



Chapter 10: File-System Interface

- File Concept
- Access Methods
- Directory Structure
- File-System Mounting
- File Sharing
- Protection



File Concept

- Contiguous logical address space
- Types:
 - Data
 - ▶ numeric
 - ▶ character
 - ▶ binary
 - Program





File Structure

- None - sequence of words, bytes
- Simple record structure
 - Lines
 - Fixed length
 - Variable length
- Complex Structures
 - Formatted document
 - Relocatable load file
- Can simulate last two with first method by inserting appropriate control characters
- Who decides:
 - Operating system
 - Program



File Attributes

- **Name** – only information kept in human-readable form
- **Identifier** – unique tag (number) identifies file within file system
- **Type** – needed for systems that support different types
- **Location** – pointer to file location on device
- **Size** – current file size
- **Protection** – controls who can do reading, writing, executing
- **Time, date, and user identification** – data for protection, security, and usage monitoring
- Information about files are kept in the directory structure, which is maintained on the disk





File Operations

- File is an **abstract data type**
- **Create**
- **Write**
- **Read**
- **Reposition within file**
- **Delete**
- **Truncate**
- $Open(F_i)$ – search the directory structure on disk for entry F_i , and move the content of entry to memory
- $Close(F_i)$ – move the content of entry F_i in memory to directory structure on disk



Open Files

- Several pieces of data are needed to manage open files:
 - File pointer: pointer to last read/write location, per process that has the file open
 - File-open count: counter of number of times a file is open – to allow removal of data from open-file table when last processes closes it
 - Disk location of the file: cache of data access information
 - Access rights: per-process access mode information





Open File Locking

- Provided by some operating systems and file systems
- Mediates access to a file
- Mandatory or advisory:
 - **Mandatory** – access is denied depending on locks held and requested
 - **Advisory** – processes can find status of locks and decide what to do



Access Methods

■ Sequential Access

read next
write next
reset
no read after last write
(rewrite)

■ Direct Access

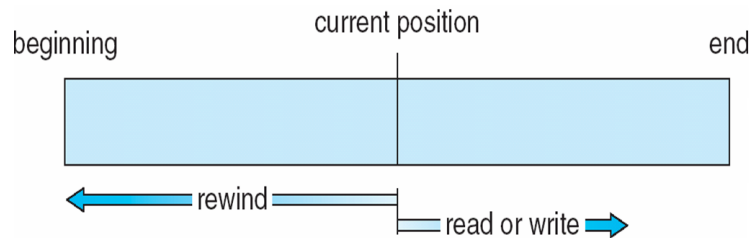
read n
write n
position to n
 read next
 write next
rewrite n

n = relative block number



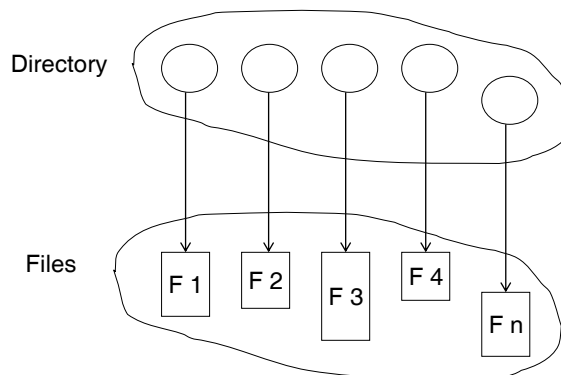


Sequential-access File



Directory Structure

- A collection of nodes containing information about all files



Both the directory structure and the files reside on disk
Backups of these two structures are kept on tapes





Operations Performed on Directory

- Search for a file
- Create a file
- Delete a file
- List a directory
- Rename a file
- Traverse the file system



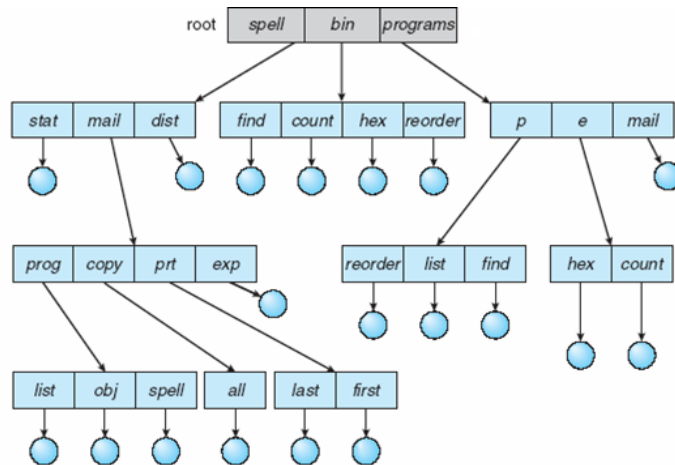
Organize the Directory (Logically) to Obtain

- Efficiency – locating a file quickly
- Naming – convenient to users
 - Two users can have same name for different files
 - The same file can have several different names
- Grouping – logical grouping of files by properties, (e.g., all Java programs, all games, ...)





