Lecture _1

Linux essentials
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Introduction

Operating System

- An operating system (OS) is a set of programs that control the execution of application programs and act as a mediator between a user of a computer and the computer hardware. OS is software that manages the computer hardware as well as providing an environment for application programs to run.

- Examples of OS : Windows, Windows/NT, OS/2,Linux and MacOS

Operating system Objectives

- (1)To make the computer system convenient and easy to use for the user.
- (2)To use the computer hardware in an efficient way.
- (3)To execute user programs and make solving user problems easier.

Computer System

- A computer system can be divided into four components: the hardware, the operating system, the application programs and the users.

  - 1. Hardware: such as CPU, memory and I/O devices.

  - 2. Operating system: provides the means of proper use of the hardware in the

  - Operations of the computer system, it is similar to government.

  - 3. Application programs: solve the computing problems of the user, such as compilers, database systems and web browsers.

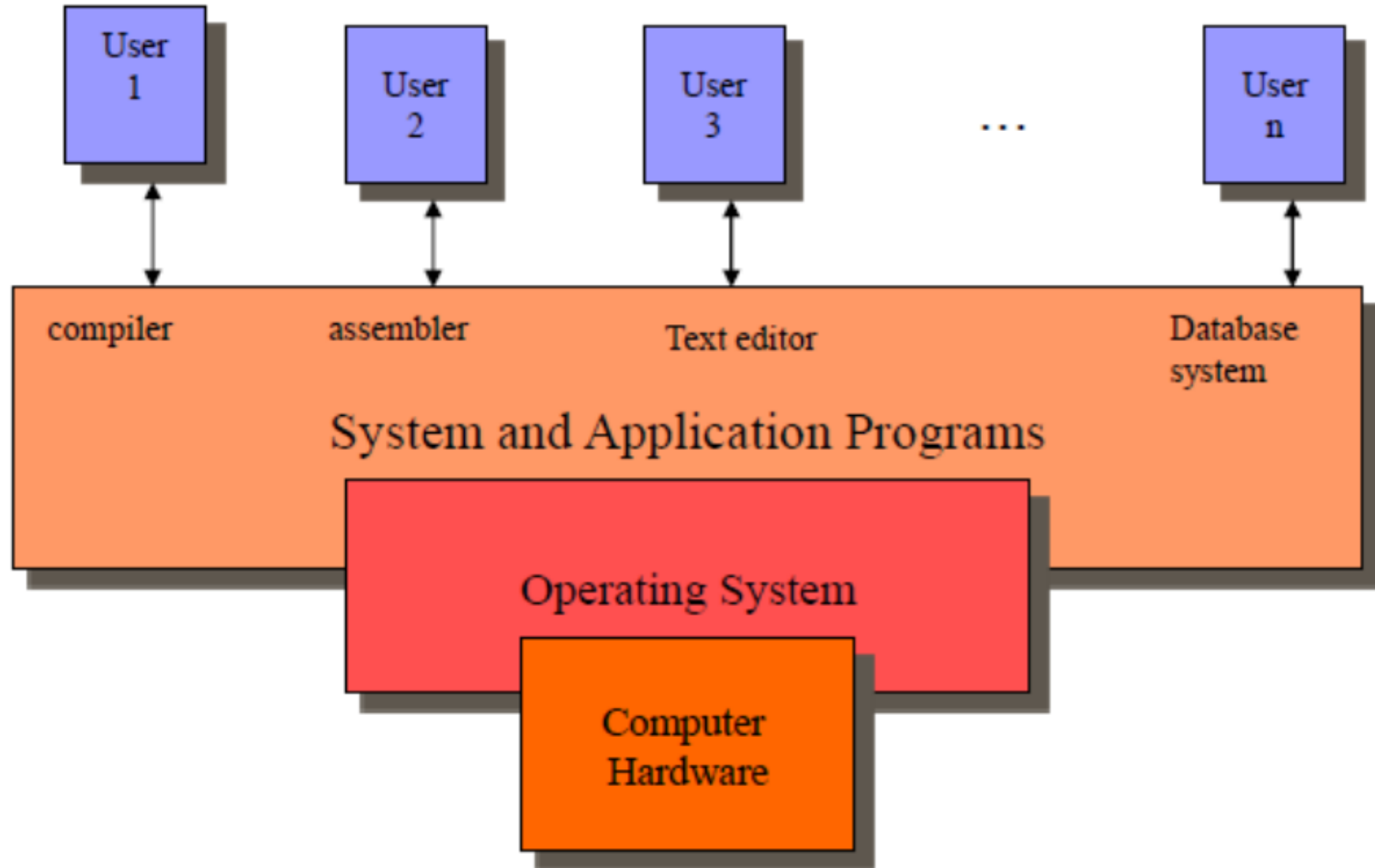 - 4. Users: peoples, machine, or another computer.

