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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

1.1 Kernel

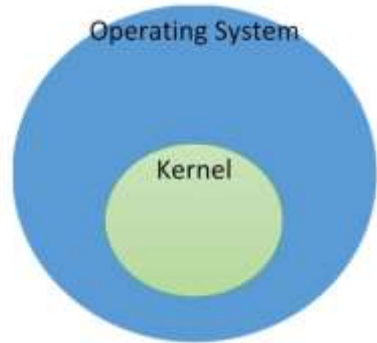


Figure 1: Kernel in Operating system

The kernel is the central part of operating system which acts as the core of the computer's operating system. Kernel has accessed the control over everything in the system. it is also actually called the heart of an operating system. It manages the operations of the computer. The kernel handles the communication between the hardware and the Software. It acts as an interface between the applications and actual data processing done at hardware level.

1.2 Function of Kernel

The function of the kernel is in the following:

- **Memory Management:** it performs the task of allocation and de-allocation of memory space to programs in need of this resources. It manages RAM memory so that all running processes and programs can work effectively and efficiently. It manages virtual memory. It handles memory protection and sharing
- **Processor Management:** it assigns processor to different tasks that must be performed by the computer system.
- **Device Management:** it performs the task of allocation and de-allocation of the devices. The peripheral devices connected in the system are used by the processes. So, the allocation of these devices is managed by the Kernel. It provides a unified interface for hardware devices. It handles device driver communication.

- **Resource Management:** It facilitates or initiates the interaction between components of hardware and software. It allocates and deallocates resources as needed. It monitors resource usage and enforces resource limits
- It also controls and manages all primary tasks of the OS as well as manages access and use of various peripherals connected to the computer.

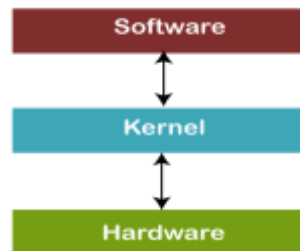


Figure 2: Kernel mode

Firstly, Kernel mode loads memory after OS has been loaded and remains in memory until OS shuts down. Firstly, Kernel mode loads memory after OS has been loaded and remains in memory until OS shuts down. Secondly, while the computer is stills turned on kernel mode goes through various function like Process Management, Memory Management, Device Management, File System Management, Resource Management, Security and Access Control and Inter-Process Communication. Both user and application have no accessibility as this is safety protected by kernel space. At last, to continue the regular processing, the system must transfer to user mode after the kernel complete the required task. This back and forth switching between kernel and user mode keeps the system safe and prevent from malicious code from accessing essential hardware. (Abraham Silberschatz, 2018).

2. Objective

The main objective of a kernel is to manage the communication between hardware and hardware. Actually, the operating system aim is also to communication between hardware and hardware but kernel as part of operating system it is responsible for

translating the commands that can understood by computer. The function of kernel is the device management, memory management and task management.

The following are the objectives of the kernel:

- To learn in detail about kernel and its functions like process management, memory management, device control etc.
- To research and compare different types of kernels that are used in operating systems.
- To learn about the importance of kernel security in modern operating systems.
- To examine case studies of kernel-level operations, bugs, or vulnerabilities

3. Types of kernel

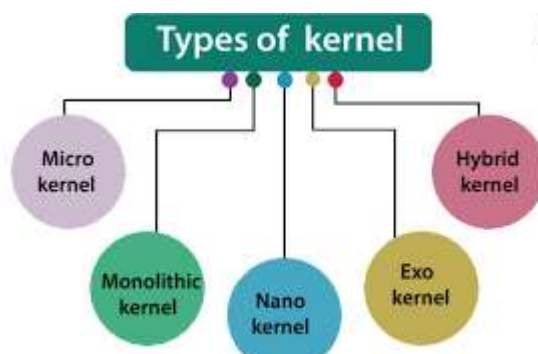


Figure 3: Types of kernel

3.1 Monolithic kernel

In monolithic kernel, all the Operating system services are packed into single program in kernel space. it is larger than other kernel as compared to. Monolithic Operating system is complex to design. its request maybe serviced faster. In monolithic kernel, All the Operating system services are included.

