# Operating systems

The operating system is the most important software in a computer system, as it is the interface between the machine and the users and programs. Its main functionalities are:

1. It allows the user and other programs to communicate with the hardware, so that they do not have to deal with the complexity of the physical devices.

The operating system as a translator:

* Users and programs. It communicates using natural or programming language.
* Operating system. Translates user commands so that they can be understood by the hardware.
* Hardware. Accepts commands from the operating system and delivers the result.

2. Manages hardware resources, allocating processors in a controlled manner, through memories, file systems and I/O devices.

The operating system as administrator.

* Operating system. It is the orchestra conductor that coordinates all the instruments that make up the orchestra to perform a composition.
* Hardware resources. These are the instruments that sound in coordination under the conductor's baton. Some are more audible than others, but all are essential to perform a work.

## 1.1. Elements and structure

The operating system is the largest and most complex piece of software on a computer, even though basically consists of:

a) The kernel. You have access to all the operations allowed by the hardware.

b) The services. The hardware administration is performed based on demand for services, which are requested by applications through a system call interface (APIs such as POSIX or Win32).

c) User and application interfaces. They enable communication between the user and the applications and the computer equipment.

Diagrama, Escala de tiempo

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These elements can be configured to form a single program or several programs that communicate with each other, depending on the architecture.

Generally, operating systems contain more software than the kernel, the services, and the interface, and it is common to find integrated applications such as the web browser, multimedia programs and other tools.

## 1.2. Functions

If the hardware is so difficult to use, how is it that virtually everyone can use a computer? Thanks to the operating system, which takes away the inherent complexity of the hardware, communication with users and programmes is facilitated, like a translator, through:

a) Interface for applications. A set of interface tools that allow programs to use the hardware resources.

b) User interfaces. They provide a command-driven, graphical, or natural language environment for the user to communicate with the operating system.

Searching for information on the Internet, watching a video or playing a video game are everyday actions on a computer that have one thing in common: they are all executed by programs stored in secondary memory that become processes when they are being executed. The operating system is in charge of managing the hardware resources so that they work together and effectively in the execution of processes, thanks to the process managers:

* Processes. Planning the use of the processor by the processes.
* Memory. Allocating or releasing main memory processes.
* Communication. Enabling communication and synchronisation between processes.
* I/O (input/output). Controlling the input and output of data from peripheral devices.
* File system. Managing secondary storage through directories and files.
* Security. Supervising and monitoring user and application access to the system.

These functions pursue the main objectives of achieving the best possible hardware efficiency and improving its usability for users and software, as well as providing facilities for evolving, adding, or improving the functionality of the operating system.

## 1.3. Processes

When a program is executed, the system converts it into one or more programs that will use several resources such as the processor or memory.

With many processes requiring the same resources at the same time, the operational system is responsible for planning the best strategy to ensure that, at any given time, resources are always being used as efficiently as possible, as well as ensuring that certain processes use those resources whenever they require them.

In this way, the processes go through different states that define at what point of execution they are.

**Execution**

Running on the processor.

Imagen que contiene Icono

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**Ready**

It can be switched to run status if selected by the planner.

**Blocked**

Waiting for a response from another process in order to be able to continue with its execution.

## 1.4. File systems

To watch a movie, listen to a song or run a program, it is necessary to access it from a file, which is nothing more than a logical unit of randomisation stored in mass memory.

These files are organised, named, stored, and manipulated according to the file system used by

the system. From the user's point of view, therefore, it is the most visible function of the operating system, providing the tools necessary for storage and access of both data and programs.

Generally, related files are organised in directories or folders, which, in turn, may contain other directories and files, forming a hierarchical tree structure.

Gráfico

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In this system, the location of any file is given by its path, which is basically a succession of directory names separated by a special character (usually '\' or '/'), depending on the hierarchy and ending with the filename.