Figure 1: computer system

Operating system Functions

- 1. Implementing user interface.

- 2. Sharing files among users.

- 3. Allowing users to share data among themselves.

- 4. Preventing users from interfering with one another.

- 5. Scheduling resource among users.

- 6. Facilitating I/O operations.

- 7. Recovering from errors.

- 8. Accounting for resource storage.

- 9. Facilitating parallel operations.

- 10.Organizing data for secure and rapid access.

- 11.Handling network communications.

HARDWARE
- CPU, Memory, Hard Drive

OPERATING SYSTEM
- Windows, Apple OS X, Linux

END USER
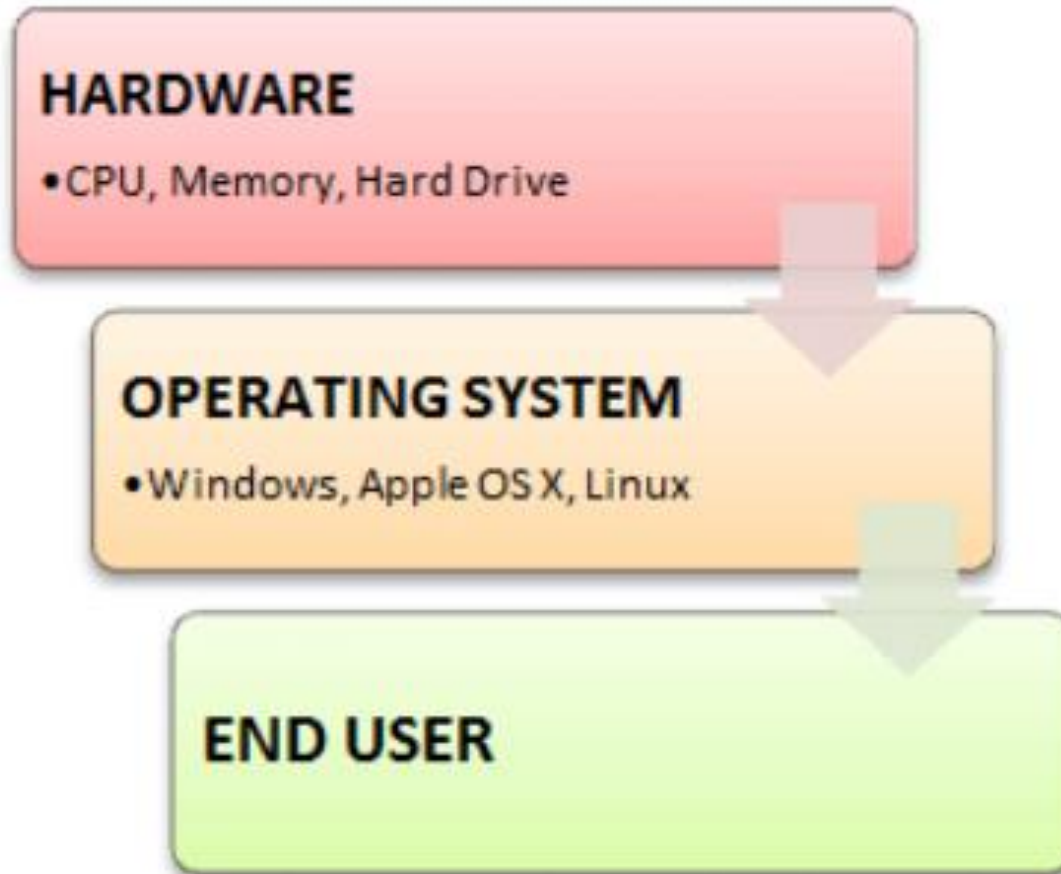
Introduction to Operating System

