File System

PAANA ACADEMY

File and Directory

File is a collection of related information stored in secondary storage.

File is sequence of bits, bytes,lines or records defined by its creator or owner.

Types of files examples:

Text file: sequence of characters

Source files:

Object files:

Executable files:

File Attributes

Name

Identifier

Type

Location

Size

Protection

Time and Date

User Identification

Operation on files

Creating a file

Writing a file

Reading a file

Repositioning within a file

Deleting a file

Truncating a file

Appending new information

Renaming a file

File Access Methods

Sequential Access

Indexed Access

Direct/Random/Relative Access

File Allocation Methods

Contiguous Allocation - each file occupy a set of contiguous address on disk.

Linked Allocation - it maintains the linked list of disk blocks, disk blocks may be scattered anywhere. It solves the problem of external fragmentation because we can take any available block they should not be contiguous. Each block contains pointer to the next block.

Indexed Allocation - solves the problem of linked allocation, all pointers are brought together in the index blocks. Each file has its own index block which is an array of disk block address.

Objective: To utilize disk space effectively and accessed quickly.

Both sequential and direct access is allowed in contiguous allocation.

Linked allocation solves the problem of contiguous allocation which is external fragmentation.

Linked allocation has disadvantage that it can only use sequential access by following the pointer. Each access to pointers require disk read or disk seek. It is not possible to

Directly move to the particular block.

Disk Structure

Platters: Circular, metal disks coated with a magnetic material where data is stored.

Spindles: Spins the platters at a constant speed (e.g., 5400 RPM, 7200 RPM).

Read/Write Heads: Positioned above and below each platter, moves to access data.

Tracks: Concentric circles on the surface of each platter.

Sectors: Divisions of tracks, typically 512 bytes each for data storage.

Cylinders: All tracks that can be accessed without head movement when the platters are rotated.

Partition: A logical division of the disk.

Boot Sector: Contains the Master Boot Record (MBR) or GUID Partition Table (GPT), essential for booting.

File Allocation Table (FAT) or **Master File Table (MFT)**: Organizes files and directories on the disk.

Terminologies regarding disk

Blocks: Smallest unit of disk space allocated to a file.

Directories: Organize files hierarchically.

Free Space Management: Tracks available and allocated space on the disk.

Disk Formatting:

- **Low-Level Formatting**: Prepares the disk by dividing it into sectors and tracks.
- **High-Level Formatting**: Installs a file system and prepares the disk for data storage.

Disk Capacity calculation

Example Calculation of Disk Capacity

Let's consider a hypothetical hard disk drive (HDD) with the following specifications:

- **Number of Platters**: 2
- **Platter Size**: 500 GB (each platter)
- **Sectors per Track**: 1000
- **Tracks per Cylinder**: 200
- **Cylinders per Platter**: 400
- **Cluster Size**: 8 KB (kilobytes)

Step-by-Step Calculation:

1. **Calculate Total Platter Capacity**: Each platter has a capacity of 500 GB.
   Total capacity of all platters = 2 platters * 500 GB/platter = 1000 GB
2. **Calculate Total Sectors per Platter**: Sectors per platter = Sectors per Track * Tracks per Cylinder * Cylinders per Platter
   Sectors per platter = 1000 * 200 * 400 = 80,000,000 sectors
3. **Calculate Total Disk Capacity**: Now, considering all platters combined:
   Total sectors for all platters = Sectors per platter * Number of Platters
   Total sectors for all platters = 80,000,000 * 2 = 160,000,000 sectors
4. **Calculate Usable Disk Capacity**: Convert sectors to bytes (assuming 1 sector = 512 bytes):
   Usable disk capacity = Total sectors * Sector size
   Usable disk capacity = 160,000,000 sectors * 512 bytes/sector = 81,920,000,000 bytes
   Convert bytes to gigabytes (GB):
   Usable disk capacity = 81,920,000,000 bytes / (1024^3 bytes per GB) ≈ 76.29 GB
5. **Considerations for Actual Disk Capacity**:
   - As mentioned earlier, manufacturers use base-10 calculations (1 GB = 1 billion bytes), while computers use base-2 calculations (1 GB = 1,073,741,824 bytes).
   - Formatting and partitioning overhead will reduce the actual usable capacity compared to the theoretical capacity calculated here.

This example provides a simplified calculation of disk capacity based on the given specifications. Adjustments may be needed depending on specific factors such as the disk interface, file system overhead, and manufacturer specifications.

