**Linux**

1.What is Linux and how is it different from other operating systems?

* **Linux:**
* Linux is an open source operating system and anyone can modify and distribute it.
* Free to download and use it.
* Linux is more secure than other OS.
* Linux is more efficient than other OS.
* Linux is more lightweight and more potimized for speed.
* Comes under Unix family.
* Linux core is an Linux kernel.
* Developed by an Individual person.
* Created by "**Linus Torvalds" in 1991.**
* Linux is known for it's Stability,Security and Flexibility.
* In Linux CLI is powerful and commonly used for system management.
* **Windows:**
* GUI with icons and windows.
* Easy to use even for beginners.
* Windows is propreitary(paid).
* Windows requires a paid liscence.
* Security is less.
* Heavier and requires more system resources.
* Can slow down over a period of time.
* Used Command Prompt(cmd) and Powershell but not extensively as Linux
* **MacOS:**
* Pre-Installed only on Apple Products.
* Highly optimized for products,ensures smooth performance.
* More Secure than Windows.
* Limited gaming support.
* Very limited customization.
* Comes with Unix-based terminal.
* **Android:**
* Android built on Linux-kernel but is not a traditional OS.
* It used Linux kernel ras unique runtime.
* It does not use GNU utilities
* Andrios is compatible with Mobiles.
* Developed by Google.
* Andriod is free and open source.
* Allows limited UI costomization.
* Supports APK-based apps.
* Regular Security updates, but suspectible to malware and privacy concerns.
* Supports mobile gaming.
* **IOS:**
* Developed for Apple mobile.
* Cannot be customisable.
* Developed by Apple Inc.
* Closed source.
* Highly Optimized and user-friendly,but restrictive.
* Secure, with sandboxed apps and regular security updates.
* Ensures smooth performance.
* Supports mobile gaming.

2.Explain the Linux file system hierarchy.

* Linux file system heirarchy follows a follows a well-defined structure that organizes the files and directories in a heirarchial tree format.
* At the top is the root directory, from which all the directories branch out.
* **Root Directory:**
* The top-level in the directory.
* All other files and directories stem from here.
* Only **root user** has unrestricted access to midify it's content.
* **/bin(Binary):**
* Contains essential user command binaries needed for basic system functionality.
* Ex: ls,cat,cp,mv,echo,rm.
* **/sbin(System Binaries):**
* Stores system administration commands used by the root user.
* Ex: fsdisk, fsck, reboot, iconfig.
* **/boot:**
* Holds files required for booting the system, including:
* Kernel
* Boot Loader
* Initial RAM disk.
* **/dev(Devices):**
* Contains special files representing hardware devices.
* Ex: First harddisk, Discarded Output, Terminal Interface.
* **/etc(Configuration Files):**
* Houses systems-wide configuration files.
* Ex: User Accounts, Mounted filesystems, Static hostname lookup.
* **/home(Directories):**
* Stores personal files for each user.
* Ex: **/home/user1, /home/user2.**
* **/lib and /lib64(Libraries):**
* Contained shared libraries required by system binaries.
* Ex: /lib/libc.so.6: Standard C library, /lib/modules: Kernel modules.
* **/media and /mnt(mount points)**:
* /media: automatically mounts removable media.
* /mnt: temporary mount point for manually mounted file systems.
* **/opt(Optional Software):**
* Used for installing third-party applications.
* Ex: /opt/google/chrome/
* **/proc(Process Information):**
* A virtual file system providing real-time system information.
* Ex: /proc/cpuinfo: CPU details, /proc/meminfo: Memoryinfo
* **/root(Root User Home):**
* The home directory for the root user.
* Located seperately from **/home** for seurity.
* **/run(Runtime):**
* Contains temporary files that store runtime information.
* **/srv(Service Data):**
* Stores data for servers like web servers and FTP.
* Ex: /srv/www/ for web server content
* **/tmp(Temporary Files):**
* Used for temporary files created by program.
* Gets cleared on system reboot.
* **/usr(User Utilities and Applications):**
* Contains user-installed applications, libraries and documentation.
* Key Subdirectories: /usr/bin/ - Non essential binaries, /usr/sbin/ - Non essential system binaries, /usr/lib/ - shared libraries, /usr/share/ - shared data like pages, icons.
* **/var(Variable Data):**
* Stores files that changes frequently.
* Includes logs, cache and mail spools.
* Ex: /var/log/ - Log files, /var/tmp/ - Temporary files surviving reboots.

