操作系统原理

第十一章：文件系统

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February 19, 2016

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File concept

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- Logical contiguous secondary storage
  - The smallest allotment of logical continuous secondary storage from a user's perspective

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- Types

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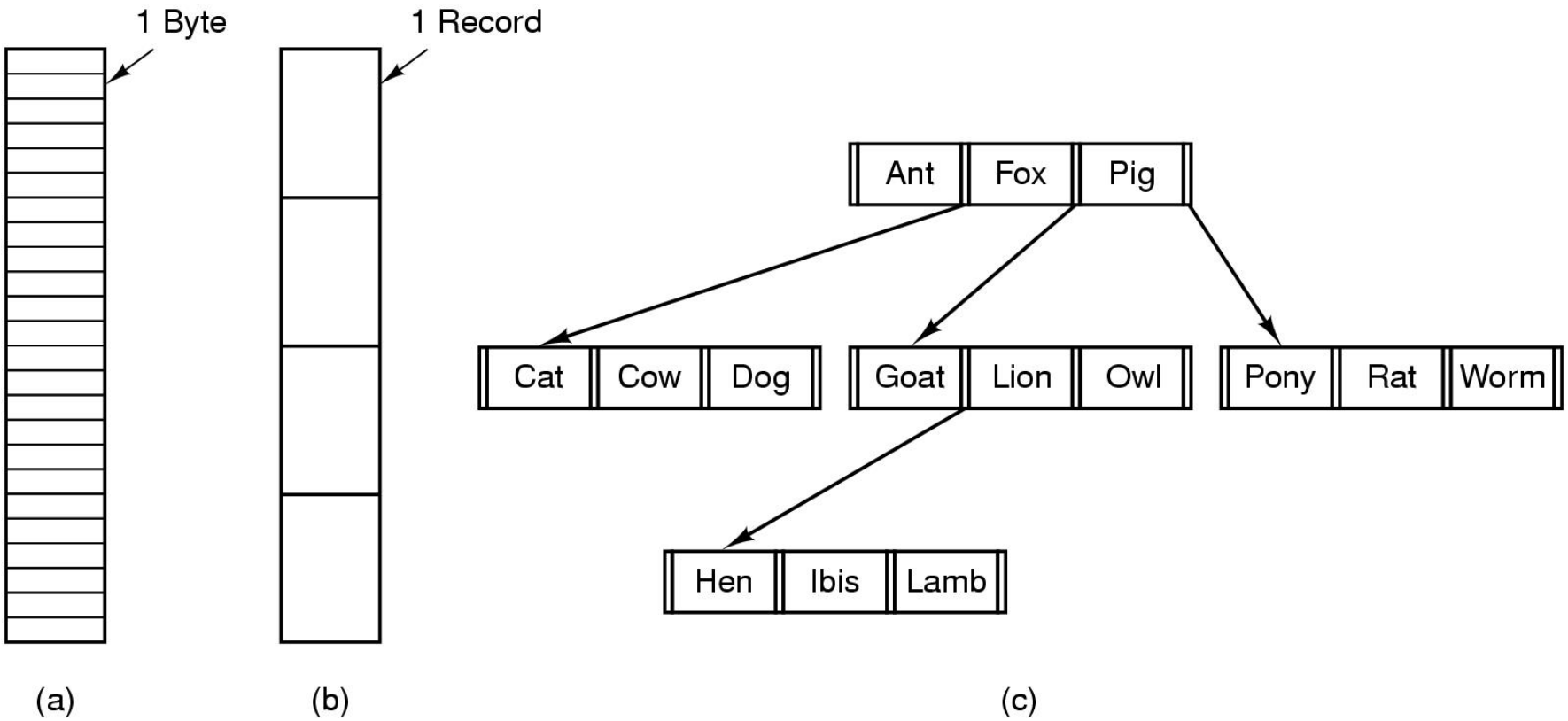

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- All these information about files are kept in the directory structure, which is maintained on the device

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file type	usual extension	function
executable	exe, com, bin or none	read 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, rrf, doc	various word-processor formats
library	lib, a, so, dll, mpeg, mov, rm	libraries of routines for programmers
print or view	arc, zip, tar	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	binary file containing audio or A/V information

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  - essential for database systems

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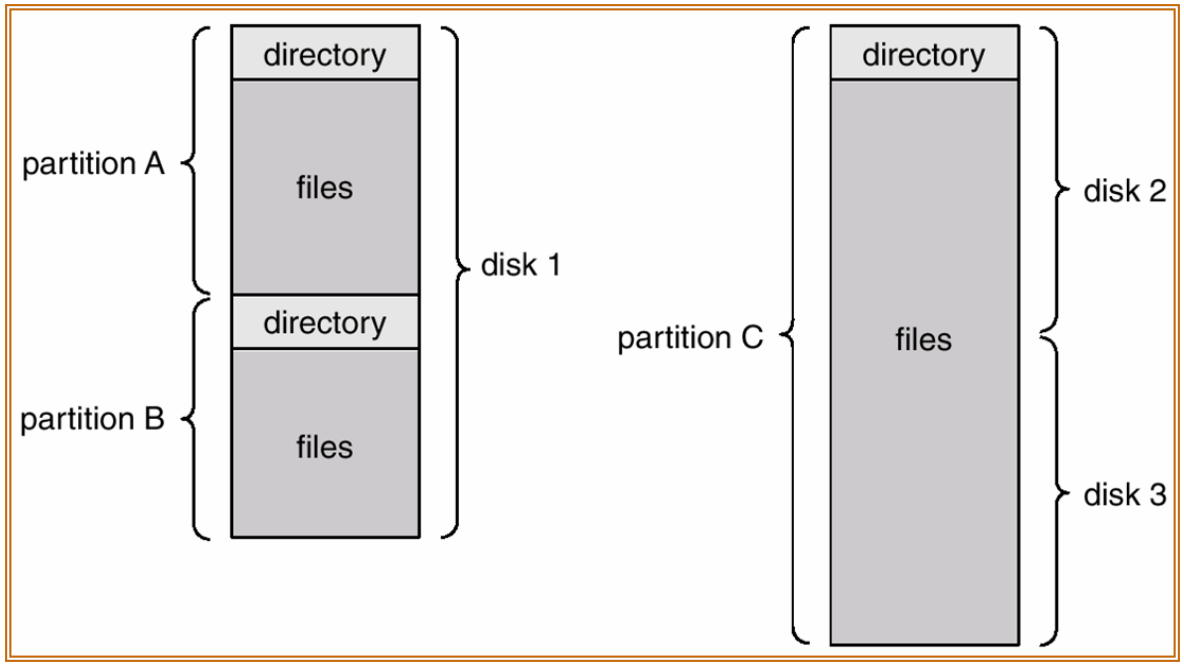

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- Create a file

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- List a directory

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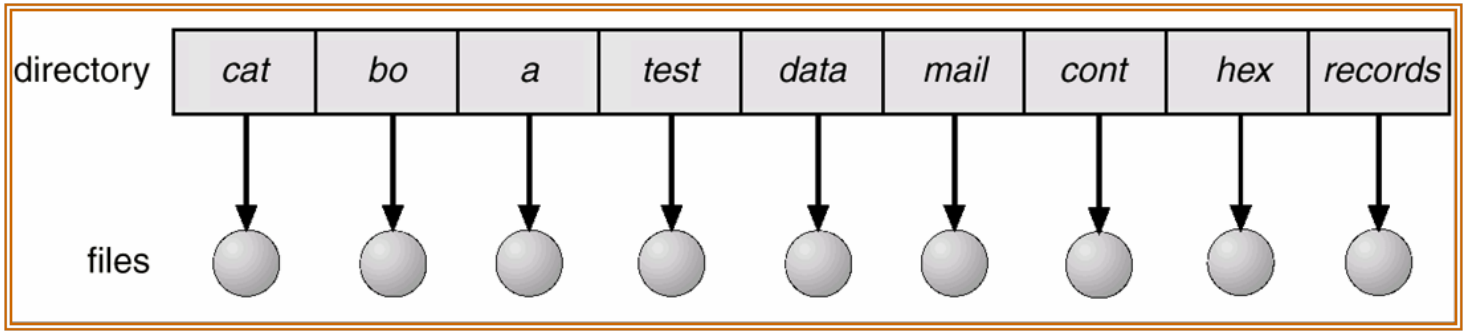
- Rename a file

Directory operations

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

Single-level directory

Single-level directory



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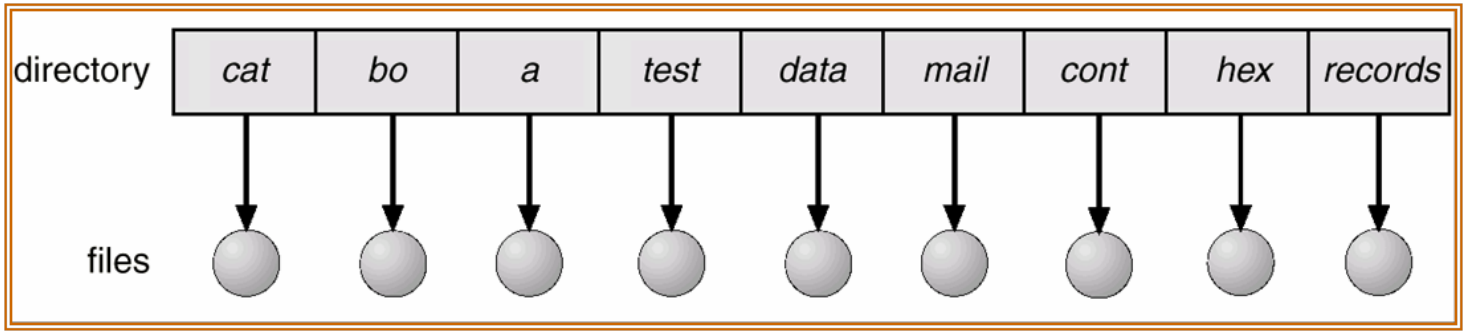

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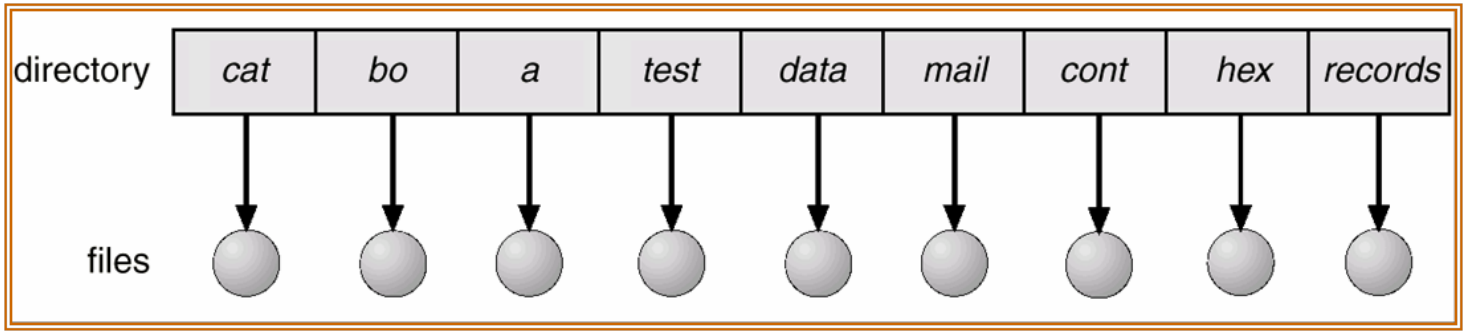

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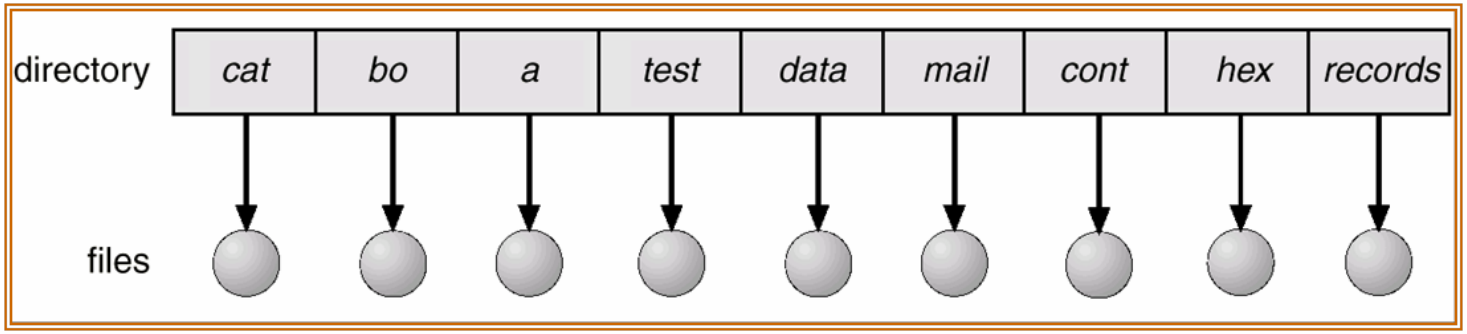

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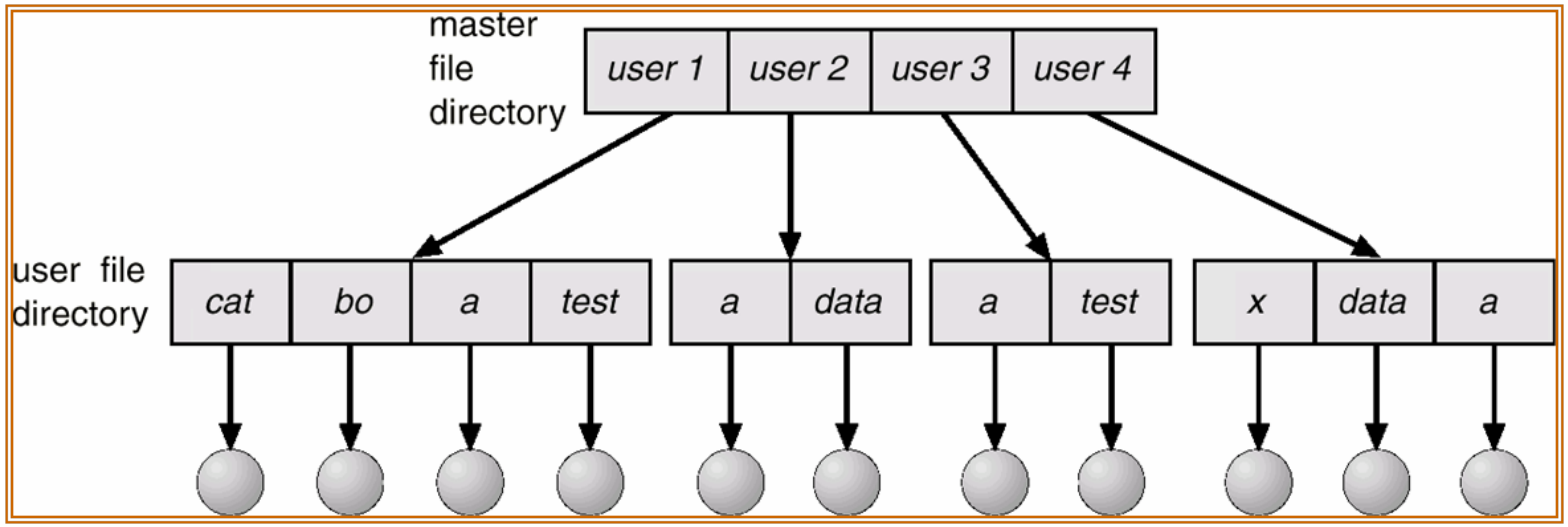

