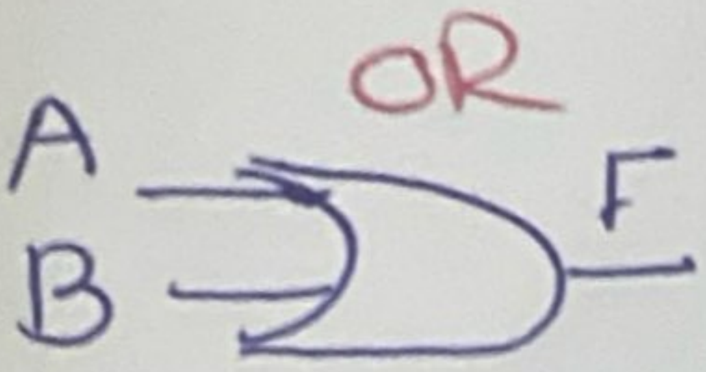
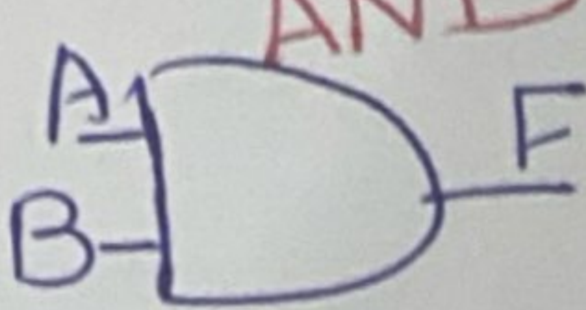
Identify Each logic gates by name, and Complete truth table (imp) (1)

