CS & IT ENGINEERING

DIGITAL LOGIC

Combinational Circuit

Lecture No. – 01

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TOPICS TO BE COVERED

01 Comparator

02 Question Practice

03 Discussion

COMPARATOR

combinational circuit

→ A circuit without memory

→ o/p depends only on present state of input.

Designing

- ✓ Comparator
- ✓ MUX
- ✓ DE-MUX
- ✓ Encoder
- ✓ Decoder
- ✓ HA
- ✓ FA
- ✓ H.S.
- ✓ F.S.
- ✓ Serial adder
- ✓ parallel adder
- ✓ LACA
- ✓ Multiplier

Designing of Combinational circuit

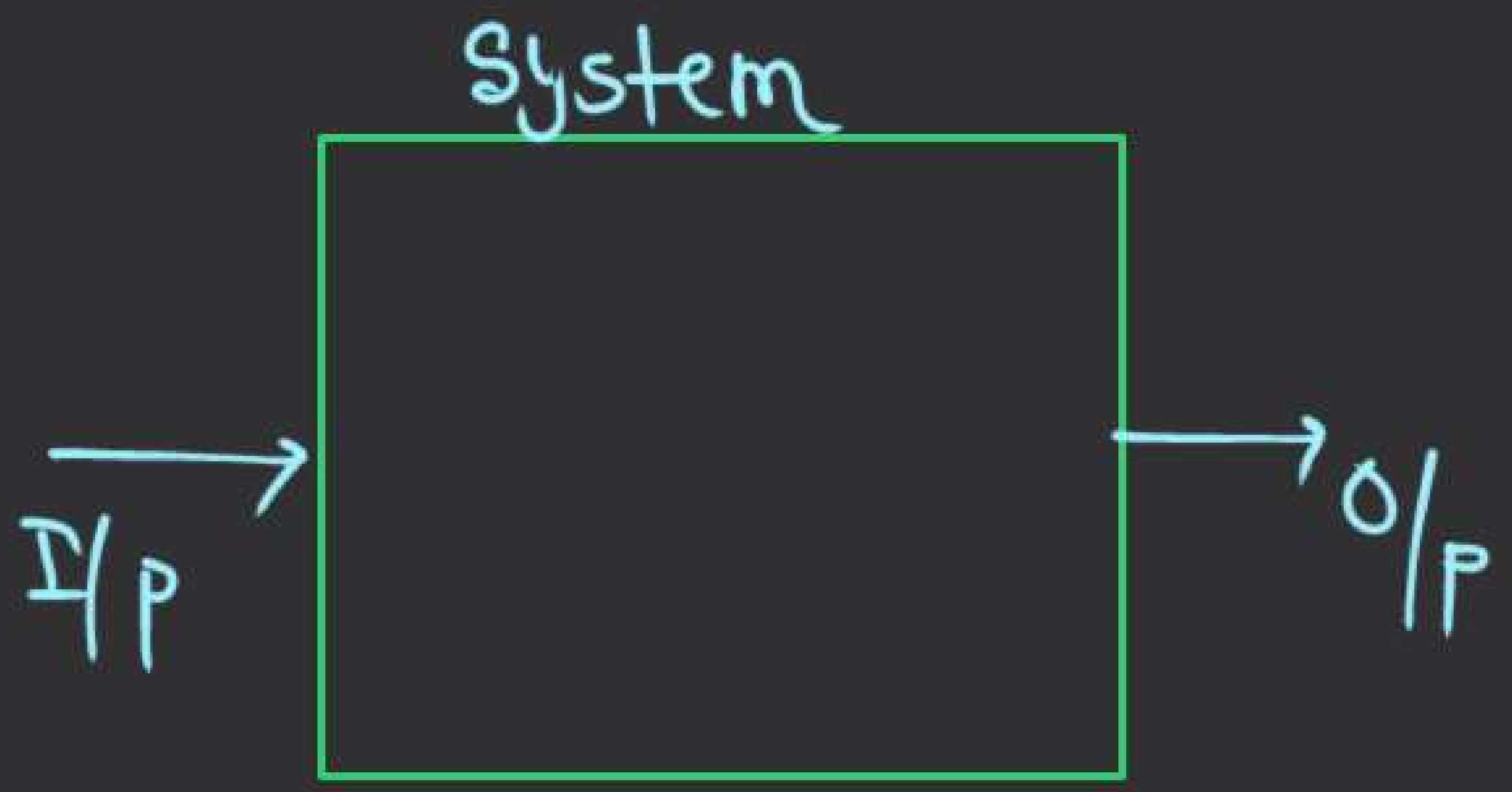
Step 1. Find the no. of inputs and outputs.

