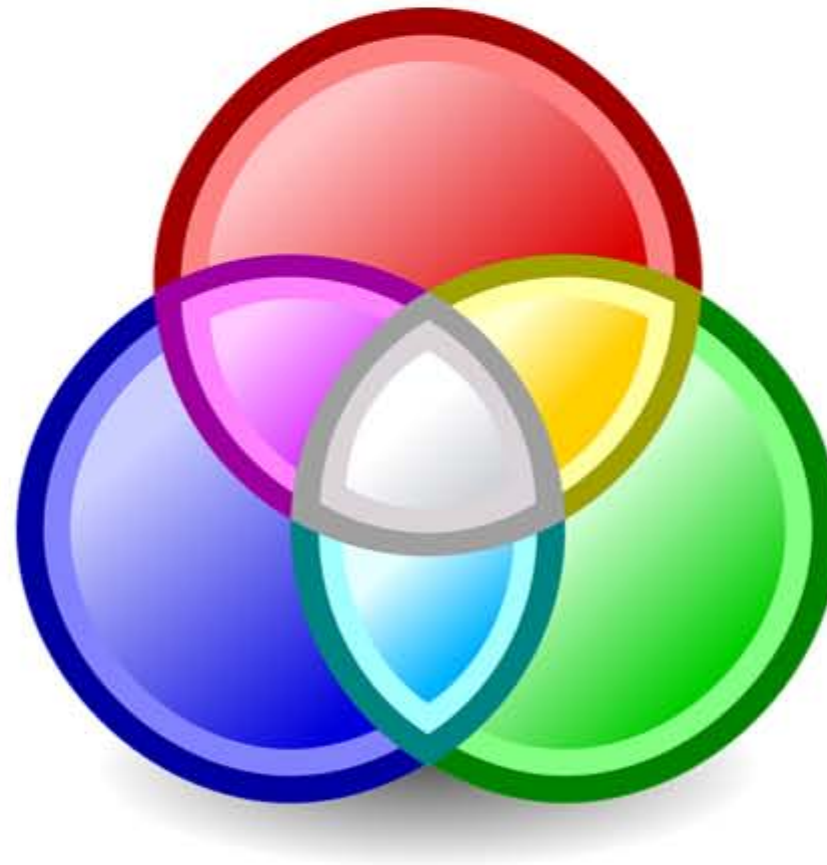


# Logic Gates

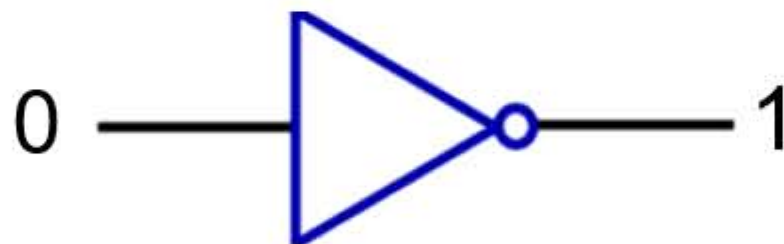


# Logic Gates

Logic gates are the fundamental building blocks of digital circuits.

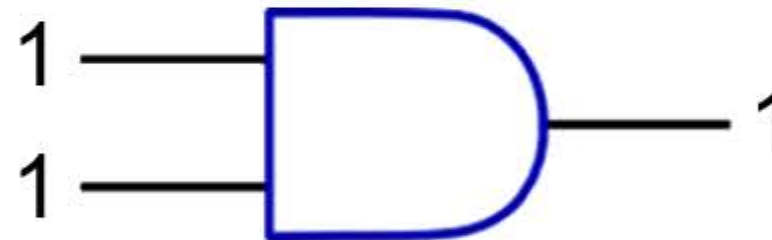
There are three main logic gates:

## NOT



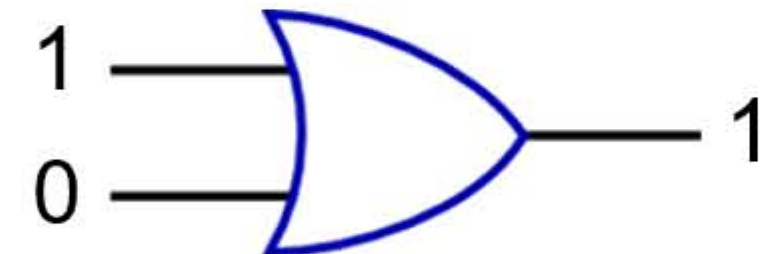
*The NOT gate reverses the input, so if 1 is inputted into a NOT gate it will output 0.*

## AND



*The AND gate will only output 1 if both inputs are 1, otherwise the output will be 0.*

## OR

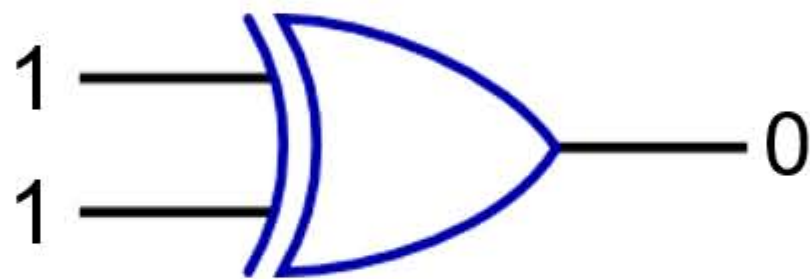


*The OR gate will output 1 if either or both of the inputs are 1.*

# Additional Gates

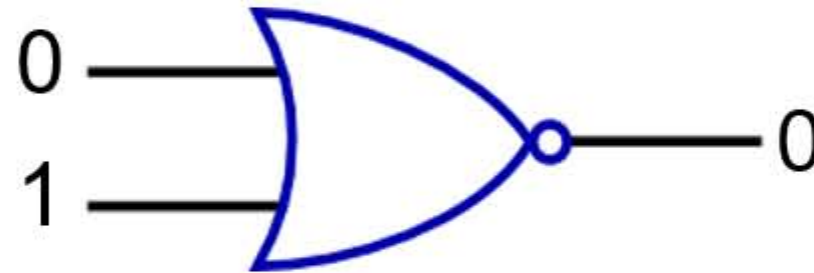
There are some additional logic gates you need to know about.

## XOR



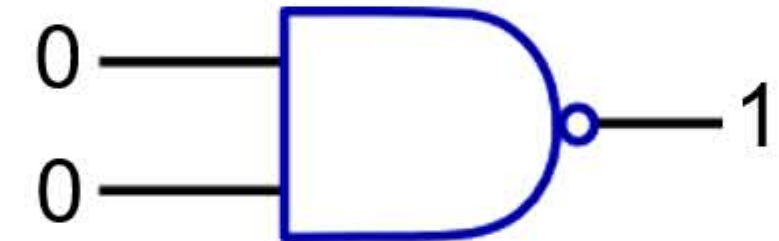
*Exclusive OR -  
Only outputs a 1 if  
one of the inputs is  
1 (not both).*

## NOR



*This is equivalent  
to an OR gate  
followed by a NOT  
gate.*

## NAND

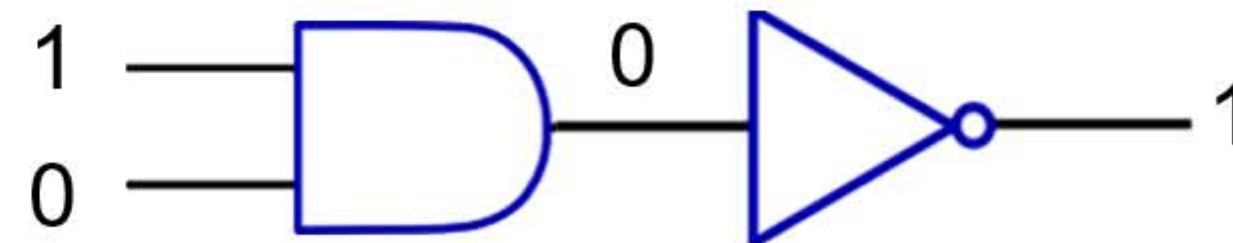
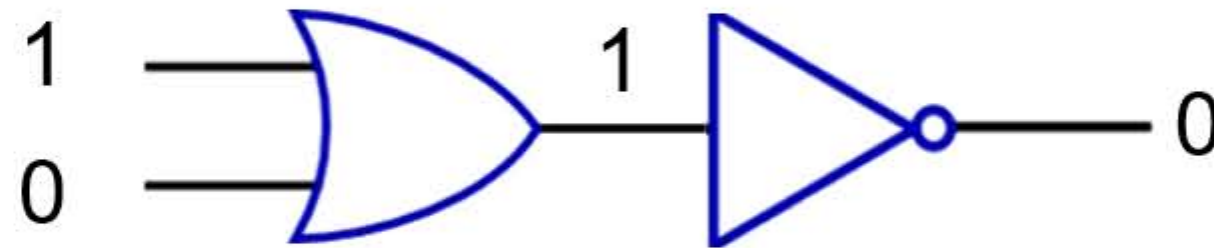


