# Assignment-1

**Linux programming**

**Nanditha M**

**ENG24cy0038**

Q1) Linux is an **open-source operating system (OS)** based on **Unix**. It acts as a bridge between computer hardware and software, managing resources like CPU, memory, and storage.

**Pros of Linux:**

1. **Open Source & Free** – Anyone can download, use, and modify it without licensing fees.
2. **Security** – Linux is less vulnerable to viruses and malware compared to Windows.
3. **Stability & Performance** – Rarely crashes, runs efficiently even on older hardware, and powers most of the world's servers.

**Cons of Linux:**

1. **Software Compatibility** – Many commercial applications (like MS Office, Adobe Photoshop) don't have native Linux versions.
2. **Gaming Support** – Limited compared to Windows, though improving with tools like Steam Proton.
3. **Learning Curve** – Requires technical knowledge (especially command-line usage) for advanced tasks.

Q2) **Linux**

1. **Open-source** – Free to use, modify, and distribute.
2. **Highly customizable** – Multiple distributions (Ubuntu, Fedora, Debian, etc.).
3. **Strong security** – Very few viruses and malware compared to others.
4. **Best for servers** – Powers majority of web servers and supercomputers.
5. **Resource-efficient** – Can run smoothly on older hardware.
6. **Package managers** – Uses tools like APT, YUM, or Pacman for software installation.

**macOS (Apple)**

1. **Proprietary OS** – Exclusively runs on Apple hardware (MacBooks, iMacs).
2. **Polished UI** – Famous for smooth, intuitive, and consistent user interface.
3. **Unix-based** – Like Linux, built on a Unix foundation, making it stable.
4. **Optimized for creativity** – Popular for video editing, design, and music production.
5. **Seamless Apple ecosystem** – Integrates perfectly with iPhone, iPad, and Apple Watch.
6. **Limited hardware choice** – Works only with Apple devices, no wide customization.

**Android**

1. **Open-source (based on Linux kernel)** – But mostly controlled by Google.
2. **Mobile-first OS** – Designed mainly for smartphones and tablets.
3. **App ecosystem** – Billions of apps available on Google Play Store.

4. **Highly customizable UI** – Skins (like Samsung One UI, MIUI) on top of stock Android.
5. **Huge hardware diversity** – Runs on devices from many manufacturers.
6. **Touchscreen focused** – Optimized for touch, gestures, and mobile usage.

### Windows

1. **Most widely used desktop OS** – Dominates PCs and laptops globally.
2. **Proprietary software** – Licensed and controlled by Microsoft.
3. **Broad software compatibility** – Almost all games and commercial apps run on Windows.
4. **User-friendly GUI** – Familiar interface with Start Menu, Taskbar, and File Explorer.
5. **Hardware compatibility** – Supports a wide range of PCs, laptops, and custom builds.
6. **Frequent updates** – Regular security patches, but sometimes cause stability issues.

## Q3) Workload Consolidation with Virtualization (z/VM, KVM on mainframes)

- A single Linux mainframe can **run thousands of virtual servers simultaneously** with very low overhead.
- Legacy apps written for older environments can be isolated in different virtual machines, **preserving compatibility** while reducing hardware sprawl.
- This makes it easier to migrate multiple legacy workloads onto **one secure Linux mainframe system**.

### Binary Compatibility & Cross-Platform Support

- Linux on mainframes supports **standard POSIX APIs** and can run software compiled for other Linux platforms with minimal modification.
- Legacy applications (COBOL, C, Java) can be integrated with modern middleware, databases, and even containers (Docker, Kubernetes).
- This **protects decades of legacy code investment** while enabling modern cloud-native services on the same box.

### Unmatched I/O Throughput & Reliability (Channel I/O Architecture)

- IBM mainframes running Linux use **specialized I/O processors (channels)** instead of relying solely on the CPU.
- This architecture delivers **extremely high transaction rates** (critical for banking, telecom, and government systems).
- Legacy applications that process **millions of records per second** benefit from Linux's ability to exploit this mainframe hardware without bottlenecks.

