操作系统原理及应用

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Chapter 10 File System Interface

Outline

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

File Concept

- A file is a named collection of related information that is recorded on secondary storage.
- 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

File Attributes

- **Name** – only information kept in human-readable form.
- **Identifier** – the non-human-readable name for the file.
- **Type** – needed for systems that support different types.
- **Location** – pointer to file location on device.
- **Size** – current file size.

File Attributes

- 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.

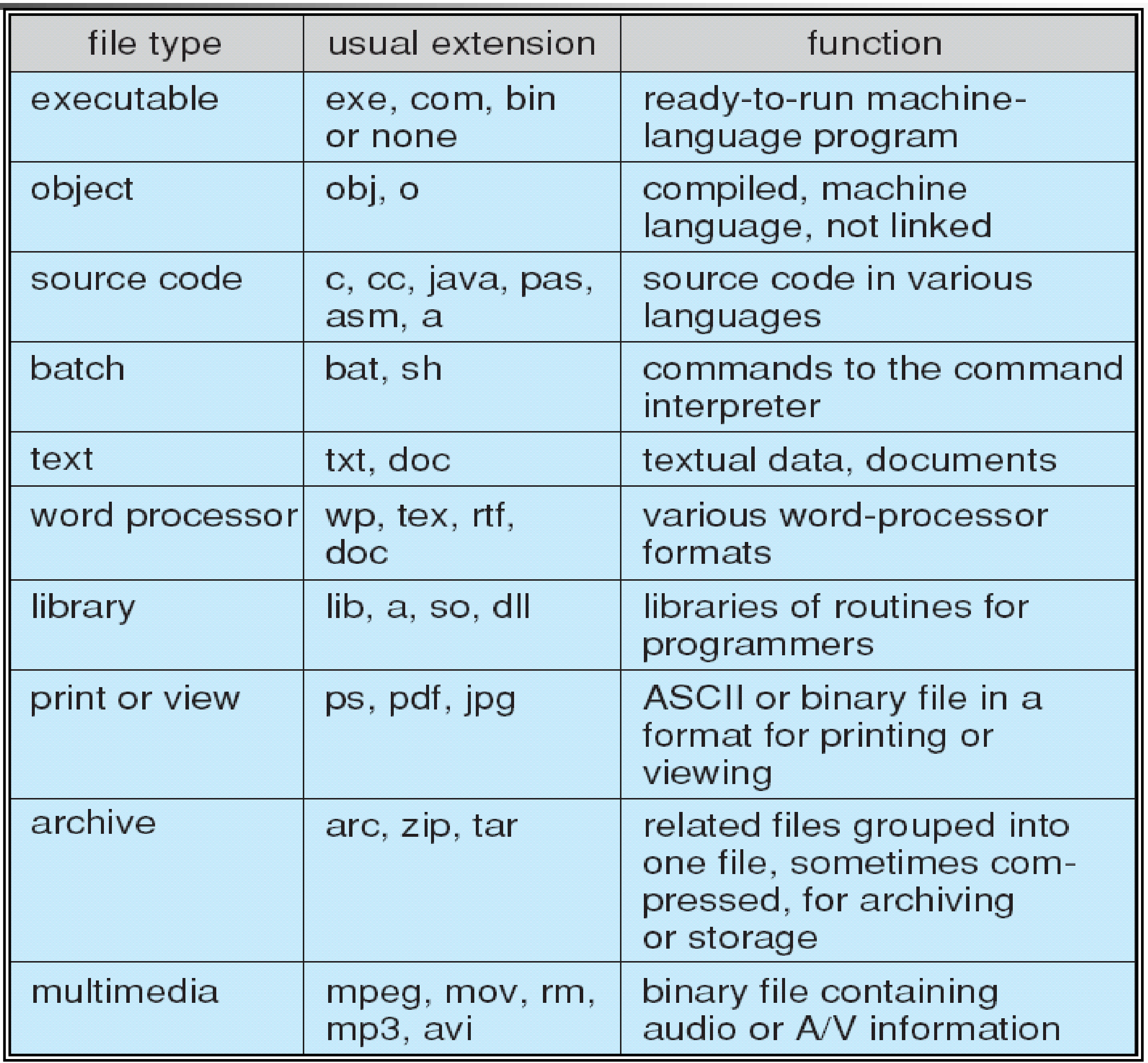
File Operations

- Create
- Write
- Read
- Reposition within file – file seek
- Delete
- Truncate（截短）— erase the contents of a file but keep its attributes.

File Operations (Cont.)

- 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.
- Two levels of internal tables
  - A per-process table
  - A system-wide table

File Types



file type	usual extension	function
executable	exe, com, bin or none	ready-to-run machine-language program
object	obj, o	compiled, machine language, not linked
source code	c, cc, java, pas, asm, a	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, a, so, dll	libraries of routines for programmers
print or view	ps, pdf, jpg	ASCII or binary file in a format for printing or viewing
archive	arc, zip, tar	related files grouped into one file, sometimes compressed, for archiving or storage
multimedia	mpeg, mov, rm, mp3, avi	binary file containing audio or A/V information

