

COM1226

Logic Gates

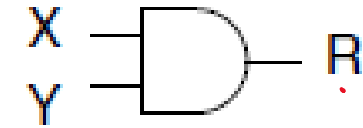
Logic gates

- Logic gates are the basic building blocks of any digital circuit and computer, that performs a specific logical operation .
- There are three elementary gates called AND, OR and NOT.
- More useful gates called NAND, NOR and XOR gates.
- All gates are binary - they take one or more binary input values and produce a binary output value;
- Each of these gates can be described using truth tables.
- Truth tables - shows all the inputs to the gate, and the output it produces dependent on the values of the inputs.

AND gate

- With the AND gate, the output is set to **1 only when both inputs are 1, otherwise the output is 0**
- Identical to the AND operation in binary arithmetic.
- It is possible to have AND gates with more than two inputs but their output follows these same rules.

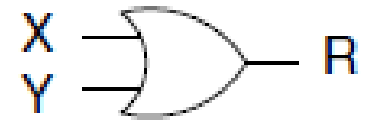
X	Y	R
0	0	0
0	1	0
1	0	0
1	1	1



OR gate

- With the OR gate, the output is set to **1** when **either (or both) of its inputs are 1**, otherwise the output is 0.
- It is possible to have OR gates with more than two inputs, but their output follows these same rules.

X	Y	R
0	0	0
0	1	1
1	0	1
1	1	1



NOT gate

- Sometimes referred to as an inverter.
- It simply inverts whatever its single input is.

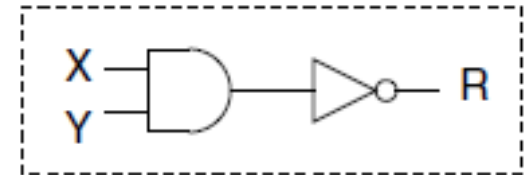
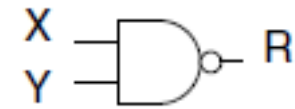
X	R
0	1
1	0



NAND gate

- NAND is short for NOT AND.
- The output from the AND gate is the input to the NOT gate.
- NAND gate produces the exact opposite output of the AND gate.

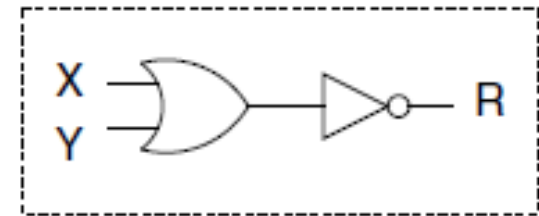
X	Y	R
0	0	1
0	1	1
1	0	1
1	1	0



NOR gate

- NOR is short for NOT OR.
- NOR gate produces the exact opposite output of the OR gate

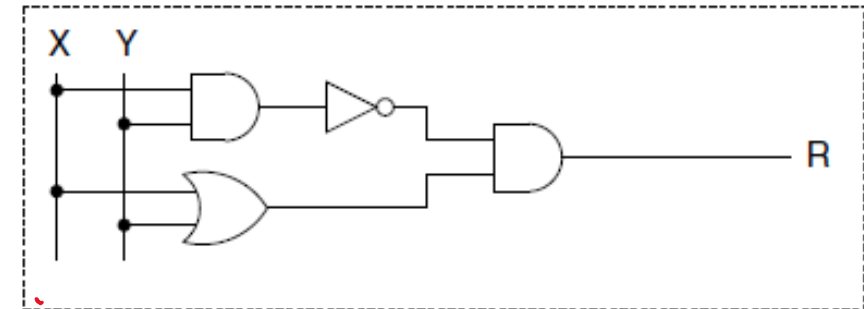
X	Y	R
0	0	1
0	1	0
1	0	0
1	1	0



XOR gate

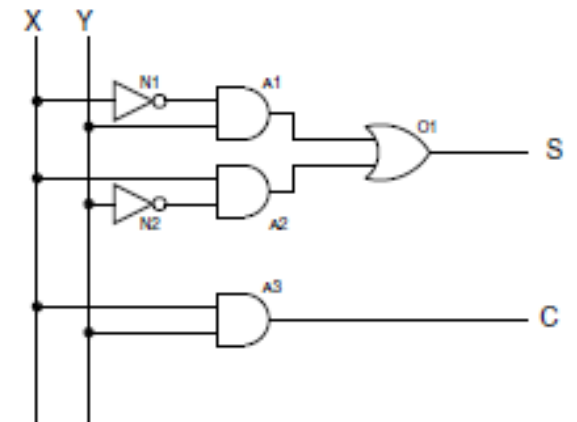
- Sometimes referred to in some texts as an EOR gate.
- Like the OR gate - apart from the fact that it's an exclusive or.
- Exclusive OR means that the **output is 1 only when either input is 1. If both inputs are set to 1 then the output is 0.**
- XOR gate can be built from basic OR, AND and NOT gates too.

X	Y	R
0	0	0
0	1	1
1	0	1
1	1	0



Building Circuits

- All logic circuits can be built from the gates (discussed) by connecting them together.
- Notice that the output from one logic element can be used as an input to another logic element, and that the same input can be used as inputs to multiple logic elements.
- Any circuit can be described in a truth table, the circuit has inputs and can have one or more outputs, and our truth table can describe the outputs for all possible inputs to our circuit.



Performance Analysis of CMOS Gates

- Parameters: Delay, Power Consumption, Noise Margin.
- Delay: The time it takes for a signal to propagate through a gate.
- Power Consumption: Energy efficiency, with a focus on dynamic and static power dissipation.
- Noise Margin: The tolerance of the gate to external noise without affecting performance.

Exercise

- Research the applications and locations of logic gates in computer systems and describe their roles and usage.