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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

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1. Introduction

An operating system (OS) is a collection of software that controls a computer’s hardware and provides services to applications. The core component of an OS is the kernel, which is the first program to run when the computer starts and continues to run throughout the entire session (Malallah, et al., 2021). The kernel is the essential part of the operating system. It's a small program that starts running when the computer turns on. This program tells the computer how to use its hardware, manage memory, and control other programs.

To sum up it is like the brain of a computer. It's the part of the operating system that controls how the computer works. It manages things like the CPU, memory, and storage, and makes sure that different programs can run smoothly without interfering with each other.

2. Objective

The main objective of this assignment is to explore the kernel, including its definition, different types, and their functions. This assignment will also emphasize gaining insight into the kernel's role in various operating systems, its essential components, types, historical development, and the boot process.

3. Types of kernels

There are several types of kernels:

- **Monolithic:** Monolithic kernels are the simplest and most common type of Kernel. They include the core functionality of the operating system and support all devices connected to it (Singh, 2024)**.** A monolithic kernel is a type of operating system kernel that combines all essential functions into a single program. This approach offers efficiency and low overhead, making it ideal for systems with limited resources. Examples of operating systems that use monolithic kernels include Linux, Windows NT, and macOS.

- **Microkernel:** A microkernel is a simplified version of an operating system. It only includes the most essential functions like managing processes, memory, and communication between programs. Some examples of operating systems that use microkernels are QNX, MINIX, and Mach.

- **Nanokernel:** A nanokernel is like a super tiny kernel that offers just the essentials for a simple operating system. It's commonly used in devices like fix systems with limited resources. This type of kernel is lightweight and works efficiently in environments where resources are too little. Examples of nanokernels include Nucleus and FreeRTOS.

- **Hybrid kernel:** Hybrid kernels blend monolithic and microkernel features, extending the microkernel idea with added code in kernel space and some monolithic kernel attributes for enhanced performance (Saxena, 2024)**.** It's like having a powerful core for speed and a flexible structure for easy updates. Some examples of operating systems that use hybrid kernels are Windows NT (to some extent) and L4 microkernel.

- **Exokernel:** An exokernel focuses on granting applications direct hardware access, aiming to reduce the software barrier between applications and hardware. This approach can lead to high performance and adaptability. Exokernel and Singularity serve as examples of this concept.

4. Popular Kernels and their history

Over the years, various kernels have emerged, each with its unique characteristics and advantages. Here are some of the most popular kernels and their historical context:

- **Ubuntu:** Ubuntu operating system is based on the Linux kernel, which manage and control hardware. The Linux kernel has evolved through the contributions of open-source community. Every new release brings improvements in kernel and in hardware support, security and performance.

- **Windows NT Kernel:** The Windows NT Kernel was made by Microsoft in the 1990s. It was a new type of kernel that replaced the older Windows systems. This kernel was designed to allow multiple programs to run at the same time and was the basis for all later Windows operating systems.

- **MacOS Kernel:** The macOS Kernel (XNU) was originally created by NeXT Computer and was later bought by Apple. It's a special kind of kernel that combines parts of two different types of kernels. XNU is the base for the macOS and iOS operating systems. It allows multiple programs to run at the same time and provides a safe space for applications.

5. Boot Process

The boot process of a computer begins with the BIOS, which checks the hardware and loads the operating system from a specified device. Once the operating system is loaded, it verifies the device drivers and initializes necessary components. Finally, the operating system starts the login program or graphical user interface, allowing the user to interact with the computer.

Types of Boot processing:

- Cold Booting: Cold booting refers to starting up a computer for the first time or after it has been shut down completely. When we press the power button to initiate a cold boot, the computer reads the Basic Input/Output System (BIOS) instructions stored in the ROM (Gupta, 2023).

- Warm Booting: Warm Booting or Rebooting is an act akin to hitting the "reset" button on a running computer. It occurs when the computer is already up and operational, but issues like system hang-ups or unresponsiveness necessitate a fresh start (theknowledgeacademy, 2023).

6. Conclusion

The kernel is the core part of an operating system that controls hardware and helps run applications. Choosing between different types of kernels, like monolithic and microkernels, depends on what the system needs. Well-known kernels like Linux, Windows NT have greatly shaped how computers work today. By learning about the kernel and how it starts up, we get a better understanding of how operating systems work and help advance technology.

The main goal of this assignment was to learn about the kernel, what it is, the different types, and how they work. It also focused on understanding the kernel's role in various systems, its key parts, history, and how it starts up.

7. References

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