Comprehensive Guide to File Systems

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Introduction to File Systems

- File systems are essential for organizing, accessing, and managing data on a disk. They provide the foundation for storing and retrieving files on computers.

Purpose of File Systems

- File systems help the operating system and users organize data efficiently. They ensure files are stored logically and can be accessed easily.

Components of File Systems

FILES: DATA STORED IN SPECIFIC FORMATS.

- FOLDERS: ORGANIZATIONAL STRUCTURES FOR GROUPING FILES.

- METADATA: INFORMATION ABOUT FILES (SIZE, PERMISSIONS, ETC.).

File Storage Basics

- Data is stored on magnetic or solid-state drives using binary values. The file system organizes binary data into accessible files.
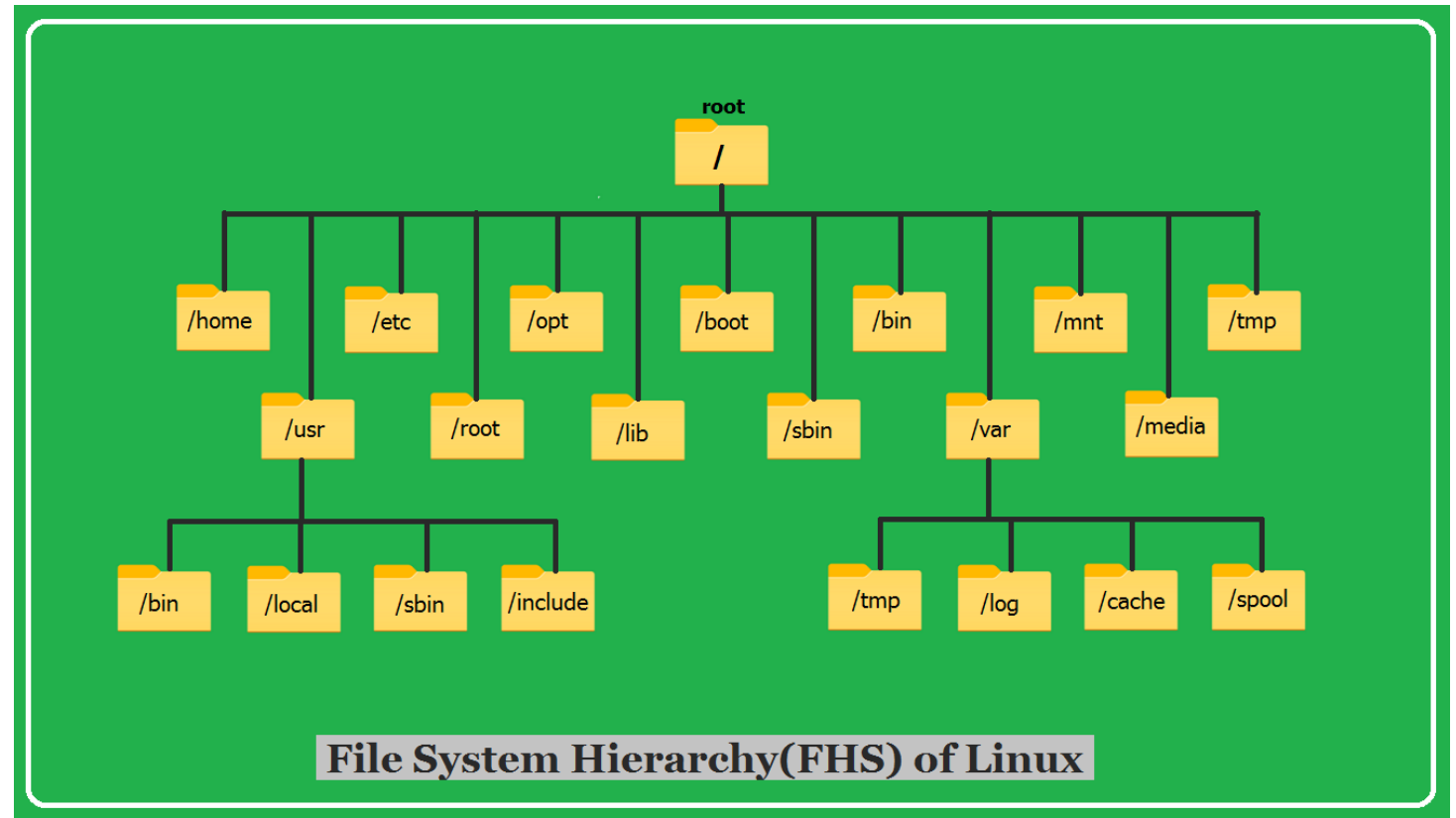
Files & Folders

