

# A Survey of Linux Operating System as an Alternative to Other Operating Systems

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**Abstract**—Linux is an operating system for Intel 386/456/Pentium-based IBM PCs and is congenial. A worldwide group of enthusiastic volunteers has joined forces in developing many aspects of Linux on the INTERNET. Linux can run the powerful set of compilers and programming tools of free software foundation and X-free 86, a port of the X Windows system from MIT. One useful feature of Linux is its ability to coexist with other operating systems. Thus, a user invested in DOS/MS Windows software may continue running these applications on the machine and install them.

Our scope for review of this paper is to study and review the Linux Operating system and its various features and functions such as History and Development, the Linux Kernel, Processes Scheduling in the Linux Operating System, Memory Management, I/O operations, networking and how it is done in the Linux OS.

**Keywords**—Multitasking, Virtual Memory, Shared Libraries, Memory management, CPU algorithm, Performance Evolution

## I. INTRODUCTION

The world of operating systems is crucial in forming the digital environment, and Linux stands out as a flexible and potent option among the competitors. Multitasking is fundamental to Linux, which allows many programs to run smoothly side by side on a single computer platform. This fundamental feature emphasizes its capacity to distribute resources effectively, enabling a dynamic and responsive computer environment [3].

Virtual memory is one of the key components that makes Linux unique and increases its flexibility. Programs whose code is larger than what can fit in physical memory can be run using virtual memory. This helps Linux maintain its reputation as a stable and scalable operating system by allowing it to manage resource-intensive applications and intricate computational processes with grace [10].

Apart from these attributes, Linux has strong support for TCP/IP networking, which is an essential protocol for network communication. With this networking capacity, Linux is positioned as a powerful platform for connectivity that facilitates data interchange and smooth communication in local and worldwide contexts. The addition of these networking features to Linux broadens its applicability and qualifies it for a variety of uses, from home networking to enterprise-level networking [3].

Linux is an open-source platform [4] hence it is not secure as any user can sell or distribute copies of the operating

system. Linux is the evolution of the operating system UNIX [3].

In contrast to the open-source philosophy of Linux, the Windows operating system is well known for its intuitive interface. Windows is excellent at creating a user-friendly interface that is accessible to people of different technical skill levels. But customization suffers as a result of this usability. Because Windows is not an open-source platform like Linux is, users' ability to customize the operating system to meet their unique requirements is limited [8].

The operating system for Apple's Macintosh computers, known as MAC OS, is notable for having an intuitive user interface that makes it easy for users to navigate the system. Like Linux, Mac OS is free and open source, allowing users to develop their own apps. But when it comes to security effectiveness, MAC OS is not as good as Linux [8].

A convincing and effective option among the complex array of operating systems is Linux. Its virtual memory management, demand loading, shared library support, networking power, and multitasking skills all work together to make it a strong and adaptable platform. While Linux's open-source design encourages creativity and customization, it also raises security-related issues.

## II. LITERATURE REVIEW

In this review paper, we delve into the comparative analysis of Linux, Windows, and Mac operating systems, aiming to

highlight the distinct advantages of Linux as a superior choice. Through an extensive exploration of existing literature, we elucidate the diverse features, performance, and user-centric benefits that position Linux as a robust and compelling operating system when compared to Windows and Mac counterparts.

### III. LINUX OPERATING SYSTEM



Figure 1. Logo of Linux Operating System [12]

Renowned for being open-source, the Linux operating system is a shining example of adaptability and personalization in the computer world. Linux is an example of open-source software, which permits users to view and alter its source code, creating a collaborative atmosphere that promotes creativity and flexibility. Because of its innate openness, application software may be installed centrally from pre-existing repositories, doing away with the need for special app stores or repositories to download and launch applications. [3]. One characteristic that makes Linux unique is how little resources it needs, which makes it compatible with a variety of hardware setups. This feature emphasizes Linux's adaptability and versatility, as does the ability to install alongside pre-existing repositories. Furthermore, Linux demonstrates a special ability to maintain required changes to its operational behavior, offering users a degree of control and personalization that is unmatched by closed-source competitors. [9]. The kernel, an essential component that acts as a bridge between applications and hardware-level data processing, is at the core of the Linux operating system. Through system calls and inter-process communication, the kernel enables communication and manages critical operations across a range of hardware platforms, such as servers, PCs, phones, and laptops. The kernel is essential to the smooth running of Linux because it handles functions like application execution, memory management, I/O management, system call control, and device management via device drivers [4]. Performance is a crucial indicator when assessing any operating system's effectiveness, and Linux excels due to its steady performance development. When compared to other essential components like the GPU (graphics processing unit), CPU (processor), RAM (memory), and SSD (solid-state drive), Linux performs exceptionally well. Linux's CPU scheduler has shorter latencies than those of other operating systems, which helps to maximize performance for a variety of computational activities. Tests of performance using TCP and UDP protocols, which quantify throughput, jitter, latency, and CPU usage, regularly show Linux-based operating systems to be leaders in providing better performance [1]. Any operating

