Operating systems

1. Operating Systems

An operating system is the core software that controls how a computer operates.

Well known operating systems include Windows, Linux, Unix, iOS and Android. Although these operating systems are very different in terms of the code they run, they do share a common purpose.

They need to:-

- **Control the hardware of the computer system**. e.g. hard disk, graphics card, mouse.
- **Manage software**, in terms of loading (and unloading) into main memory.
- **Provide security**, such as user name and password control.
- **Provide a user interface**, to allow a person to interact with the computer.
- **File management**, including managing files and folders

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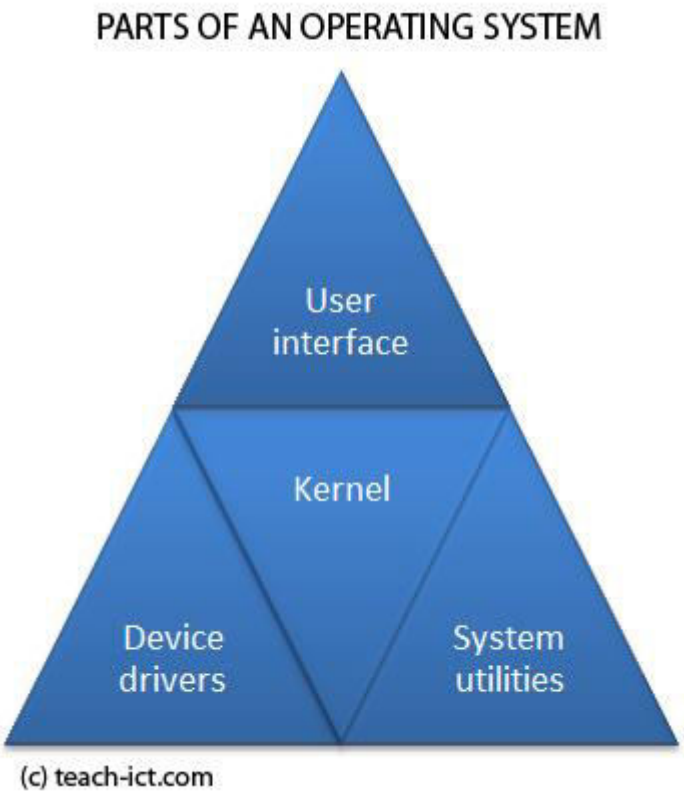
2. Parts of an Operating System

An operating system has a number of important roles which are shown in the diagram below.



The operating system has four main parts:

- The KERNEL
- The DEVICE DRIVERS
- The USER INTERFACE
- The SYSTEM UTILITIES

The next few pages describe these sections.

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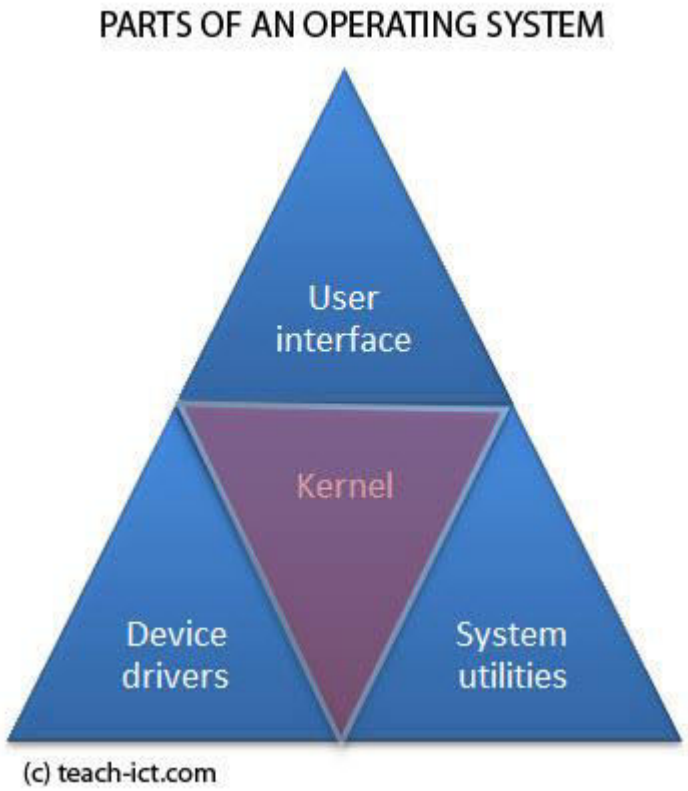
3. The Kernel

The kernel has the task of:

- Loading / Unloading applications from memory
- Scheduling tasks to run efficiently on the CPU
- Memory management

- File storage to and from secondary storage devices such as the hard disk
- File management
- Data security



The kernel within each different type of operating system is responsible for a slightly different blend of tasks.