- File systems organize files hierarchically into folders (directories). Folders can contain subfolders and files for efficient management.
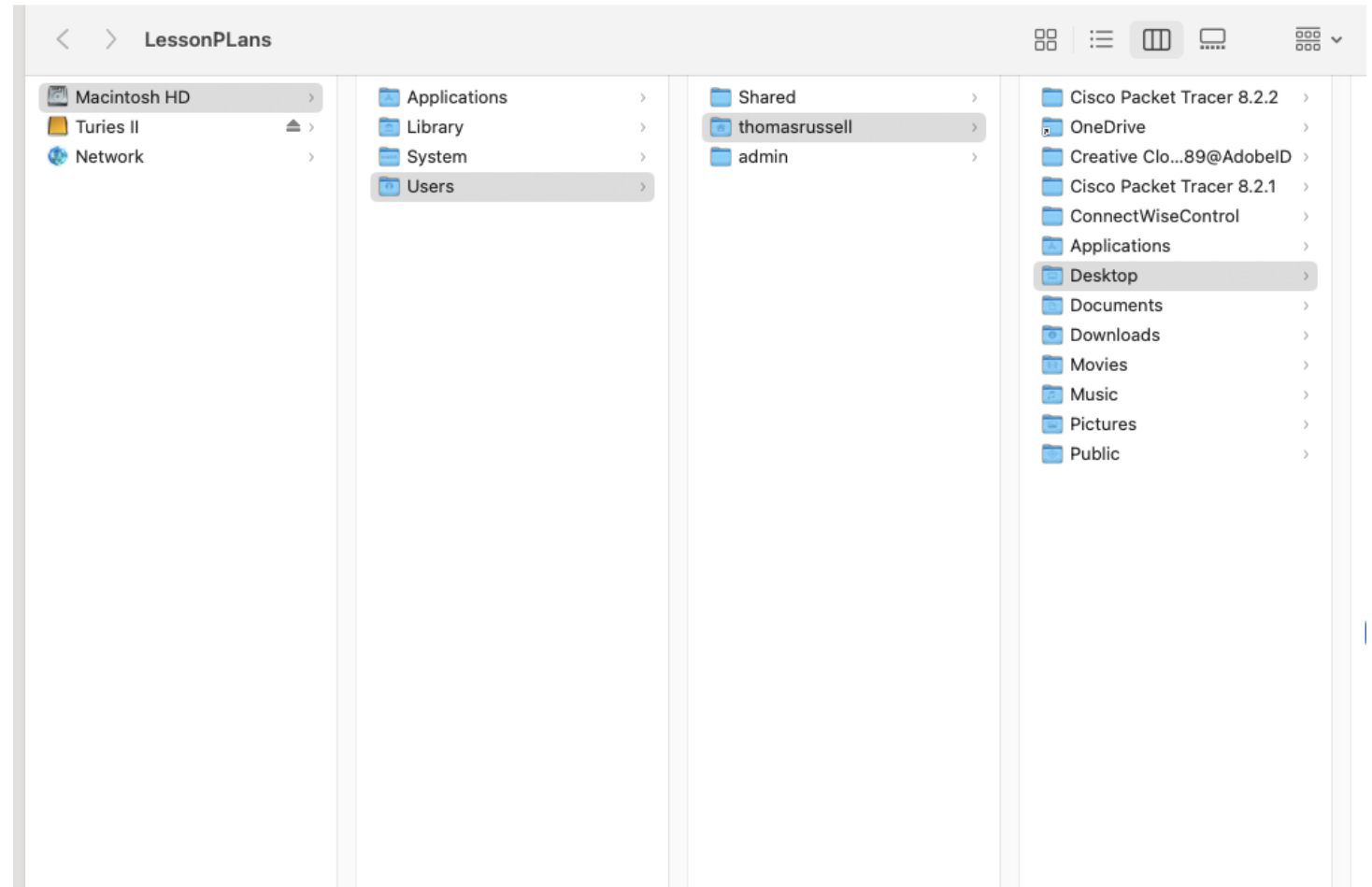
structures