File System

A file system provides a structured way to store and retrieve data files on a storage medium. It organizes data into files and directories (folders), manages access to these files, and ensures efficient storage and retrieval of data.

File systems vary based on the operating system and the requirements of the storage medium. Some common file systems include:

Commonly Used File Systems

FAT (File Allocation Table): Used primarily on older Windows systems, including FAT16, FAT32, and exFAT (Extended File Allocation Table).

NTFS (New Technology File System): The primary file system for modern Windows operating systems. It offers improved performance, security features, and support for large file sizes and volumes.

HFS+ (Hierarchical File System Plus): Used by Apple's macOS for organizing files on hard disks and other storage devices.

ext4 (Fourth Extended File System): A widely used file system for Linux distributions, known for its performance, reliability, and support for large volumes and files.

APFS (Apple File System): Introduced by Apple for macOS and iOS devices, offering enhanced performance, security, and efficiency compared to HFS+.

Functions of file system

Data Organization: Organizes data into files and directories, providing a hierarchical structure for efficient storage and retrieval.

File and Disk Management: Manages allocation and deallocation of disk space for files, ensuring efficient use of storage resources.

Access Control: Enforces permissions and security settings to control who can read, write, or execute files and directories.

Error Handling: Detects and corrects errors that may occur during storage or retrieval of data.

File System Recovery: Provides mechanisms to recover data in case of system crashes or disk failures.

Terminologies of file system

Disk Access Speed:

- **Seek Time**: The time taken for the disk's read/write head to move to the correct track.
- **Latency**: The time taken for the disk to rotate the platter to the correct sector.
- **Transfer Rate**: The speed at which data is transferred between the disk and the computer.

Raw disk: disk without file system.

If the block of free-space list is free then bit will _____1_____

System Administration tasks

Server health check up

- **Running processes:** Check for processes that are consuming more resources than expected, and take action to fine-tune the applications (with the help of the application team).
- **CPU utilization:** Consistently monitor and check the CPU utilization of the critical process like "java", "http", "mysql" etc. to ensure that these are not consuming the CPU resources more than expected. If it is so, then coordinate with the application team to check it at application level and fine tune the same. Parallely analyse the OS parameters like "Ulimits".
- **Memory utilization:** Check memory utilization and clear the cache, if required.
- **Zombie processes:** Check for processes where the PID still exists in the process table after it is terminated. Zombie processes degrade server performance, so find and kill any that exist.
- **Load average:** If you're having performance issues, check the load average and tune the server for performance.
- **Disk/SAN/NAS utilization:** Check the I/O reports for externally attached storage to track and check the speed of read/write operations. If you find any issues, coordinate with the storage and network teams immediately to correct them.

Patching

Operating system patches for known vulnerabilities must be implemented promptly. There are many types and levels of patches, including:

- Security
- Critical
- Moderate

When a patch is released, check the bug or vulnerability details to see how it applies to your system (e.g., does the vulnerability affect the hardware in your system?), and take any necessary actions to apply the patches when required. Make sure to cross-verify applications' compatibility with patches or upgrades.

POST

A power-on self-test (POST) is a set of routines performed by firmware or software immediately after a computer is powered on, to determine if the hardware is working as expected.

Bootstrapping

When POST is successfully finalized, bootstrapping is enabled. Bootstrapping starts the initialization of the OS.

Boot Sequence

The boot sequence is the process of starting a computer/system.

The boot process is initiated when the power button is pressed, it sends power to the boot-loader in the cache memory. The Boot loader performs POST as a preboot sequence and if everything is working well without any errors the BIOS(Basic Input Output System) is activated which finds and loads the operating system.

Finally the software has to interact with the hardware units to complete the process. To avoid any hardware errors while executing a software program, the pre-boot sequence would test the hardware and initiate the OS if and only if the basic hardware units are functioning as expected. he principal duties of the main BIOS during POST are as follows:

Shutdown procedures

shutdown procedures, kill all running processes, write data to disk, and shut down the system software to the appropriate run level.

Shutting down a system improperly can result in loss of data and the risk of corrupting the file systems.

To avoid having your system shut down improperly during a power failure, you should use an uninterruptible power supply (UPS) that is capable of shutting down the system cleanly before the power is shut off. Be sure to follow the UPS manufacturer’s recommendations for maintenance to eliminate the risk of the UPS becoming the cause of an improper shutdown.

MCQ

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