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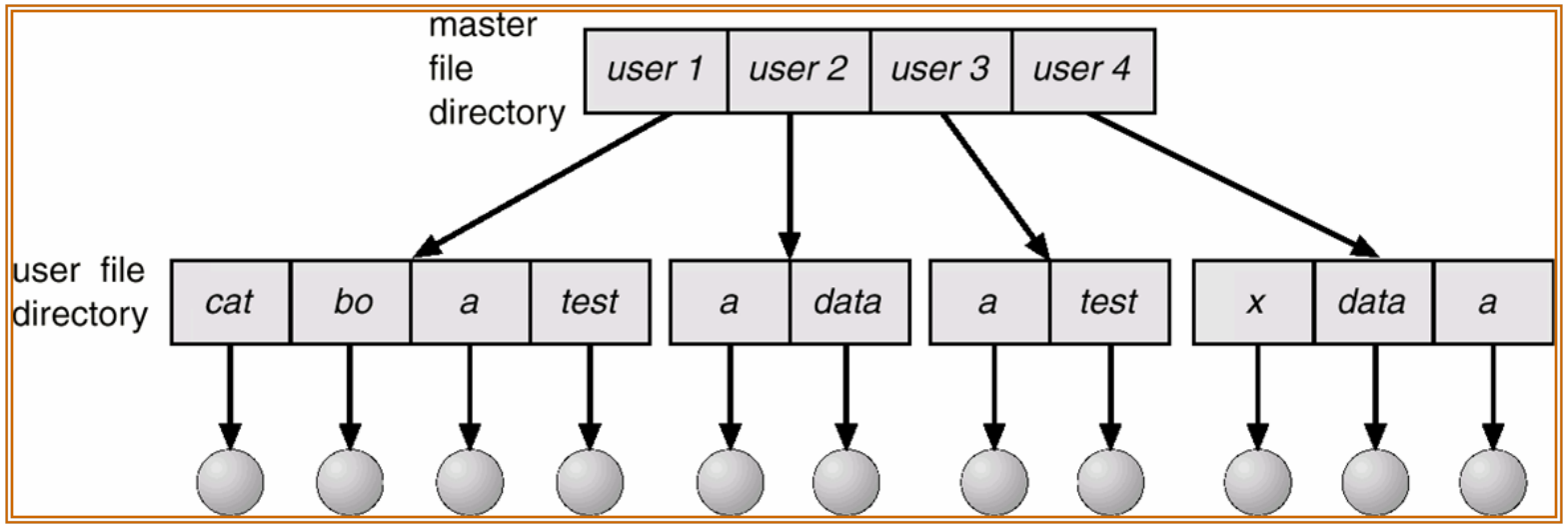

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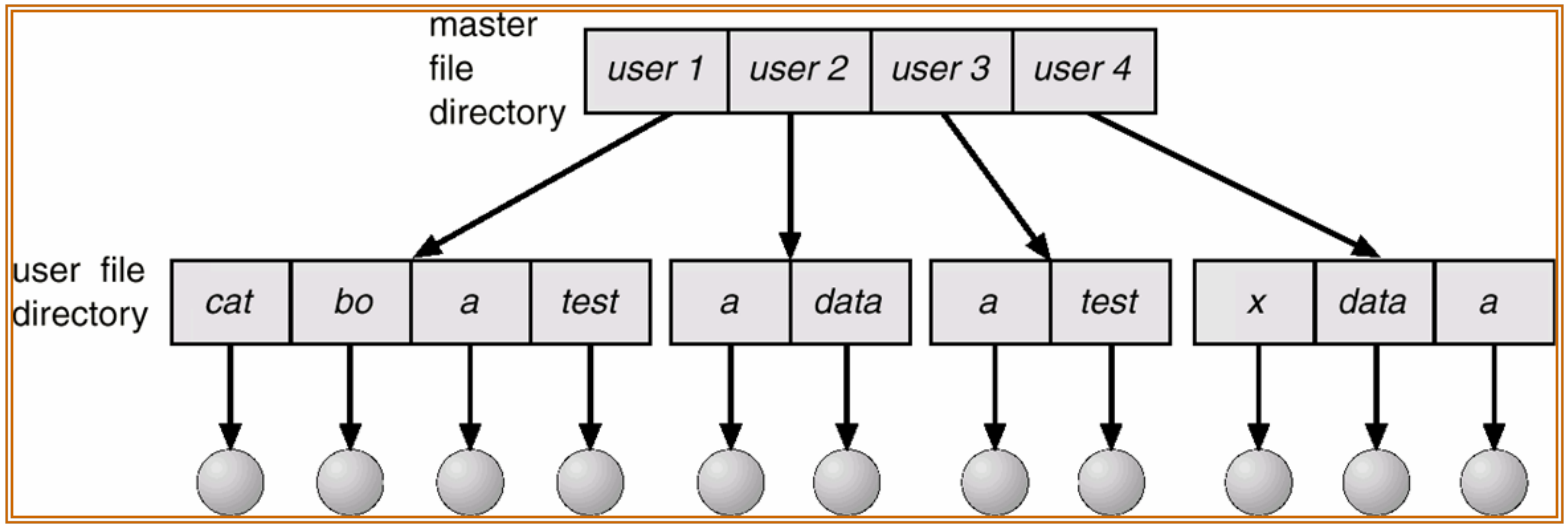

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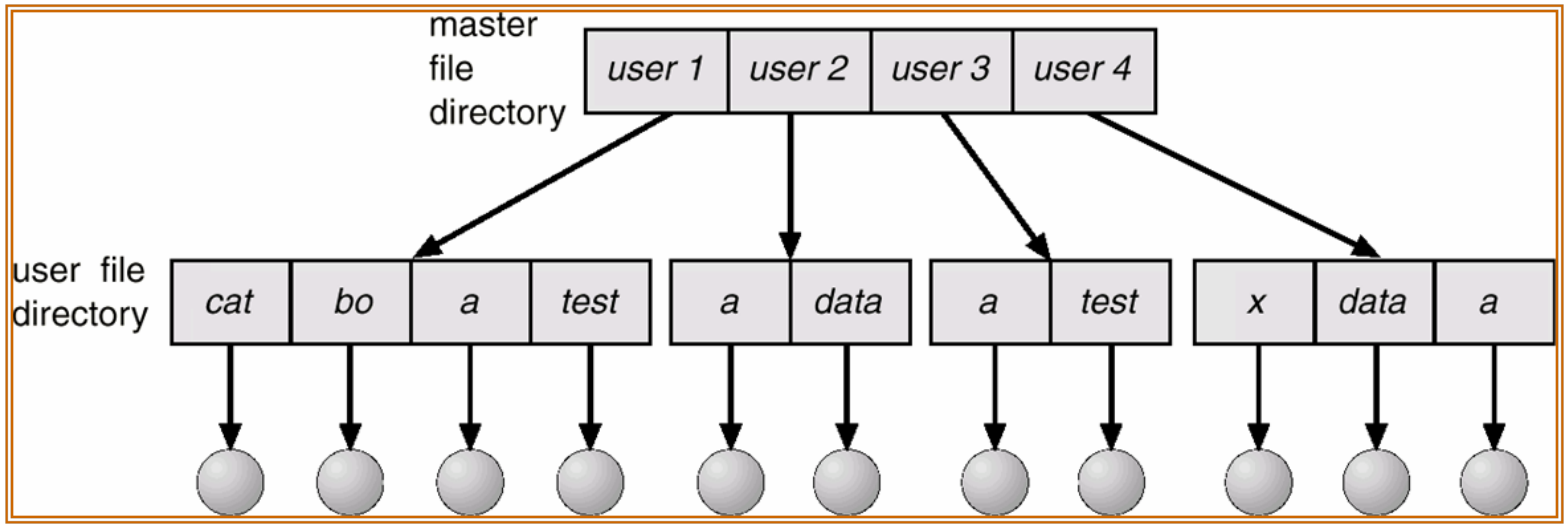

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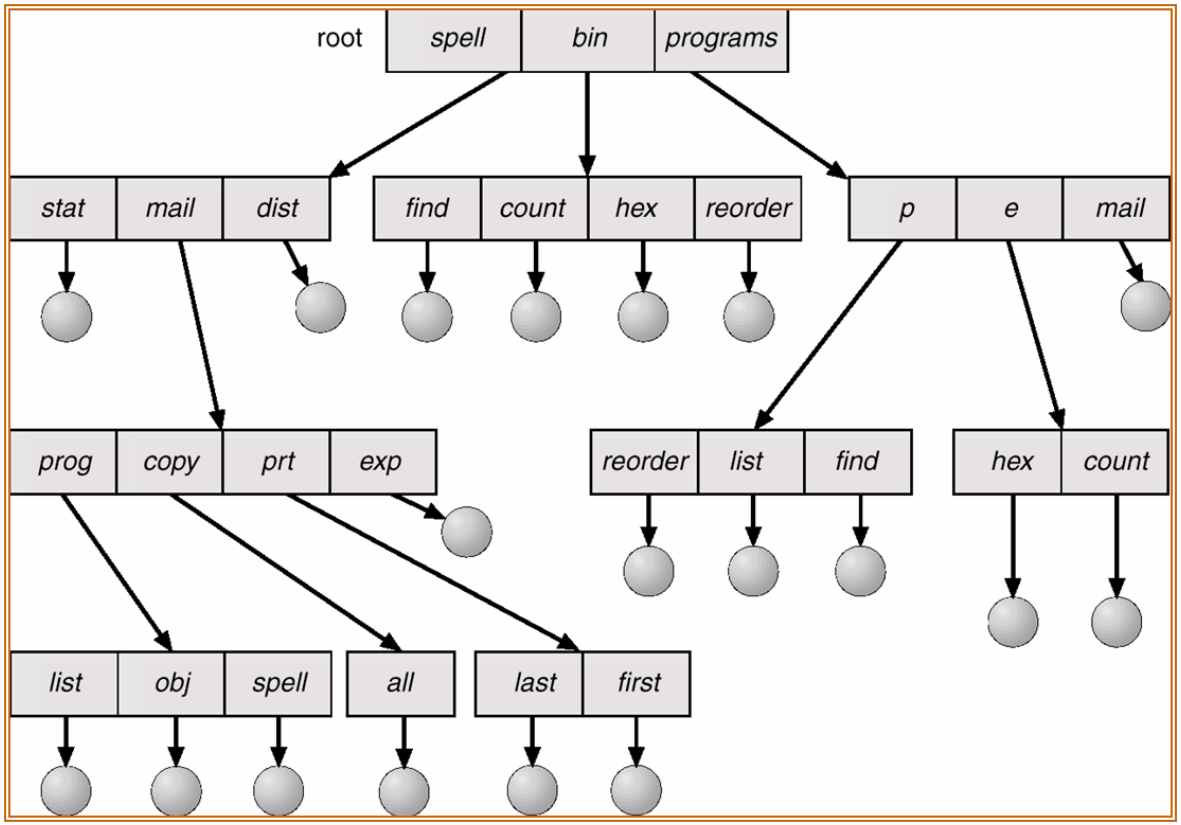

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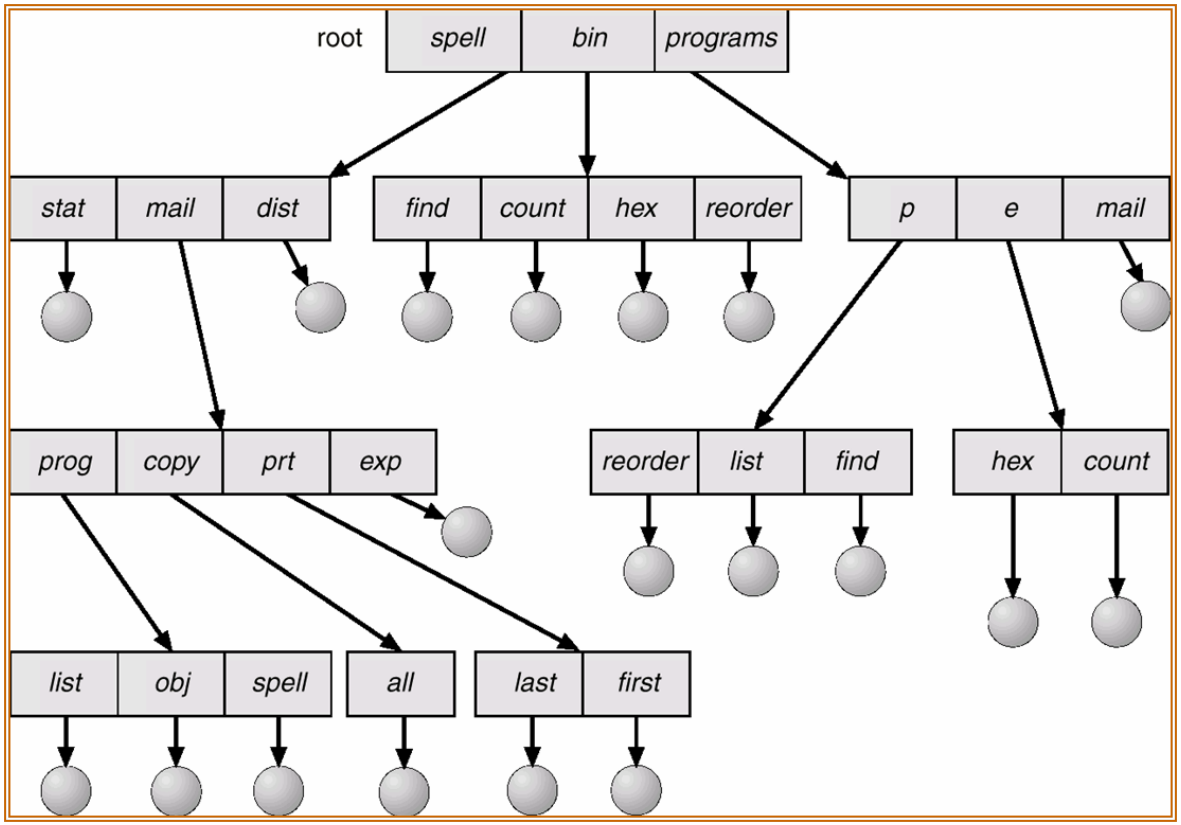