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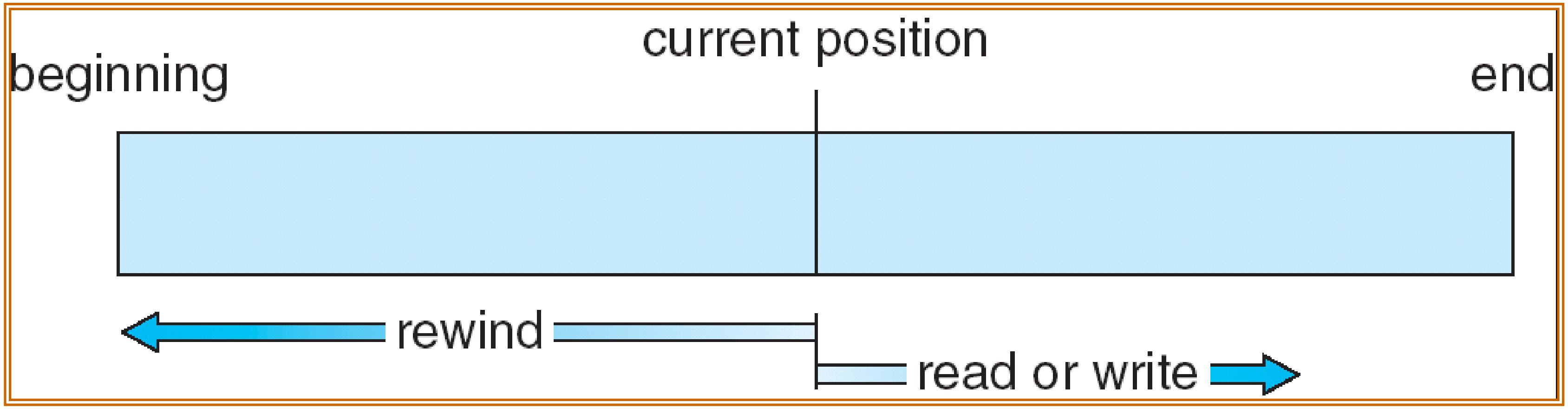
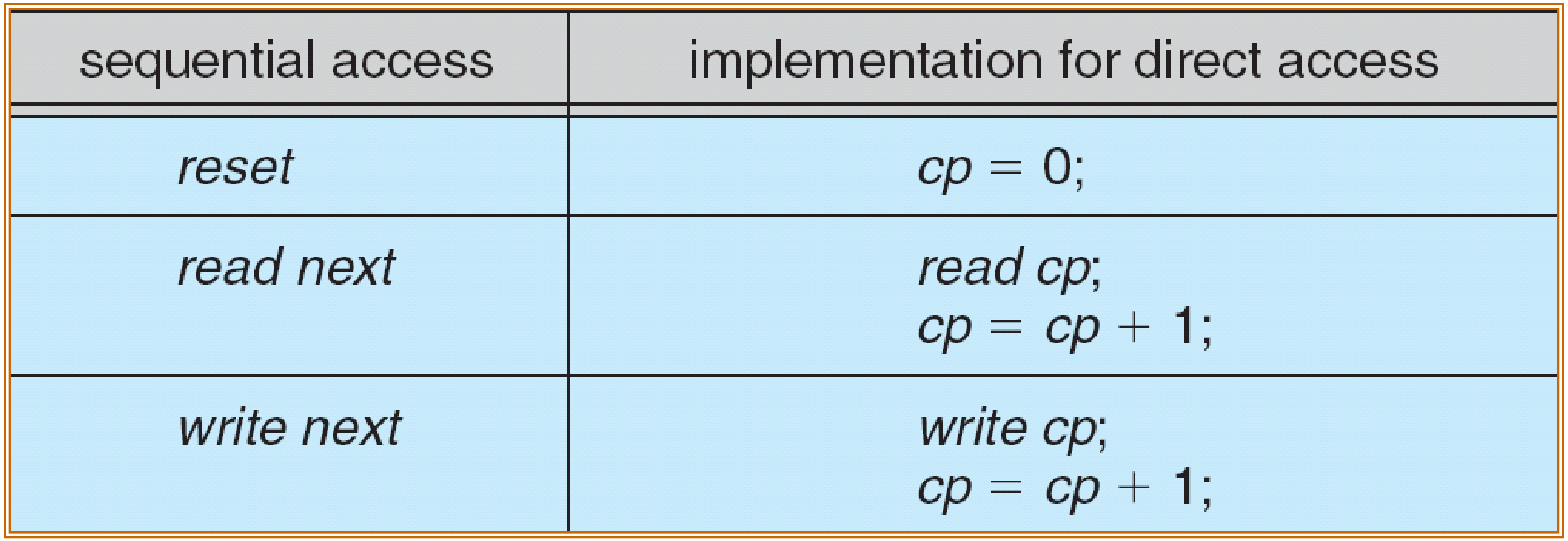
Access Methods

