Day 1 – Phase 1: System Update & Directory Setup

Tasks:

• Refresh package lists and upgrade the system.

```
salma2002@MSI:~$ sudo apt upgrade
[sudo] password for salma2002:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following package was automatically installed and is no longer required:
  libllvm17t64
Use 'sudo apt autoremove' to remove it.
The following upgrades have been deferred due to phasing:
  base-files libegl-mesa0 libgbm-dev libgbm1
  libgl1-amber-dri libgl1-mesa-dri libglx-mesa0
  mesa-libgallium mesa-vulkan-drivers motd-news-config
  snapd wsl-setup
0 upgraded, 0 newly installed, 0 to remove and 12 not upgraded.
```

• Verify system details: kernel version, user, time.

```
0 upgraded, 0 newly installed, 0 to remove and 12 not upgraded.
salma2002@MSI:~$ uname -a
Linux MSI 6.6.87.2-microsoft-standard-WSL2 #1 SMP PREEMPT_DYNAMIC Thu Jun  5 18:30:46 UTC 2025 x86_64 x86_64 x86_64 GNU/Linu
x
```

• Create /home//iot_logger with subdirectories: logs, scripts, data.

```
salma2002@MSI:~$ cd /home
salma2002@MSI:/home$ ls
salma  salma2  salma2002
salma2002@MSI:/home$ cd /salma2002 && mkdir iot_logger
-bash: cd: /salma2002: No such file or directory
salma2002@MSI:/home$ cd salma2002 && mkdir iot_logger
salma2002@MSI:~$ cd /home/salma2002 && mkdir iot_logger
mkdir: cannot create directory ‘iot_logger’: File exists
salma2002@MSI:~$ cd /home/salma2002
salma2002@MSI:~$ ls
Desktop  Documents  Downloads  iot_logger  yes  yes.pub
salma2002@MSI:~$ cd iot_logger && mkdir logs scripts data
salma2002@MSI:~/iot_logger$ ls
data  logs  scripts
salma2002@MSI:~/iot_logger$
```

Open-Ended Questions:

• Draw or describe the Linux architecture layers (hardware → kernel → shell → user space). Where do system calls fit?

Linux Architecture Layers

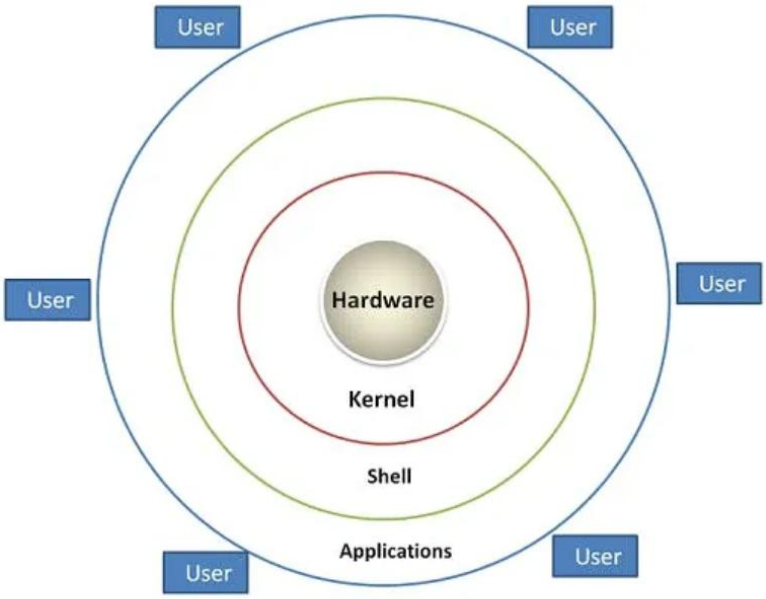
Linux is structured into several layers that work together, starting from the physical hardware to the applications you interact with:

1. **Hardware**
   At the base of the Linux system is the hardware layer, which includes all physical components of a computer such as the CPU, RAM, hard disk, motherboard, network devices, and peripherals. This layer provides the foundation for all higher layers.

