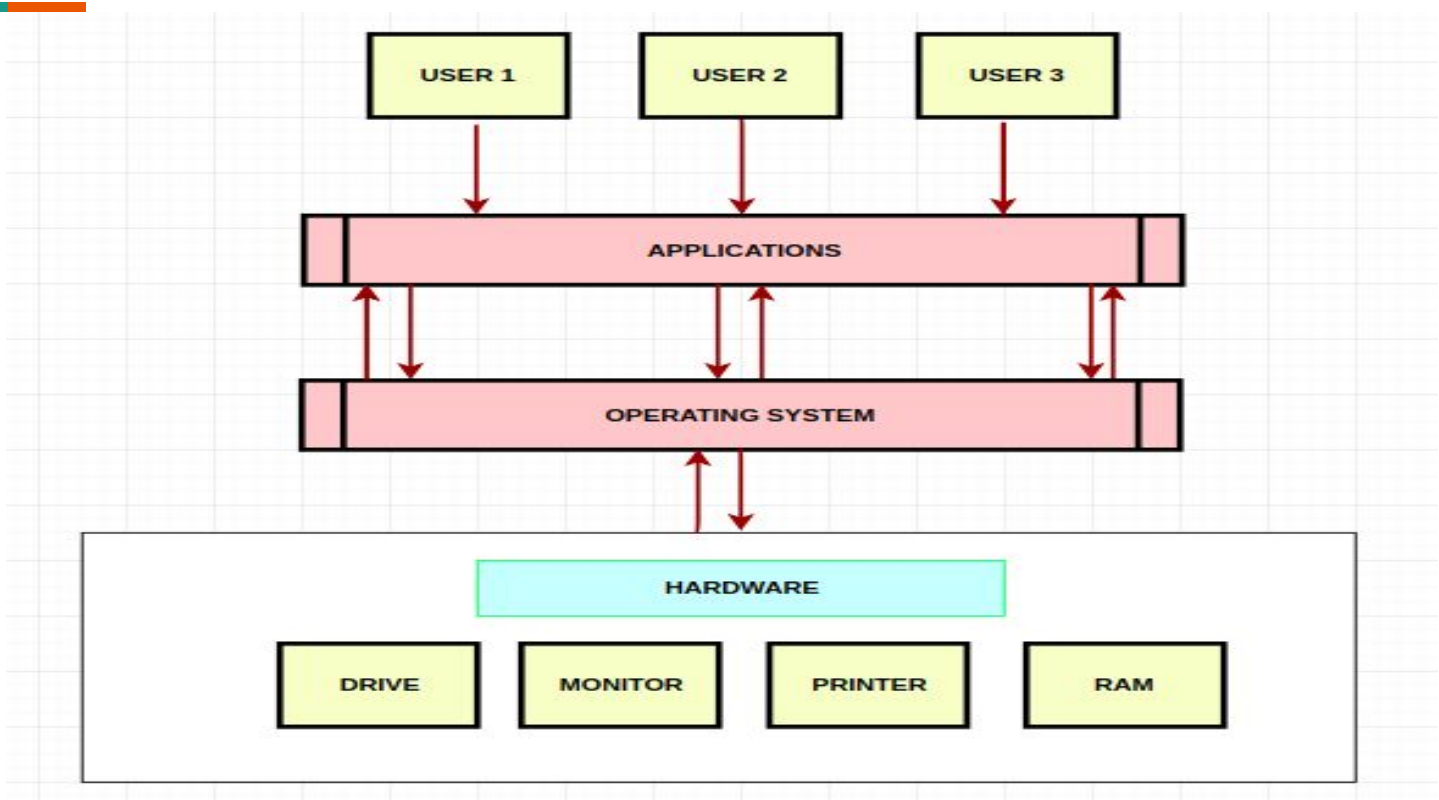
LINUX

Introduction to OPERATING SYSTEM (OS)



Introduction to OPERATING SYSTEM (OS)

- An Operating System is a program that acts as an interface between a user of a computer and the computer hardware.
- Operating System is a system software that manages hardware and software resources and provide services for computer programs and makes the computer into a useful tool for its users.

Introduction to OPERATING SYSTEM (OS)

- Computer understand machine language, also known as **Machine code.** Machine code is a set of binary instructions consisting of 1's and 0's.
- Your **operating system** also works as a translator in your PC. It converts those 1s and 0s, values into a human readable language that user will understand.

Introduction to OPERATING SYSTEM (OS)

- All computers and computer-like devices require operating systems, including your laptop, tablet, desktop, smartphone, smartwatch, and router.

Introduction to OPERATING SYSTEM (OS)

- Primary goals:
  - Convenience (windows)
    - Windows and Mac are the most convenient OS for the users.
  - Throughput (linux)
    - Multiple tasks executed per unit time, it means we have running multiple applications and OS need to respond fast.
    - Respond fast in specific amount of time.

Major Functionality of Operating System

1. Resource Management
2. Process Management
3. Storage Management
4. Memory Management
5. Security Management

Major Functionality of Operating System

1) **Resource management.**
    a) Resource management works when multiple users connected from a single machine like server.
    b) Especially it use where parallel users connected from a machine.
2) **Process management**
    a) If we have multiple applications/process running at a time like media player, browser, gaming app, OS manages it using CPU SCHEDULING.

Major Functionality of Operating System

3) Storage Management (Hard drive).

a) Store data in drive using file system.

4) Memory Management (RAM)

a) All process first come in RAM before execution.
b) RAM allocate memory and send it to CPU.
c) CPU executes the program/application.

Major Functionality of Operating System

5) Security Management

a) **Operating System** refers to specified steps or measures used to protect the **OS** from threats, viruses, worms, malware or remote hacker intrusions.

b) Check the authentication.

History Of Operating Systems

Operating System History (cont..)

