KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COMPUTER ENGINEERING
OPERATING SYSTEMS

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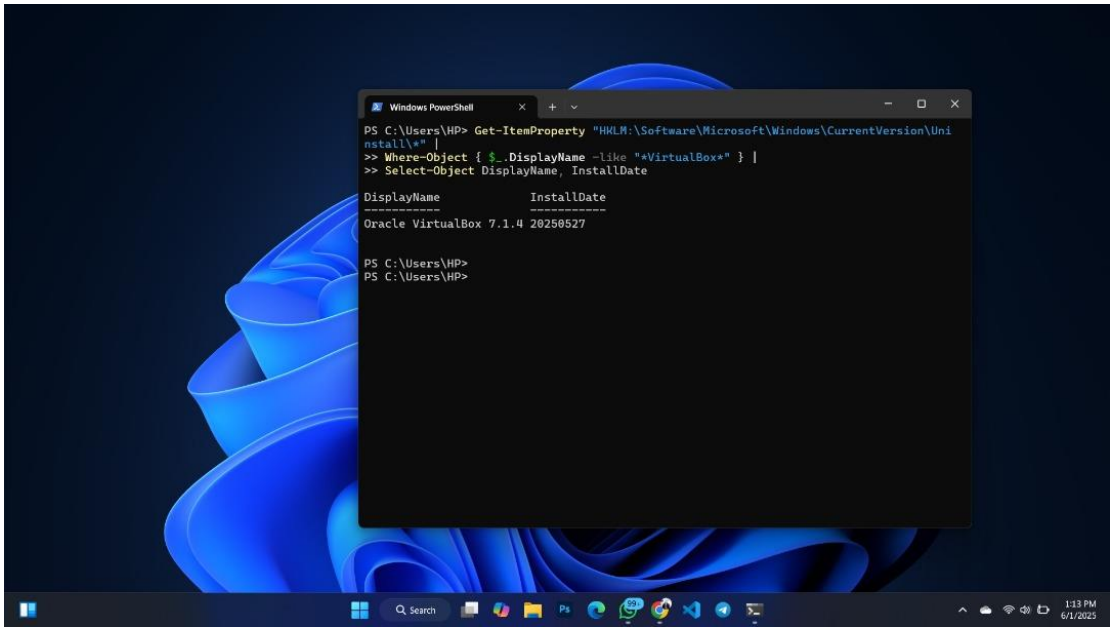
LECTURE ONE OF OPERATING SYSTEMS

INTRODUCTION

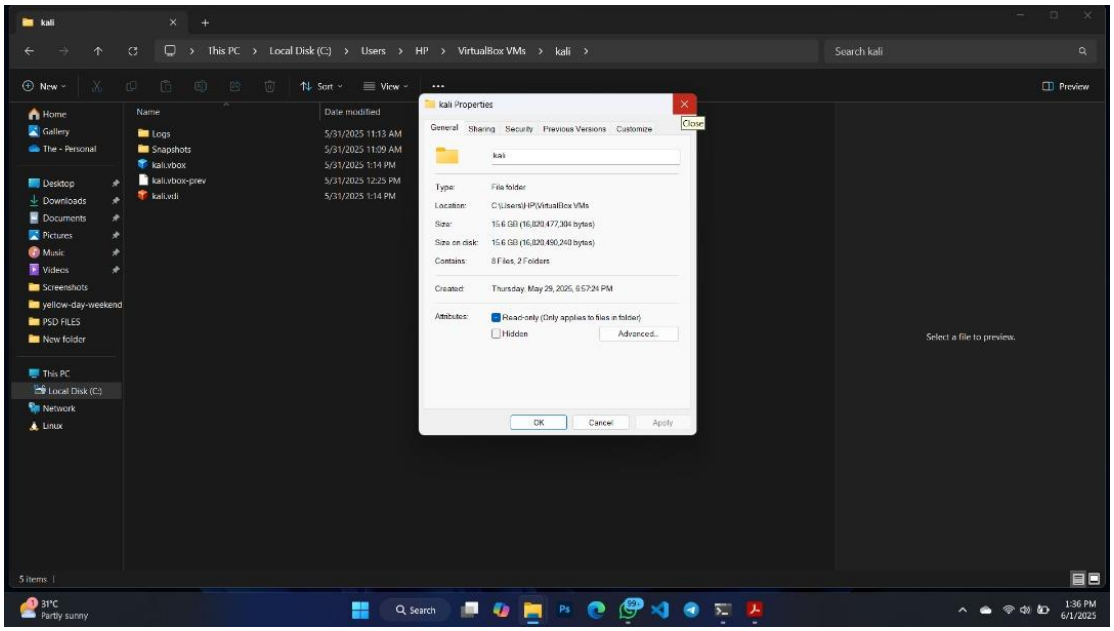
As part of my Operating Systems course, I explored the fundamental roles of an operating system by installing and analyzing two operating systems, Ubuntu and Kali Linux, on virtual machines using VirtualBox.
To begin, I downloaded VirtualBox from https://www.virtualbox.org to create and manage virtual environments. Next, I obtained the Ubuntu 24.04 LTS ISO from https://www.ubuntu.com/download/desktop and the Kali Linux 2024.2 ISO from https://www.kali.org/getkali/, both of which are popular Linux distributions suitable for this project.
These installations allowed me to investigate the OS as a resource manager, predefined library, and user interface. This report details the installation process, accessing the OS registry equivalents, and demonstrations of the OS roles with screenshots from my virtual machines.

