KARNAVATI UNIVERSITY

Unitedworld Institute of Technology

Operating Systems
Course Code: **71203002004**
Introduction to File Systems

by -

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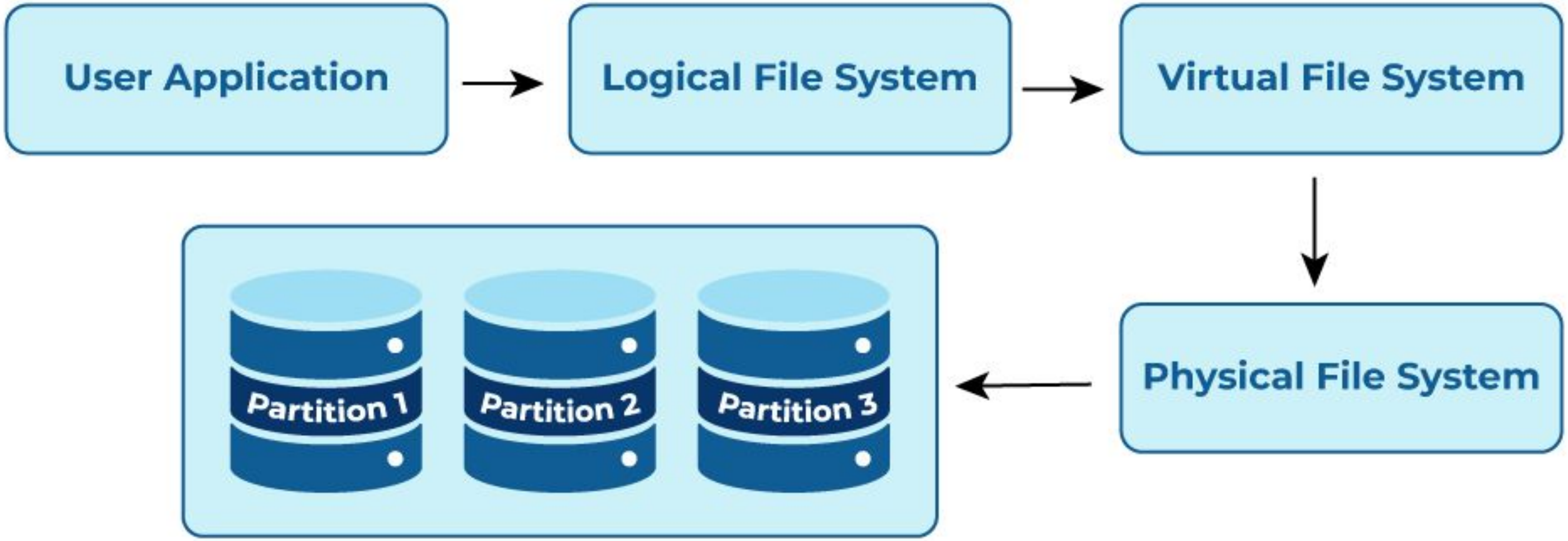
File

A file is a named collection of related information stored on secondary storage like hard drives, SSDs, CDs, or tapes. It can be made up of bits, bytes, lines, or records, and its meaning depends on the creator and user.

A **file system** is part of the operating system that helps store, organize, and manage these files on storage devices.

