

Operating System (OS)

To understand operating systems, you must first understand what software is. Because the operating system falls within the category of system software.

Software

Software is a set of instructions, data or programs used to operate computers and execute specific tasks. It is the opposite of hardware, which describes the physical aspects of a computer. Software is a generic term used to refer to applications, scripts and programs that run on a device. It can be thought of as the variable part of a computer, while hardware is the invariable part. The user cannot touch the software but can see through the Graphical User Interface (GUI).

Types of Software

There are mainly two types of software that can run on a computer;

- System Software
- Application Software

Other categories of software include utility software, driver software, middleware, and programming software.

System Software

The system software is a type of computer software that is designed for running the computer hardware parts and the application programs. It is the platform provided to the computer system where other computer programs can execute. The system software act as a middle layer between the user applications and hardware. The operating system is the type of system software. The operating system is used to manage all other programs installed on the computer. Operating systems like Windows, macOS, Android and iOS are examples of system software.

Application Software

Application software is a type of computer program that performs a specific function likes personal, educational, and business function. Each application is designed to assist end-users in accomplishing a variety of tasks, which may be related to productivity, creativity, or

communication. The operating software runs the application software in the computer system. Examples of applications software include office suites, graphics software, databases and database management programs, web browsers, word processors, software development tools, image editors and communication platforms.

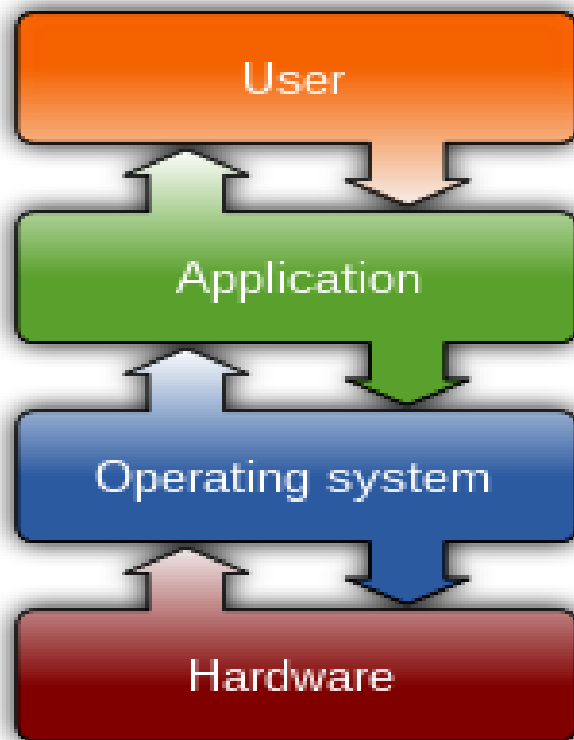
Difference between Application Software and System Software

Basis	System Software	Application Software
Definition	System software consists of variety of programs that support the operation of computer.	Application software focuses on an application or problem to be solved.
Installation	System software are installed on the computer when operating system is installed.	Application software are installed according to user's requirements.
User Interaction	In general, the user does not interact with system software because it works in the background.	In general, the user interacts with application software.
Usage	System software is used for operating computer hardware.	Application software is used by user to perform specific task.
Dependency	System software can run independently. It provides platform for running application software.	Application software can't run independently. They can't run without the presence of system software.
Purpose	The System Software is a general-purpose software	Application Software is specific purpose software.
Execution	The System Software starts running when the system is powered on and runs until the system is powered off.	The Application Software starts when the user begins, and it ends when the user stops it.
Acts as	It acts as an interface between the Application Software and Computer hardware.	It acts as an interface between the end-user and System Software.
Programming Language	It is written in a low-level language like a machine or assembly language.	A high-level language such as C, C++, Java, etc. are used to write Application Software.
Example	Examples of System Software are Operating systems, Compiler, Assembler, Device drivers, etc.	Examples of Application Software are Web browsers, MS office, Graphic design software, etc.

Operating System (OS)

Concept

- An Operating System (OS) is an interface between a computer user and computer hardware.
- It is a system software that manages computer hardware, software resources, and provides common services for computer programs.
- It performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.



Graph; Operating System (OS) Placement.

Objectives of Operating System (OS)

The objectives of the operating system are;

- To make the computer system convenient to use in an efficient manner.
- To hide the details of the hardware resources from the users.
- To provide users a convenient interface to use the computer system.
- To act as an intermediary between the hardware and its users, making it easier for the users to access and use other resources.
- To manage the resources of a computer system.
- To keep track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users.
- To provide efficient and fair sharing of resources among users and programs.

