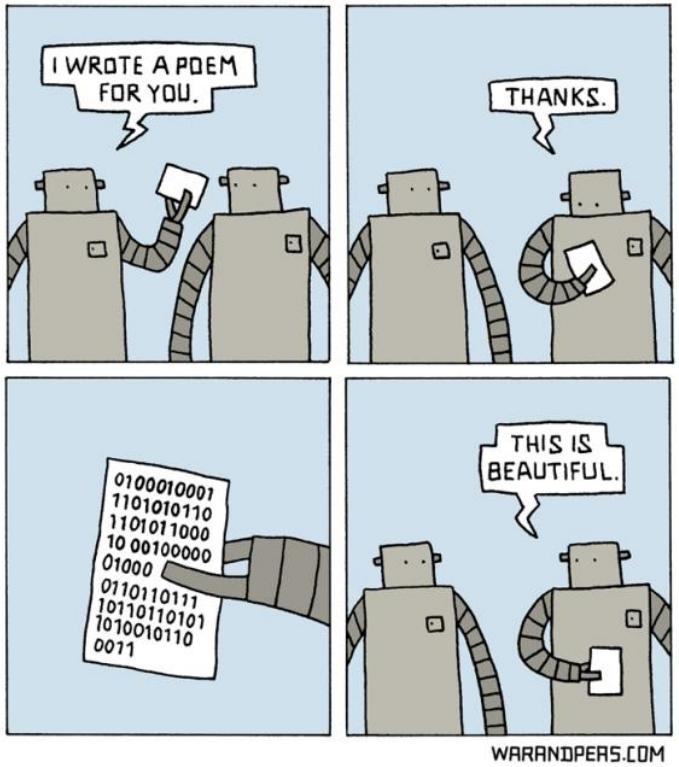
Binary and logic



Recap and agenda

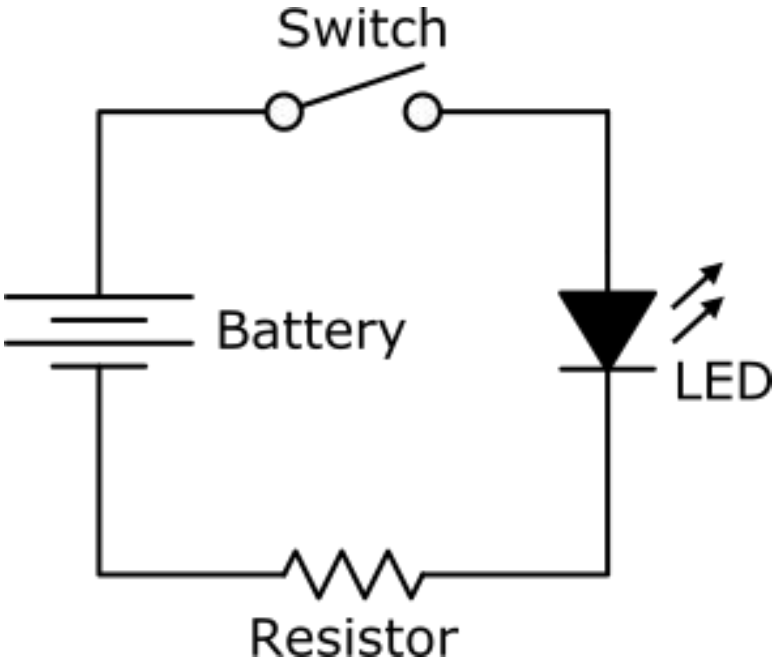
Welcome back! Last week we:

- Looked at the components we will discuss in this course
- Messed around with circuits

Today we take it to the next level, looking at:

- Transistors
- Binary
- Logic gates

First up, recreate your circuit from last week



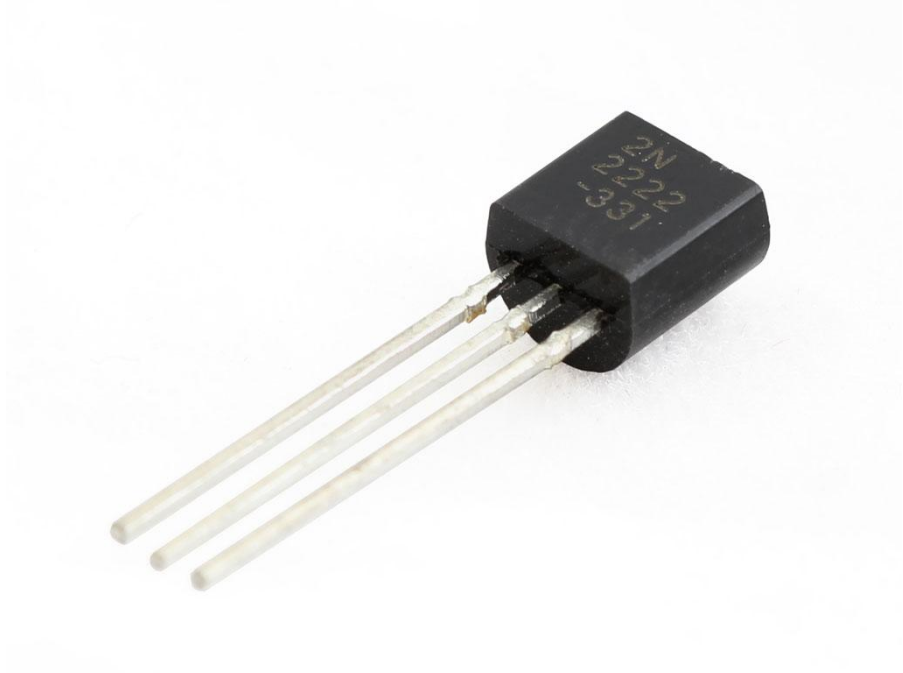
Controlling electricity without a button

Transistor

It’s hard to describe how important the transistor was to the evolution of computers.

Computers operate by a bunch of 1s and 0s (binary). These values need to change a lot! Transistors offer ab easy way to control a current (on or off)

Binary is the basis of computing, with everything boiling down to just 1s and 0s



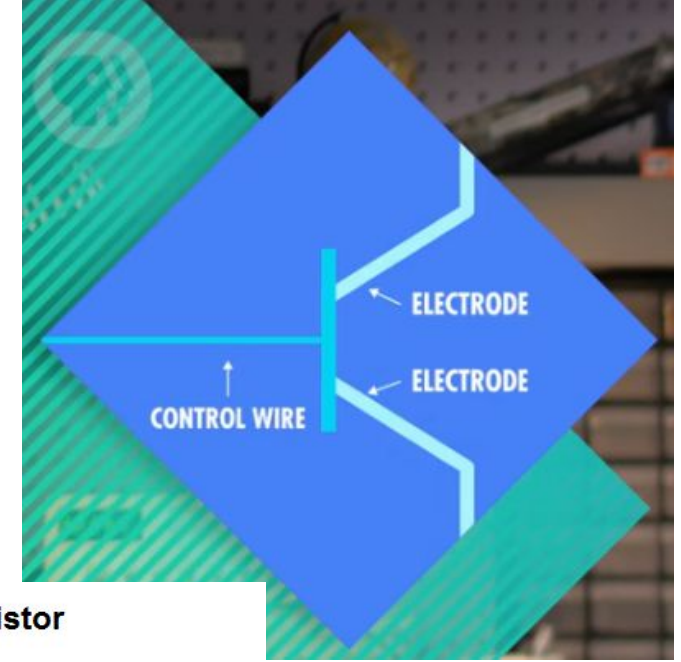
But why binary?

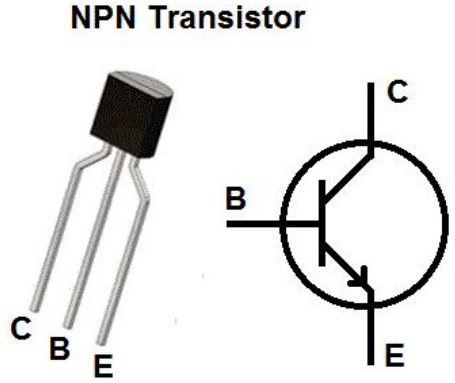
So how to transistors work?

Transistors are like electrical switches that can control the flow of electricity.