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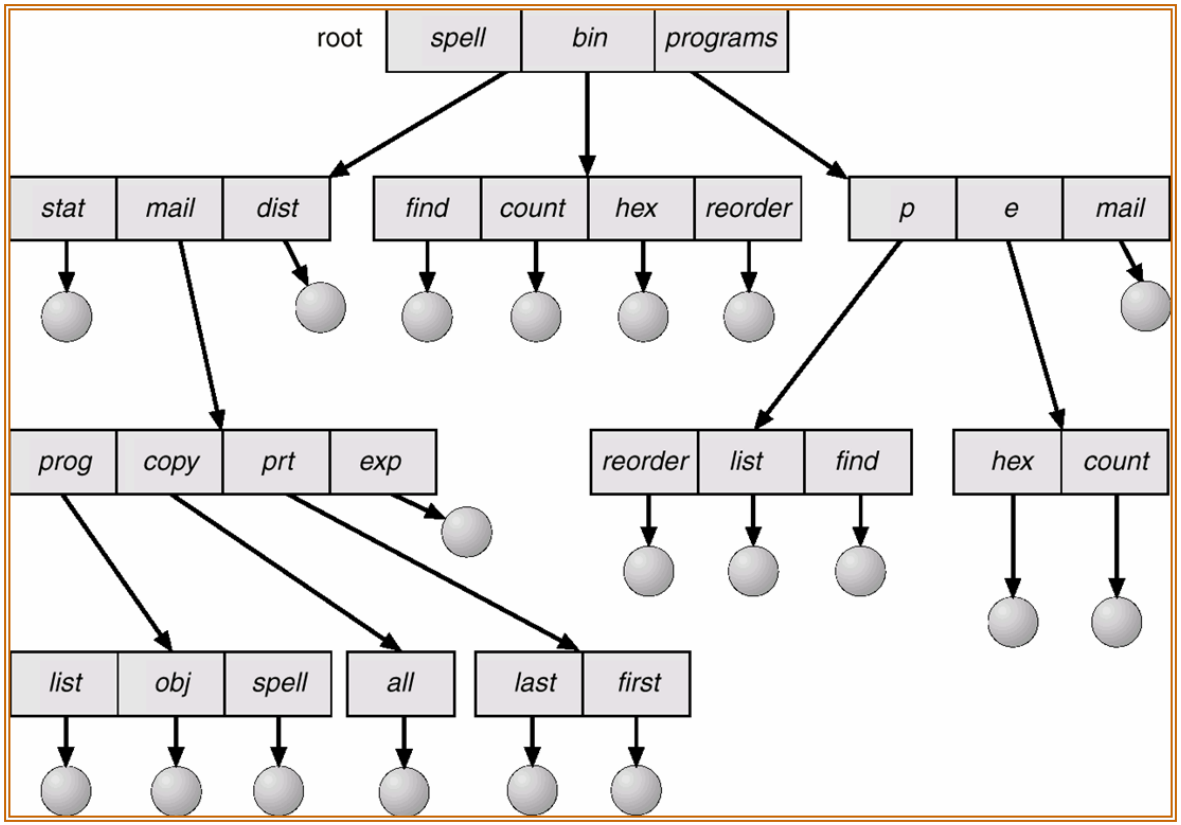

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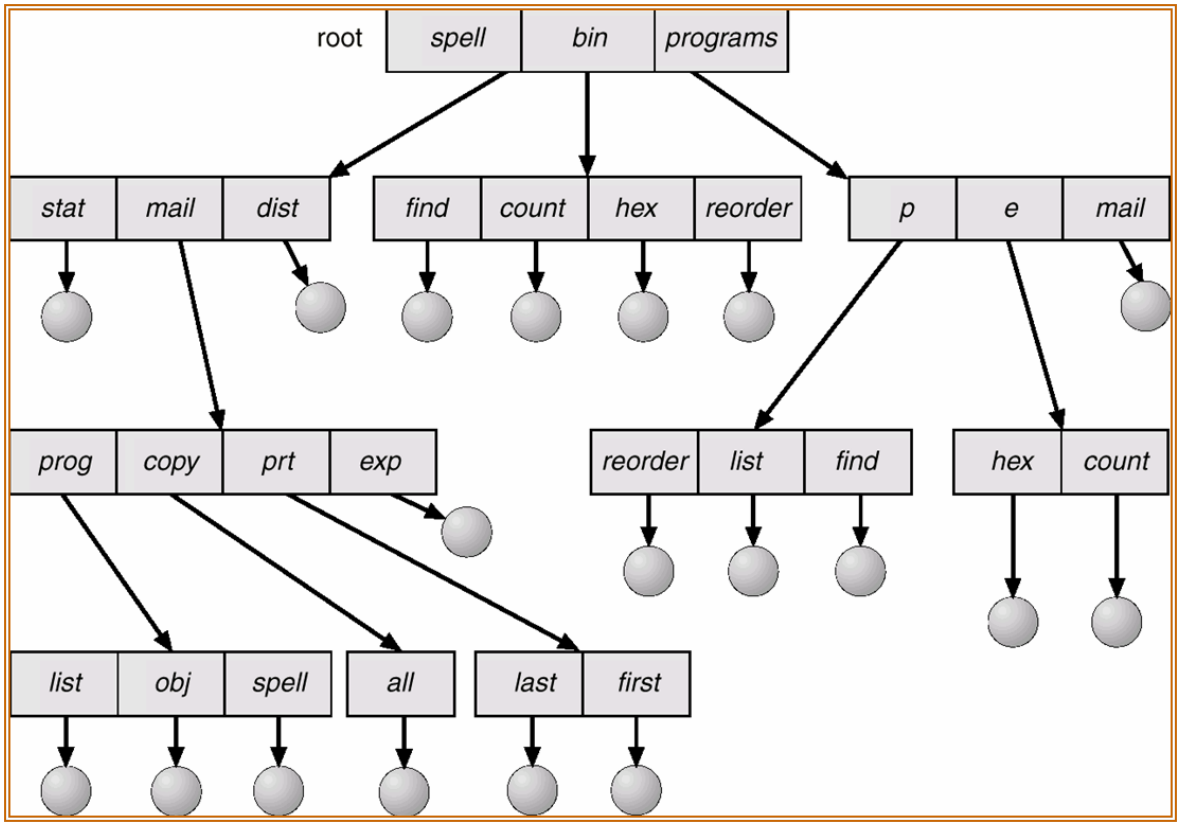

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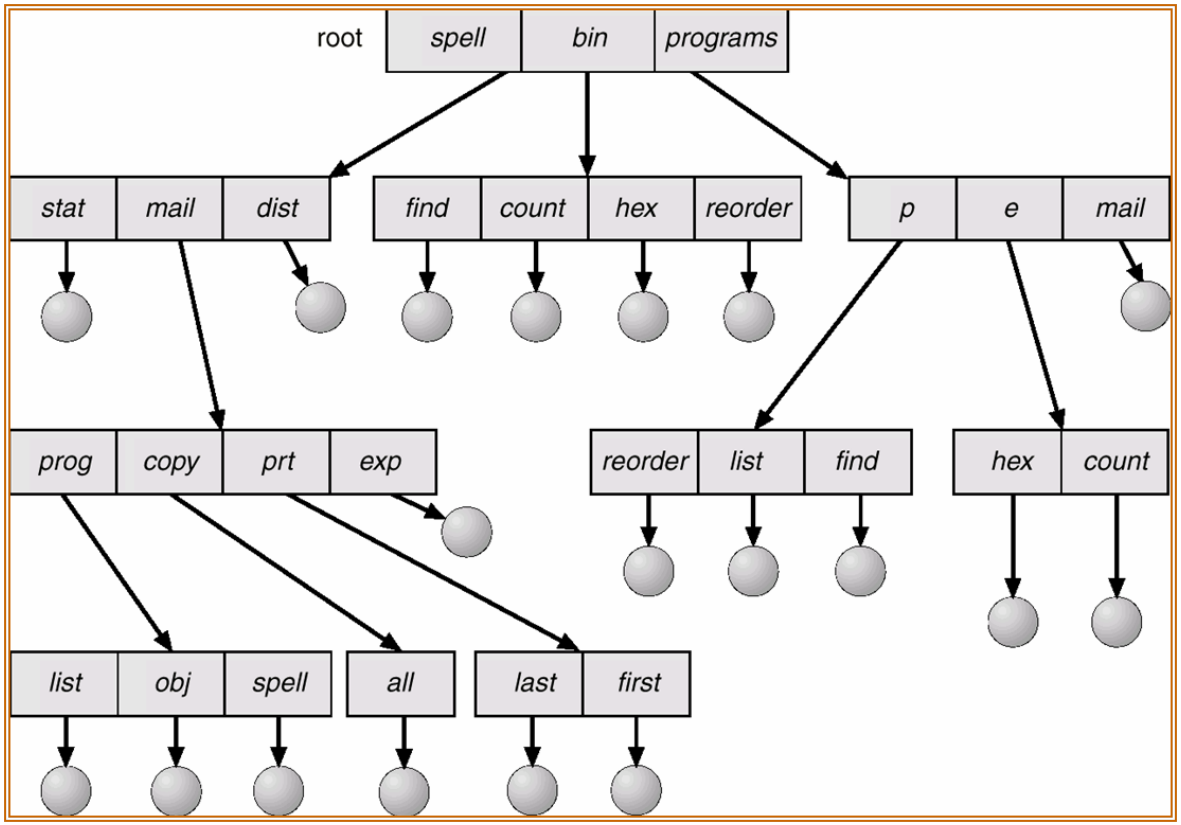

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  - *Working* (*current*) directory of each process

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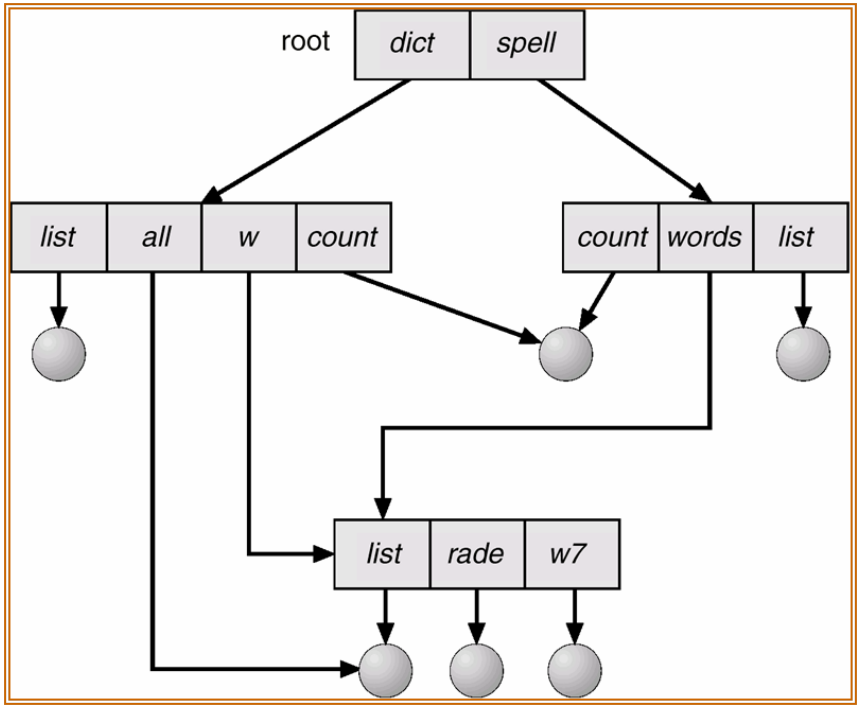

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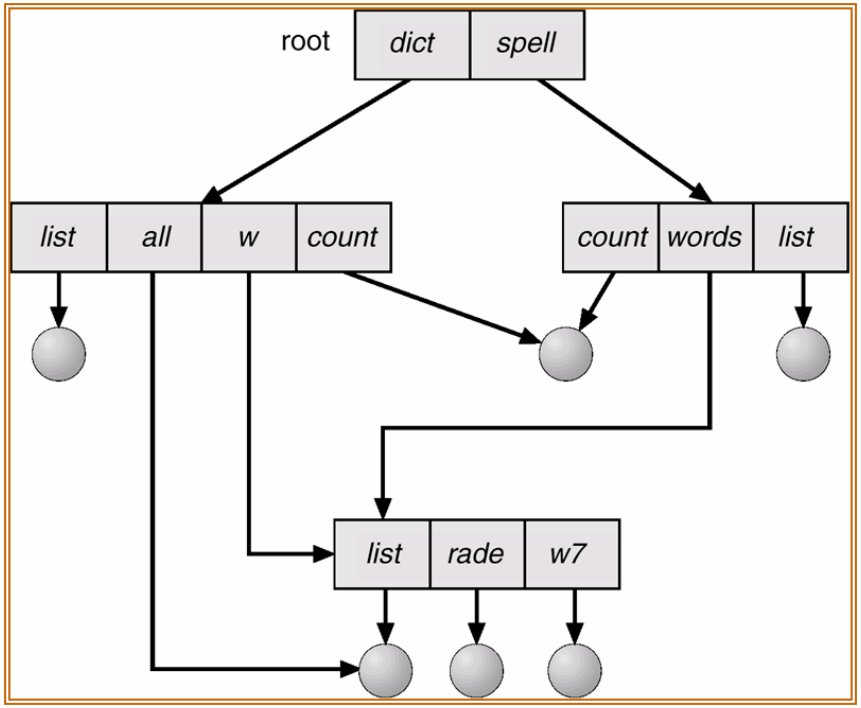

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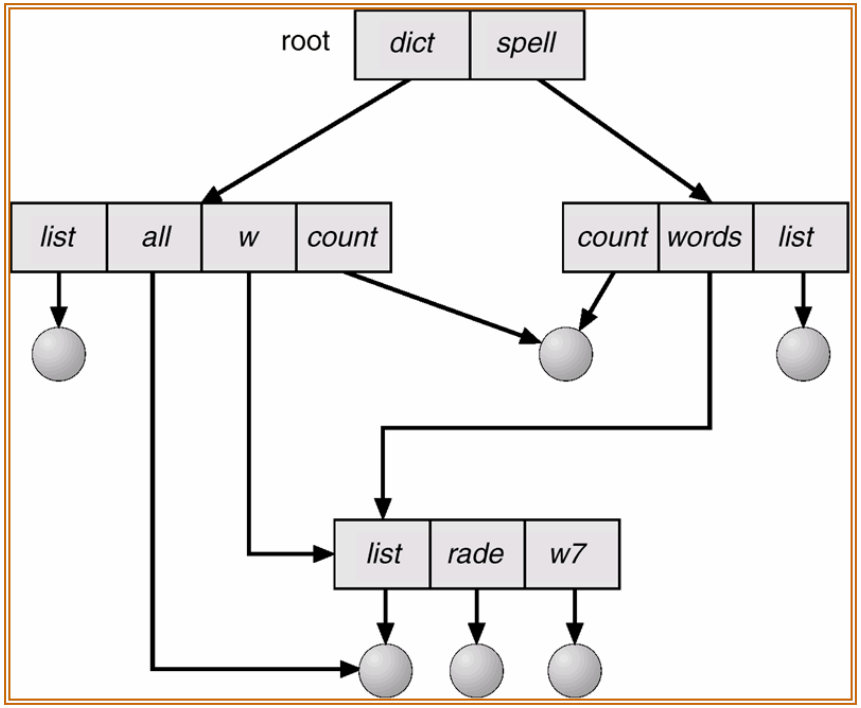