Step 2. Write the truth table

Step 3. Write the logical expression

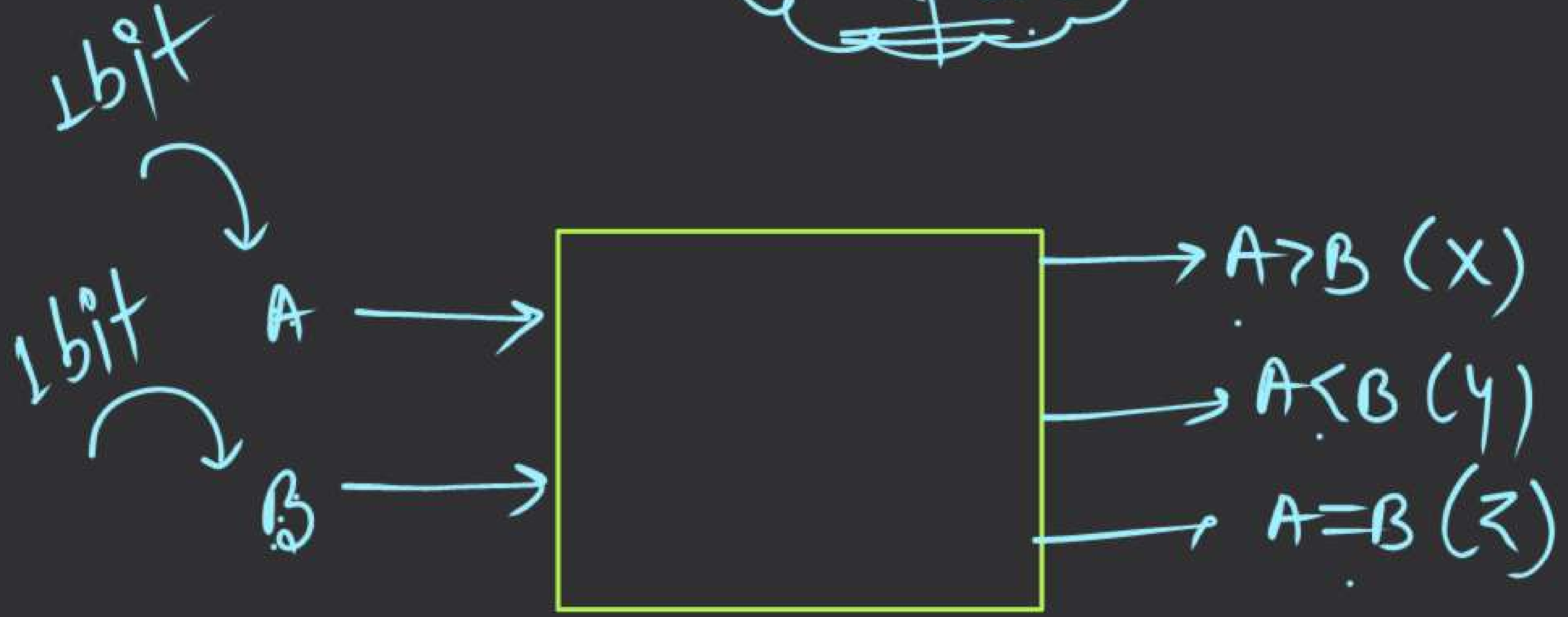
Step 4. Minimization

Step 5: Hardware Implementation.



"Comparator"

Compare.