When current is applied to the base of the transistor, current is allowed to flow from the collector to the emitter

This is the foundation of computing



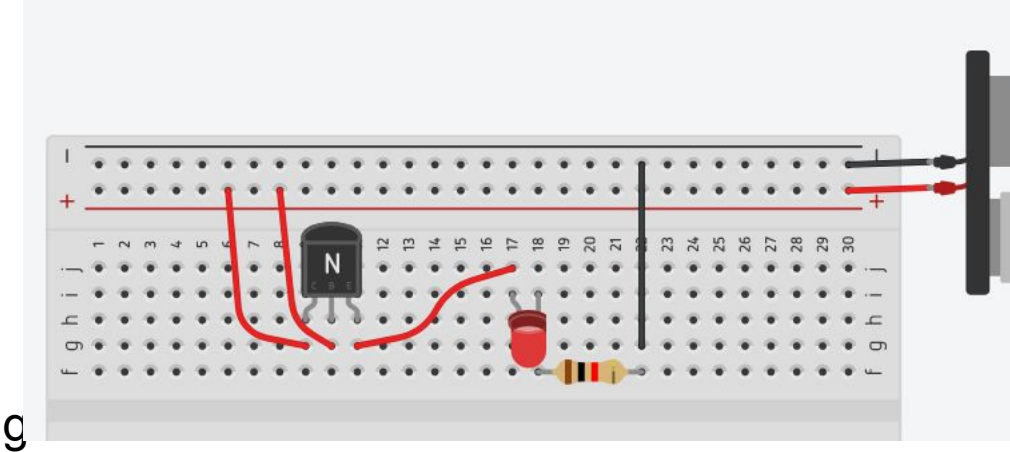


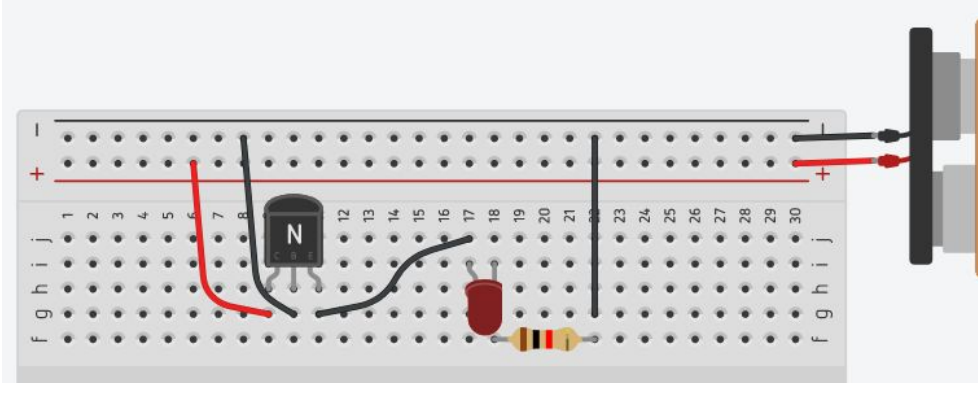
Let’s add a transistor to our breadboard

Firstly, remove the button.

Then, add a transistor anywhere in the circuit. This transistor will control whether the light is on or off.

Note the change in the cable connecting the base of the resistor to the rails!

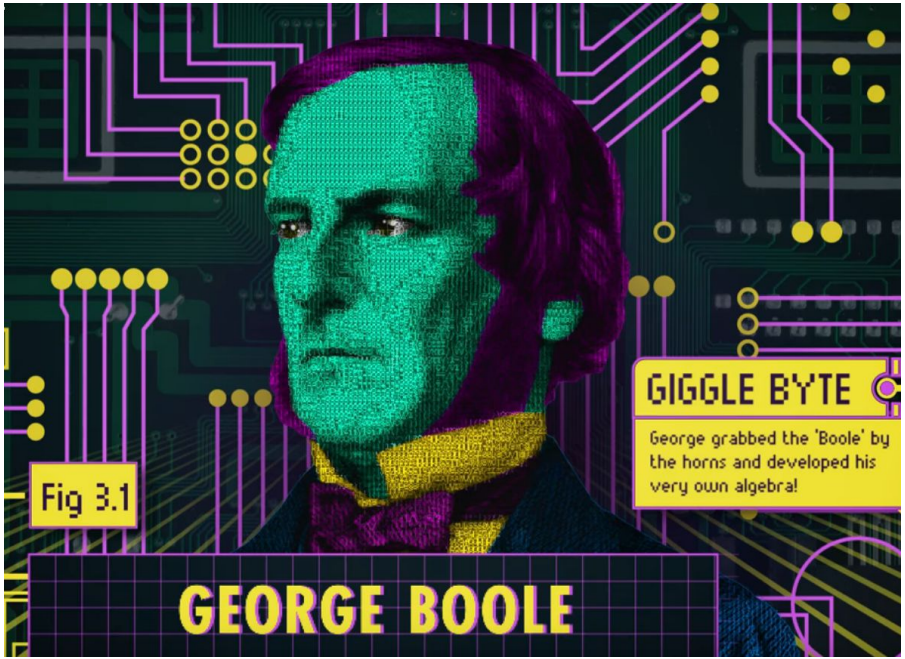




Nice, but not interesting

Remember George Boole? Well he wrote about more than just true = true and false = false, he wrote about *operations* we can do to these values.