- Earlier computers were built to perform a series of single tasks, like a calculator.
- Basic operating system features were developed in the 1950s.
- In the early 1950s, a computer could execute only one program at a time.

Operating System History (cont..)

- Later machines came with libraries of programs.
- Unix is the complete OS, earlier so many OS introduced but that all have some problems.
- UNIX is Closed Source Operating System.
- The right to use the UNIX Trademark requires the Licensee to pay to The Open Group an additional annual fee.

Operating System History (cont..)

- UNIX is the operating system which is developed in 1970's in Bell Labs by Ken Thompson and Dennis Ritchie.
- Dennis Ritchie also the creator of c language.
- Later AT&T purchased unix operating system.

Why linux IS better than WINDOWS for SERVERS

- Free and Open Source
  - Linux is free and open source; you can see the source code used to create Linux (kernel).
- Stability and Reliability
  - Linux is Unix-based and Unix was originally designed to provide an environment that’s powerful, stable and reliable yet easy to use. Linux systems are widely known for their stability and reliability, many Linux servers on the Internet have been running for years without failure or even being restarted.

Why linux IS better than WINDOWS for SERVERS (con)

- Security
  - Linux is without doubt the most secure kernel out there, making linux based operating systems secure and suitable for servers.
- Flexibility
  - Linux is so powerful and flexible. You can tune it to meet you server needs: it allows you to do whatever you want (if possible). You can install a GUI (graphical user interface) or simply operate your operate your server via a terminal only.

Why linux IS better than WINDOWS for SERVERS (cont..)

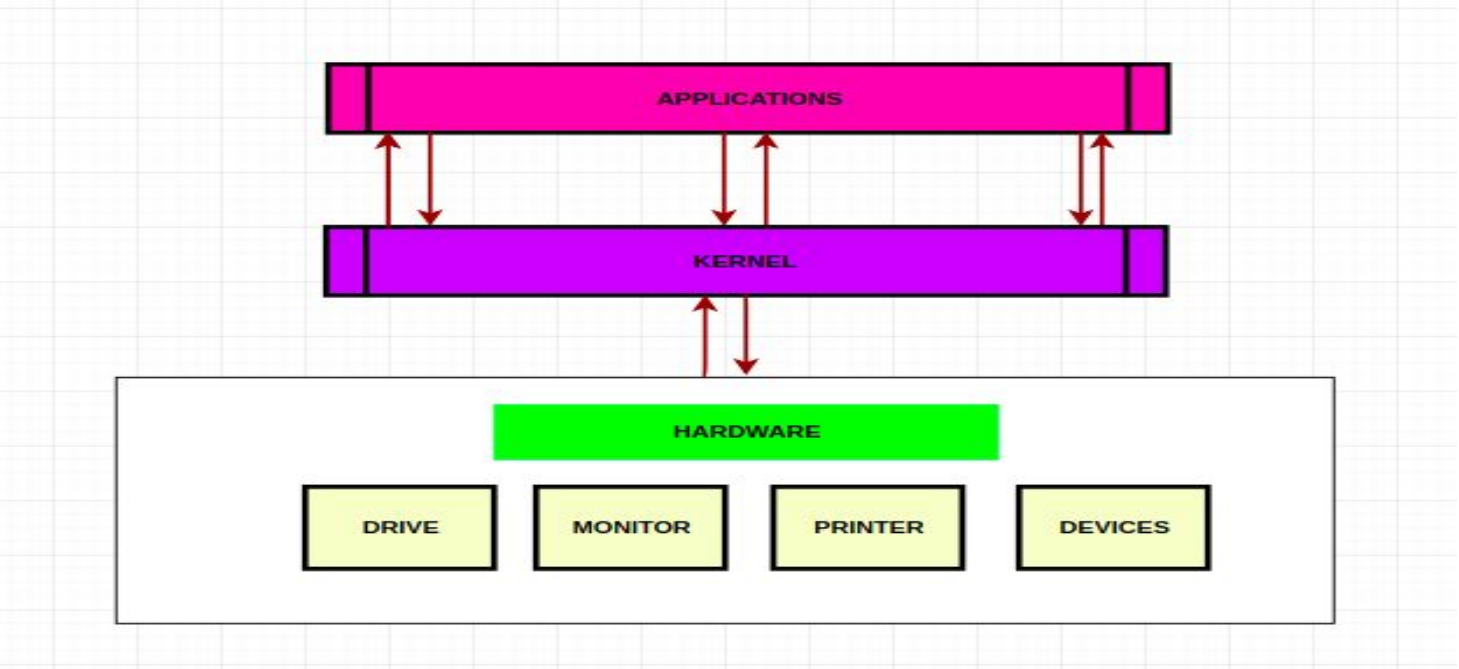
- Cost And Maintenance
  - Finally, the total cost of owning and maintaining a Linux server is lower compared to a Windows server, in terms of licensing fees, software/hardware purchase and maintenance costs, system support services and administrative costs.

Linux and the Open Source Movement

What is LINUX?

- An open-source operating system modelled on UNIX.
- Just like Windows XP, Windows 7, Windows 8, and Mac OS X, Linux is an operating system.
- An operating system is software that manages all of the hardware resources associated with your desktop or laptop.
- The operating system manages the communication between your software and your hardware. Without the operating system (often referred to as the “OS”), the software wouldn’t function.

