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Windows, Linux, Mac Operating System and Decision Making

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ABSTRACT

This paper presents a comparative study of choosing footstep of Windows, Linux and Mac, the three popular operating systems. This paper provides seven factors which needed to be considered before choosing an operating system. They are convenience, capability, security, interface, recovery, booting time and cost. These seven factors were generated from background study and analysis. Some important characteristics such as dependency upon hardware, user interface, and security are also discussed. Moreover, open-source and closed source paradigm were discussed for user support. Finally, based on user data, it has been shown how these three-operating systems are used by users in the last couple of years.

General Terms

Operating System

Keywords

Windows, Linux, Mac, Decision Making

1. INTRODUCTION

Nowadays, there are so many several disparate things are needed to be considered while choosing a new operating system. Several aspects like disk space, budget, upgradability, and hidden costs are crucial factors for choosing an operating system. This task is often tedious for average PC users. For example, the task of examining all operating systems and to note down the differences or similarities is a painstaking task for even an experienced tech-savvy user. At present, there are many operating systems in this innovative world and Windows, Linux, and Macintosh (Mac) are exoteric.

Focusing in-depth into these three operating systems and drawing comparisons makes this research interesting. Multi-criteria decision making offers to reach the best decision from all the possible choices [16]. One of the important factors is that the operating system used by an individual or organization has a lot to do with the applications and systems that they need to run. Often, specific software is designed for a specific operating system. For example, software like ShareX and IDM can only be used in Windows.

However, software like Google Chrome and Mozilla Firefox are designed for multiple operating systems. It is hard to gather information about an everyday user, who is using what type of operating system. For example, how many people are using Windows operating system compared to other operating systems? There is no exact answer to this problem, but statistics can be provided. However, data for providing statistics are difficult to gather.

This type of problem was solved before with low criteria. [18] has proposed a decision-making system for the operating system, where three criteria are involved. With these three criteria, they use the Analytic Hierarchy Process (AHP) for decision making. Numerical calculation needs to be done by this process, which may be difficult for a new user. Usually, AHP shows specialist cognition but cannot comprehend human mentation [19]. Another approach was proposed by [13], where they used five factors to choose an operating system. In this research, it has been found that these five factors are not enough, and a new method has been proposed with seven criteria for selecting an operating system. Based on some collected user data, the current situation of these operating systems is also shown.

Usually, the basic tasks of operating systems allows software to communicate with hardware, manages system security, handled system errors and alert users, manages files and folders, shares out system memory, recognizes and install peripheral devices, handles input and output, moves data to and from the hard disk, loads and run other software applications [2]. One of the limitations is that this paper has considered a finite set of factors that might vary for individuals. Some substantial factors like scalability has not been included in our research. Scalability is a serious factor for people trying to maintain updated hardware on their machines. Furthermore, some of these factors may be invalidated at any time due to technological advancement. Factors such as boot-time, capability, and cost highly provisional may diminish at any moment. The market has already experienced a plummet of SSD prices as much as 30% according to the 2018 report [5].

The rest of the paper is organized as follows. Section 2 presents a brief description of the three operating systems. Section 3 differentiates between closed source versus open-source operating system. Section 4 provides a description of hardware support and user interface. Section 5 discussed server-side operating systems and security. Section 6 presents the research method to choose a perfect operating system for users. Section 7 provides a comparison of these three operating systems based on user data and finally, section 8 concludes the paper.

2. OVER VIEW OF WINDOWS, LINUX AND MAC OPERATING SYSTEMS

2.1 Linux Operating System

Linux is free and open-source software based on kernel software where the kernel is nothing but the main part of the Linux operating system. The fame of Linux operating system has mainly arisen because of excellent performance and effectiveness [12]. Anyone can contribute to development, modification, rearrange and all have also access to the source code which they are free to audit, customize and analyze in any way what they choose. It has two interfaces which are named as CLI (Command Line Interface) and GUI (Graphical User Interface). It can be downloaded freely and distributed through any medium like magazines, books, etc. This operating system is also available in PRO versions that are usually cheap. A user is identified by a username, which is given when the user logs on to the system. Internally, a user is identified with a User Identification Number (UID), which is a numeric value selected by the system administrator at the time the account is created[26]. Some of the organizations, which develop Linux are renowned companies, such as Red Hat, Gentoo, Debian, SuSE, Turbolinux, and Ubuntu. Besides being cheap and mostly free, Linux is also available for most 32-bit and 64-bit CPU architectures. It is also virus free possibly malware-free, costs no money, makes more efficient use of resources like CPU and Memory.