What is Linux Operating System

➡ Linux is based on the **UNIX** operating system. **UNIX** is a powerful, multi-user, multitasking operating system originally developed in the **1970s at AT&T Bell Labs**. It laid the foundation for many modern operating systems, including Linux.

The main benefits and advantages of Linux over other operating systems:

➡Linux is free and open-source, accessible to everyone.

➡Its source code can be inspected and modified by anyone.

➡This promotes global collaboration and innovation.

➡Linux offers efficient performance and strong security.

➡It works well across many devices and industries.

- The Linux Operating System is a Unix-like operating system that combines a wide range of open-source tools and components to form a complete computing environment. These components include file systems, user interfaces, system utilities, and application programs all working together to manage hardware and enable users to interact with their computer systems.

- To create a full and functional system, the Linux is combined with a collection of software packages and utilities, which are together called Linux distributions.

What is a "distribution?"

- Linux distribution is an operating system that is made up of a collection of software based on Linux kernel or you can say distribution contains the Linux kernel and supporting libraries and software. And you can get Linux-based operating system by downloading one of the Linux distributions and these distributions are available for different types of devices like embedded devices, personal computers, etc.

Around **600 + Linux Distributions** are available and some of the popular Linux distributions are:
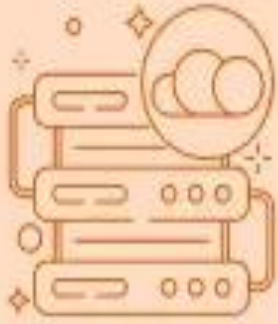
- MX Linux
- Manjaro
- Linux Mint
- Elementary
- Ubuntu
- Debian
- Solus
- Fedora
- openSUSE
- Deepin

