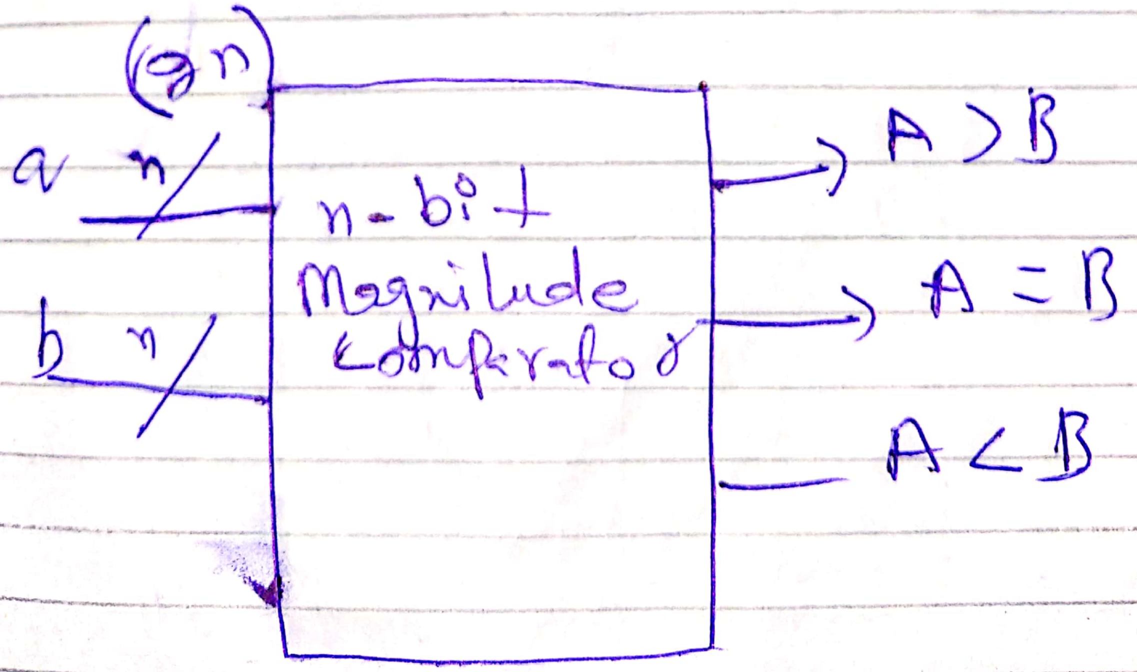
(DLD- LAB-7)

⇒ Comparators

A magnitude comparator is a combinational circuit that compares two digital or binary numbers (consider A and B) and determines their relative magnitudes. in order to find out whether one number is equal, less than or greater than the other digital number

⇒ Three binary numbers variables are used to indicate the outcome of the comparison

A>B, A<B, or A = B



(1-Bit Magnitude Comparator)

		Less	Equal	Greater
A	B	A < B	A = B	A > B
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

