



**Post Graduate Diploma in Advanced  
Computing (PG-DAC)**

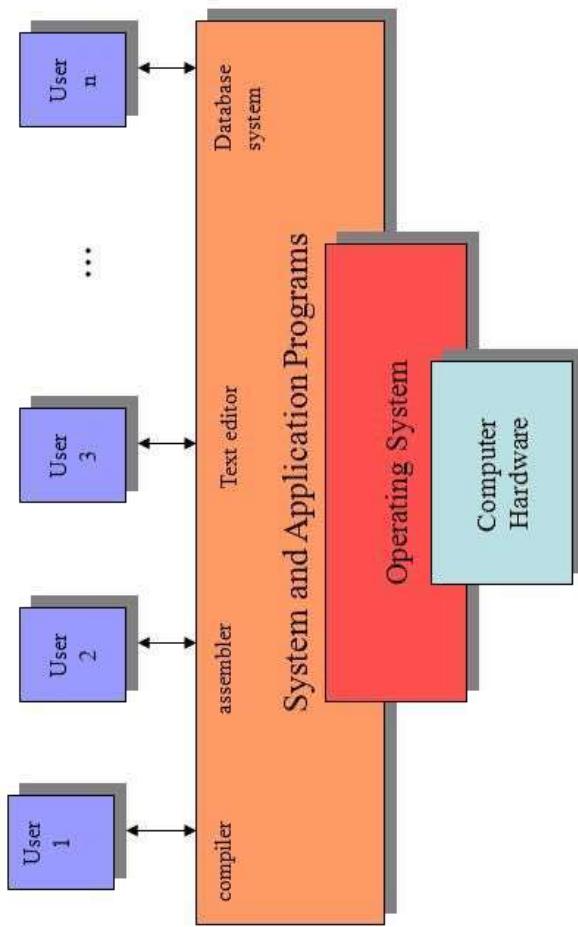
**Subject:**

Operating System

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# Abstract View of System

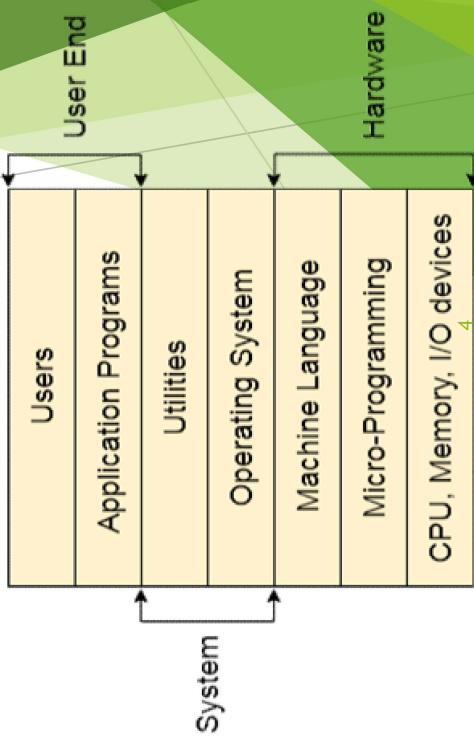


## What is Operating System

- ✓ An Operating System (OS) is an interface between a computer user and computer hardware.
- ✓ It is responsible for the execution of all the processes, Resource Allocation, CPU management, File Management and many other tasks.
- ✓ The purpose of an operating system is to provide an environment in which a user can execute programs in convenient and efficient manner.

## Structure of a Computer System

- Users (people who are using the computer)
- Application Programs (Compilers, Databases, Games, Video player, Browsers, etc.)
- System Programs (Shells, Editors, Compilers, etc.)
- Operating System ( A special program which acts as an interface between user and hardware )
- Hardware ( CPU, Disks, Memory, etc )



## What does an Operating system do?

- 1) Process Management
- 2) Process Synchronization
- 3) Memory Management
- 4) CPU Scheduling
- 5) File Management
- 6) Security

- ✓ An operating system performs basic activities like recognizing keyboard input and then displaying the output.
- ✓ It also maintains track of the directories on the disk and the active files. It acts as a controller, ensuring that different programs and users stay logged in on the computer and do not conflict.
- ✓ It gives security and safety and allowing users to access the system without difficulty.
- ✓ Some examples of the operating system are **Microsoft Windows, iOS, Linux, and Ubuntu.**

## What is an Application Software?

- ✓ Application software is a type of software that is designed to do a certain set of tasks. It is a form of software that runs or executes on the user's request.
- ✓ It performs single tasks. These software applications are specifically developed to solve certain problems like document creation, image editing, calculation, etc.
- ✓ The application software is written in high-level languages like Java, C, and C++. It cannot be installed without an operating system.
- ✓ Some examples of Application software are VLC media player, Google Chrome, Adobe Photoshop, Mozilla Firefox, Opera, etc.

