

Hardware and Software

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What is Hardware?

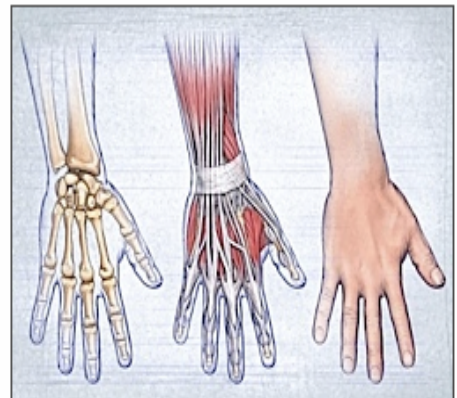
Hardware is the **physical** parts of the computer system – the parts that you can **touch** and **see**.

A motherboard, a CPU, a keyboard and a monitor are all items of hardware.



An analogy...

Your hardware is all of the parts that make up your body: bones, muscles, skin, blood, etc.



What is Software?

Software is a **collection of instructions** that can be 'run' on a computer. These instructions tell the computer what to do.

Software is **not a physical thing** (but it can of course be stored on a physical medium such as a CD-ROM), it is just a bunch of codes.

An operating system such as Windows XP or Mac OS X, applications such as Microsoft Word, and the instructions that control a robot are all examples of software.

To continue the analogy...

Your software is all of your thoughts and mental processes: these are the instructions that tell your physical body what to do



The Difference Between Hardware and Software

Computer **hardware** is the **physical components** that make up the computer system. Hardware is useless without software to run on it.

Software is **instructions** that tell computer hardware what to do. Software is useless unless there is hardware to run it on.

For a computer system to be **useful** it has to consist of **both hardware and software**.

Completing the analogy...

Your physical body cannot function without your thoughts.

And your thoughts need a physical body to exist within



Main Computer Components

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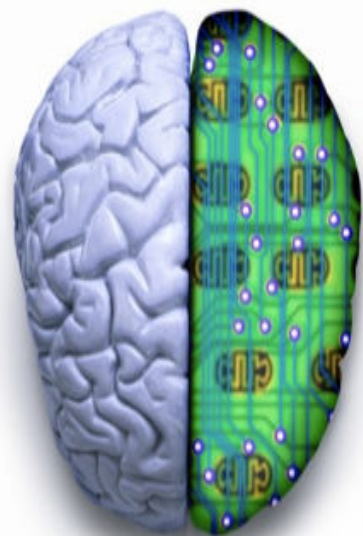
Central Processing Unit (CPU)

The CPU is the '**brain**' of the computer. It is the device that carries out software instructions.



The Pentium processor made by Intel is an example of a CPU.

CPUs usually plug into a large socket on the main circuit board (the motherboard) of a computer. They get very hot when they are operating so usually have a large fan attached to their top to keep them cool.





The speed of a CPU is measured in **Hertz (Hz)**.

The speed generally corresponds to the number of actions the CPU can perform every second.

- 1 **Megahertz (MHz)** is 1,000,000 (1 million) Hertz
- 1 **Gigahertz (GHz)** is 1,000,000,000 (1 billion) Hertz

A typical, modern, fast CPU runs at around 2.8GHz. That means it can perform almost 3 billion actions every second!

Main Memory

Any **data** or **instructions** that are to be **processed** by the CPU must be placed into **main memory** (sometimes known as **primary storage**).

Random Access Memory (RAM)

Random Access Memory (RAM) is the part of the computer that **temporarily stores** the **instructions** that the computer is running, and the **data** it is processing.

RAM is a **volatile** storage device. This means that if the computer's power is turned off the contents of RAM disappear and are **lost**.

RAM, like the CPU, also plugs in to sockets on the motherboard.

When a computer is in use, its RAM will contain...

1. The **operating system** software
2. The **application software** currently being used
3. Any **data** that is being processed



The storage capacity of memory is measured in **Bytes**.

Usually RAM can hold millions of bytes of data, so you will see capacities measured in:

- **Megabytes (MB)** or 1,000,000 (1 million) Bytes
- **Gigabytes (GB)** or 1,000,000,000 (1 billion) Bytes

So, if a computer has 2GB of RAM, it can hold 2 billion bytes of data and instructions at any time.

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Read-Only Memory (ROM)

Read-Only Memory (ROM) is used in most computers to hold a small, special piece of software: the **'boot up'** program.

This 'boot up' software is known as the BIOS (Basic Input Output System)

This software runs when the computer is switched on or 'boots up'. The software checks the computer's hardware and then loads the operating system.

ROM is **non-volatile** storage. This means that the data it contains is **never lost**, even if the power is switched off.

Peripheral Devices

Technically, a computer need only be made up of a CPU and some RAM. But a computer like this would not be much use to anybody – other devices need to be connected to allow data to be passed in and out of the computer.

'Peripheral' literally means 'around the edge'.

In other words these devices are not part of the central core of the computer.

The general name for these extra devices is **'peripheral devices'**. They are usually categorised into **input** devices, **output** devices and **storage** devices.

Input and **output** devices are explored more fully in [Section 2](#).

Storage devices are explored more fully in [Section 3](#).

What Are Input Devices?

Devices that pass **data into the computer** are known as input devices.



A keyboard, a mouse and a webcam are all examples of input devices.

They all take information from the outside world (key presses, hand movements, images), convert them into data and then send this data into the computer for processing.



What Are Output Devices?

Devices that take **data from the computer** are known as output devices.



A monitor, a printer and a loudspeaker are all examples of output devices.

They all take information from the computer and convert it into real world things (images, paper hardcopy, sound).