No coincidence that these operations are fundamental to computers and how they operate, and lucky for us we all have an intuition as to how these operations work!



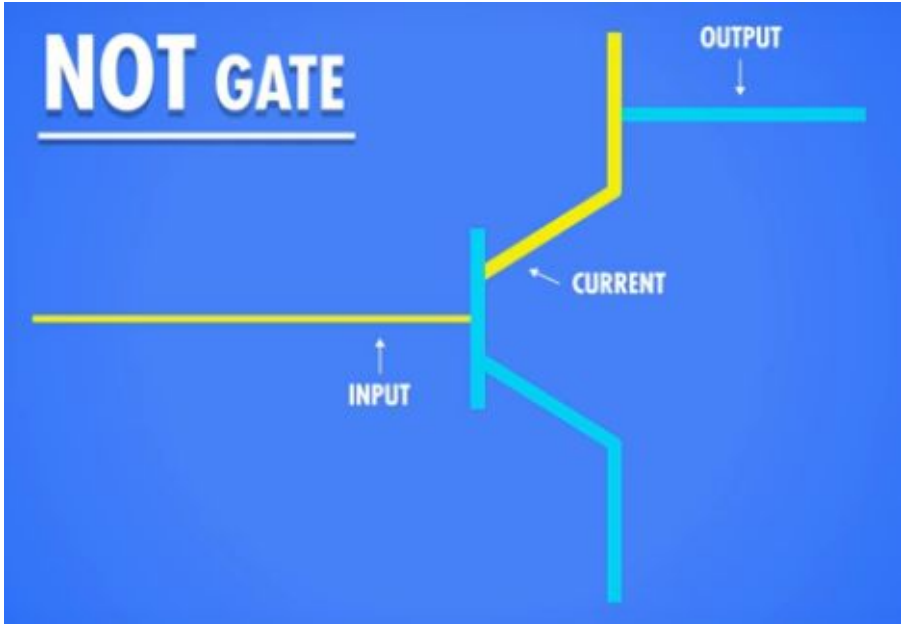
Back to crash course!

Let’s implement that NOT gate!

When the base of the transistor is false, the light should be on

When it’s true, the light should be off

Hint: you can do this by only changing one wire and adding one wire!

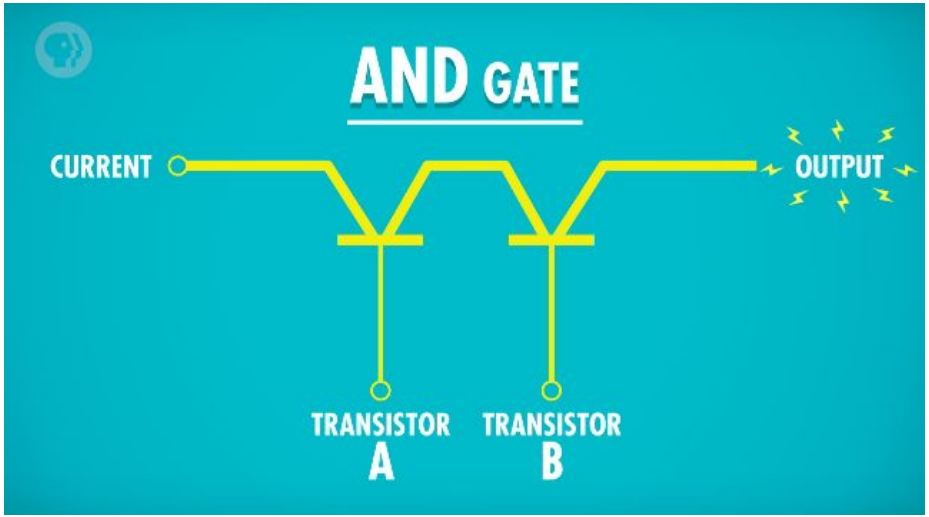


Back to crash course!

