Orientation to Computing-I

L T P :2 0 0

Unit-2 (Operating System)

- **Operating System:** Operating Systems and its components, Windows Operating Systems Versions and features, Installation process, Directory Hierarchy of Windows Operating System (single level and multiple level), Bootloader
- **Linux Operating System:** Linux OS and its features, Distribution versions, installation process, Directory Hierarchy of Linux System (single level and multiple level). Partitions: Understanding disk partitions and obtaining partition information using system tools, Comparison of windows and Linux OS, Virtual Machines

What is an Operating System?

- **What is an Operating system?**
  - **A program that acts as an intermediate/ interface between a user of a computer and the computer hardware.**
  - **Resource allocator (Managing the resources efficiently)**
  - **Control Program**

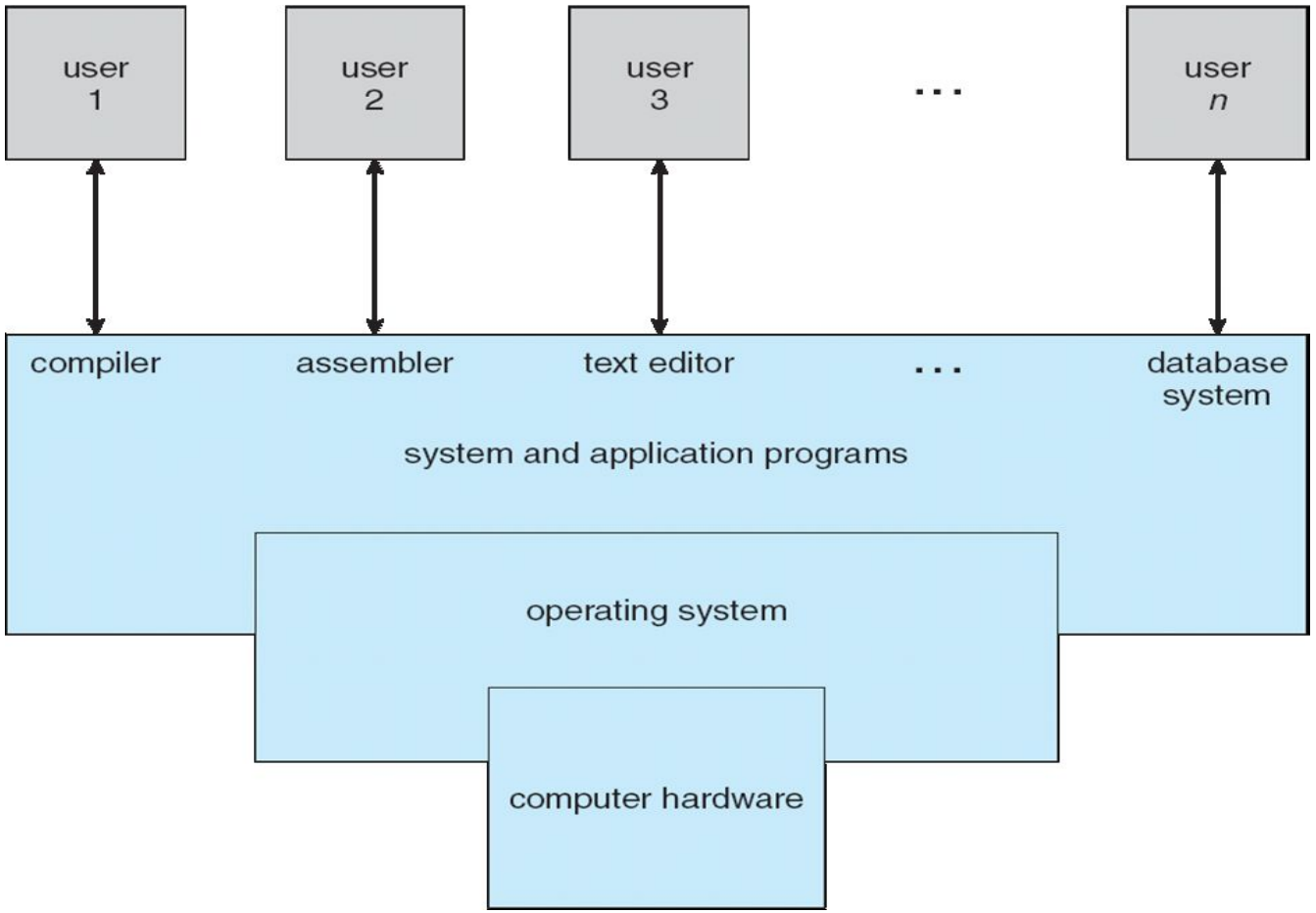
- **Operating system goals:**
  - **Execute user programs and make problem solving easier.**
  - **Make the computer system convenient to use**
  - **Efficiently use available resources**

- An operating system is the one program that is running at all the times on the computer- usually called the kernel.
- Kernel is a program that (allow) let the hardware to recognize and read the program/process.

Computer System Structure

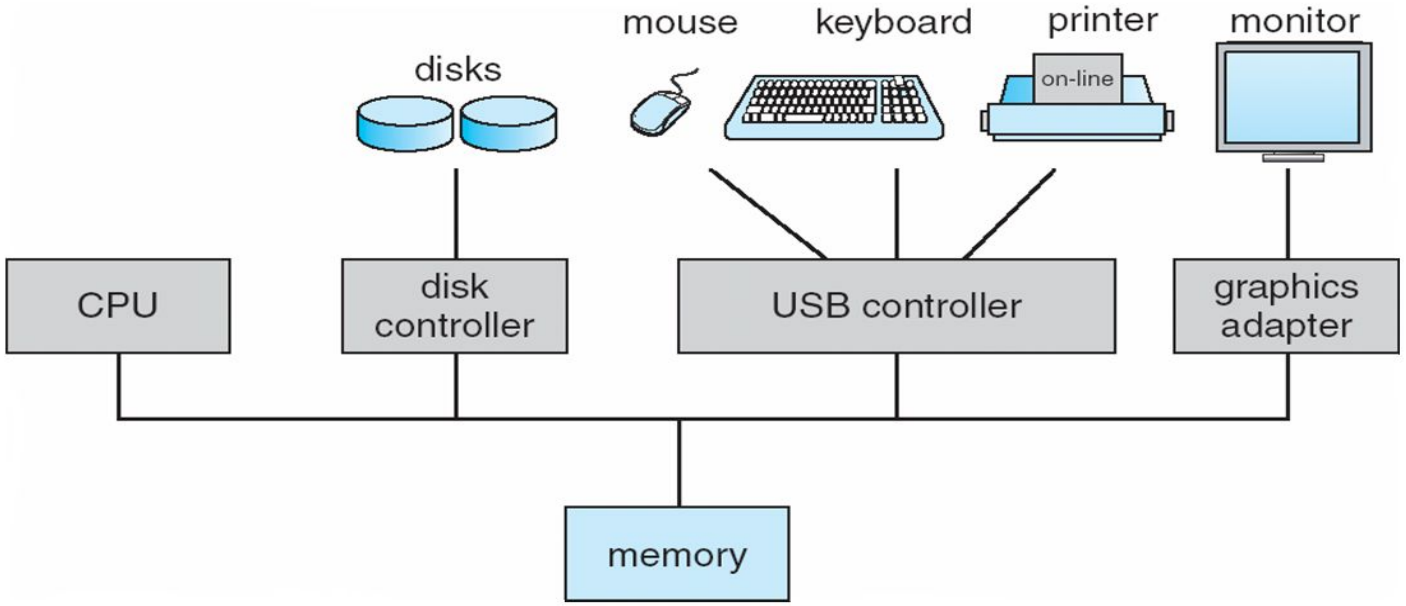
- **Computer system can be divided into four components:**
  - **Hardware** – provides **basic computing resources**
    - CPU, memory, I/O devices
  - **Operating system**
    - **Controls and coordinates use of resources** among various applications and users
  - **System/Application programs** – define the ways in which the system resources are used to solving user problems
    - Word processors, compilers, web browsers, database systems, video games
  - **Users**
    - People, machines, other computers

Four Components of a Computer System



Computer System Organization

- Computer-system operation
  - One or more CPUs, device controllers connect through common bus providing access to shared memory
  - Concurrent execution of CPUs and devices competing for memory cycles



Components of Operating System

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

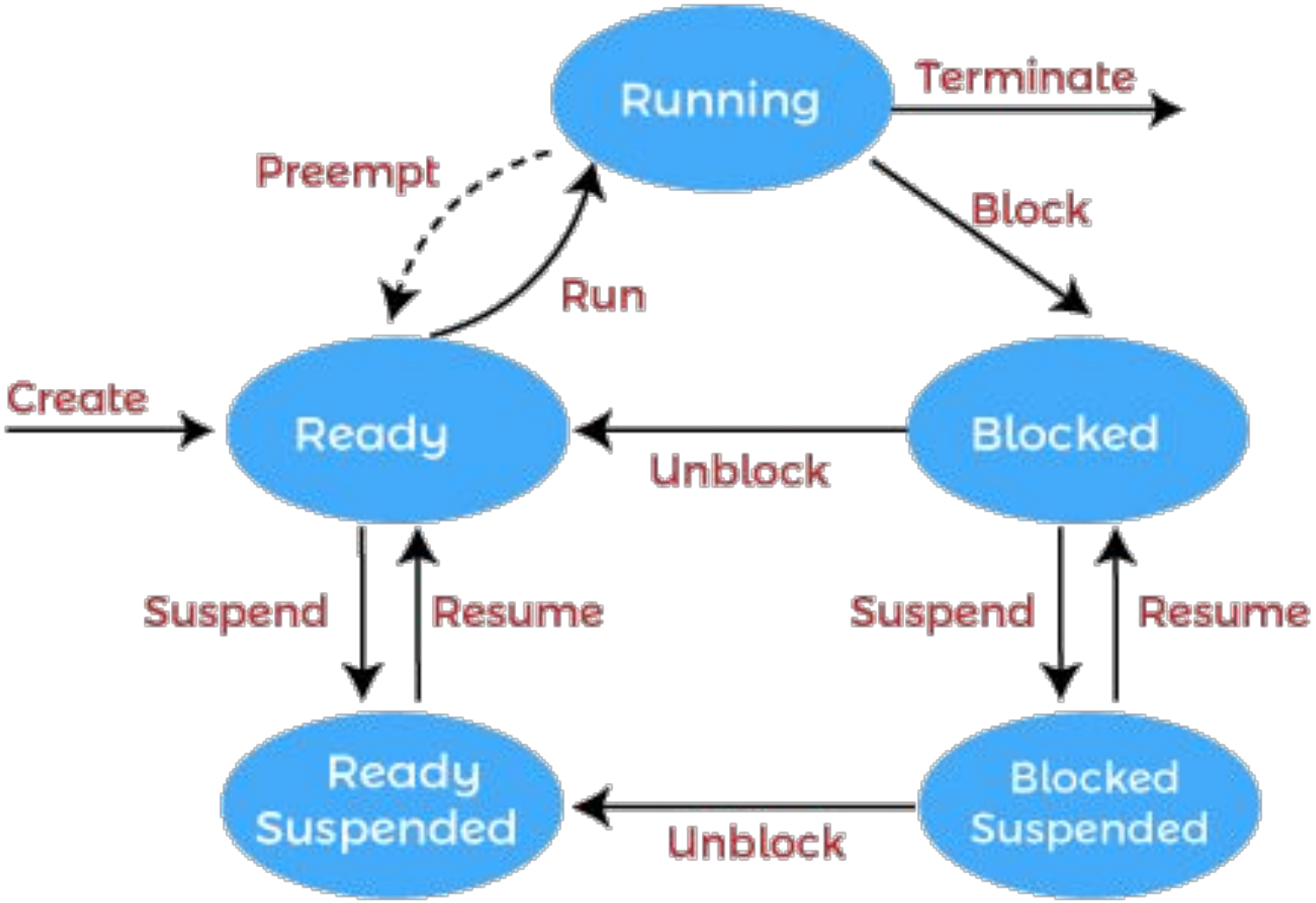

Process Management
File Management
Network Management
Main Memory Management
Secondary Storage Management
I/O Device Management
Security Management
Command Interpreter System
Operating System Components