3.What are the basic Linux commands for file operations?

* **File Creation and Viewing:**
* **touch filename:** creates an empty file.
* **cat filename:** displays the contents of the file.
* **less filename:** view a filename page by page.
* **more filename:** similar to less, but only moves forward.
* **nano filename:** open a file in the nano editor.
* **vim filename:** open a file in the Vim editor.
* **Copy, Move and Rename Files:**
* **cp sourcefile destination:** copy a file.
* **cp -r sourcefile destination:** copy a directory recursively.
* **mv oldname newname:** rename a file
* **mv file /path/to/destination/:** move afile to another directory.
* **Delete Directories and files:**
* **rm filename:** remove a file
* **rm -r directoryname:** deletes a directory and it's contents.
* **rmdir directoryname:** deletes a directory
* **Find and Searches files:**
* **find /path -name 'filename':** search a file by name.
* **find /path -type f -size +10M:** finds files larger than 10mb.
* **grep 'text' filename:** Search for a specific text in a file.
* **File Permissions and ownership:**
* **chmod 644 filename:** change file permissions.
* **chmod +x filename:** make a file executable.
* **chown user:grouop filename:** Changes file Ownership
* **File Compression:**
* **tar -cvf archive.tar files:** creates a archive tar
* **tar -xvf archive.tar:** extract a tar archive
* **gzip filename:** compresses a file.
* **gunzip filename:** uncompress a file.

4.How do you change file permissions in Linux?

* In Linux, you can change file permissions by using the chmod command.
* Here, are some ways to modify the file permissions:
* **Octal Value:**
* Permissions are represented by a three digit number:
* **4 = Read(r)**
* **2 = Write(w)**
* **1 = Execute(x)**
* Here, each digit represents the permission for: Owner, Group and Others.
* Ex: **chmod 755 filename**
* 7(4+2+1): Owner: Read, Write and Execute
* 5(4+0+1): Group: Read, Execute
* 5(4+0+1): Others: Read, Execute
* **Using Symbolic Mode:**
* You can modify file permissions with symbols:
* u - Owner
* g - Group
* o - Others
* a - all (Owner, Group, Others)
* Operators:
* + - Add permission
* - - Remove permission
* = - Set Specific permission
* **Change Permission for Directories Recursively:**
* To apply persions for all files and directories.
* **Checking File Permission:**
* Use ls -l to check file permissions.

5.What is the difference between chmod and chown?

* **chmod(Change Mode):**
* Used to changes permissions of file or directory.
* Modifies read(r), write(w) and execute(x) permissions for the Owner, Groups and Others.
* Operators: +, -, = or numeric operations.
* Changes the file permissions.
* **chown(Change Owner):**
* Used to change the owner or group of a file / directory.
* Only root or users with sudo previliges can change ownership.

6.Explain the use of grep command.