OR

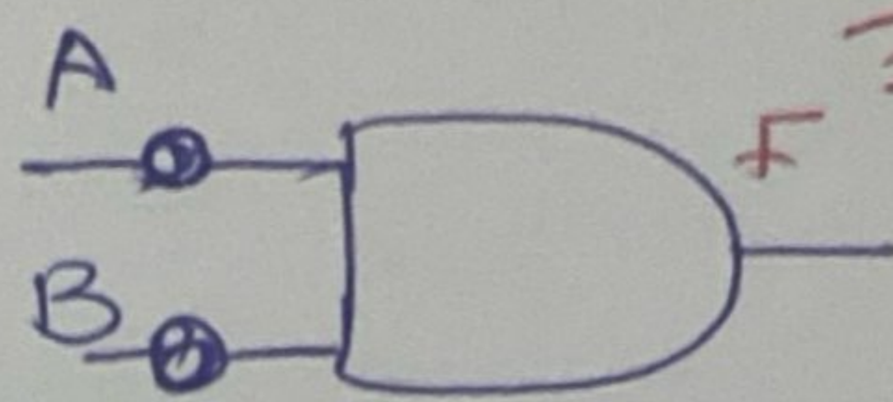


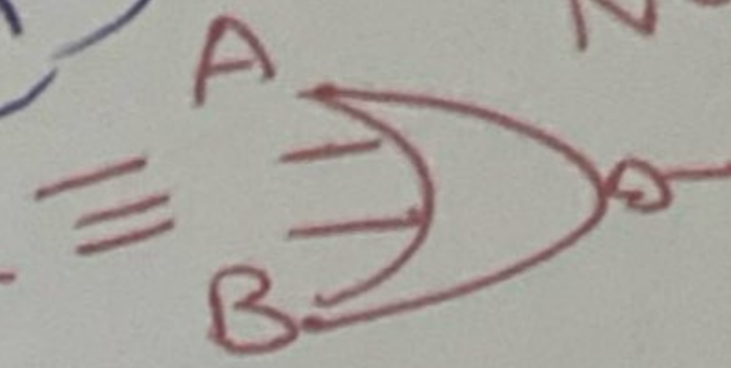
A	B	F
0	0	0
0	1	1
1	0	1
1	1	1

AND



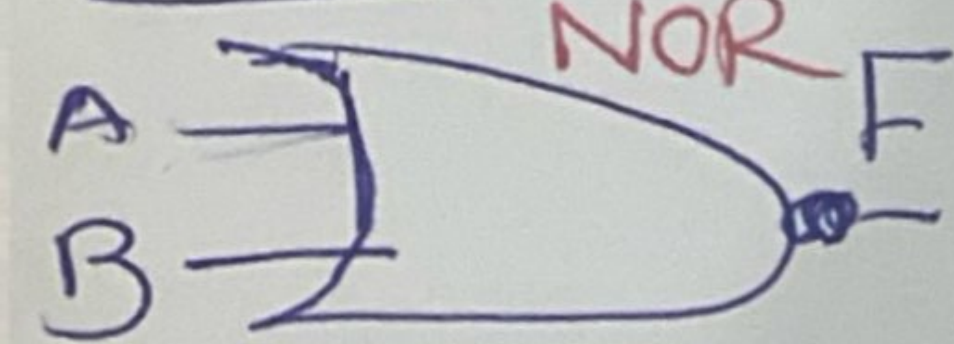
A	B	F
0	0	0
0	1	0
1	0	0
1	1	1



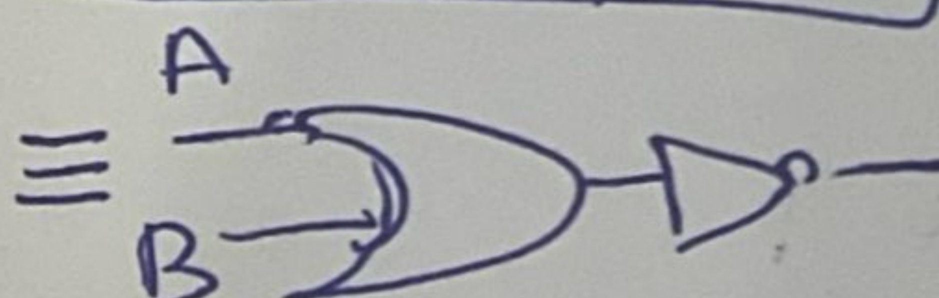


A	B	$\bar{A}$	$\bar{B}$	F
0	0	1	1	1
0	1	1	0	0
1	0	0	1	0
1	1	0	0	0

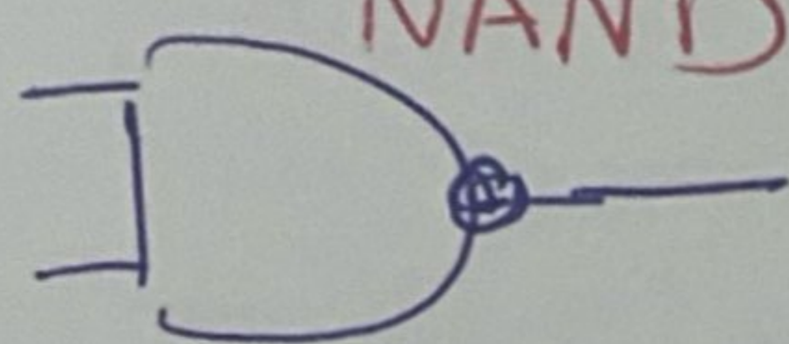
NOR



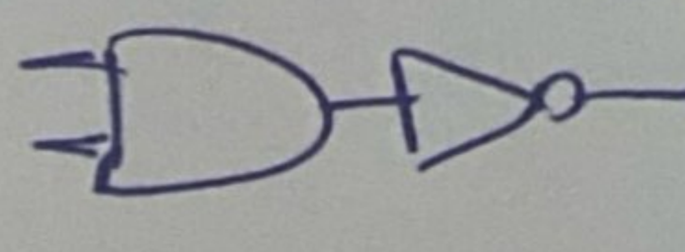
A	B	F
0	0	1
0	1	0
1	0	0
1	1	0



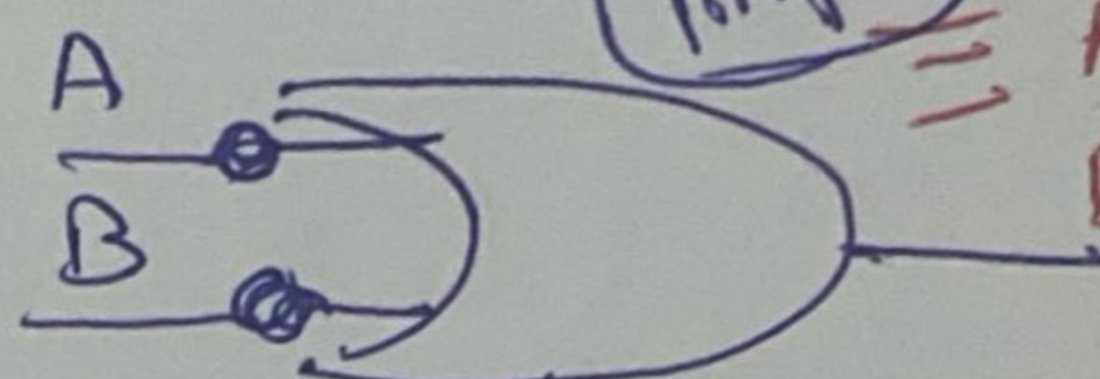
NAND

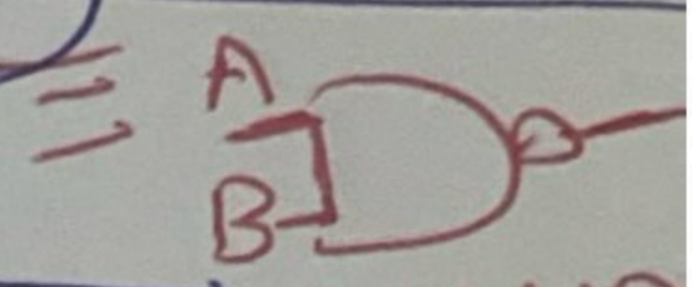


A	B	F
0	0	1
0	1	1
1	0	1
1	1	0

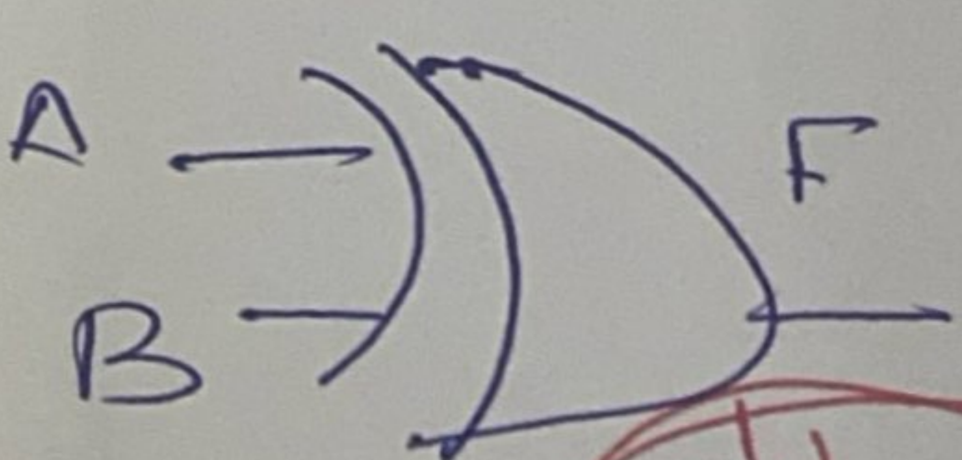


imp



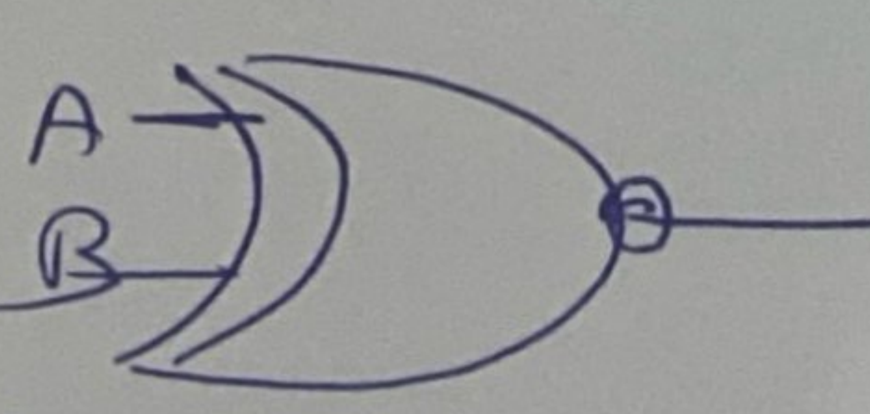


A	B	$\bar{A}$	$\bar{B}$	F
0	0	1	1	1
0	1	1	0	1
1	0	0	1	1
1	1	0	0	0



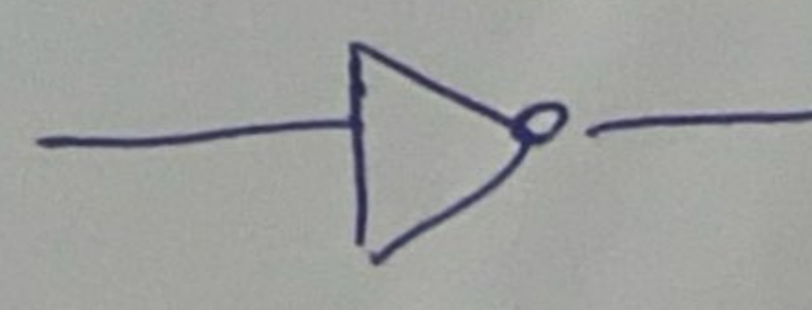
XOR (odd No of ones)

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



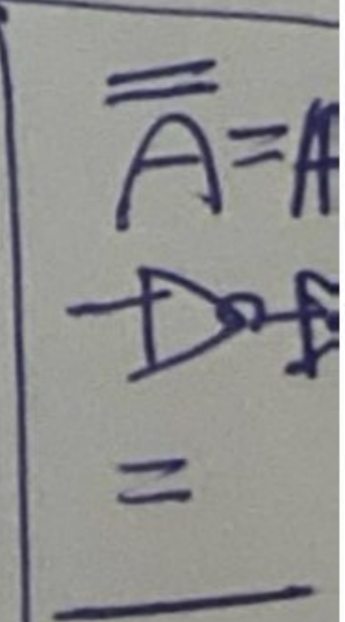
XNOR

A	B	F
0	0	
0	1	
1	0	
1	1	



NOT

A	F
0	1
1	0



Truth table

Rules

No of Rows $= 2^{\text{No of inputs}}$

$N(A, B, C) \Rightarrow 2^3 = 8$

$N(A, B) \Rightarrow 2^2 = 4$

$N(A, B, C, D) \Rightarrow 2^4 = 16$

from 0 to $2^n - 1$