Common Operating System (OS)

- Linux Operating System.
- UNIX Operating System
- MS-DOS
- Microsoft Windows Operating System.
- Ubuntu Operating System
- Palm OS
- Macintosh Operating System.
- Solaris Operating System.
- Symbian Operating System.
- Google Android Mobile Operating System.
- Apple iOS Mobile Operating System.

Platform Based Operating System (OS)

Platform	Operating System
Microcomputers	Linux, Macintosh OS, MS-DOS, Windows 98, Windows 2000
Minicomputers	Linux, OpenVMS Alpha, UNIX
Mainframe computers	IBM OS/390, IBM OS/400, UNIX
Supercomputers	IRIX, UNICOS

Functions of Operating System (OS)

The four major functions of an operating system are:

- Providing a User Interface
- Running Programs
- Managing Hardware Devices
- Organizing Files and Folders

Providing a User Interface

The OS provides a user interface (UI), an environment for the user to interact with the machine. It facilitates communication between an application and its user by acting as an intermediary between them. The UI is either graphical or text-based.

Graphical User Interface (GUI)

The graphical user interface is a type of GUI that enables the users to interact with the operating system by means of point-and-click operations. GUI contains several icons representing pictorial representation of the variables such as a file, directory, and device. The graphical icon provided in the UI can be manipulated by the users using a suitable pointing device such as a mouse, trackball, touch screen and light pen. The other input devices like keyboard can also be used to manipulate these graphical icons. GUIs are considered to be very user- friendly interface because each object

is represented with a corresponding icon. Unlike the other UIs the users need not provide text command for executing tasks.

Advantages of GUI Based Operating System (OS)

- The GUI interface is easy to understand and even the new users can operate on them on their own.
- The GUI interface visually acknowledges and confirms each type of activities performed by the users. For example when the user deletes a file in the Windows operating system, then the operating system asks for the confirmation before deleting it.
- The GUI interface enables the users to perform a number of tasks at the same time. This features of the operating system are also known as multitasking.

Disadvantages of GUI Based Operating System (OS)

- There are various moving parts in a graphical user interface. As a result, it is much slower than a CLI.
- GUI implementation is not an as easy process as it looks while using it. The programmer must be aware of properly creating functions so that users may use this interface more easily. A single error on the part of the coder can render all of their efforts in vain.
- The design of the graphical user interface makes development more complex and expensive. Additionally, a GUI must be linked with additional hardware, which may increase overall costs.
- It usually uses high power and computer memory than other interfaces due to all graphical representations. It is not resource-efficient. As a result, it will use a huge amount of computer resources.

Command Line Interface (CLI)

An OS also provides a method of interaction that is non-graphical, called the command line interface (CLI). This is a text-only service with feedback from the OS appearing in text. Using a CLI requires knowledge of the commands available on a particular machine.

Advantages of using the command line include;

- A faster way to get tasks done

- It is more flexible than a GUI
- It uses less memory

Disadvantages of using the command line include;

- Difficult to remember all of the CLI's commands
- The mostly commands in CLI may not be undone or reversed.
- If users write wrong commands or create a typo, the file may be deleted or moved to the wrong location. If users delete a file by accident, it causes difficulties because it may contain crucial information.
- CLI might be perplexing to new users

Differences between the CLI and GUI

Basis	Command Line Interface (CLI)	Graphic User Interface (GUI)
Definition	Interaction is by typing commands	Interaction with devices is by graphics and visual components and icons
Understanding	Commands need to be memorized	Visual indicators and icons are easy to understand
Memory	Less memory is required for storage	More memory is required as visual components are involved.
Working Speed	Use of keyboard for commands makes CLI quicker.	Use of mouse for interaction makes it slow
Resources used	Only keyboard	Mouse and keyboard both can be used
Flexibility	Command line interface does not change, remains same over time	Structure and design can change with updates
Data Presentation	The information can be viewed to the user in plain text and files in the CLI.	In a GUI, information can be viewed or presented to the user in several ways, including simple text, videos, graphics, etc.
Errors	Spelling mistakes and typing errors are not avoided	Spelling mistakes and typing errors are avoided. Spelling mistakes and typing errors are avoided.