For example, a 'single user, single application' operating system does not have to deal with networking, whereas the kernel in a network operating system would be responsible for this.

Because memory is such a limited resource on mobile phones, their operating systems require a more efficient memory management kernel as opposed to those running on PCs.

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4. User Interface

The user interface allows a person to interact with the computer. There are different types of user interfaces.

1. Menu interface
2. Command line interface
3. Graphical user interface

The standard way of interacting with a computer (desktop etc) is with a mouse, keyboard, or a finger pad on a laptop. And with smart-phone and tablets, touch screens and finger gestures are common.

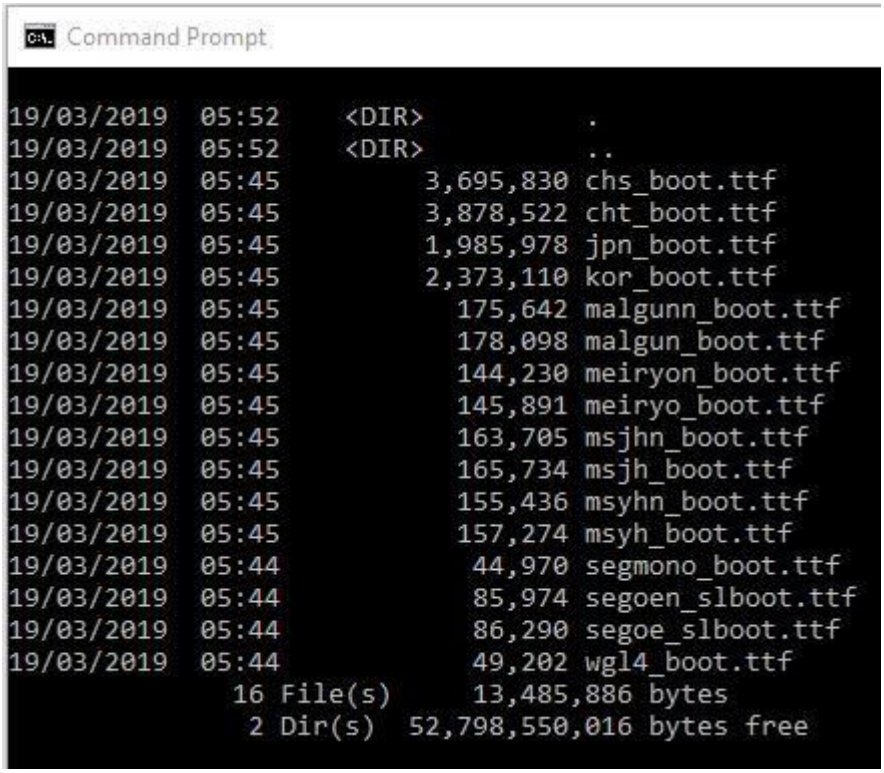
Menu Interface

Menu-based interfaces give users a list of possible actions that the system can carry out. If an action isn't on the menu, the user can't ask the operating system to do it.

Menu-based interfaces are useful when a computer is intended to only handle a small number of tasks such as the automated check-in machine at an airport (shown below).