The Architecture of a File System



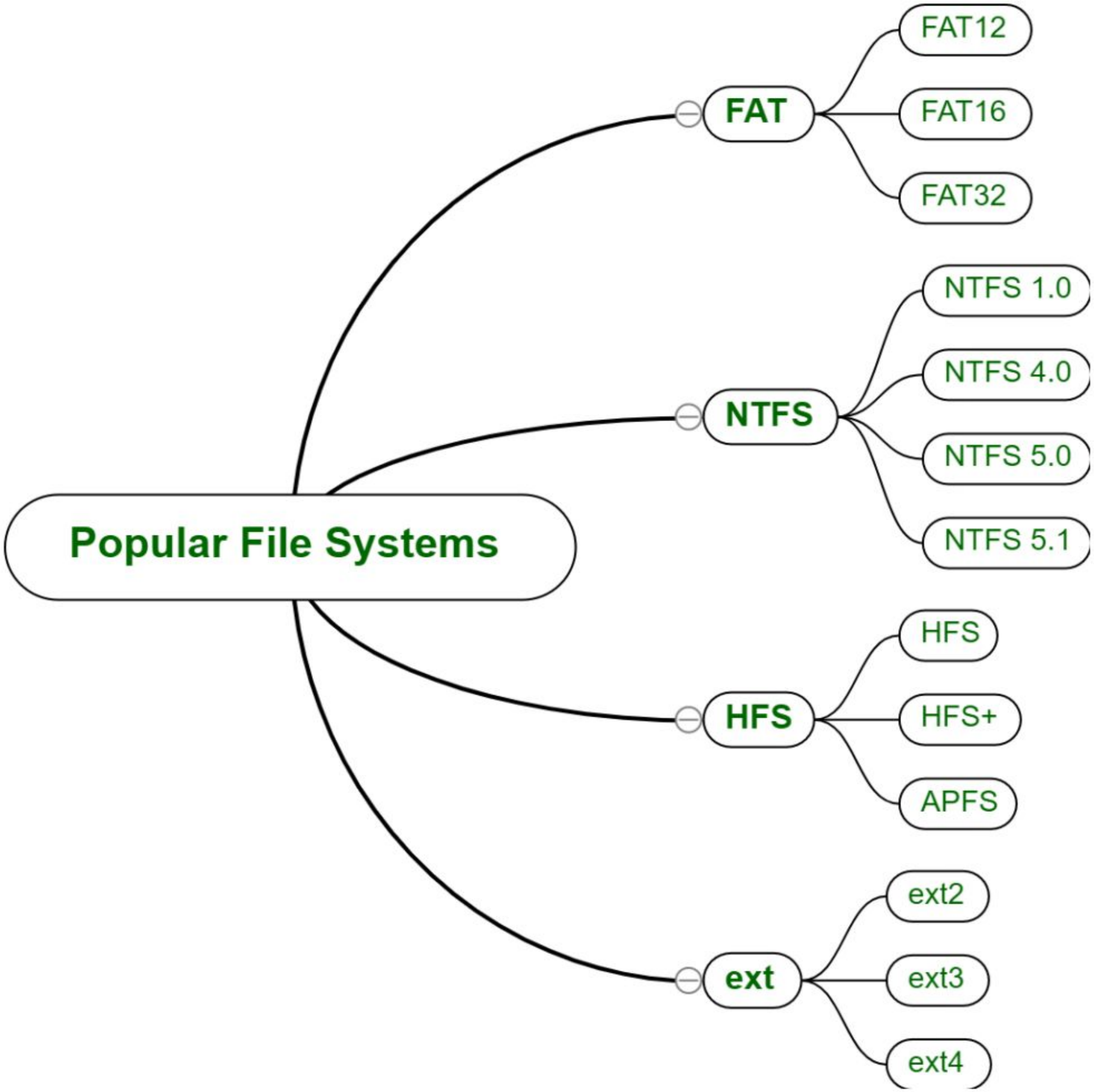
Architecture of a File System

- User Application: Programs or software that ask for file operations (read, write, delete, etc.).
- Logical File System: Manages file details like names, directories, and permissions.
- Virtual File System (VFS): Provides a common interface so different file systems can work together.
- Physical File System: Deals with the actual storage of data blocks on the disk.
- Partitions (Partition 1, 2, 3): Divisions of the storage device where files are physically stored.

Overall, the file system acts as a bridge between the operating system and storage hardware, making it possible to perform CRUD operations (Create, Read, Update, Delete) on files in an organized and efficient way.