All files have several attributes:

a) Name. This is usually descriptive of the contents of the file, although is not mandatory. It has a finite length, usually 256 characters counting the complete path and, in addition, certain characters are not allowed such as ' \ / : \* ? “ < > l '

b) Type. It can be text, audio, video, binary information, compressed information, etc. In some Windows systems it is identified by the extension, which is the final three characters of the file name. On other systems such as Linux, the extension is not necessary, and it is enough to use the command to know what kind of information the file stores.

c) Size. The amount of space it occupies in secondary storage.

d) Location. File path.

e) Permissions. Access rights of system users.

f) Time. Of creation, access, or modification.

The Permissions property controls which users and with what kind of access can use the file.

Depending on the file system, this tool is implemented in different ways.

Each operating system uses different file systems:

Most commonly used file systems:

Interfaz de usuario gráfica, Texto, Aplicación

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## 1.5. User interface

The user can communicate with the operating system mainly through three types of non-exclusive interfaces:

a) Command line interface (CLI). Users use commands, which are nothing more than commands written in a language understandable to the operating system. Generally, they consist of a command and, optionally, parameters for the command to be executed in a certain way.

b) Graphical User Interface (GUI). Most current operating systems provide a graphical user interface that presents a visual environment with elements such as scripts, windows, menus, icons or buttons with which the user interacts, thus sending commands to the operating system.

c) Natural Language Interface (NLI). Interaction with computer hardware is performed by recognising the user's natural movements or actions and interpreting them as commands. For example, Siri (macOS), Cortana (Windows) or Google Now (Android) are personal assistants that use natural language processing to answer questions, make recommendations or perform actions.

There is no one interface that is better than another, and their advantages and disadvantages depend on the fineness for which they are to be used:

|  |  |  |
| --- | --- | --- |
| **Interface** | **Advantages** | **Disadvantages** |
| CLI | • Access to all the functionalities of the system.  • Ease of automation.  • It consumes fewer resources. | • Knowledge of commands.  • Complexity. |
| GUI | • Ease of use  • Standardised.  • Used in most programmes. | • Actions limited to the interface.  • It consumes more resources. |
| NUI | • Ease of use without the need for a pointing device.  • Intuitive. | • Inaccuracies.  • Simple actions. |

## 1.6. Classification and characteristics

There are a multitude of operating systems to meet different user needs. Depending on their characteristics, they have traditionally been differentiated and classified according to the number of users, the number of tasks or the number of processors.

These categorisations are not mutually exclusive; thus, an operating system can be multi-user, multi-task and multi-processor.

Imagen que contiene Diagrama

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In addition to these features, there are others that should be considered when purchasing an operating system:

a) Target device:

- Personal computer. Also called desktop, for common tasks such as Internet browsing, office work or leisure activities.

- Server Optimised for remote user management, network services, security, and business process-oriented tools.

- Mobile device (smartphone, tablet, etc.). Adapted to consider the hardware resources of mobile devices, such as processor, battery, touch screen, etc.

b) Control system:

- Embedded. Dedicated to performing control tasks that require extreme reliability for uninterrupted operations in an unattended environment, such as controlling a lift or room temperature.

- Real-time. They are often confused with the above because many embedded systems are real-time like vxWorks, but not always. They are systems that must respond to events within a given time interval, such as a car's airbag control system.

c) Price: in certain professional environments, it is a major constraint on the ability to select an operating system.

d) Usability: through intuitive and comfortable interfaces that allow the user to perform their tasks in a simple and effective way.

e) Efficiency: the operating system must be able to squeeze the maximum out of the computer's hardware resources. For example, you can install a 32-bit operating system on a computer with a G4-bit processor, but you will be under-utilising its capacity.

f) Compatibility. Some software is not supported by certain operating systems. The same applies to hardware.

g) indicates what can and cannot be done with the operating system, such as distribution, modifications, etc.

h) Security: No operating system is immune to a computer attack and its damaging consequences, so it is important that the system incorporates security mechanisms for users and programs accessing the system.

i) Upgrading: A frequently updated operating system is a system that adapts to the new requirements of the software and the hardware, as well as being more robust, reliable, and secure.

j) Support: allows you to solve technical problems or queries quickly and easily.

k) Fine version: provides the ability to run the operating system without having to install it on the hard disk.