Logic Gates

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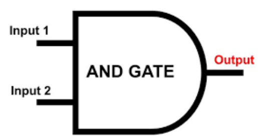
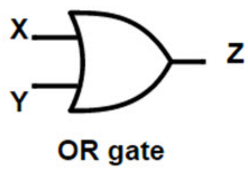
1 Introduction

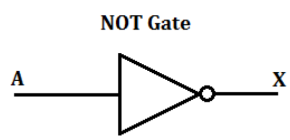
Logic gates were fabricated from an array of configurable switches, each consisting of a monolayer of redox-active rotaxanes sandwiched between metal electrodes [1].
A gate in a simple electronic componet that functions like a lightbulb. They function by combining multiple signals to produce a single signal based on their unique properties [2].

2 Types of Logic Gates

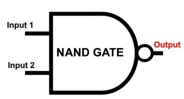
1 Fundamental gates are AND, OR , NOT:

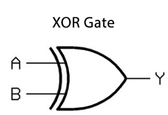


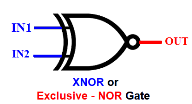




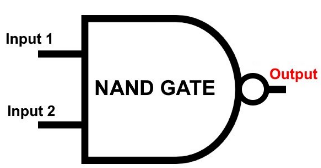
2 Derived Gates NAND, NOR, XOR and XNOR(derived from fundamental gates)

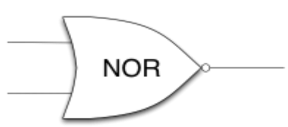






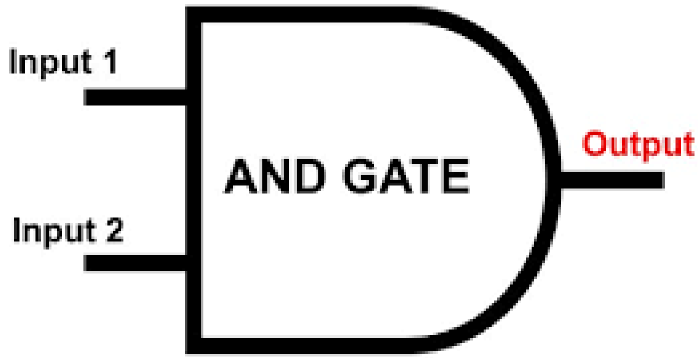
3 Universal Gates NAND and NOR gates(The fundamental gates can be realized through them).





referenced from [3]

2.1 AND Gate

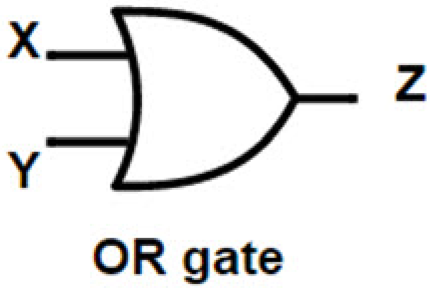


The **AND** operation produces a true output (result of 1) only for a single case when all of the input variables are 1 and a false output(result of 0) where one or more inputs are 0.

Table 1: AND Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	1
1	0	0
0	1	0
0	0	0

2.2 OR Gate

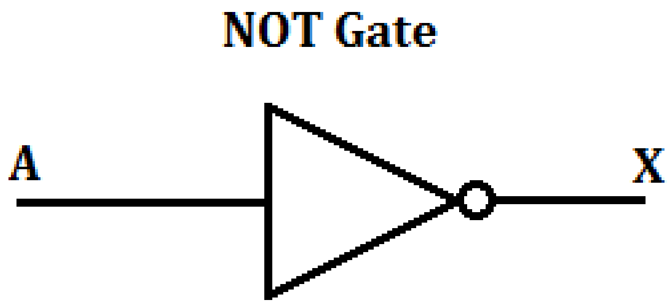


The **OR** operation produces a true output (result of 1)when any of the input variables are 1 and a false output(result of 0) where both inputs are 0.

Table 2: OR Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	1
1	0	1
0	1	1
0	0	0

2.3 NOT Gate

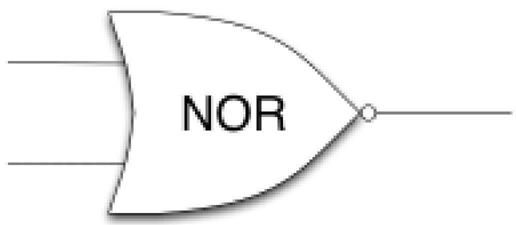


The **NOT** operation also known as a **logical inverter**, has only one input and produces the oppostite of the input signal.