- **Sequential Access**



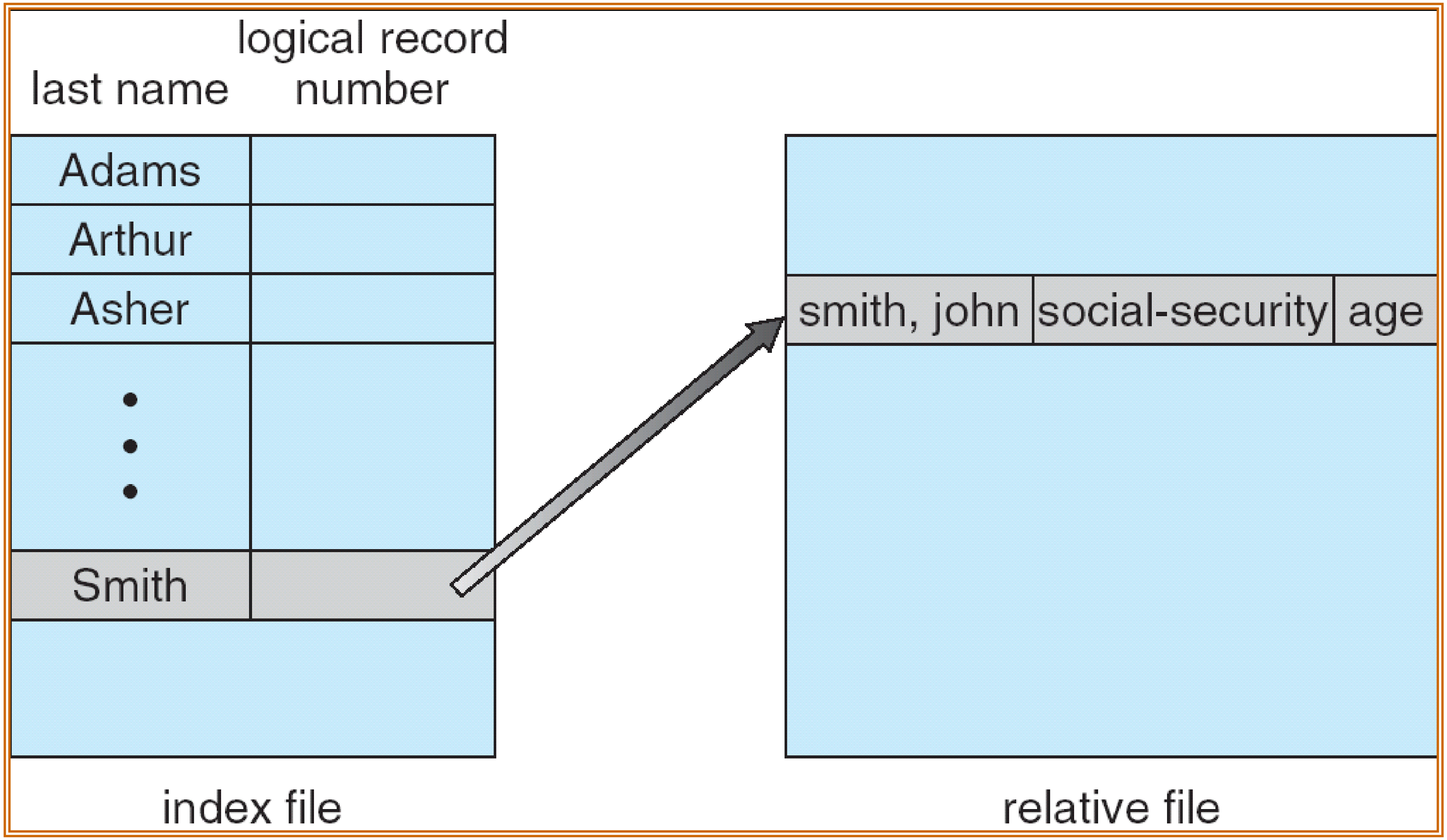
- **Direct Access**

Simulation of Sequential Access on a Direct-access File



sequential access	implementation for direct access
reset	$cp = 0;$
read next	*read* cp; $cp = cp + 1;$
write next	*write* cp; $cp = cp + 1;$

Example of Index and Relative Files



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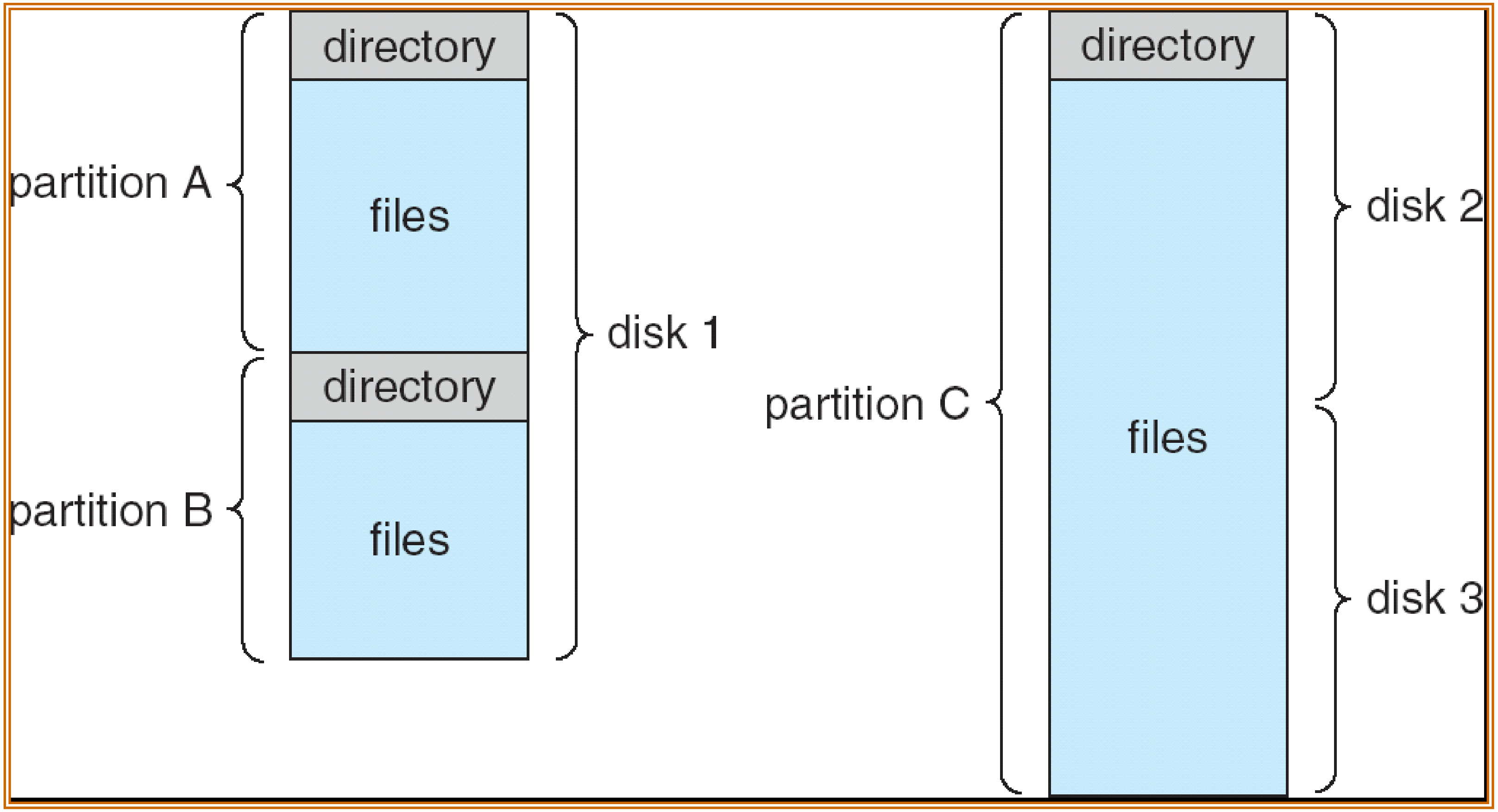
Directory Structure

- Disks are split into one or more partitions.
- Each partition contains information about files within it.
- The information is kept in entries in a device directory or volume table of contents

