**Comparison of Windows, macOS, and Linux Operating Systems**

**Operating systems are crucial software that manage the hardware and software on a computer. Among the most widely used are Microsoft Windows, Apple’s macOS, and the open-source Linux (with versions like Ubuntu, Fedora, and Mint). Although they serve the same purpose, these systems differ in how they manage files, organize folders, run applications, and interact with the user**

|  | **🔷 Windows** | **🍏 macOS** | **🐧 Linux** |
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| **Folder Structures:**  **Each system organizes its storage differently:** | **Windows separates storage into drives, such as C:\ and D:\.**  **Most system files and applications are found in the C:\ drive.**  **C:\Program Files – for installed software**  **C:\Users – for individual user data**  **C:\Windows – the core system directory** | * **macOS follows a Unix-based file layout that begins with a single root /.** * **It uses forward slashes in file paths.** * **Example: /Users/student/Documents/file.txt** * **Important directories include:** * **/Applications – for app installations** * **/Users – user profiles and personal files** * **/System and /Library – for macOS system files and libraries** | **/home – where all user files are stored**  **/etc – configuration files**  **/bin, /usr/bin – for system commands and programs**  **/mnt or /media – for mounted external devices** |
| **📝 2. Naming Rules** | **File names are not case-sensitive, meaning File.txt and file.txt are the same.**  **Restricted characters include: \ / : \* ? " < > |**  **Certain names like CON, PRN, and AUX are reserved and cannot be used.**  **File extensions are required to indicate the file type (e.g., .docx, .mp3).** | **macOS is generally not case-sensitive, but it can be changed to be case-sensitive if needed.**  **You cannot use : in file names.**  **It supports Unicode, meaning you can name files using various symbols or languages.**  **File extensions (like .app, .jpg, .pdf) help identify the file type.** | **File names are case-sensitive, so file.txt and File.txt are different.**  **The only characters that cannot be used are the forward slash (/) and the null character (\0).**  **File extensions are optional—Linux focuses more on file permissions and content than on name endings.** |
| **💽 3. File Systems and FAT Usage** | **NTFS offers advanced features such as file encryption, access control with security permissions, and the ability to handle large file sizes and volume efficiently**  **NTFS is the default system for internal drives.**  **It also supports FAT32 and exFAT—commonly used on USB drives and SD cards.**  **mes efficiently.** | **Uses APFS (Apple File System) for most modern devices.**  **Previously used HFS+.**  **Also supports FAT32 and exFAT to share files with Windows systems or external drives.** | **The main file system is ext4, which is stable and efficient.**  **Also supports newer systems like Btrfs, XFS, and ZFS.**  **Linux can read/write FAT-based systems for external storage compatibility.** |
| **File Types for Executables and Script Handling** | **.exe – Standard executable files used to launch programs.**   * **.bat and .cmd – Batch script files used to run commands in the Command Prompt.** * **.msi – Windows installer packages for software installation.** * **.ps1 – PowerShell script files used for automation and administrative tasks.** | **Applications often appear as .app bundles, which are actually folders packaged as single files.**  **Other executable types include:**  **.command and .sh for scripts run via Terminal**  **You must set file permissions to allow execution.** | **Doesn’t rely on extensions to identify programs.**  **Common script and app types include:**  **.sh – shell scripts**  **.run, .bin – for installers or binary executables**  **.AppImage – portable apps that run without installation**  **A file must be given executable permission using a command like chmod +x filename.** |

| **🧾 2. Running Scripts and Shell Access** | **Windows offers both Command Prompt and PowerShell for running scripts. PowerShell is more advanced and supports .ps1 scripts, while traditional batch files (.bat, .cmd) are run via Command Prompt.** | **macOS uses the Terminal with the zsh shell (or bash on older versions). Before running, scripts must be given execute permission and are launched using commands like ./script.sh or bash script.sh. macOS also supports various scripting languages such as Python, Ruby, and AppleScript.** | * **Linux provides a robust command-line environment, typically using bash or zsh. Scripts usually begin with a shebang line (e.g., #!/bin/bash) to indicate the interpreter. To run scripts, users can use bash script.sh or ./script.sh after making them executable.** |
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📌 Where is FAT still used?

Though outdated, FAT32 remains widely used for removable storage devices such as:

USB sticks

SD cards

Cameras and game consoles

It's preferred for compatibility, though it has a 4GB file size limit and lacks security features.