Popular File Systems

- **FAT (File Allocation Table):** Older file system used in early Windows and other OS.
- **NTFS (New Technology File System):** Used in modern Windows; supports permissions, compression, and encryption.
- **ext (Extended File System):** Common in Linux/Unix systems.
- **HFS (Hierarchical File System):** Used in older macOS versions.
- **APFS (Apple File System):** Modern file system for Macs and iOS devices.



Popular File Systems

FAT

FAT12

FAT16

FAT32

NTFS

NTFS 1.0

NTFS 4.0

NTFS 5.0

NTFS 5.1

HFS

HFS

HFS+

APFS

ext

ext2

ext3

ext4

File Naming & Issues Handled by file system.

A file name has two parts:

- **Name**
- **Extension** (separated by a period, e.g., report.docx).

Issues:

- When a file is deleted, **free space** is created on the disk.
- That space can be **reused** by other files.
- A key challenge is deciding **where to place files** on the disk, since a file may occupy one or more blocks.

File Type

File type helps the operating system recognize different kinds of files (like text, source code, binary, etc.).

Types of Files (in MS-DOS, UNIX, etc.):

1. **Ordinary Files**

    - Store user information (text, database, programs).
    - Users can add, modify, delete, or remove them.

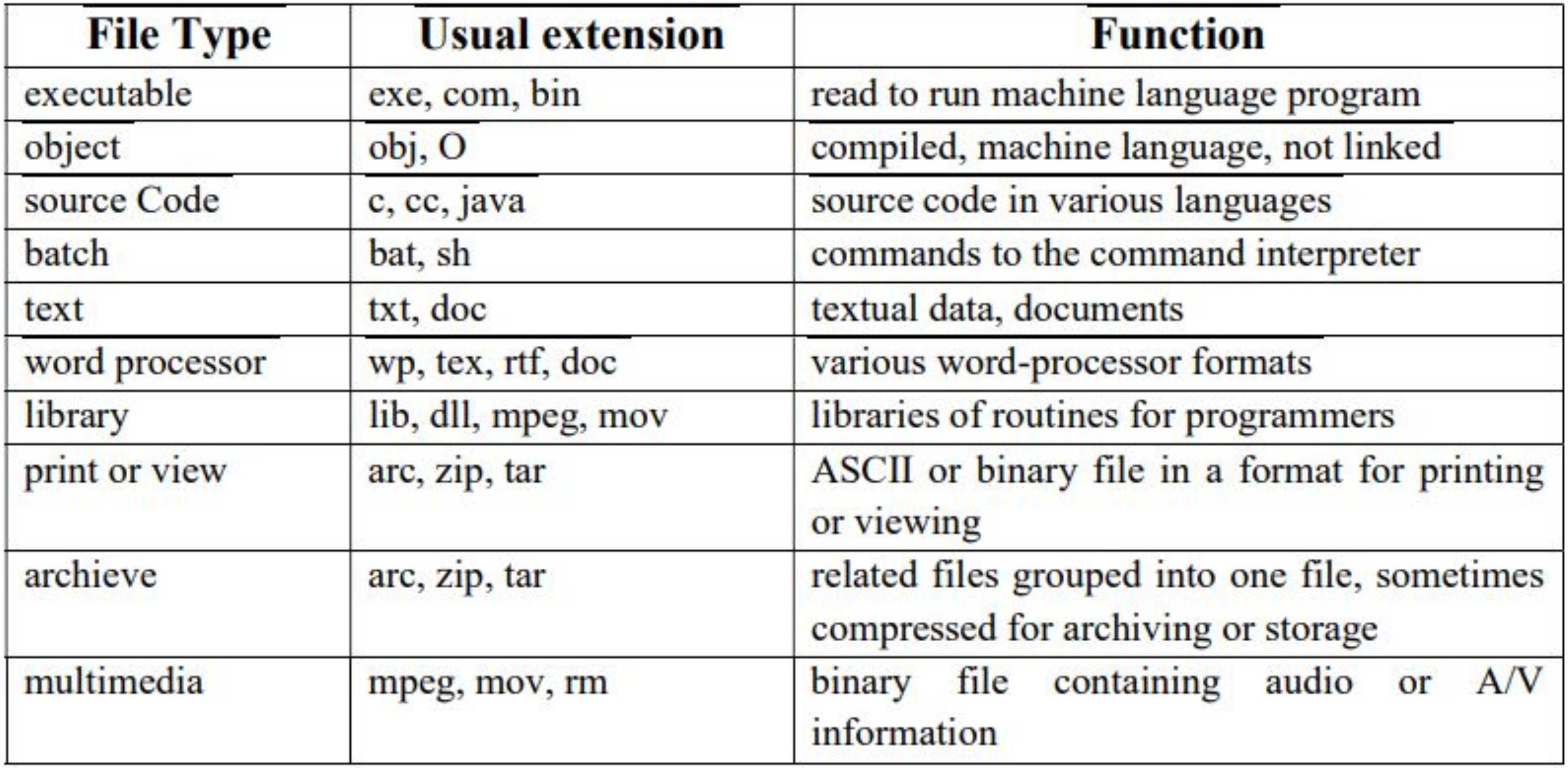
File Type

2. Directory Files

- Contain lists of file names and details about those files.

3. Special Files (Device Files)

- Represent physical devices like disks, printers, terminals, networks, tape drives.
- Two kinds:
  - **Character Special Files** – Data handled one character at a time (e.g., terminals, printers).
  - **Block Special Files** – Data handled in blocks (e.g., disks, tapes).



File Type	Usual extension	Function
executable	exe, com, bin	read to run machine language program
object	obj, O	compiled, machine language, not linked
source Code	c, cc, java	source code in various languages
batch	bat, sh	commands to the command interpreter
text	txt, doc	textual data, documents
word processor	wp, tex, rtf, doc	various word-processor formats
library	lib, dll, mpeg, mov	libraries of routines for programmers
print or view	arc, zip, tar	ASCII or binary file in a format for printing or viewing
archieve	arc, zip, tar	related files grouped into one file, sometimes compressed for archiving or storage