A Typical File-system Organization



Operations Performed on Directory

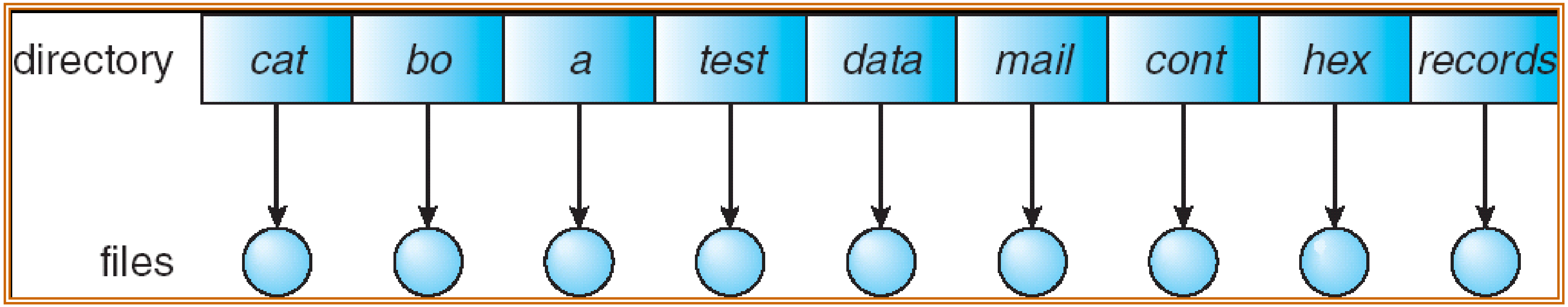
- Search for a file
- Create a file
- Delete a file
- List a directory
- Rename a file
- Traverse the file system

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, …)

