

File System Implementation

Kishan Swaroop
2003EE10329

OVERVIEW

- File-System Structure
 - File-System Implementation
 - Allocation Methods
 - **Contiguous allocation**
 - **Linked allocation**
 - **Indexed allocation**
-

File-System Structure

- File structure
 - Logical storage unit
 - Collection of related information
 - File system resides on secondary storage (disks)
 - File system organized into layers
 - **File control block** – storage structure consisting of information about a file
-

A Typical File Control Block

file permissions

file dates (create, access, write)

file owner, group, ACL

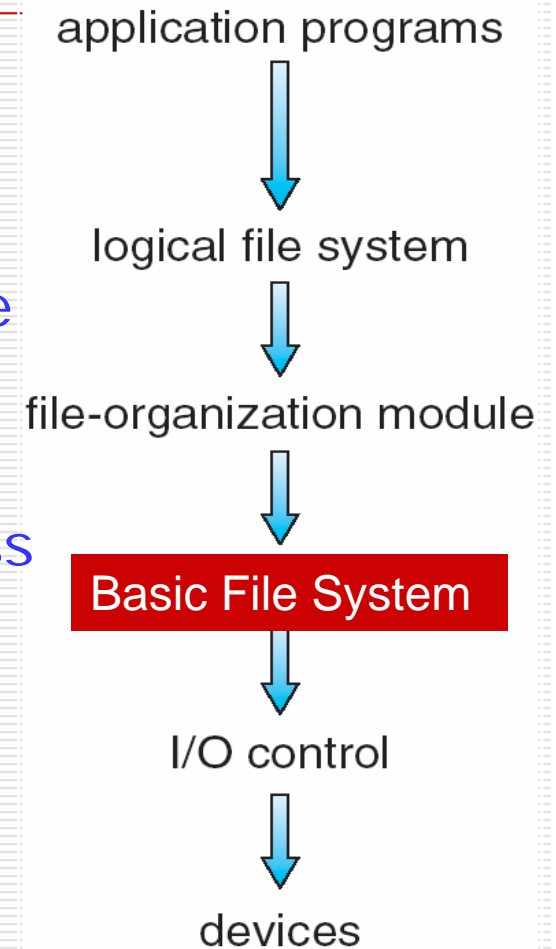
file size

file data blocks or pointers to file data blocks

Layered File System

Basic File System

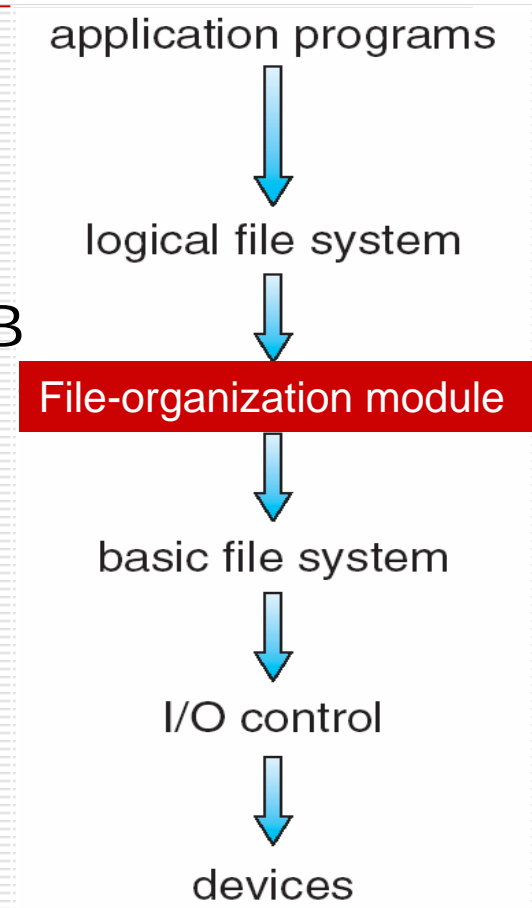
- Issue generic commands to **read and write** PB
- PB is identified by its numeric **disk address**



