**Abstract**

This documentation serves to provide an overview and analysis of the operating systems, defining what they are. Comparisons are drawn between two major operating systems in the marketplace: Windows and Linux; delving into the kernels, user interfaces, memory management and usability.

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Assignment 2: Operating Systems

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**Operating Systems**

An operating system is a high-level computing platform that manages and controls the computers processes and memory operations, as well as storing and indexing files, folders, and software.

Most operating systems in the market are shipped with one or multiple Graphical User Interfaces, or GUIs for short. A GUI is an additional layer that allows users to manipulate on screen graphics to select, scroll, click, and open menus to perform a variety of different tasks.

Operating systems that are not shipped with GUIs will instead come with a command line, text-based utility for executing commands and traversing files and folders.

Application Programming Interfaces, or APIs are usually provided with operating systems to allow programmers and software engineers to develop applications to run on top of the operating system kernel without exposing end users to the inner workings.

Additionally, the operating system is responsible for multi-tasking, resource allocations and memory management.

Microsoft, Linux, and MacOS are the most common desktop environments, but it does not stop there. Routers, switches, smartphones, tablets, and a wide range of other devices all use operating systems to control the resources and applications. Android and iOS are the two main mobile operating systems in the market.

# OS Kernel

## Windows

The Windows NT Kernel is proprietary, closed source software developed exclusively by Microsoft.

It is a type of hybrid kernel in the sense that it can work with both uniprocessor and symmetrical processors, and contains a hardware abstraction layer, as well as driver support built in.

The primary focus of the Windows NT Kernel is to start and configure the required device drivers when the system is booted. This is done ad-hoc, depending on what is needed. It then coordinates and controls the programmes that are run on the Windows operating system by acting as an intermediary to the controls and requests of the user applications and the underlying hardware.

The Windows NT Kernel is used only on Windows devices designed and developed by Microsoft.

This kernel keeps all its information in separate Registry hives, with driver and application information contained within, usually in the form of binary or string representations.

## Linux

The Linux Kernel, in contrast to the Windows NT Kernel is open sourced and is developed by thousands of contributors around the world. In addition to this the Linux kernel is a monolithic type, meaning that the applications that run on it run on their own virtual address space.

The main difference between the user applications is that on the Linux Kernel, user applications have access directly to the kernel itself. On Windows this is not the case.

The Linux kernel stores all the driver and application configurations in text files, often referenced as symbolic links. Each device or application that utilizes something in the kernel usually has a symbolic link drawing information from these config files.

Lithmee, 2018 ‘What is the Difference Between Windows Kernel and Linux Kernel, *Pediaa*, . Available at: URL: https://pediaa.com/what-is-the-difference-between-windows-kernel-and-linux-kernel/ (Accessed: 30 March 2021).

# File System

## Windows

Windows utilizes two major file systems: NTFS and FAT.

NTFS, short for New Technology File System is the primary file system for all modern versions of Windows and is generally considered an extremely reliable operating system, primarily due to the strong journaling support available. At its core NTFS stores all its files in the Master File Table which is essentially a large matrix with links to information pertaining to a particular file: size, name, memory address, etc.

FAT, also known as File Allocation Table, has been around since the 1980s. FAT is different to NTFS in that all files are stored in directories instead of indexes. FAT is largely uncommon as the primary FS for Windows based operating systems, mainly due to its legacy approach and the fact it does not support larger file sizes (not on Windows anyway).

At the file level, windows utilizes access control lists mapped to NTFS permissions to control what users can access specific protocols, files, and folders.

## Linux

Linux on the other hand has extensive support for lots of different file systems. The main ones are the Ext family.

Ext, short for Extended File System now on version Ext4 is the native file system designed when Linus Torvalds created Linux in the 90s. Like NTFS, this also supports journaling but is generally considered to be more developed that NTFS. Ext4 also supports higher capacity storage and maximum file sizes.

Author Unknown, Year unknown ‘The Basics of File systems, *UFS Explorer*, . Available at: URL: https://www.ufsexplorer.com/articles/file-systems-basics.php (Accessed: 30 March 2021).

# Memory Management

## Windows

Memory on Windows is managed in a ‘tree’ of sorts, where each item in the tree mark items as free, reserved or committed. All the available memory in a Windows system is shared between all the active applications, along with what the kernel needs. On a 64-bit version of Windows a total of 16TB of virtual address space is (dependent on physical memory available), and this is usually split out equally between the kernel and the system/user applications.