2.2 Windows Operating System

Windows is available for an amount of money; it is developed and distributed by Microsoft [17]. It also called a User-Friendly Operating system which is needed every moment in our life. It supports the PE file system and its source code is also closed. Thus, the user does not have access to the human-readable programming code that describes how the operating system works. Keyboard and mouse are very highly used to operate Microsoft windows. It runs primarily on the Intel architecture. GUI (Graphical User Interface) is the interface and Graphical is the default user interface for this software. Everything can be controlled through GUI and incompatibility problems are exceptional [17]. Assembly language, C, C++ can be easily programmed in the Microsoft windows. This software is expensive, plugged with viruses and malware, resource-intensive and is based on the idea that proprietary software equals market control. This family of the operating system has dominated PCs all over the world ever since its inception. Windows is the most popular and widely using operating system to date, because of user-friendliness and easy to operate the operating system still use by most of the people in the world [18].

2.3 Mac Operating System

Macintosh is a whole computing platform which is a graphical user interface-based software. It is also proprietary software that was developed by Apple INC in 1984 [17]. Transferring files and applications from old Macintosh to a new one is a more efficient process compared to migrating from one Windows PC to another. The exact state of older Macintosh can be recreated perfectly on a new computer in just a few steps. In Macintosh, a software update is less important, and installing operating conformity is easier and uninstalling applications is much simpler. Apple Inc's Macintosh operating system has some powerful productivity and multimedia apps preinstalled. Its a lot easier to organize multimedia content and create new content. This software is expensive and can only be used with a Macintosh PC. It is simple to operate which is just plug and play but it is commonly used for desktop systems. It supports HFS or HFS+, Macintosh file system[18]. It is secure and virus designed for windows operating system does not work on Macintosh.

3. OPEN SOURCE VS CLOSED SOURCE OPERATING SYSTEM

3.1 Full access VS no access

The source code of an open-source operating system like Linux is accessible whereas the source code of closed source operating systems like Windows, Macintosh is not accessible. If this matter is examined, it can be seen that improvement is faster in the open-source operating system as bug arises.

3.2 Licensing freedom VS licensing restriction

In an open-source operating system source code can be modified to republish and even sold also. Many users can use the same software in different machines. This cannot be done in a closed source operating system. The number of licenses purchased determines how many machines can the software used.

3.3 Online peer support VS paid help desk support

There is a large community support like forums, websites, blogs, etc. for providing solutions to user issues for the open-source operating system. For closed source operating system peer solutions are available and purchased support is provided.

4. HARDWARE SUPPORT AND USER INTERFACE

As an open operating system, Linux is a light operating system and requires a less powerful process [23]. Whereas the Windows operating system is heavier than Linux [11]. Some global business [21] manufacture hardware in a way that it acts as an intermediate layer between client and Microsoft Corporation. However, operating system like MAC bind with their own hardware [13] as a result MAC operating system cannot be installed in another type of machine.

Graphical User Interface (GUI) is unreplaceable in Windows [27] because it is an integral component of Windows. Windows also have a command shell (cmd) from where a program can directly run. Similarly, Mac operating system has a graphical user interface which is UNIX based [3]. Linux operating system has a default shell named BASH. To operate in this shell programming skill is required. To compute with GUI type operating system Linux had launched a GUI based operating system [23].

5. SERVER-SIDE OPERATING SYSTEM AND SECURITY

Nowadays Windows, Linux and MAC all have server-side operating systems. Windows latest released server named Windows Server 2019 [10]. According to [13] Windows has a 64% share in the server market. MAC offer server operating system which is based on open and closed source component [25]. Their latest server released on March 25, 2019 [4]. Many distributed systems like CentOS, Ubuntu, etc. produced from Red Hat Enterprise Linux (RHEL) for server-side operating systems. Since Linux has a strong firewall, it also makes the server secured from any virus attack.

The aim of all operating system producer is to shield the valuable data of a computer [17]. Over the last few decades operating system security is enhancing gradually, and this also become a research

topic [20]. In one instance, after detecting a threat in Windows, Microsoft took 2 to 3 months to fix [12]. Apple regularly releases updates for Mac operating system [1] to enhance security. Threat detection and solution is better in Linux as developer across the world continuously working with Linux.