Table 3: NOT Logic Table

INPUT	OUTPUT
1	0
0	1

2.4 NOR Gate

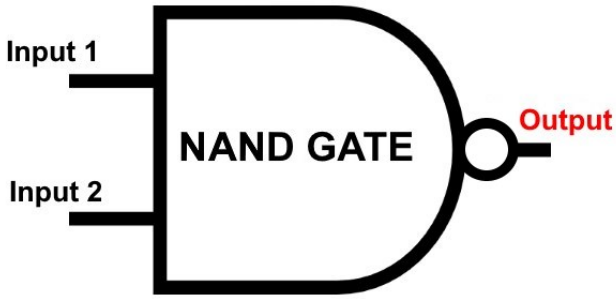


The **NOR** operation produces the opposite result of an OR Gate.

Table 4: NOR Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	0
1	0	0
0	1	0
0	0	1

2.5 NAND Gate

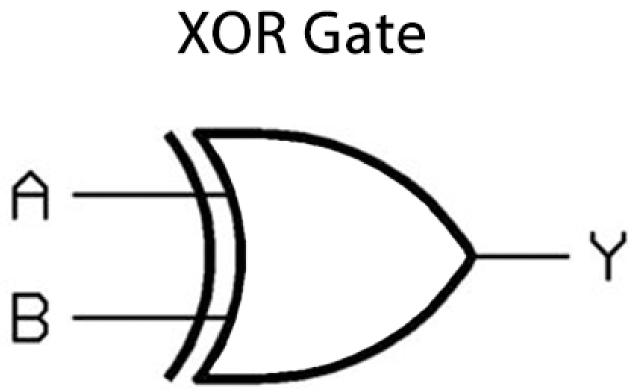


The **NAND** operation produces the opposite output of an AND Gate.

Table 5: NAND Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	0
1	0	1
0	1	1
0	0	1

2.6 XOR Gate

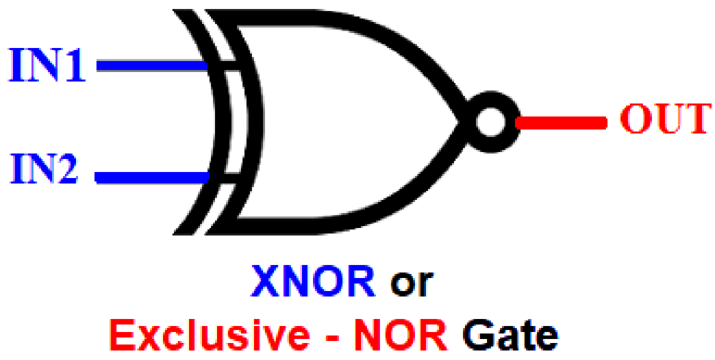


The **XOR** operation produces a true output (result of 1) if either case of the input variables are 1 and a false output(result of 0) if both inputs are 0 or one at the same time.

Table 6: AND Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	0
1	0	1
0	1	1
0	0	0

2.7 XNOR Gate



The **XNOR** operation produces the opposite output of the operation XOR Gate Referenced from [4]

Table 7: XOR Logic Table

INPUT 1	INPUT 2	OUTPUT
1	1	1
1	0	0
0	1	0
0	0	1

3 Summary

In a nutshell, Logic Gates are basic computer components used in the design of logical componets. They are used in various complex combinations and connections to perform operations. They are implemented in various technologies and from the foundation for computers.

References

[1] C. Collier, E. Wong, M. Belohradskỳ, F. Raymo, J. Stoddart, P. Kuekes, R. Williams, and J. Heath, "Electronically configurable molecular-based logic gates," *science*, vol. 285, no. 5426, pp. 391–394, 1999.

[2] N. Okoacha, "Logic gates [powerpointslides] - introduction," *GST 108: Introduction to Quantitative Reasoning*, pp. 1–6, 2021.

[3] N. Okoacha, "Logic gates [powerpointslides] - types of logic gates," *GST 108: Introduction to Quantitative Reasoning*, p. 8, 2021.

[4] N. Okoacha, "Logic gates [powerpointslides] - tables of logic gates," *GST 108: Introduction to Quantitative Reasoning*, pp. 9–21, 2021.