Windows automatically creates a page file, in the OS install drive by default, which is used when the total available memory of a system has been exhausted.

## Linux

Linux essentially works the same as Windows when it comes to memory management, but one fundamental difference between Linux and Windows, is that Linux uses what is known as ‘Swap space’ to store memory when it has been exhausted physically. This is a set portion of the hard disk drive that will always be waiting, but only ever used when there is no free physical memory.

This is different to Windows in that the page file on Windows is entirely dynamic, and never a set fixed size.

# User Interface

## Windows

The main Graphical User Interface for Windows is designed and developed exclusively by Microsoft, and is the only type of GUI that can, and is used on Windows. The GUI is shipped as part of the Windows NT kernel, and as such runs at the same layer as the kernel itself.

The .NET framework has extensive support for the Windows GUI, utilizing dialog boxes and forms to display content on screen.

## Linux

Linux is much more varied in the GUI environments it supports and is much more modular. Due to the nature of Linux, and with it being open sourced anyone is free to create a GUI for Linux, with minimal standardization. GUIs on Linux are run in the user space, completely isolated from the windows kernel, which adds the possibility of creating custom interfaces to meet different requirements and needs.

This has led an extremely large amount of desktop environments to be created throughout its history. Gnome, XFCE and KDE are the most used, and are actively developed by collaborative users around the world.

Linux predominantly uses Unix based permissions to delegate what users and processes can run protocols and applications.

Madalina Dinita, 2019 ‘Differences between Windows kernel and Linux kernel, *WindowsReport*. Available at: URL: https://windowsreport.com/windows-linux-kernel-differences (Accessed: 30 March 2021).

# System Security

## Windows

Due to Windows being the primary user focused operating systems in almost every organization worldwide, it has a much larger attack vector as it is makes sense to target By default, in Windows, users are generally given a high level of access to system resources – this is especially true for home users, as user accounts created on the machine are generally system administrator accounts, with access to everything by default.

User Account Control, known as UAC has long been implemented to attempt to counteract this, but has been proven multiple times to have been overwritten, or ignored. Often at times this is in self elevating applications that are installed in the user context.

## Linux

Linux does not offer the same control to users automatically. Even if a user has access to files and folders at a high administrative level, there are usually more hurdles to jump over to make changes to directories and files. ‘Sudo’ is a common command across Linux, standing for ‘Substitute user do’, or ‘Super user do’ and is used to elevate a specific session or action in Linux.

Because more people are actively developing Linux than Windows, there is a much larger collaborative ‘team’ dedicated to mitigating attack vectors on the Linux system. It is also fair to say that Windows has the upper hand when it comes to third party security suite compatibility, as most of the anti-virus software developed is released on Windows.

Connor Jones, 2019 ‘Windows vs Linux: Support, security, and design’, *ITPro*, . Available at: URL: https://www.itpro.co.uk/operating-systems/24841/windows-vs-linux-whats-the-best-operating-system/page/0/1 (Accessed: 30 March 2021).

# Performance

It is widely accepted that Linux is the faster of the two operating systems, and again this is generally because there is a larger active development group working across Linux. Most performance issues are usually identified and rectified quickly and made publicly available as soon as possible. Windows however sticks to a strict schedule of only release noncritical security releases on a weekly basis.

Performance does not just mean speed, however. Reliability is another factor that must be considered, and there are often where Windows, despite issues it may have is generally more reliable than the Linux OS. The problem arises from the lack of standardization used when developing for Linux, in that there is no set procedure for how something should be programmed or not.

# User Suitability

Windows and Linux are both great operating systems in my opinion, but there are specific use cases for each, owing to the nature of the operating system and the user friendliness of it.

A Graphical Designer and a HR consultant would, in my opinion, be better using a Windows operating system, due to Windows being much friendlier and easier to use for the average user. Windows requires very minimal effort to set up and start using, whereas Linux has different parameters that, because are exposed to users or technicians setting them up, must be considered.

Most end-user applications used in a corporate environment are programmed to work on Windows operating systems, and as a result is another reason why the average user would be better using Windows – the application range just is not diverse enough for proven, actively used applications: Sage, SAP, Office Suite, etc.

In a corporate environment, specifically in technical roles, there are cases where using a Linux operating system makes much more sense, and these are usually used where high performance, low calculations are needed such as the data science sector, or the cyber security industry.