INSTALLATION OF VIRTUAL BOX MACHINE

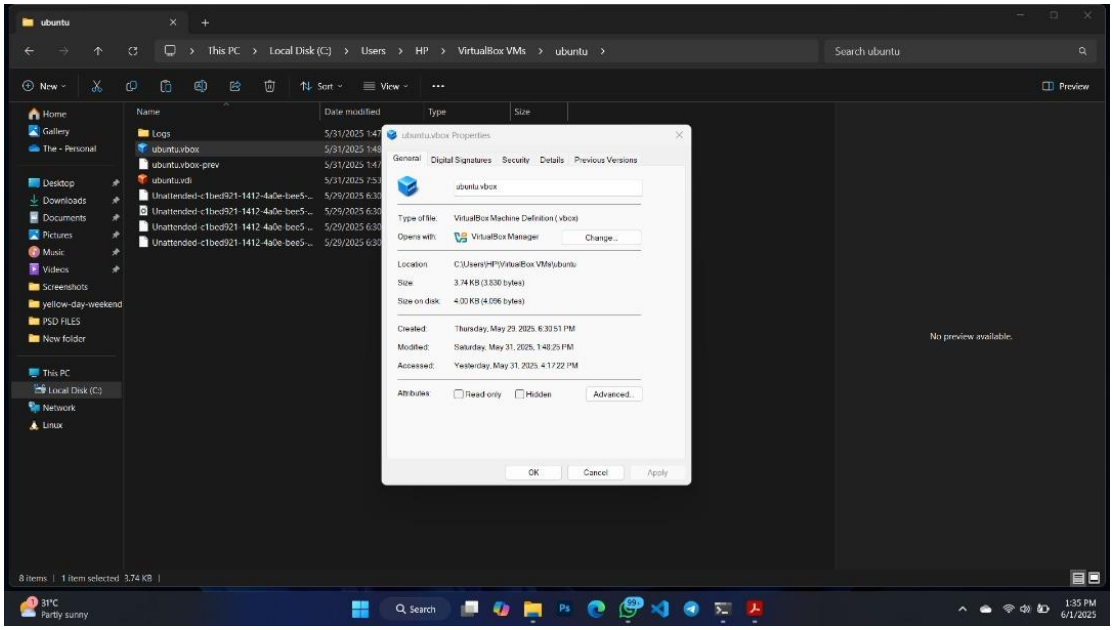


Installed on 27th May, 2025.

Installation of Kali Linux



Installation of Ubuntu



HOW THE OPERATING SYSTEM ACTS AS A RESOURCE MANAGER

The OS acts as a resource manager by allocating and coordinating hardware resources (CPU, memory, storage, I/O devices) among multiple processes to ensure efficient and fair usage. It prevents conflicts (e.g., two programs trying to use the same memory) and optimizes performance.