* **grep:**
* Grep command in linux is used to search for the patterns in the file systems.
* It stands for Global Regular Expression Print.
* Widely used in text processing and data extraction.
* Syntax: grep [options] 'pattern' filename.
* Here: Pattern - The text or regular expression to search for, filename: the files to search for
* Common uses:
* **Searching for a word in a file:**
* Ex: grep 'error' logfile.txt
* Here: Searches for the word 'error' and prints the matching lines.
* **Case-Insensitive Search:**
* Ex: grep -i 'error' logfile.txt
* Here: Finds 'error, 'Error', 'ERROR', etc., ignoring case.
* **Searching recursively in a Directory:**
* Ex: grep -r 'error' /logs/var
* Here: serches for error inside the /logs/var directories.
* **Diplay line numbers:**
* grep -n 'error' logfile.txt
* Ex: prints the 'error' matching lines along with the line numbers.
* **Diplay only matching words;**
* Ex: grep -o 'error' logfile.txt
* Here: returns only the mattched words instead of matching lines.
* **Inverting the Match:**
* Ex: grep -v 'error' logfile.txt
* Here: Displays the line that do not have the word error.
* **Searching for Multiple Patterns:**
* Ex: grep -E 'error|warning' logfile.txt
* Here: Uses Extended Regular Expressions to match multiple patterns.
* **Counting Matches:**
* Ex: grep -c 'error' logfile.txt
* Here: Counts the number of lines containing error.
* **Searching for a whole word:**
* Ex: grep -w 'error' in logfile.txt
* Here: only searches for 'error' but not 'errors'

7.How do you check disk usage in Linux?

* In Linux, you can check the disk usage using various commands.
* Here are some commonly used one's:
* **Check Disk Space Usage:**
* Syntax: df -h
* Here: df: Disk File system command shows disk space usge, -h: human readable: flag displays sizes in GB/MB.
* **Chheck Directory Size:**
* Syntax: df -sh /path/to/directory/
* Here: du: shows disk space used by directories/file, -s: flag shows total size for a directory, -h: human readable: flag displays sizes in GB/MB.
* **Check Disk Space:**
* Syntax: sudo du -sh /home/\*

8.What is the difference between soft link and hard link?

* The Soft Link(Symbolic Link) and Hard Link are two different ways of links to files in Linux file systems.
* **Hard Link:**
* A Hard Link is a direct reference to the physiucal data on the disk.
* It shares the same inode number as the original file.
* Deleting the same inode does not delete the original file.
* The remains accessible as long as atleast one hardlink exists.
* Hard links cannot link directories.
* Hard link must be on same file systems.
* Syntax: ln originalfile.txt hardlink.txt
* **Soft Link(Symbolic Link):**
* A Soft link(Symbolic link) that points to the original file path rather than the file.
* It has a different inode number from the original file.
* If the Original file is deleted then it become a broken link.
* Can link to files and as well as directories.
* They can span accross different filesystems.
* Syntax: ln -s original.txt softlink.txt

9.How do you schedule a cron job in Linux?

* **Open the Crontab:**
* Syntax: **crontab -e**
* Run the following command to edit the cron table for your user.
* Syntax: **sudo crontab -e -u username**
* Run the following command to give permission for the different user.
* **Cron job Syntax:**
* A crojob follows this format
* \* \* \* \* \* command-to-run - first \* - minute, second \* - hour, third \* - day of the month, fourth \* - month, fifth \* - daay of the week.
* \*- to run at every possible way.
* A specific number
* A range from 1-5
* A comma seperated list
* An interval
* **Example of cron jobs:**
* Run a script at everyday 5 P.M
* 0 17 \* \* 1 /path/to/script.sh
* **Save and Exit:**
* After editing save file and exit. if using nano, press:
* CTRL+X and Y then Enter.
* **View scheduled Cronjobs:**
* Syntax: **crontab -l or sudo -l -u username**
* **Restart the Crontab:**
* Syntax: **sudo systemctl restart cron.**

10.What is the purpose of the /etc/passwd file?

* The /etc/passwd file in linux system is a file that stores essential information about user accounts.
* It is a plain-text-file and can be viewed using command: cat /etc/passwd.
* Structure of /etc/passwd: each line in the file represents a single user accounts and contains seven fields and they are seperated by colons(:).
* Syntax: **username:x:UID:GID:comment:home\_directoy:shell**
* username: The unique login name of the user
* x: Placeholder for the password
* UID: User ID
* GID: Group ID
* comment: A description feild
* home\_directory: The user's home directory
* shell: The default shell assigned to the user.