AND Gate

Only when both transistors are true (as in power being supplied to the base) will the LED light up

Hint: you're going to need to add a transistor - but make sure the emitter of one transistor is connected to the collector of the other

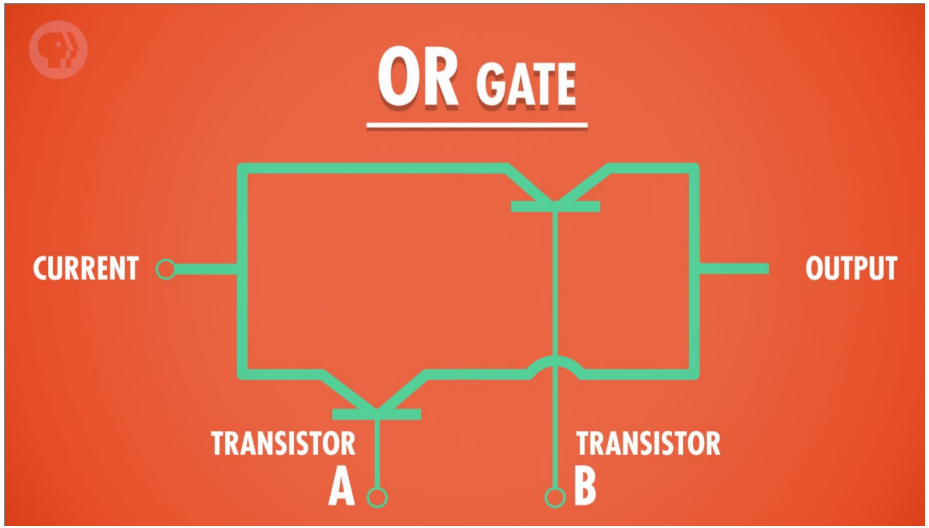


Back to crash course!

OR Gate

Only false is both inputs are false!

Hint: This is not far off from the AND gate!

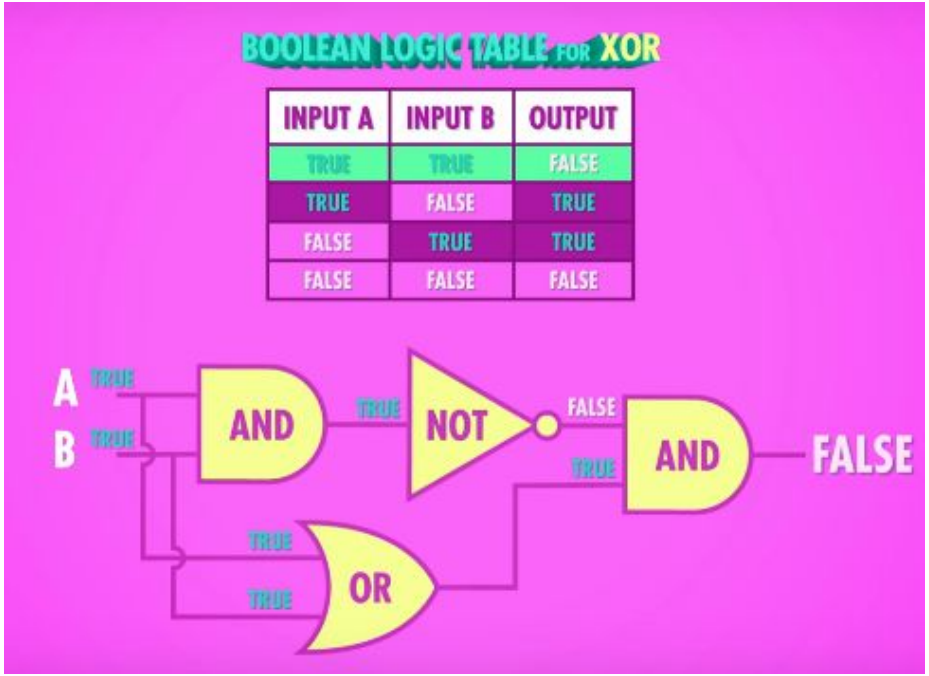


Back to crash course!

Final gate, XOR

Only when both inputs are different (one true one false) does the LED light up. Otherwise it the output is false!

Hint: you're going to need to add a few transistors to this. Try splitting up the logic gate construction amongst groups mates!



Recap

That was intense! Today we covered:

- Transistors
- Logic gates
- Logic gate transistors on a breadboard

Next week, the party rages on with:

- Integrated circuits
- And the ALU