3 inputs A, B, C

$2^3 - 1 = 7$

Example. $N(A, B, C)$ Range from $0 : 7$

Example

We have a circuit That output $\boxed{1}$ if Two or more input of A, B, C is $\boxed{1}$ otherwise = 0, find Truth Table

1. 3 inputs $\Rightarrow 2^3 = 8$ rows

   $\boxed{0} \longrightarrow \boxed{7}$

2. Draw inputs
3. put outputs

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

Sum-Of Products & Product of Sum

output for last Example is

	A	B	C	F	
	0	0	0	0	m_0
	0	0	1	0	m_1
	0	1	0	0	m_2
$\bar{A}BC$	0	1	1	1	m_3
	1	0	0	0	m_4
$A\bar{B}C$	1	0	1	1	m_5
$AB\bar{C}$	1	1	0	1	m_6
ABC	1	1	1	1	m_7

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

Sum of Products

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

or

$$F = \prod M(0,1,2,4)$$

$\hookrightarrow (A+B+C)\cdot(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+C)$

$\hookrightarrow$ Product of Sum

De Morgan's Theorem

$\overline{AB} \rightarrow \bar{A} + \bar{B}$

$\overline{A+B} \rightarrow \bar{A} \cdot \bar{B}$

Note ① → Move $\overline{\quad}$ To inputs

② → $+ \rightarrow \cdot \qquad \cdot \rightarrow +$

→ Apply again if needed!

