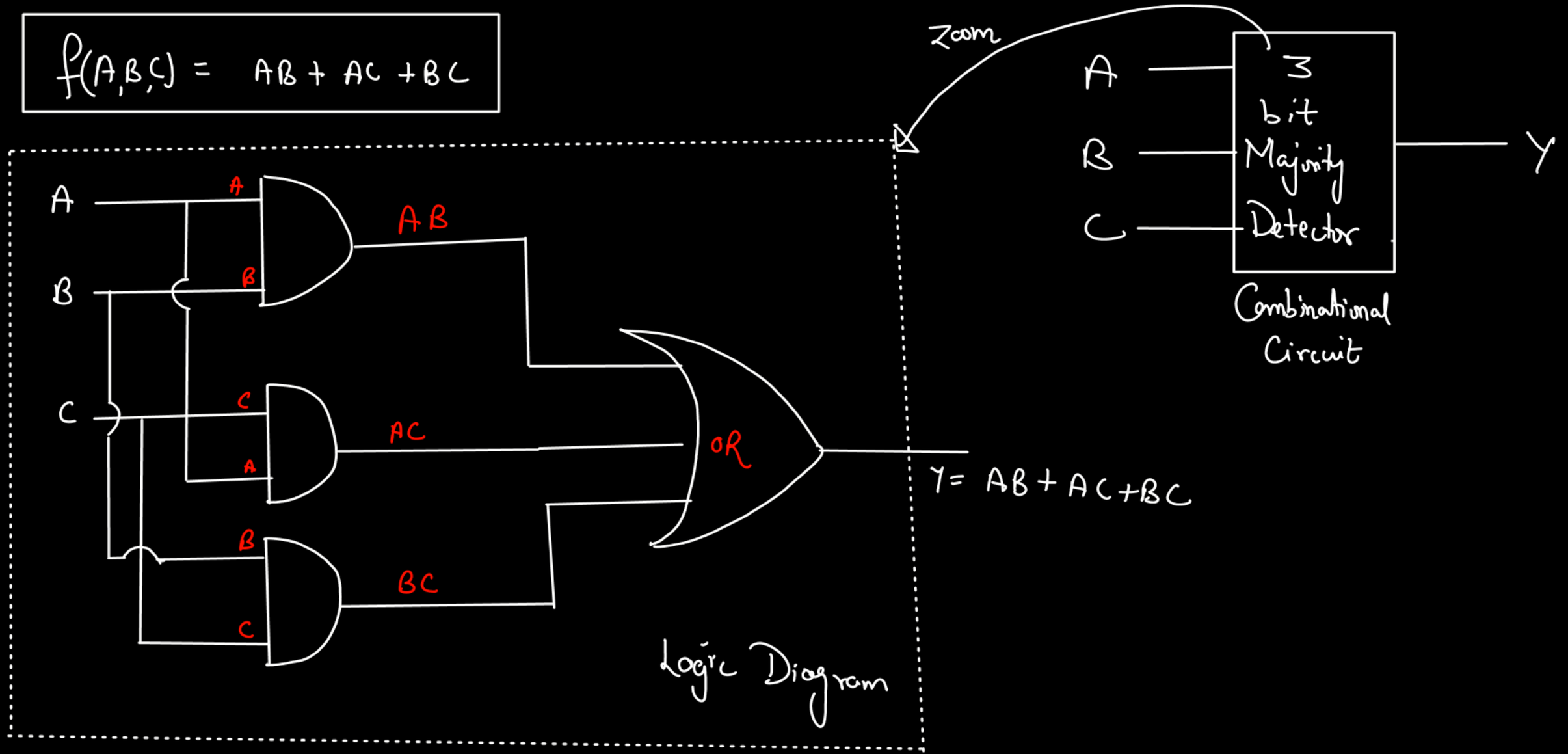
$$f = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$f(ABC) = \sum m(3, 5, 6, 7)$$



$$f(A,B,C) = AB + AC + BC$$

$$f(A,B,C) = AB + AC + BC$$


Zoom
A
B
C
3
bit
Majority
Detector
Y
Combinational
Circuit
A
B
C
AB
AC
BC
OR
Y= AB + AC + BC
Logic Diagram

3 bit Minority Detector: output 1 when no. of 1's in input are less.