system must prioritize security and stability over performance, and Linux shines in these areas. Because Linux is open-source, it encourages teamwork in security by allowing for ongoing monitoring and quick reaction to new threats. Because of its collaborative spirit and stable, well-maintained codebase, Linux is positioned to be a safe and dependable option for users in a variety of computer scenarios [1].

This essay explores three noteworthy Linux OS versions: Pop!\_OS 20.04, Linux Mint 19.3 Tricia, and Ubuntu 20.04 LTS. To meet the various tastes and needs of users, each of these distributions contributes special features and strengths to the Linux community. One of the easiest operating systems to install is Linux, which prides itself on its installation simplicity. The lack of system crashes—which are a frequent occurrence on other platforms—also improves user experience. Linux's capacity to manage crashes gracefully, limiting the impact on individual applications rather than creating a disturbance to the entire system, is a clear indication of its stability [6].

### IV. WINDOWS OPERATING SYSTEM



Figure 2. Logo of Windows Operating System [13]

The Windows operating system, created by Microsoft Inc., is a computing industry mainstay. It offers an extensive feature set that includes memory management, software-to-hardware mediation, and resource management for applications and input/output devices. One unique feature of Windows is its added capability to diagnose both hardware and software, which helps to guarantee that the system runs smoothly by efficiently identifying defects and faults [5]. Although Windows and Linux both have comparable looks and accomplish the same basic operating system tasks, they differ greatly in terms of ownership and usability. Because Windows is a Microsoft-exclusive product, it is frequently expensive, making it an operating system that customers must pay for. In contrast, Linux is free and open-source software that embodies the ideas of community-driven development and cooperation. [7]. One important area where Windows and Linux differ from one another is in terms of security. Because it is an open-source operating system, Linux has the advantages of a cooperative security approach that includes ongoing monitoring and prompt reactions to new threats. The security architecture of Linux is made more strong and resilient by this collaborative mindset. However, despite putting strong security measures in place, Windows has had bugs and vulnerabilities in the past. The perception that Linux's security is stronger than Windows' highlights how crucial an operating system's development process

and underlying philosophy are in determining its overall security posture [7]. Analyzing the Windows operating system's performance evolution reveals a path characterized by improvements and advancements across successive iterations. A significant milestone, Windows 7 showed excellent performance in areas like network performance, disk driver management, CPU scheduling, and visual subsystem management. It was unique in the Windows lineage, setting the standard for dependability and effectiveness. The progress that followed, which saw the release of Windows 10, resulted in notable enhancements to network management, decreased latency, and improved CPU utilization efficiency. Microsoft's dedication to improving user experience and adjusting to the changing computing technology landscape is seen in this progression. Windows 10 was designed to adapt to the evolving needs of contemporary computer settings with its simplified UI and improved performance metrics [1]. Even with Windows 10's performance improvements, the main points of contention when comparing Windows with Linux are frequently accessibility, affordability, and security as much as performance. Windows serves a wide range of users due to its extensive use and interoperability with a large number of software programs. On the other hand, some users may find Windows' licensing fees prohibitive, particularly when compared to Linux's free availability [8]

## V. MAC OPERATING SYSTEM



Figure 3. Logo of MAC Operating System [14]

