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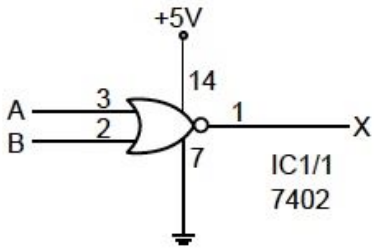
Name: ..... Student ID: .....

Laboratory 7

NOR Gate and *NAND* Gate

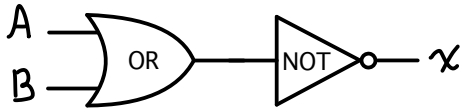
1. *NOR*-Gate:

1.1 Connect a logic circuit as shown in the figure below. Use the logic switches to supply input signals as specified. Connect the output signals to the logic monitor and record the results for each input pairs.



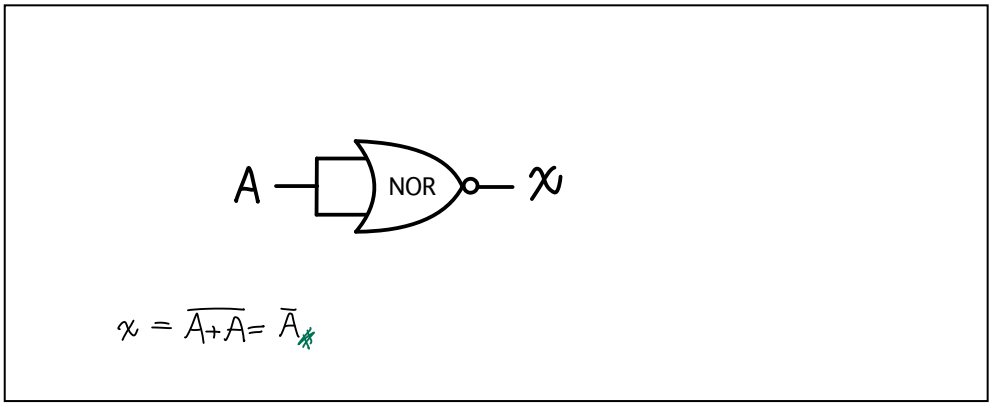
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

1.2 Draw an equivalent circuit of *NOR* gate using basic gates (*AND, OR* and *NOT* gates)



Instructor's signature

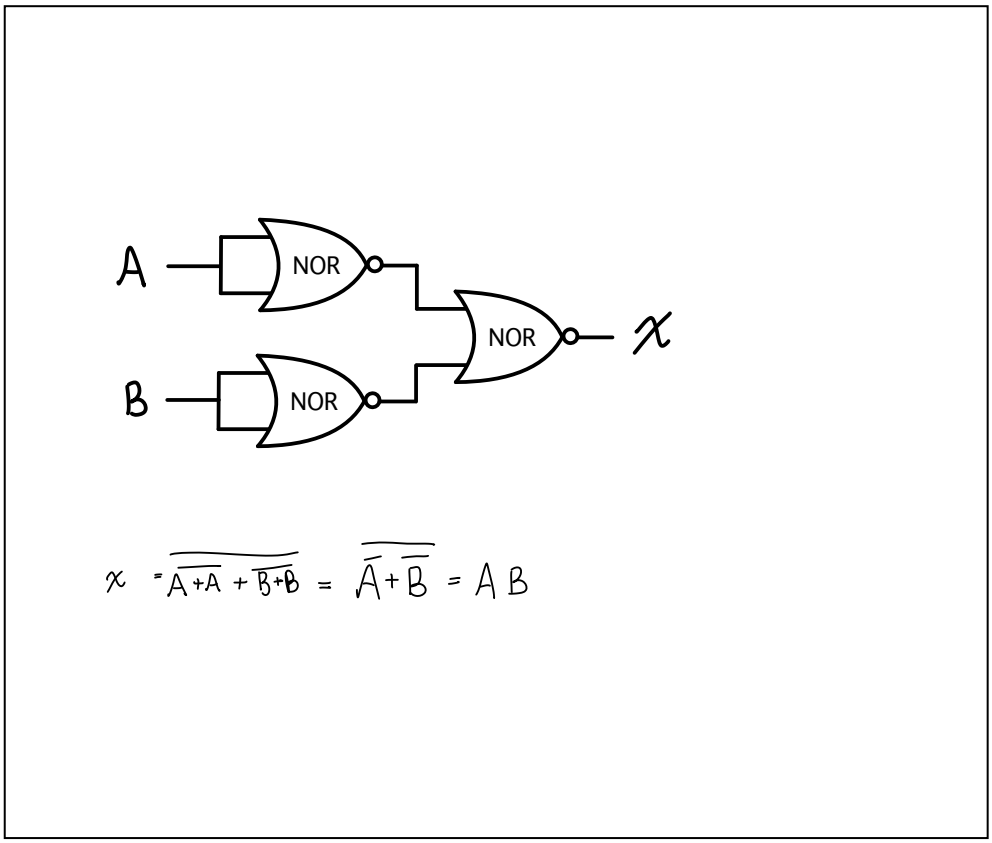
1.3 Draw and construct a *NOT* gate using only *NOR* gate. Prove your answer using Boolean algebra.