Process Management

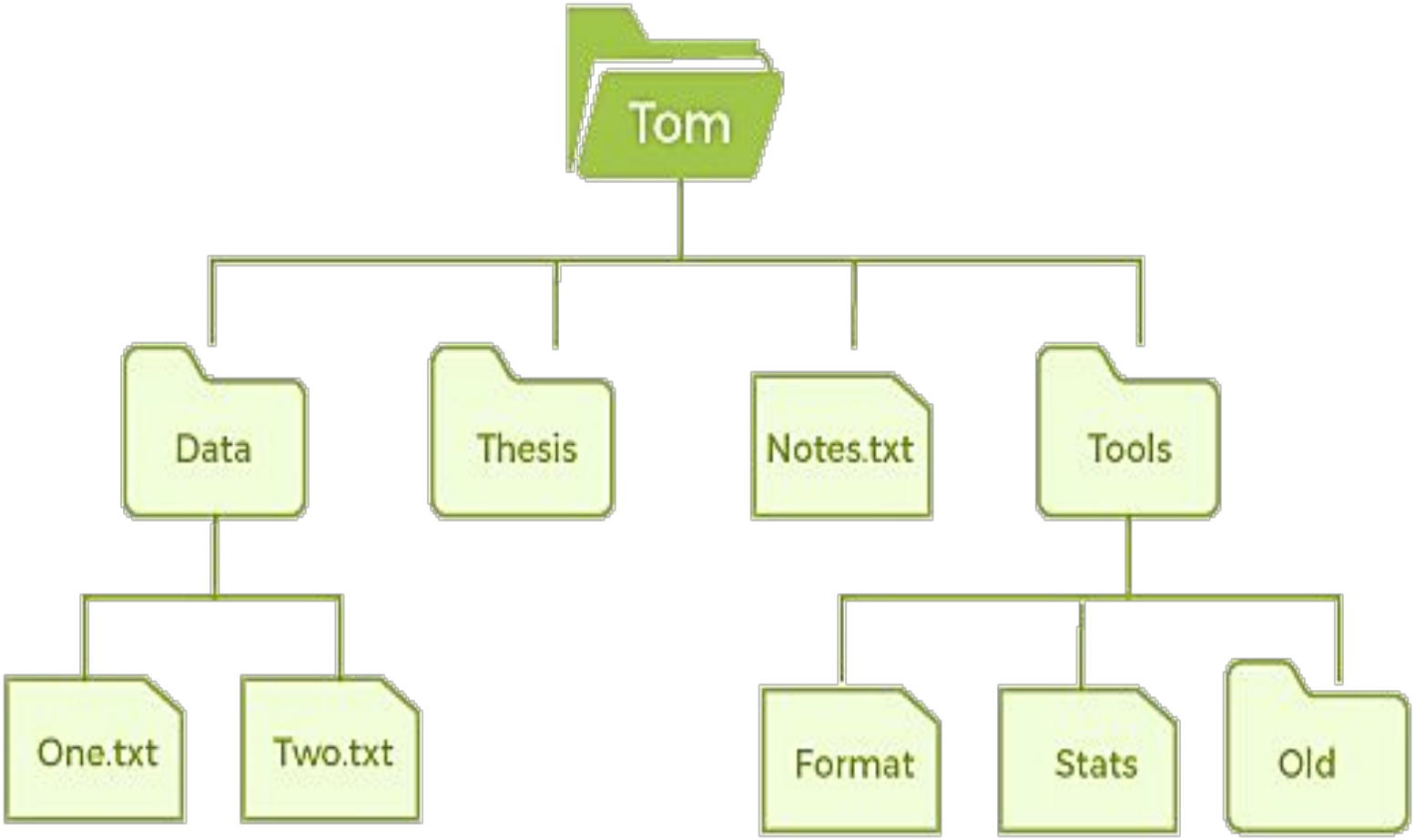
- The process management component is a procedure for managing many processes running simultaneously on the operating system. Every running software application program has one or more processes associated with them.
- For example, when you use a search engine like Chrome, there is a process running for that browser program.
- Process management keeps processes running efficiently. It also uses memory allocated to them and shutting them down when needed.
- The execution of a process must be sequential so, at least one instruction should be executed on behalf of the process.

Functions of process management

- Here are the following functions of process management in the operating system, such as:
- Process creation and deletion.
- Suspension and resumption.
- Synchronization process
- Communication process


Running
Terminate
Preempt
Block
Run
Create
Ready
Blocked
Unblock
Suspend
Resume
Suspend
Resume
Ready Suspended
Blocked Suspended
Unblock

- **File Management**
- A file is a set of related information defined by its creator. It commonly represents programs (both source and object forms) and data. Data files can be alphabetic, numeric, or alphanumeric.
- **Function of file management**
- The operating system has the following important activities in connection with file management:
- File and directory creation and deletion.
- For manipulating files and directories.
- Mapping files onto secondary storage.
- Backup files on stable storage media.


Tom
Data
Thesis
Notes.txt
Tools
One.txt
Two.txt
Format
Stats
Old

- **Network Management**
- Network management is the process of administering and managing computer networks. It includes performance management, provisioning of networks, fault analysis, and maintaining the quality of service.
- A distributed system is a collection of computers or processors that never share their memory and clock.
- In this type of system, all the processors have their local memory, and the processors communicate with each other using different communication cables, such as fibre optics or telephone lines.
- The computers in the network are connected through a communication network, which can configure in many different ways.
- The network can fully or partially connect in network management, which helps users design routing and connection strategies that overcome connection and security issues.

- **Functions of Network management**

- Distributed systems help you to various computing resources in size and function. They may involve minicomputers, microprocessors, and many general-purpose computer systems.
- A distributed system also offers the user access to the various resources the network shares.
- It helps to access shared resources that help computation to speed up or offers data availability and reliability.

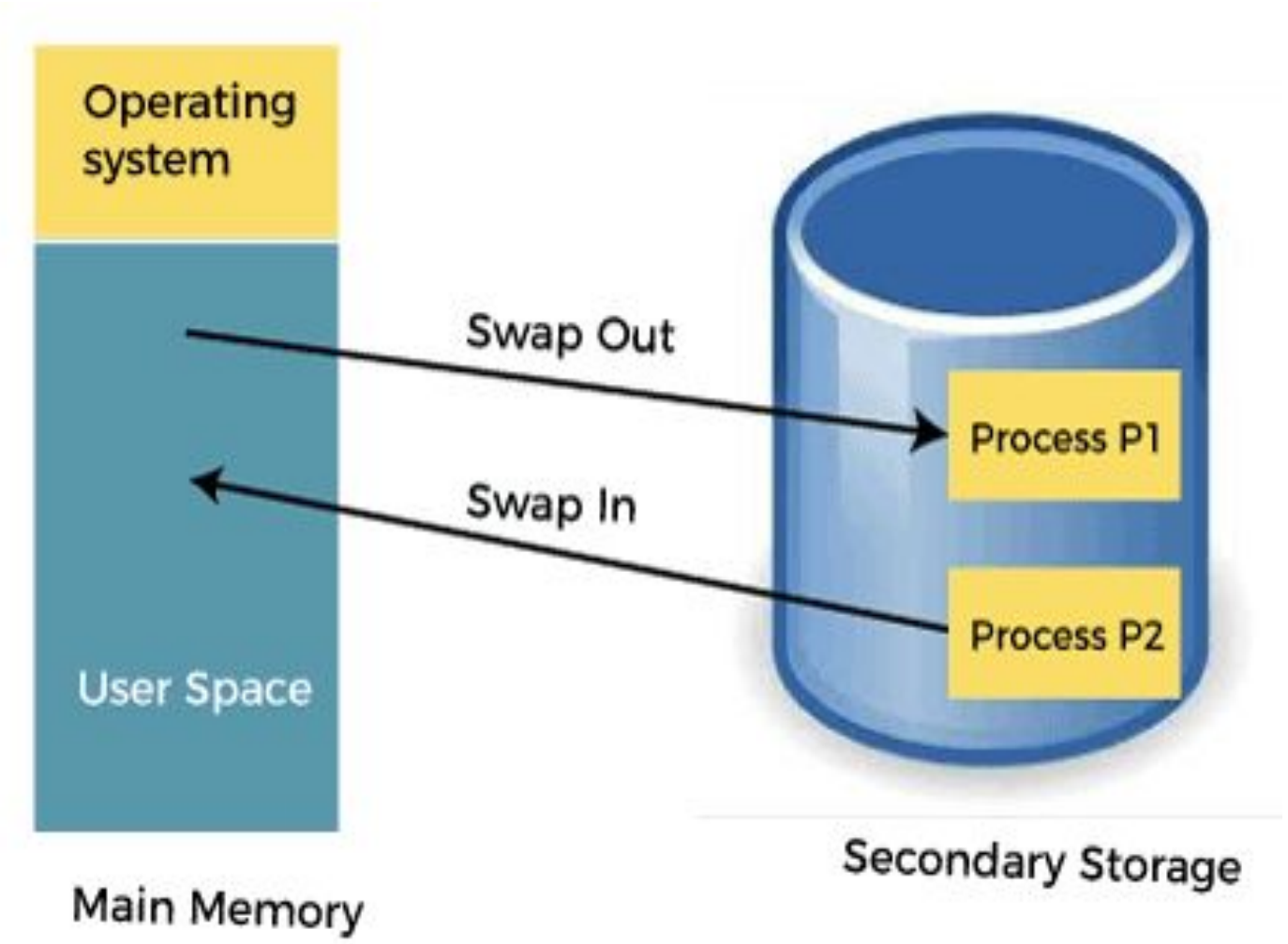
Computer Networks

When we hook up computers together using data communication facilities, we call this a computer network.

