22516 Operating System

Unit-II Services and Components of Operating System

2.1 Different Services of Operating System.

An operating system (OS) provides several essential services to both the user and the applications running on a system. Here are some of the key services provided by an operating system:

1. **Process Management**: The OS is responsible for managing all the processes running on the system. This includes scheduling processes, allocating resources to them, monitoring their execution, and handling process communication and synchronization.
2. **Memory Management**: The OS is responsible for managing the system's memory. This includes keeping track of each byte in a system's memory and which processes are using which memory, allocating memory to processes when they need it, and freeing it for use when they don't.
3. **File Management**: The OS manages files and directories on the computer. It keeps track of which regions of the disk are free, which are reserved, and manages access to them. It also provides a filing system to store, retrieve, organize, and manipulate data.
4. **Device Management**: The OS manages device communication via their respective drivers. It translates user input into device instructions and also controls peripheral devices like disk drives, printers, displays, etc.
5. **Security and Access Control**: The OS provides mechanisms to protect data and system resources from accidental or malicious interference. This includes user authentication, authorization, logging, and access control lists.
6. **Error Detection and Recovery**: The OS continually checks for possible errors. This could be internal (like a memory leak) or external (like a failure of an I/O device). It takes appropriate action when an error occurs, such as recording the error, notifying the user, or restarting the system.
7. **User Interface**: Every OS provides some kind of user interface. This could be a command line interface (CLI), graphical user interface (GUI), or both.
8. **Resource Allocation**: When there are multiple users or multiple jobs running at the same time, the OS manages the allocation of system resources such as CPU cycles, main memory, and I/O devices to these users or jobs.
9. **Inter-process Communication**: The OS provides mechanisms for processes to communicate with each other and synchronize their actions.

These are some of the most common services provided by operating systems. The exact services can vary based on the design and purpose of the specific operating system.

2.2 System Calls- Concept, types of system calls

System calls are the interface between the user-level applications and the operating system. They provide a way for programs to request services from the operating system, such as creating a process, reading a file, or accessing the network.

When a system call is made, it's handled by the kernel (the core of the operating system). The kernel executes the request on behalf of the user-level application, as it has the necessary permissions to interact directly with the hardware and system resources.

There are several types of system calls, typically falling into these major categories:

1. **Process Control**: These system calls can create, terminate, or end processes. Examples include fork(), exit(), and wait().
2. **File Management**: These system calls are used to read, write, open, and close files. Examples include open(), read(), write(), and close().
3. **Device Management**: These system calls are used to request access to devices, read or write to devices, and release devices. Examples include ioctl(), read(), and write().
4. **Information Maintenance**: These system calls are used to get or set system data. They can be used to get the system time, get process or system information, and set process or system information. Examples include time(), getpid(), and setuid().
5. **Communication**: These system calls create, send, receive, and manage communication between processes. Examples include pipe(), socket(), send(), and receive().

In general, system calls allow user-level applications to interact with the system and its resources in a controlled and safe manner, without requiring the application to have direct access to the hardware or other low-level resources.

Types of system calls

System calls are the interfaces between a process and the operating system. They provide the means for a user program to request services of the operating system. Here are the main types of system calls:

1. **Process Control System Calls**: These are used for controlling processes. Examples include **fork()**, **exit()**, **wait()**, **exec()**, **getpid()**, etc. They are used for operations such as process creation, process termination, and process attributes control.
2. **File Manipulation System Calls**: These are used for file management. Examples include **open()**, **close()**, **read()**, **write()**, **link()**, **unlink()**, **seek()**, **stat()**, etc. They are used for operations such as file creation, deletion, opening, closing, reading, and writing.
3. **Device Management System Calls**: These are used for device manipulation. Examples include **ioctl()**, **read()**, **write()**, etc. They are used for operations like requesting a device, releasing a device, reading, writing, repositioning, etc.
4. **Information Maintenance System Calls**: These are used for system data operations. Examples include **getpid()**, **getuid()**, **alarm()**, **sleep()**, **time()**, **chmod()**, etc. They are used for operations such as setting/getting process attributes, setting/getting file attributes, setting/getting system attributes, etc.
5. **Communication System Calls**: These are used for interprocess communication. Examples include **pipe()**, **shmget()**, **shmctl()**, **semget()**, **semop()**, **msgget()**, **msgsnd()**, **msgrcv()**, etc. They are used for operations like creating, destroying communication connection, sending/receiving messages, transferring status information, etc.