11.Explain the basic features of the Linux OS.

* Linux is an Open-Source and free operating system.
* Linux is widely-used for personal, server and embedded systems.
* Basic feature of Linux OS:
* **Open Source:**
* Linux is free to use, modify and distribute.
* It's source code is availble for anyone to inspect and improve.
* **Multi - User System:**
* Multiple users can work on the system at the same time without interfering with each other.
* **Multi tasking:**
* Multiple programs can run on the system without affecting the performence.
* **Portability:**
* Linux can be run on different hardware platforems, from PC's and Severs to Embedded Systems and Mobile Systems.
* **Security:**
* Provides robust security with user authentication, file permissions and encryption features.
* **File System Heirarchy:**
* Uses a file system heirarchial directory layout, starting with the root(/).
* **Shell and Command Line Interface:**
* Linux provides powerful Command-Line utilities for managing the system, scripting and automation.
* **Graphical User Interface:**
* Supports all the desktop environments.
* **Device Independence:**
* Linux can interact with different types of hardware through device drivers.
* **Networking Support:**
* Comes with built-in networking capabilities, making it ideal for servers, embedded systems and cloud computing.
* **Support for Programming Languages:**
* Supports multiple languages like C,Python,Java and Shell Scripting.'
* **Kernel Customization:**
* Can be customized and configured according to the specific needs.
* **Process Management:**
* Efficiently handles process scheduling,creation and termination.
* **Virtualization:**
* Supports virtualiztion technologies such as KVM, VirtualBox and Docker for running virtual machines and containers.
* **Software Package Management:**
* Uses package managers for software installation and updates.

12.What are the major differences between Linux and Windows?

* **Linux:**
* Linux is an free and open source .
* Created by 'Linus Torvalds'.
* The code is availbke and can be modify easily.
* Free to use and Distribute.
* Offers multiple Desktop Environments.
* Heavy Lisence on the termonal for the administration and System tasks.
* More secure and efficient.
* Availble to the fewer applications.
* Requires additional drivers for certain hardware.
* Light weight distrubutions run efficiently on software.
* Highly Customizable, allowing the changes to the desktop environments.
* Frequent updates, but users control when to install them.
* Preferred for servers, development, cybersecurity and embedded systems.
* **Windows:**
* Propreitary.
* Owns by Microsoft.
* Paid, with different licencing fees depending on the version.
* Has a consistent GUI.
* Uses Command Prompt and Power Shell.
* Targeted by malware due to it's widespread and use.
* Require specal drivers for certain hardware.
* More resource intensive, requires higher-system specifications.
* Limited customization.
* Regular upates, sometimes forced.
* Domining in personal computing, gaming and business environments.

13. Define the basic components of Linux.

* **Kernel:**
* The core of Linux OS.
* Manages hardware resources.
* Handles process management, memory management, file systems and device drivers.
* **Shell:**
* Acts as an interface between the user and kernel.
* Allows users to execute commands and scripts.
* **File Systems:**
* Organises and manages the storage data.
* Follows a heirarchial directory storage.
* **System Libraries:**
* Provides essential functions and for the OS and Applications.
* **System Utilities:**
* Essential tools for System Manageent and Maintainence.
* **Init System:**
* Manages system boot-up and Service Processes.
* **Package Management:**
* Handles software installation, updates and dependencies.
* **Graphical User Interface:**
* Provides a virtual interface foir users who prefer not to use the command line.

14. What is the chmod command in Linux, and how do you use it?

* **chmod(Change Mode):**
* Used to changes permissions of file or directory.
* Modifies read(r), write(w) and execute(x) permissions for the Owner, Groups and Others.
* Operators: +, -, = or numeric operations.
* Changes the file permissions.