- **Main Memory management**
- Main memory is a large array of storage or bytes, which has an address.
- The memory management process is conducted by using a sequence of reads or writes of specific memory addresses.
- It should be mapped to absolute addresses and loaded inside the memory to execute a program. The selection of a memory management method depends on several factors
- However, it is mainly based on the hardware design of the system. Each algorithm requires corresponding hardware support.
- Main memory offers fast storage that can be accessed directly by the CPU. It is costly and hence has a lower storage capacity. However, for a program to be executed, it must be in the main memory.

- **Functions of Memory management**

- An Operating System performs the following functions for Memory Management in the operating system:
- It helps you to keep track of primary memory.
- Determine what part of it are in use by whom, what part is not in use.
- In a multiprogramming system, the OS decides which process will get memory and how much.
- Allocates the memory when a process requests.
- It also de-allocates the memory when a process no longer requires or has been terminated.

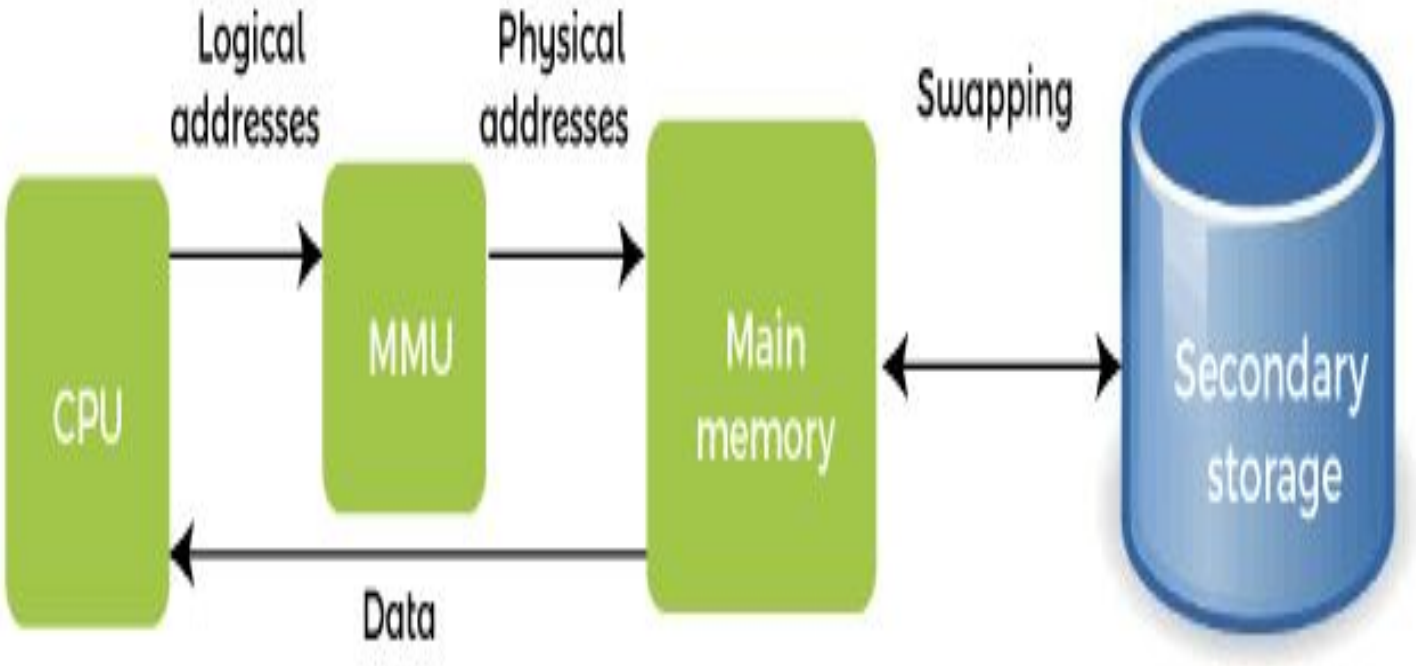

Operating system
User Space
Main Memory
Swap Out
Swap In
Process P1
Process P2
Secondary Storage

- **Secondary-Storage Management**
- The most important task of a computer system is to execute programs. These programs help you to access the data from the main memory during execution.
- This memory of the computer is very small to store all data and programs permanently. The computer system offers secondary storage to back up the main memory.
- Today modern computers use hard drives/SSD as the primary storage of both programs and data.
- However, the secondary storage management also works with storage devices, such as USB flash drives and CD/DVD drives.
- Programs like assemblers and compilers are stored on the disk until it is loaded into memory, and then use the disk is used as a source and destination for processing.

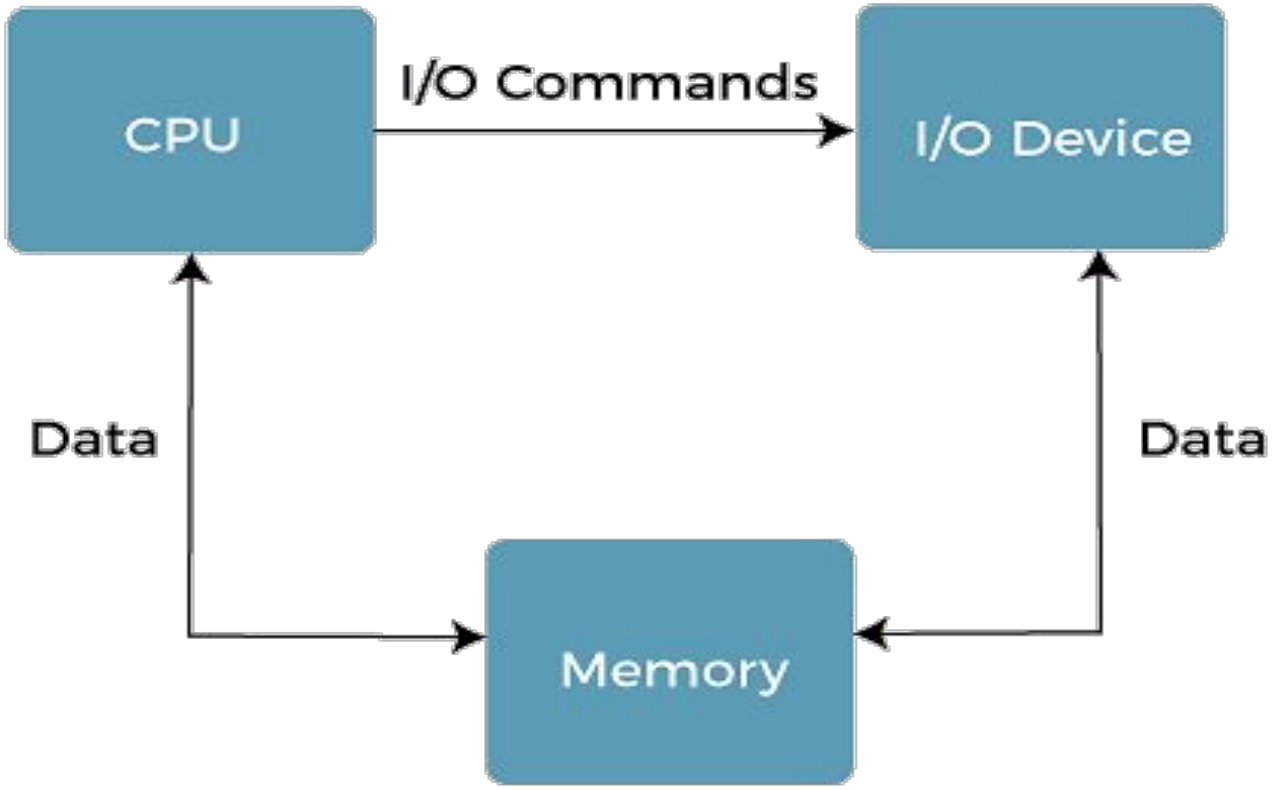
- **Functions of Secondary storage management**

Here are some major functions of secondary storage management in the operating system:

- Storage allocation
- Free space management
- Disk scheduling

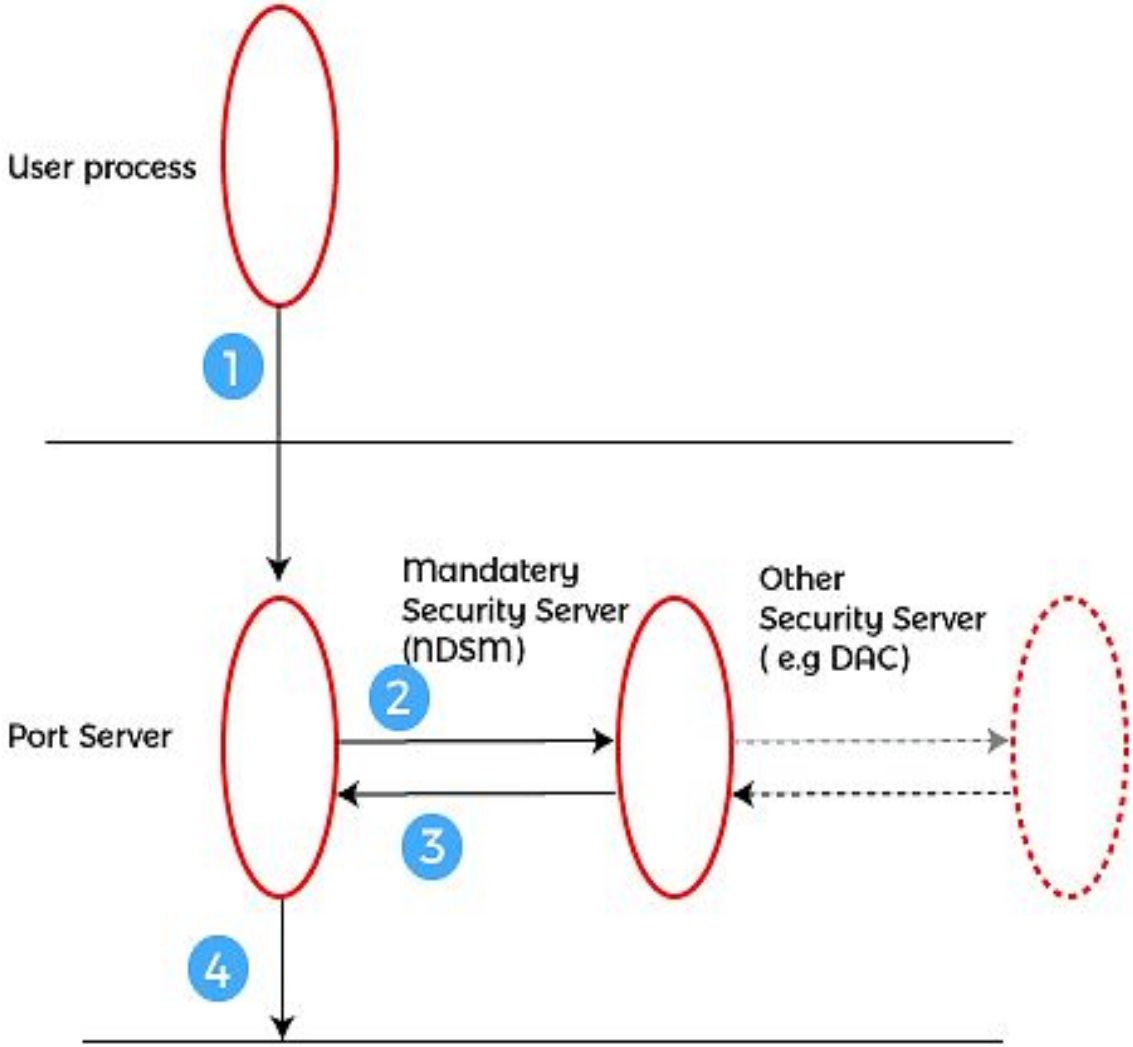

Logical addresses
Physical addresses
Swapping
CPU
MMU
Main memory
Secondary storage
Data

- **I/O Device Management**
- One of the important use of an operating system that helps to hide the variations of specific hardware devices from the user.
- **Functions of I/O management**
- The I/O management system offers the following functions, such as:
- It offers a buffer caching system
- It provides general device driver code
- It provides drivers for particular hardware devices.
- I/O helps you to know the individualities of a specific device.

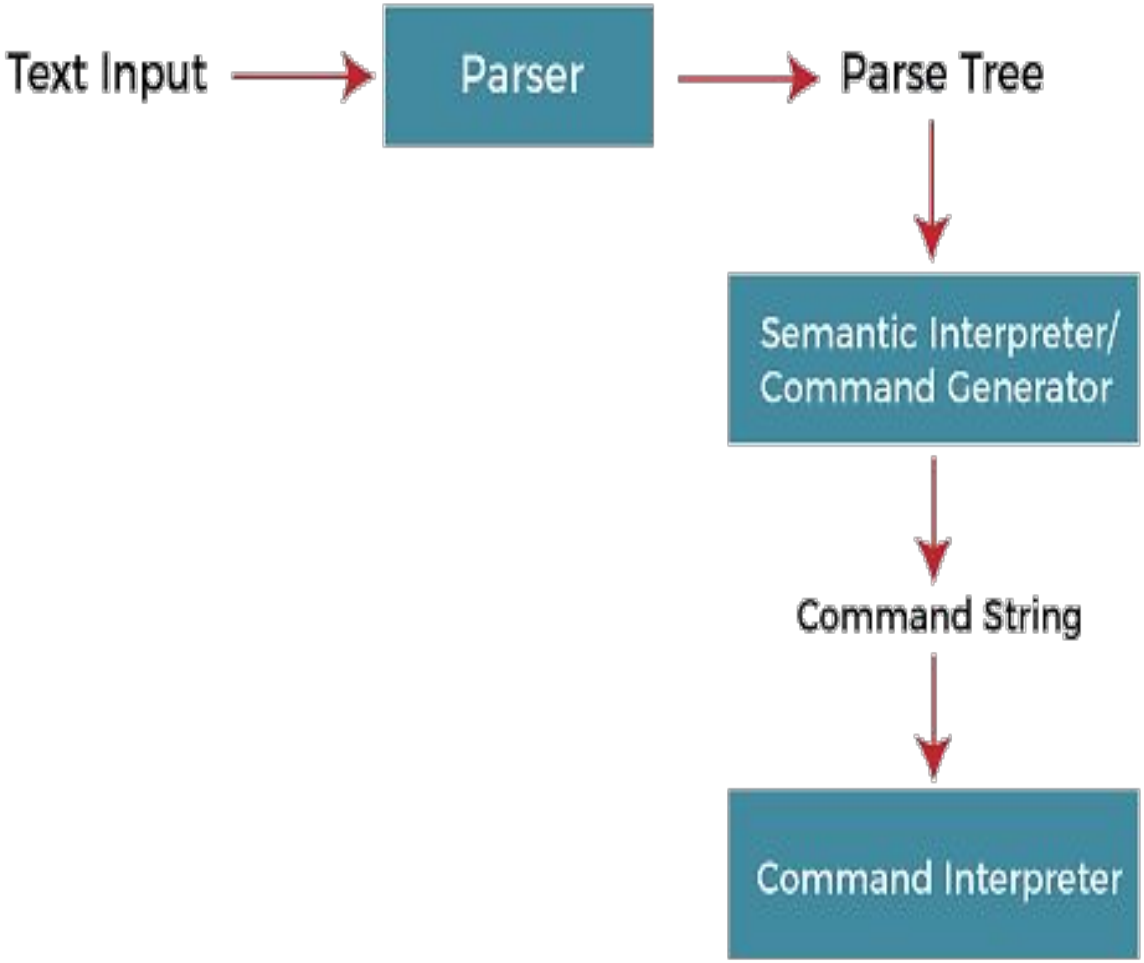

CPU
I/O Commands
I/O Device
Data
Data
Memory

- **Security Management**
- The various processes in an operating system need to be secured from other activities.
- Therefore, various mechanisms can ensure those processes that want to operate files, memory CPU, and other hardware resources should have proper authorization from the operating system.
- Security refers to a mechanism for controlling the access of programs, processes, or users to the resources defined by computer controls to be imposed, together with some means of enforcement.
- For example, memory addressing hardware helps to confirm that a process can be executed within its own address space.
- The time ensures that no process has control of the CPU without renouncing it.

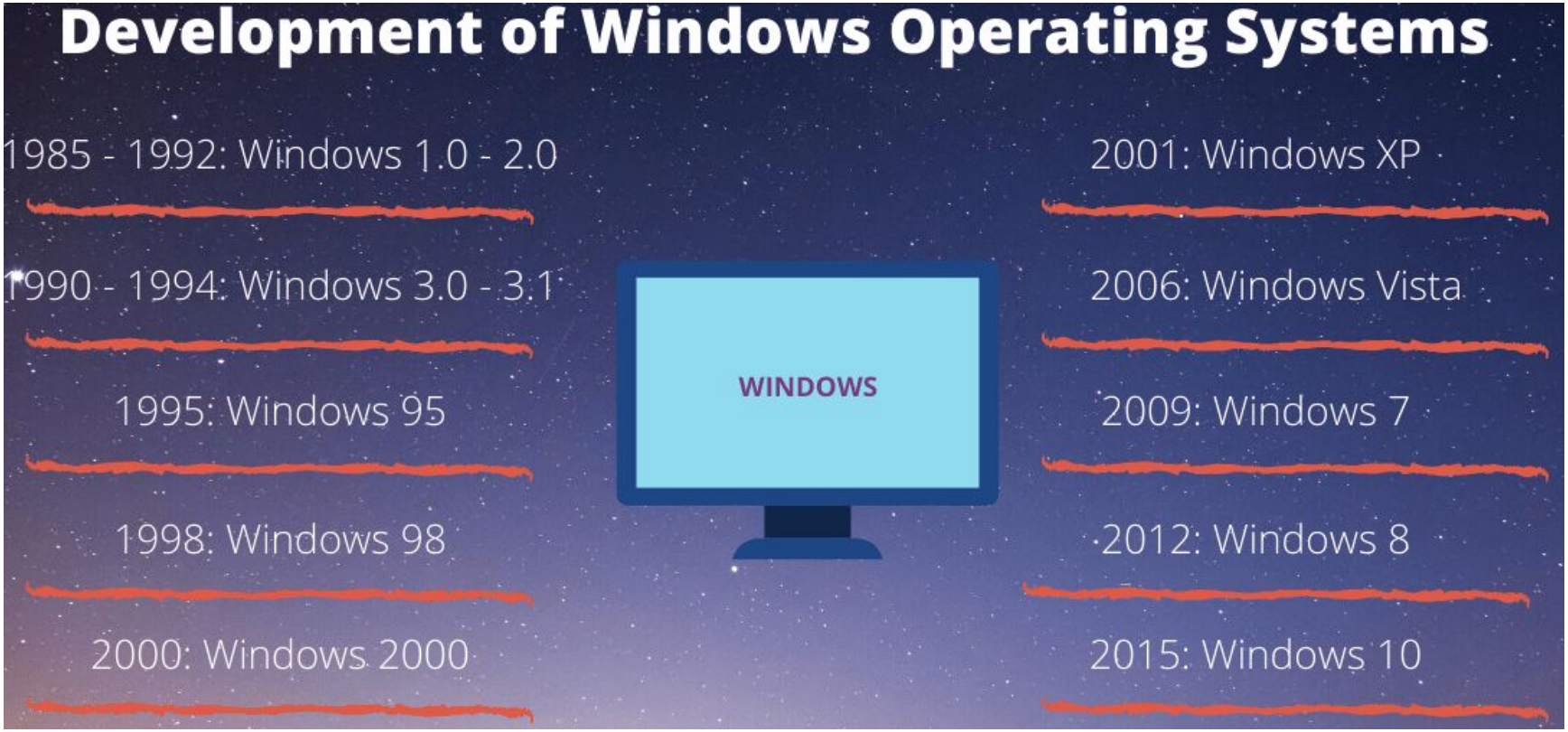
- **Security Management**
- No process is allowed to do its own I/O to protect, which helps you to keep the integrity of the various peripheral devices.
- Security can improve reliability by detecting latent errors at the interfaces between component subsystems.
- Early detection of interface errors can prevent the foulness of a healthy subsystem by a malfunctioning subsystem.
- An unprotected resource cannot misuse by an unauthorized or incompetent user.


User process
1
Mandatery
Security Server
(NDSM)
Other
Security Server
(e.g DAC)
Port Server
2
3
4

- **Command Interpreter System**
- One of the most important components of an operating system is its command interpreter. The command interpreter is the primary interface between the user and the rest of the system.
- Many commands are given to the operating system by control statements. A program that reads and interprets control statements is automatically executed when a new job is started in a batch system or a user logs in to a time-shared system. This program is variously called:
- The control card interpreter,
- The command-line interpreter,
- The shell (in UNIX), and so on.
- Its function is quite simple, get the next command statement, and execute it. The command statements deal with process management, I/O handling, secondary storage management, main memory management, file system access, protection, and networking.