The graphical user interface-based Mac operating system, created by Apple Inc., is well-known for its effectiveness in enabling the smooth transfer of files between platforms. Its user-friendly experience is enhanced by the ease of file

sharing, which distinguishes it from other operating systems, such as Windows. The graphical user interface improves the system's overall usability by giving users an easy-to-use interface on which to navigate and interact with their Macintosh computers [8]. The Mac operating system's simplified method of installing, uninstalling, and upgrading software is one of its main benefits. Because of the user-friendly design of these procedures, users may effectively control their software without encountering needless difficulties. Because of its emphasis on simplicity throughout the whole user experience, Mac is the favored option for people who value usability in their computing environment. However, the price of Macs is an important factor to take into account and is frequently a source of disagreement [8]. Although Mac OS's perceived value is increased by being limited to Macintosh PCs, this restriction also restricts its accessibility to a particular hardware environment. This closed-source design is similar to Windows, where the operating system cannot be installed on devices made by other manufacturers since it is tightly integrated with the hardware for which it is intended. Similar to Windows, Mac OS can only be used with Apple's own hardware due to its closed-source architecture. Although this exclusivity guarantees a strictly regulated environment, consumers who would prefer more hardware options for their computing needs will lose some flexibility. Mac OS is limited to a set of devices, in contrast to open-source alternatives like Linux. When the Macintosh was first introduced, Apple's marketing campaign placed a strong emphasis on the operating system's natural simplicity of use. Originally known as System Software, the Mac OS was distinguished by its graphical user interface, which was a departure from the common text-based commands and directory paths of its peers. The Finder was a graphical interface that allowed users to browse virtual folders and files displayed as icons. This creative strategy paved the way for the majority of computer operating systems to eventually embrace the graphical user interface model [2].

Table 1. Comparison table of windows, linux, and mac os

The Basis of Comparison	Windows	MAC	Linux
<b>History</b>	In 1985, Windows was initially made available. On top of MS-DOS, a graphical user interface was intended. Later, with the advent of Windows 95, all MS-DOS features were incorporated. It was a big success and prompted the switch to Windows [8].	Apple's operating system predates Windows for several years. It was initially published in 1984. Right from the start, it had a graphical user interface. The architecture of MAC OS was modified to an Intel x86-based design in 2005 [8].	It was initially created at a university in Finland. It was made for GNU programmers and released in 1991. Later, Linux incorporated it thanks to GNU developers. It is accessible to consumers, who are free to utilize it however they see fit [6].
<b>File structure</b>	Windows uses a directory structure to store the various user file types. It features cabinet drawers and logical drives. Folders are also included. Documents, images, music, movies, and downloads are a few examples of common folders. These folders can hold all of these files, and additional folders can be made [8].	MAC OS X is the name given to the file system of the MAC computer. You may access the hard drive of your MAC through the finder, where you will see several directories. When someone visits their own MAC book, they could run into the root directory of MAC [8].	The file structure of Linux is entirely distinct from that of Windows and Mac. It was created using a unique code base. It keeps data organized like a tree. Every drive on your system is mounted over a single file tree [10].

<b>Registry</b>	The primary database used to store all settings on your computer is called Windows registry. It is in charge of keeping track of all user data, passwords, and device-related data. You may inspect all keys, values, and even drivers in the registry's editor if necessary [2].	The numerous preferences folders in MAC contain a series of .plist files that contain all of the program settings. All properties are included in this .plist file in binary or plain text format. These are located in the folder: /Library/Preferences [8].	Additionally, Linux lacks a unique registry of its own. All application settings are saved in the same file hierarchy format on a program-by-program basis under various users. Periodic cleaning is also not necessary because there is no centralized database for keeping track of these details [1].
<b>Interchangeable Interfaces</b>	Up until Windows 8, the Windows interface was not replaceable. Windows XP included some upgrades, but they weren't enough. Windows Explorer, the start menu, the taskbar, and the system tray [10].	A virtual network interface bridge is a feature of MAC. The interfaces can be managed by going to system preferences [8].	Changing interfaces on Linux is simple. You don't need to move all the installations to change the environment. Services like GNOME and KDE are available to aid with these requirements [9].
<b>Command terminal</b>	The best way to run commands is through a terminal or command prompt. The Windows Command Processor is yet another name for it. It is used to run various batch files and commands. Additionally, it may be used to troubleshoot and resolve all Windows-related issues [10].	A console is offered by MAC as a terminal application. It has a terminal, prompt, console, and command line. Your commands are entered into a command line. You can run commands and receive some information from the prompt. A genuine interface that also offers a contemporary graphical user interface is a terminal [8].	A terminal is also available in Linux. Applications -> System or Applications -> Utilities are where you can locate the terminal. Along with this, a shell prompt is also present. The most widely used shell is bash. It establishes the behavior and appearance of the terminal upon execution [1].
<b>Package Manager</b>	Windows don't come with a default package manager. If you want one, you need to install it first. One of the package managers available for Windows is Chocolatey [5].	Mac's package manager is called homebrew. On GNU/Linux, the default package manager depends on the distro. For example, Ubuntu comes with APT, Arch comes with Pacman, and so on [8].	Linux comes with package managers installed by default. A package manager is a piece of software that allows you to install, update, and uninstall programs from the terminal, just by entering a few commands [9].
<b>Cost</b>	Windows has a freemium model currently [2].	MacOS runs only on Mac computers, which are quite pricey as you may know [2].	Linux distros are completely free for anyone to use [2].
<b>Security and Stability</b>	Windows, on the other hand, is considered the least secure and stable of the three. Given that it's the most popular OS, most malware is developed to attack Windows OS too [10].	Mac is secure because the code is accessed only by the authorized user which makes it more secure and advantageous to use. It is no doubt stable but it only works over its specified hardware which makes it a difficult operating system to work upon [2].	Linux distros are considered the most secure and stable ones nowadays. The fact that the code is available to everyone isn't a security threat as you may think at first – but rather it's an advantage. Bugs can be identified and worked on quicker, and when a security breach is identified lots of people can work on it and propose fixes [9].