Example

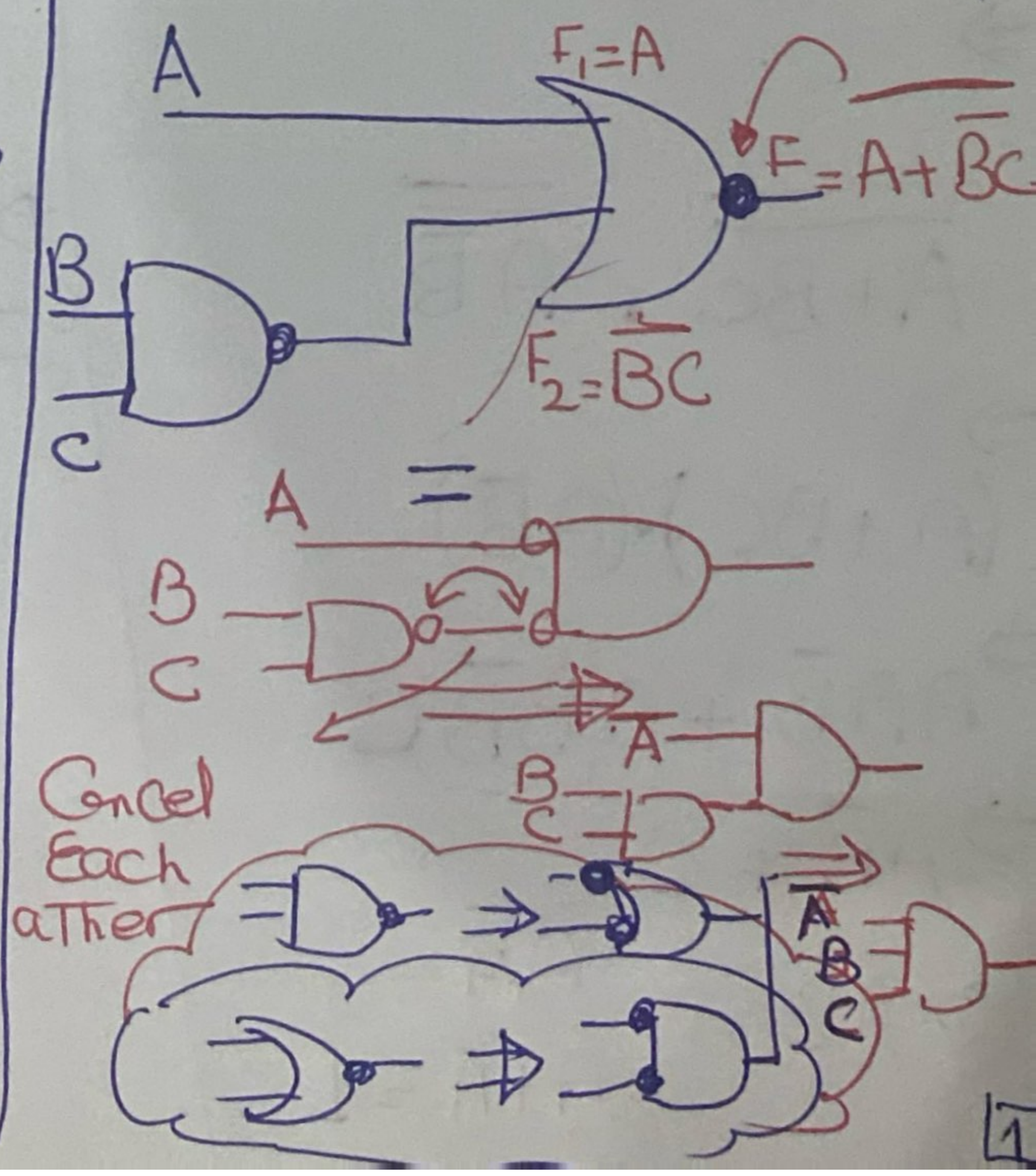
$\overline{A + \overline{BC}}$

$\Rightarrow \bar{A} \cdot \overline{\overline{BC}}$

$\Rightarrow \bar{A} \cdot BC \Rightarrow \bar{A}BC$ ✓

\# $\boxed{\overline{\overline{A}} = A}$ #

graphical demorgan



Example

$$\overline{AB + CD}$$