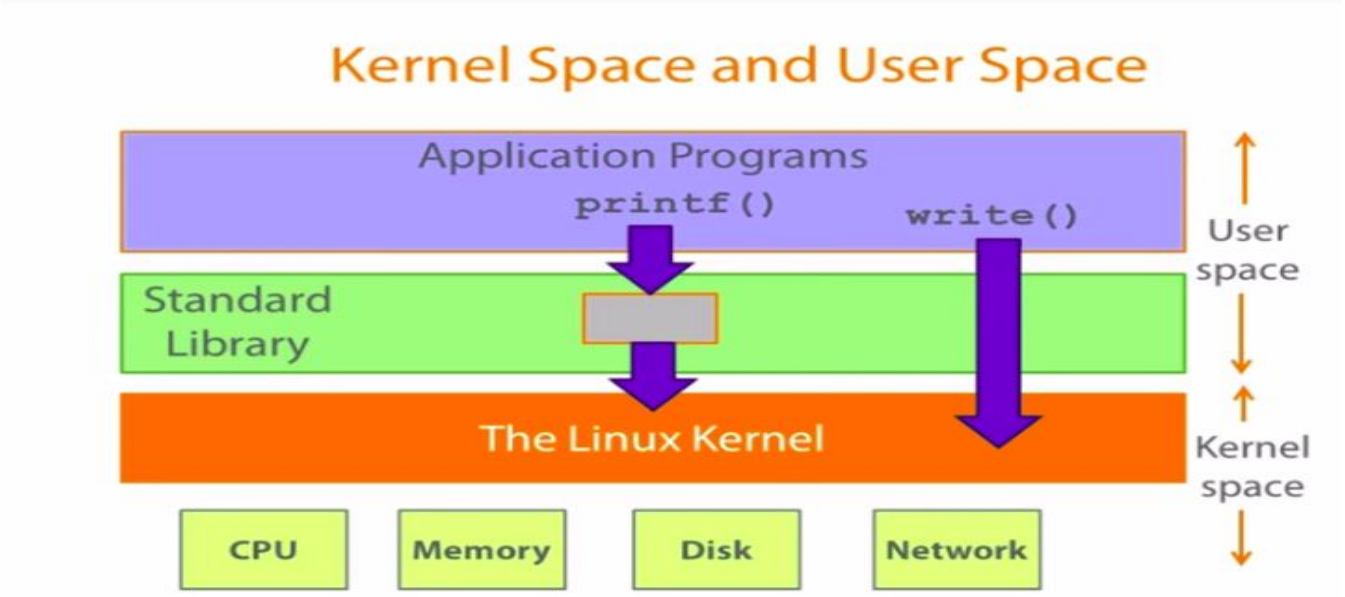
WHAT IS KERNEL?



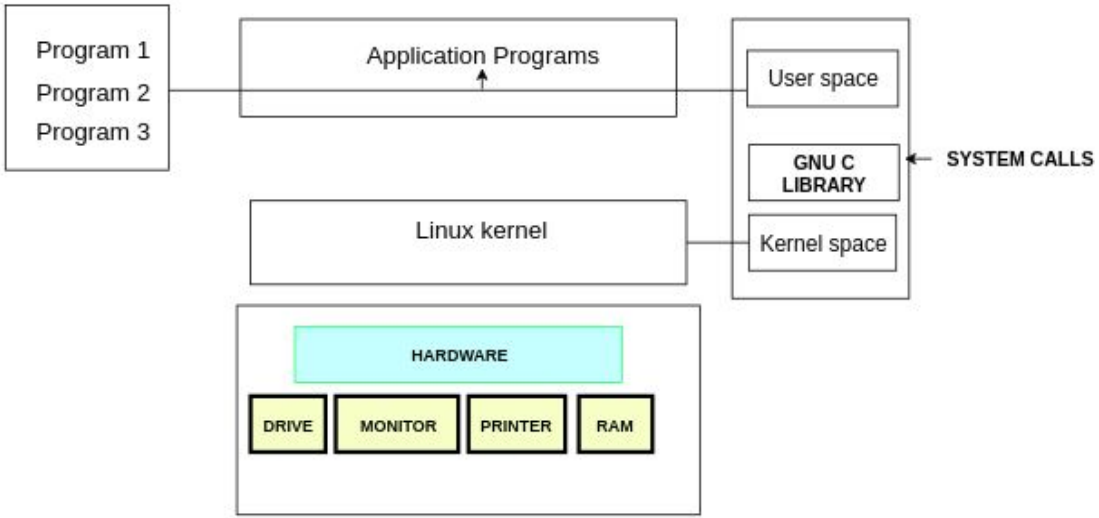
WHAT IS KERNEL?

- Kernel is the core component of the Operating system.
- Kernel manages the hardware of the device in which the Operating system is running.
- Computer consists on many hardware components like RAM, CPU, DRIVE etc.
- Kernel connects hardware with the applications.