#### SUMMARIZATION OF THE ABOVE TABLE

From the above comparison, we get to know that, Windows is the easiest available operating system, which is a graphical user interface. It uses a directory structure to store various files. This OS keeps updating itself in short spans of time which makes it more favorable for users. It doesn't come with a default package manager. If you want one, you need to install it first. And the most advantageous thing about this is it is very less costly. But, apart from this advantage, it has a very frequent disadvantage in that it lacks security and stability which is somewhere a threat to the data and information of the user. So it becomes less favorable for users with business purposes.

Linux OS was created at a university in Finland and was used for better use than Windows. Unlike Windows and MAC, its file structure is designed on a unique code base and the database was arranged in a tree format. Here it

lacks its own registry to store. It is an easily interchangeable interface in which we need to uninstall or reinstall all the system software again and again, which makes it more efficient. It comes with package managers installed by default. It is also completely and freely available software which is better for the users. And being the most secure and stable, it is one of the favorite operating systems.

MAC OS is Apple's operating system. Here, the file system is named X of the MAC computer. The numerous preferences folders in MAC contain a series of plist files that contain all of the program settings. A virtual network interface bridge is a feature of MAC. The interfaces can be managed by going to system preferences. As a terminal reference, MAC offers a console for its use of installing and uninstalling. Mac's package manager is called homebrew. The main disadvantage of MAC OS is

that, is the most expensive OS because it can run only over its MAC hardware. It is one of the most secure and stable networks which makes it more advantageous.

## VI. CONCLUSION

After careful consideration of Windows, Linux, and macOS, among other operating systems, it has been determined that Linux is the best option for a broad range of applications, including personal workspaces, business settings, and student use. This conclusion is based on an examination of Linux's higher temporal and spatial complexity, enhanced security measures, and excellent stability.

Linux is an incredibly effective operating system due in large part to its impressive time and space complexity. After careful analysis, it is clear that Linux performs better than its competitors when it comes to resource usage, guaranteeing effective operation even in contexts with limited resources. Because of its efficiency, Linux offers a smooth user experience, making it the perfect option for customers with a variety of computing requirements [1].

Another factor that contributes to Linux's dominance is security. Because Linux is open-source, it has a strong security framework that enables ongoing monitoring and quick reaction to new threats. Linux is a highly recommended option for both individual users and businesses looking to establish a secure computer environment because of its enhanced security features. Linux's proactive security features position it as a dependable defense against a wide range of potential vulnerabilities as cyber threats continue to emerge [11].

One of Linux's best qualities that further solidifies its position as the recommended operating system is stability. System crashes and malfunctions are less likely due to the stable computing environment created by the strong design and stringent testing protocols. This consistency is critical, especially in work environments where continuous productivity is required [8].

Linux's versatility and compatibility are highlighted in terms of software interface improvements. When changing program interfaces, the operating system makes the transition smooth and ensures compatibility without sacrificing functionality. Due in large part to its adaptability to changing user and organizational requirements, Linux is a progressive and dynamic option. What distinguishes Linux from its competitors is how much easier it is to install and remove programs and other software. The user-friendly package management system streamlines these procedures, improving user comfort and reducing the likelihood of issues. Linux is an accessible and user-friendly option because of its ease of use, which greatly enhances the entire user experience [6].