$A' \cdot B'$ —

$A' \cdot B \rightarrow$ less

$A \cdot B' \rightarrow$ Greater

$A \cdot B \rightarrow$

$A' \cdot B' + A \cdot B$

Equal

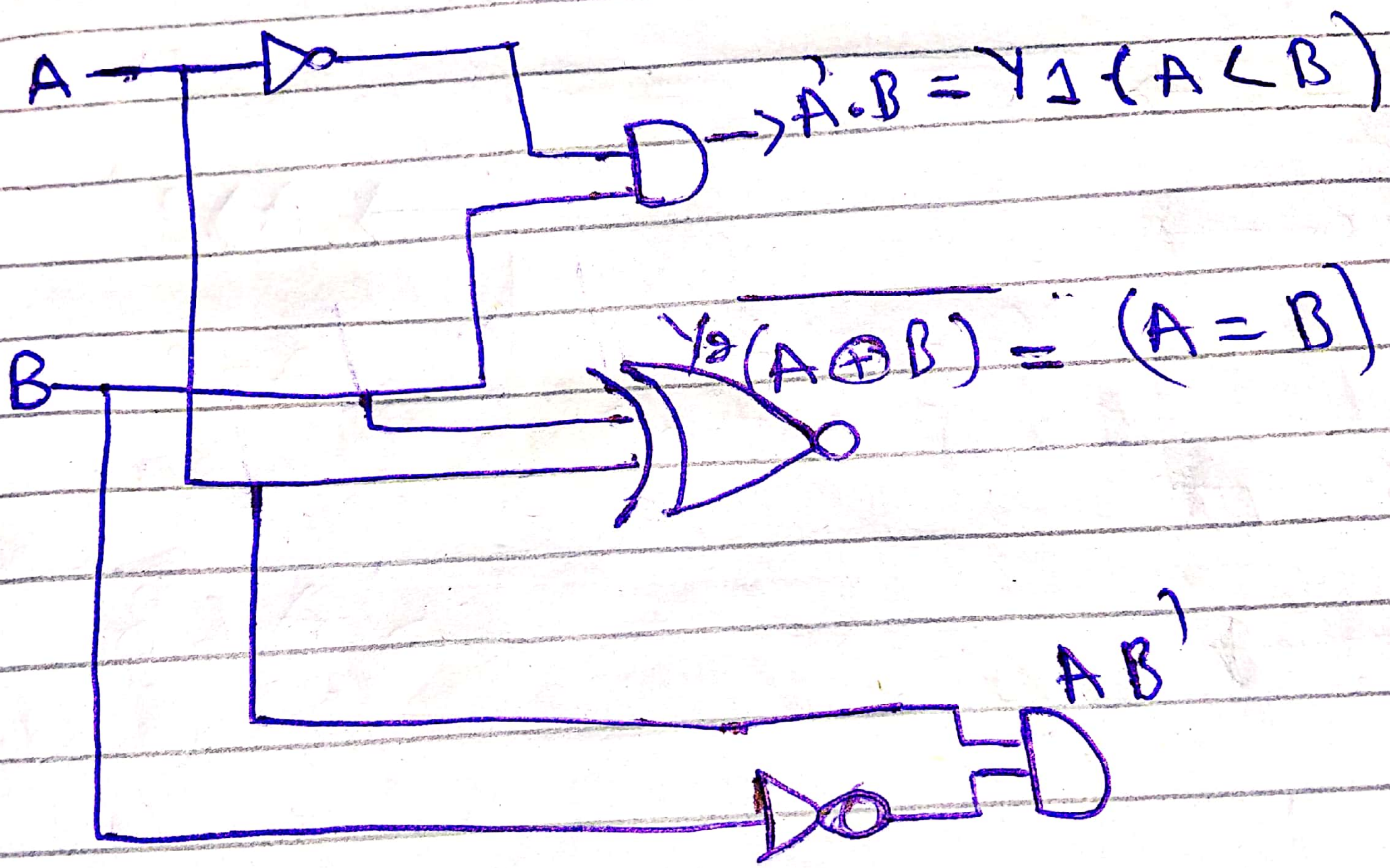
equal to 1 to X-Nor

$(\overline{A \oplus B})$

$Y_1 = (A<B) = A'B$

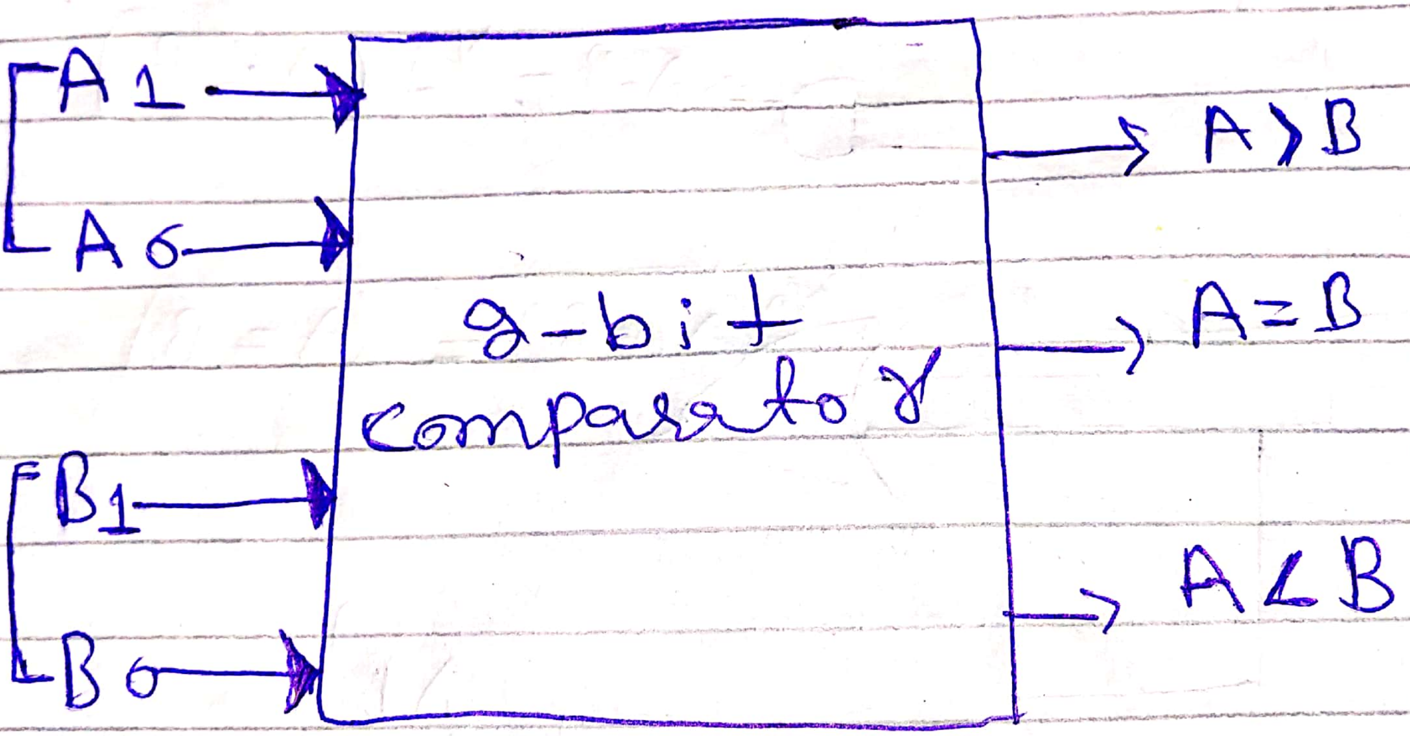
$Y_2 = (A=B) = A'B' + AB = (\overline{A \oplus B})$