Running Programs

To run and execute a program, several tasks need to be performed. Both the instructions and data must be loaded into the main memory. In addition, input-output devices and files should be initialized, and other resources must be prepared. The Operating structures handle these kinds of tasks. The activities which are performed by the operating system to run and execute programs;

- Loads a program into memory.
- Executes the program.
- Handles program's execution.
- Provides a mechanism for process synchronization.
- Provides a mechanism for process communication

Managing Hardware Devices

A computer is a mix of hardware and software. Software has to interact with the hardware in order to receive data from input devices and to send its result to output devices. Another important function of the operating system is to manage the way this happens. Every piece of hardware comes with software called a 'device driver', for example, the printer will have a print driver, a mouse will have its own mouse driver. A device driver acts as the go-between for other software to 'talk' to the hardware. For example a word-processor will send text and images to a printer by sending instructions and data through the printer's device driver. A music player will send music to the sound card by means of the sound card's device driver and so on.

Organizing Files and Folders

The OS allows to organize the contents of computer in a hierarchical structure of directories that includes files, folders, libraries, and drives. Windows Explorer helps you manage your files and folders by showing the location and contents of every drive, folder, and file on your computer. Creating folders is the key to organizing files because folders keep related documents together. Following naming conventions and using proper file extensions are also important aspects of file management.

The following are some of the tasks performed by operating system to organize files and folders;

- It helps to create new files in computer system and placing them at the specific locations.

- It helps in easily and quickly locating these files in computer system.
- It makes the process of sharing of the files among different users very easy and user friendly.
- It helps to stores the files in separate folders known as directories. These directories help users to search file quickly or to manage the files according to their types or uses.
- It helps the user to modify the data of files or to modify the name of the file in the directories.

Types of Operating System (OS)

OS can be categorized into four major types. Following are the major types of OS (Operating System);

- Real Time Operating System (RTOS)
- Single-User/ Single-Tasking OS
- Single-User/ Multitasking OS
- Multi-User/ Multitasking OS

Real Time Operating System (RTOS)

- A real-time operating system (RTOS) is a special-purpose operating system used in computers that has strict time constraints for any job to be performed.
- It is mostly used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines.
- Real time Operating Systems are very fast and quick respondent systems.
- Real time processing requires quick transaction and characterized by supplying immediate response.

- Examples of the real-time operating systems: Airline traffic control systems, Command Control Systems, Airlines reservation system, Heart Pacemaker, Network Multimedia Systems, Robot etc.
- The real-time operating systems can be of 3 types –
 - **Hard Real-Time Operating System;** These operating systems guarantee that critical tasks be completed within a range of time. Examples are Airbag control in cars, anti-lock brake, engine control system, etc.
 - **Soft Real-Time Operating System;** This operating system provides some relaxation in the time limit. This type of system is used in Online Transaction systems, digital camera, mobile phones, etc.
 - **Firm Real-time Operating System;** RTOS of this type have to follow deadlines as well. In spite of its small impact, missing a deadline can have unintended consequences, including a reduction in the quality of the product. For Example, this system is used in various forms of Multimedia applications.

Advantages of RTOS

- **Maximum Consumption:** Maximum utilization of devices and system, thus more output from all the resources
- **Task Shifting:** The time assigned for shifting tasks in these systems are very less. For example, in older systems, it takes about 10 microseconds in shifting one task to another, and in the latest systems, it takes 3 microseconds.
- **Focus on Application:** Focus on running applications and less importance to applications which are in the queue.
- **Real-time operating system in the embedded system:** Since the size of programs are small, RTOS can also be used in embedded systems like in transport and others.
- **Error Free:** These types of systems are error-free.
- **Memory Allocation:** Memory allocation is best managed in these types of systems.

Disadvantages of RTOS

- **Limited Tasks:** Very few tasks run at the same time and their concentration is very less on few applications to avoid errors.
- **Use heavy system resources:** Sometimes the system resources are not so good and they are expensive as well.
- **Complex Algorithms:** The algorithms are very complex and difficult for the designer to write on.
- **Device driver and interrupt signals:** It needs specific device drivers and interrupts signals to respond earliest to interrupts.
- **Thread Priority:** It is not good to set thread priority as these systems are very less prone to switching tasks.

Single-User/ Single-Tasking OS

An operating system that allows a single user to perform only one task at a time is called a Single-User/ Single-Tasking Operating System. Functions like printing a document, downloading images, etc., can be performed only one at a time. This operating system is designed especially for wireless phones as well as two-way messaging devices. Examples include MS-DOS, Palm OS, etc.