Command Line Interface

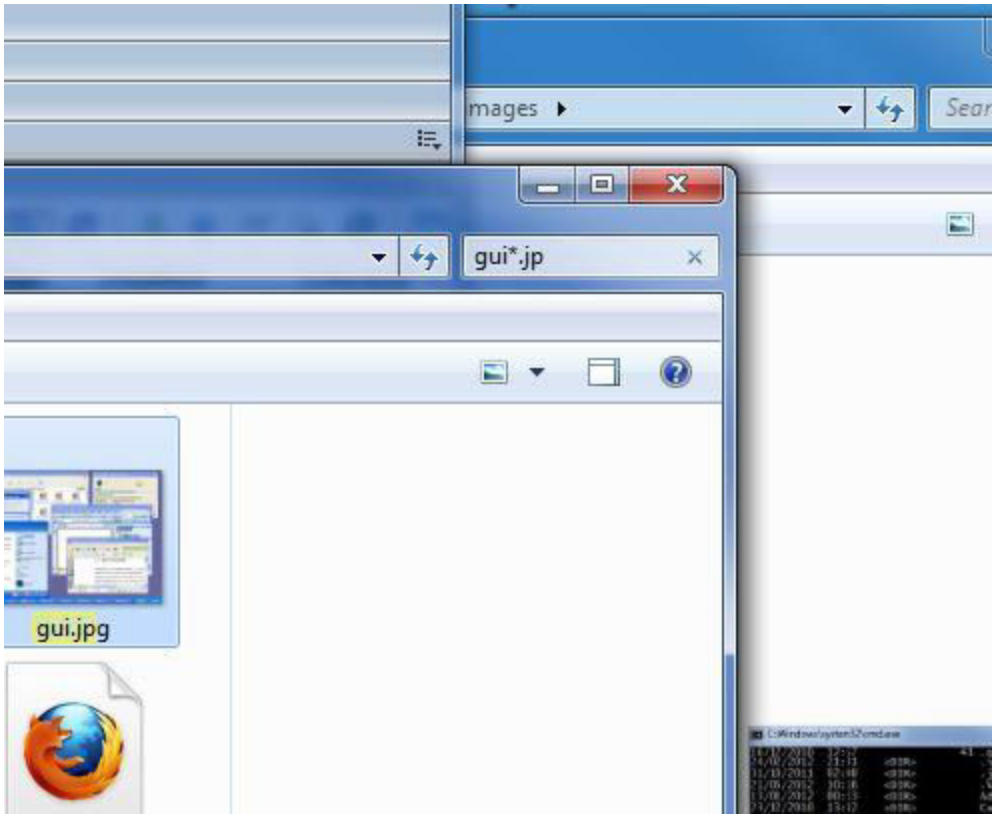
A Command Line Interface allows the user to interact directly with the computer system by typing in commands (instructions) into a screen which looks similar to the one below:



Graphical User Interface

A graphical user interface (GUI) is the most commonly used interface. It is a very easy and natural way for people to interact with the computer because it makes use of pictures, graphics and icons - hence why it is called graphical.

This part of the operating system directs what you see on the screen and reacts to your key presses, mouse clicks and touch on a touch sensitive screen.



Some popular graphical user interfaces include the Windows, Mac OS X interface on an Apple computer and Gnome on Linux.

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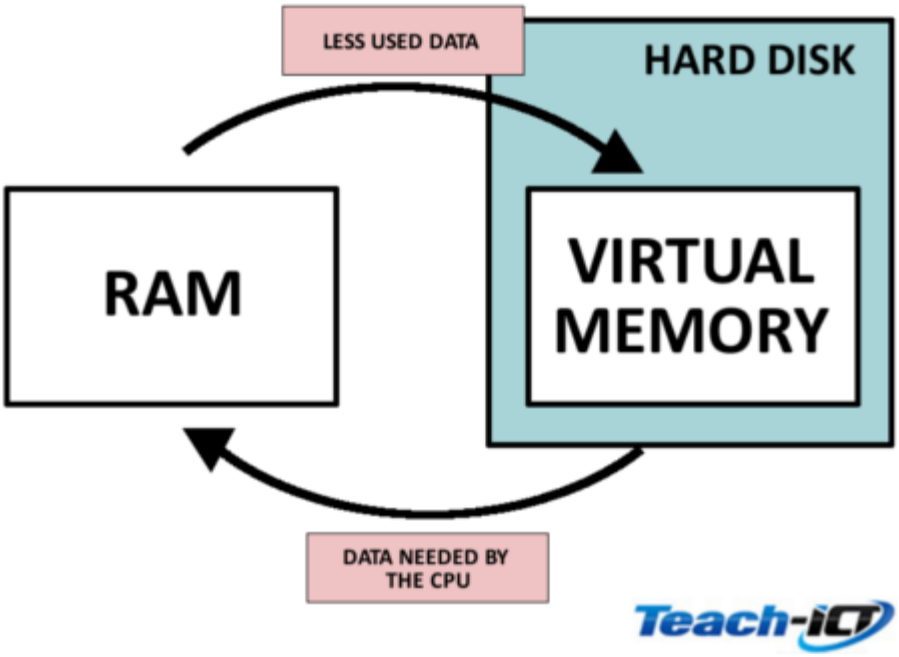
5. Memory management

Every computer has a limited amount of memory. And so, like any limited resource, memory needs to be managed. The part of the operating system responsible for this is called the memory manager. It is part of the kernel.