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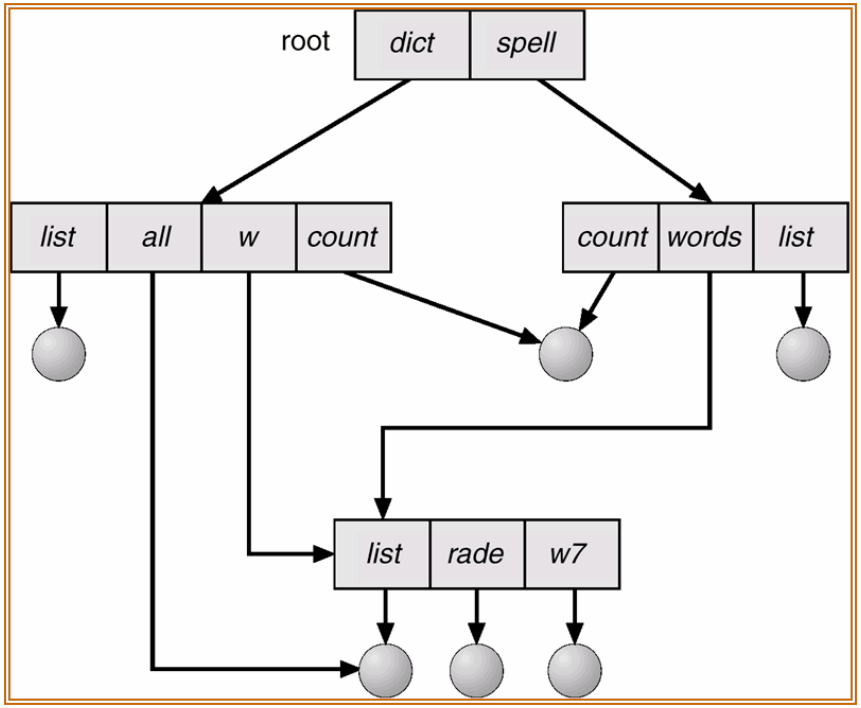

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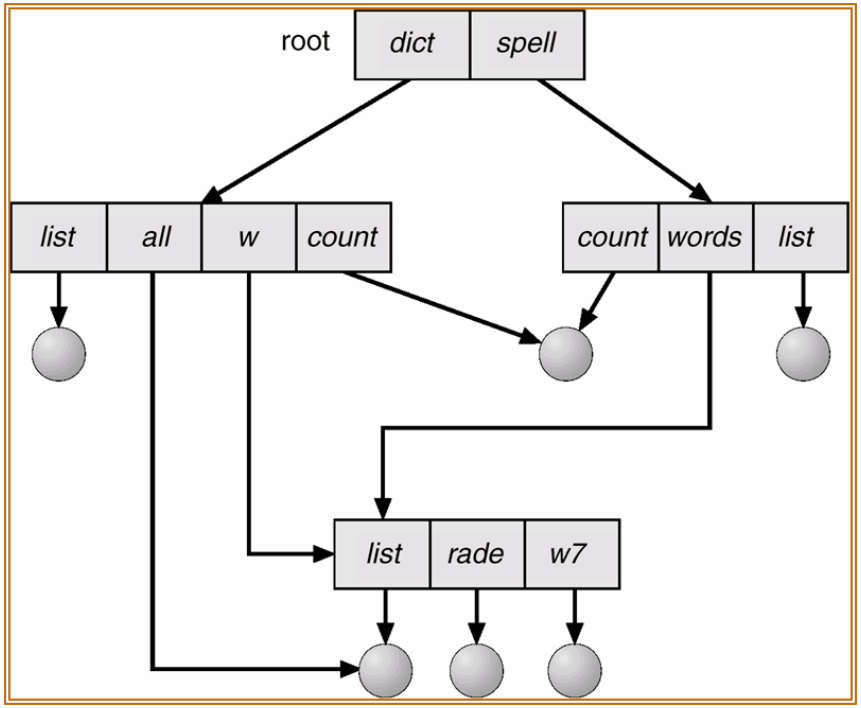

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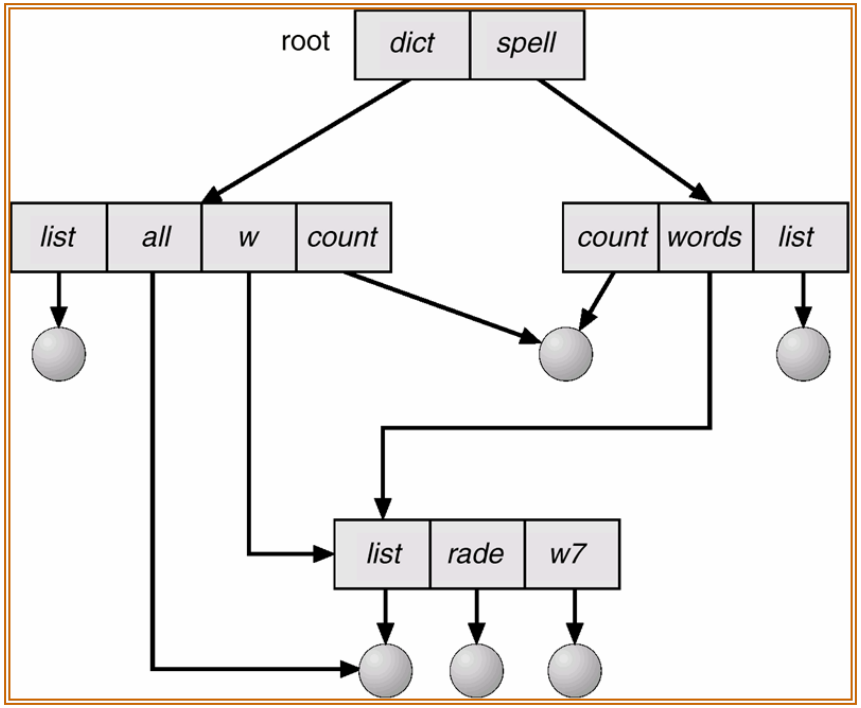

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    - UNIX/LINUX and Windows (7+) support it via *symbol link*

Questions

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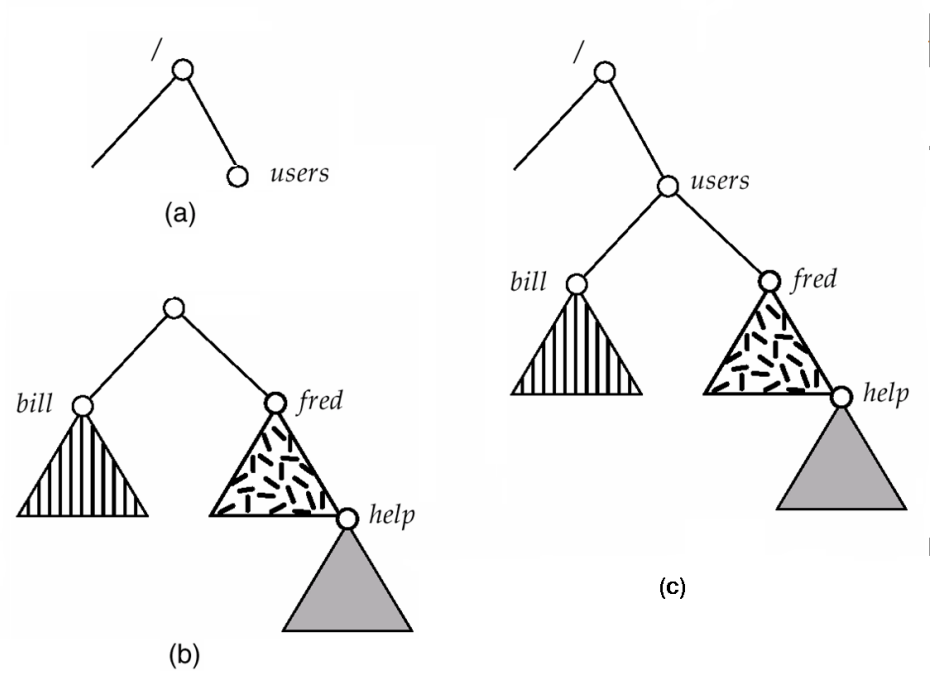

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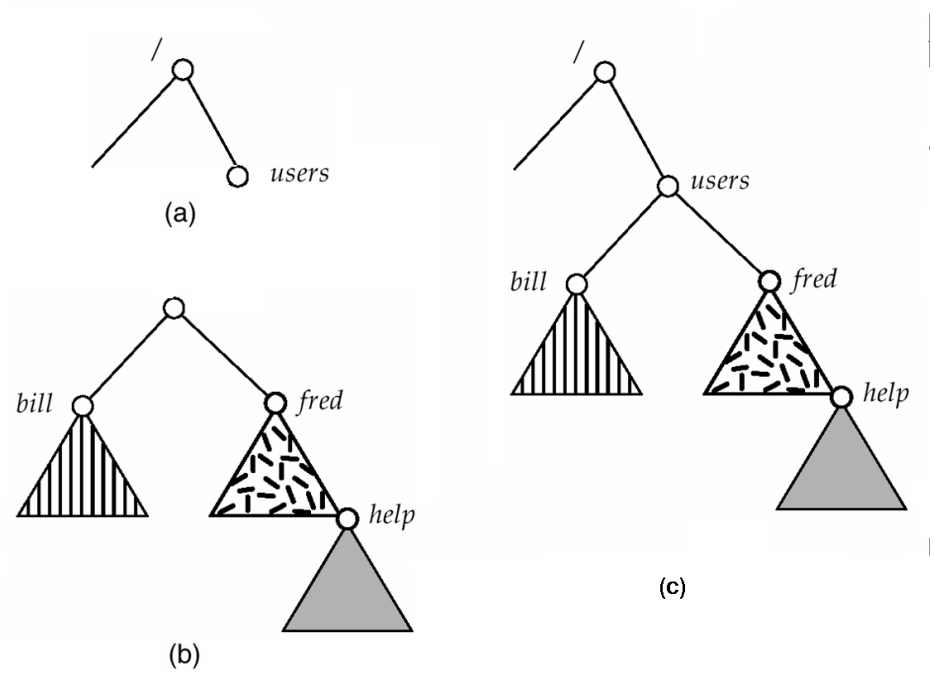

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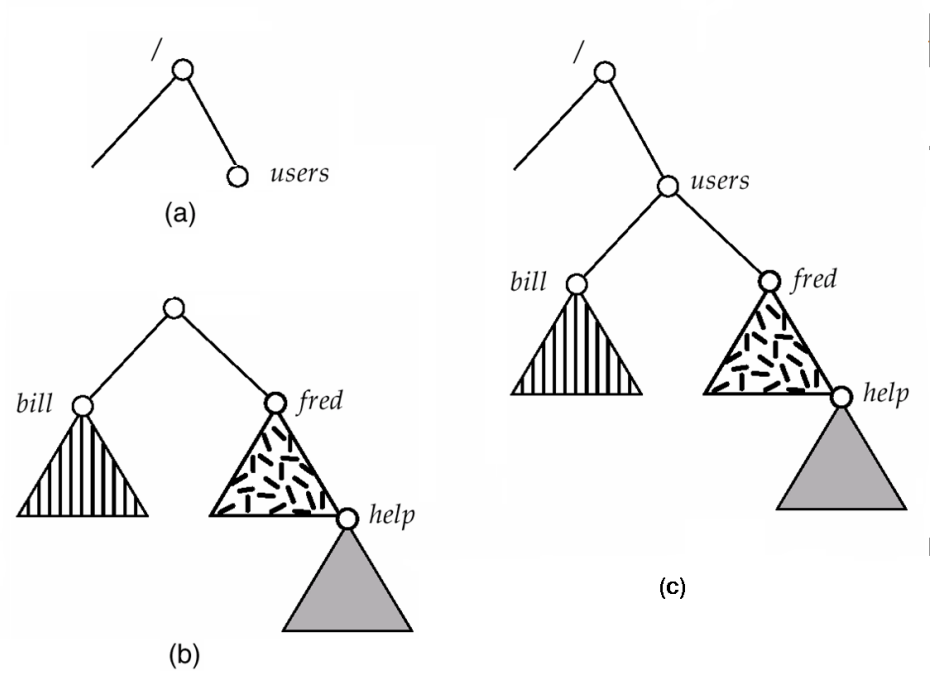

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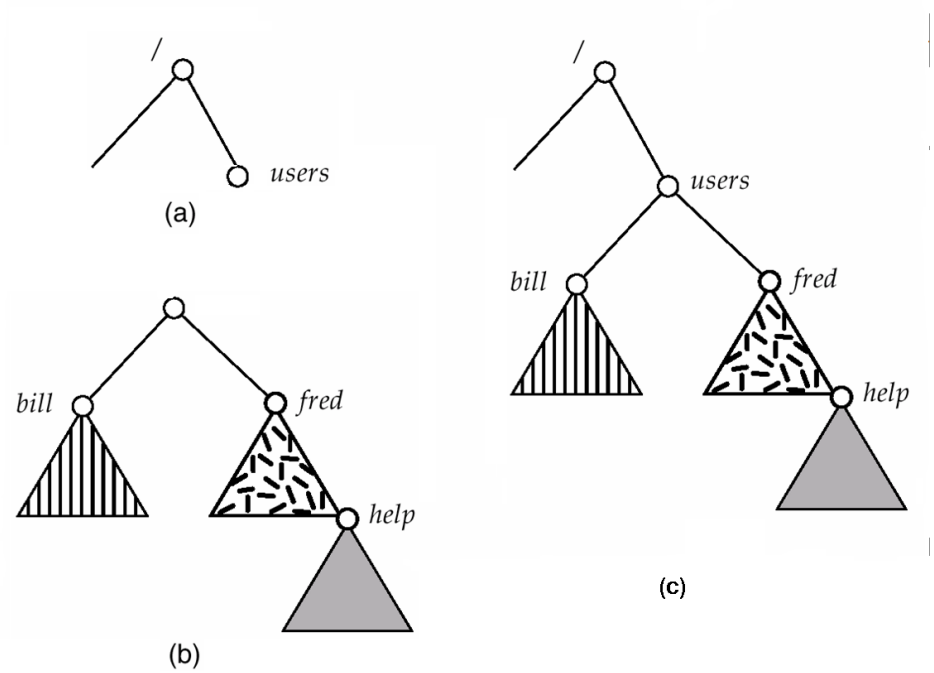