## How OS is different from other application software

- ✓ An operating system is system software that acts as an interface between the user and the hardware, whereas application software is a program that performs a specific task.
- ✓ It is impossible to install the application software on a computer system without an operating system

## Differences between the Operating System and Application Software

- 1) The operating system acts as the interface between the user and the system hardware. It also handles memory management, hardware device control, task scheduling, process management, and various other tasks. In contrast, application software focuses on a specific task.
- 2) Picasa is the best example of application software because it can open images in various file formats. On the other side, Microsoft Windows is the best example of an OS, which helps in the operation of a system.
- 3) The application software does not exist on the computer. It must be downloaded through the internet. On the other hand, because an operating system is an important part of the computer, it is usually preinstalled.
- 4) Users may have to pay money to obtain the original version of the operating system unless it is already included with the device. On the other hand, Application software comes in both free and paid versions, each with its own set of options.

## **Differences between the Operating System and Application Software**

- 5) Some most popular operating systems are Microsoft, Ubuntu, and Linux. On the other hand, WhatsApp, Instagram, and Viber are some of the most popular application software.
- 6) People can use application software to do things that are not visible to the rest of the world. On the other hand, an OS helps in working a computer and performs basic tasks.
- 7) An operating system is much more expensive than application software.
- 8) Operating systems are typically written in C, C++, or Assembly. Application software can be written in different languages, including Java, Visual Basic, C, and C++.

## **Why Operating System is hardware dependent**

Hardware Dependent Software means:

- (a) operating system kernel software;
- (b) hardware driver software; and
- (c) other software, if any, where the foregoing (a), (b) and (c) is written for specific platform hardware and operating system, according to a specification of software interface that describes and exposes the functionality as needed by the application software

## Components of OS

The components of an operating system play a key role to make a variety of computer system parts work together. There are the following components of an operating system, such as:

- 1) Process Management
- 2) File Management
- 3) Network Management
- 4) Main Memory Management
- 5) Secondary Storage Management
- 6) I/O Device Management
- 7) Security Management
- 8) Command Interpreter System



# Hardware and Software Requirements

## Recommended Operating Systems

- **Windows:** 7 or newer
- **MAC:** OS X v10.7 or higher
- **Linux:** Ubuntu

## Hardware Requirements

We strongly recommend a computer fewer than 5 years old.

- Processor: Minimum 1 GHz; Recommended 2GHz or more
- Ethernet connection (LAN) OR a wireless adapter (Wi-Fi)
- Hard Drive: Minimum 32 GB; Recommended 64 GB or more
- Memory (RAM): Minimum 1 GB; Recommended 4 GB or above
- Sound card w/speakers
- Some classes require a camera and microphone

Examples of well known OS

## Mobile Operating System

- ✓ A mobile operating system allows the user to run other different application software on the mobile, tablets, etc. Moreover, we can say that it is a type of operating system which is specially designed for mobiles, tablets, smartwatches, etc.
- ✓ Furthermore, they are a mixture of computer OS with some additional features for mobiles. Also, they are comparatively light and simple.

## Popular Mobile Operating System

### [Android OS \(Google Inc.\)](#)

**Google** is the developer of Android. Moreover, it is an open source and free operating system. This OS is based on the **Linux** kernel.

### [Bada](#)

**Samsung** is the launcher of this operating system

### [Blackberry OS](#)

The developer of this operating system is **Reasearch In Motion (RIM)**. It was specifically designed for blackberry devices.

## Apple iOS

After android, it is one of the most popular OS. It is designed to run on Apple devices such as iPhones, iPad tablets, etc.

## Windows Mobile Operating System

The developer of this OS is **Microsoft**. It is basically designed for pocket PCs and smartphones. Moreover, it has the features of computer based Windows OS and additional features for mobile phones.