Tree-Structured Directories



Tree-Structured Directories (Cont)

- Efficient searching
- Grouping Capability
- Current directory (working directory)
 - `cd /spell/mail/prog`
 - `type list`



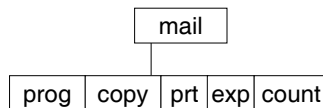


Tree-Structured Directories (Cont)

- **Absolute** or **relative** path name
- Creating a new file is done in current directory
- Delete a file
`rm <file-name>`
- Creating a new subdirectory is done in current directory
`mkdir <dir-name>`

Example: if in current directory `/mail`

`mkdir count`

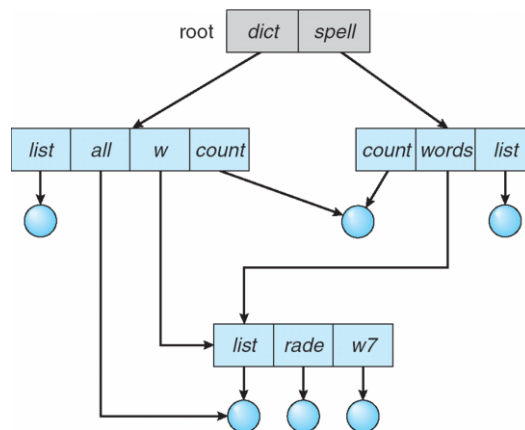


Deleting "mail" \Rightarrow deleting the entire subtree rooted by "mail"



Acyclic-Graph Directories

- Have shared subdirectories and files



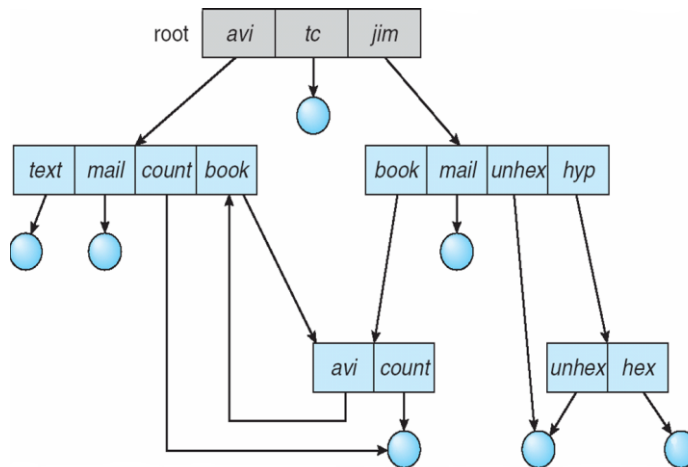


Acyclic-Graph Directories (Cont.)

- Two different names (aliasing)
 - If *dict* deletes *list* \Rightarrow dangling pointer
- Solutions:
- Backpointers, so we can delete all pointers
Variable size records a problem
 - Backpointers using a daisy chain organization
 - Entry-hold-count solution
- New directory entry type
 - **Link** – another name (pointer) to an existing file
 - **Resolve the link** – follow pointer to locate the file



General Graph Directory





General Graph Directory (Cont.)

- How do we guarantee no cycles?
 - Allow only links to file not subdirectories
 - Garbage collection
 - Every time a new link is added use a cycle detection algorithm to determine whether it is OK

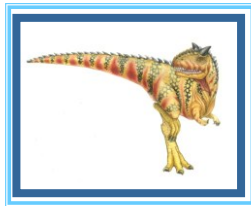


A Sample UNIX Directory Listing

-rw-rw-r--	1 pbg	staff	31200	Sep 3 08:30	intro.ps
drwx-----	5 pbg	staff	512	Jul 8 09:33	private/
drwxrwxr-x	2 pbg	staff	512	Jul 8 09:35	doc/
drwxrwx---	2 pbg	student	512	Aug 3 14:13	student-proj/
-rw-r--r--	1 pbg	staff	9423	Feb 24 2003	program.c
-rwxr-xr-x	1 pbg	staff	20471	Feb 24 2003	program
drwx--x--x	4 pbg	faculty	512	Jul 31 10:31	lib/
drwx-----	3 pbg	staff	1024	Aug 29 06:52	mail/
drwxrwxrwx	3 pbg	staff	512	Jul 8 09:35	test/



End of Chapter 10



Operating System Concepts – 8th Edition,

Silberschatz, Galvin and Gagne ©2009