Layered File System

File-organization Module

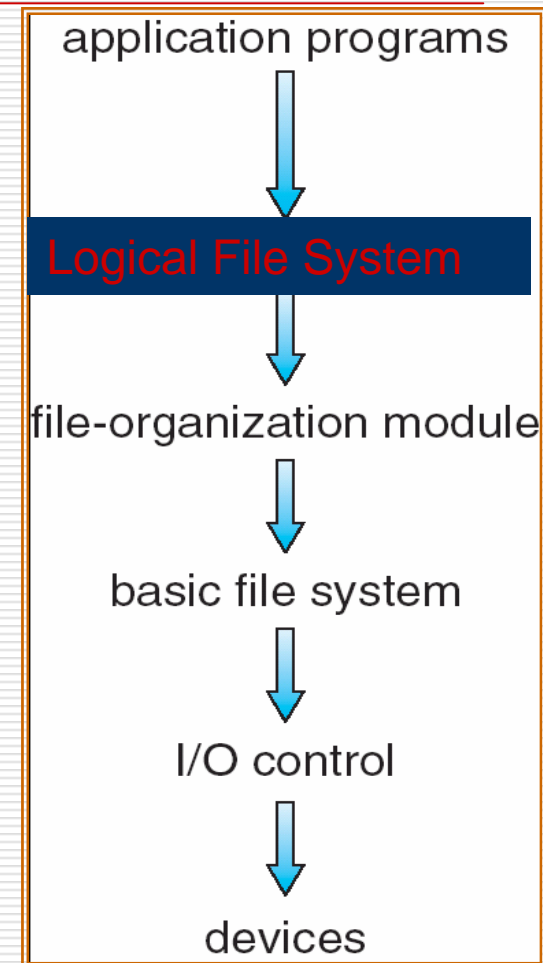
- knows about files and their logical and PB
- Translate LBA to PB addresses for the basic file system to transfer.
- Includes the free-space manager
 - which tracks unallocated blocks



Layered File System

Logical File System (LFS)

- ❑ LFS manage
 - ❑ metadata information.
 - ❑ directory structure to provide the file organization module
 - ❑ file structure via file-control blocks (FCB).
- ❑ Responsible for protection and security



In-Memory File System Structures

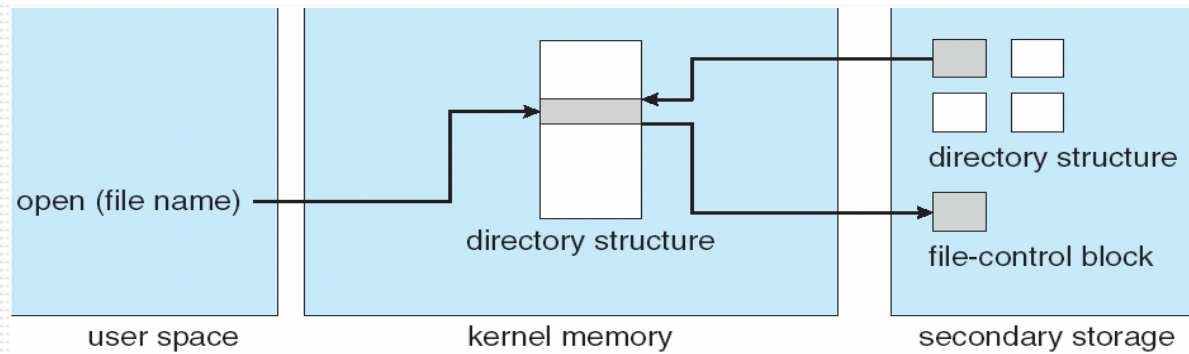
- **in-memory mount table** Contains
 - information about each mounted volume.

 - **in-memory directory-structure cache** holds
 - directory information of recently accessed directories.