## Symbian OS

**Symbian Ltd.** is the developer of this OS. Moreover, **Nokia** was the first to use this OS on its mobile phones. Furthermore, it provides high level integration with communication. This OS is based on java language.

A mobile OS has the following features:

- Easy to use
- Good app store
- Good battery life
- Data usage and organization

## **Embedded Operating System**

- ✓ An embedded operating system is a computer operating system designed for use in embedded computer systems.
- ✓ These operating systems are designed to be **small, resource-efficient, dependable**, and reduce many features that aren't required by specialized applications.
- ✓ The term "**embedded operating system**" also refers to a "**real-time operating system**". The main goal of designing an embedded operating system is to perform specified tasks for non-computer devices

### **Characteristics of Embedded Operating System**

There are various characteristics of an embedded operating system. Some of them are as follows:

- 1.It provides real-time operations.
- 2.Direct use of interrupts
- 3.Input/Output device flexibility
- 4.Reactive operation
- ~~5.Streamlined protection mechanisms~~
- 6.Configurability

## Embedded Operating Systems

### eCos

It stands for '**E**mbedded **C**onfigurable **O**perating **S**ystem', and all of its components provide a wide range of configuration options. The eCos operating system may support a wide range of popular embedded CPUs.

### mbed OS

It is a free and open-source embedded operating system that offers a systematic and comprehensive environment for intelligent hardware development.

### VxWorks

**Wind River Company** firstly introduced it in **1983**. It is supported with task synchronization, memory efficiency management, and other features.

### Embedded Operating System Uses

Car navigation system

Parking Metering

Medical Equipment

The navigation system of a plane

## **Advantages**

There are various advantages of an embedded operating system. Some of them are as follows:

- 1.It is small in size and faster to load.
- 2.It is low cost.
- 3.It is easy to manage.
- 4.It provides better stability.
- 5.It provides higher reliability.
- 6.It provides some interconnections.
- 7.It has low power consumption.
- 8.It helps to increase the product quality.

## **Disadvantages**

There are various disadvantages of an embedded operating system. Some of them are as follows:

- 1.It isn't easy to maintain.
- 2.The troubleshooting is harder.
- 3.It has limited resources for memory.
- 4.It isn't easy to take a back of embedded files.
- 5.You can't change, improve, or upgrade an embedded system once it's been developed.
- 6.If any problem occurs, you need to reset the setting.
- 7.Its hardware is limited.

## **Desktop/Client Operating System**

- ✓ A client operating system is a computer OS that runs on desktop computers and other portable devices like laptops and smartphones. It may handle different hardware components connected to it, such as printers, monitors, and cameras.
- ✓ These OSs support a single user at a time. A client operating system may use a server operating system to acquire services. Furthermore, when compared to server operating systems, client operating systems offer multiprocessing capacity at a low cost. Client OS includes Windows, Mac, Android, etc.

## **Features of Client Operating System**

Various features of the client operating system are as follows:

- 1) It provides support to a single user at a time.
- 2) It runs on desktop systems and portable devices.
- 3) Some client operating systems are Windows, Android, Mac, etc.

## **Server Operating System**

- ✓ It is an operating system designed for usage on servers. It is utilized to give services to a large number of clients. It is a very advanced operating system that can serve several clients simultaneously. It is a more advanced operating system with features and capabilities needed in a client-server architecture or comparable enterprise computing environment.
- ✓ A server is a computer that makes data available to other computers. It can serve data across the Internet to systems on a LAN or a WAN
- ✓ For instance, a Web server can execute **Apache HTTP Server** or **Microsoft IIS**, which offer access to websites on the Internet.

## **Features of Server Operating System**

Various features of the server OS are as follows:

- 1.It may access the server both in GUI and CLI.
- 2.It controls and monitors client computers and operating systems.
- 3.It installs and uses web applications and business applications.
- 4.It helps to execute most processes from the OS commands.
- 5.It offers a central interface for managing users, implementing security, and performing other administrative tasks.

Client and server OS are two different types of operating systems. The client OS runs on end-user devices like PCs and other portable devices. In contrast, server OS runs on a specific device known as a server. Therefore, the client and server both operating systems differ.

## **Main Function of Server Operating System**

The interaction between a Web server and browser is a good example of how a server's most crucial duty is to listen in on a port for incoming network requests.