2. **Kernel**
   The kernel sits directly above the hardware. It is the core component of the Linux operating system, managing critical tasks like process scheduling, memory allocation, disk operations, and hardware communication.
   - Linux uses a monolithic kernel, meaning it bundles device drivers, file system management, and system calls into one large binary.
   - System calls act as the interface between user applications and the kernel, enabling programs to request services such as file access, process control, or network communication.
3. **Shell**
   The shell is a user interface that enables interaction with the kernel. Typically, this takes place through a command-line interface (CLI).
   - Users enter commands, which the shell interprets and passes to the kernel.
   - Popular shells include Bash, C Shell (csh), and Z Shell (zsh), each offering different syntax and features.
4. **Applications**
   At the top layer are applications — the software tools and programs that users directly work with, such as text editors, browsers, or file managers.
   - Applications depend on the kernel for hardware access and often use the shell for command execution.
   - For example, running a command to open a file involves the shell parsing the command, the kernel retrieving data from storage, and the application displaying it to the user.

   Summary: Together, the hardware, kernel, shell, and applications create a layered structure where system calls serve as the critical bridge between user space and the kernel.

   Reference: ***Medium: Linux Architecture***



- **Explain the purpose of these directories: /, /bin, /sbin, /usr, /etc, /var.**

Linux uses a hierarchical file system where each directory serves a distinct role in system operation and organization. Below are the purposes of important directories:

- ***/ (Root Directory):***
  The top-level directory from which the entire Linux file system hierarchy starts. Every other directory and file branches from here.
- ***/bin:***
  Contains essential binary executables needed for basic system operations. These commands (like ls, cp, mv) are required for both normal users and during system startup.
- ***/sbin:***
  Stores system binaries mainly used for administrative tasks and system management (e.g., ifconfig, reboot). These tools are typically executed by the root user.
- ***/usr:***
  Holds user-related programs, utilities, libraries, and documentation that are not essential for booting but are necessary for day-to-day operations.

- ***/etc:***
  Contains configuration files for system and application settings. These are usually plain text files, often with a .conf extension, that define how services and software behave.
- ***/var:***
  Designed for files that change frequently during normal system use. Examples include system logs, cache data, spool files, and temporary data generated by applications.
- ***/root:***
  The home directory of the root (superuser) account, separate from the general /home directory used for regular users.
- ***/mnt:***
  A temporary mount point used for attaching external file systems, such as USB drives, network shares, or other storage devices.

  Reference: ***Baeldung: Linux Directories***

• Why does Linux treat everything as a file? Explain the difference between a program and a process.

Linux follows the philosophy that everything is represented as a file, whether it's data on disk, a hardware device, or even a network socket. This design choice provides several benefits:

- **Convenience:** Programs can interact with hardware in the same way they interact with files. For example, sending commands to a mouse or keyboard can be done through simple read/write operations. Permissions can also be applied consistently, just as they are with regular files.
- **Unification:** Instead of having different mechanisms for handling files, devices, sockets, or processes, Linux uses a single unified interface — the file abstraction.
- **Consistency:** Regardless of what you are accessing (a hard disk, USB, keyboard, or memory info), the same basic operations apply: open, read, write, and close.
- **Flexibility:** Because everything is treated like a file, it becomes easy to connect different system components. For example, input from a device can be redirected directly into another program using simple file-like operations.

Difference Between a Program and a Process

1. **Program**
    - A program is a set of instructions stored on disk, usually in the form of an executable file.
    - It is a passive entity — simply code waiting to be run.
    - Example: /bin/ls is a program that lists directory contents.
2. **Process**
    - A process is an active instance of a program in execution.
    - It has its own memory space, CPU state, environment variables, and open file descriptors.
    - Example: When you type ls in the terminal, the kernel loads the /bin/ls program into memory and runs it as a process.

Key Distinction:

- A program is static (code on disk).
- A process is dynamic (a running execution of that code).