Q4) /

├── bin     -> Essential binaries

├── boot    -> Boot loader, kernel files

├── dev     -> Device files

├── etc     -> Configuration files

├── home    -> User home directories

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│   ├── user1
│   └── user2
├── lib      -> Shared libraries
├── media    -> Removable media
├── mnt      -> Temporary mount point
├── opt      -> Optional software
├── proc     -> Process info (virtual fs)
├── root     -> Root user's home
├── sbin     -> System binaries
├── srv      -> Service-related data
├── tmp      -> Temporary files
├── usr      -> User applications
│   ├── bin
│   ├── lib
│   └── share
└── var
```

Q5) **1. Subscription & Support (Enterprise Linux / RHEL)**

- Red Hat sells *subscriptions* for Red Hat Enterprise Linux (RHEL). Enterprises pay for stable, certified builds, long-term maintenance, security patches, updates, SLAs, and compatibility with hardware/software ecosystems.
- In their recent reporting, they added ~7,000 RHEL subscriptions in Q3, up about **27% sequentially**.
- Renewal rates are high: approximately **90%** for RHEL subscriptions in recent quarters. That means recurring revenue is strong.

**2. Hybrid Cloud / OpenShift & Platform Products**

- OpenShift, Red Hat's Kubernetes-based container and application platform, is a major growth driver. In recent quarters, OpenShift growth has been **20-plus percent** year over year.
- Its *Annual Recurring Revenue* (ARR) has reached ~$1.5-1.7 billion recently.
- Many customers are using OpenShift for migrating legacy applications, for hybrid cloud deployments, for consistent container orchestration whether on premises, in private clouds or public clouds. This gives Red Hat leverage to push value-added features, consulting, managed services, security compliance, etc.

**3. Automation, Tools & Other Products**

- Red Hat also sells other enterprise tools: **Ansible** (automation), **virtualization**, management tools, integrations, etc. These are often bundled or offered as add-ons to the core subscription.

- These products help customers reduce operational overheads, manage infrastructure better, automate compliance/security updates, all of which are valuable for enterprise customers.

## 4. Recurring Revenue & Deferred Revenue

- The subscription model ensures recurring revenue. Enterprises expect long-term support, predictable maintenance, and SLAs. Renewal rates (e.g. RHEL ~ 90%) and growing deferred revenue show revenue that is backed by prior commitments.
- Deferred revenue: Red Hat reports increases in its deferred revenue (money already committed but "earned" over time) which is a sign of stable cash flow ahead.

## 5. Services, Consulting, Training, Certifications

- Beyond selling software, Red Hat provides consulting (migration, integration, deployment), technical support, training, certification of operators, developers. These services come at premium for enterprise customers.
- Partners also play a big role: according to an IDC/Red Hat-commissioned study, partners providing OpenShift cloud services have earned on average ~$45 million in annual revenue, with ~28% gross margin.
- Managed services and professional services around deployment, optimisation, upgrades etc., tend to have higher margins.

## 6. Market Position & Demand Tailwinds

- Hybrid cloud, cloud-native apps, containerization, AI / data / security compliance are in high demand. Companies want flexibility: ability to run workloads on-prem, in private clouds, in public clouds, or edge. Red Hat's portfolio (RHEL + OpenShift + other tools) fits well into this trend. Several metrics show Red Hat / IBM software (led by Red Hat) growing strongly in double digits in software segment.
- In IBM's recent earnings, Red Hat contributed strongly to IBM's software growth; software revenue growth overall is helped significantly by Red Hat's business.

Q6) The command that can be used to display the current date and time is: **date.**

Q7) **Uptime** command is used to check how long the system has been running.

Q8) **shutdown -h**

- **Meaning**: Shut down the system immediately.
- **Process**:
  1. Notifies all logged-in users.
  2. Stops services and processes gracefully.
  3. Unmounts filesystems safely.
  4. Then powers off or halts the machine (depending on configuration).

**halt**

- **Meaning**: Stop all CPU functions immediately.
- **Process**:
  - Kills all processes.

- Stops the CPU, but **may not power off the system** (depends on hardware & init system).
  - Does not always notify users or gracefully shut down services.

## Q9)  **init 0**

- Sends the system to **runlevel 0** (which is the halt state).
- Immediately stops all services and brings the system down.
- Doesn't always notify logged-in users.
- On some distros, it may not perform all cleanup tasks (e.g., scheduled jobs, filesystem sync).
- Considered more **abrupt** compared to shutdown.

### shutdown -h

- The recommended command to **halt (power off) the system safely**.
- Steps:
    1. Notifies all logged-in users.
    2. Kills processes gracefully.
    3. Stops services in order.
    4. Unmounts all mounted filesystems properly.
    5. Then halts (or powers off) the machine.
- More **controlled and systematic** than init 0.
- **shutdown -h is safer** because:
    1. It follows a proper shutdown sequence.
    2. Ensures filesystems are cleanly unmounted (avoiding corruption).
    3. Warns users before shutting down.

## Q10)  **1. Filesystem Corruption**

- Since Linux constantly writes to disk (logs, databases, cache), an improper shutdown can leave files in an **inconsistent state**.
- This may cause:
    - Corrupted files.
    - Missing data.
    - Filesystem errors requiring a repair (fsck).

### 2. Data Loss

- Any **unsaved or cached data in RAM** is lost immediately.
- Applications like databases (MySQL, PostgreSQL) may lose transactions that weren't committed to disk.

### 3. Service & Application Failures

- Services (e.g., web server, mail server, DB server) may not stop gracefully.
- On restart, they might fail to start properly because of corrupted configs, PID lock files, or unfinished processes.

### 4. Hardware Stress

- Sudden power-offs can stress hard drives (especially HDDs) and lead to bad sectors.
- In extreme cases, repeated abrupt shutdowns can shorten hardware lifespan (disks, RAID controllers, PSU).

**5. Security Risks**

- Log files may be incomplete, making it harder to trace security events.
- Incomplete shutdowns might also leave temporary files or sockets exposed.