multimedia	mpeg, mov, rm	binary file containing audio or A/V information

File Structure

Four key terms are used for files:

- **Field**: Smallest unit of data, e.g., name, date.
- **Record**: A collection of fields, e.g., employee details.
- **File**: A collection of records, treated as one unit.
- **Database**: A collection of related data with relationships between them.

Example: A telephone book (file) has records (entries), and each record has fields (name, address, phone number).

File Attributes

Each file has properties (attributes), such as:

- **Name**: File’s label.
- **Identifier**: Unique number for identification.
- **Type**: Kind of file (text, binary, etc.).
- **Location**: Where it is stored.
- **Size**: Storage space used.
- **Protection**: Who can read, write, or execute it.
- **Time/Date/User ID**: Info about creation, last use, and modifications.

File Operations

The file system allows several common operations:

- **Create**: Allocate space and add file entry in directory.
- **Read**: Access data using a read pointer.
- **Write**: Store data using a write pointer.
- **Reposition (Seek)**: Move to a specific position in a file.
- **Delete**: Remove file and free its space.
- **Truncate**: Clear contents but keep file attributes.

File Access Mechanisms

Ways in which records of a file can be accessed:

1. **Sequential Access**
   - Records are read/written one after another in order.
   - Example: Compilers process files this way.
2. **Direct (Random) Access**
   - Each record has an address, so it can be accessed directly. Records don't need to be in sequence or adjacent on disk.
3. **Indexed Sequential Access**
   - Combines sequential and direct access.
   - An **index** is created with pointers to file blocks.
   - The index is searched sequentially, then the pointer is used to access data directly.

DISCUSSION & REVISION

1. Which file system is mainly used in Windows today?
2. What does the extension in a file name come after?
3. Which access method reads records one by one in order?
4. Which type of file represents devices like printers or disks?
5. What does CRUD stand for "C" in file operations?

REFERENCES

1. https://www.geeksforgeeks.org/operating-systems/file-systems-in-operating-system/
2. https://www.tutorialspoint.com/operating_system/os_file_system.htm