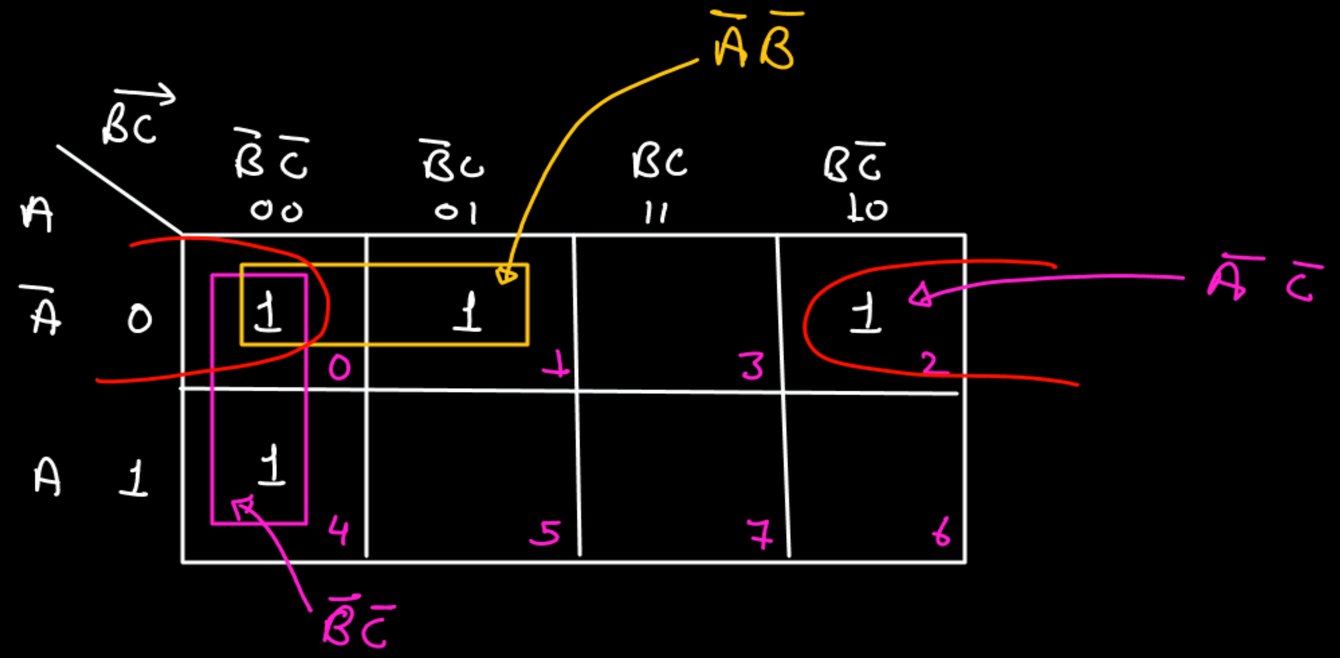
output 1 तभी आना चाहिए जब No. of zeroes ज्यादा हो, या No. of 1's कम हो।

Input → $Y = F(A, B, C)$

	A	B	C	$Y = f(A,B,C)$
0	0	0	0	1 ($\bar{A}\bar{B}\bar{C}$)
1	0	0	1	1 ($\bar{A}\bar{B}C$)
2	0	1	0	1 ($\bar{A}B\bar{C}$)
3	0	1	1	0
4	1	0	0	1 ($A\bar{B}\bar{C}$)
5	1	0	1	0
6	1	1	0	0
7	1	1	1	0