$Y_3 (A>B) = AB'$



(2-Bit Magnitude Comparator)

⇒ A comparator used to compare two 2-bit numbers. It has 4 binary inputs.
number A : $A_1 A_0$, number B : $B_1 B_0$
and Binary outputs
greater than , equal and less than relations.



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	Inputs				Outputs		
	A_1	A_0	B_1	B_0	$A>B$	$A=B$	$A<B$
0	0	0	0	0	0	1	0
1	0	0	0	1	0	0	1
2	0	0	1	0	0	0	1
3	0	0	1	1	0	0	1
4	0	1	0	0	1	0	0
5	0	1	0	1	0	1	0
6	0	1	1	0	0	0	1
7	0	1	1	1	0	0	1
8	1	0	0	0	1	0	0
9	1	0	0	1	1	0	0
10	1	0	1	0	0	1	0
11	1	0	1	1	0	0	1
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	1	0

For A<B

$2^4 = 16$

$A_1A_0 \backslash B_1B_0$	$B_1'B_0'$ 00	$B_1'B_0$ 01	B_1B_0 11	B_1B_0' 10
$A_1'A_0'$ 00	0	1: 1	3: 1	2: 1
$A_1'A_0$ 01	4: 1	5	7: 1	6: 1
A_1A_0 11	12	13	15	14
A_1A_0' 10	8	9	11: 1	10

$A_1'A_0'B_0 + A_1'B_1 + B_1B_0A_0'$

For A=B

$A_1A_0 \backslash B_1B_0$	$B_1'B_0'$ 00	$B_1'B_0$ 01	B_1B_0 11	B_1B_0' 10
$A_1'A_0'$ 00	0: 1	1	3	2
$A_1'A_0$ 01	4	5: 1	7	6
A_1A_0 11	12	13	15: 1	14
A_1A_0' 10	8	9	11	10: 1

$A_1A_0 \cdot B_1'B_0 + A_1'A_0B_1'B_0 + A_1A_0B_1B_0$
$+ A_1A_0'B_1B_0'$

For A > B

A_1A_0 \ B_1B_0	$B_1'B_0'$ 00	$B_1'B_0$ 01	B_1B_0 11	B_1B_0' 10
00 $A_1'A_0'$	0	1	3	2
01 $A_1'A_0$	4 1	5	7	6
11 A_1A_0	12 1	1 13	15	14 1
10 A_1A_0'	8 1	19	11	10

$$Y_3 = A_0\bar{B}_1\bar{B}_0 + A_1\bar{B}_1 + A_1A_0\bar{B}_0$$

Simplifying A=B equation

$$\Rightarrow Y_8 = \overline{A_1}\,\overline{A_0}\,\overline{B_1}\,\overline{B_0} + A_1 \overline{A_0} B_1 \overline{B_0} + \overline{A_1} A_0 \overline{B_1} B_0 + A_1 A_0 B_1 B_0$$

$$\Rightarrow \overline{A_0}\,\overline{B_0}\left(\overline{A_1}\,\overline{B_1} + A_1 \cdot B_1\right) + A_0 B_0\left(\overline{A_1}\,\overline{B_1} + A_1 B_1\right)$$

$$\Rightarrow \left(\overline{A_0}\,\overline{B_0} + A_0 B_0\right) \cdot \left(\overline{A_1}\,\overline{B_1} + A_1 \cdot B_1\right)$$

$$X_8 = \left(\overline{A_1 \oplus B_1}\right) \cdot \left(\overline{A_0 \oplus B_0}\right)$$