6. RESEARCH METHODOLOGY

This paper proposed methodology will help a user to choose the best operating system for their unique needs. LePine [14] suggested to analyze data of comprehensive factor to choose the operating system. In our method, we will combine [18] and [13] method to find out the optimal choice. Our research methodology is shown below in Figure 1.

(1) Convenience: The operating system acts as a resource manager [29]. Users can choose operating system based on their needs and many of them rely on familiarity and availability. The users want the facility for troubleshooting and replacement when needed [22]. The client always moves towards convenience.

(2) Capability: Graphics requirements, CPU utilization and compiling program requires a lot of Random Access Memory. The operating system which deals with hardware is better and makes the operating system unparalleled [28].

(3) Security: Security in the operating system works as an encapsulation. To enhance flexibility and features sometimes security is hampered. Now a days third-party companies can provide solutions for operating system security [30].

(4) Interface: Usually maximum user depends on Graphical User Interface rather than programmer. General consumers always give a visual metric to the interface and programmer or developer thinks how deeply they can interact with the machine by using the command line [15].

(5) Recovery: Due to the overriding of applications and viruses, the machine turns slow. Machine format is needed in a way so that no data is lost. Compact Disc and portable drive are used for operating system recovery.

(6) Boot Time: In computing, booting is the first step which consists of a set of operation that a computer performs when electric power turn is on. According [24] Windows, Mac and Linux have different booting processes. The user chooses the operating system, which has less complexity in the booting process.

(7) Cost: According to the users point of view, they build their machines based on their budget and needs. Macintosh PCs can be upgraded but the hardware is very expensive to upgrade. Besides users should also consider the replaceability of hardware when buying.

7. COMPARISON OF WINDOWS, LINUX AND MAC WITH STATISTICS

Stack overflow conducted survey over the last few years [6], [7], [8], [9]. Both software developers and normal users who mainly use Windows, Macintosh, Linux and others were involved in this survey. Table 1 shows the percentage of operating system used by the user in each year. Table 2 shows they also counted the total number of people who participated in the survey from 2017.

The results of Table 1 are plotted in the bar chart as shown in Figure 2. From their survey, it can be discerned that while the number of Windows users is decreasing, the number of Macintosh and Linux users is increasing gradually. It is a point to note that, in the year 2016, no users choose other operating systems.

Table 1. Percentage of operating system used by user

	Types of operating system used by the user (%)			
Year	Windows	Linux	Mac	Others
2013	60.4	19.9	18.7	1
2014	58.3	20.9	20.3	0.5
2015	54.5	20.5	21.5	3.5
2016	52.1	21.7	26.2	0
2017	41	32.9	18.4	7.7
2018	49.9	23.2	26.7	0.2
2019	47.5	25.6	26.8	0.1

Table 2. User participated in the survey

Year	No of operating system user participated
2017	29114
2018	76179
2019	87851

Most people choose Windows when they are a novice as they find Windows easy to work with. As people grow adept and want to go deeper and interact with the machine, they choose Linux. Usually, a programmer feels comfortable with Linux because they can customize their operating system to fit their needs and run their programs while minimizing the cost. On the other hand, photographers, graphic designers, and video editors choose Macintosh OS because it gives them better graphical processing power due to the power of the Central Processing Unit (CPU) and Graphical Processing Unit (GPU), coupled with complementary applications.

8. CONCLUSION

The operating system acts as a layer between user and hardware to reduce human effort. In this paper, the focus of the study is on how to choose an operating system within Windows, Linux, and Mac. Some crucial characteristics of these operating systems have been discussed. Seven pivotal criteria have been proposed for choosing an operating system. Furthermore, based on user data, some statistics on the current market situation has been presented. The target is to provide a summary to the user, which can help them to choose their operating system based on their requirements. The result of the analysis shows that there is no unparalleled superior operating system. Each operating system consists of features in diverse fields at different levels. Due to the variance of operating systems and hardware in the market with several distinguishable features on each, there is an opportunity to develop a sophisticated application system, where, upon inserting user requirements and affordability the system will suggest the best choice of operating systems along with required hardware and software specifications while considering future scalability. Building this type of system requires a robust knowledge base with a huge amount of user data. This also reveals a new opportunity for future research.