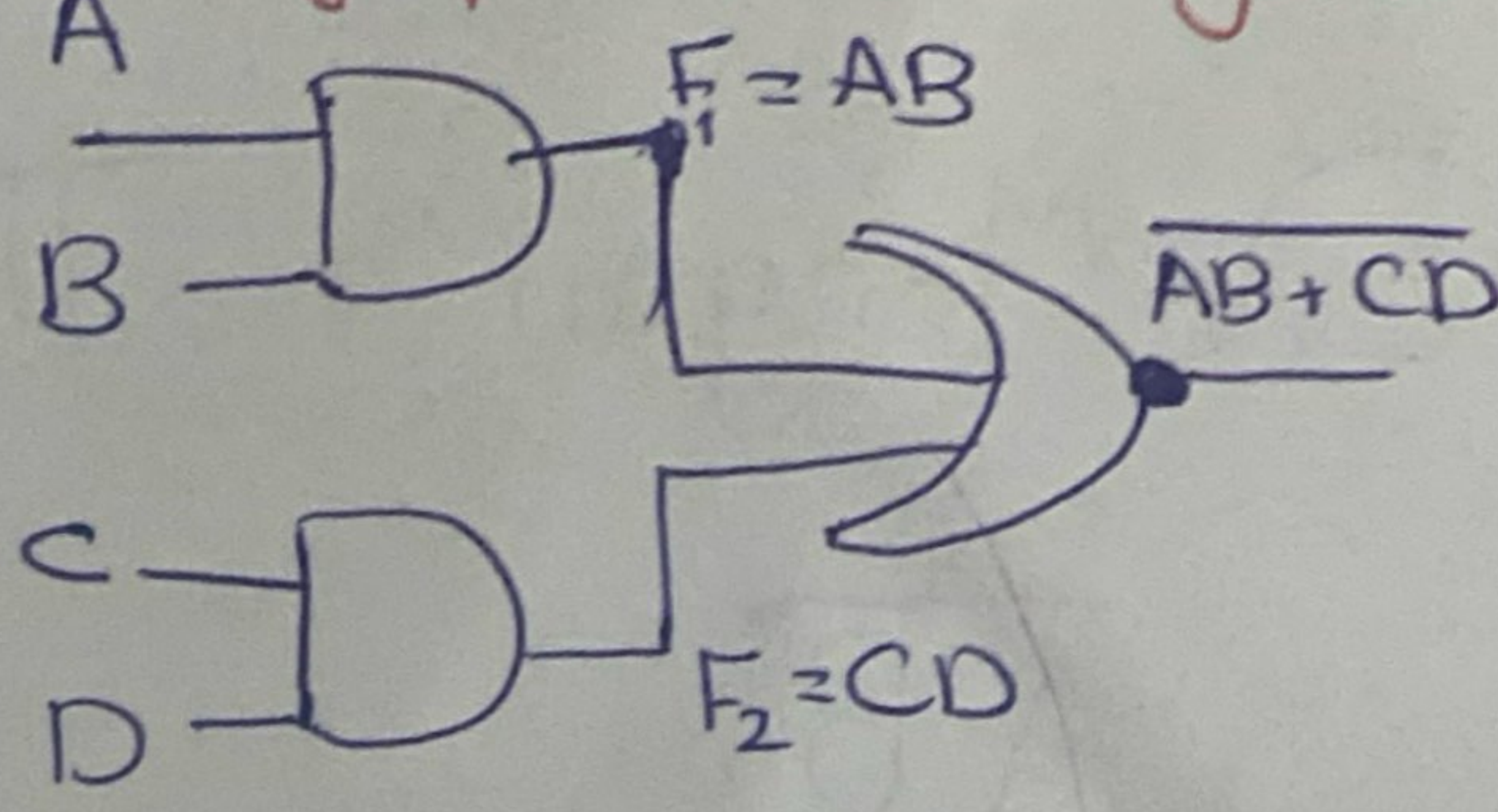
=

$$(\overline{AB})\cdot(\overline{CD})$$

$$\Rightarrow (\overline{A}+\overline{B})\cdot(\overline{C}+\overline{D})$$

graphical demorgan

⇒



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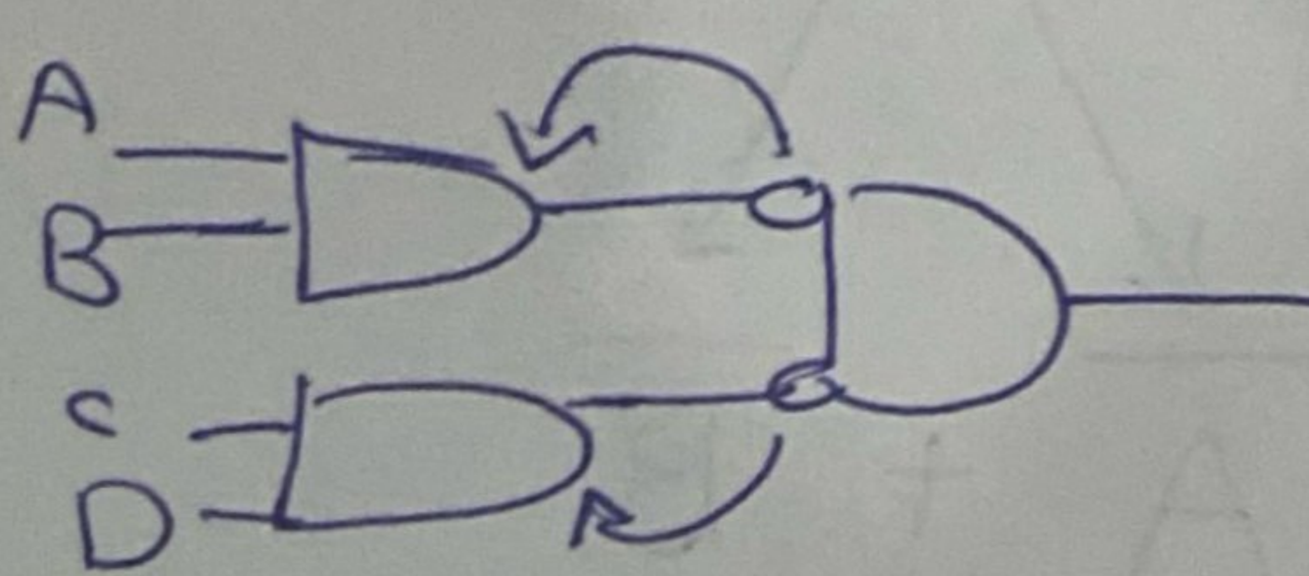