KERNEL SPACE AND USER SPACE

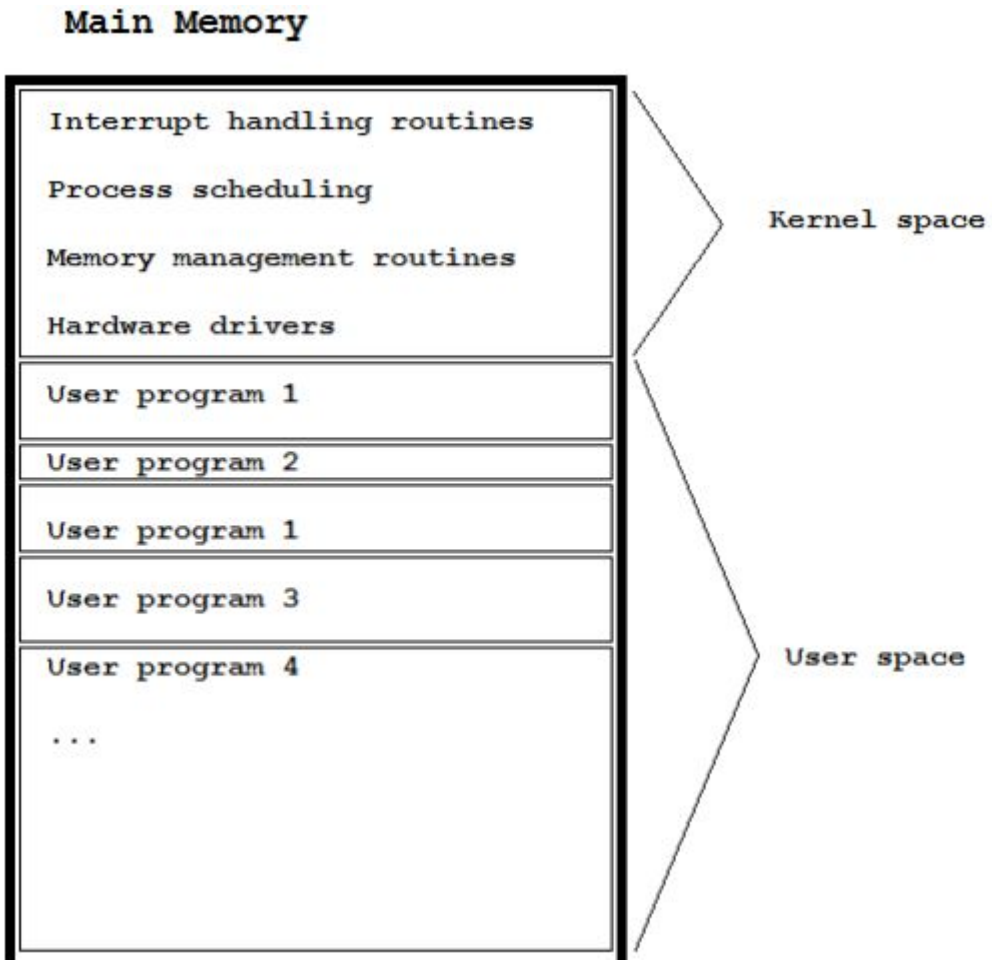


KERNEL SPACE AND USER SPACE



KERNEL SPACE AND USER SPACE

- Kernel space and User space.
  - Kernel space is where the kernel (i.e., the core of the operating system) executes (i.e., runs) and provides its services.
  - User space is that set of memory locations in which user processes (i.e., everything other than the kernel) run.
  - One of the roles of the kernel is to manage individual user processes within this space and to prevent them from interfering with each other.
  - Kernel space can be accessed by user processes only through the use of system calls


Main Memory
Interrupt handling routines
Process scheduling
Memory management routines
Hardware drivers
User program 1
User program 2
User program 1
User program 3
User program 4
...
Kernel space
User space

LINUX (cont..)

The OS is comprised of a number of pieces:

- **The Bootloader:**
  - The software that manages the boot process of your computer. For most users, this will simply be a splash screen that pops up and eventually goes away to boot into the operating system.
- **The kernel:**
  - The kernel is the core of the system and manages the CPU, memory, and peripheral devices. The kernel is the “lowest” level of the OS.

LINUX (cont..)

- **Daemons:**
  - These are background services (printing, sound, scheduling, etc) that either startup during boot, or after you log into the desktop.

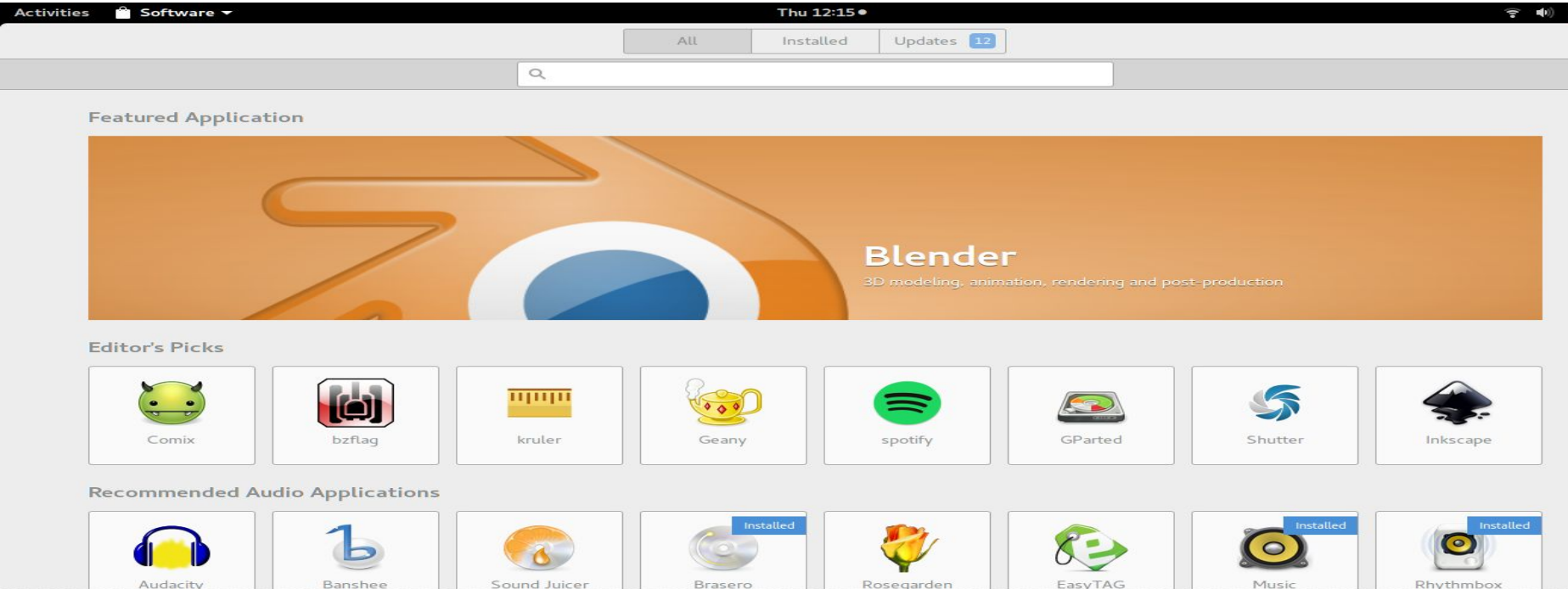
LINUX

- Linux is an open-source operating system.
- This means that Linux is continuously developed collaboratively.
- Unlike Windows and MAC which are both tied to the respective companies (Microsoft and Apple).
- Not one company own’s Linux development and support.
- Based on statistics, there are at least 100 companies and more than 1000 developers who work together for every kernel release.