Ubuntu distribution
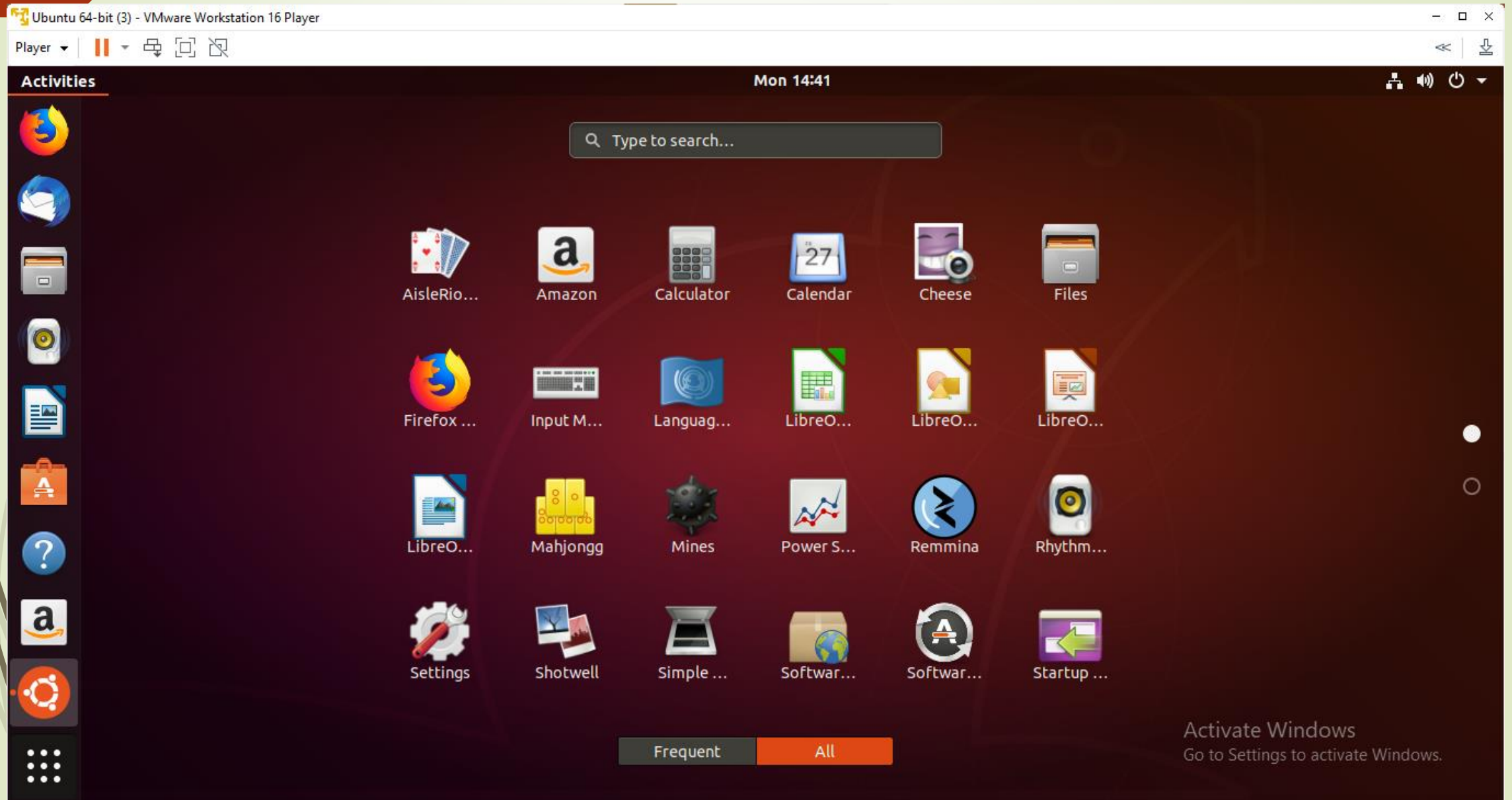
How is the Linux Operating System Used?

◗ The Linux operating system is widely used across various domains due to its flexibility, security, and open-source nature as shown in the following figure:

Linux Operating System Uses

Servers and Hosting

Development

Desktop and Personal Use

Cybersecurity

Embedded Systems

Supercomputers

- **Servers and Hosting**: Powers web servers, cloud infrastructure, and database management systems.

- **Development**: Used by developers for coding, debugging, and running applications.

- **Desktop and Personal Use**: Provides secure and customizable desktop environments.

- **Cybersecurity**: Essential for ethical hacking and security research.

- **Embedded Systems**: An embedded system is a combination of hardware and software designed to perform a specific function or set of functions, often within a larger mechanical or electrical system.

- Runs lightweight devices like routers, IoT gadgets, and smart appliances.(Ex: **Timer and heat control**)

- **Supercomputers**: Dominates high-performance computing for scientific research and simulations.

- **Education**: A cost-effective tool for teaching programming and system administration.