What is Secondary / Backing Storage?

Secondary storage (sometimes called **backing storage**) is the name for all of the devices (apart from ROM and RAM) that can **store** data in a computer system.



A hard drive, a CD-ROM, a floppy disc and a USB memory stick are all examples of secondary storage devices.

Secondary storage is **non-volatile**, so data that is stored on these devices remains there safely.

When we talk about 'saving' a file, what we mean is moving data from volatile RAM to non-volatile secondary storage.

e.g. If we are typing a letter using Word, the data for the letter is in RAM (if the power goes off we lose it all).

When we save the letter, the data is copied from RAM to a storage device such as a memory stick or hard-drive for safe-keeping.

What is an Operating System?

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An operating system is a special piece of **software** that **manages** the general operation of a computer system:

- It provides a **user interface** so that we can interact with the computer
- It manages **applications** that are running on the computer, starting them when the user requests, and stopping them when they are no longer needed
- It manages **files**, helping us save our work, organise our files, find files that we have saved and load files
- It manages the computer's **memory**, deciding what should be loaded into memory and what should be removed
- It looks after computer **security**, preventing unauthorised access to the system
- It manages the computer's **input and output** hardware such as printers, etc.

An operating system is a bit like the manager of a factory - the manager's job is to keep the factory running smoothly, to make sure all the sections of the factory work together, to check that deliveries arrive on time, etc.

But, for the factory to actually make anything, other people (the workers) are required - the manager cannot make anything him/herself.

Without an operating system, a computer is of little use.

But, just having an operating system running alone on a computer is also not very useful - we need to have **application software** (such as Word, Excel, etc.) so that we can actually do useful tasks with the computer.

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Useless!

On its own, the **hardware** of a computer is a fairly useless lump of plastic and metal!



It Works!

(But it's not very useful)

Add in an **operating system** and you have a computer that actually works.



+



Useful!

To do any useful work you will also have to add **application software**.



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+



Operating systems that you may have heard of:

- Windows XP
- Windows Vista
- Mac OS X
- Linux

User Interfaces

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The system that **people** use to **interact** with a **computer** (to give it commands, to see the results of those commands, etc.) is known as the **user interface**.

There are two that you need to be aware of:

- Graphical User Interface (GUI)
- Command-Line Interface (CLI)

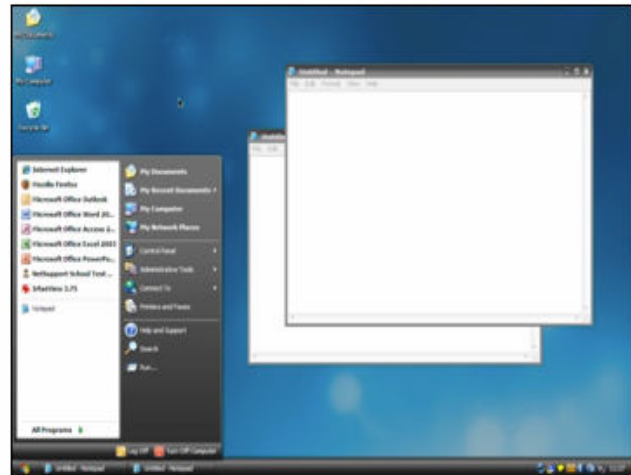


Graphical User Interface (GUI)

A GUI is an interface built around visual (graphical) things:

- **Windows** are regions of the screen used to display information
- **Icons** are small pictures that are used to represent folders, software, etc.
- **Menus** are lists of options the user can select from
- A **pointer** is an arrow that can be moved around the screen and is used to select things

Windows XP is an example of an operating system with a GUI.



GUIs are quite **easy to use** due to the visual nature of the interface – the user has lots of visual clues as to what things do.

A GUI is sometimes called a WIMP interface:

However, to display all of the nice graphics required by a GUI takes a lot of computing power so quite a **powerful** computer is needed.

Windows, Icons, Menus, Pointer

Command Line Interface (CLI)

Many years ago when computers were **not very powerful** they could not display the colourful graphics required for a GUI. The only interface available to most computer users was the 'command line'.

The user would see nothing but a black screen. They would have to **type a command** to make anything happen.

e.g. To copy a text file called NOTES from a floppy disc to the hard drive the user would have to type:

```
> COPY A:\NOTES.TXT C:\
```

The user would have to learn a whole set of strange commands so that they could make use of the computer system. Plus it was not very interesting look at – no visual clues to tell you what to do next.

This meant computers used to be quite **difficult to use**, so this type of interface is only really suitable for **expert users**.

```
C:\>dir
Volume in drive C is Windows
Volume Serial Number is B4F7-C128

Directory of C:\

01/10/2007  19:38    <DIR>          25c7843ff7527e04ca374
19/09/2007  16:56    <DIR>          97a61370012ce95093c63
19/09/2007  16:42                0 AUTOEXEC.BAT
19/09/2007  16:36                211 boot.ini.comodofirewa
19/09/2007  16:42                0 CONFIG.SYS
19/09/2007  16:48    <DIR>          Documents and Settings
19/09/2007  16:53    <DIR>          e4a32567d68c0d02f07b4
19/09/2007  16:54    <DIR>          Intel
01/03/2008  21:48    <DIR>          Program Files
19/09/2007  16:57                516 RHDSetup.log
25/11/2007  13:03    <DIR>          UBCD4Win
13/03/2000  11:32    <DIR>          WINDOWS
                4 File(s)      727 bytes
                8 Dir(s)     1,479,077,888 bytes free

C:\>
```

Command-line interfaces are still used today on many servers.

These computers need to use all of their computing power running networks, etc. so they do not use GUIs.