$x = \overline{A+A} = \bar{A}$

Instructor's signature

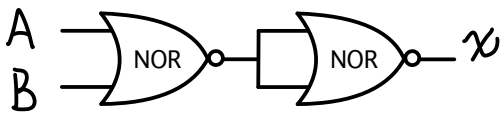
1.4 Draw and construct an *AND* gate using only *NOR* gate. Prove your answer using Boolean algebra.



$x = \overline{\overline{A+A} + \overline{B+B}} = \overline{\bar{A}+\bar{B}} = AB$

Instructor's signature

1.5 Draw and construct an *OR* gate using only *NOR* gate. Prove your answer using Boolean algebra.



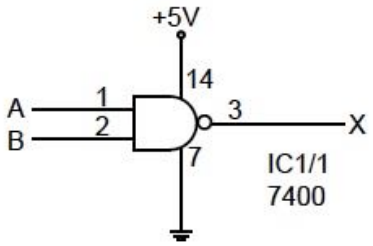
$$x = \overline{\overline{A+B}+\overline{A+B}} = \overline{\overline{A+B}} = \overline{\bar{A}\bar{B}} = A+B$$

Instructor's signature

Sugar

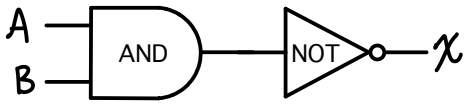
2. *NAND*-Gate:

2.1 Connect a logic circuit as shown in the figure below. Use the logic switches to supply input signals as specified. Connect the output signals to the logic monitor and record the results for each input pairs.



A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

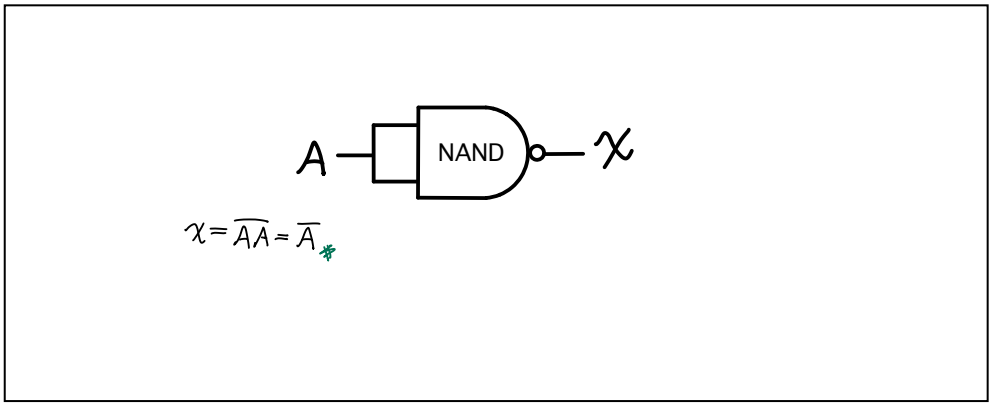
2.2 Draw an equivalent circuit of *NAND* gate using basic gate (*AND, OR* and *NOT* gates)



Instructor's signature

Sugar

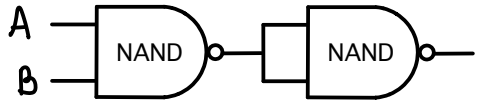
2.3 Draw and construct a *NOT* gate using only *NAND* gate. Prove your answer using Boolean algebra.



