classmate

Date

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LAB 1 - Drawing Basic Circuits

OM - ETH Zürich - Sping 2020

1. Design a 4-bit Comparator circuit that has two 4-bit binary inputs (A and B) and outputs a logic - 1 if both inputs are equal

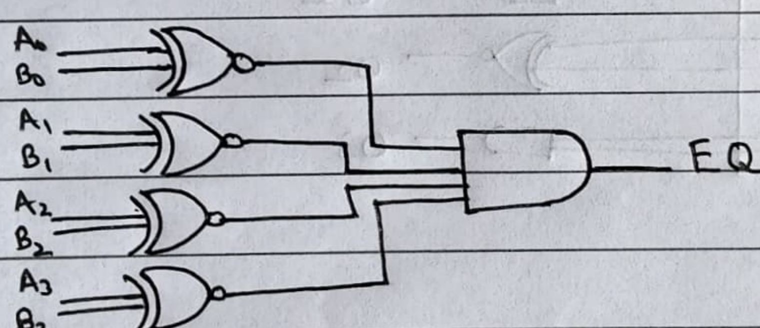
→ $A = A_3 A_2 A_1 A_0$

$B = B_3 B_2 B_1 B_0$

EQ = 1 when $(A_0 == B_0)$ and $(A_1 == B_1)$ and $(A_2 == B_2)$ and $(A_3 == B_3)$

A	B	EQ
0	0	1
0	1	0
1	0	0
1	1	1

⇒ XNOR Gate



2. Design a circuit that receives two 1-bit inputs A and B, and:

- sets its first output (O1) to 1 if $A > B$
- sets the second output (O2) to 1 if $A = B$
- sets the third output (O3) to 1 if $A < B$

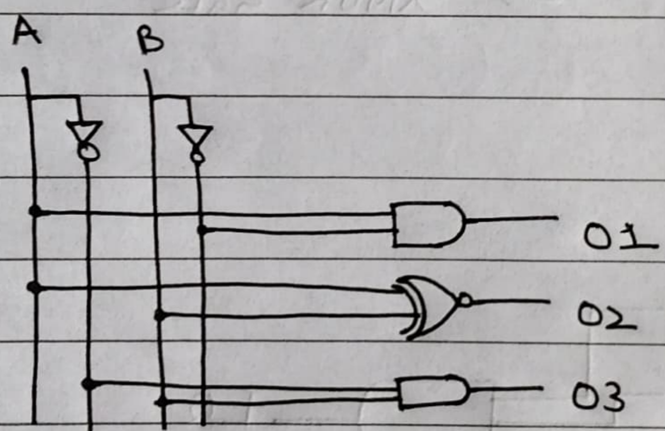
→

A	B	O1	O2	O3
0	0	0	1	0
0	1	0	0	1
1	0	1	0	0
1	1	0	1	0

$O1 = A\bar{B}$

$O2 = A \odot B$

$O3 = \bar{A}B$



3. Re-draw the schematic of part 2 with only 2-input NANDs

→ $A \odot B = \bar{A}\bar{B} + AB$

Applying DeMorgan's Theorem,

$A \odot B = \overline{\overline{\bar{A}\bar{B}} \cdot \overline{AB}}$

X

reverse: $\overline{\underbrace{\overline{\bar{A}\bar{B}}}_{C} \cdot \underbrace{\overline{AB}}_{D}}$

$\therefore \overline{C \cdot D} = \bar{C} + \bar{D}$

$\therefore \overline{\overline{\bar{A}\bar{B}} \cdot \overline{AB}} = \overline{\overline{\bar{A}\bar{B}}} + \overline{\overline{AB}} = \bar{A}\bar{B} + AB$

X

Hence redrawing the circuit using only 2-input NANDs,