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A Comparative Study of Operating Systems: Case of Windows, Mac and Linux

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ABSTRACT

Over the years, a variety of operating systems have been invented, each with their own set of characteristics and capabilities. Users' decisions on which operating system (OS) to install will be guided by a thorough understanding of the features and functionalities of such OSs. As a result, a thorough examination of the strengths and drawbacks of various operating systems is required in order to identify the appropriate operating system to install based on the intended use. This research compares the file systems, user friendliness, security threats, kernel type, reliability, compatibility, and cost of the Windows, Mac, and Linux operating systems. The results of a quantitative investigation of three of the most commonly used operating systems demonstrate that the most widely used operating system is the latest version of Windows, followed by Mac and Linux. This is because Windows is often inexpensive, compatible, user-friendly, and reasonably secure. According to the study, Macs are more secure and reliable than Windows and Linux, but they are also more expensive. End-users can customize Linux because it is open source. Finally, it was noted that each operating system has some advanced capabilities that are specific to that operating system and are unknown to many users. This study provides insight to guide end-users' decisions about the operating systems that are best for them based on their purpose of usage.

Keywords: Operating System (OS); Windows; Macintosh; Linux; Computability; Reliability; Security-Threat; Comparative Analysis.

Introduction

An OS, operating system, is software that functions as a controller/ manager for the hardware and software in a computer system. In a computer, the operating system is the most important piece of software. Programs that run on the computer require OS to

function, every application program runs under the control of OS. The operating system serves as a link between programs and the computer's hardware for functions such as input and output.

In layman's words, an operating system can be viewed as the soul and intellect that brings

silicon and wire things to life on the screen. It might be as simple as a program that interacts with chips in children's toys. What complicates OS is its capacity to respond to user commands, which is referred to as intelligent system (Alhassan & Bach, 2014).

The most widely used operating systems are Windows, Mac, Unix, and Linux. Users select an operating system depending on expert advice, their prior experience, and their requirements (Alhassan & Bach, 2014). There are a variety of operating systems developed for various purposes around the world; some are used at home or in schools, while others are used by the government, such as in the military, and the majority are distributed for commercial use, such as in airports, stock exchange markets, and other business locations. Windows, Mac, Unix, and Linux are the most widely used operating systems. Users choose the operating system they want based on expert recommendations, their background experience and their needs. (Alhassan & Bach, 2014).

Because of the provider, operating systems are classified into different levels. As a result, each operating system has a strong and weak side that distinguishes it from others. As a result, a wide range of factors influence people's decisions. User friendliness, security threat, reliability, computability, and cost are some of the most important factors to consider.

This paper compares the features of Windows, Mac, and Linux operating systems, as well as their strengths and weaknesses. The primary goal behind this research is to assist users in deciding which Operating System to adopt based on their intended use. The following factors will be used as a measure of weakness and strength for Windows, Mac, and Linux operating systems. File System, Kernel Type, User Friendliness, Security-Threat, Reliability, Computability and Cost

Review of related work

Several studies on the use of OS systems on computers and cellphones have been conducted. This section contains a summary of the existing work.

(Alhassan & Bach, 2014) developed a model for decision making when choosing an operating system. They developed a model of five factors; convenience, capability, security, interface and recovery as factors to be considered while choosing an operating system. According to their findings, there is no single good or bad operating system. The goal was to increase user awareness of the many operating systems available. If they are concerned about security and stability, Mac and Linux may be the best options; they have a good security rating. Windows and Mac are also the market leaders in terms of application and availability, with millions of developers supporting them. Linux and Windows operating systems fall into this category when customers are worried about the latest hardware technology. Apart from personal computer experience, the author concludes that user requirements and the intended usage of the operating system itself are the most important criteria in picking an operating system after carefully analyzing the market leaders. They conclude that Windows is the most widely used because of its friendly graphic interface, chief cost and high advertisement by Microsoft company due to this reasons user tend to choose windows over other OS's even if they are aware of a weakness instability and security.

The comparison of Microsoft Windows and Linux operating systems has been a hot issue in the computer industry for a long time.(Abhilash & sri vasthavV, 2015). In a paper presented by (Abhilash & sri vasthavV, 2015), the contrasts between Windows and Linux were highlighted, with a focus on sophisticated features that are exclusively available in one operating system and not the other. In terms of philosophy, affordability, adaptability, and stability, Linux and Microsoft Windows differ, with each attempting to improve in areas where they perceive they are weak. Users are unable to tell whether OS is preferable to the other despite their differences. This is because Some people are unaware that each operating system has some advanced capabilities that are specific to that operating system. An individual or organization must examine the apps and systems that they need to execute

before selecting an operating system.(Golam & Ar, 2019).