COMPARATOR

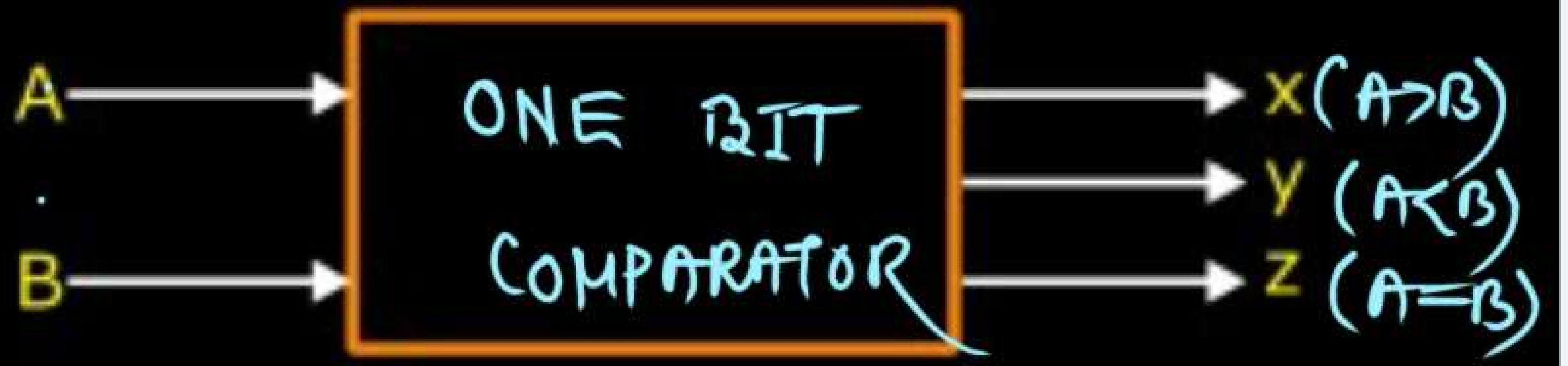
DESIGNING OF COMBINATIONAL CIRCUIT

Step 1. Find the number of inputs and outputs.
Step 2. Write the truth table.
Step 3. Write the logical expression.
Step 4. Minimize the logical expression.
Step 5. Hardware implementation.

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

1. Design a one-bit comparator



Step 1.

