



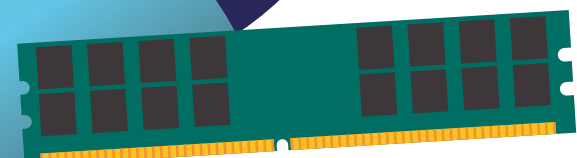
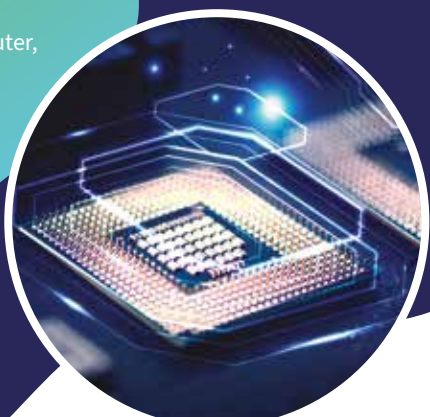
Take a Deep Dive into the world of Supercomputers

Computers are all around us, we have smartphones, tablets, laptops, desktops and music players. But what's inside a computer? And what's a supercomputer?

Computers vary but all contain:

A central processing unit (CPU)

The workhorse of the computer, this calculates, sorts and carries out instructions from you. Your CPU's clock speed tells you how fast it is.



Memory

Just like your own memory, this holds the data and instructions needed by the CPU. Be aware it's only temporary though! When you turn off your computer this will disappear.

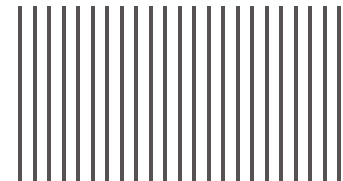


Storage

Just like the local library, this holds your data for the long-term. You may, for example, have a hard drive on your computer.

Input and output devices

These allow you to tell the computer what to do, and to see what the computer has produced. Keyboard, mouse, monitor, printer are all good examples.



What is a Supercomputer?

A computer that is, well, super! Supercomputers are very powerful computers that can carry out calculations that other computers can't do, either because they are too big, or will take too long.

Supercomputers usually have many, many CPUs. **These CPUs work together to carry out a single calculation**, each CPU carrying out a part of the work.

Each CPU usually has multiple cores as well, individual small CPUs which can carry out instructions simultaneously to other cores.

For example, **each processor on ARCHER2 has 64 cores and the whole system has 750,080 cores in total.**

Supercomputers also need **very fast ways to communicate between the CPUs**, to allow data to be shared.

All these cores, together with very fast communication mechanisms, **provide a very powerful supercomputer.**



Why do we need Supercomputers?

Supercomputers help us investigate the latest challenges we face in society. For example, ARCHER2 is the UK's National Supercomputer. It has 750,080 cores in total and is used by scientists all over the UK to investigate, amongst others:

- **Climate change** and how to reduce the impact on people, animals and the environment;
- **Predicting extreme weather events** so that we can plan and reduce loss of life and property;
- Discovery of **new drugs**;
- Improve **new energy sources** such as energy from wind turbines;
- **Reduce noise pollution** from planes when they land;
- **Reduce air pollution** from many forms of transport such as planes and boats.



Are Supercomputers going to be Net Zero?



Supercomputers carry out scientific discovery, including looking at climate change and renewal energy sources. But they do require electricity and generate heat.

All the electricity needed by the Supercomputers at Edinburgh University is provided by a green energy tariff. This means that our energy supplier purchases green energy to match our usage.

We also work hard to reduce the amount of energy we use.

Supercomputers generate heat. We have a cold-water supply that is used to help cool systems such as ARCHER2. **This cold-water supply is kept cool by passing it through fans on the roof of the building, using the cold temperature of Scotland to cool the liquid naturally.**

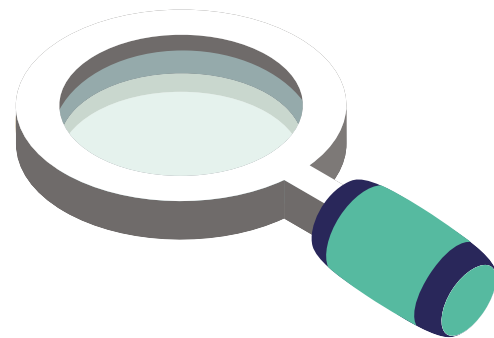
In the same way you might switch on power saving mode or turn off your computer to save electricity, **we look at lots of different ways to sleep, turn-off or slow down bits of the supercomputer when it isn't needed.** For example, reducing the clock speed can run some things just as fast, but without using as much power.

ACTIVITY

Have a look inside the different computers and see if you can identify the CPU, memory and storage. Are they the size and shape you expected?

Have a look at the inside of a blade of ARCHER2. A blade contains 4 nodes, each with 2 AMD EPYC 64-core processors.

Can you spot the processors? And the memory? + **What do you think the copper-coloured parts are for?**



Now look at the display panels, you will see how each blade is stacked within a cabinet. The largest display shows the panels to scale. ARCHER2 has 23 of these cabinets.

