FACT FILE
Computers

Transistors and circuits can be combined to create logic gates. These building blocks can be combined to form functions which decide on what the output should be based on exactly what is input.

These in turn can be combined to form more complex functions, which are able to **make decisions with a greater variety of outputs based on many more inputs**.

Ultimately these can provide the central processing unit (CPU), the workhorse of the computer, with functions sophisticated enough to take instructions from a computer program as inputs and **produce, for example, calculations, graphics and sound as output**.

epcc | archer2 | Hewlett Packard Enterprise | UKRI Engineering and Physical Sciences Research Council | Natural Environment Research Council | The University of Edinburgh

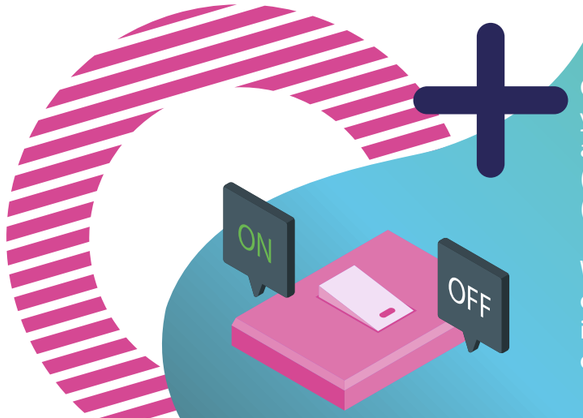
SPINTRONICS BUILD MECHANICAL CIRCUITS

Spintronics can be obtained from
https://upperstory.com/spintronics/

Seriously Sensational Switches

FACT FILE
Circuits and Switches

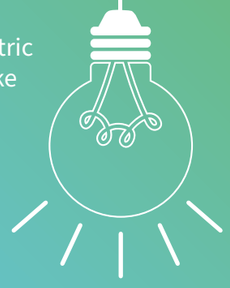
A circuit is a circular path that allows electricity to flow through it. A circuit will have a power source (e.g. a battery) and a device that uses the electricity (e.g. a light).



Circuits often have switches, which allow you to control the flow of electricity, known as the electric current. When a switch is “on” (TRUE) current can flow, when it is “off” (FALSE) the flow of current stops.

When you **turn on a light switch** the electric current can flow to the light bulb and make it **light up**, when you **switch if off**, the circuit is broken and the **light goes out**.

Computers are built from millions and millions of microscopic switches called transistors.



ACTIVITY

Can you create your own circuit?

Create a circuit using spintronics – current will flow from the battery, through an ammeter to create a sound and back to the battery.

You will need:

- A battery
- a resistor, to limit the amount of current
- a switch, to turn the sound on and off
- an ammeter, which indicates the speed of current. Ours generates sound to show your circuit is working.

			
A battery	**A resistor**	**A switch**	**An ammeter**

Connect these together using the chain and see what happens.

What happens when you switch off the switch?

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And when you switch it on?

FACT FILE
Logic Gates

Logic gates are circuits that take several inputs, compare these inputs and provide a single output based on logical functions such as AND and OR. You can look at these functions as deciding what the output should be based on what the inputs are.

An **AND logic gate** has two inputs, with each input being **TRUE** or **FALSE**. The output is only TRUE if both inputs are TRUE.

For example, if you turn on your **burglar alarm** and a burglar walks past a sensor then the burglar **alarm will go off**. But it won't go off if you forget to set the alarm or if there is no burglar.

ACTIVITY

Can you create an AND gate?

Using the same circuit as before, we can add an additional switch to turn this into an AND gate.

By adding two switches, the ammeter will only create a sound if both switches are "on" (TRUE).

Modify the circuit you created above to include two switches.

You will need:

			
A battery	**A resistor**	**Two switches**	**An ammeter**

What happens when both switches are off?

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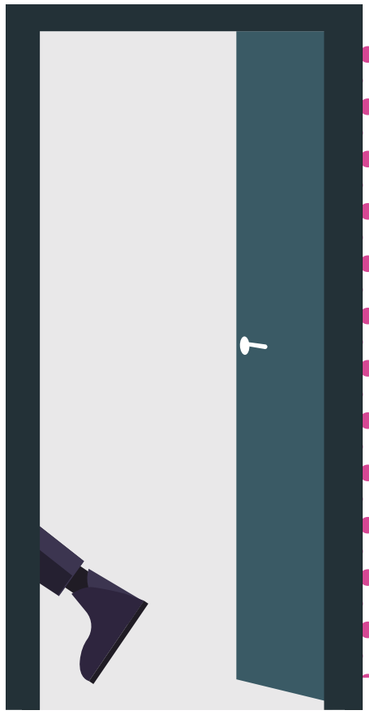
Or when one switch is on or off?

FACT FILE
OR gate

An OR gate also has two inputs, but the output is TRUE if either of the two inputs are TRUE.

For example, our burglar could set the alarm off by **walking past** a motion sensor **OR** by triggering a sensor when they **break open a door**.



ACTIVITY

Create an OR gate

Our previous AND circuit only worked if both switches were on. For our OR gate, the trick is to use a junction, which allows you to split the current.

This particular junction has three sprockets, so current can flow into the junction and split into two streams. If one of those streams is blocked, current will still flow to the other. But if both are blocked, then everything will stop.

To create your OR gate, you will need your resistor, ammeter and battery as before.

Connect in the junction, with the current flowing into the bottom sprocket of the junction. Connect one switch to the middle sprocket and another switch to the top sprocket.

				
A battery	**A resistor**	**Two switches**	**An ammeter**	**A junction**

What happens when both switches are off?

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Or when one switch is on or off?