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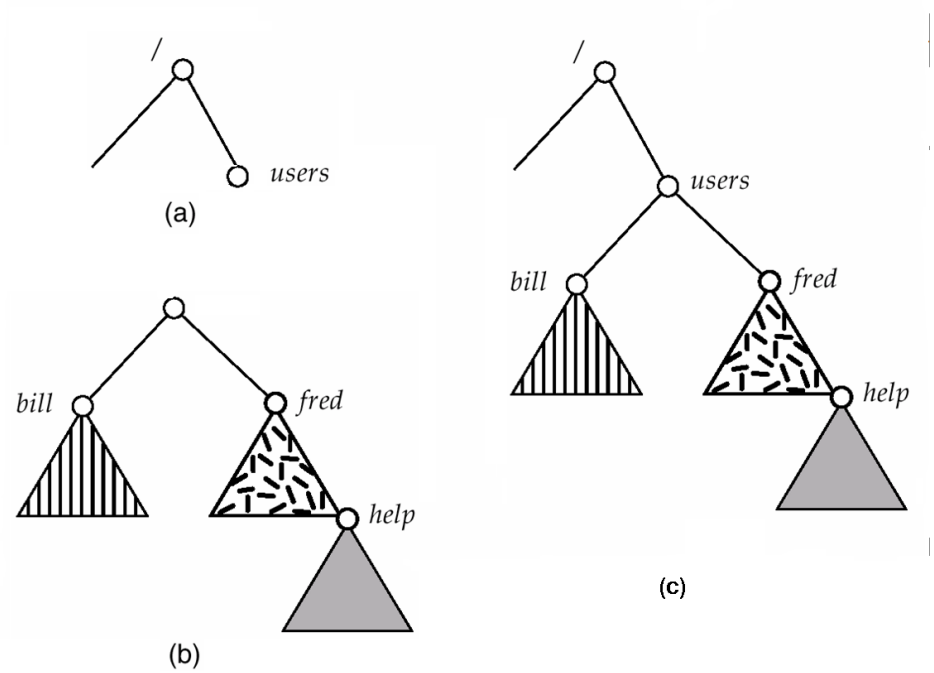

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  - The user who owns a file is the *owner* of the file.

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  - For example, Windows NT or later and Solaris 2.6 or later use this combined approach.

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Outline

File system structure

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- File

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- File
  - Logical storage unit

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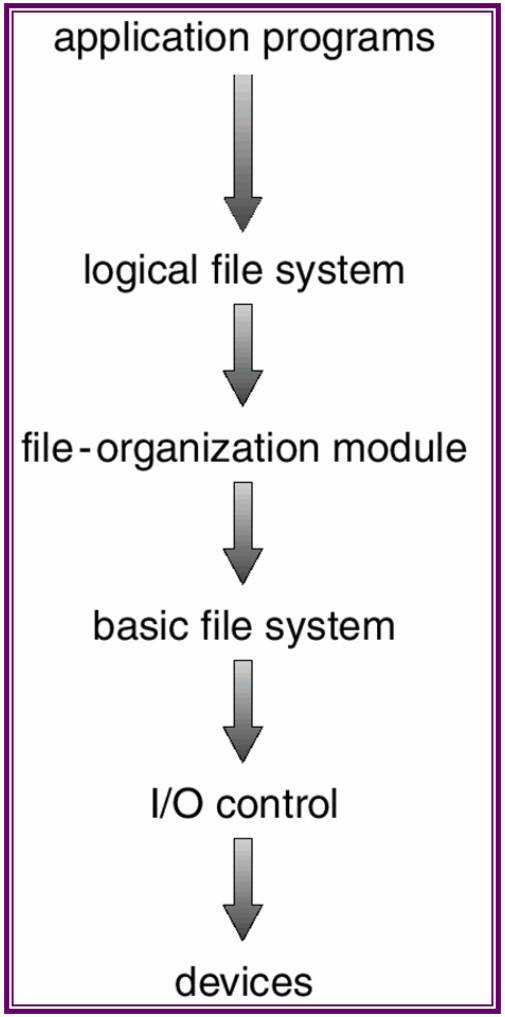
- A file system resides on the secondary storages and is organized into layers

Layered File system

Layered File system



A typical file control block

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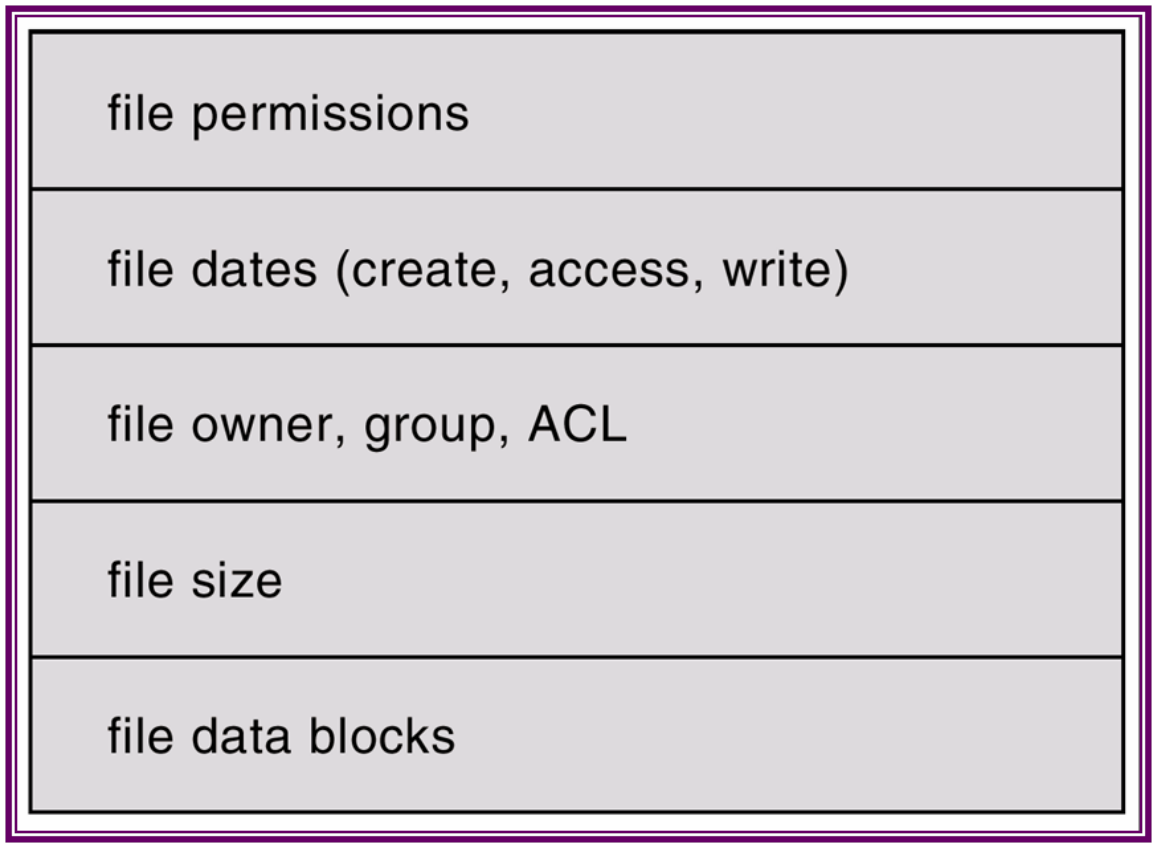

On-disk file system structure (1/2)

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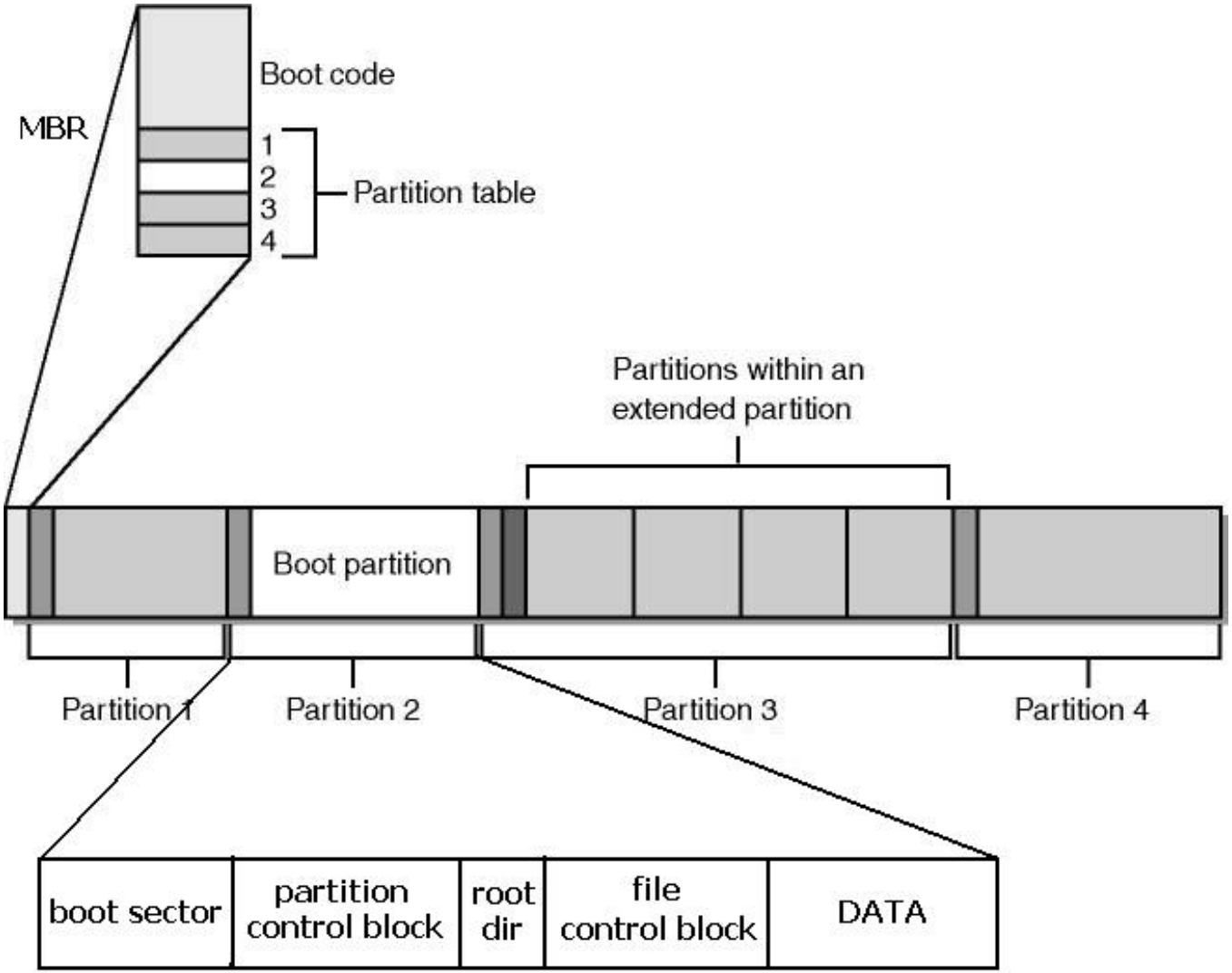

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  - It's also known as "superblock" in UNIX or "Master File Table" in Windows NT.

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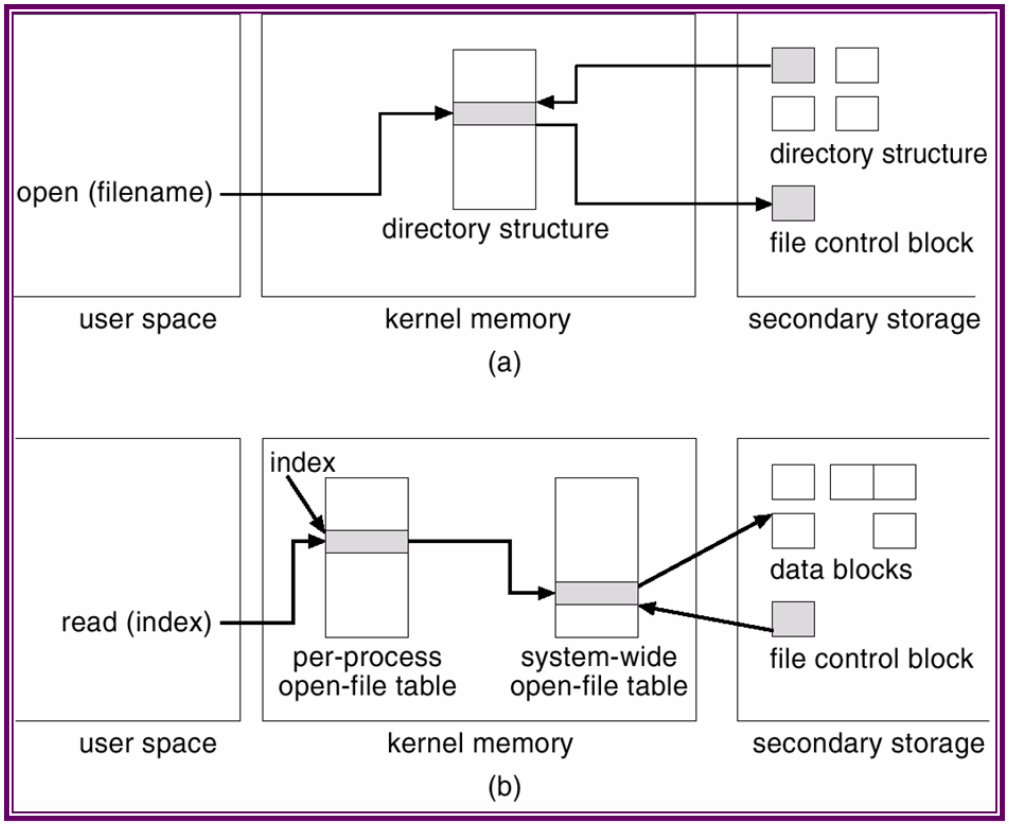