## **Types of Server Operating System**

Windows Operating System

Linux Operating System

UNIX Operating System

Netware Operating System

Red Hat Enterprise Linux (RHEL)

## **Benefits of Server Operating System**

### **Higher Efficiency**

It helps in reducing dependence on physical servers, resulting in greater savings.

### **Future-Proofing**

It ensures long-term sustainability by calculating the expected growth of the corporate network.

### **Higher savings with reduced downtime**

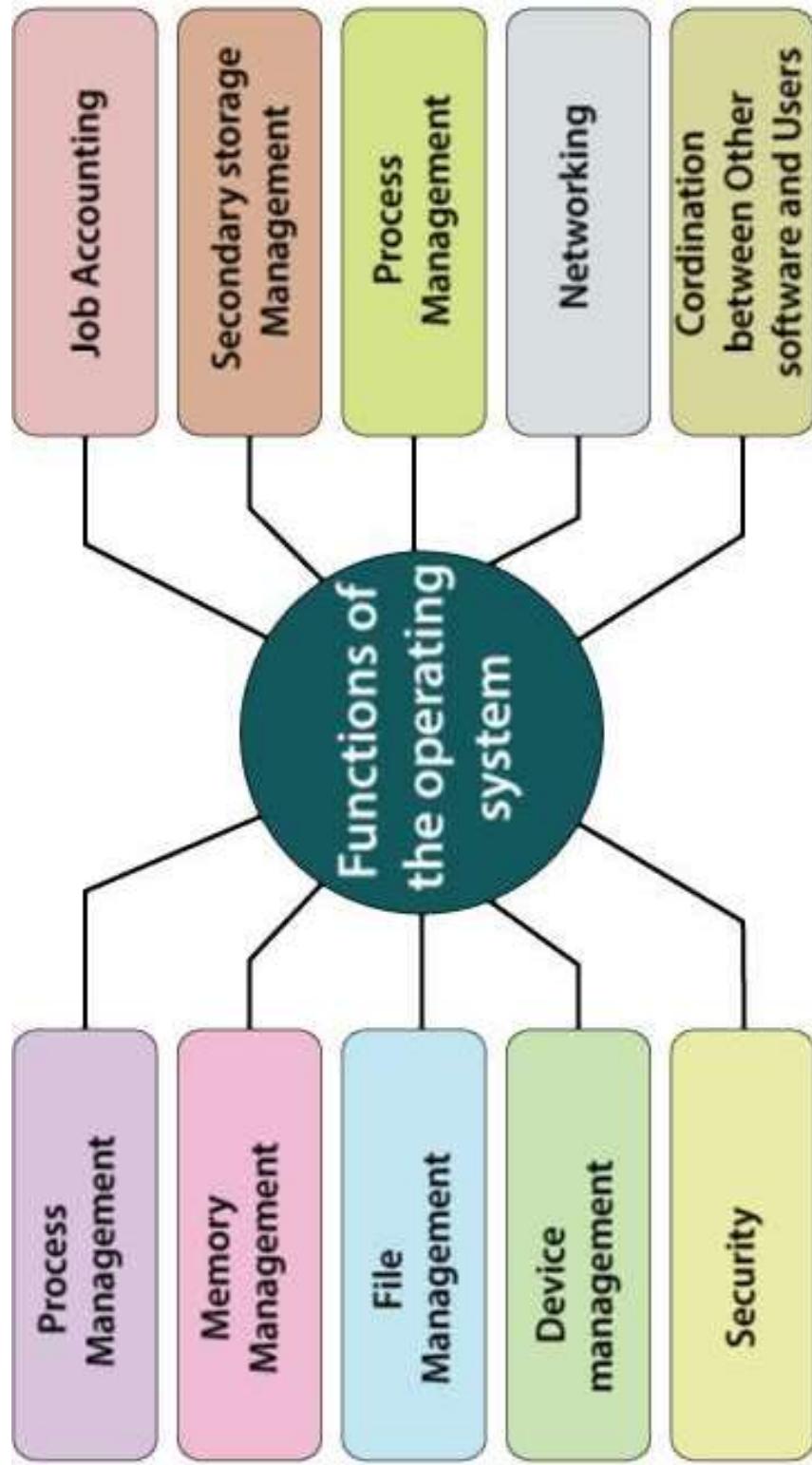
Reduced downtime leads to increased savings for any organization.