Single-Level Directory

- A single directory for all users

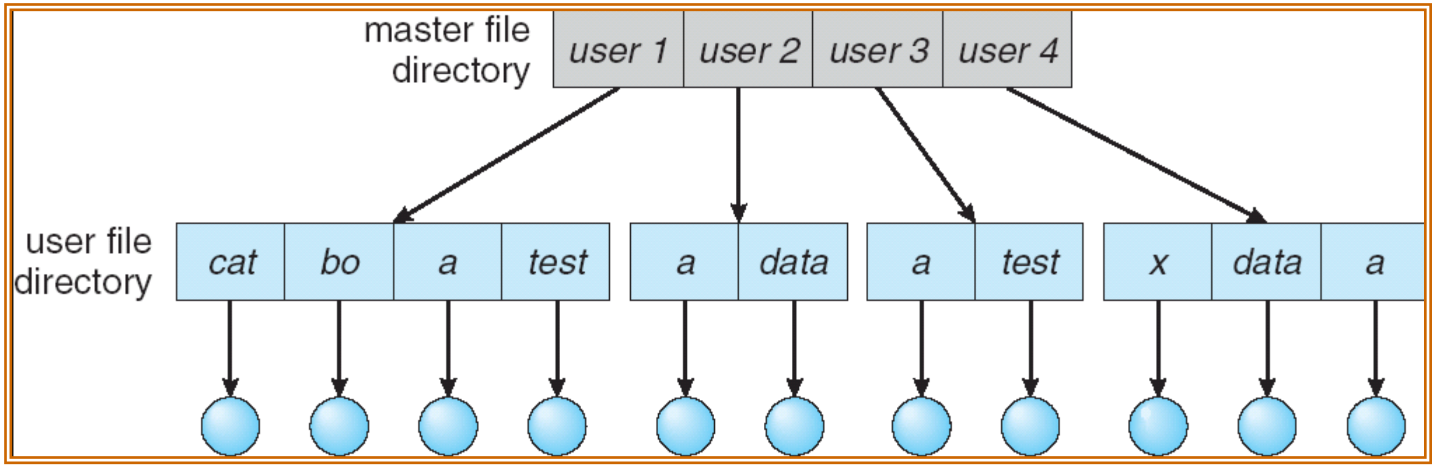


Naming problem

Grouping problem

Two-Level Directory

- Separate directory for each user



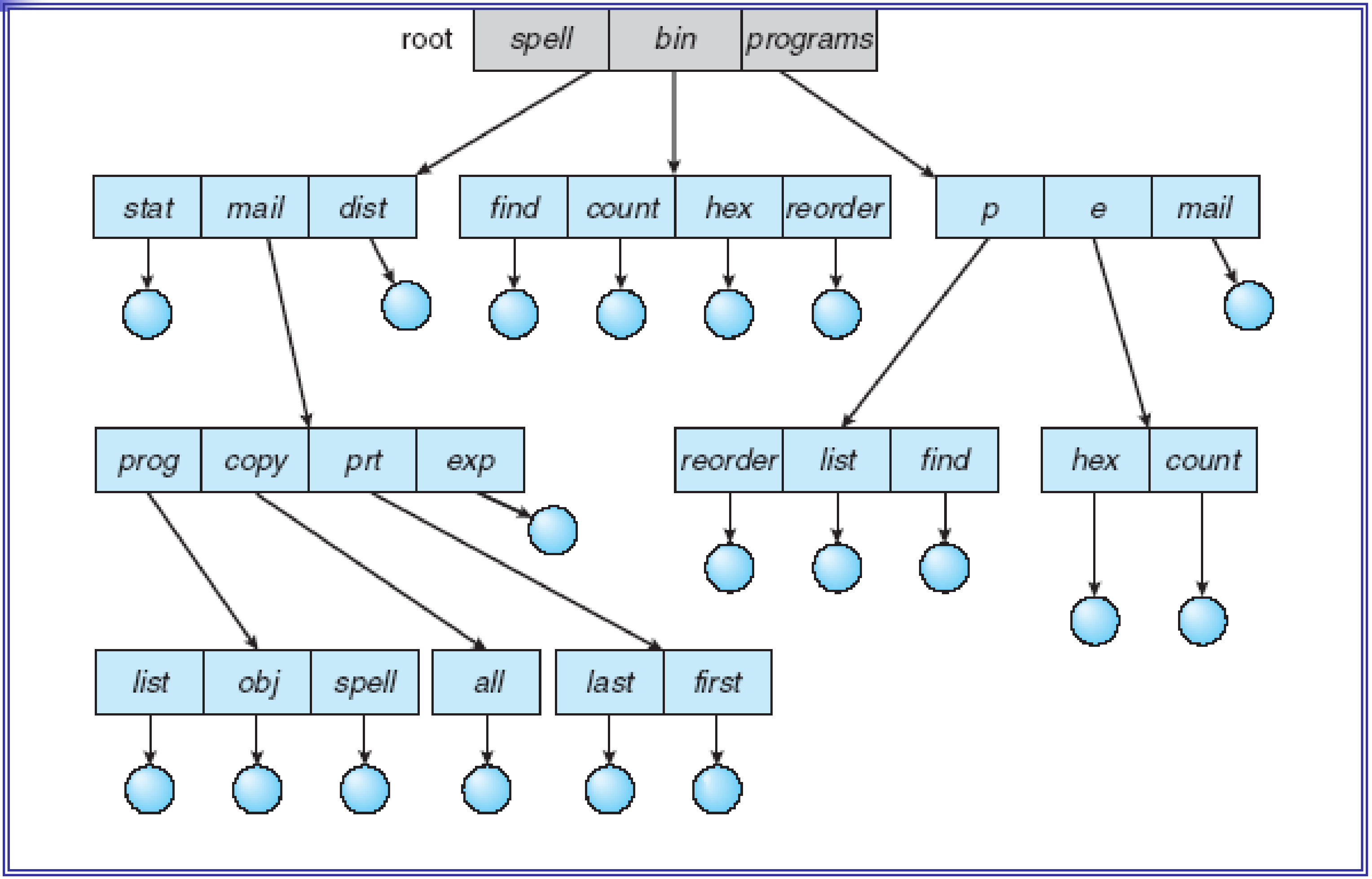
Path name

Can have the same file name for different user

Efficient searching

No grouping capability

Tree-Structured Directories



Tree-Structured Directories

- Efficient searching
- Grouping Capability
- Current directory (working directory)
  - cd /spell/mail/prog
- Absolute or relative path name
- Creating a new file is done in current directory
- Delete a file
  - rm <file-name>

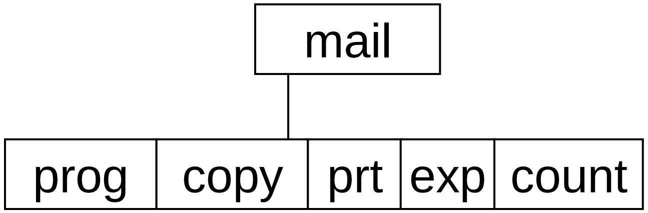
Tree-Structured Directories

- **Creating a new subdirectory is done in current directory.**

mkdir <dir-name>

Example: if in current directory /mail

mkdir count



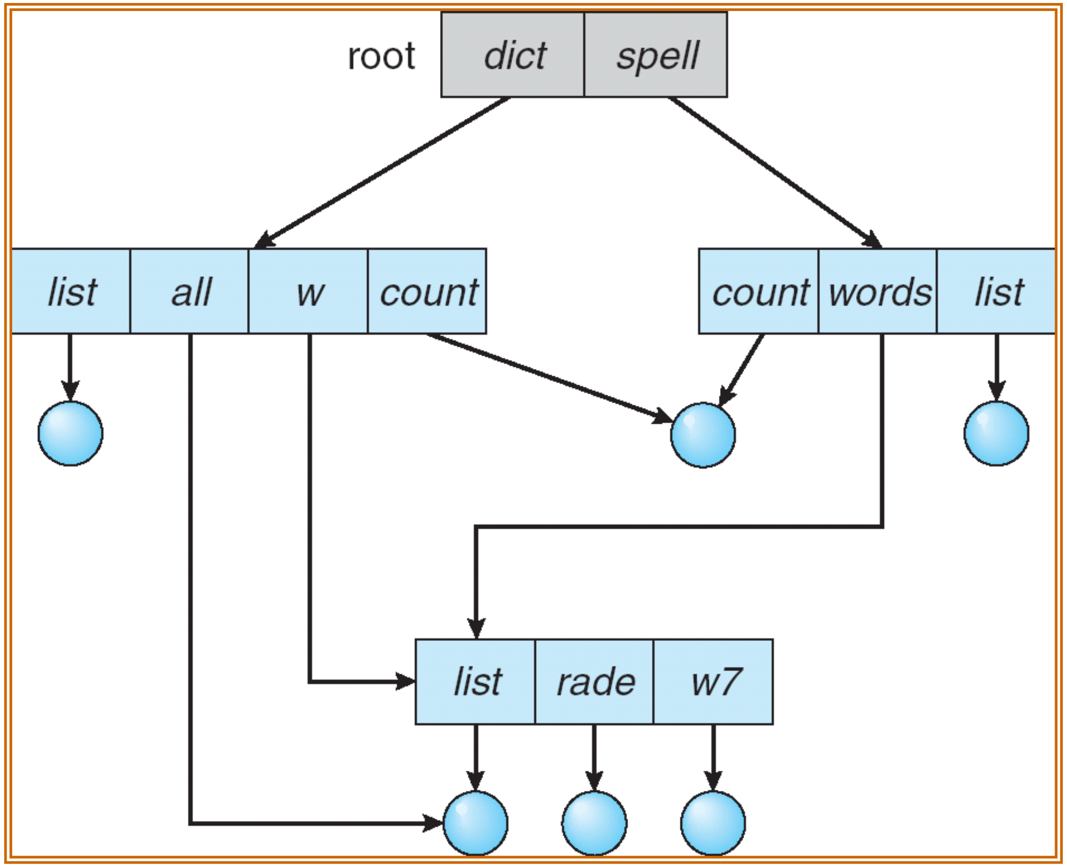
mail

prog copy prt exp count

Deleting “mail” ⇒ deleting the entire subtree rooted by “mail”.

