

LINUX PROGRAMING

ASSIGNMENT-1

1. What is Linux Operating System (OS)? List three pros and cons of it.

A. Linux is open-source operating system. Linux is build based on the Unix OS. Unix OS is foundations for many different OS distributions like Ubuntu, Red hat, Kali Linux. Unix is first developed by the Linus Torvalds in 1991. After developing Linux OS, it was used widely by the people in world. Linux is free to use. The source code of Linux is opened for public. Anyone can access the source code and it gives access to the users to customize the OS according to their needs.

Pros of Linux OS:

1. Open source and free:

- Linux is open-source means. The source code is available for all so anyone can modify, view and distribute the code. The Linux is free to download, Cost effective. Organization benefited by installing this OS in multiple computers.

2. Community support:

- More usage of Linux OS by mankind. We can troubleshoot the software related problems easily.

3. Strong network and server capabilities:

- All over the world most of the servers and supercomputers runed by the Linux operating system. Most of the Cyber security professionals preferers Unix based operating system. And they access more hacking related tools.

Cons of Linux OS:

1. Learning curve for administration:

- Linux not user friendly. It is difficult for beginners to get use of this OS. Because users should know about that bash command, shell scripting, System administration, package management.

2. Gaming limitations:

- Most of the popular games will still run better on Windows.

3. Professional software gaps:

- Tools like Adobe Photoshop, AutoCAD, etc. are not natively available. Alternatives are out there but not more effective.

2. Differentiate between Linux, Mac, Android, and Windows OS with at least six unique features.

A.

Linux:

1. Open-source and free GPL license alterations and redistribution are encouraged or anyone can modify, view.
2. Very customizable there are many desktop environments like GNOME, KDE.
3. Can run on nearly any kind of hardware, from old PCs to supercomputers.
4. Very secure and stable and OS of choice for servers and certain critical systems.
5. Large active support and growing open-source software community.
6. Limited commercial apps available like Adobe, MS Office, etc.

MacOS:

1. A proprietary operating system created by Apple which built based on the Unix OS.
2. Graceful and cohesive user interface (Aqua GUI).
3. Only operates on Apple hardware like MacBook, iMac, Mac Mini.
4. Highly secure, but a controlled ecosystem that means customization is limited.
5. Optimized for creative work, video editing, music production, graphic design.
6. The software is mainly available from the Mac App store and Apple's ecosystem.

Android OS

1. Developed from the Linux core designed by Google.
2. Originally designed for touch enabled mobile devices- phones, tablets, smart TVs.
3. It is open source although there are proprietary Google services such as Play Store, Gmail, etc.
4. It has the largest app ecosystem in the world via the Google Play Store.
5. Security is device dependent and the ecosystem can be insecure due to sideloading and fragmentation.
6. It is very popular in IoT devices, wearables, and smart devices.

Windows OS

1. Windows OS operating system created by Microsoft.
2. Has a graphical user interface incorporating the Start Menu, Taskbar, and File Explorer.

3. Has the largest library of commercial software and games on the desktop.
4. Works on a wide variety of PC hardware created by many manufacturers.
5. Especially popular in business, education, and personal computing.
6. Often targeted by malicious software and viruses, simply because it is popular.

3. Why is Linux preferred for Mainframe Servers for legacy application? Give three out-of-the-box technical reasons.

A.

1. Compatibility with Binary Executables and Running Software in Virtualized Environments

- KVM for IBM-Z virtual machine enable Linux to run legacy workloads in virtualized environments with traditional workloads on the same mainframe.
- In practice this means that legacy like COBOL, C, or custom enterprise applications can run without rewrites and leverage the modern Linux ecosystem at the same time.

2. Scalability and Parallel Processing

- Linux on mainframes enables extraordinary parallelism and thousands of virtual Linux servers run on a single mainframe.
- Applications often depend on batch processing and high Input and output.
- Unlike common servers, Linux on mainframes scales vertically with significant CPU threads and large memory pools, permitting legacy applications to run with improved performance.

3. Open Standards & Middleware Integration

- This allows for the integration of older systems with new technologies
- Instead of rewriting decades of code, Linux provides a compatibility layer for new systems to work together with legacy workloads.

4. Explain the structure of the Linux File System with proper diagram. Note: you can use the tree command to find it out.

A. In Linux all the files and directories and devices are organized in a single root hierarchy that starts at the '/' called the root directory. Windows has address like C:\D:\newfolder..... etc but in Linux there is one root '/' and everything branches out from there.

Some imp directories in Linux:

1. / - root directory.
2. /home - home directory for users.
3. /root - home directory of the root for the super user
4. /tmp - temporary files.
5. /usr - user program and documents.
6. /etc - system configuration files.
7. /boot - bootloader files.
8. /bin - basic commands like ls, cp, etc.
9. /dev - device files.
10. /lib - shared libraries.

Example for structure of the Linux File System using “tree” command:

```
saidatta@sai:~$ ls
bashrc  cupp  demo  Desktop  Documents  Downloads  Music  Pictures  Public  python.py  snap  SocialMediaHackingToolkit  Templates  Videos
saidatta@sai:~$ cd cupp
saidatta@sai:~/cupp$ tree
.
├── CHANGELOG.md
├── cupp.cfg
├── cupp.py
├── itachi.txt
├── LICENSE
├── output.txt
├── output.txt.cupp.txt
├── README.md
├── sai.txt
├── sathvik.txt
├── screenshots
│   └── cupp-example.gif
└── test_cupp.py

2 directories, 12 files
saidatta@sai:~/cupp$
```

5. If Linux OS is open source, how do companies like Red Hat still making money from it? Do a market study and answer properly.