Advantages

- This operating system occupies less space in memory.
- It is cost-effective.
- Easy to maintain
- Concentrate on one task.
- Run on inexpensive computer.

Disadvantages

- It can perform only a single task at a time.
- Tasks take longer time to complete.

- Idle time is higher.

Single-User/Multitasking OS

Single-User Multi-Tasking operating system is developed specially for one user, but this single user is able to perform to multiple tasks run at a same time frame. Some examples such as you can write any text, while surfing internet and downloading images with watching movies, etc. This type of operating system is found in personal desktop and laptop computers. Examples include Microsoft Windows, Linux and Macintosh OS.

Advantages

- It is time saving as it performs multiple tasks at a time yielding high productivity.

Disadvantages

- This operating system is highly complex and occupies more space.
- Require expensive computer.

Multi-User/ Multitasking OS

Multiuser/Multitasking operating system is a powerful operating system that supports more than one user at a time, performing more than one task at a time. Powerful computer like a mainframe or supercomputer is required for multi-user, multi-tasking operating system to make maximum use of the machine. It is an operating system that permits several users to utilize the programs that are concurrently running on a single network server. The single network server is termed as "Terminal server". "Terminal client" is a software that supports user sessions. UNIX, VMS is example of a multiuser/ multitasking operating system.

Advantages

- It is highly productive as it performs multiple tasks at a time.
- It is time saving as we don't have to make changes in many desktops, instead can make changes only to the server.

Disadvantages

- If the connection to the server is broken, user cannot perform any task on the client as it is connected to that server.
- Powerful computer like a mainframe or supercomputer is required.

Enhancing an OS with Utility Software

Operating systems are created to allow users to perform the majority of the actions they would ordinarily perform on a computer, such as managing files, loading programs, printing documents, and so on. But software developers are constantly creating new programs-called utilities- that enhance or extend the operating system's capabilities, or that simply offer new features not provided by the operating system itself. Utility Software is system software that helps to maintain the proper and smooth functioning of a Computer System. It assists the Operating System to manage, organize, maintain, and optimize the functioning of the computer system. As an operating system is improved and updated, the functionality of popular utilities is included with subsequent releases of the OS. There are thousands of different utility programs, and you can find many on the Internet—some free and some at a price ranging from very inexpensive to hundreds of dollars. While it is difficult to give a definitive list of utility software categories, the most common types that ordinary people use are disk and file management, Internet security, and OS customization tools. The following sections describe a small selection of popular utilities.

Backup Software

A backup utility is software that is built into or bundled with an OS, software application or storage system to provide targeted data protection. Backup software creates extra exact copies of files, databases, or entire computers and is used to do backups. These utilities not only assist user in transferring files to a backup medium, but also in organizing them, updating backups, and restoring backups to disk in the event of data loss, file corruption, accidental/intentional deletion or a disaster. Popular backup software tools include Norton Ghost, Symantec Backup Exec, Acronis True Image and TotalRecovery Pro.

Anti-Virus Software

An antivirus utility can examine the contents of a disk or RAM for hidden viruses and files that may act as hosts for virus code. Effective antivirus products not only detect and remove viruses;

they also help to recover data that has been lost because of a virus. Popular antivirus software providers include AVG, McAfee, Norton and Kaspersky.

Firewall

A firewall is a network security device that monitors incoming and outgoing network traffic and permits or blocks data packets based on a set of security rules. Its purpose is to establish a barrier between the internal network and incoming traffic from external sources (such as the internet) in order to block malicious traffic like viruses and hackers. Kerio WinRoute Pro, Cisco Secure Firewall, Zone Labs Firewall etc. are common firewall platforms.

Intrusion Detection

While a firewall protects against predictable incursion, intrusion detection software identifies the types of attacks that a firewall is preventing, documents the attempts, and alerts users to specific types of intrusion attempts. In the competitive utility software field, intrusion detection is often added as a feature to firewall or bundled Internet security programs. Snort is the popular network intrusion detection & prevention system software.

Screen Savers

Screen savers are popular utilities, although they serve little purpose other than to hide what would otherwise be displayed on the screen. A screen saver automatically appears when a keyboard or pointing device has not been used for a specified period of time. Screen saver decorates idle screens. It was first used to prevent damage to older monitors but is now used as a way to prevent viewing of desktop contents while the user is away. Fliqlo, System 47 etc. are the popular screen saver software platform.