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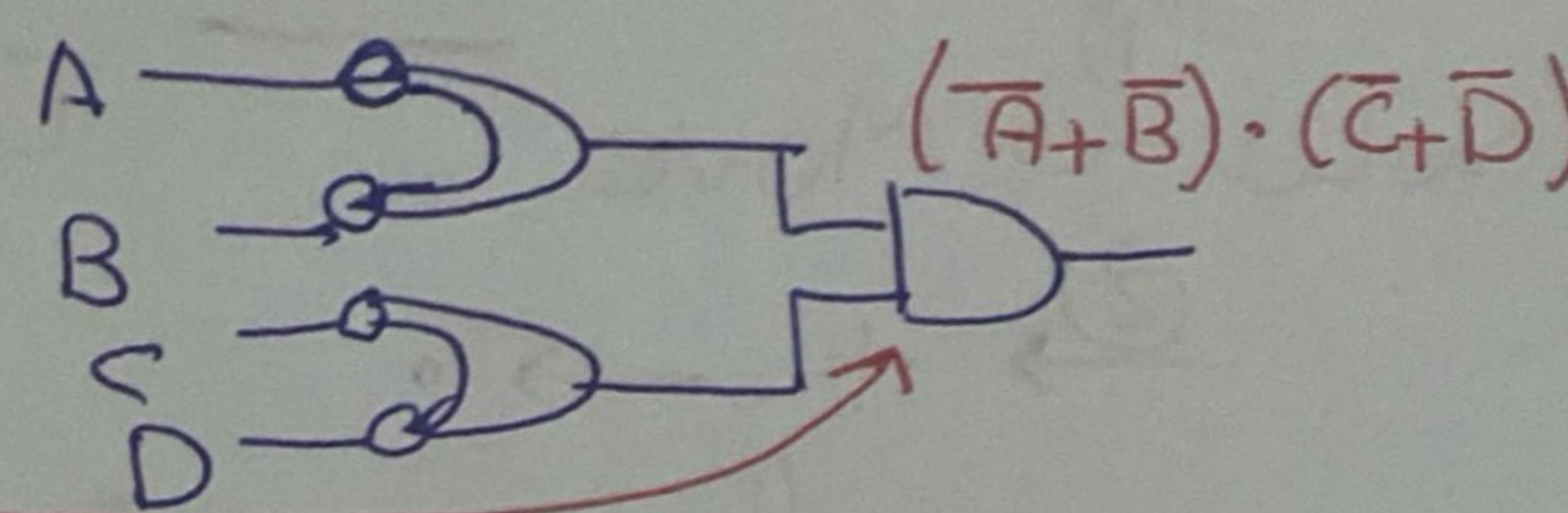


Example

$$\overline{\overline{A+BC} + \overline{A\overline{B}}}$$

$$\Rightarrow \overline{\overline{A+BC}}\cdot\overline{\overline{A\overline{B}}}$$

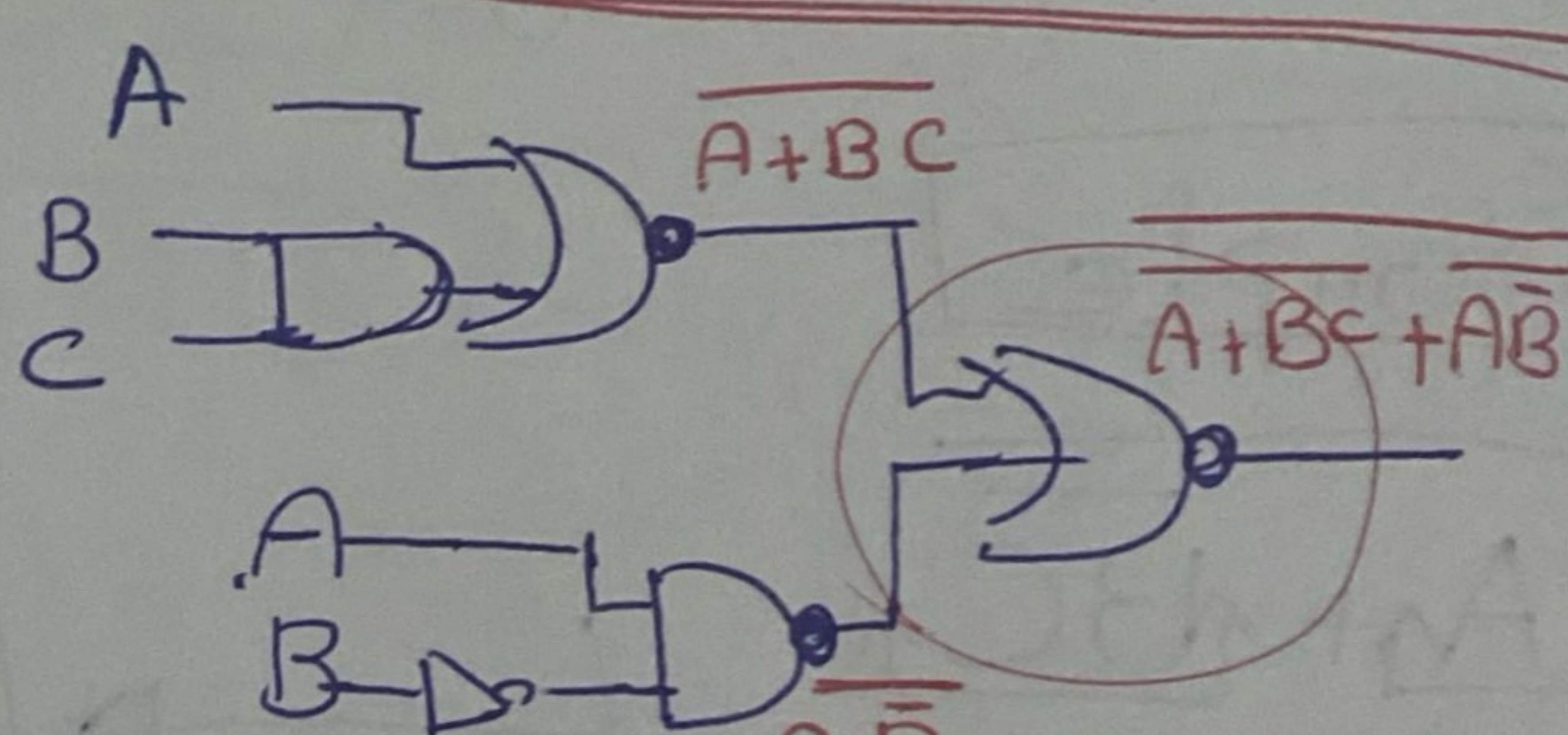
$$\Rightarrow (A+BC)\cdot(A\overline{B})$$