### **Increased Performance**

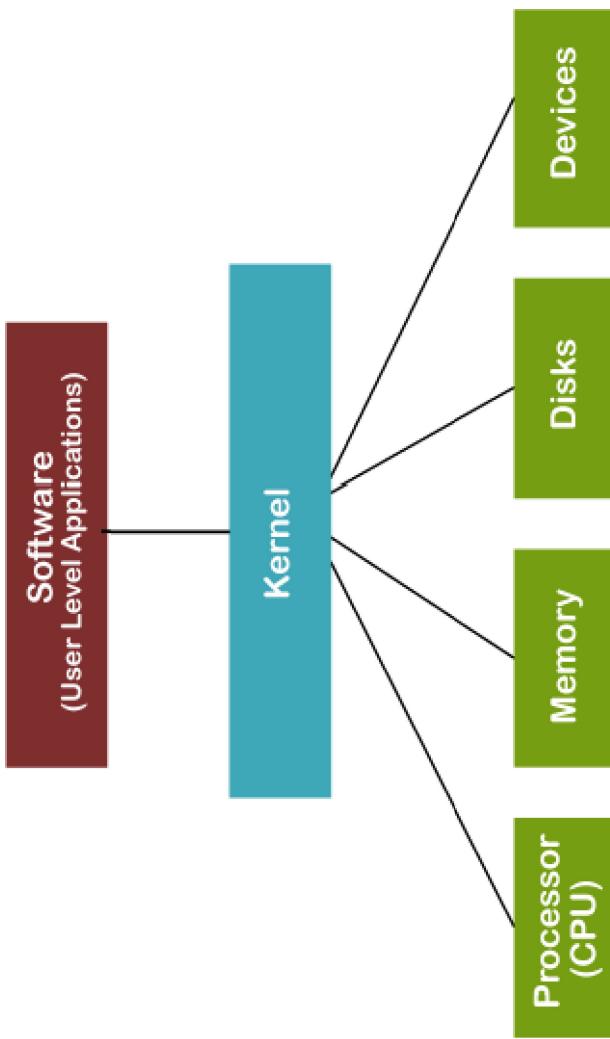
A network-supporting system with higher performance can support more users and storage options than another.

## **Differences between the Mobile and Desktop Operating System**

- 1) Mobile OS handles cellular and wireless connectivity and device access. On the other hand, the desktop OS handles the software and hardware resources of the system.
- 2) Mobile OS runs on touchscreen or touchpad devices. On the other hand, the desktop OS runs through many input devices, including mouse, keyboard, etc.



## Kernel in Operating System



- ✓ As discussed above, Kernel is the core part of an OS(Operating system); hence it has full control over everything in the system. Each operation of hardware and software is managed and administrated by the kernel.
- ✓ It acts as a bridge between applications and data processing done at the hardware level. It is the central component of an OS.
- ✓ It is the part of the OS that always resides in computer memory and enables the communication between software and hardware components.
- ✓ It is the computer program that first loaded on start-up the system (After the bootloader). Once it is loaded, it manages the remaining start-ups. It also manages memory, peripheral, and I/O requests from software. Moreover, it translates all I/O requests into data processing instructions for the CPU. It manages other tasks also such as **memory management, task management, and disk management**.
- ✓ A kernel is kept and usually loaded into separate memory space, known as **protected Kernel space**. It is protected from being accessed by application programs or less important parts of OS.
- ✓ Other application programs such as browser, word processor, audio & video player use separate memory space known as **user-space**.
- ✓ Due to these two separate spaces, user data and kernel data don't interfere with each other and do not cause any instability and slowness.

## Functions of a Kernel

### ✓ Device Management

To perform various actions, processes require access to peripheral devices such as a mouse, keyboard, etc., that are connected to the computer. A kernel is responsible for controlling these devices using device drivers. Here, a **device driver** is a computer program that helps or enables the OS to communicate with any hardware device.

A kernel maintains a list of all the available devices, and this list may be already known, configured by the user, or detected by OS at runtime.

### ✓ Memory Management

The kernel has full control for accessing the computer's memory. Each process requires some memory to work, and the kernel enables the processes to safely access the memory. To allocate the memory, the first step is known as **virtual addressing**, which is done by paging or segmentation. **Virtual addressing** is a process of providing virtual address spaces to the processes. This prevents the application from crashing into each other.