Text Input
Parser
Parse Tree
Semantic Interpreter/
Command Generator
Command String
Command Interpreter

Windows Operating Systems
Versions and features



- **1. Windows 1.0**
- It was released on November 20, 1985
- Pure Operating Environment
- Used Graphical User Interface
- Simple Graphics
- Offered limited multi-tasking was expected to have a better future potential
- **2. Windows 2.0**
- It was released on December 9, 1987
- 16-bit Graphic User Interface (GUI) based operating environment
- Introduced Control Panel, and the first version of MS Word and Excel
- Unlike Windows 1.0, it had the capacity to allow applications to overlap each other
- It was also the last Windows OS which did not require a hard disk
- Hardware played an important role

- **3. Windows 3.0**
- It was released in 1990
- It was better at multitasking
- Used 8086 microprocessors
- It has both, conventional and extendable memory
- First version of Windows to gather critical appreciation
- Better memory/ storage
- **Note*** – None of the above mentioned Windows was Operating Systems. They all came under the category of Windows, working based on a graphical operating environment. It was Windows 95, which was the first Operating System released by Microsoft.

- **4. Window 95**
- It was the first complete Operating System
- It was released on August 15, 1995
- It merged MS-DOS and Windows products
- It simplified plug and play features
- Taskbar and Start menu was introduced with this Windows OS
- Advanced from 16 bit GUI to 32 bit GUI
- Long file names could be saved
- Initially, computers with Windows 95 did not have Internet Explorer installed but by the release date of Windows 95, the first version of Internet Explorer was installed in the software
- On December 31, 2001, Windows declared this version of OS outdated and ended its support for the same

- **5. Windows 98**
- It was released to manufacturing on May 15, 1998
- It was a 16 bit and 32 bit product based on MS DOS
- It was not an entirely new version but just a tuned-up version to Windows 95
- Internet Explorer 4.01 was released along with this Windows version
- It did not support USB printers or mass storage devices
- An update to this version "Windows SE" was released in 1999

- **6. Windows 2000**
- It was officially released on February 17, 2000. However, its manufacturing had begun in late 1999
- A core set of features was followed for manufacturing Windows 2000 but 4 different editions, targeting different sectors of the market were released. These included: Server, Professional, Advanced Server and Datacenter Server
- It was considered as one of the most secure OS ever
- A local disk manager was introduced with these Windows
- Multilingual User Interface – it supported many different languages

- **7. Windows XP**
- While the manufacturing started on August 24, 2001, the official product was released on October 25, 2001
- Advanced portable PC support
- Automatic wireless connection support
- Fast start-up
- Better Graphical User Interface (GUI)
- Help and support centre
- **8. Windows Vista**
- It was released on January 30, 2007
- It had an upgraded version of Graphical User Interface
- It was the first operating system to use DVD-ROM for installation

- **9. Windows 7**
- It was released on October 22, 2009
- A large number of new features were introduced
- Redesigned Windows shell with an updated taskbar
- Incremental upgrade to the Windows line
- Libraries were added in the file management system
- A few features from the past Windows were removed
- Extended hardware support
- **10. Windows 8**
- It was released for retail on October 26, 2012
- Optimisations for touch-based. Installed in new devices like Laptops, Mobile phones, tablets, etc.
- Increased integration with cloud services. Windows Store service for software distribution. Task manager had been redesigned
- New security features were introduced
- Online Applications could be directly downloaded

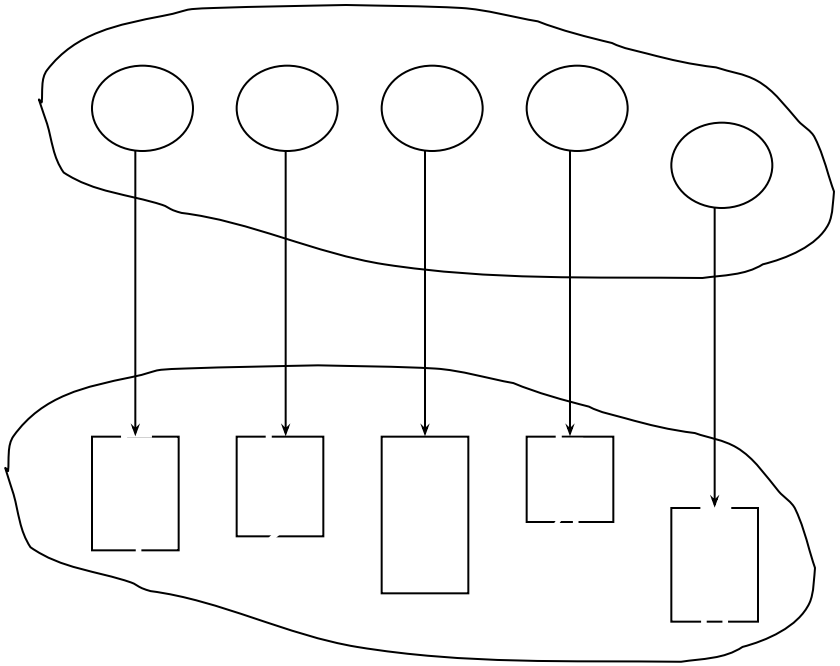
- **11. Windows 10**
- It was released on July 29, 2015
- Addresses shortcomings in the user interface first introduced with Windows 8
- A virtual desktop system
- It had the ability to run windows store apps within windows on the desktop rather than in the full-screen mode
- Included new icons
- To reduce storage shortcomings, Windows 10 automatically compresses the file size

Installation process

1. Set up the display environment
2. Erase the primary boot disk
3. Set up the BIOS
4. Install the operating system
5. Install the operating system, update the drivers, and run operating system updates, as necessary.

Directory Structure

- Symbol table of files that stores all related information about a file it holds with its contents



Both the directory structure and the files reside on disk
Backups of these two structures are kept on tapes

Operations Performed on Directory

Directory: collection of files or directories

- A Symbol Table that translates file names into their directory entry.

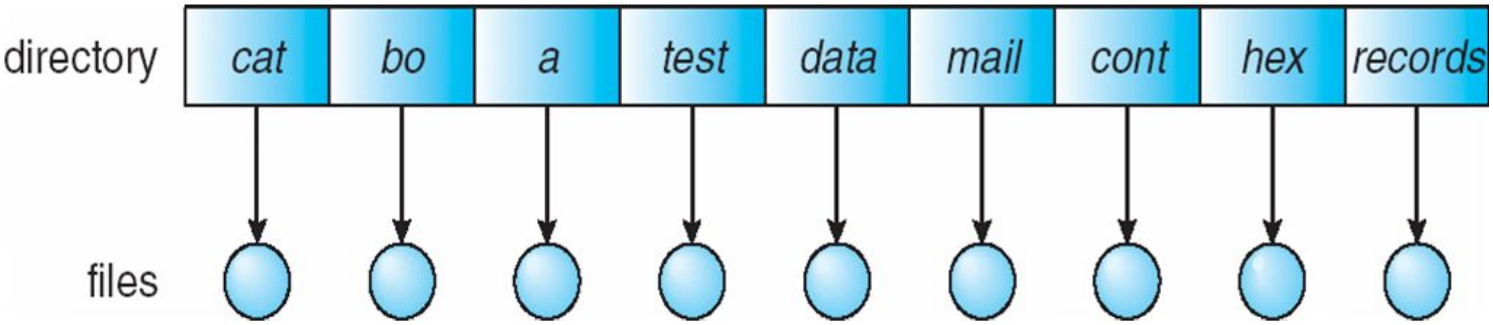
Operations:

- Search for a file
- Create a file
- Delete a file
- List a directory
- Rename a file
- Traverse the file system : Search all directories/ sub directories and files

Directory Schemes

1. Single Level Directory

One directory many files



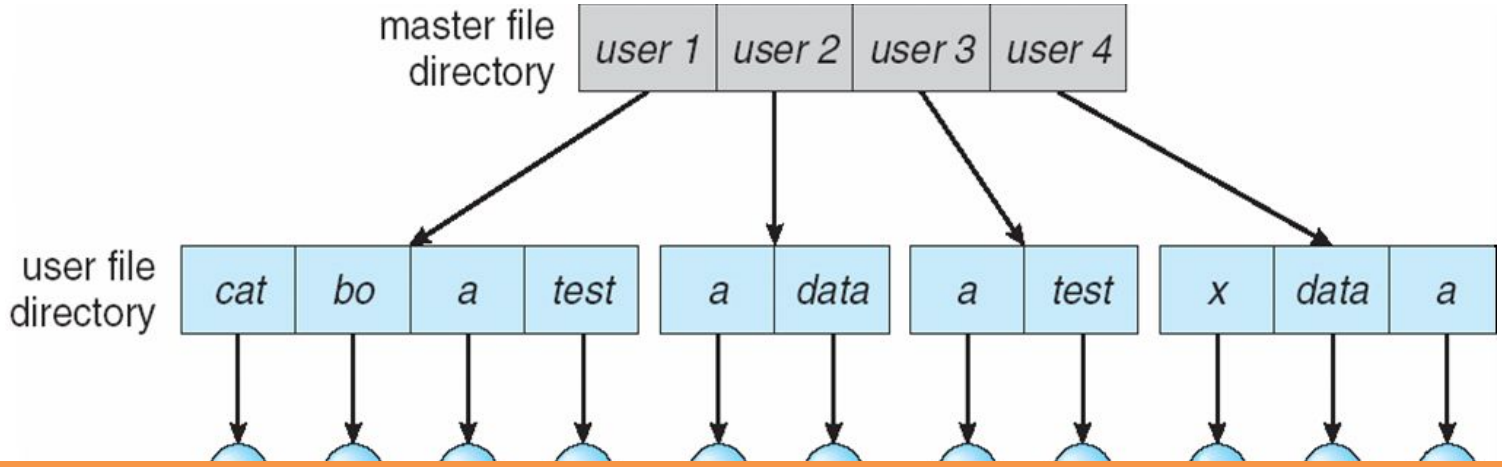
Disadvantage:

1. Difficult to remember the name of files when files increases
2. Single directory for all users
3. File names created by different users should be different.