Step 2. Truth Table

A	B	X (A>B)	Y (A<B)	Z (A=B)
0	0	0	0	1
0	1	0	1	0
1	0	1	0	0
1	1	0	0	1

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 3. Logical expression

$X(A > B) = A\bar{B}$

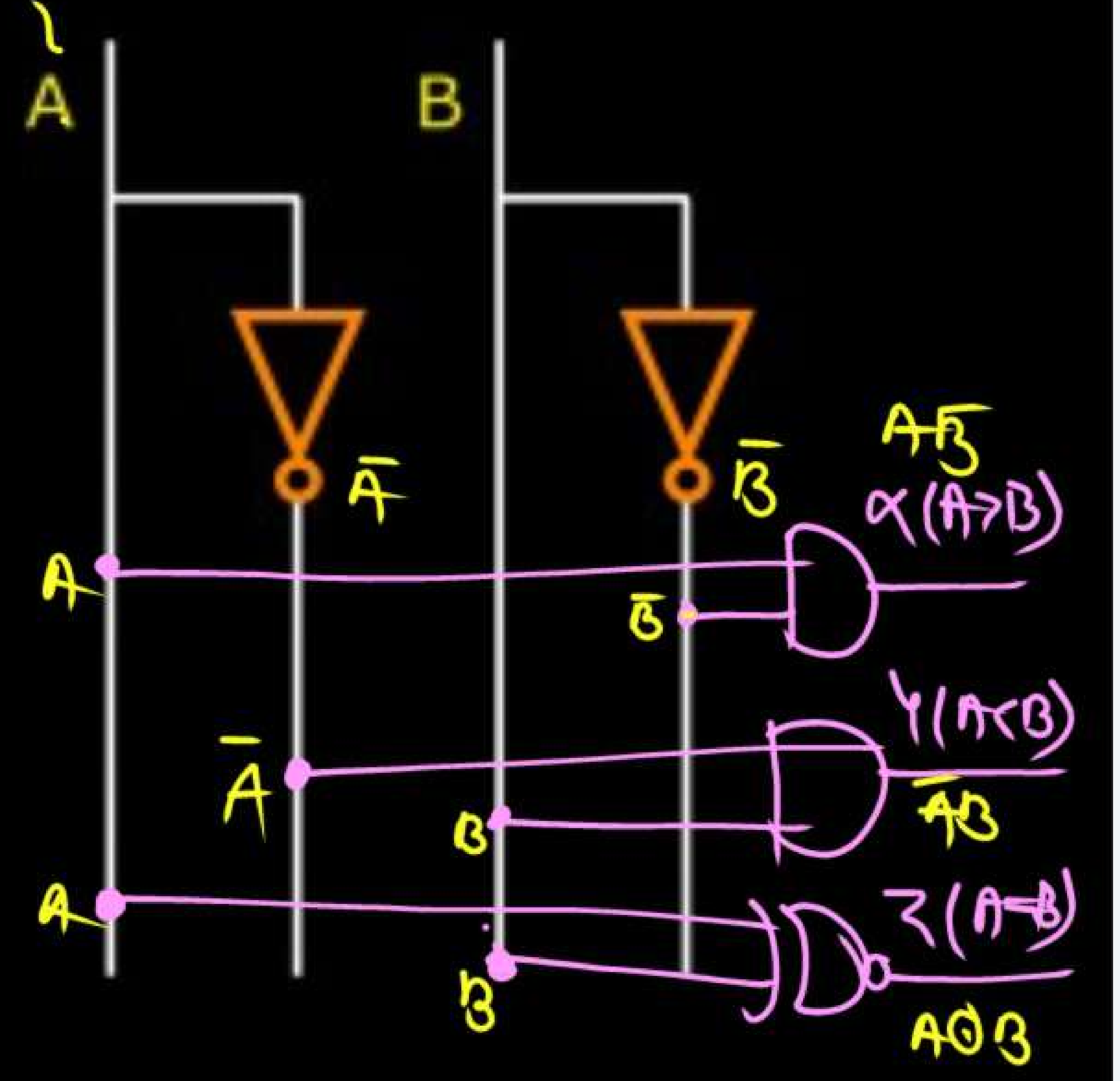
$Y(A < B) = \bar{A}B$

$Z(A = B) = \bar{A}\bar{B} + AB = A \odot B$

Step 4. Minimization

↳ Already minimize

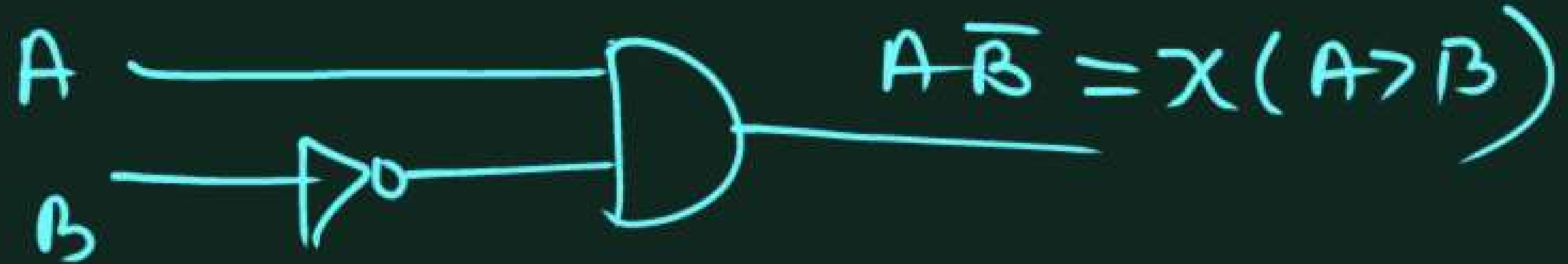
Step 5. Hardware implementation

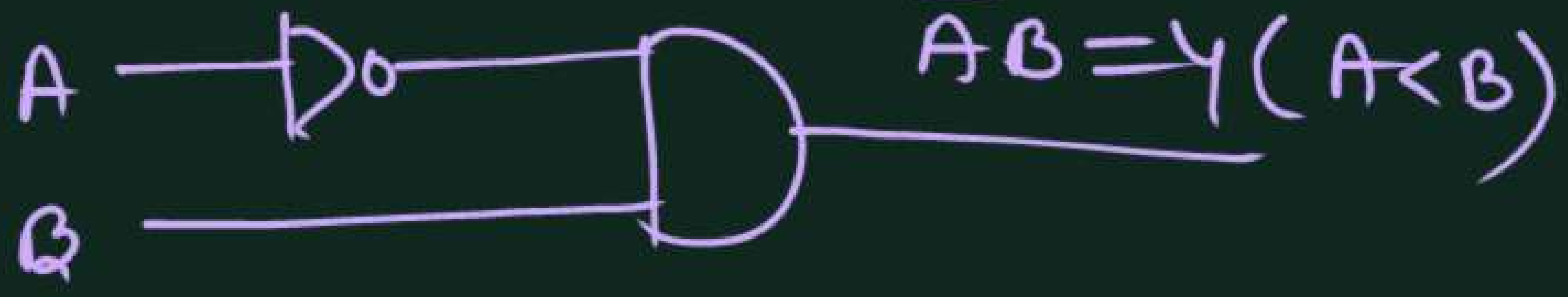


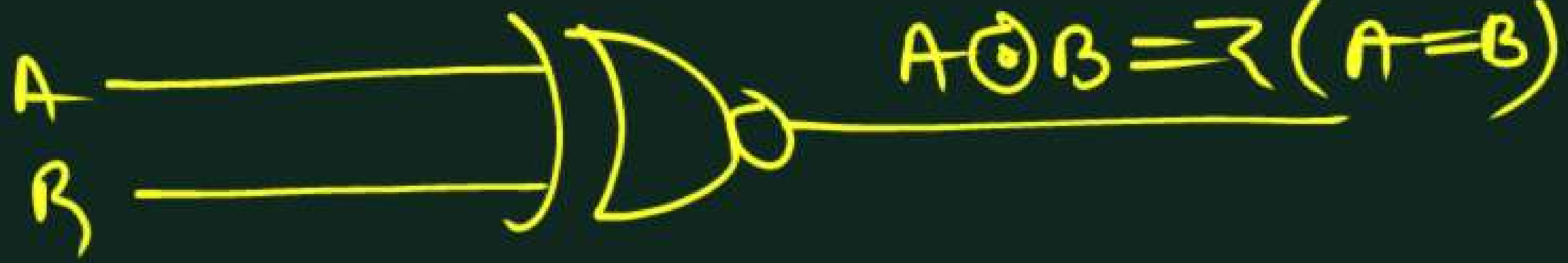
$$X(A>B) = A\bar{B}$$

$$Y(A<B) = \bar{A}B$$

$$Z(A=B) = A \odot B$$







COMPARATOR

A

A_1 A_0

B

B_1 B_0

DESIGNING OF COMBINATIONAL CIRCUIT

2. Design a two-Bit comparator?

Step 1.

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 2. Truth table

	A		B		A>B	A<B	A=B
	A_1	A_0	B_1	B_0	x	y	z
0	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0
2	0	0	1	0	0	1	0
3	0	0	1	1	0	1	0
4	0	1	0	0	1	0	0
5	0	1	0	1	0	0	1
6	0	1	1	0	0	1	0
7	0	1	1	1	0	1	0
8	1	0	0	0	1	0	0
9	1	0	0	1	1	0	0
10	1	0	1	0	0	0	1
11	1	0	1	1	0	1	0
12	1	1	0	0	1	0	0
13	1	1	0	1	1	0	0
14	1	1	1	0	1	0	0
15	1	1	1	1	0	0	1