Acyclic-Graph Directories

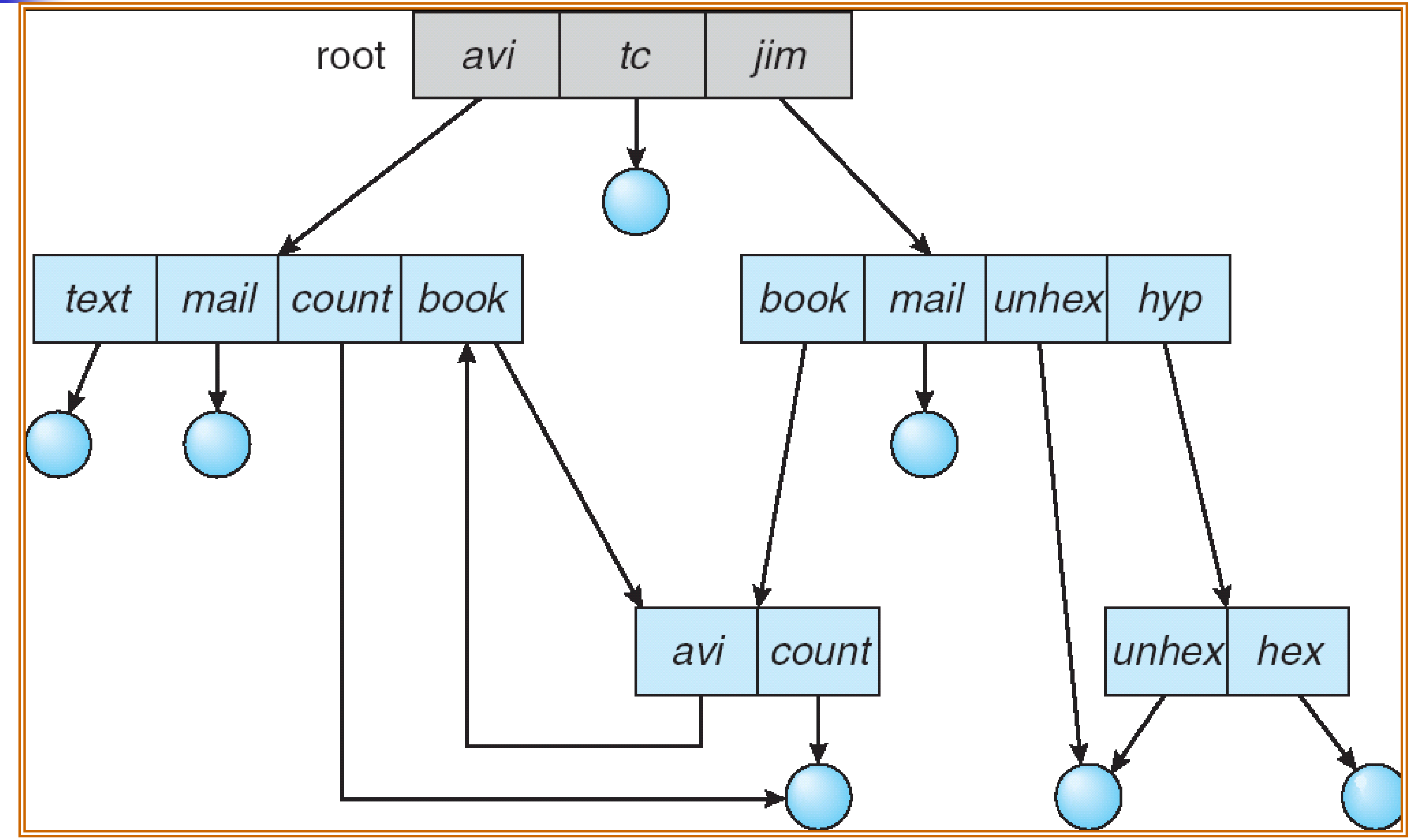
- Have shared subdirectories and files.



Acyclic-Graph Directories

- Two different names (aliasing)
- If *dict* deletes *count* ⇒ dangling pointer.
- Solutions:
  - Backpointers, so we can delete all pointers.
  - Entry-hold-count solution.

General Graph Directory



General Graph Directory

- 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.