$X = \overline{AA} = \overline{A}$

Instructor's signature

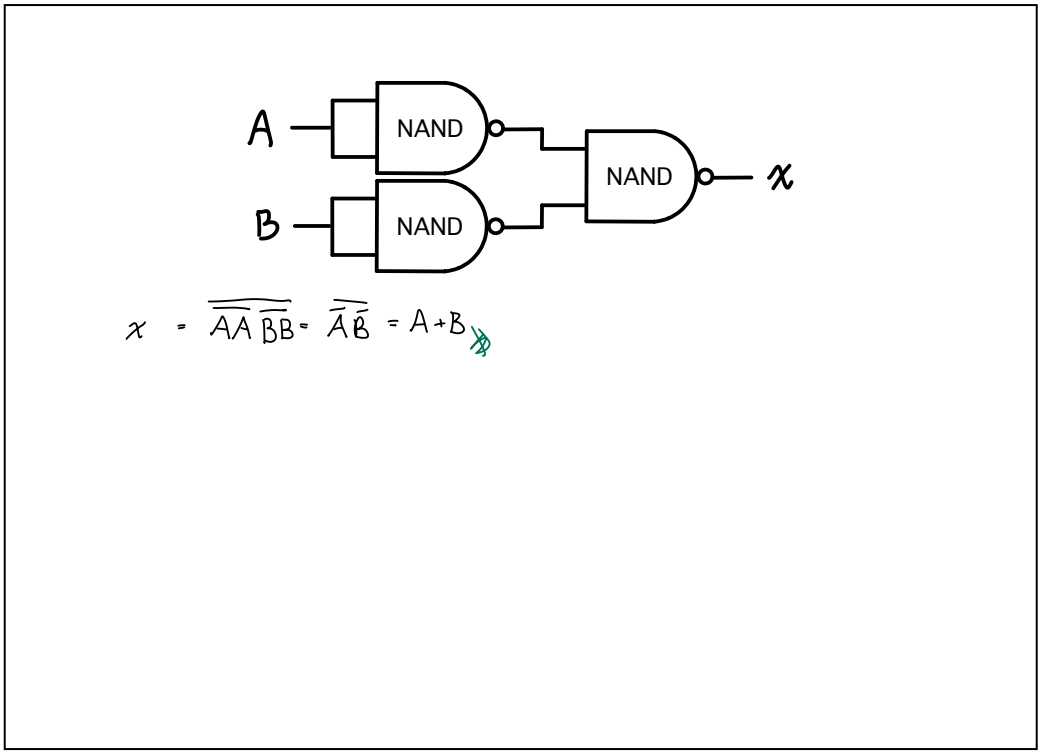
2.4 Draw and construct an *AND* gate using only *NAND* gate. Prove your answer using Boolean algebra.



$X = \overline{\overline{AB}\,\overline{AB}} = \overline{\overline{AB}\,\overline{AB}} = \overline{\overline{AB}} = \overline{\overline{A}+\overline{B}} = AB$

Instructor's signature

2.5 Draw and construct an *OR* gate using only *NAND* gate. Prove your answer using Boolean algebra.



Instructor's signature

3. Assignments

3.1 Build a *NOR* gate using only *NAND* gates.

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3.2 Build a *NAND* gate using only *NOR* gates