$$\Rightarrow AA\overline{B} + AB\overline{B}C$$

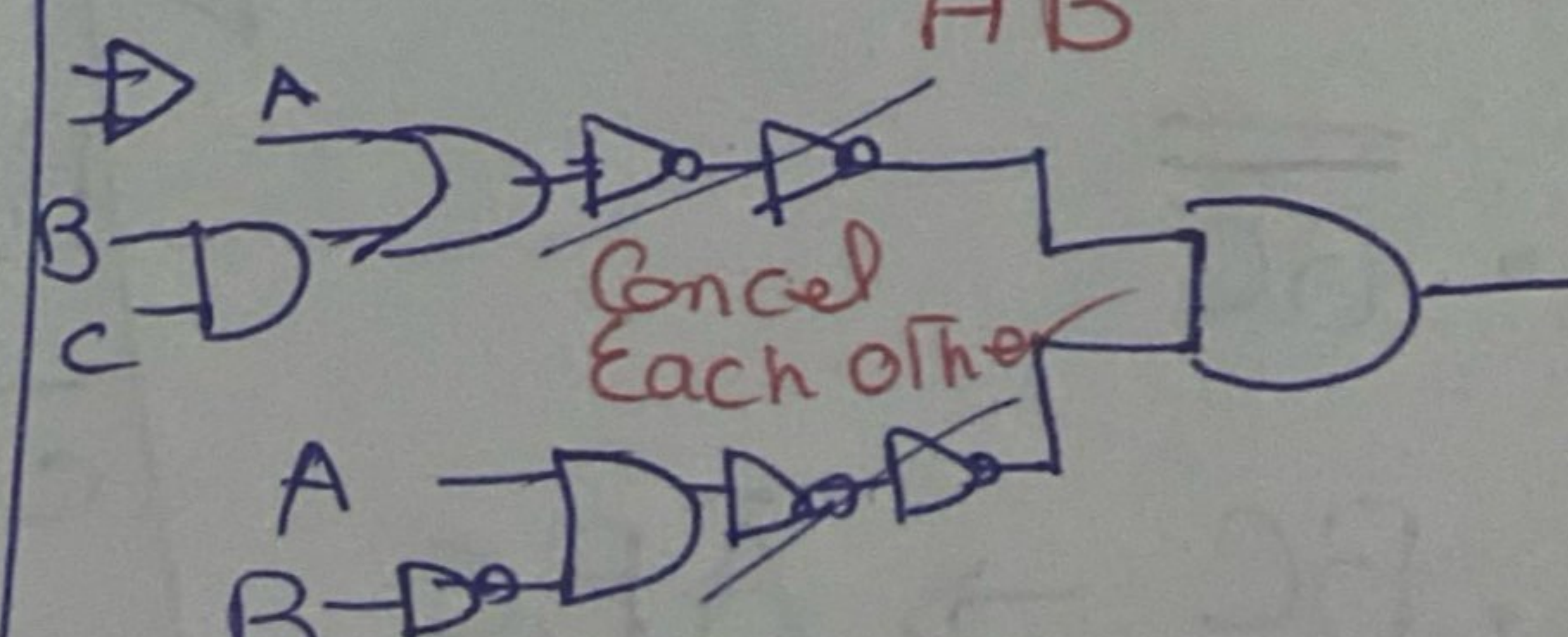
$$\Rightarrow A\overline{B} + 0$$

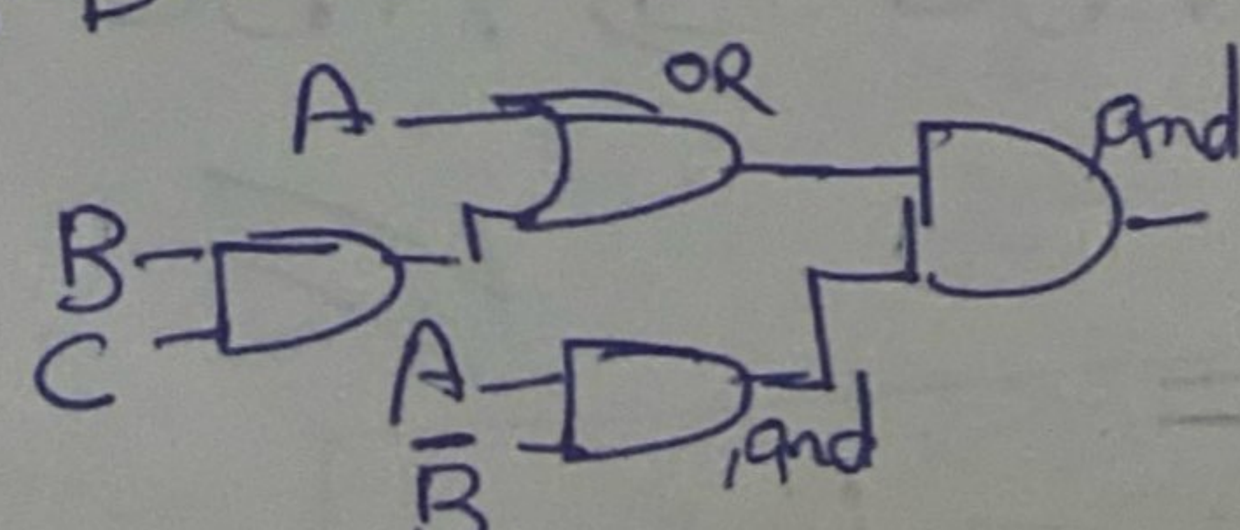
$$\Rightarrow A\overline{B}$$

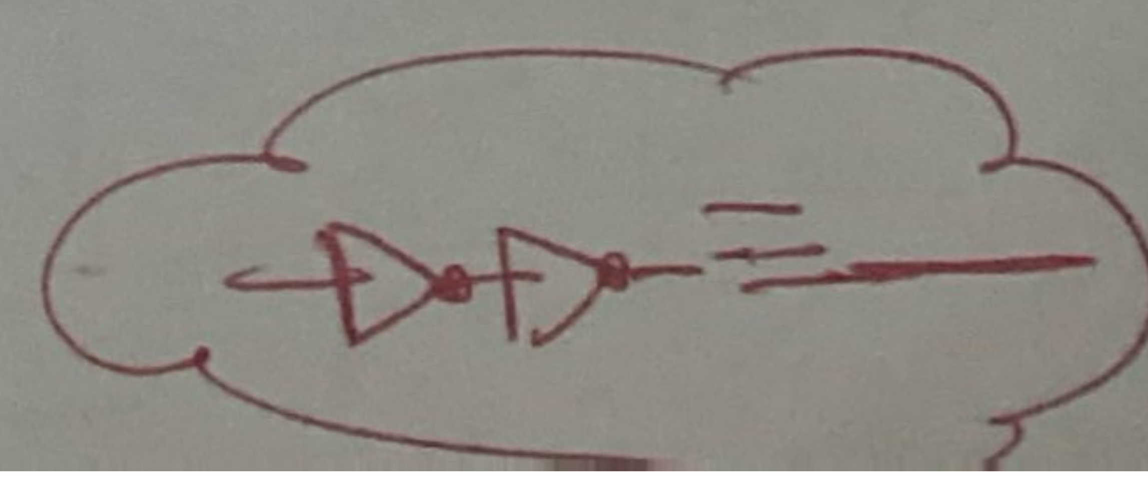
$$A\overline{A} = 0$$
$$A+\overline{A} = 1$$



⇒







What is Complement

complement $= F' = \overline{F}$

Find the Complement of $F = A + BC + \bar{A}\bar{B}$

Sol

$$F' = \overline{F} = \overline{A + BC + \bar{A}\bar{B}}$$

complement

we can use demorgen here to simplify

$$= \bar{A} \cdot \overline{BC} \cdot \overline{\bar{A}\bar{B}}$$

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

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

$$= (\underbrace{A\bar{A}}_{0} + \bar{A}B)(\bar{B} + \bar{C})$$

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

$$= \bar{A}\underbrace{B\bar{B}}_{0} + \bar{A}B\bar{C}$$

$$= (\underbrace{\bar{A} \cdot 0}_{0}) + \bar{A}B\bar{C}$$

$$\boxed{= \bar{A}B\bar{C}}$$ #

What is Dual?

Change $\cdot \to +$ $\quad + \to \cdot$ $\quad 0 \to 1$ $\quad 1 \to 0$ $\quad A \to A$
$\bar{A} \Rightarrow \bar{A}$

Find

1. Complement of Function $\boxed{F = A + BC + \bar{A}\bar{B}}$

$$\bar{F} = \overline{A + BC + \bar{A}\bar{B}} = \bar{A}\,\overline{BC}$$

↳ Solved before #

2. Find dual