KEY FUNCTIONS:

- **Memory Management:** The operating system allocates RAM to processes and uses virtual memory to handle shortages.
- **I/O Management:** The operating system manages communication between software and hardware using device drivers. It is responsible for managing access to devices like keyboards, mouse and printers.
- **Storage Management:** The operating system organizes file storage and retrieval on disks.
- **CPU Scheduling:** The operating system decides which process runs on the CPU and for how long by using a Scheduler. It supports multitasking and ensures efficient execution and system responsiveness.

EXAMPLE OF HOW THE OS ACTS AS A RESOURCE MANAGER USING UBUNTU:

1. I run two programs (Fire fox and a text editor) on my ubuntu machine.

2. In the 'Processes" tab from System Monitor, the text editor and Firefox were listed with their CPU and memory usage.

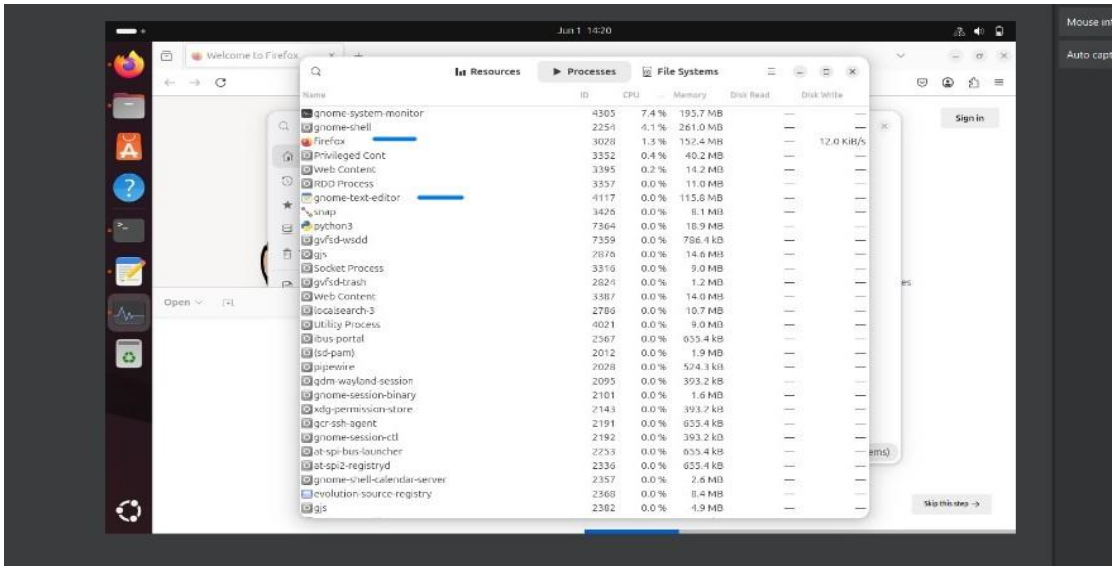
3. The Operating System allocated different amounts of memory and schedules CPU time (Percentages fluctuate as the OS switches between processes).

Firefox: Memory Allocation (152.4MB), CPU time (1.3%)

Text Editor: Memory Allocation (115.8MB), CPU time (0.0%)

