

# Operating Systems Concepts

## File System Management

INFO 2603  
Platform Technologies 1

Week 2: 11-Sept-2018

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## File System Management

File system management encompasses the provision of a way to store your data in a computer, as well as a way for you to find and access that data when you need it.

RAM is only useful for the temporary storage of data and instructions that are currently being used by a computer. It is very fast, it is *volatile memory*.

## Long-Term Storage of Information

In order to permanently store information, an operating system has several requirements:

- A storage device (typically a magnetic hard disk).
- A device controller and device driver for the storage disk.
- Strategies for reading and writing data to a disk.
- A file system that provides a structure and rules for file encoding, management and security.

Hard disks are by far the most common long-term data storage media.

## The File Manager

The *File Manager* is the part of the operating system that is responsible for the management of long-term storage devices such as hard disks.

The File Manager provides a framework (or a *hierarchical structure*) for the organization of data that is stored on a disk.

## File Manager Responsibilities

The primary responsibilities of the File Manager include:

- The organization of similar data (text, images, music and sounds, video, etc) in some manner, and putting that data into files.
- The organization of files into directories and folders.
- The organization of different levels of folders.
- The management of different partitions in a disk.
- The management of multiple disks for data storage.

## The File Manager

The primary responsibilities of the File Manager include:

- Partitioning and formatting disks.
- Establishing file-naming rules or conventions.
- Providing data integrity.
- Providing error recovery and prevention tools.
- Providing file security.
- Providing directory paths.
- Providing command sets to manipulate files.

## File Systems

*File systems* provide the conventions for the encoding, storage and management of data on a storage device such as a hard disk.

They also provide the tools that help users to interact with files.

Different operating systems use different file systems, and files created/stored using one file system are not always compatible with an operating system that uses a different file system.

## File Systems Examples

Some of the more common file systems include:

- FAT12 (floppy disks)
- FAT16 (DOS and older versions of Windows)
- FAT32 (older versions of Windows)
- NTFS (newer versions of Windows)
- EXT3 (Unix/Linux)
- HFS+ (Max OS X)

## File System Conventions

Regardless of which file system an operating system uses, the file system provides the following conventions and information for file management:

- Data and time the directory (folder) or file was created.
- Date and time the directory or file was last modified.
- Directory or file size.
- Directory or file attributes.

## File System Comparisons

Two of the most common file systems are the FAT32 (32-bit File Allocation Table) and NTFS (New Technology File System) systems used by later versions of Windows.

FAT32 is an older file system with a disk size limitation of 32 GB. FAT32 also limits the size of any single file to a maximum of 4 GB.

NTFS allows for disk (or volume) sizes of up to 2 terabytes (TB), with an unlimited number of files and folders. It also eliminates the 4 GB file size restriction.

## File System Comparisons

**Table 6.1**  
Comparison of FAT32 and NTFS

FAT32	NTFS
<ul style="list-style-type: none"><li>• Used for older versions of Windows.</li><li>• Still used for smaller capacity storage devices, such as USB flash drives.</li><li>• Maximum disk (or volume) size of 32 GB.</li><li>• Maximum file size of 4 GB.</li><li>• File fragmentation issues.</li></ul>	<ul style="list-style-type: none"><li>• Default file system for Windows XP, Vista, and Windows 7.</li><li>• Maximum disk (or volume) size of 2 TB.</li><li>• No maximum file size.</li><li>• No maximum number of files.</li><li>• Greater security features, including individual <i>file compression</i>, <i>disk quotas</i>, and <i>file encryption</i>.</li><li>• Easy to convert volumes from FAT32 to NTFS.</li></ul>

**Is NTFS More Efficient Than FAT32?**

## Modern Computing Environments

- Large hard disk sizes are standard on most personal computers,
- File security is important: compression
- File encryption: one user's files are encoded in such a way that they cannot be accessed by another user on the same computer

## Interacting with File Systems

The first is the concept of a *file*. A file is simply a collection of data that is being used together. Pieces of a file may be scattered throughout a hard disk but, as we have seen, keeping track of all of those pieces is the responsibility of the File Manager.

From a user's perspective, a file exists as a single item on a storage device. Files are organized based on *file type* (which is specified by a *file extension*) that associates the file with the application used to create (or view) it.

*Directories* (or *folders*) are simply a means of organizing files so that they are easier for the user to find and manage. Sub-directories (or sub-folders) can exist inside of other folders, and act as a means of further organizing files for ease of management.

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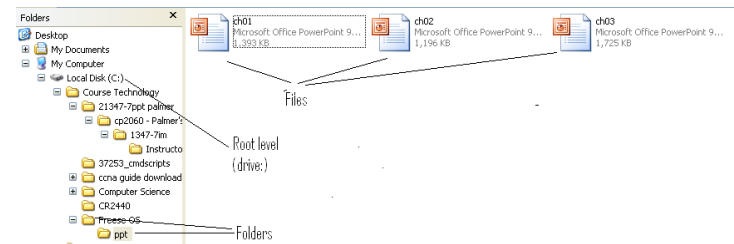
## Hierarchical Structure

In most operating systems, directories (or folders) are organized into a hierarchical structure.

Directories are organized from a root level (such as the C:\ drive in Windows), which then branches out like a tree into all of the directories and subdirectories created by the user.

Some directories are created at the root level by the operating system itself, such as C:\Windows (which stores all of the files used by the operating system), or C:\Programs (which stores the files belonging to most of the applications installed on the computer).

## Hierarchical Structure



Hierarchical File Structure in Windows XP

## Paths

The location of a file in a directory on a computer is referred to as its *path*.

When we give the location of a file, we can provide it as either an *absolute path* or a *relative path*.

## Absolute Paths

An absolute path provides the complete path to the file from the root level.

For instance, in the example described above for folders you created for an operating systems course, the absolute path to that folder might be:

```
C:\Documents and Settings\User 1\My
Documents\Operating System
Fundamentals\Assignments\Assignment_1.doc
```

## Relative Paths

We could also describe the location of this file using a relative path.

A relative path is simply the path to a file from a predetermined relative level. For instance, we could provide the relative path for Assignment 1.doc as

```
(1)My Documents\Operating System
Fundamentals\Assignments\Assignment 1.doc
```

```
(2)Operating System
Fundamentals\Assignments\Assignment 1.doc
```

## File Attributes

File attributes allow the user control access to files, as well as the archiving and backup of files. The most common file *attributes* in Windows are:

- Read Only – the file can be read, but not modified.
- Hidden – the file is hidden from other users (usually used to hide critical operating system files so that they are not accidentally modified by users).
- Archive – the file is marked for archiving, so that it will be included when the next file system backup operation is carried out.
- Index – the file is indexed in a database so that it will be easier for the operating system to find and retrieve the file from the disk when it is needed.

# References

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- Magnetic Tape:
  - [https://spectrum.ieee.org/computing/hardware/why-the-future-of-data-storage-is-still-magnetic-tape?utm\\_source=techalert&utm\\_campaign=techalert-09-06-18&utm\\_medium=email](https://spectrum.ieee.org/computing/hardware/why-the-future-of-data-storage-is-still-magnetic-tape?utm_source=techalert&utm_campaign=techalert-09-06-18&utm_medium=email)
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