Instructor's signature

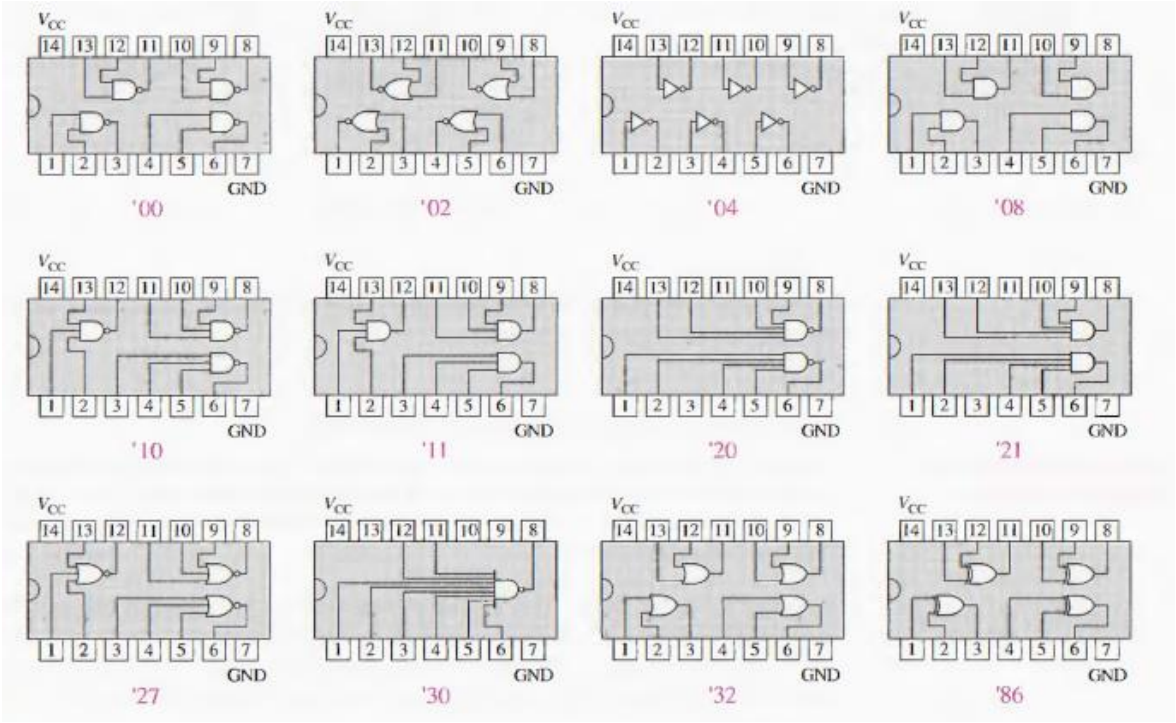
3.3 Build *XOR* gate using only *NAND* gates

Instructor's signature

3.4 Build half adder circuit using NAND and NOR gates

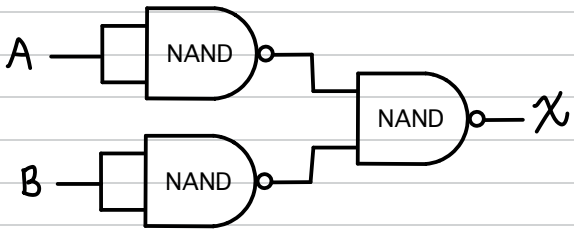
Instructor's signature

Logic Diagram of frequently used gates



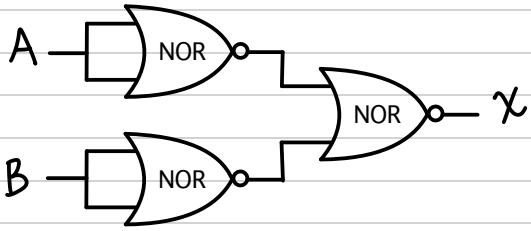
3.1 Build a *NOR* gate using only *NAND* gates.

$$X = \overline{(\overline{A}\overline{A})(\overline{B}\overline{B})}$$
$$= \overline{(\overline{A}+\overline{A})(\overline{B}+\overline{B})}$$
$$= \overline{\overline{A}\,\overline{B}}$$
$$= \overline{A+B}$$



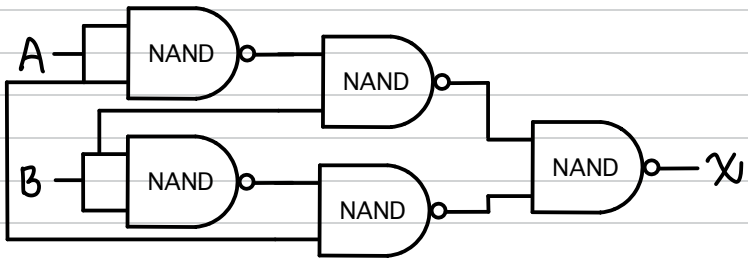
3.2 Build a *NAND* gate using only *NOR* gates

$$X = \overline{(\overline{A}+A)+(\overline{B}+B)}$$
$$= \overline{\overline{A}A + \overline{B}B}$$
$$= \overline{\overline{A}+\overline{B}}$$
$$= \overline{AB}$$



3.3 Build *XOR* gate using only *NAND* gates

$$X = \overline{(\overline{A\overline{A}(B)})(\overline{A(\overline{B}\overline{B})})}$$
$$= \overline{(\overline{(\overline{A}+\overline{A})B})(\overline{A(\overline{B}+\overline{B})})}$$
$$= \overline{(\overline{\overline{A}B})(\overline{A\overline{B}})}$$
$$= \overline{A}B + A\overline{B}$$
$$= A \oplus B$$



3.4 Build half adder circuit using NAND and NOR gates