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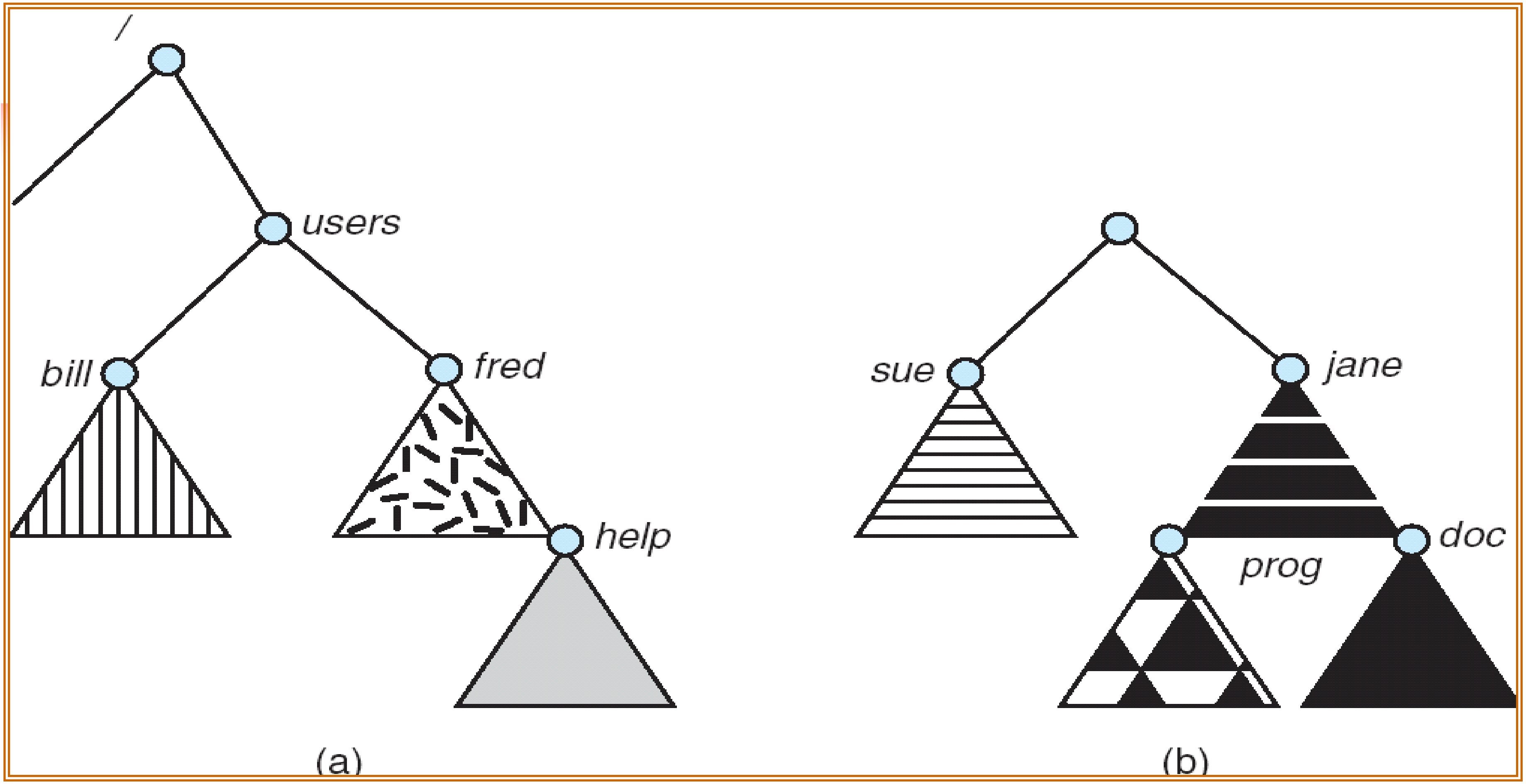
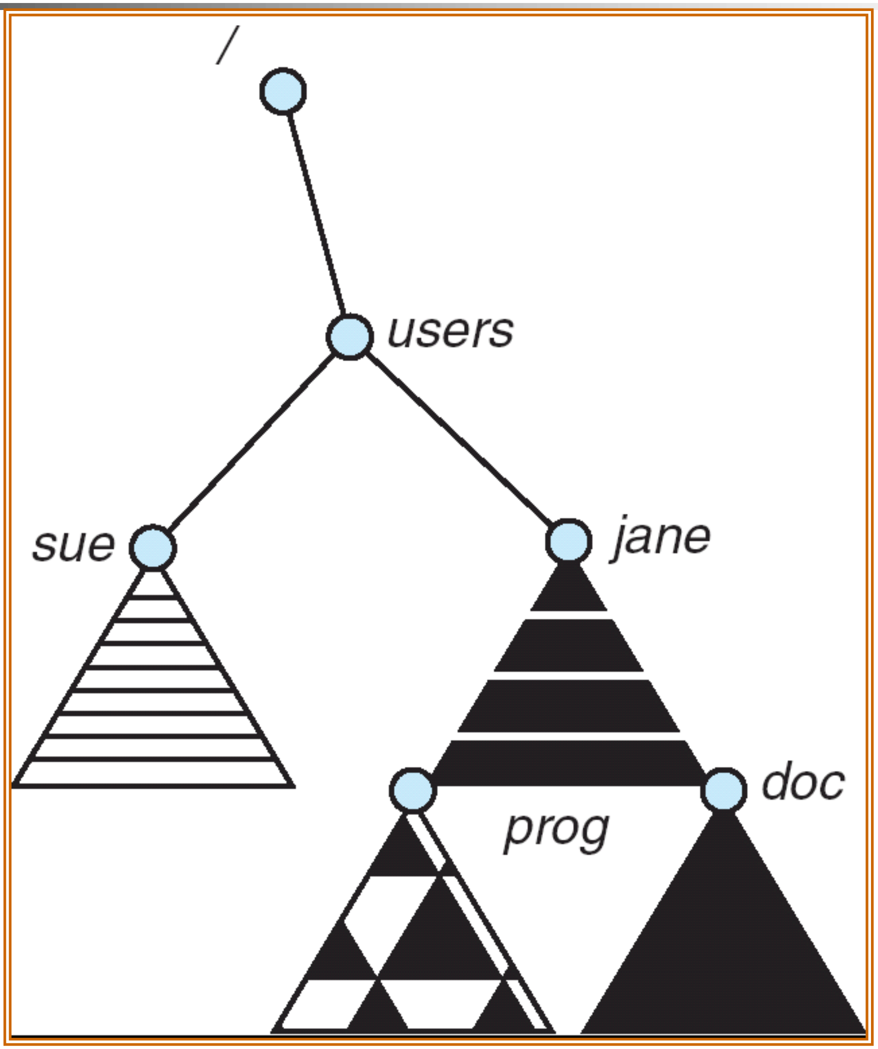
File System Mounting

- A file system must be mounted before it can be accessed.
- An unmounted file system is mounted at a mount point.



(a) Existing **(b) Unmounted Partition**

Mount Point



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File Sharing

- **Sharing of files on multi-user systems is desirable.**
- **Sharing may be done through a *protection* scheme.**
- **On distributed systems, files may be shared across a network.**
- **Network File System (NFS) is a common distributed file-sharing method.**

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Protection

- File owner/creator should be able to control:
  - what can be done by whom
- Types of access
  - Read
  - Write
  - Execute
  - Append
  - Delete
  - List