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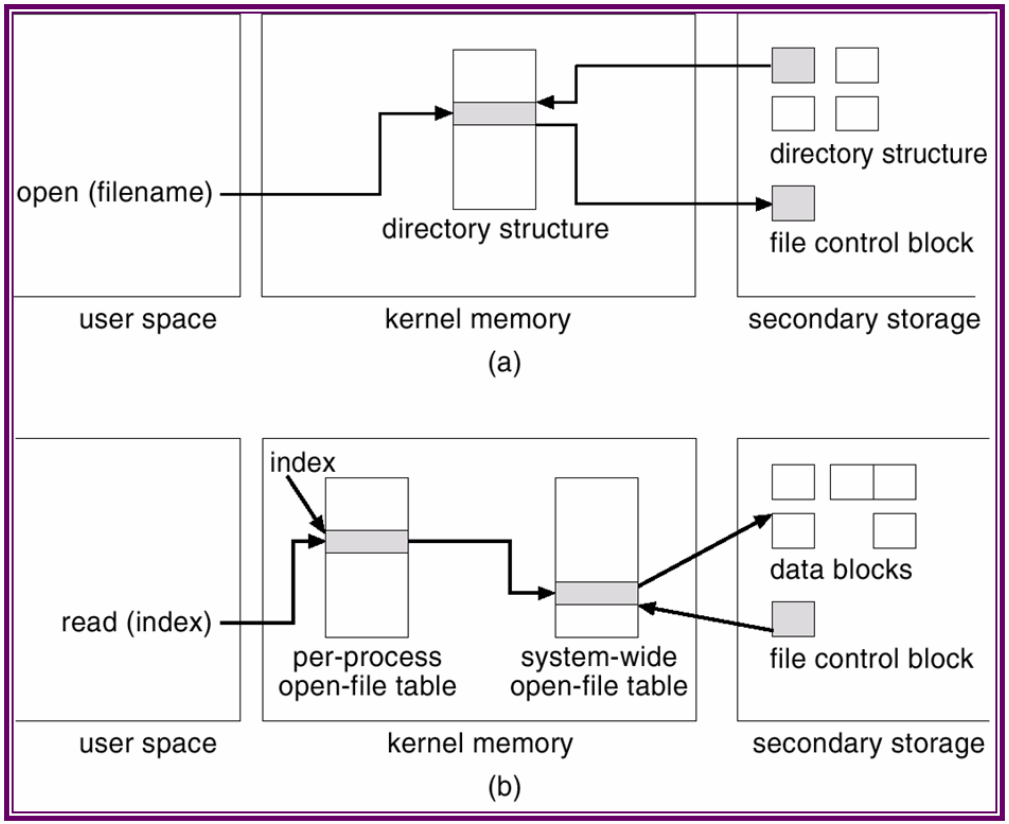

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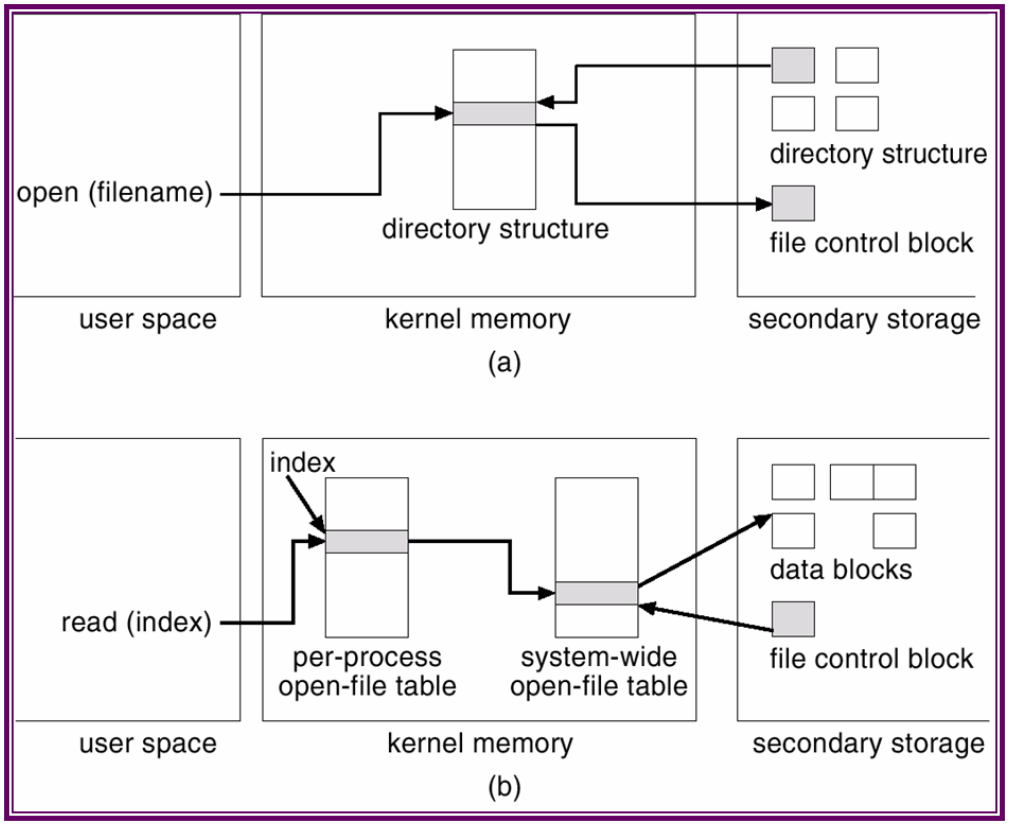

- The "index" in the above figure is known as *file descriptor* in UNIX or *file handle* in Windows NT.
  - It's the value returned by the system call "open" in UNIX or "CreateFile" in Windows NT

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  - The file system interface contains the system calls such as “open”, “close”, “read”, “write” and “seek”, etc.

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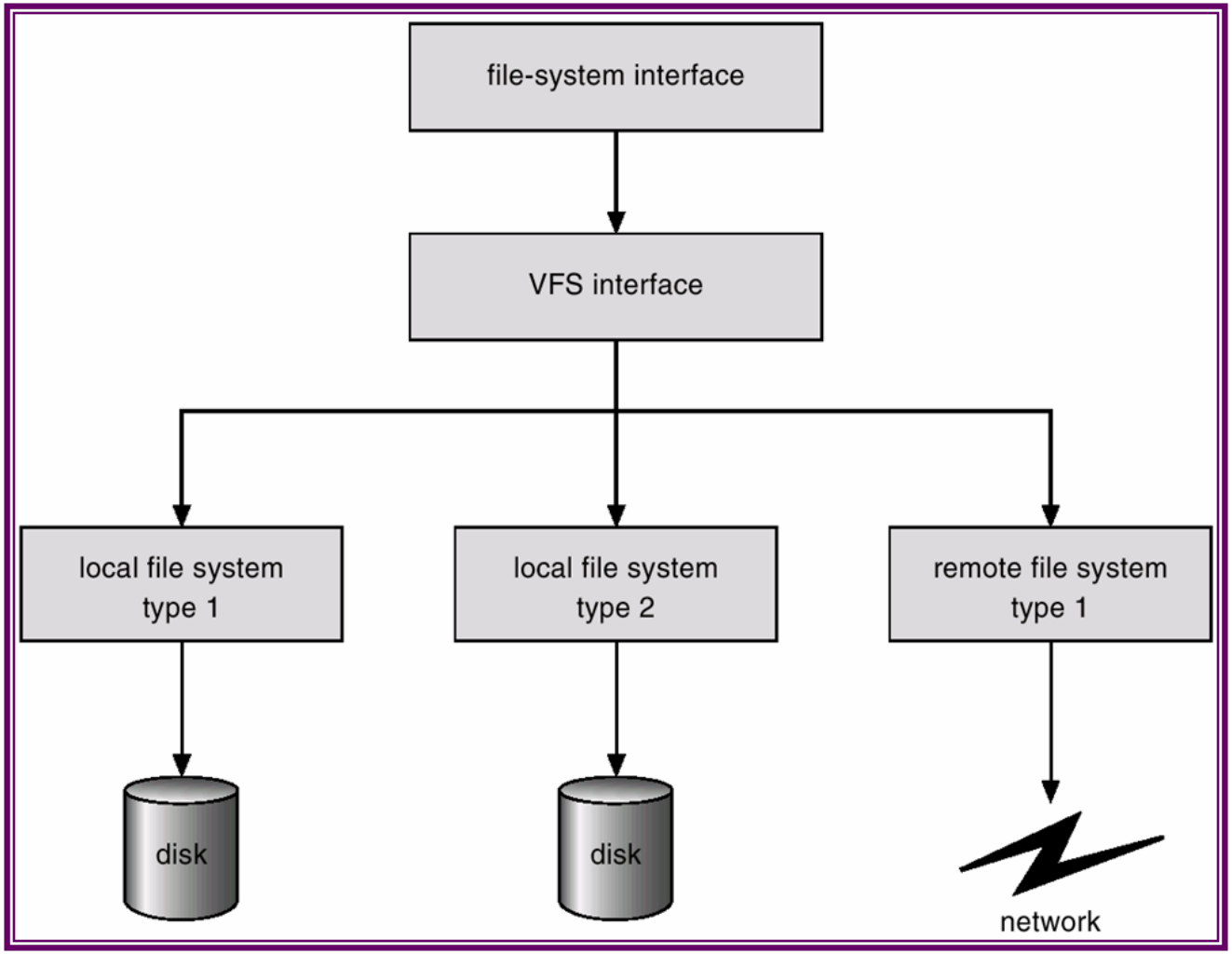

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  - The VFS is based on a file-representation structure, called a *vnode*, that contains a numerical designator for a network-wide unique file

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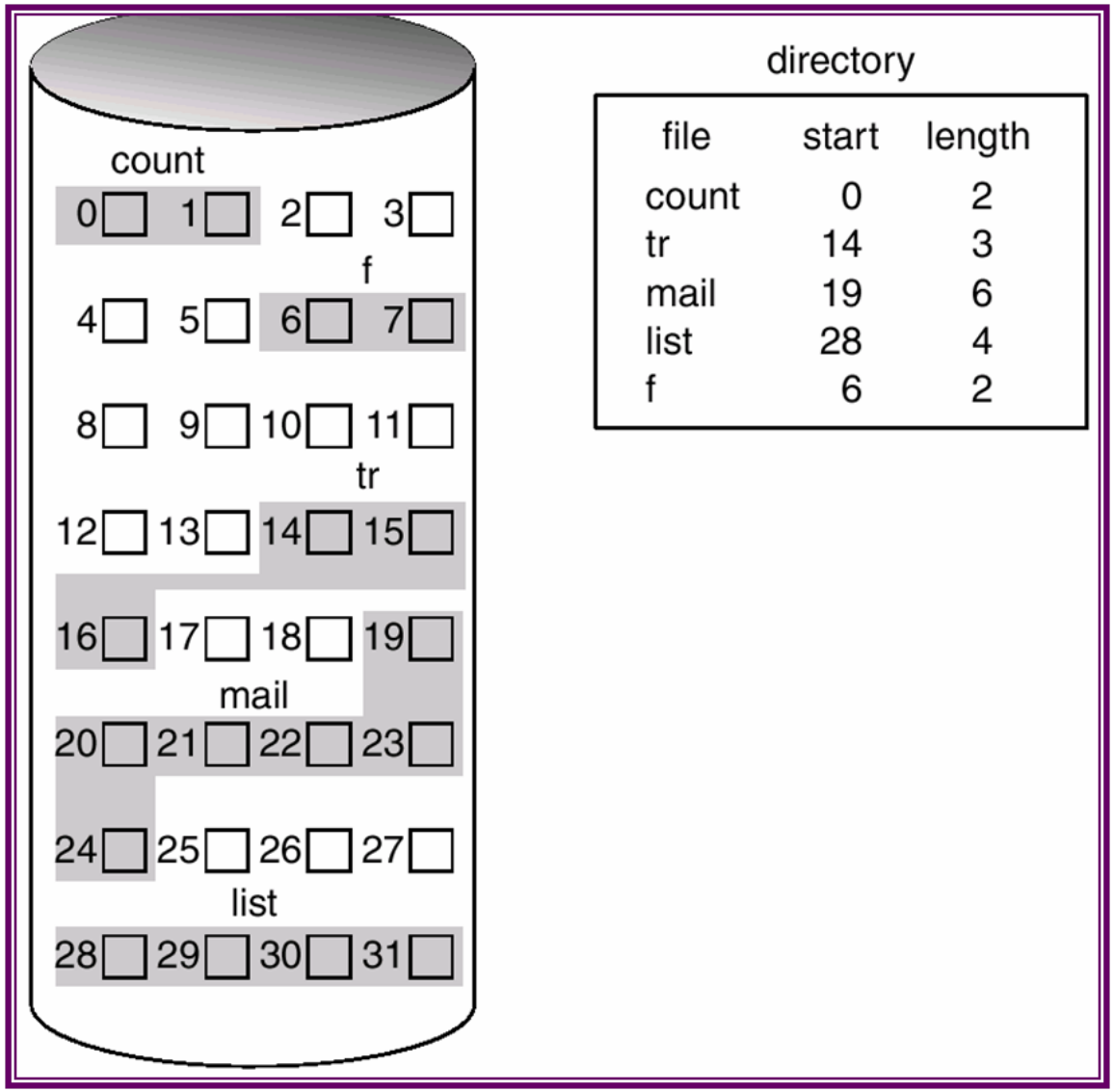
count
0 1 2 3
f
4 5 6 7
8 9 10 11
tr
12 13 14 15
16 17 18 19
mail
20 21 22 23
24 25 26 27
list
28 29 30 31
directory
file start length
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- Pros and cons
  - Simple: need only starting address
  - No waste of space
  - Extra space required for the pointer
  - No random access
  - Bad reliability because of scattered pointers
- The overhead of the pointers can be decreased by collecting several blocks into one larger block called a *cluster*

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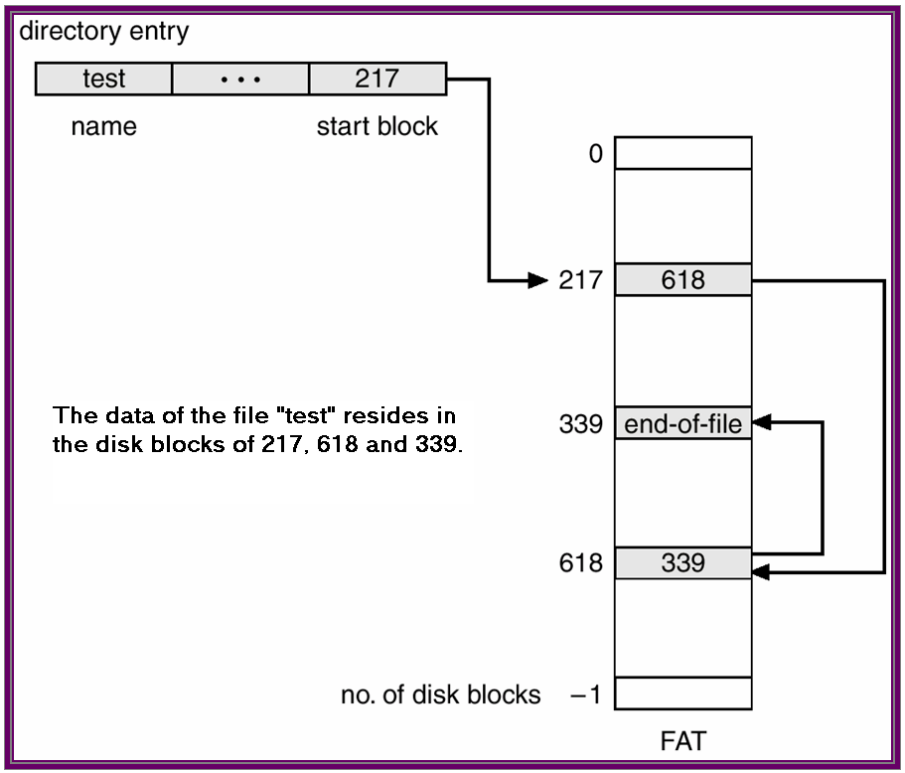