LINUX

- Linux is composed of a kernel.
- The core control software, plus plenty of libraries and utilities that provide different features.
- Linux is available through many distributions.
- These are what we can call Linux flavours.
- The most popular ones include Arch, SUSE, Ubuntu, and Red Hat.
- Linux has the largest market share when it comes to server OS.
- Windows 10 Mac OS X FreeRTOS, Raspbian Unix Azure Sphere

SOFTWARE CENTER



INSTALLATION LINUX

Install Linux for Beginners

https://www.youtube.com/watch?v=Dx2dJUPsJso

Dual boot Windows and Ubuntu?

https://www.youtube.com/watch?v=JvBZBfY5Pfc&feature=youtu.be

UBUNTU INSTALLATION

- **Download the Ubuntu Linux ISO file.**
  - Go to https://www.ubuntu.com/download/desktop
  - Scroll down and click **Download** to the right of your preferred version.
  - Scroll down and click the **download** link.
  - Wait for the download to start or click the **download now** link.

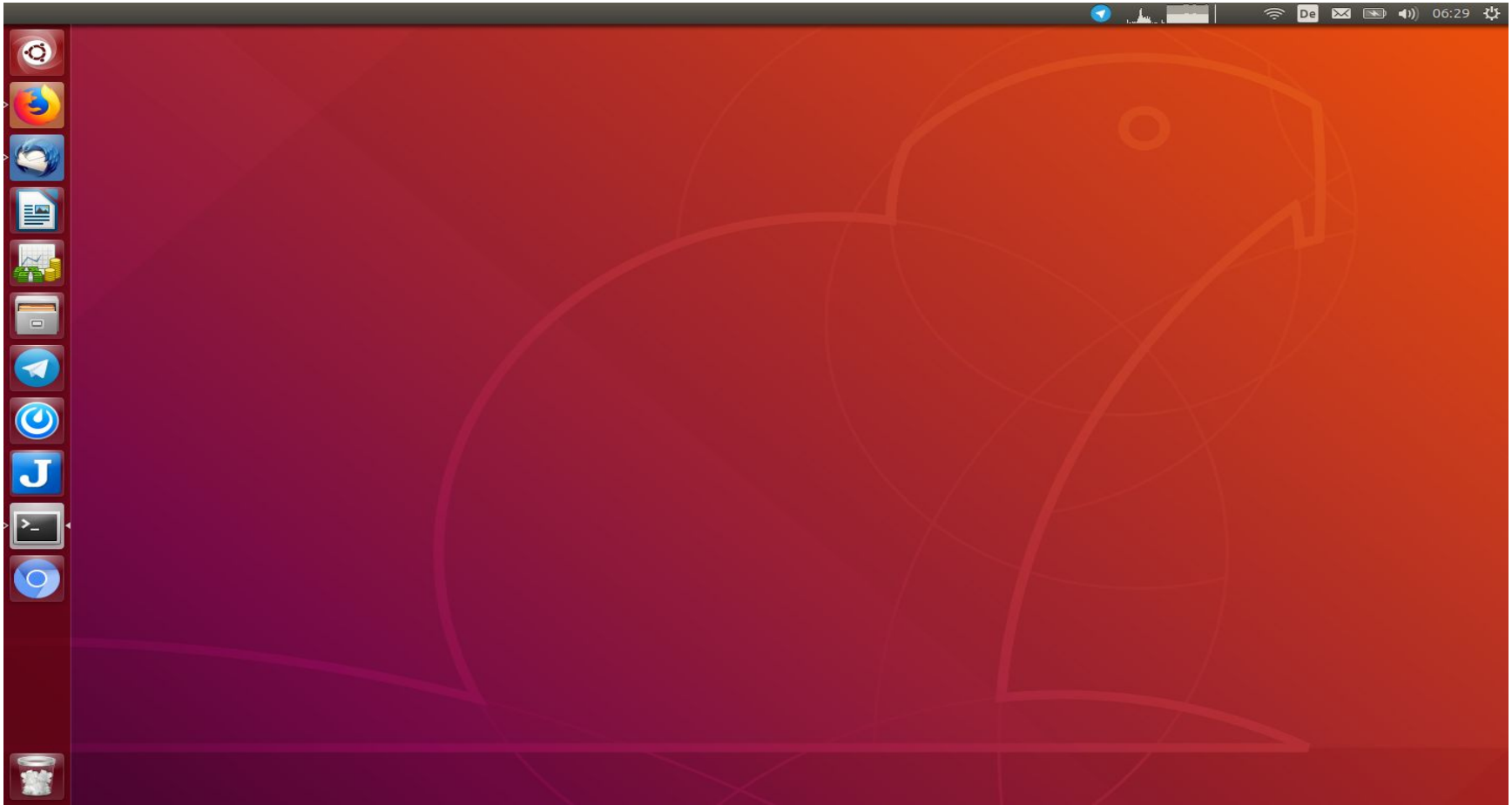
UBUNTU INSTALLATION

- **Download rufus to** Create bootable USB**:**
  - https://rufus.ie/
- Connect your bootable USB to the system.
- Boot your system with Bootable USB drive.
- Check Install Prerequisite:
- Select the **Installation** Type.
- Select your respective Time Zone.