To compare Windows, Linux, and Mac, seven important characteristics (interface, capability, security, cost, convenience, booting time, and recovery) were selected by (Golam & Ar, 2019). The investigation reveals that there is no operating system that is unrivaled in its superiority. Each operating system has functionality in a variety of disciplines at various levels. Because there are so many different operating systems and hardware on the market, each with its own set of distinguishing features, there is an opportunity to create a sophisticated application system that, given user requirements and affordability, will recommend the best operating system, as well as required hardware and software specifications, while taking future scalability into account.

(Adekotujo et al., 2020) investigated and compared among different varieties of operating systems. Based on the OS features and their strengths and shortcomings, they compared Windows, Unix, Linux, Mac, Android, and iOS operating systems. Their findings revealed that Windows 10 had a malware file of 0.04 and Windows 7 had a malware file of 0.08. Malware for Android devices is more common than malware for iOS devices. Windows 10 is less secure and dependable than Linux, UNIX, and Mac OS. Windows and Android are more widely used, user-friendly, and simpler than Mac OS. They also support a larger number of application programs. Linux and Android are completely free, but Windows is relatively expensive and Mac OS is extremely expensive. The only exceptions are Mac and iOS.

Result and Discussion

Comparative Analysis of Windows, Macintosh, and Linux Operating System

A comparative analysis of the operating systems Windows, Mac, and Linux is carried out in this research paper. File System Supported, User Friendly for Lay Users, Security Threats, Kernel Type, Reliability, Compatibility, and Cost are all issues to be concerned with. Additionally, each operating system's pros and disadvantages were noted.

Table 1 compares operating systems according to their features and capabilities.

Table 1: Comparison of Windows, Mac, and Linux

FACTORS	OPERATING SYSTEM		
	Windows	Mac	Linux
Cost	Low	High	Moderate
File System	NTFS, FAT, and exFAT with ISO 9660; UDF, a third-party driver that supports ext2, ext3, ReiserFS, and HFS file systems	AFP, with ISO 9660, FAT, and UDF (Mac OS 8.0 and before) HFS+, HFS, MFS	ext2, ext3, ex4, ReiserFS, FAT, ISO 9660, UDF, NFS, and others
User friendliness	Easy to Use	Easy to Use	Not easy to use
Security Threat	Huge	Negligible	Negligible
Type of Kernel	Hybrid	Module-based monolithic	Module-based monolithic
Reliability	Great	Greatest	Great
Compatibility	On local networks, it can cohabit alongside Windows, BSD, Macs, and other Unix-like systems. More compatible	Only a few programs are compatible with Mac.	When compared to Windows, it has fewer apps and games. However, it is more compatible and scalable than the Mac.

Operating System Benefits and Drawbacks: Windows, Mac, and Linux

Windows
Windows OS was introduced in the year 1985 and cover almost 90% of the market share over all other operating systems available (Adekotujo et al., 2020). As it takes over most of the market share, it became the most widely used OS in commercial buildings, industrial facilities, as well as in homes and school's computers. Because of the cost-

effectiveness, user-friendliness, compatibility, and availability of apps and device drivers, this was accomplished.

The Microsoft Operating System was created as a graphical layer to replace the existing MS-DOS command line, yet it still employs the cmd.exe DOS Box Command prompt. The earliest version of the Windows NT core appeared in the OS/2 operating system, and all future versions rely on it. Windows OS, DEC Alpha, PowerPC architectures, and MIPS are also compatible with the latest versions on AMD and Intel systems, as well as low and mid-range servers. The Windows operating system is also compatible with database and web servers. In recent years, Microsoft has made significant marketing and financial investments to show that Windows compatibility is unquestioned and that it has what it takes to run any enterprise applications.(Adekotujo et al., 2020)

Benefit of Windows OS

- i. Technical and maintenance assistance: Because most people use it, online or offline support is always available. Because so many users accept it, support is provided either online or offline.
- ii. Compatibility: Different types of drivers, applications and game works are easily accommodated by windows
- iii. Enormous quantity of functions: As you become more familiar with Windows, you will discover that there are a range of tasks that you may perform relatively simply and for little or no cost.