*This is equivalent  
to an AND gate  
followed by a NOT  
gate.*

# Combining Gates

Logic gates can be combined in order to create logic circuits.

For example:

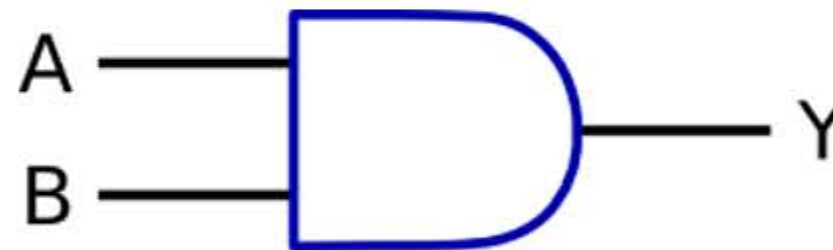




# Truth Tables

All the possible outcomes of a logic diagram can be represented using a truth table.

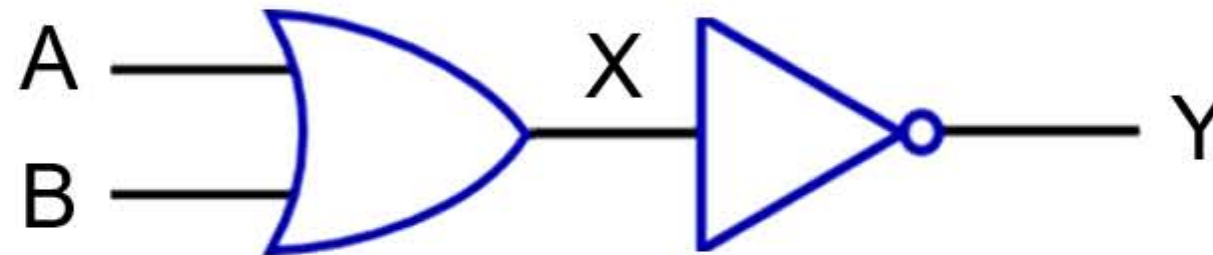
We start by filling in all the possible combinations of inputs.



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

# Another Example

Here is another example of a truth table for a logic diagram consisting of two logic gates.



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

# Logic Statements

Logic diagrams can also be written as logic statements.

$$C = A \text{ OR } B$$

This logic statement shows that C is 1 if either or both A and B are 1.

We can also combine Boolean operators to create more complex logic statements.

$$C = \text{NOT}(A \text{ OR } B)$$

In this case the **NOT** operator is applied to the output of **A OR B**, meaning it is reversed.



# Scenarios (1)

You may be asked to produce a logic diagram for a given scenario.

## Example Scenario

- A system is used to monitor athletes while they are training.
- A heart rate (H) monitor is used to monitor the athlete's heart rate.
- An oxygen (O) is used to monitor the athlete's oxygen levels.
- An alarm (A) is sounded if both the heart rate (H) and oxygen (O) readings are outside safe limits.





# Scenarios (2)

You could also be asked to produce a truth table for a logic statement that relates to a specific scenario.



INPUTS		OUTPUT
H	O	A
0	0	0
0	1	0
1	0	0
1	1	1