Linux also performs exceptionally well in terms of storage efficiency. Users are given enough storage capacity for

their data and programs thanks to the operating system's skillful management of storage resources, which maximizes space utilization. This capability is very helpful at a time when data volumes are constantly increasing.

Even though Linux is now the best option, you should always be aware of any changes to the operating system market in the future. We offer a theoretical scenario in which Windows, with significant software updates that integrate state-of-the-art technologies, might challenge Linux's existing hegemony. Similar to Linux, the likelihood of macOS replacing it depends on price; it has been suggested that competitive pricing may tilt the scales in favor of Apple's operating system [6].

Finally, the thorough analysis of operating systems clearly establishes Linux as the best option for a variety of user requirements. It is the go-to operating system for professionals, students, and individual users due to its excellent performance in terms of security, stability, adaptability, and storage efficiency as well as its time and space complexity. Although the current study recognizes that Windows may continue to progress and that macOS may become more affordable, Linux remains the most efficient operating system. While it is still necessary to keep an eye on technological advancements, Linux continues to be the best option for the best computing experience as of right now.

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### Authors Profile

**Ms. Vaishnavi Mishra**, a dedicated final-year student pursuing a Bachelor of Technology degree in Computer Science and Engineering at Khwaja Moinuddin Chishti Language University, Lucknow, stands out as a promising talent in the field. With a specialization in web development, Ms. Mishra has showcased her proficiency by successfully completing various web development projects during her academic journey. Her practical experience extends beyond the academic realm, as evidenced by her role as a Software Development Trainee at Bluebook Foundation. In this capacity, she focused on testing methodologies, contributing significantly to the quality assurance processes within the organization. This exposure to real-world software development has honed her skills and provided valuable insights into the intricacies of the industry. Notably, Ms. Mishra possesses a keen understanding of operating systems, showcasing adeptness in both Linux and Windows environments. Her comprehensive knowledge extends beyond the theoretical, as she has applied these skills in practical scenarios, further enriching her technical acumen. Beyond her academic and professional pursuits, Ms. Vaishnavi Mishra exudes a passionate curiosity for emerging technologies. This eagerness to explore and master the latest advancements in the field underscores her commitment to staying at the forefront of technological innovation, making her a promising asset to the ever-evolving landscape of computer science and engineering.



**Mrs. Saima Aleem**, serving as an Assistant Professor at Khwaja Moinuddin Chishti Language University in Lucknow since July 2020, brings a wealth of academic and research experience to her role. Currently, she plays a crucial role as a co-project investigator in a research initiative backed by the Department of Higher Education, Uttar Pradesh Government. Simultaneously, she is advancing her academic journey as a Ph.D. scholar at Integral University. Saima Aleem's research expertise spans diverse domains, including Computer Networks, Artificial Intelligence, e-services, and e-governance. Her commitment to scholarly pursuits and active involvement in impactful research projects underscores her dedication to advancing knowledge and contributing to the academic community. With an unwavering commitment to academic excellence, Saima Aleem has demonstrated a passion for interdisciplinary research. Her role as a co-project investigator underscores her proactive engagement in cutting-edge research initiatives, reflecting her dedication to addressing contemporary challenges. As a Ph.D. scholar at Integral University, she is actively contributing to the academic discourse, focusing on expanding the frontiers of knowledge in areas vital to the intersection of technology and governance.



**Dr. Shish Ahmad**, an Associate Professor in the Department of Computer Science and Engineering at Integral University in Lucknow, India, Shish Ahmad's research is focused on lightweight network security, sensor networks, MANET, cloud computing, IoT, and big data. He has a Ph.D. in Computer Science and Engineering from Integral University, an MTech in Computer Science from U.P. Technical University, and a B.E. in Computer Engineering and Information Technology from M.J.P. Rohail Khand University. Shish Ahmad has over 20 years of teaching and research experience, and his work has resulted in three awarded and five working Ph.D. supervisions and two patents. He has published 3 papers in SCI/SCI-E journals, 9 papers in SCOPUS-indexed journals, and 15 papers in Google Scholar/peer-reviewed international journals. Additionally, he has presented papers at five international conferences and book chapters, and his papers have been cited 135 times in Google Scholar, 28 times in Scopus, and 18 times in the Web of Science. Shish Ahmad has also attended several short-term courses, workshops, and seminars on topics such as effective teaching, academic leadership, cloud infrastructure, networking, and more.