UBUNTU INSTALLATION

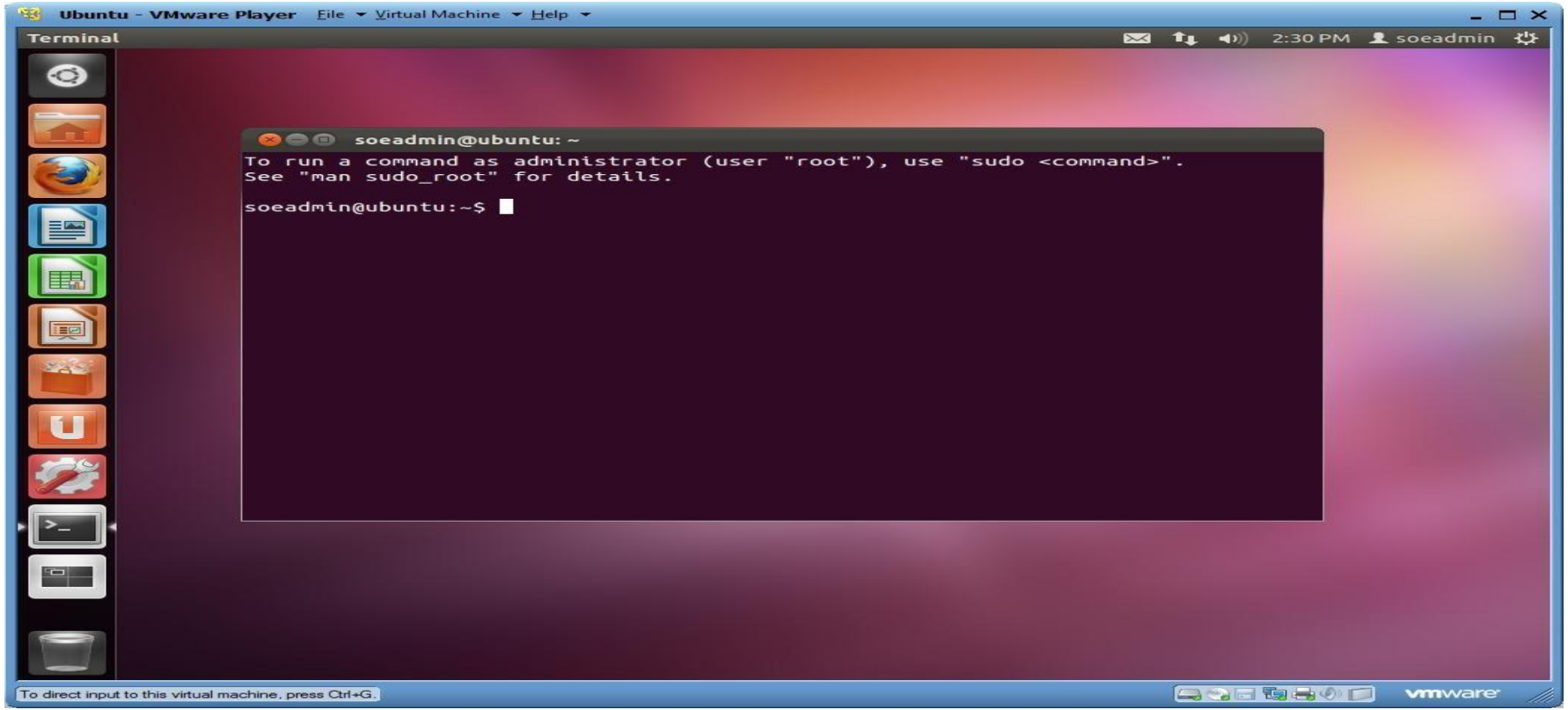
- Select your respective Keyboard Layout.
- Set the Hostname of your system and User credentials that will be used after installation.
- Click on Continue to start Installation.
- After Installation a pop up will be appear , click on “Restart Now”.
- Login Screen after reboot.
- Installation is Completed.

Ubuntu



Getting to Know Shell

IN SEARCH BAR WRITE “TERMINAL”


Ubuntu - VMware Player
File
Virtual Machine
Help
Terminal
2:30 PM
soeadmin
soeadmin@ubuntu: ~
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
soeadmin@ubuntu:~$
To direct input to this virtual machine, press Ctrl+G.
vmware