Two Level

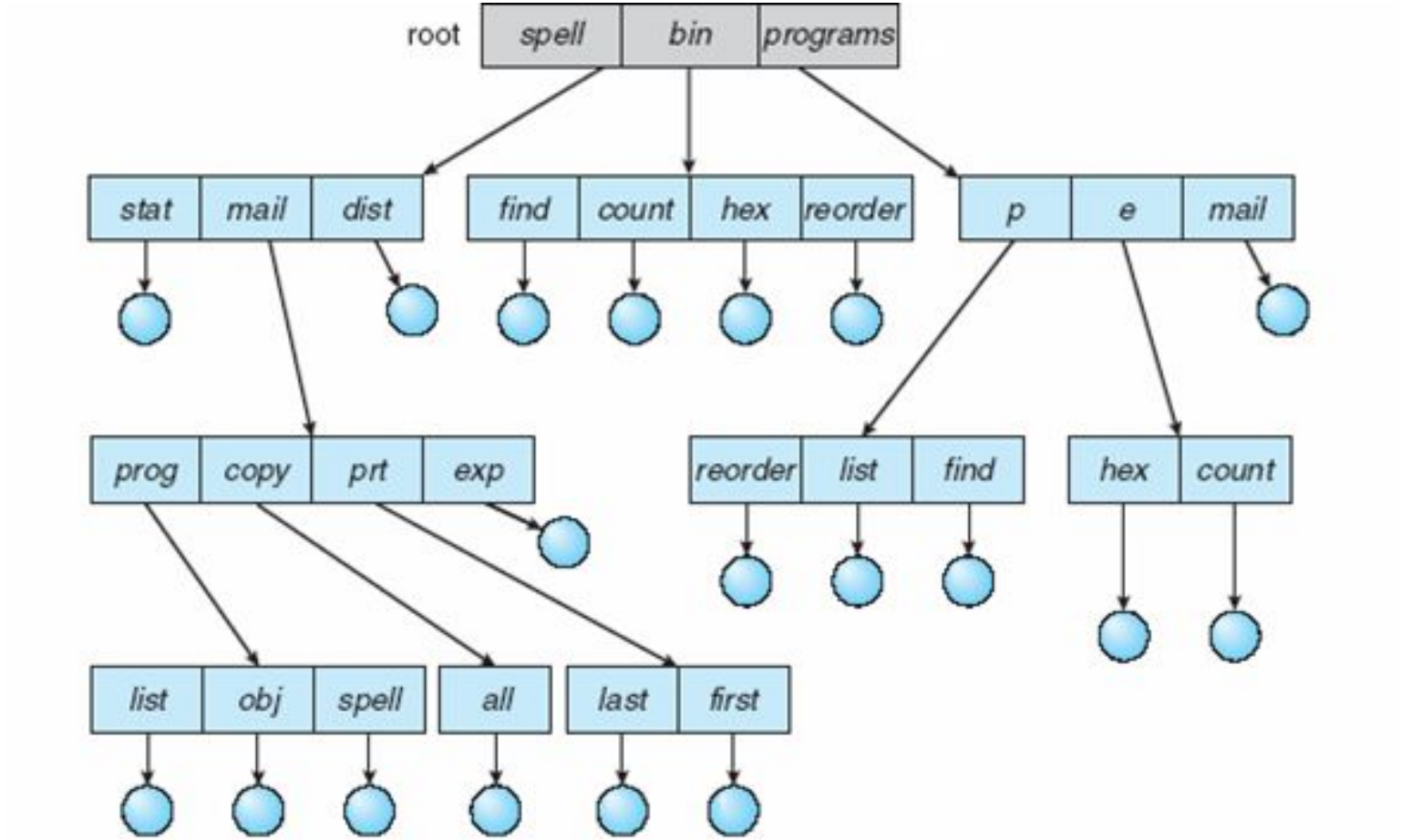
- **2. Two level directory**, **each user has his own user file directory(UFD).**

- UFDs have the similar structure, but each **lists files of a single user**.



Tree Structure

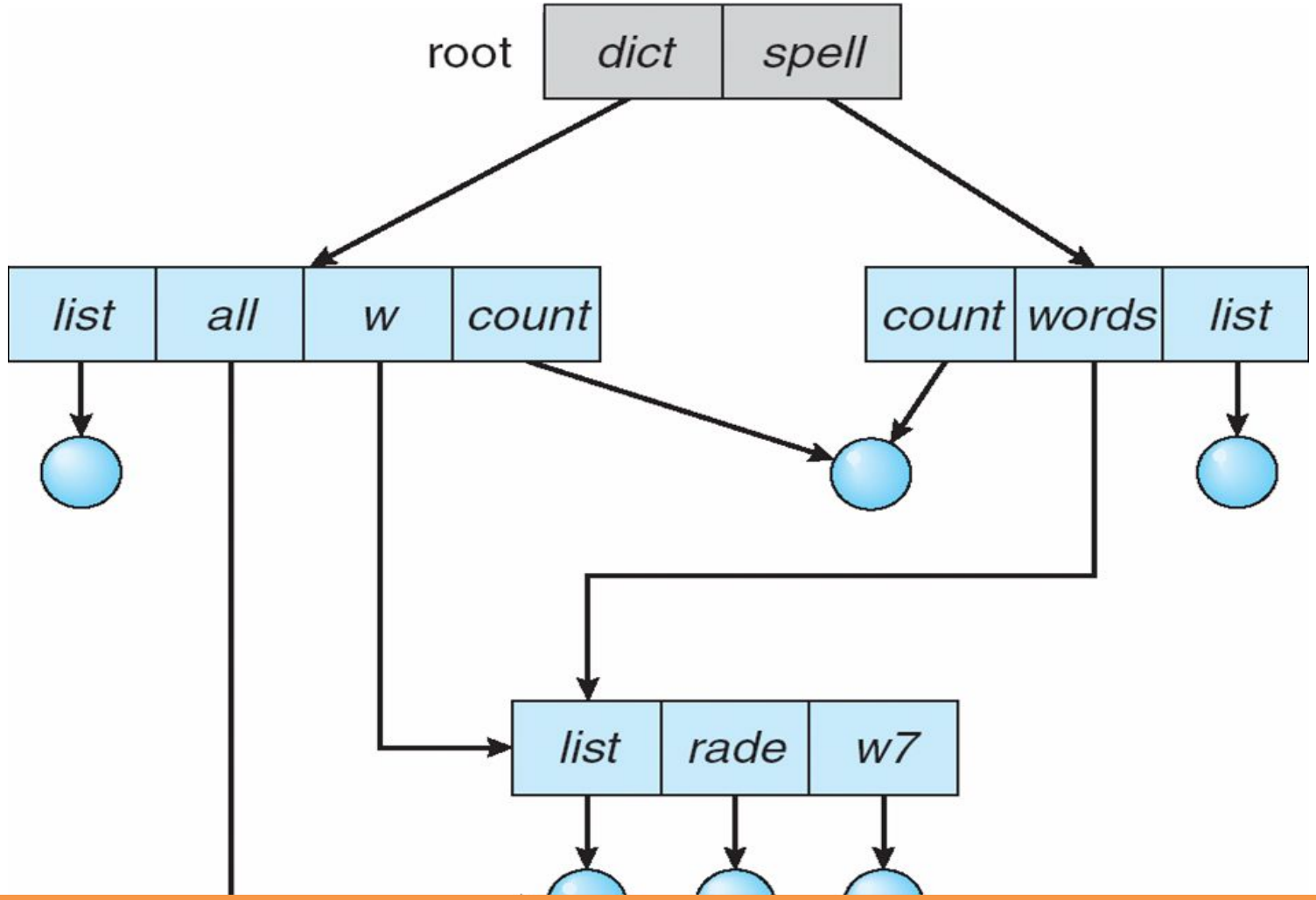
- Users can create their sub directories to manage the files.
- Three has Root directory and files have unique file names



Acyclic-Graph Directories

- Multiple users can Have **shared subdirectories and files**
- **Users have their own working directory** and may have one shared directory
- Shared subdirectory created by one user in one directory is automatically visible to all users sharing that directory.
- Shared directory or file may exist at multiple places simultaneously
- Because of sharing, a file may have multiple absolute paths
- So different names can refer to same file

Acyclic-Graph Directories



General Graph Directories

- Created by adding links to the existing directory
- Allows cycles in the same directory

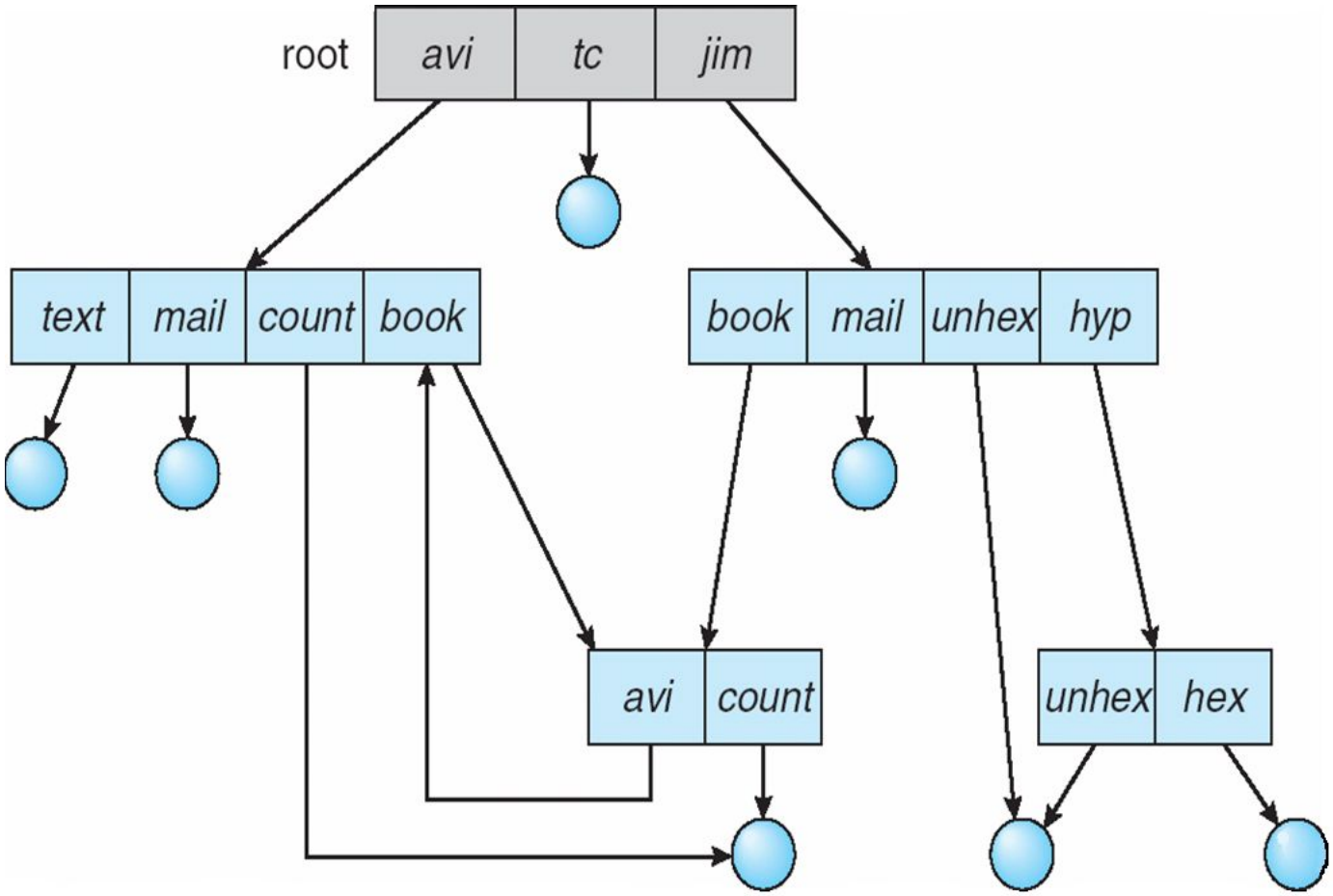
- As all files are dependent / linked deleting a main file may harm other files

- In case of deletion: Garbage Collection is used
- In First Pass: Traversing the entire file and marking everything that can be accessed

- In Second Pass: Collect everything that is not marked as the free space

General Graph Directories

- There can be cycle in the directory arrangement



Directory Implementation

- Directories need to be fast to search, insert, and delete, with a minimum of wasted disk space.