### ✓ Resource Management

One of the important functionalities of Kernel is to share the resources between various processes. It must share the resources in a way that each process uniformly accesses the resource. The kernel also provides a way for synchronization and **inter-process communication (IPC)**. It is responsible for context switching between processes.

### ✓ Accessing Computer Resources

A kernel is responsible for accessing computer resources such as RAM and I/O devices. **RAM or Random-Access Memory** is used to contain both data and instructions. Each program needs to access the memory to execute and mostly wants more memory than the available. For such a case, Kernel plays its role and decides which memory each process will use and what to do if the required memory is not available. The kernel also allocates the request from applications to use I/O devices such as keyboards, microphones, printers, etc.

## User Mode and Kernel Mode

The dual-mode operations in the operating system protect the operating system from illegal users.

To ensure proper operating system execution, we must differentiate between machine code execution and user-defined code. Most computer systems have embraced offering hardware support that helps distinguish between different execution modes. We have two modes of the operating system: ***user mode*** and ***kernel mode***.

Mode bit is required to identify in which particular mode the current instruction is executing. If the mode bit is 1, it operates user mode, and if the mode bit is 0, it operates in kernel mode.

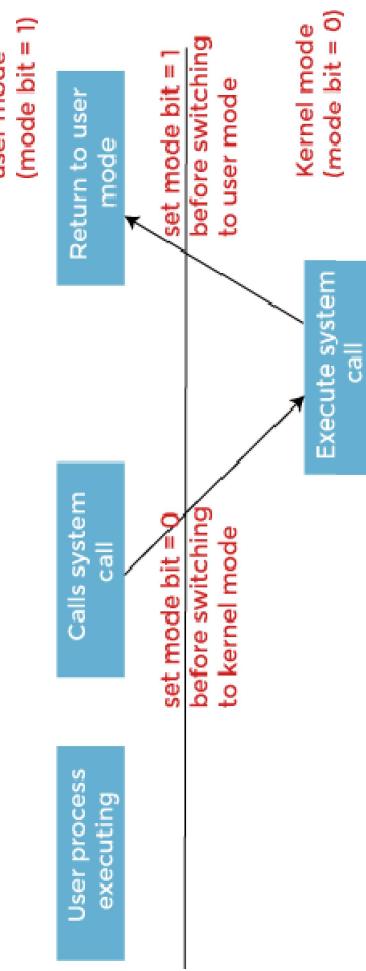
### 1. User Mode

When the computer system runs user applications like file creation or any other application program in the User Mode, this mode does not have direct access to the computer's hardware. For performing hardware related tasks, like when the user application requests for a service from the operating system or some interrupt occurs, in these cases, the system must switch to the Kernel Mode. The mode bit of the user mode is 1. This means that if the mode bit of the system's processor is 1, then the system will be in the User Mode.

## 2. Kernel Mode

All the bottom level tasks of the Operating system are performed in the Kernel Mode.

As the Kernel space has direct access to the hardware of the system, so the kernel-mode handles all the processes which require hardware support. Apart from this, the main functionality of the Kernel Mode is to execute privileged instructions.



With the mode bit, we can distinguish between a task executed on behalf of the operating system and one executed on behalf of the user.

- ✓ When the computer system executes on behalf of a user application, the system is in ***user mode***.
- ✓ However, when a user application requests a service from the operating system via a system call, it must transition from ***user*** to ***kernel mode*** to fulfill the request. As we can say, this architectural enhancement is useful for many other aspects of system operation.
- ✓ At system boot time, the hardware starts in ***kernel mode***.
- ✓ The operating system is then loaded and starts user applications in ***user mode***.
- ✓ Whenever a trap or interrupt occurs, the hardware switches from ***user mode*** to ***kernel mode***, changing the mode bit's state to 0.
- ✓ Thus, whenever the operating system gains control of the computer, it is in ***kernel mode***.
- ✓ The system always ***switches to user mode*** by setting the mode bit to 1 before passing control to a user program.

## Need for Dual-Mode Operations

- ✓ Certain types of processes are to be made hidden from the user, and certain tasks that do not require any type of hardware support. Using the *dual mode* of the OS, these tasks can be deal with separately.
- ✓ Also, the Operating System needs to function in the *dual mode* because the Kernel Level programs perform all the bottom level functions of the OS like process management, Memory management, etc. If the user alters these, then this can cause an entire system failure. So, for specifying the access to the users only to the tasks of their use, Dual Mode is necessary for an Operating system.