COMPARATOR

$X(A_1 A_0 B_1 B_0)$
$Y(A_1 A_0 B_1 B_0)$

DESIGNING OF COMBINATIONAL CIRCUIT

A B

1 1 1 0

3 > 2

A > B

Step 3. Logical expression

$X(A > B) = \Sigma m(4, 8, 9, 12, 13, 14)$

$Y(A < B) = \Sigma m(1, 2, 3, 6, 7, 11)$

$Z(A = B) = \Sigma m(0, 5, 10, 15)$

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

$Y = \bar{A}_1 B_1 + \bar{A}_1 \bar{A}_0 B_0 + \bar{A}_0 B_1 B_0$

Step 4. Minimization

For X $= A_1 \bar{B}_1 + A_0 \bar{B}_1 \bar{B}_0 + A_1 A_0 \bar{B}_0$ ✓

A_1A_0 \ B_1B_0	$\bar{B}_1\bar{B}_0$ 00	$\bar{B}_1 B_0$ 01	$B_1 B_0$ 11	$B_1 \bar{B}_0$ 10
$\bar{A}_1\bar{A}_0$ 00				
$\bar{A}_1 A_0$ 01	1			
$A_1 A_0$ 11	1	1		1
$A_1 \bar{A}_0$ 10	1	1		

For Y

A_1A_0 \ B_1B_0	00	01	11	10
00		1	1	1
01			1	1
11				
10			1	

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 4. Minimization

$$Z = (A_1 \odot B_1) \cdot (A_0 \odot B_0)$$

For Z

$A_1A_0 \backslash B_1B_0$	00	01	11	10
00	1			
01		1		
11			1	
10				1

COMPARATOR

FOR ONE BIT COMPARATOR

Total condition = 4

Equal condition = 2

Unequal condition = 2

Greater = Less condition = 1

COMPARATOR

FOR TWO BIT COMPARATOR

Total condition = 16

Equal condition = 4

Unequal condition = 12

Greater = Less condition = 6

COMPARATOR

FOR THREE BIT COMPARATOR

Total condition = 64

Equal condition = 8

Unequal condition = 56

Greater = Less condition = 281

COMPARATOR

'N' BIT COMPARATOR

Total condition = 2^{2n}

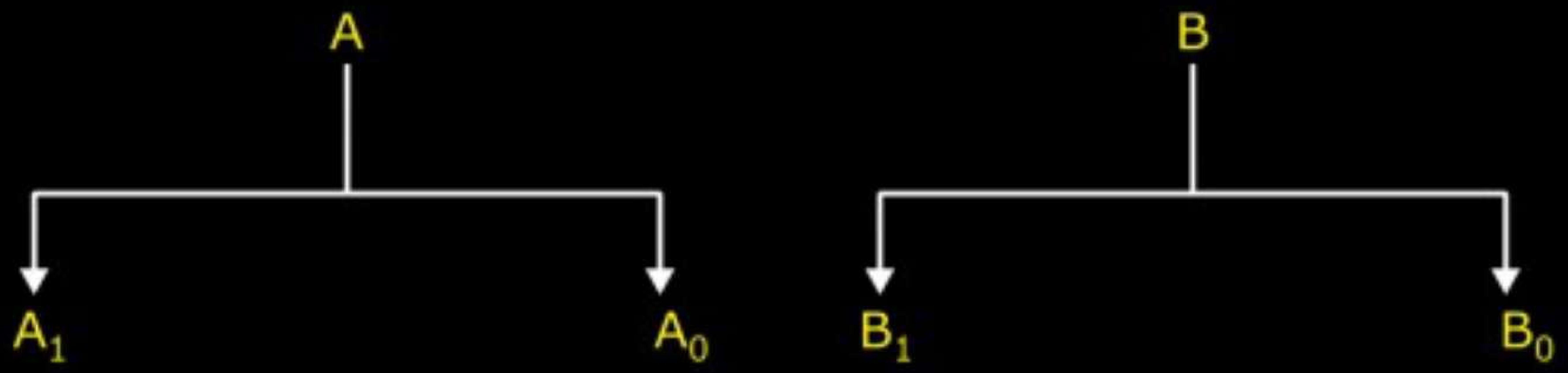
Equal condition = 2^{n}

Unequal condition = $2^{2n} - 2^{n}$

Greater = Less condition = $(2^{2n} - 2^{n})/2$

COMPARATOR

SHORT TRICK TO USE SEMI MINIMIZED EXPRESSION



Thank you

GW

Soldiers !