1 Linear List

- A linear list is the simplest and easiest directory structure
- Finding a file requires a linear search.
- Deletions can be done by moving all or one entry to vacant position and deleting the pointer.

2 Hash Table

- A hash table can also be used to speed up searches.
- Implementation is by using Hash value.
- **(Division/Variant Method)**

Bootloader

- A boot loader, also called a boot manager, is a small program that places the operating system (OS) of a computer into memory.
- When a computer is powered-up or restarted, the basic input/output system (BIOS) performs some initial tests, and then transfers control to the Master Boot Record (MBR) where the boot loader resides.
- Most new computers are shipped with boot loaders for some version of Microsoft Windows or the Mac OS.
- If a computer is to be used with Linux, a special boot loader must be installed.

Bootloader

- The two most common boot loaders are known as:
  - LILO (LInux LOader) and
  - LOADLIN (LOAD LINux).

An alternative boot loader, called GRUB (GRand Unified Bootloader), is used with Red Hat Linux.

LILO is the most popular boot loader among computer users that employ Linux as the main, or only, operating system.

Bootloader

- LOADLIN is preferred by some users whose computers have multiple operating systems, and who spend relatively little time in Linux.
- LOADLIN is sometimes used as a backup boot loader for Linux in case LILO fails.
- GRUB is preferred by many users of Red Hat Linux, because it is the default boot loader for that distribution.

Linux OS and its features

- Linux is one of popular version of UNIX operating System.
- It is open source as its source code is freely available.
- It is free to use.
- Linux was designed considering UNIX compatibility.
- Its functionality list is quite similar to that of UNIX.

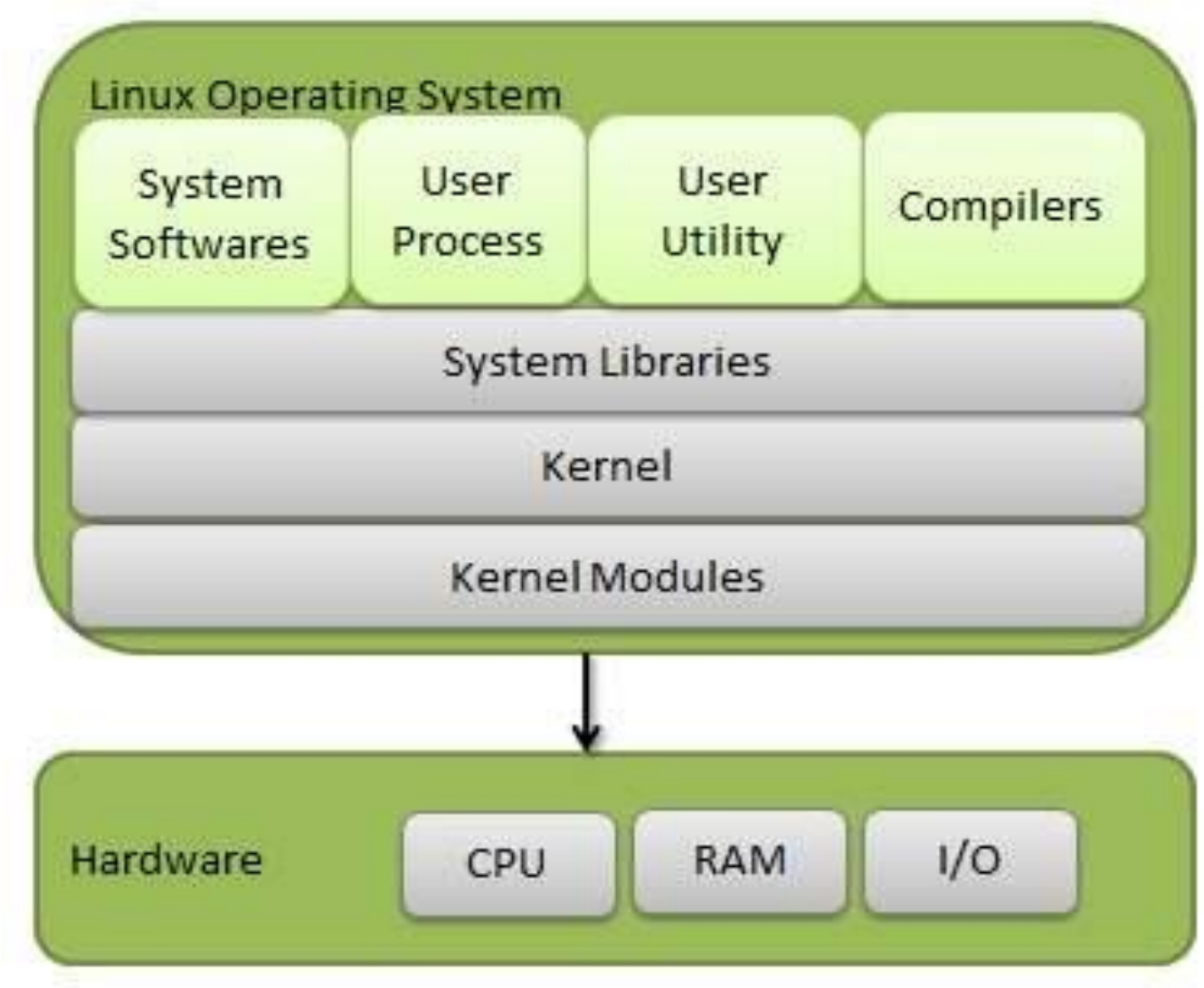
Linux OS and its features

Components of Linux System

Linux Operating System has primarily three components

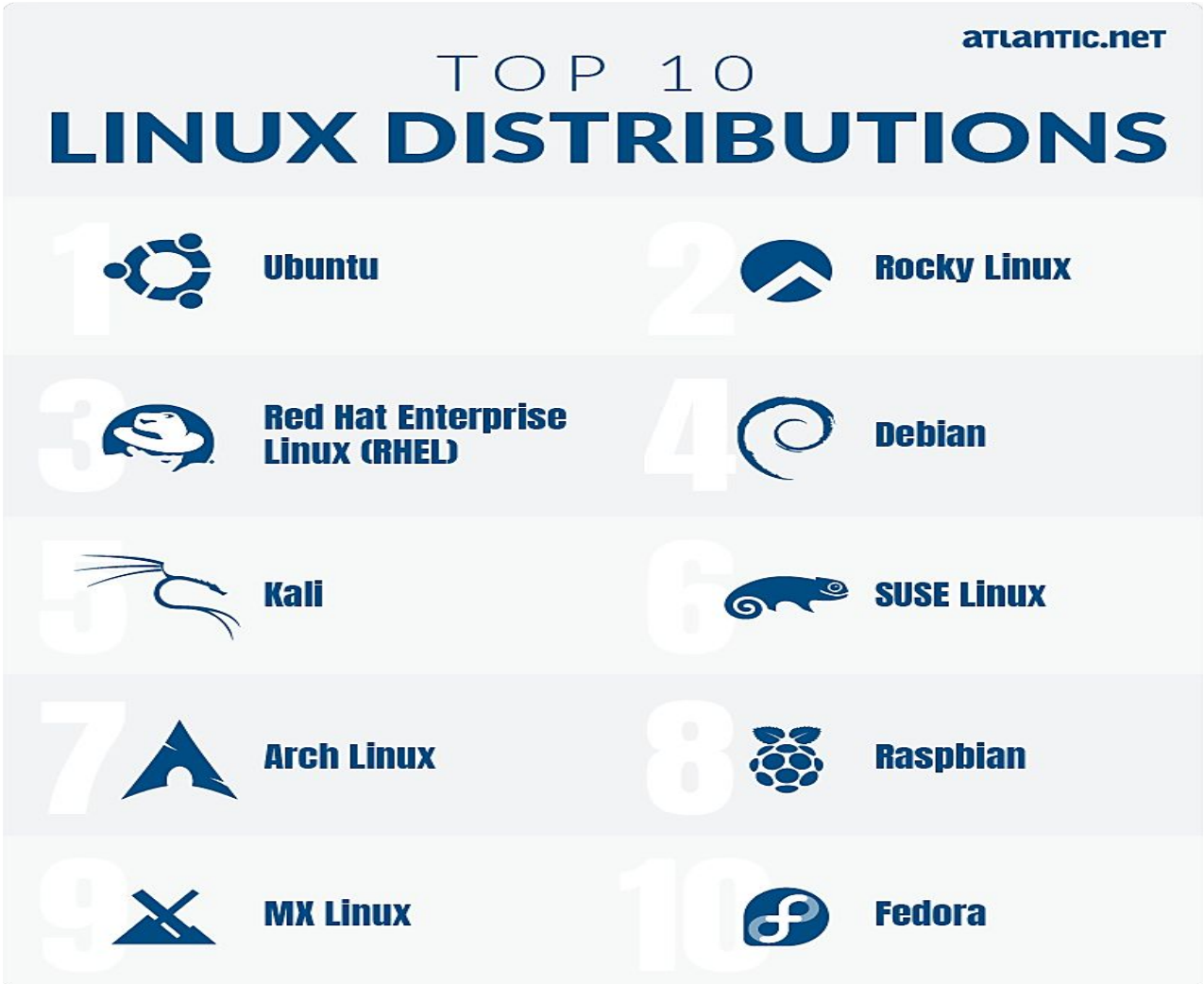
- **Kernel** − Kernel is the core part of Linux. It is responsible for all major activities of this operating system. It consists of various modules and it interacts directly with the underlying hardware. Kernel provides the required abstraction to hide low level hardware details to system or application programs.
- **System Library** − System libraries are special functions or programs using which application programs or system utilities accesses Kernel's features. These libraries implement most of the functionalities of the operating system and do not requires kernel module's code access rights.
- **System Utility** − System Utility programs are responsible to do specialized, individual level tasks.