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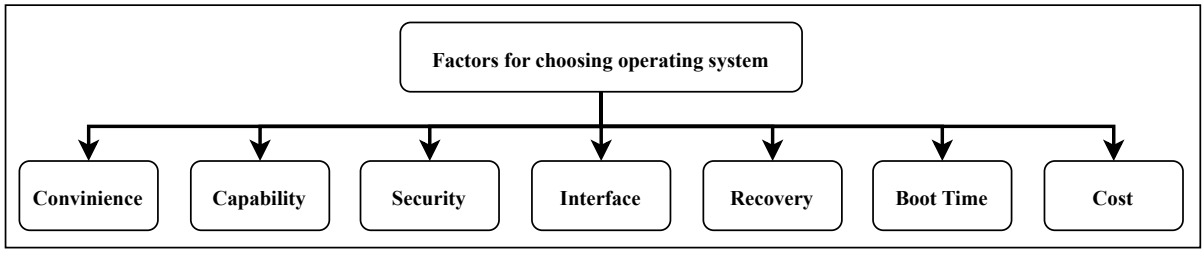

Fig. 1. Proposed research methodology for choosing an operating system

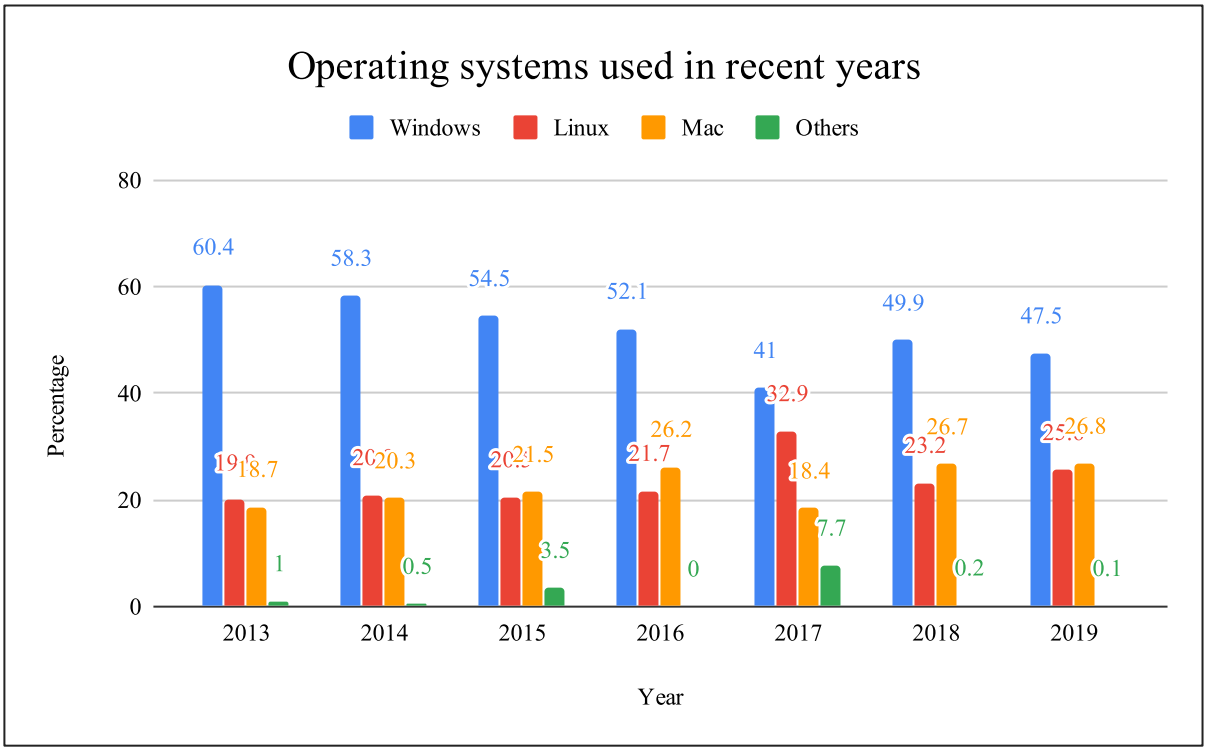

Fig. 2. Bar chart showing operating systems used by the user in recent year

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