3.2 Microkernel

As compared to monolithic kernel, microkernel is smaller than monolithic kernel. Microkernel is easy to design and request maybe serviced slower than

monolithic kernel. Microkernel provides only interprocess communication and lower-level device management services.

3.3 Hybrid kernel

Hybrid kernels are the combination of monolithic and microkernels. They include more services than microkernels but less than monolithic kernels. This allows them to offer some of the benefits of both kernels. It borrows speed from the monolithic kernels and modularity from microkernels.

3.4 Nano Kernel

As the word Nano represent small Nano kernels are the smallest type of Kernel, consisting of only a few thousand lines of code. It means that the code executing in the privileged mode of the hardware is minimal. They are used primarily in embedded systems or devices with limited resources.

3.5 Exo kernel

As compared to nano kernel, it diff in design. Exo kernel job is to give protection and security .it is not used to manage the hardware resources. .it manages its resources directly without any third party.

4. Kernel History

The first Linux kernel released to the public was version 0.01, dated May 14, 1991. It had no networking, ran only on 80386-compatible Intel processors and PC hardware, and had extremely limited device-driver support (A. Silberschatz, Operating system concepts., 2018).

The most popular operating System used by (Ios, Windows and Ubuntu) are in the following:

- Ios
 - In iOS, the kernel used is XNU, which is called hybrid kernel

The XNU kernel is the kernel that powers Apple's OS X and iOS operating system. Originally developed by Next, but later acquired by Apple it has been around for more than twenty years. (Keuper, 2012).

- Windows

-In Windows, the kernel used is Windows NT kernel, which is called a hybrid kernel.

The foundation of all modern Windows operating systems is the powerful, hybrid Windows NT kernel. It combines features from monolithic and microkernel designs, blending performance and modularity. It is Suitable for a variety of hardware, multitasking capabilities, security features for consumer. Throughout the years, Microsoft has fine-tuned and developed this core component to align with the ever-evolving requirements of computing systems.

- Ubuntu

-In Ubuntu, the kernel used is Linux kernel, which is called a monolithic kernel.

5. Booting Process.

Very briefly, the boot process is as follows. Every PC contains a parent board (formerly called a motherboard before political correctness hit the computer industry). On the parent board is a program called the system BIOS (Basic Input Output System).. (S.Tannenbaum, 2009).

The boot process is the sequence of operations that a computer system undergoes when it is powered on, leading to the loading of the operating system (OS). The boot process is crucial because it initializes the hardware and loads the kernel, allowing the OS to take control of the system. As briefly mentioned before, the parent board, also known as the motherboard, contains the BIOS (Basic Input/Output System), which is where the Pentium boot process starts. The flash RAM-based BIOS first checks the RAM and other fundamental devices, such as the keyboard. It looks for plug-and-play

and legacy devices on the ISA and PCI busses. If modifications are found, the device configuration is changed. The boot device is then selected by the BIOS, which normally tries the hard drive, CDROM, and floppy disk in order. The software to check the partition table, load the secondary bootloader, and load the operating system is included in the first sector of the boot device that is read into memory. After the OS has loaded, it loads the required device drivers and asks the BIOS for configuration information. The OS launches a login prompt or a graphical user interface after starting background tasks.

Conclusion

-In conclusion, through this report I got to learn that kernel is the heart of the operating system, that insures the efficient management of key computer resources such as CPU, memory, files and processes. It The kernel handles the communication between the hardware and the Software. It acts as an interface between the applications and actual data processing done at hardware level.

After completing this project, it was quite challenging but after searching the papers about the subject of the kernel and understand its role in the system. While working on the project, I struggled with grasping how the kernel operates at such a low level in the system. Simplifying these complex technical concepts demanded thorough research and analysis.

Although I faced several difficulties, this coursework provided me with a great learning experience. I gained valuable insights into the kernel and its significance. Even though the process was stressful at times, it was a rewarding journey, leaving me more confident and knowledgeable about the kernel

References

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