- **Kernel Mode vs User Mode**
- Kernel component code executes in a special privileged mode called kernel mode with full access to all resources of the computer. This code represents a single process, executes in single address space and do not require any context switch and hence is very efficient and fast. Kernel runs each processes and provides system services to processes, provides protected access to hardware to processes.
- Support code which is not required to run in kernel mode is in System Library. User programs and other system programs works in User Mode which has no access to system hardware and kernel code. User programs/ utilities use System libraries to access Kernel functions to get system's low level tasks.


Linux Operating System
System Softwares
User Process
User Utility
Compilers
System Libraries
Kernel
Kernel Modules
Hardware
CPU
RAM
I/O

- **Basic Features**
- **Portable** − Portability means software can works on different types of hardware in same way. Linux kernel and application programs supports their installation on any kind of hardware platform.
- **Open Source** − Linux source code is freely available and it is community based development project. Multiple teams work in collaboration to enhance the capability of Linux operating system and it is continuously evolving.
- **Multi-User** − Linux is a multiuser system means multiple users can access system resources like memory/ ram/ application programs at same time.
- **Multiprogramming** − Linux is a multiprogramming system means multiple applications can run at same time.
- **Hierarchical File System** − Linux provides a standard file structure in which system files/ user files are arranged.
- **Shell** − Linux provides a special interpreter program which can be used to execute commands of the operating system. It can be used to do various types of operations, call application programs. etc.
- **Security** − Linux provides user security using authentication features like password protection/ controlled access to specific files/ encryption of data.

Distribution versions

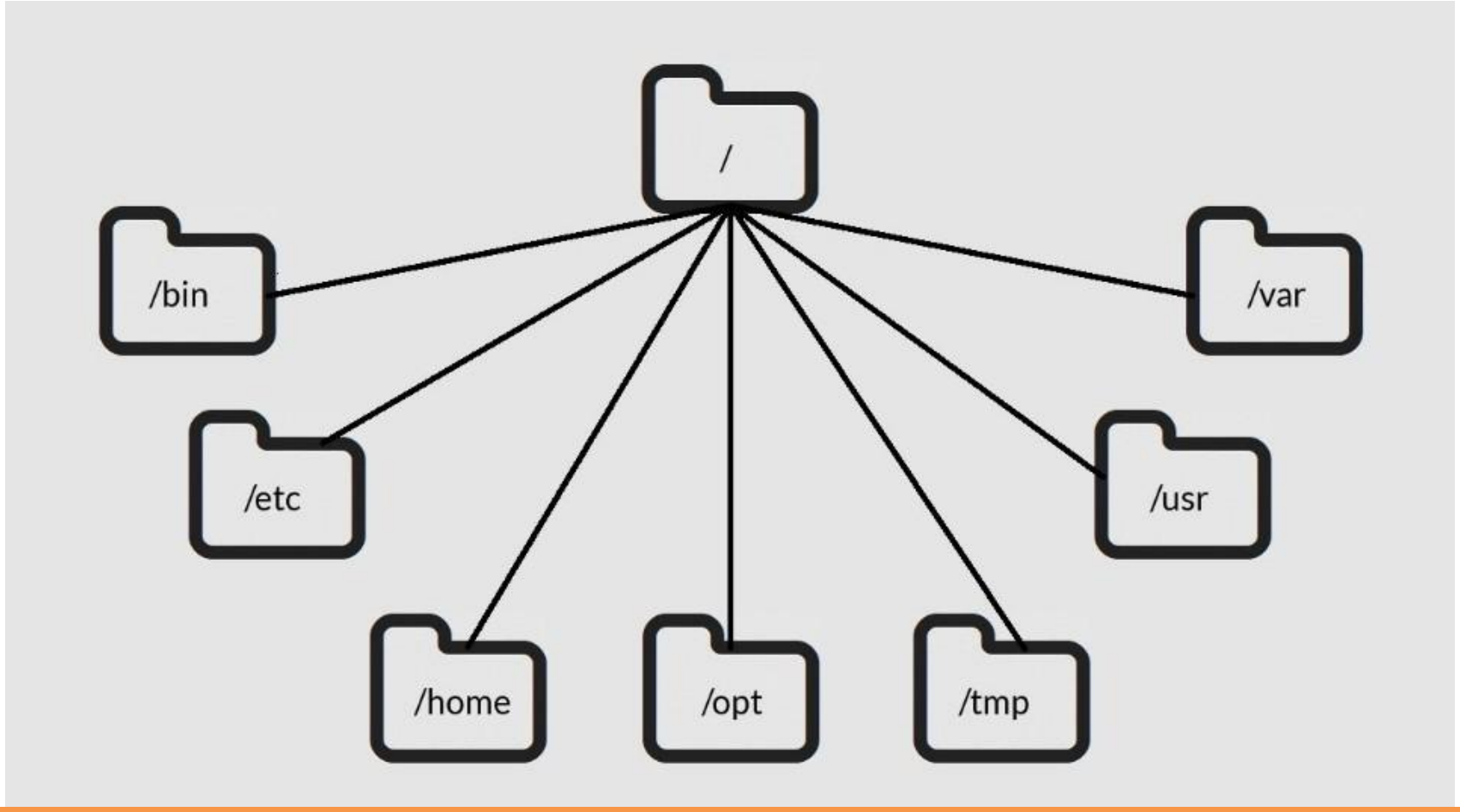


Installation

1. Insert a bootable Linux USB drive
2. Click the start menu
3. Then hold down the SHIFT key while clicking Restart
4. Then select Use a Device
5. Find your device in the list
6. Your computer will now boot Linux
7. Select Install Linux
8. Go through the installation process

Linux Directory Structure and File System Hierarchy

Dir	Description
/	The directory called "root." It is the starting point for the file system hierarchy. Note that this is not related to the root, or superuser, account.
/bin	Binaries and other executable programs.
/etc	System configuration files.
/home	Home directories.
/opt	Optional or third party software.
/tmp	Temporary space, typically cleared on reboot.
/usr	User related programs.
/var	Variable data, most notably log files.


/
/bin
/var
/etc
/usr
/home
/opt
/tmp

How to partition a disk in Linux

- Creating and deleting partitions in Linux is a regular practice because storage devices (such as hard drives and USB drives) must be structured in some way before they can be used.

- In most cases, large storage devices are divided into separate sections called partitions. Partitioning also allows you to divide your hard drive into isolated sections, where each section behaves as its own hard drive.

How to partition a disk in Linux

The following explains the process of partitioning a storage device with the parted command.

- **List the partitions:** Use parted -l to identify the storage device you want to partition.
- Typically, the first hard disk (/dev/sda or /dev/vda) will contain the operating system, so look for another disk to find the one you want (e.g., /dev/sdb, /dev/sdc, /dev/vdb, /dev/vdc, etc.).

- **2. Open the storage device:** Use parted to begin working with the selected storage device. It is important to indicate the specific device you want to use. If you just type parted with no device name, it will randomly select a storage device to modify.
- **3. Set the partition table:** Set the partition table type to GPT, then type "Yes" to accept it. The mklabel and mktable commands are used for the same purpose (making a partition table on a storage device). The supported partition tables are: aix, amiga, bsd, dvh, gpt, mac, ms-dos, pc98, sun, and loop. Remember mklabel will not make a partition, rather it will make a partition table.

- **4. Review the partition table:** Show information about the storage device.

- **5. Get help:** To find out how to make a new partition, type: (parted) help mkpart.

- **6. Make a partition:** To make a new partition (in this example, 1,396MB on partition 0), type the following:

(parted) mkpart primary 0 1396MB

Comparison of Windows and Linux OS

S.NO	Linux	Windows
1.	Linux is a open source operating system.	While windows are the not the open source operating system.
2.	Linux is free of cost.	While it is costly.
3.	It's file name case-sensitive.	While it's file name is case-insensitive.
4.	In linux, monolithic kernel is used.	While in this, micro kernel is used.
5.	Linux is more efficient in comparison of windows.	While windows are less efficient.
6.	There is forward slash is used for Separating the directories.	While there is back slash is used for Separating the directories.
7.	Linux provides more security than windows.	While it provides less security than linux.
8.	Linux is widely used in hacking purpose based systems.	While windows does not provide much efficiency in hacking.
9.	There are 3 types of user account – (1) Regular , (2) Root , (3) Service account	There are 4 types of user account – (1) Administrator , (2) Standard , (3) Child , (4) Guest
10.	Root user is the super user and has all administrative privileges.	Administrator user has all administrative privileges of computers.
11.	Linux file naming convention in case sensitive. Thus, sample and SAMPLE are 2 different files in Linux/Unix operating system.	In Windows, you cannot have 2 files with the same name in the same folder.

Virtual Machines

- A Virtual Machine (VM) is a compute resource that uses software instead of a physical computer to run programs and deploy apps. One or more virtual "guest" machines run on a physical "host" machine. Each virtual machine runs its own operating system and functions separately from the other VMs, even when they are all running on the same host. This means that, for example, a virtual MacOS virtual machine can run on a physical PC.

- Virtual machine technology is used for many use cases across on-premises and cloud environments. More recently, public cloud services are using virtual machines to provide virtual application resources to multiple users at once, for even more cost efficient and flexible compute.

- **What are virtual machines used for?**
- Virtual machines (VMs) allow a business to run an operating system that behaves like a completely separate computer in an app window on a desktop.
- VMs may be deployed to accommodate different levels of processing power needs, to run software that requires a different operating system, or to test applications in a safe, sandboxed environment.
- Virtual machines have historically been used for server virtualization, which enables IT teams to consolidate their computing resources and improve efficiency.

- **What are virtual machines used for?**

Additionally, virtual machines can perform specific tasks considered too risky to carry out in a host environment, such as accessing virus-infected data or testing operating systems. Since the virtual machine is separated from the rest of the system, the software inside the virtual machine cannot tamper with the host computer.

- **How do virtual machines work?**
- The virtual machine runs as a process in an application window, similar to any other application, on the operating system of the physical machine. Key files that make up a virtual machine include a log file, NVRAM setting file, virtual disk file and configuration file.