Architecture of Linux
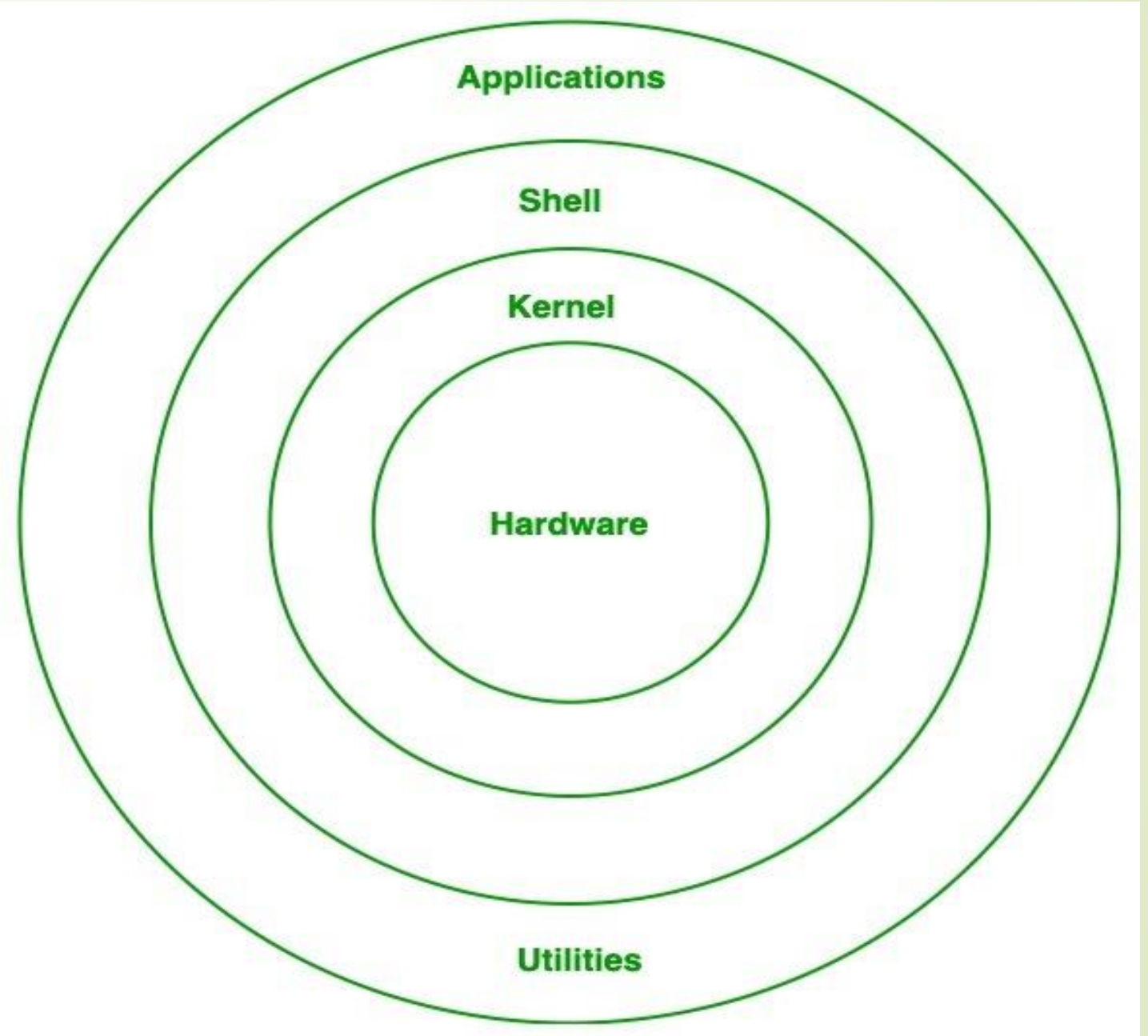
Kernel

- A kernel is the core component of an <u>operating system</u>, acting as the bridge between the system's <u>hardware</u> and software. The kernel manages system resources and facilitates the interactions between hardware and software components. Whenever a system starts, the Kernel is the first program that is loaded after the bootloader because the Kernel has to handle the rest of the thing of the system for the Operating System. The Kernel remains in the memory until the Operating System is shut-down.

- The Kernel is responsible for low-level tasks such as disk management, memory management, task management, etc. It provides an interface between the user and the hardware components of the system. When a process makes a request to the Kernel, then it is called System Call.