A. Yes even though the Linux OS is an open source. While everyone can access source code, inspect, modify it but few enterprises often buy source code of premium version. Like Red hat's business model provides that enterprise's needs.

How Red Hat Generates Revenue from Open Source

1.Subscriptions - Support - Maintenance:

- Customers pay for subscription costs related to Red Hat Enterprise Linux to receive stable builds, patches, security updates, and vendor support.
- This model works because enterprises require stability, accountability, and a quick ability to fix things in production.

Certification & Ecosystem Assurance:

- Red Hat certifies hardware, cloud providers, middleware, and so on.
- Enterprises pay for compliance, predictable performance, and reduced risks of integration.

Consulting -Services -Education:

- Red Hat sells consulting services related to setup, migration, optimization, and education
- Companies pay for services to minimize labor on the employee side and avoid costly errors.

Product Other Products (Cloud, Middleware, Platforms);

- Red Hat sells OpenShift), tools to enable automation, products to develop storage, and cloud platforms.
- This could yield high margin income for Red Hat and enable them to remain relevant in the cloud/container solution era.

6.Write the command to display today's date and time.

A. date command: this command is used to show the date of the present day.

- Example output: Sat Sep 21 15:45:10 IST 2025
- date +"%Y-%m-%d" - this command is used to change the date.

```
saidatta@sai:~$ date
Sun Sep 21 11:30:59 PM IST 2025
saidatta@sai:~$ date+"2025-09-23"
date+2025-09-23: command not found
saidatta@sai:~$ date +"2025-09-23"
2025-09-23
saidatta@sai:~$ date +"05-45-10"
05-45-10
```

7. Which command is used to check how long the system has been running?

A. uptime – command is used to check how long the system has been running.

```
saidatta@sai:~$ uptime
23:39:10 up 9 min, 1 user, load average: 0.62, 0.46, 0.23
saidatta@sai:~$ who -b
system boot 2025-09-22 05:00
saidatta@sai:~$
```

- 23.39.10 -- current system time.
- Up 9min – system uptime “9mins”.
- 1 user – number of users logged-in.

Who -b – this command shows the last boot time of the system.

8. What is the difference between shutdown -h now and halt?

A. Shutdown -h now:

Instructs the system to halt (terminate all processes) and power off immediately.

Goes through the proper shutdown process:

- Notifies all current users.
- Stops services and daemons gracefully.
- Unmounts filesystems cleanly.
- Halts the system last.

More safely and recommended for shutting down the system because it is less likely to cause data corruption.

Halt:

Immediately ceases CPU function without necessarily completing any normal shutdown procedure.

Subject to the particular setup of the operating system:

- It may not power down (only halt the system).
- It may bypass unmounting file systems or stopping daemons.
- It may lead to file system inconsistencies if misused.

Key difference:

- `shutdown -h now` - graceful shutdown.
- `halt` - Immediate halt.

9. Compare `init 0` and `shutdown -h`. Which is safer? Why?

A. `init 0`:

- `init` is used to change the run level of the system.
- `init 0` indicates to change to run level 0, which is halt mode (the system will require a shutdown).
- The `init` command will directly switch to run level 0. The system begins to stop the processes and ultimately will power off.
- Does not notify any connected users before shutting down the machine (unless used in conjunction with `wall` commands).
- Also, this is an older way to shut down the system and is not usually recommended in systems today where `systemd` can replace the original `init`.

`shutdown -h`:

- A proper shutdown command for safe powering off the system.
- Initiates an orderly shutdown process:
 - 1) Warns/logs off users.
 - 2) Gracefully stops all services and daemons.

- 3) Safely unmounts file systems before final shutdown.
- 4) Finally, shuts down and powers off the system.
 - Works consistently in both Sys init and systemd systems.

Relative Safety

shutdown -h is safer than init 0.

It is a much safer method of shutting down as it performs proper cleanup of the processes sync the disks and unmounts the file systems. Using 'init 0' in certain cases may cut short the safe shutdown process therefore increasing the risk of corruption to data or potentially failing to terminate services correctly.

10. A system administrator accidentally powers off a Server machine without shutting it down properly. What problems can occur to the said Server?

A. If a system administrator abruptly turns off a server without the proper shutdown procedures, various issues can arise as the operating system has no opportunity to stop processes, flush buffers, or unmount file systems in a safe way. Here are the major issues:

File System Corruptions:

- Data that are still in memory may not be written to disk.
- You can have corrupt files and/or filesystem corruption.
- It may require you to run fsck (file system check) on boot.

Loss of Data:

- Any unsaved, unfinished transactions could be lost.
- This is especially dangerous if the server is running a database, mail server.

Applications/Service Failures:

- Services that are running may improperly terminate.
- When you restart the server, the application may fail, require repair,

Disk Failure (Hardware Stress):

- A sudden cut in power can stress physical hard drives and lead to premature death.

- If RAID arrays exist, it may label disks as bad, due to incomplete writes occurring.

Configuration/Log File Corruption

- Configuration or log files storing system changes during the power-off can become corrupt.
- All the above problems result in increased downtime, which is an important part of the evaluation to run on a production server.