$$F^{D} = A \cdot (B + C) \cdot (\bar{A} + \bar{B})$$

Same.

3. Find Complement from dual

Change only $\bar{A} \to A$ $\quad$ S. $A \to \bar{A}$

$\bar{F}$ from dual

$$= A' \cdot (\bar{B} + \bar{C})(\bar{\bar{A}} + \bar{\bar{B}})$$

$$= (A'B' + A'C')(A + B)$$

$$= \underbrace{AA'}_{0}B' + A'\underbrace{B'B}_{0} + \underbrace{AA'}_{0}C' + A'C'B$$

$$= 0 + A'\underbrace{B'B}_{0} + 0 + A'BC' = \boxed{A'BC'}$$ #

Karnaugh Mapping K-maps

Use this truth table to find simplified function of 3 inputs

	A	B	C	F
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

Rule

1. Large groub
2. groub of 1, 2, 4, 8, ..
3. Don't leave any 1 alone.

note

A \ BC	00	01	11	10
0	1	1	1	0
1	0	1	0	0

F = $\bar{A}$·

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

Examples

A \ BC	00	01	11	10
0	1	0	0	1
1	1	0	0	1

$F = \overline{C}$

A \ BC	00	01	11	10
0	1	1	1	1
1	1	0	0	1

$F = \overline{C} + \overline{A}$

A \ BC	00	01	11	10
0	0	1	1	0
1	1	0	0	1

$F = A\overline{C} + \overline{A}C$

A \ BC	00	01	11	10
0	1	0	0	1
1	1	0	0	0

$F = \overline{B}\overline{C} + \overline{A}\overline{C}$

A \ BC	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$F = \overline{A}\overline{B}C + A\overline{B}\overline{C}$
$+ ABC + \overline{A}B\overline{C}$

A \ BC	00	01	11	10
0	1	1	0	0
1	0	0	1	1

$F = \overline{A}\overline{B} + AB$