Drawbacks of Windows OS

- i. Viruses: Even while free antivirus is available, it has limits to some tasks and must be activated often.
- ii. Slow: Because the Windows operating system, particularly earlier versions, uses a lot of system resources such registers, cache, main memory, CPU, and disk space, programs run slowly.
- iii. Price: Because of the expensive cost, only a few customers can afford Windows OS, necessitating cracking,

which results in a pirated software version being available.

MAC OS

Mac OS is far older than Windows OS, having been published a year before Windows OS and being the first ever successful graphical-inclined OS among others. Mac OS has gone through two major design changes, the third of which is already complete.

The transition from just supporting one application at a time to multitasking numerous applications (MultiFinder) was the first step of the design; the second was the transfer from 68000 to PowerPC processors; and the third was Mac OS X's combination of Mac OS design principles with a Unix-derived infrastructure.

The Mac Interface Guidelines explain how Mac OS differs from Unix in terms of design. The Mac Interface Guidelines emphasize the importance of keeping things where they belong.(Adekotujo et al., 2020)

Benefits of Mac OS

- i. Viruses: This is because Windows has surpassed all other operating systems in terms of market share.
- ii. Reliability: Only Macs can run on Apple computers, making them less prone to component failure.
- iii. Looks: Mac OS appears to be more attractive than Windows OS.

Drawbacks of Mac OS

- i. Expensive: The price of a Mac is more than that of a Windows or Linux computer.
- ii. Compatibility: Available exclusively on Apple computers; MAC OS is incompatible with other operating systems and cannot be installed on them. Otherwise, you'll have to buy a new computer with Mac OS already installed.

Linux OS

Linux is a very new operating system on the market. It was created in 1991 and has since been improved for modern use. Linux and Windows are similar to an entity whose floor and roof can be replaced or not. Furthermore, both the floor and the roof on Linux can be moved in any direction, whereas the floor and

roof on Windows are so stiff that they remain unchangeable. It is impossible to go beyond what Microsoft has built. (Adekotujo et al., 2020).

Linus Torvalds created Linux in 1991, and it is the leader of a collection of new school open-source Unices that began in 1990, including FreeBSD, NetBSD, OpenBSD, and Darwin. All of them are instances of a design direction that the entire team agreed on. Although Linux code differs from the original UNIX source tree code, it follows UNIX standards to operate like a UNIX.

In comparison to old-school Unices, which have a greater share desire in the server and workstation market, developers in the Linux open-source community have put in a lot of effort to gain more share of end-user desktops, resulting in a rise in Linux's intended users.

Merits of Linux OS

Price: Linux is free and open source. It is free to download, install, use, and modify.

Variety: Linux is a kernel rather than a full operating system. Because it is a kernel, it necessitates the use of extra software add-ons. As a result, there are many different distributions or distros.

Virus: It is less vulnerable than Mac because it is open-sourced.

Drawbacks of Linux OS

- i. Complicated: To work in a Linux environment, one must have excellent computer skills.
- ii. Compatibility: Linux, like Mac, has a small percentage of the market share, but it lacks the variety of apps and games that Windows has.
- iii. Vendors: Because there are few Linux PCs on the market, one must first purchase a Windows computer, format the hard disk, and then install Linux.

Conclusion

Windows tends to be the most widely used over MAC and Linux OS, especially the

newest versions, as it covers 90% of the market share because it was inexpensive, secure, reliable, compatible, and user-friendly, it received these praises. It's reasonable to say that any operating system development business directs their design by considering target clients and their interests. Customers benefit from competitive and distinct features and services provided by each operating system, including mobile operating systems. Furthermore, all open-source operating systems benefit from the constant addition of new ideas and upgrades by various community developers. Their security and performance are also improved. We may, however, infer that no single operating system is good or bad. That's to say, every OS is good based on what service is required by the users. The main goal of this review is to help users choose the OS to install on their computer based on the services required. We can conclude that when the user's priority is on security and stable operation, then MAC is the best; if they are after application availability, a reliable gaming environment, and low cost, then Windows is the best; and if one is after the latest hardware technology and a reliable programming environment, then Linux is the best.

Recommendation

This work considers only important features of the operating systems. For future work, more study should be conducted on the analysis of memory utilization and program execution speed. Another research area that should be investigated is developing an application that will suggest the best choice of operating system to be installed upon inserting user requirements.

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