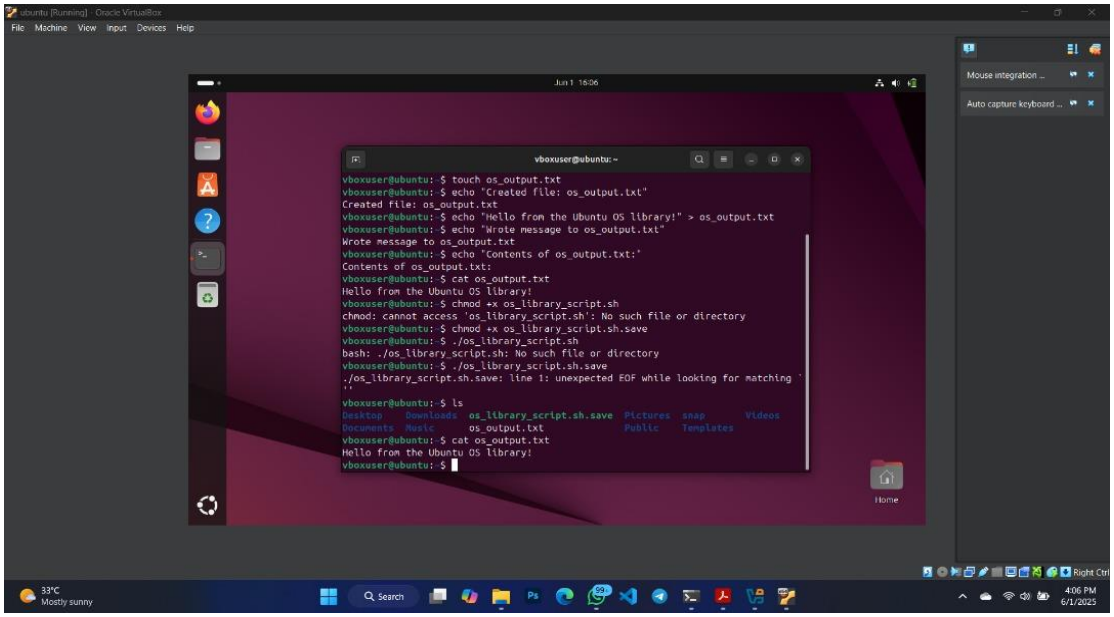
4. Moreover, when I typed in the Text Editor, the OS routed keyboard input to it, and not to Firefox, ensuring data flow.

Conclusion: The above example highlights how the Operating System acts as a resource manager by scheduling which process gets access to the CPU, and communication between my keyboard and the text editor.



HOW THE OPERATING SYSTEM ACTS AS A PREDEFINED LIBRARY

The Operating System provides a predefined library of functions (system calls) that applications use to interact with hardware and perform tasks like file operations, network communication, or process management. These system calls abstract the complexity of hardware, making it easier for developers to write software.



In the picture above, the bash script uses shell commands (ls, touch, echo , cat) that rely on Linux system calls provided by the OS:

- ls: Invokes readdir() to read directory contents from the file system.
- touch: Uses open() with create flags to create a new file.
- echo >: Uses write() to write data to a file via output redirection.
- cat: Uses read() to read and display file contents.

Why This Demonstrates the Predefined Library Role:

The OS provides a standardized set of system calls that shell commands access, acting as a "library" for scripts and programs.

Without these system calls, the script would need complex code to interact with the disk or file system directly.

The script is portable across Linux distributions (e.g., Ubuntu and Kali) because the OS standardizes these system calls.

HOW THE OPERATING SYSTEM ACTS AS AN INTERFACE BETWEEN THE COMPUTER HARDWARE AND USER

The OS provides a user interface (UI) that allows users to interact with hardware without needing to understand its complexities. This includes graphical user interfaces (GUIs) like desktops and command-line interfaces (CLIs) like terminals.

Key Functions:

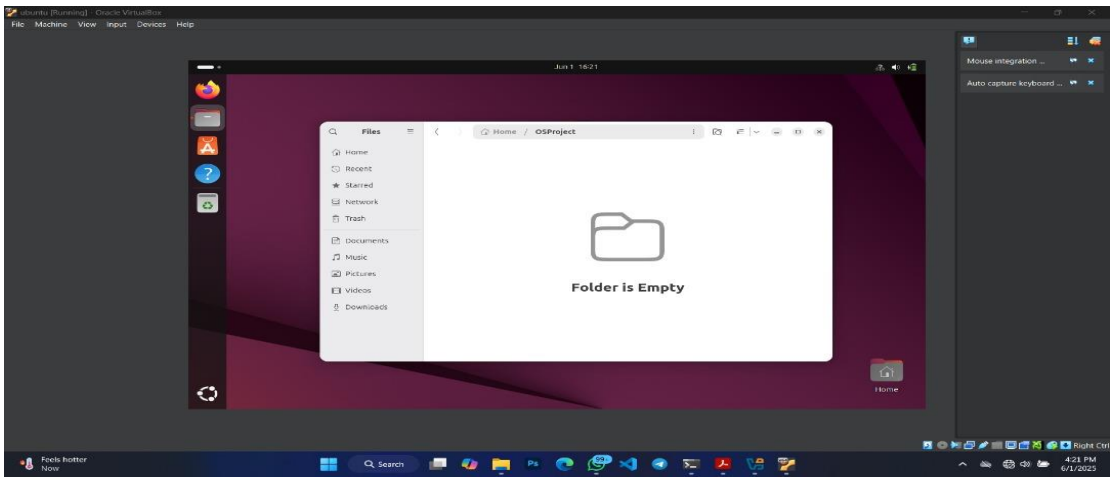
GUI: Provides visual elements (windows, icons, menus) for user interaction (e.g., Ubuntu's GNOME desktop, macOS's Finder).