2.3 OS Components: - Process Management, Main Memory Management, File Management, 1/0 System management, Secondary Storage management.

OS Components

An operating system (OS) consists of several key components that help it manage resources and provide services. Here are the main components of an operating system:

1. **Kernel**: This is the core of the operating system. It interacts directly with the hardware and controls the execution of programs and the resources they use.
2. **Process Scheduler**: The scheduler is responsible for deciding which process gets access to the CPU, when, and for how long. It helps in efficient utilization of CPU.
3. **Memory Manager**: The memory manager controls the system's memory space. It is responsible for keeping track of each byte in memory, who is using it, and what it's being used for.
4. **Device Drivers**: These are software components that interpret the high-level commands of the OS to instructions a specific piece of hardware can understand. They allow the operating system to interface with different hardware devices.
5. **File System**: The file system is how an OS organizes and keeps track of files on a disk. It manages the available space on a disk, keeps track of which sectors belong to which files, and manages access to files on the disk.
6. **User Interface**: This component allows users to interact with the system. It can be graphical (like a desktop with windows and icons) or command-line based (where users type commands to perform tasks).
7. **System Utilities**: These are programs provided by the OS to help manage, maintain, and control the computer's operation. Examples include system performance monitors, security management tools, and file system management utilities.
8. **Inter-process Communication (IPC)**: This component of the OS allows processes to communicate with each other and synchronize their actions. Mechanisms for IPC include message passing, synchronization, shared memory, and pipes.

These components work together to provide a platform for running applications, managing hardware resources, and providing services needed by applications.

Process Management, Main Memory Management, File Management, 1/0 System management, Secondary Storage management.

These are the key aspects of an operating system that manage the computer's resources and make it possible for users to interact with the computer:

1. **Process Management**: The operating system is responsible for creating, scheduling, and terminating processes. It manages process resources and handles process communication and synchronization. Process management also includes keeping track of processor state, managing the execution stack, and handling process hierarchies.
2. **Main Memory Management**: The operating system is responsible for managing the computer's physical memory, which includes allocating and tracking memory to processes, managing virtual memory, and handling memory protection and faults.
3. **File Management**: File management involves managing files on the disks, which includes creating, deleting, moving, and modifying files or directories. The operating system also needs to keep track of information about files, such as permissions, usage dates and times, and disk location.

4. **I/O System Management**: The I/O system management involves managing the computer's input/output with peripherals such as keyboards, mice, disk drives, printers, displays, etc. This is usually done through device drivers, which are interfaces between devices and the operating system.
5. **Secondary Storage Management**: Secondary storage management involves the management of non-volatile storage, such as hard disk drives. The operating system must keep track of which parts of the disk are used, by which files, and who can access them. It's also responsible for backup and recovery operation of files from secondary storage.

These are some of the critical management roles that an operating system has to fulfil to function effectively as an intermediary between the user and the computer hardware.

2.4 Use of operating system tools user management, security policy, device management, performance monitor, task scheduler

Operating system tools play a crucial role in managing various aspects of a computer system. Here's how some of these tools function:

1. **User Management**: This tool helps manage user accounts on a system. It is used to create new user accounts, delete existing ones, assign user roles, grant permissions, etc. It is critical for systems where multiple users need different access levels to system resources.
2. **Security Policy**: The security policy tool is used to manage system-wide security policies. This might include password requirements, account lockout policies, firewall settings, and more. It ensures that the system is secure and that only authorized users have access to the system resources.
3. **Device Management**: The device management tool is used to manage all the hardware devices connected to a system. It is used to install and update device drivers, configure devices, handle device conflicts, etc. It ensures that all devices are working correctly and efficiently.
4. **Performance Monitor**: The performance monitor tool is used to track system performance. It can monitor various aspects of the system like CPU usage, memory usage, network traffic, disk usage, etc. It helps in identifying system bottlenecks, underperforming components, and helps in system tuning.
5. **Task Scheduler**: The task scheduler tool is used to automate tasks. It is used to set up tasks to be run at specified times or under specified conditions. For example, a system administrator might schedule a backup operation to run every night or a software update check to run every week.

By using these tools effectively, system administrators can ensure that their systems are running efficiently, securely, and can effectively cater to the needs of their users.


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