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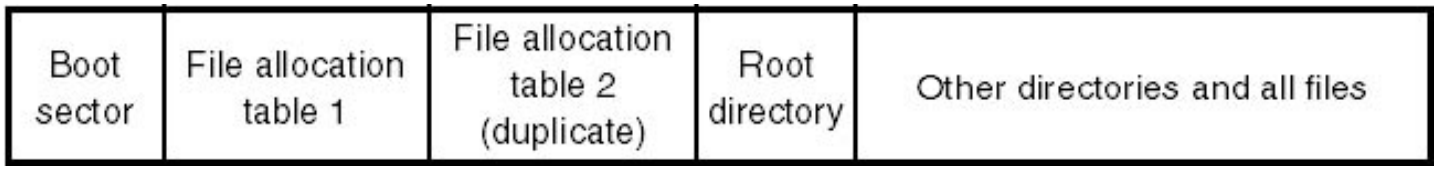

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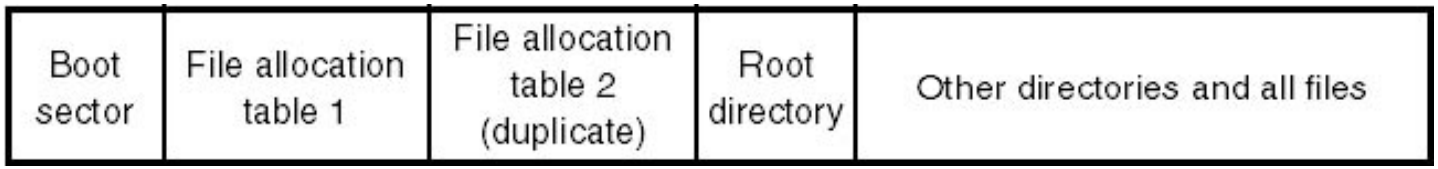

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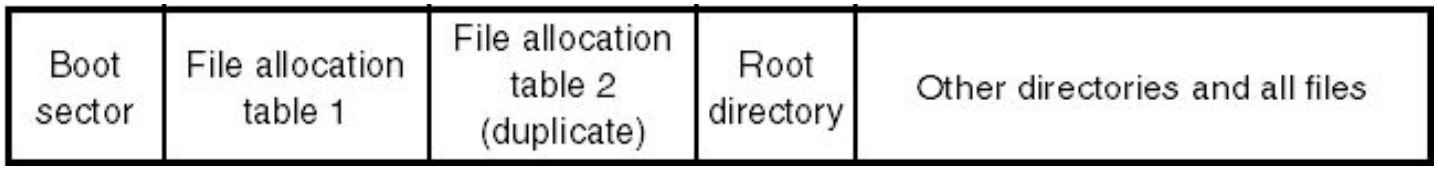

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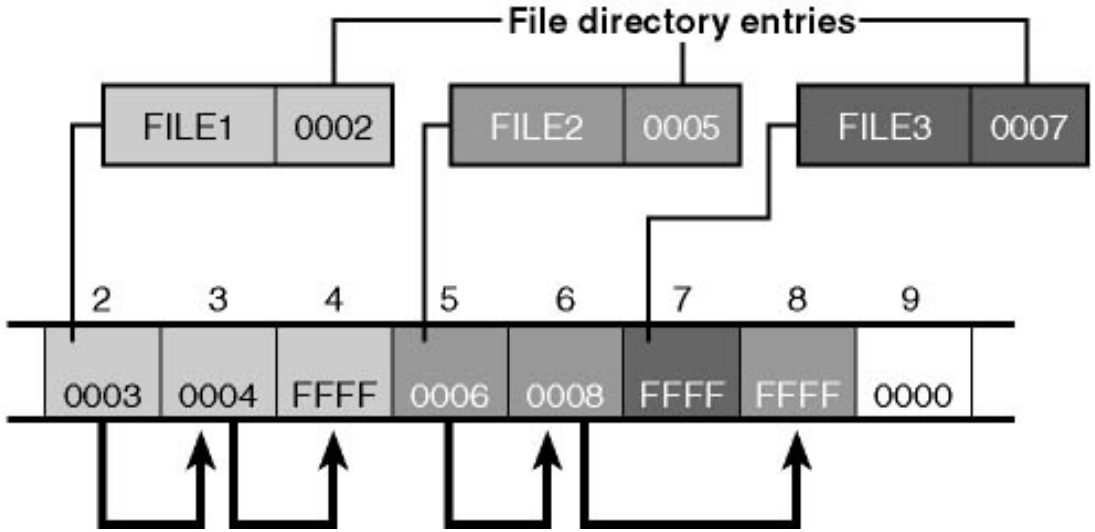

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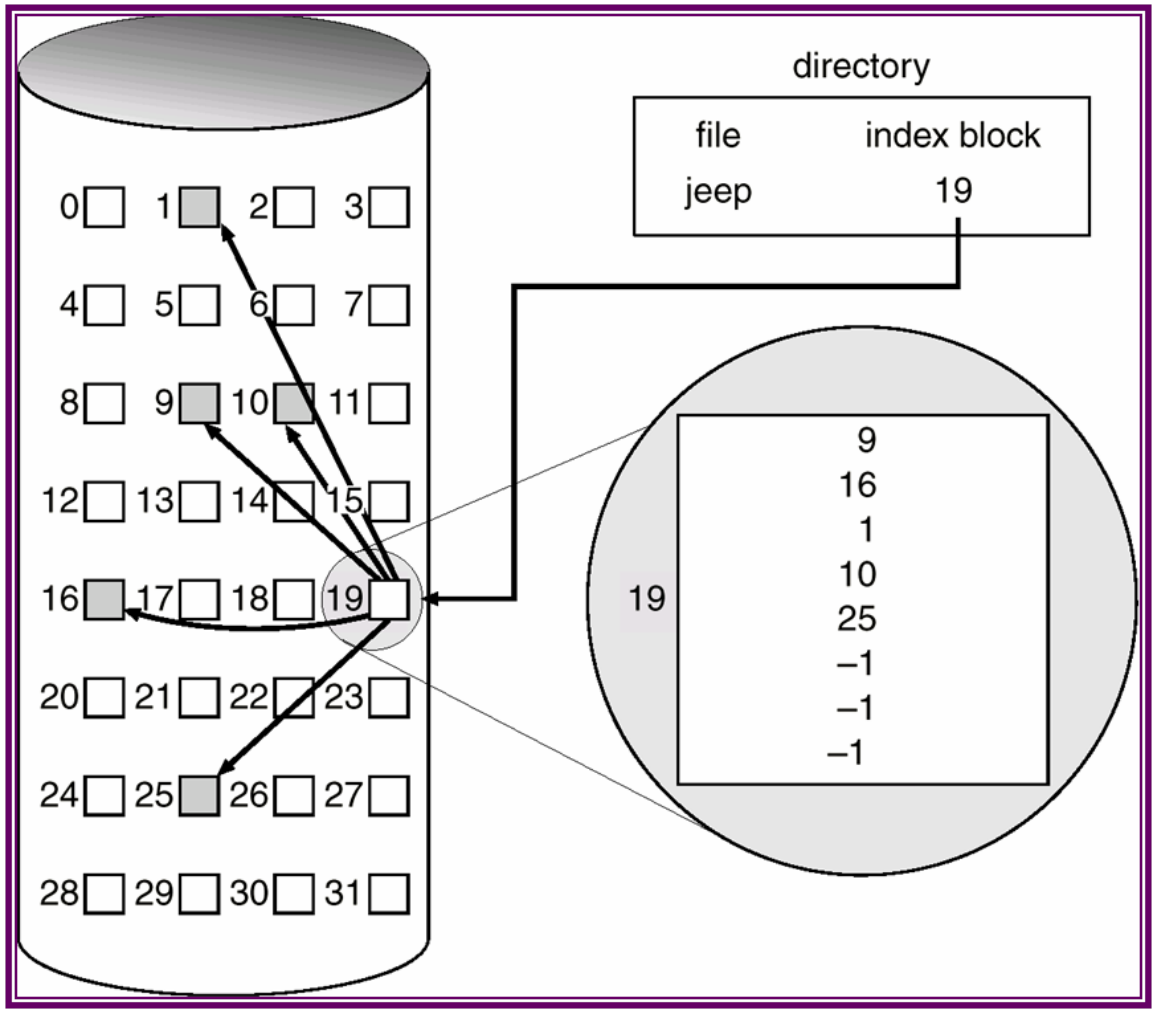

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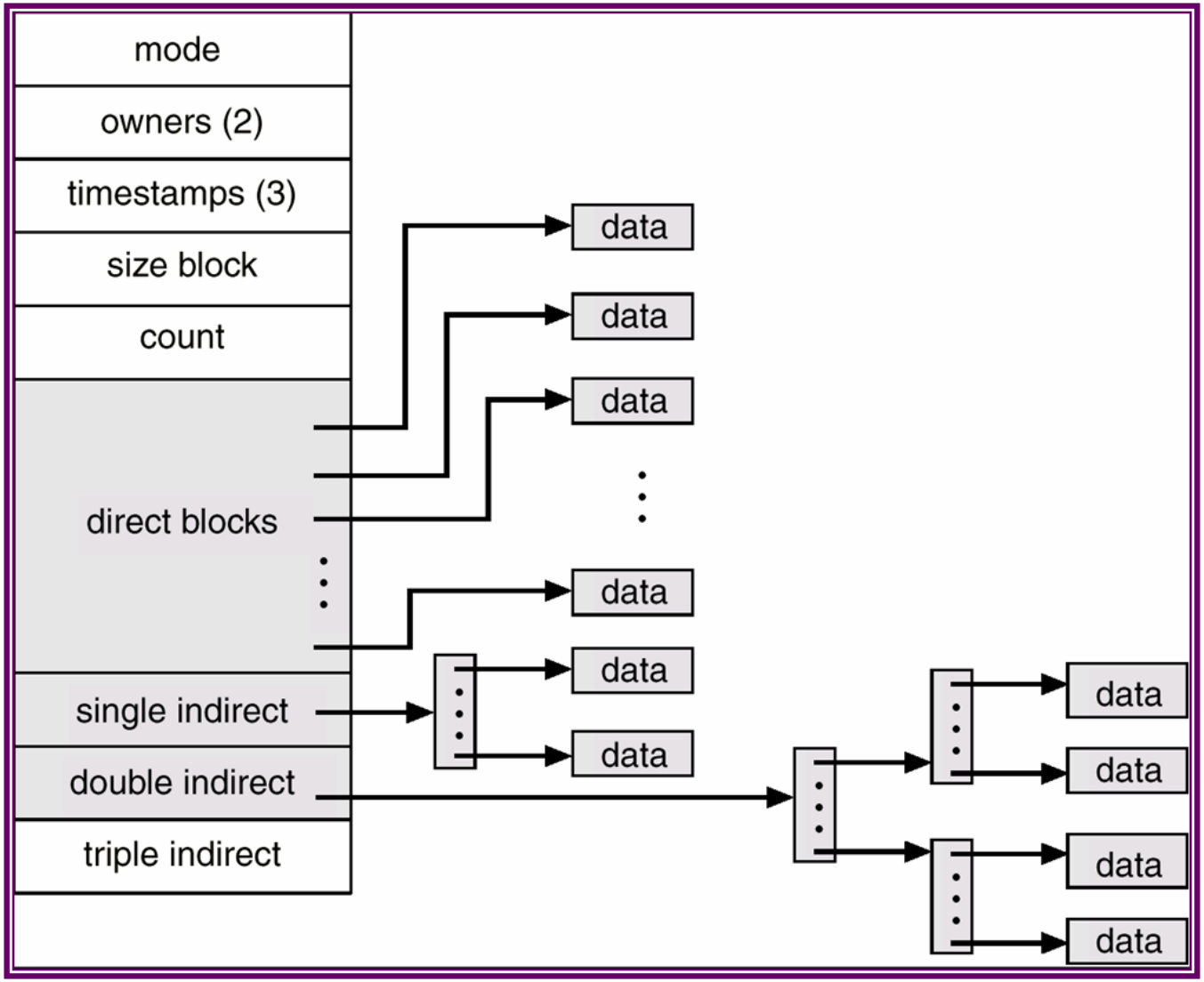

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    - Assume block size $= 2^{12}$ bytes and disk size $= 2^{30}$ bytes (1 gigabyte), then n=$2^{30}/2^{12} = 2^{18}$ (32K bytes)

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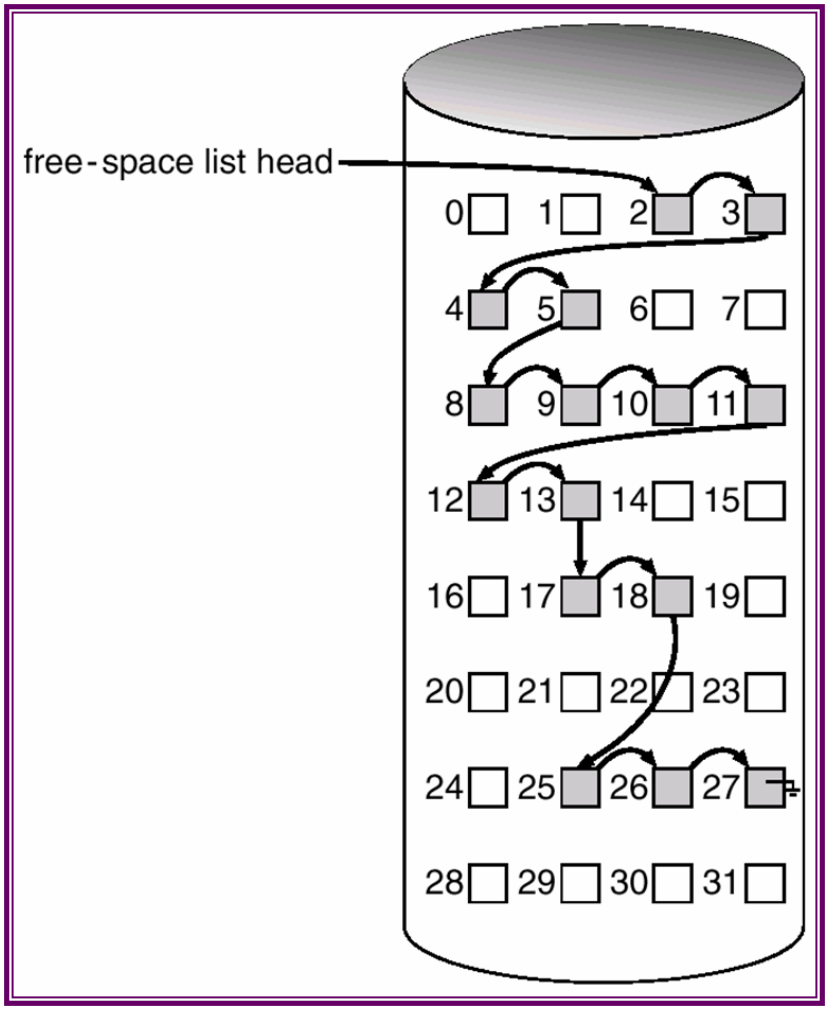
free-space list head
0
1
2
3
4
5
6
7
8
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10
11
12
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17
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31