15. What are the most important Linux commands?

* **pwd:** print the curent director.
* **ls:** list all the files and directories.
* **cd directoryname:** changes to the tthat particular directoryname.
* **mkdir directoryname:** creates a directory.
* **rmdir directory name:** deletes a directory
* **rm filename:** remove a file
* **rm -r directoryname:** deletes a directory and it's contents.
* **cp sourcefile destination:** copy a file.
* **cp -r sourcefile destination:** copy a directory recursively.
* **mv oldname newname:** rename a file
* **mv file /path/to/destination/:** move afile to another directory.
* **filename:** creates an empty file.
* **cat filename:** displays the contents of the file.
* **less filename:** view a filename page by page.
* **more filename:** similar to less, but only moves forward.
* **File permission and Ownership:**
* **chmod permissions filename:** change file permissions.
* **chmod owner : group filename:** change file and group.
* **ls -l:** checks all the file permissions.
* **Process Management:**
* **ps:** show running processes.
* **top:** shows active processes
* **kill <PID>:** terminate a process
* **killall <Process\_name>:** terminate all the process names with a specific name.
* **htop:** interactive process viewer.
* **Networking:**
* **ping host:** test connectivity to a host.
* **ifconfig / ip a :** display a network interfaces.
* **netstat -tulnp / ss -tulnp:** Show active network connections.
* **wget <URL> :** Download files from the web.
* **curl <URL> :** Fetch content from a URL.
* **Disk storage and usage:**
* **df -h:** show disk space usage.
* **du -sh directoryname:** show size of a directory.
* **mount devicename mountpoint:** mount a file system.
* **umount mountpoint:** unmount a file system.
* **fdisk -l:** list disk partitions.
* **User Management:**
* **whoami:** shows current user.
* **who:** lists logged-in users.
* **id user:** shows userid and groupid.
* **add username:** add a new user.
* **passwd username:** changes the password.
* **usermod -aG group user:** add user to a group
* **deluser useeername:** removes a user name.
* **Package Management:**
* **apt update:** update package lists.
* **apt upgrade:** upgrades package lists.
* **apt install package:** installs the package
* **apt remove package:** removes the package.
* **RHEL/CentOS:**
* **yum install package:** install a package.
* **yum update:** update packages.
* **Arch Linux:**
* **pacman -Syu:** update systems and packages.
* **File Search:**
* **find /path -name filename:** searches a file by name.
* **locate file:** find a file quickly.
* **grep 'text' filename:** searches for a text in the file.
* **grep -r 'text' directory:**  searches for a text in files recursively.
* **Compression and Archiving:**
* **tar -cvf archive.tar files:** creates a archive tar
* **tar -xvf archive.tar:** extract a tar archive
* **gzip filename:** compresses a file.
* **gunzip filename:** uncompress a file.
* **System Information:**
* **uname -a:** show system info**.**
* **uptime:** shows system uptime.
* **free -h:** show memory usge.
* **vmstat:** shows performance statistics.
* **lscpu:** displays CPU info.
* **lsblk:** shows block devices.
* **dmidecode:** shows hardware details.
* **Logging and Monitoring:**
* **dmesg:** show system boot logs.
* **journalctl -xe:** view system logs.
* **tail -f /var/logs/syslogs/:** view system logs in real time.
* **Job Control:**
* **&:** ru the command in the background.
* **jobs:** list background jobs.
* **fg job\_number:** brings a background jobs to the fore ground.
* **bg job\_number:** resumes the job running in the background.
* **nohup command &:** run a command immune to hangups.
* **Text Processing:**
* **awk '{print $1}' filetxt:** process text.
* **sed 's/old/new/g' file.txt:** find and replaces the text.
* **cut -d':' -f1 /etc/passwd/ :** extract specific names.
* **Shutdown and Restart:**
* **shutdown -h now:** shutdown system immidiately
* **shutdown -r now:** restarts system immidiately
* **reboot:** restarts system.