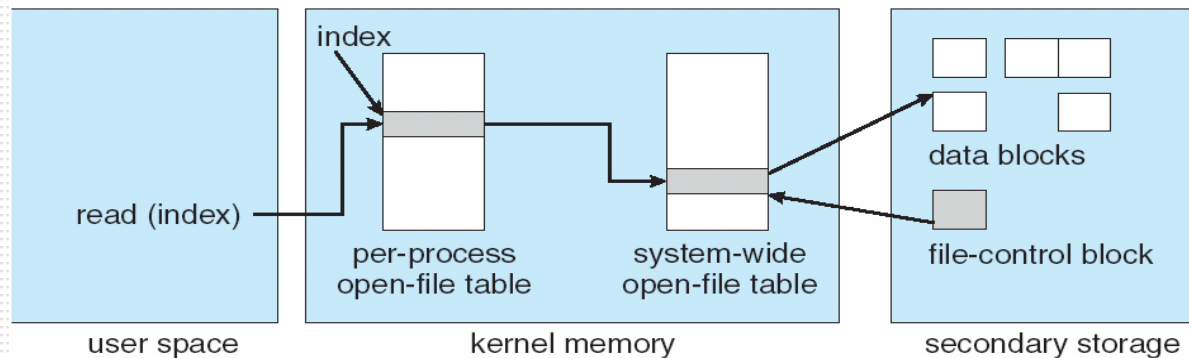
 - **system-wide open-file table** contains
 - copy of the FCB of each open file, as well as other information.

 - **per-process open-file table** contains
 - pointer to the appropriate entry in the system-wide open-file table
-

In-Memory File System Structures



(a)