- File systems use hierarchical structures to manage files and folders. Permissions can be set to restrict or allow access to specific users.

File System Hierarchy(FHS) of Linux

Key Features of File Systems

Permissions: Manage file access.

- Compression: Save disk space.

- Encryption: Secure sensitive files.

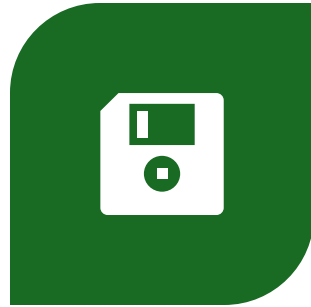- Journaling: Protect against interruptions.

Reserved File Extensions

- Operating systems use reserved extensions for specific purposes. Examples:

- - .exe: Executable files in Windows

- - .apk: Android application packages

- Macintosh and Linux systems track file executability differently.

Key Features of File Systems

PERMISSIONS: MANAGE FILE ACCESS.

- COMPRESSION: SAVE DISK SPACE.

- ENCRYPTION: SECURE SENSITIVE FILES.

- JOURNALING: PROTECT AGAINST INTERRUPTIONS.

Permissions

- Permissions control who can read, write, delete, or execute files. This ensures that files are accessed securely and only by authorized users.

Compression

- Compression reduces file sizes by replacing duplicate data with placeholders. Compressed files take up less space, improving storage efficiency.

Encryption

- Encryption secures files by converting them into unreadable formats. Decryption keys are required to access encrypted files.

Journaling

- Journaling file systems maintain logs of planned changes. This helps recover data in case of interruptions like power failures.

NTFS

- The NTFS file system supports:
- - Compression
- - Encryption
- - Journaling
- It is the default file system for Windows.

FAT32

FAT32 is an older file system that:

- Lacks compression, encryption, and journaling.

- Limits file sizes to 4GB.

It is still supported by many operating systems.

Ext4

- Ext4 is commonly used in Linux systems. It supports:
- - Compression
- - Encryption
- - Journaling
- Files can be up to 16TB in size.

HFS and HFS+

1 HFS (Hierarchical File System) and HFS+ were early Apple file systems. HFS+:

2 - Supports compression, encryption, and journaling.

3 - Allows file sizes up to 16 exabytes.

Apple's APFS is optimized for SSDs

- Supports encryption.

- Improves crash protection.

- Lacks native compression support.

Summary of Filesystem characteristics

Filesystem	FAT32	NTFS	ext4	HFS	HFS+	APFS
Operating System	Windows	Windows	Linux	Mac	Mac	Mac
Encryption	No	Yes	Yes	No	Yes	Yes
Compression	No	Yes	Yes	No	Yes	No
Journaling	No	Yes	Yes	No	Yes	No
Maximum File Size	4 GB	16 EB	16 TB	2 GB	16 EB	16 EB

Summary

Understanding file systems is crucial for managing data efficiently.

Key takeaways:

- File organization and features.

- Types of file systems (NTFS, FAT32, Ext4, etc.).

- Security features like permissions and encryption.