Programs have to be loaded into main memory (RAM) before they can run. And to run more than one program, they all have to be in memory at the same time.

It is essential that programs cannot interfere with one another - and so the memory manager gives each program a private memory area in which to run.

The memory manager is also responsible for moving programs between RAM and virtual memory, if that method being used.



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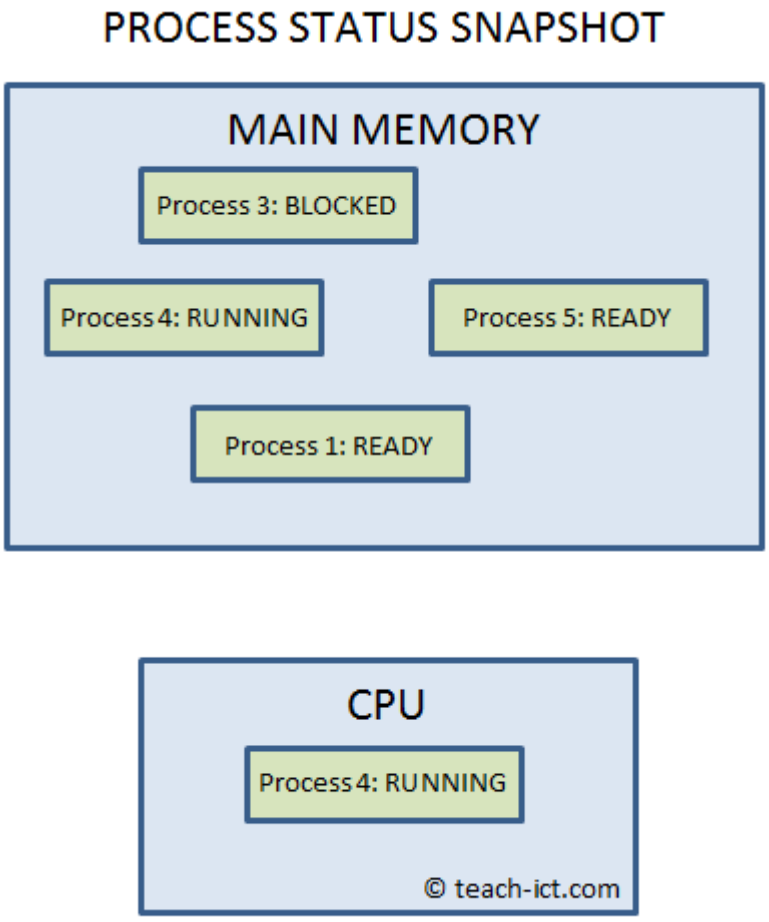
6. Multi-tasking

A multi-tasking operating system allows more than one program to run at the same time - or at least they appear to run together as far as the user is concerned.

You are probably very familiar with this kind of operating system, as it is what runs on most personal computers.

Examples of a multi-tasking operating system includes Windows, OS X, Linux and Android.

The diagram below shows a number of programs loaded into memory, where they are called a 'process'.



A multi-tasking operating system arranges for every process in memory to run in the CPU once they are ready to do so, switching between processes from different applications to keep them all up to date.

The CPU is able to process billions of instructions per second, so this switching of processes is not apparent to the user.

For example, you may have a word processing application open, be listening to music from a streaming service and be using your web browser to check something on the Internet. In addition, there will be many system background tasks also running.