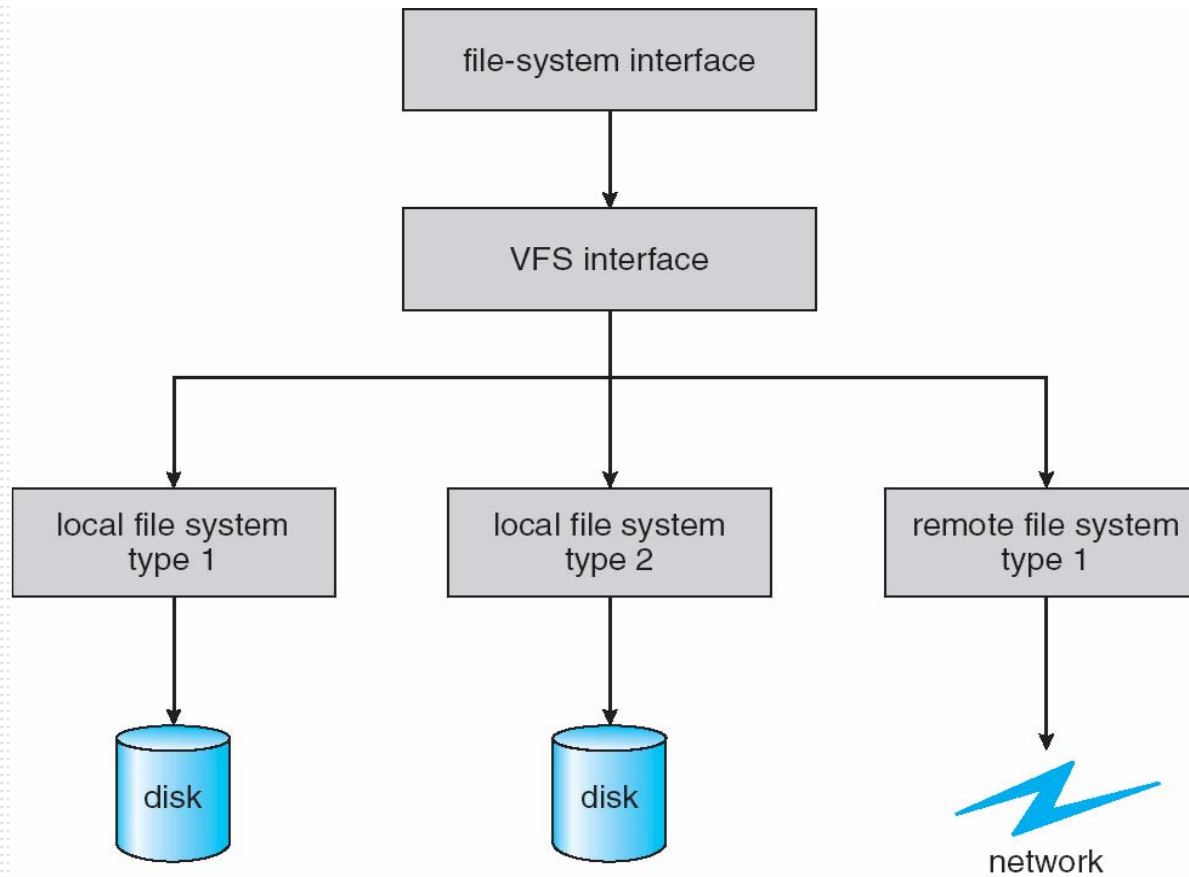


(b)

Virtual File Systems (VFS)

- ❑ VFS provide an object-oriented way of implementing file systems.
 - ❑ VFS allows the same system call interface to be used for different types of FS.
 - ❑ The API is to the VFS interface, rather than any specific type of FS
-

Schematic View of Virtual File System



Allocation Methods

- An allocation method refers to how disk blocks are allocated for files:
 - **Contiguous allocation**
 - **Linked allocation**
 - **Indexed allocation**
-

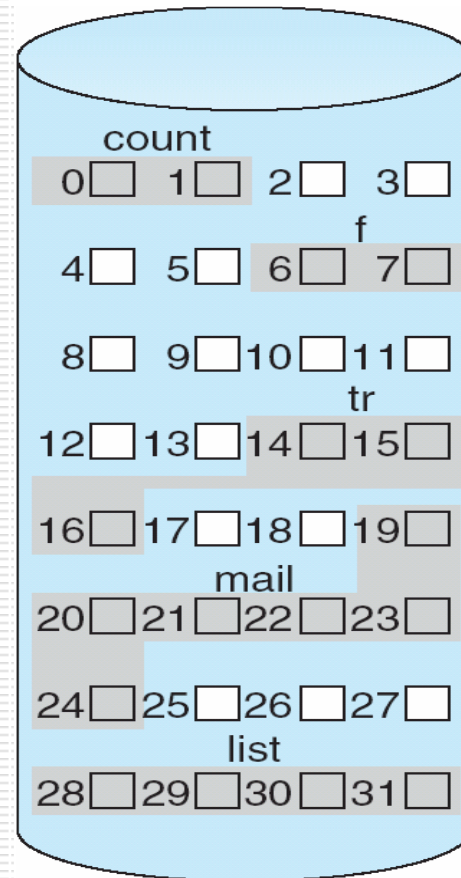
Contiguous Allocation

- Each file occupies a set of contiguous blocks on the disk

 - Its Simple -
 - **starting location** (block #)
 - **length** (number of blocks) are required

 - Random access
-

Contiguous Allocation of Disk Space



directory		
file	start	length
count	0	2
tr	14	3
mail	19	6
list	28	4
f	6	2

Contiguous Allocation (Cont.)

PROBLEMS ?

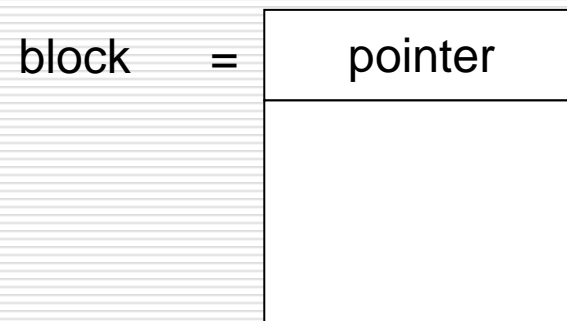
- Finding space for a new file.
 - Wasteful of space
 - How much space is needed for a file
 - Files cannot grow
-