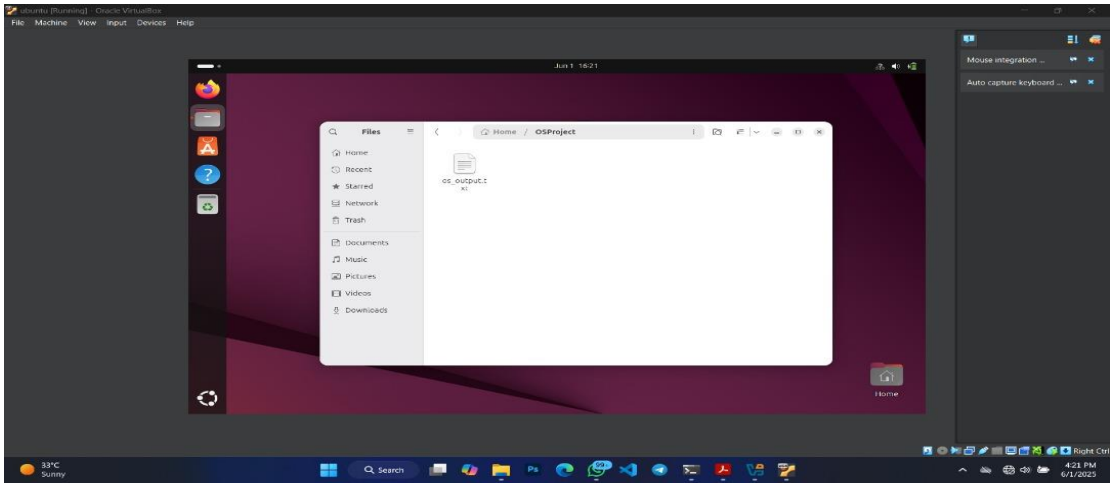
CLI: Allows users to issue text-based commands (e.g., Bash in Linux, Terminal in macOS).

Device Interaction: Translates user inputs (e.g., mouse clicks, keyboard presses) into hardware instructions.

EXAMPLE OF THE OS ACTING AS AN INTERFACE BETWEEN THE COMPUTER HARDWARE AND USER:

I created a folder called **OSProject** then dragged and drop a different file called **os_output.txt** into it.





Observation:

In the Ubuntu virtual machine, the GUI drag-and-drop actions into file system operations. The command line interface confirms the operation by listing the file in the new location.

2. **HOW THE OPERATING SYSTEM PROTECTS USER INFORMATION**

The OS ensures that your personal data like files, passwords, or settings stays safe from unauthorized access, accidental deletion, or malicious attacks. The OS acts as a security guard for the computer, controlling who can access what and keeping information private and secure.

How Ubuntu Protects User Information:

1. User Accounts and Permissions:

Ubuntu creates separate user accounts for each person using the computer. Each account has its own private space (like a personal folder) where files are stored.
Files have permissions that control who can read, write, or execute them. For example, documents are only accessible to the user unless the user explicitly shares them.

2. Password Protection:

When you log into Ubuntu, you need a username and password. The OS encrypts your password (turns it into a secret code) so hackers can't easily steal it.
Passwords are like PIN for bank card, only the user knows it, and the OS ensures it is stored securely.