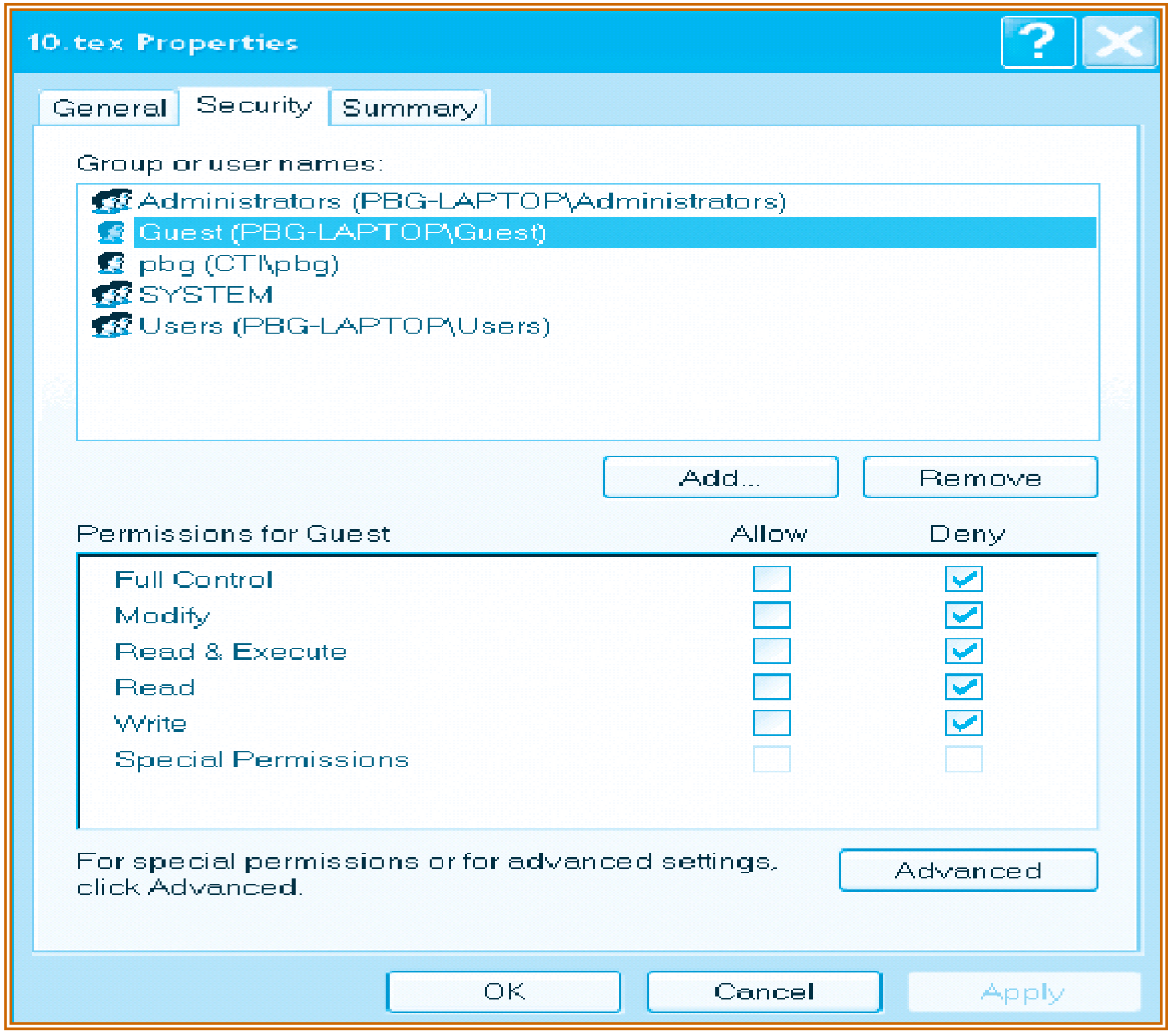
Access Lists and Groups

- Mode of access: read, write, execute
- Three classes of users

			RWX
a) owner access	7	⇒	1 1 1
b) group access	6	⇒	1 1 0
c) public access	1	⇒	0 0 1

- Ask manager to create a group (unique name), say G, and add some users to the group.
- For a particular file (say *game*) or subdirectory, define an appropriate access.

Windows XP Access-control List Management



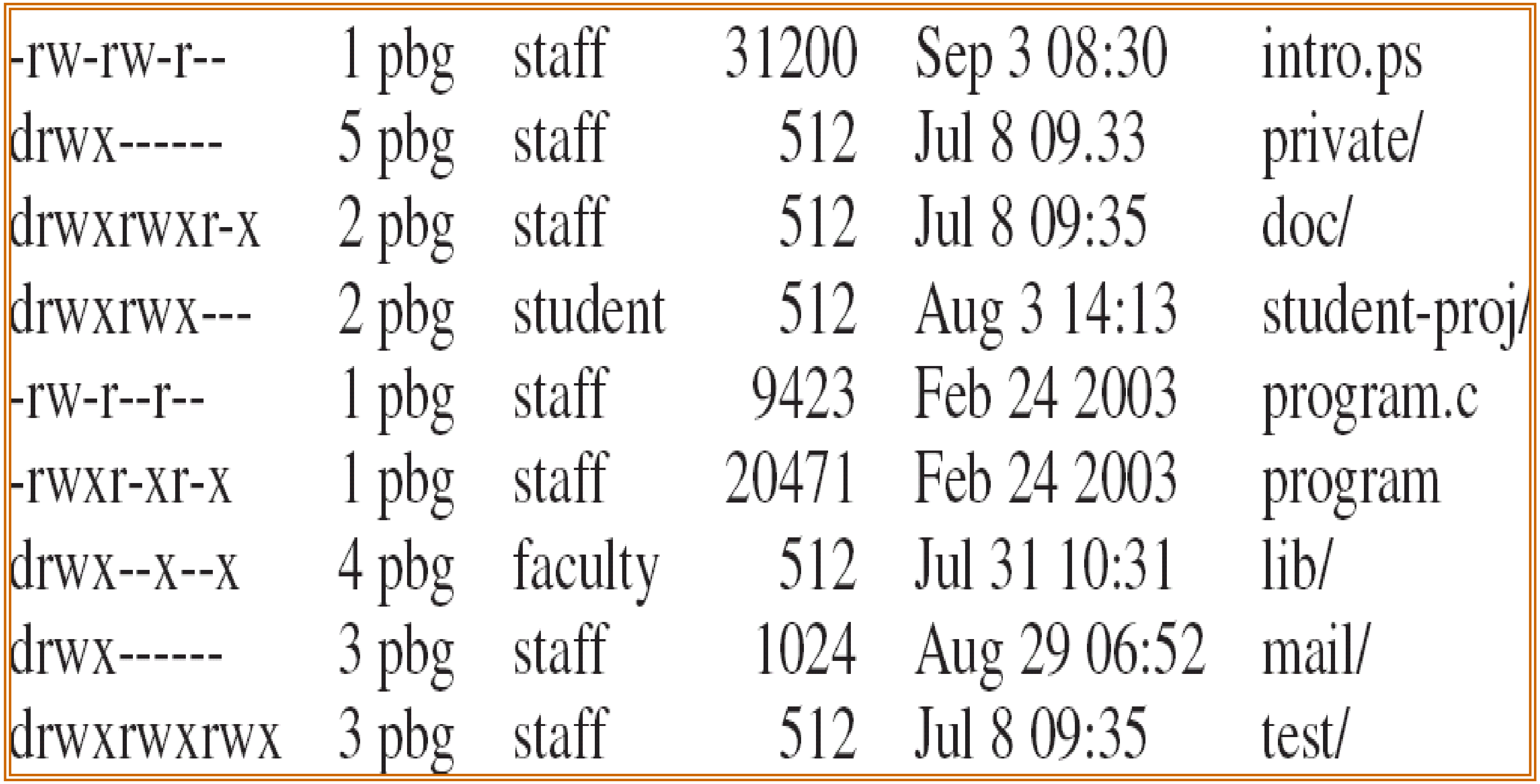
Group or user names:

- Administrators (PBG-LAPTOP\Administrators)
- Guest (PBG-LAPTOP\Guest)
- pbg (CTI\pbg)
- SYSTEM
- Users (PBG-LAPTOP\Users)

Permissions for Guest	Allow	Deny
Full Control	□	☑
Modify	□	☑
Read & Execute	□	☑
Read	□	☑
Write	□	☑
Special Permissions	□	□

For special permissions or for advanced settings, click Advanced.

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/
```