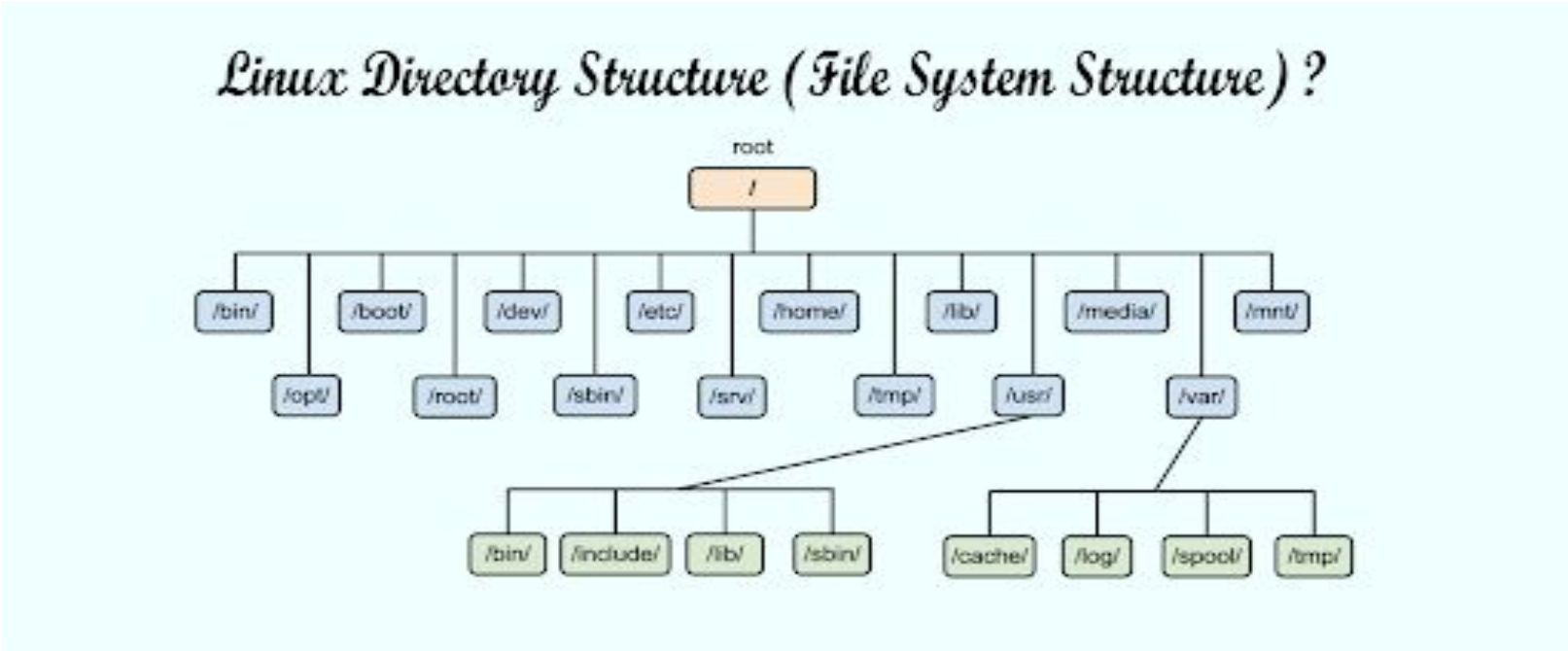
Files System

- Linux organizes files using a hierarchical system.
- Files are stored in directories and these directories can also contain other directories.
- When you compare the Linux filesystem to Windows, you will find that there are no drive letters in Linux.

Files System

- All files are stored in a single root directory noted as /.
- To find a file in Linux, you also need the information about the directory hierarchy known as the pathname.

File System Structure



Top-Level Directory	Files that the directory contains
/	Single root directory – file system base
/bin	Executable files such as Linux commands cat,cp,ls
/boot	Files that the boot loaders access during start-up – including the Linux kernel
/dev	Files for the different hardware/devices
/etc.	Initialization scripts and system config files
/home	User directories
/lib	Library files which includes driver modules
/lost+found	For lost files
/media	Mounting removal media filesystems
/mnt	Temporary directory for mounted filesystems
/opt	For storing application packages
/proc	Information on Linux processes
/root	Root user home directory
/sbin	Executable files for commands used by root user
/srv	For services hosted by the system (e.g. FTP, web)
/tmp	Temporary directory – deleted during system reboot
/usr	Contains subdirectories for program files
/var	Log files

TERMINAL COMMANDS

- The shell is where you can run executable files and shell scripts.
- The shell is also what we call the command line. Commands are written using the general syntax below:
    - command option1 option2 . . . optionN

FEW COMMANDS BELOW:

- uptime
    - uptime is the command that shows the duration that the computer has been up.

TERMINAL COMMANDS

- uname –srv
  - uname is the command to show the operating system name. –s (print the operating system name), -r (print the operating system release), and –v (print the operating system version) are options that you can use for the uname command.
- man
  - The man command is extremely useful, especially for beginners. This displays all the options that you can use. Try to use the command for every Linux command that you encounter.

Navigation In Directories

- To navigate in the directories on Linux, you can either use the GUI, using the universal text-based search function, or by using the command line.
- You can use the following useful commands in your terminal to:
    - **ls**
        - List down all the contents of a director
    - cd
        - Changes directory

Navigation In Directories And Commands

- You can use the following useful commands in your terminal.
  - cd ~
    - the tilde (~) sign signifies the user’s home dir – change dir to home directory.

Navigation In Directories And Commands

- You can use the following useful commands in your terminal.
    - cd ..
        - Means to change directory one level up. For example, you are currently /home/daniyal/, using the command will take you to /home/

Navigation In Directories And Commands

- You can use the following useful commands in your terminal to: (cont ..)
  - mkdir
    - A command used to create directories.

Navigation In Directories And Commands

- pwd
  - Short for present working directory. This command will display the directory where you are currently in.
- touch
  - This command creates the file.

Navigation In Directories And Commands

- You can use the following useful commands in your terminal to: (cont ..)
  - cat test.txt
    - Command to print all the contents of test.txt in the screen
  - cp text.txt /home
    - Copy contents of text.txt to /home

Navigation In Directories And Commands

- mv text.txt /home
  - Move the file text.txt to the /home/ directory. You can also use this command to move the entire directory to another directory.

Navigation In Directories And Commands

- You can use the following useful commands in your terminal to:

  (cont ..)

  - rm text.txt
    - Delete the file text.txt.
  - hostname
    - System host name

Navigation In Directories And Commands

- hostname -I
  - Display the IP addresses of the host
- man
  - This command displays all the options that you can use. Try to use the command for every Linux command that you encounter.

Commands

- find / -name “linux*”
  - This command is use for searching using the command line. The command here will search for any file or directory with a name that starts with linux
- uname -a
  - This command displays information about the machine, the processor architecture, and the operating system details.

Commands

- lscpu
  - This command returns more information about the system such as the number of CPUs and the CPU speed.
- df -h
  - This command displays the disk space usage in all of the mounted devices. The -h option presents the results in a human-readable output, using G for gigabytes or M for megabytes sizes.

Commands

- du /home/edulaney/files/
  - This command displays all the files inside the specified directory and their corresponding file sizes. You can also specify a filename.
- du -s /home/edulaney/files/
  - The –s option provides the total file size of the specified directory.