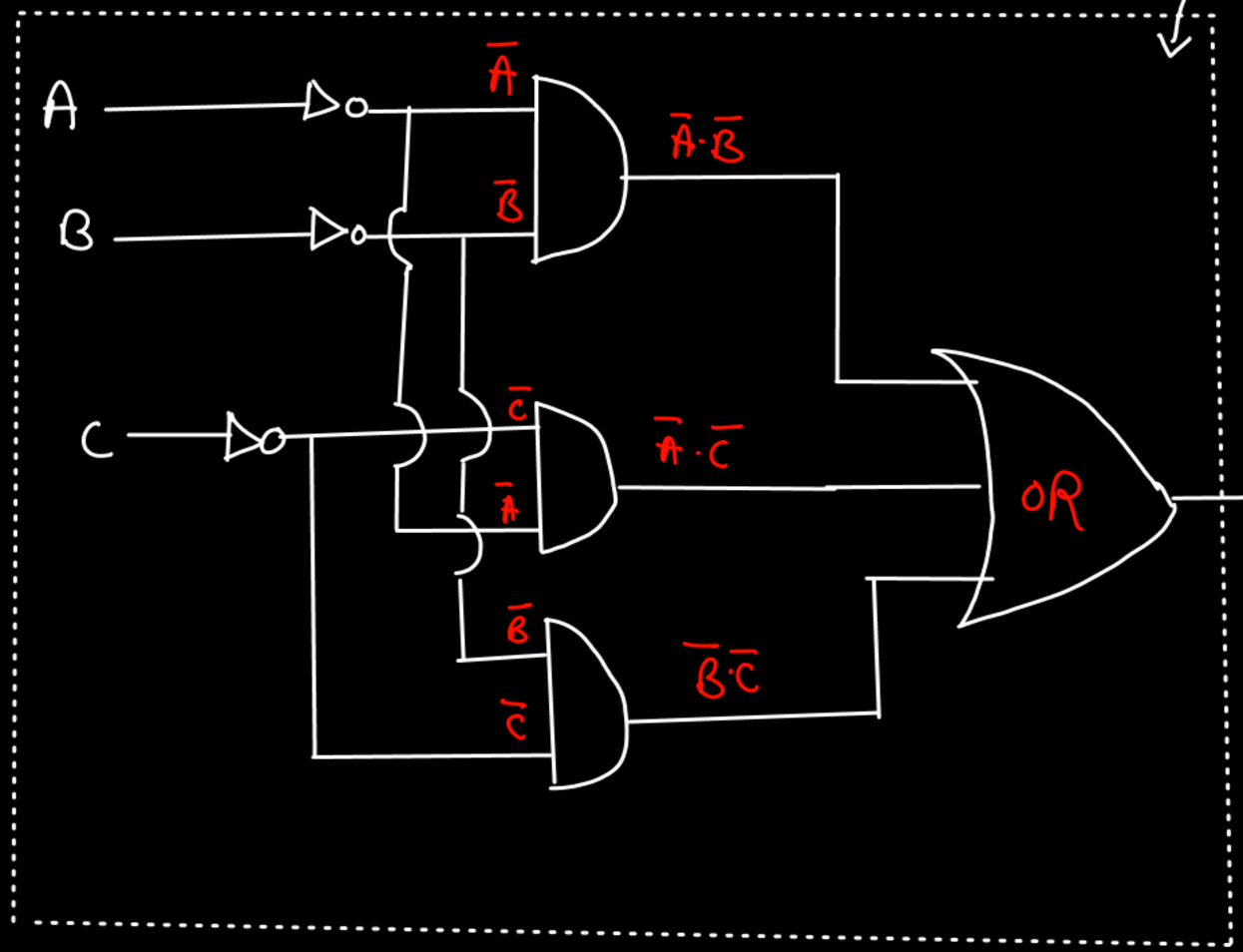
$$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$$

$$f(A,B,C) = \sum m(0, 1, 2, 4)$$

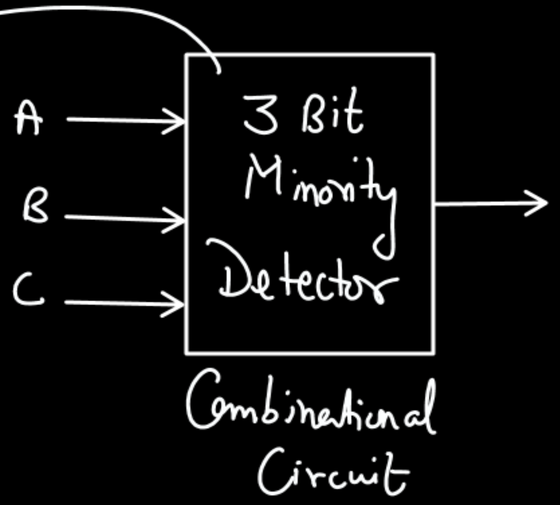


$$f(A,B,C) = \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$$

$$f(A,B,C) = \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$$



Zoom



$$Y = \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$$