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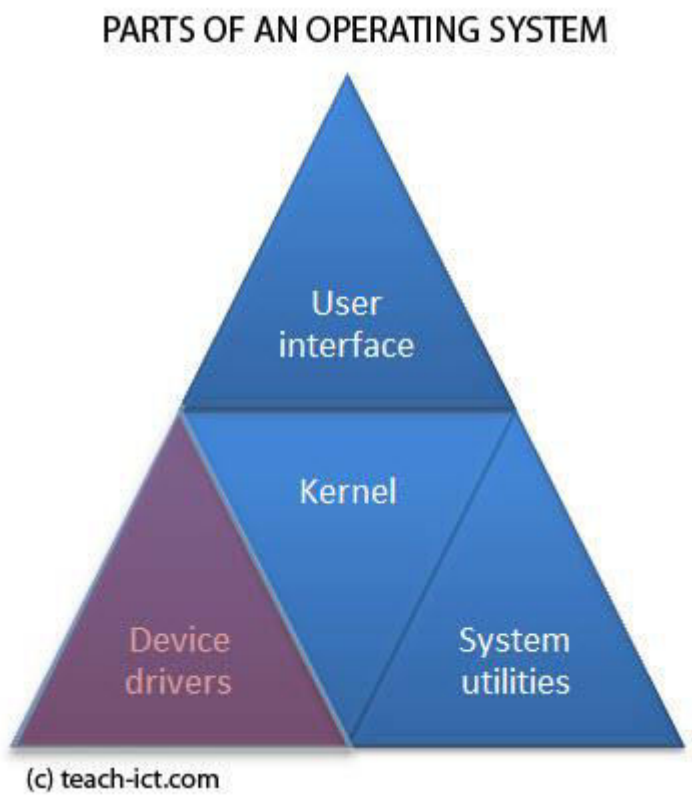
7. Device drivers

Device drivers are a core part of the operating system. They help hardware connected to the computer communicate with the computer's software and with the user.



Every piece of hardware that communicates with the operating system needs a device driver, for example:

- internal: the hard disk, RAM, graphics card, sound card etc
- external: printer, monitor, mouse, keyboard etc

A device driver enables the operating system to control and communicate with the device.

There could be hundreds of device drivers pre-installed with the operating system, and the right ones for that particular computer set-up is loaded on boot-up.

Makers of printers, graphics tablets, scanners, digital cameras and so on, will normally provide device drivers for each make of operating system. A device driver for Windows is different from the device driver for Linux.

This is why if you remove an operating system such as Windows from a hard disk, and install Linux instead, you will need to make sure you have all the correct device drivers available for each piece of hardware.

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8. File management

One of the most basic things a computer should handle is the management of data storage.

Many applications allow the user (or operating system) to create data such as text, video, music and so on. This data is stored in a single item called a 'file'. The file has a specific name given by its creator. For example the operating system itself will have hundreds or even thousands of files that store its data.

In order to help manage all these files, they can be grouped together into a 'folder' or 'directory'. Both the users and operating system create folders to organise their files.

For example an user may create a folder simply called 'my stuff' and dump all their personal data files in that single folder. On the other hand, a more organised person would create folders within folders to help arrange their data files in a more organised way.

It is the task of an operating system to support the creation, copying, moving, deletion and renaming of files and folders.

Files and folders are stored on secondary storage devices such as hard disk and external drives.

The operating system will provide the user with a convenient application to manage files and folders. For example, Windows has 'File Explorer' built into the operating system, MacOS has 'Finder'.

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9. User management

User management is part of the kernel.

Often, a single computer will be used by more than one person - but not at the same time. Each person has an account on that computer. The operating system creates a private desktop and a set of folders that only they can access once they are logged in. A person can also tell the operating system if any of their files or folders are to be made available to other users should they log

in.

In a larger, networked computer system, the operating system also controls access to what the user can see or alter. This is done by the system administrator, who sets out user access rights for each person (or application) They define the kind of action an user can do

- whether a file or folder is even visible to them
- can they just read the file, folder
- are they allowed to alter, delete, rename certain files within a folder
- are they allowed to run certain execution files

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10. Summary

- Operating systems control how the computer functions and how the user interacts with it.
- Operating systems have four major components:
    - The kernel

    - User interface
    - Drivers
    - Utilities
- The kernel is responsible for many of the essential background processes of the operating system, such as memory management and data security.
- There are several types of user interface:
    - Menu based interface, where users are limited to a preset menu of commands
    - Command line interface, where users interact through text commands
    - Graphical user interfaces, where users interact using graphics, windows, and icons
- Memory is a resource that has to be managed. Programs have to be loaded into and out of main memory as they run.
- In multitasking operating systems, more than one process or program can run at a time.
- Device drivers interface between hardware peripherals and the computer's software.
- The operating system controls user security and permissions.
- The operating system handles files and folders