Navigation In Directories And Commands

- You can use the following useful commands in your terminal to: (cont ..)
  - date
    - Show the current date and time
  - cal
    - Show this month's calendar

Navigation In Directories And Commands

- w
  - Display who is online
- whoami
  - Display current user

Commands

- apt-get install package-name (advanced package tool)
  - This command use to install packages to your computer.
- apt-cache search keyword
  - This command will download the specific package name that you want to install. In case you do not know the package name, you can search for a keyword.

Commands

- apt-cache search .
  - To get a list of all packages.
- info
  - Shows online information about a command
- whatis
  - Shows a short description of a specific keyword
- type
  - Shows the location of a command file

Commands

- bg
  - Run a program or a process in the background
- free
  - Check for the free memory
- kill
  - Stop a process

Commands

- nice
  - Run a program with a low priority.
- ps
  - Show current running processes
- top
  - Show list of CPU and memory utilization of processes

Commands

- su -
  - To switch to root while in the shell, input your root password. Changing to root password while in the shell environment will allow you to run tasks that only administrators and superusers can do.
- shutdown
  - Turn off computer

Assignment

Create file “assignment.txt” using command line interface (cli).

Edit file “assignment.txt” using vi editor of terminal.

COMMANDS

Package installation using CLI

apt-get install <package-name>

USERS ROLES AND SUDO

sudo su <switch to root user>
sudo apt-get install <package-name>

COMMANDS

COMMAND COMPLETION AND COMMAND HISTORY

- Unam and enter tab
- Arrow Up/Down
  - Display the previous commands from the more recent going to the oldest entered
- Arrow Right/Left
  - Moves the cursor one character to the right/left
- CTRL key + A
  - Transfers cursor to the beginning of the line

COMMANDS

- CTRL key + E
  - Transfers cursor to the end of the line
- Delete key
  - The character under the cursor is deleted
- Backspace
  - The character to the left of the cursor is removed
- CTRL key + R
  - Search for a particular command from the command history. After you use CTRL key + R, type the first few letters of the command that you want to use

COMMANDS

FILES, DIRECTORY AND EDITOR

Touch, ls, mkdir and vi

SCRIPTING

A script is a program that can be interpreted by a shell or a compiled program. We call them shell scripts in Linux because most scripts are run in bash or in any other shell. Scripts are useful in automating and simplifying administrative tasks, log monitoring of the system, and data processing. To begin scripting, open a text file with vi or a text editor of your choice.

#!/bin/s

The first line in the file indicates which shell should be used to interpret the script

- **LOAD AVERAGE**
  - uptime
    - uptime is the command that shows the duration that the computer has been up.This command prints the load average for the last one, five, and fifteen minutes.
  - uname –srv
    - uname is the command to show the operating system name. –s (print the operating system name), -r (print the operating system release), and –v (print the operating system version) are options that you can use for the uname command.

COPY, MOVE AND REMOVE (8)

cp filename path

mv filename path

mv filename

SEARCH USING COMMAND LINE (9)

find <path> “search-value”*

CPU INFORMATION (10)

uname -a

lscpu “The command lscpu prints CPU architecture information from sysfs and /proc/cpuinfo as shown below”

cat /proc/cpuinfo “You can simply view the information of your system CPU by viewing the contents of the /proc/cpuinfo file with the help of cat command as follows”

CHECK DISK SPACE (10)

df -h

du /home/edulaney/files/

du -s /home/edulaney/files/

Install, remove and search software with package manager. (11)

apt-get install <package-name>

apt remove <package-name>

apt-cache search <keyword>

ESSENTIAL COMMANDS (12)

Info (Shows online information about a command)

Man (Shows details of a command) (ls, cat)

Whatis (Shows a short description of a specific keyword) (ls, cat)

Type (Shows the location of a command file) (man , cat, touch)

Alias (Assign a command alias – especially useful for long commands)

Unalias (Remove command alias)

ESSENTIAL COMMANDS

Ln (Create links to files and directories) (14)---------

Whereis (Search for executable files)

Which (Search for files in the directories part of the PATH variable)

Dd (Copy lines of data)

Diff (Display the results of comparing two files)

More (Show a text file one page at a time – display can only go forward)

Less (Show a text file one page at a time – display can only go forward and backwards)

ESSENTIAL COMMANDS

Wc (Display the count of the number of characters, words, and lines in a file)

Cut (Get sections of text in a file)

Grep (Display results of finding expressions in a file)

Sed (Perform editing commands, then copy to a standard output)

Split (Specify a size to break a file into)

Sort (Arrange the lines in a file)

Uniq (Keep unique lines in a file and delete duplicates)

ESSENTIAL COMMANDS

Compress (Use to compress a file)

Uncompress (If a file was compressed with a compress command, use this to decompress)

Gunzip (Use GNU Zip to decompress files)

Gzip (Compress files with GNU Zip)

Tar (Archive files with one or more directories)

Bg (Run a program or a process in the background)

Free (Check for the free memory)

ESSENTIAL COMMANDS

Kill (Stop a process)

Nice (Run a program with a low priority)

Ps (Show current running processes)

Top (Show list of CPU and memory utilization of processes)

Reboot (Restart the computer)

Shutdown (Turn off computer)

USER MANAGEMENT

Files Permissions

There are three types of permissions

- r - read
- w - write
- x - execute = running

Files Permissions

Each permission (rwx) can be controlled at three levels.

- u - user = yourself
- g - group = can be people in the same project
- o - other = everyone in the system

Files Permissions

File or directory permission can be displayed by running ls -l command

- -rwxrwxrwx

Command to change permission

- chmod

Permissions using letters

chmod u- w

chmod u- r

chmod u+w

Permissions using Numeric Mode

0	No permission
1	Execute
2	Write
3	Execute + Write
4	Read Permission
5	Read + Execute
6	Read + Write
7	Read + Write + Execute

THANK YOU