  It manages the following resources in Linux os :

  - ❑ **File management**
  - ❑ **Process management**
  - ❑ **I/O management**
  - ❑ **Memory management**
  - ❑ **Device management**

Shell

- The shell is the user interface of the Linux Operating System. It allows users to interact with the system by entering commands, which the shell interprets and executes. The shell serves as a bridge between the user and the kernel, forwarding the user's requests to the kernel for processing.

- It provides a convenient way for users to perform various tasks, such as running programs, managing files, and configuring the system.

# Shell is classified into two categories:

1-Command line shell

- Used by command line interface like Terminal in Linux or command prompt in windows.

- The CLI terminal is a powerful tool that is often the primary method used to administer small low-power devices, extremely capable cloud computing servers, and everything in between.

2- GUI graphical shell

- Manipulating programs based on graphical user interface GUI Such as doing a process by opening or closing windows

Command line shell
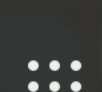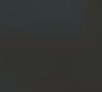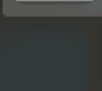
GUI graphical shell

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Introduction to Linux Operating System,GUI v/s CLI

Introduction

The context of use largely affects The definition of the word Linux. Linux actually means the kernel of the system, which is the sole controller of whatever happens on the computer system. When we talk or say that x " runs Linux " we usually refer to the system kernel and set of the tools that are used with it. Each of the present components will be checked so that we understand exactly what functions each does.

The Linux based kernel can run a wide variety of software across many different hardware-based platforms. A computer can act as a server, which means it primarily handles data on other's behalf or can act like a desktop, which means a user will be interacting with it directly. The system can run software or it can be used as a development pc in the process of creating any software. Linux can perform multiple roles as there is no specifical allocation to Linux about the role of the system; it's only a matter of configuring the present applications and how do they execute.

Command Line Interface (CLI)

The Command Line Interface (CLI), is a non-graphical, text-based interface to the computer system, where the user types in a command and the computer then successfully executes it. The Terminal is the platform or the IDE that provides the command line interface (CLI) environment to the user.

The CLI terminal accepts the commands that the user types and passes to a shell. The shell then receives and interprets what the user has typed into the instructions that can be executed by the OS(operating system). If the output is produced by the specific command, then this text is displayed in the terminal. If any of the problems with the commands are found, then some error message is displayed.

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Hardware Layer

- The hardware layer encompasses all the physical components of the computer, such as RAM (Random Access Memory),HDD (Hard Disk Drive), CPU (Central Processing Unit), and input/output devices. This layer is responsible for interacting with the Linux Operating System and providing the necessary resources for the system and applications to function properly.

System Utility

➧ System utilities are essential tools and programs provided by the Linux Operating System to manage and configure various aspects of the system. These utilities perform tasks such as installing software, configuring network settings, monitoring system performance, managing users and permissions, and much more. System utilities simplify system administration tasks, making it easier for users to maintain their Linux systems efficiently.

What is a command?

- A command is a software program that when executed on the CLI (command line interface), performs an action on the computer. When you type in a command, a process is run by the operating system that can read input, manipulate data and produce output. A command runs a process on the operating system, which then causes the computer to perform a job.

To apply (i.e. run or execute) **Linux commands**, you need a few basic components set up

You need a Linux Environment:

1. **Native Installation (Dual Boot or Full Install)**
   - Linux is installed directly on your machine (e.g. Ubuntu, Fedora, CentOS, etc.)
   - Use the terminal built into the OS to run commands.

2. **Virtual Machine (VM)**
   - Use tools like **VMware**, **VirtualBox**, or **QEMU** to run Linux inside another OS (like Windows or macOS).
   - You can install a Linux distribution in the VM like Ubuntu.
   - Open the terminal inside the VM to run Linux commands.

What is VMware program?

▶ VMware is a leading company that provides virtualization software and cloud infrastructure solutions. At its core, VMware enables you to create and manage virtual machines (VMs), which are software-based simulations of physical computers. These VMs can run their own operating systems and applications just like a physical computer, but they share the underlying resources (CPU, memory, storage) of the host system.

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