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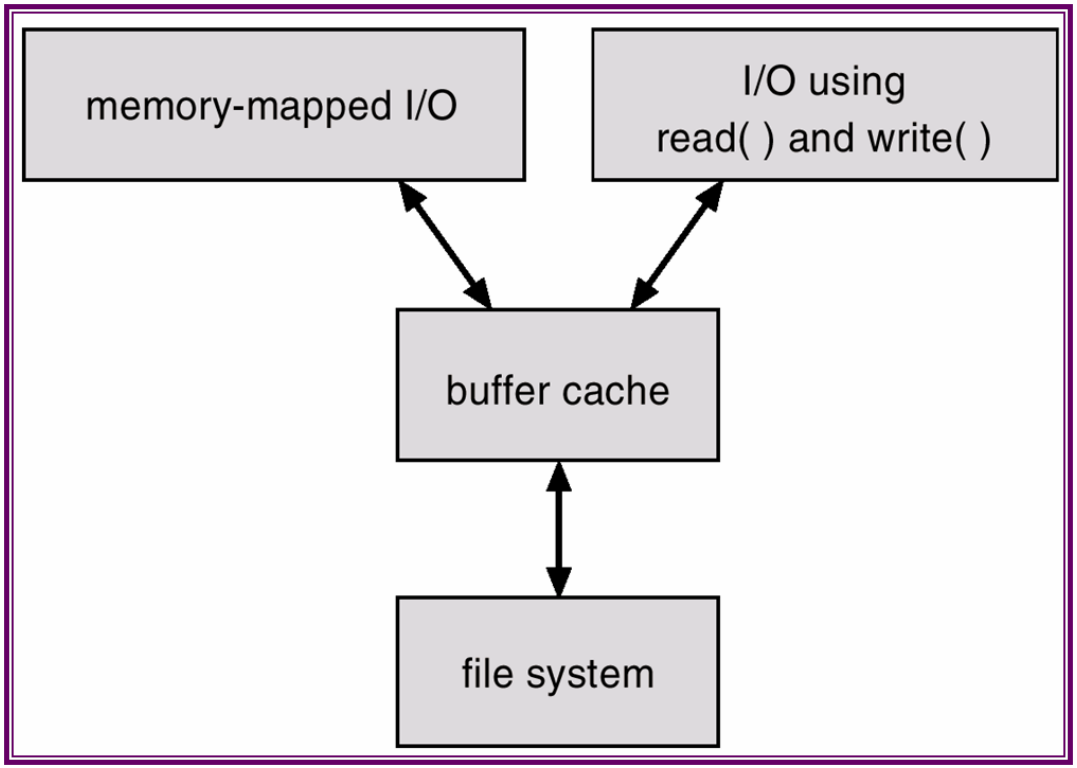

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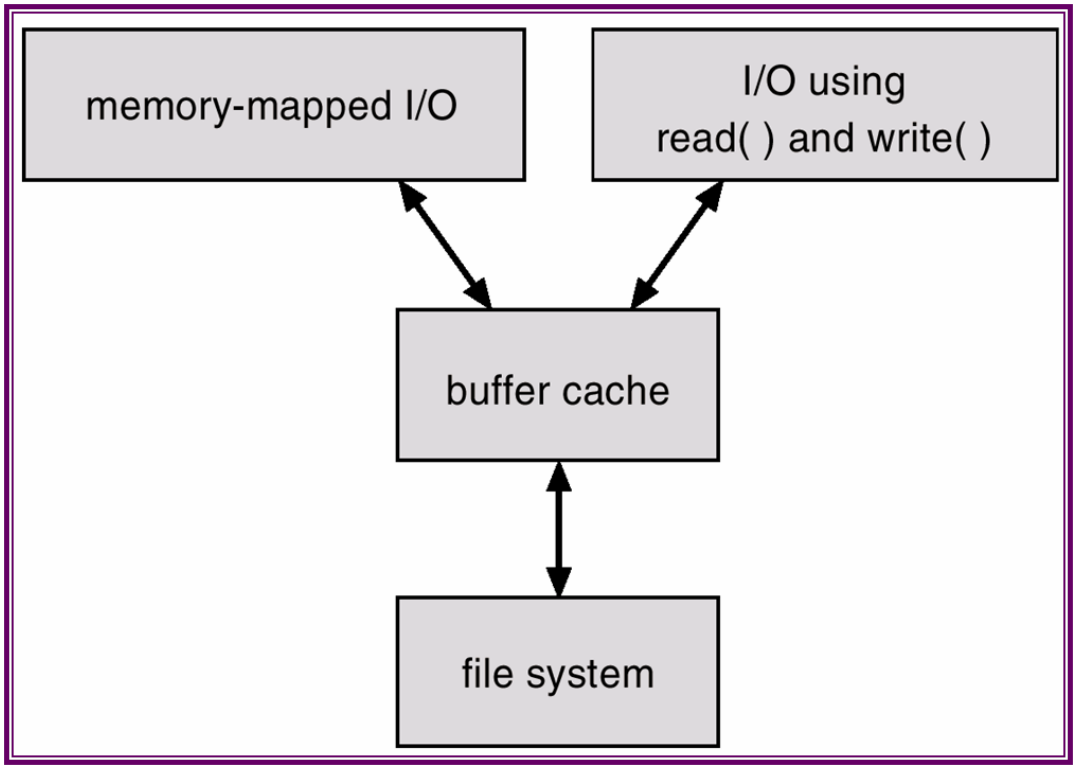

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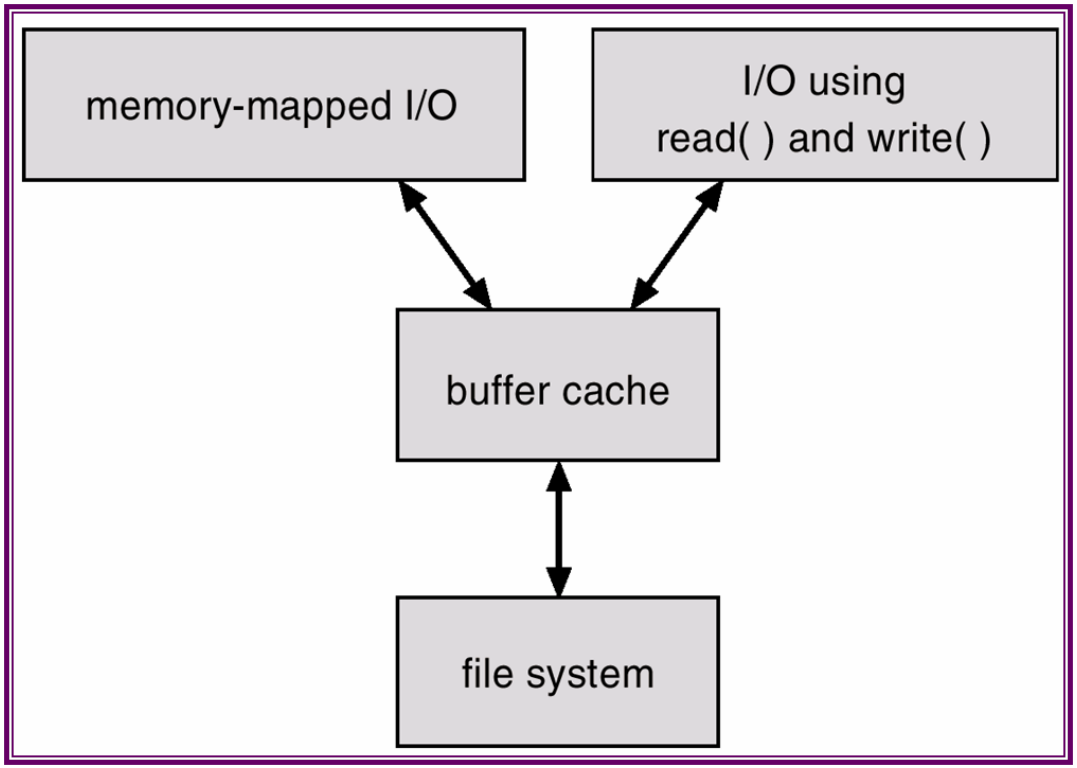

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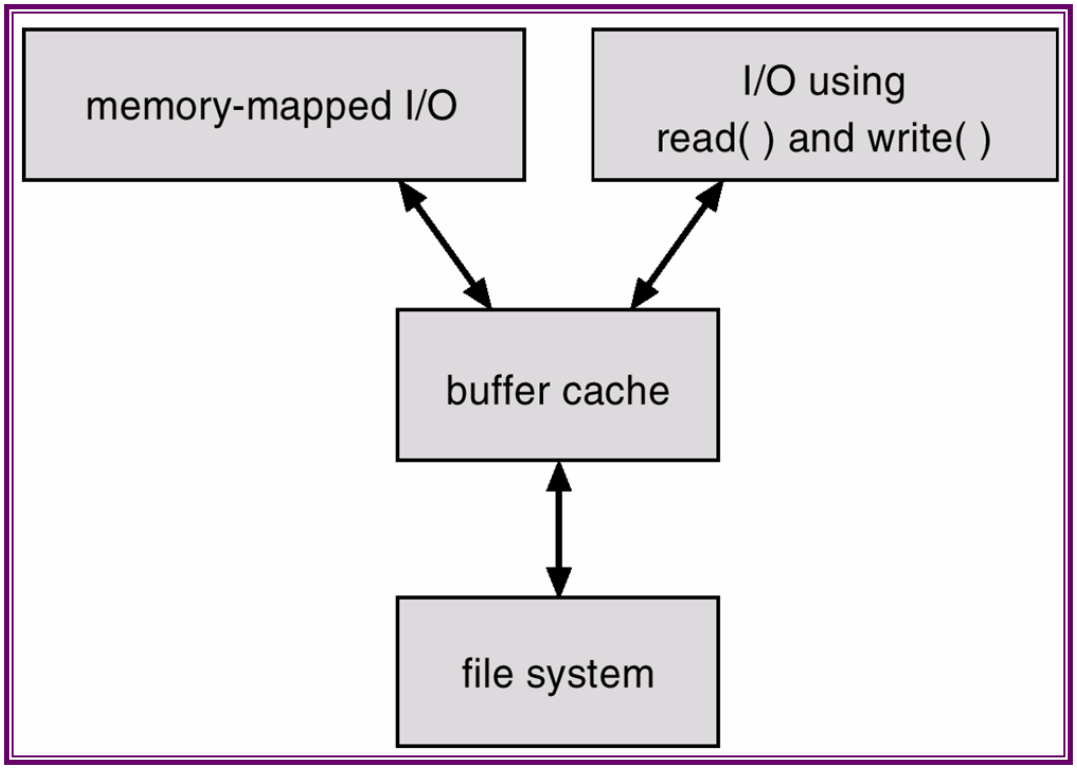

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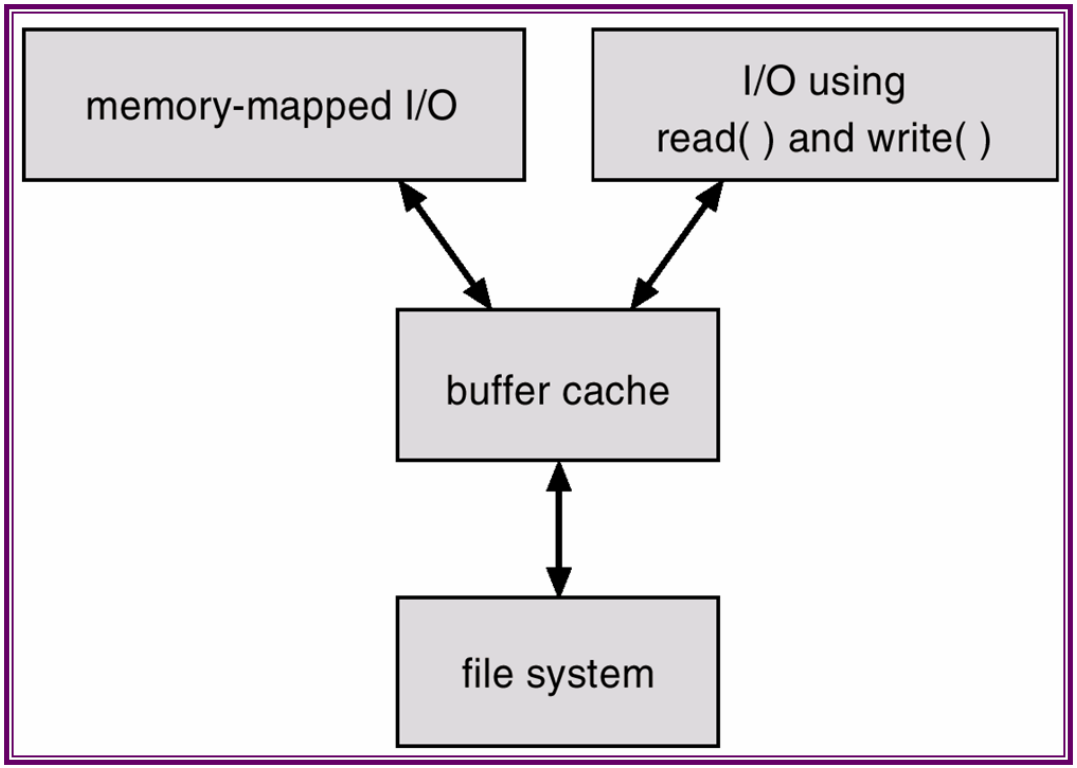

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- Unfortunately, RAM disks are only useful for temporary storage, since its contents will be lost between reboots

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