Extent-Based Systems

- Many newer file systems use a modified contiguous allocation scheme
 - Extent-based file systems allocate disk blocks in **extents**
 - An **extent** is a contiguous block of disks
 - Extents are allocated for file allocation
 - A file consists of one or more extents.
-

Linked Allocation

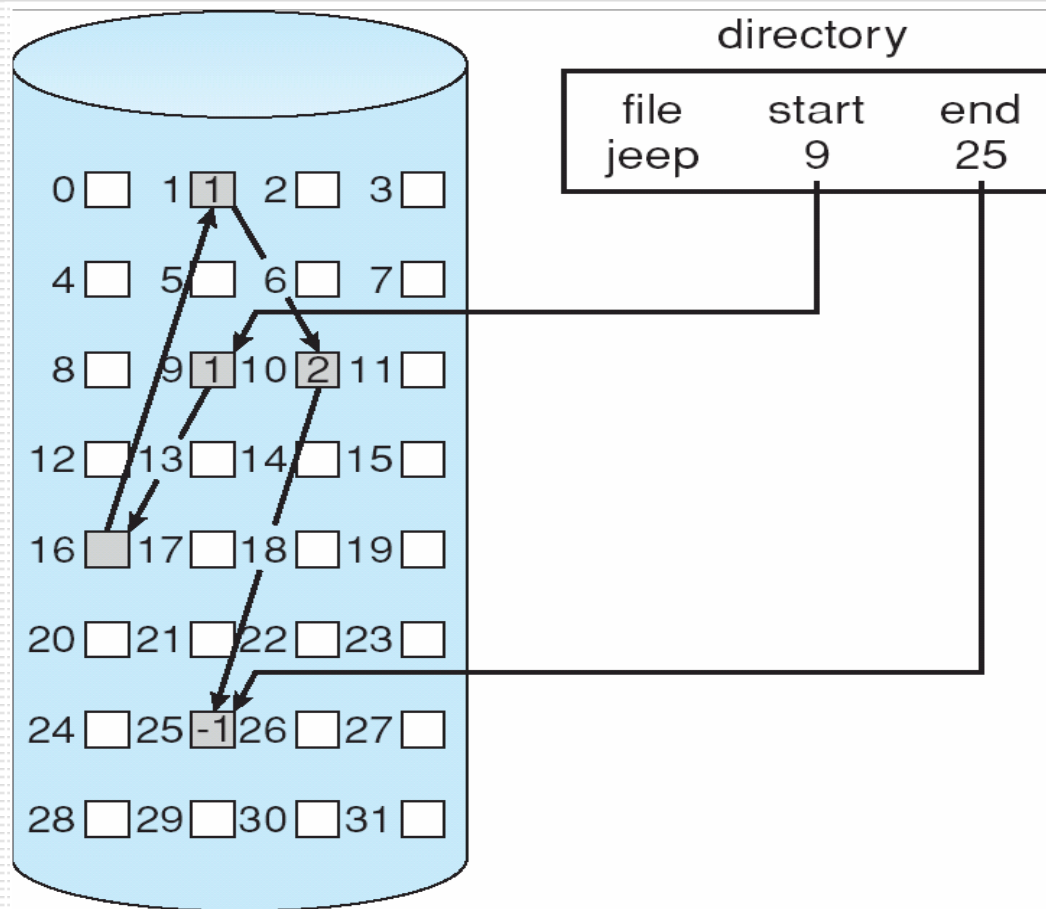
- ❑ Each file is a linked list of disk blocks
- ❑ Blocks may be scattered any where on the disk.



Linked Allocation (Cont.)

- ❑ Simple – need only starting address
 - ❑ Free-space management system – no waste of space
 - ❑ No random access
 - ❑ Mapping
 - ❑ **File-allocation table (FAT)** -
 - disk-space allocation used by MS-DOS and OS/2.
-

Linked Allocation (Cont.)

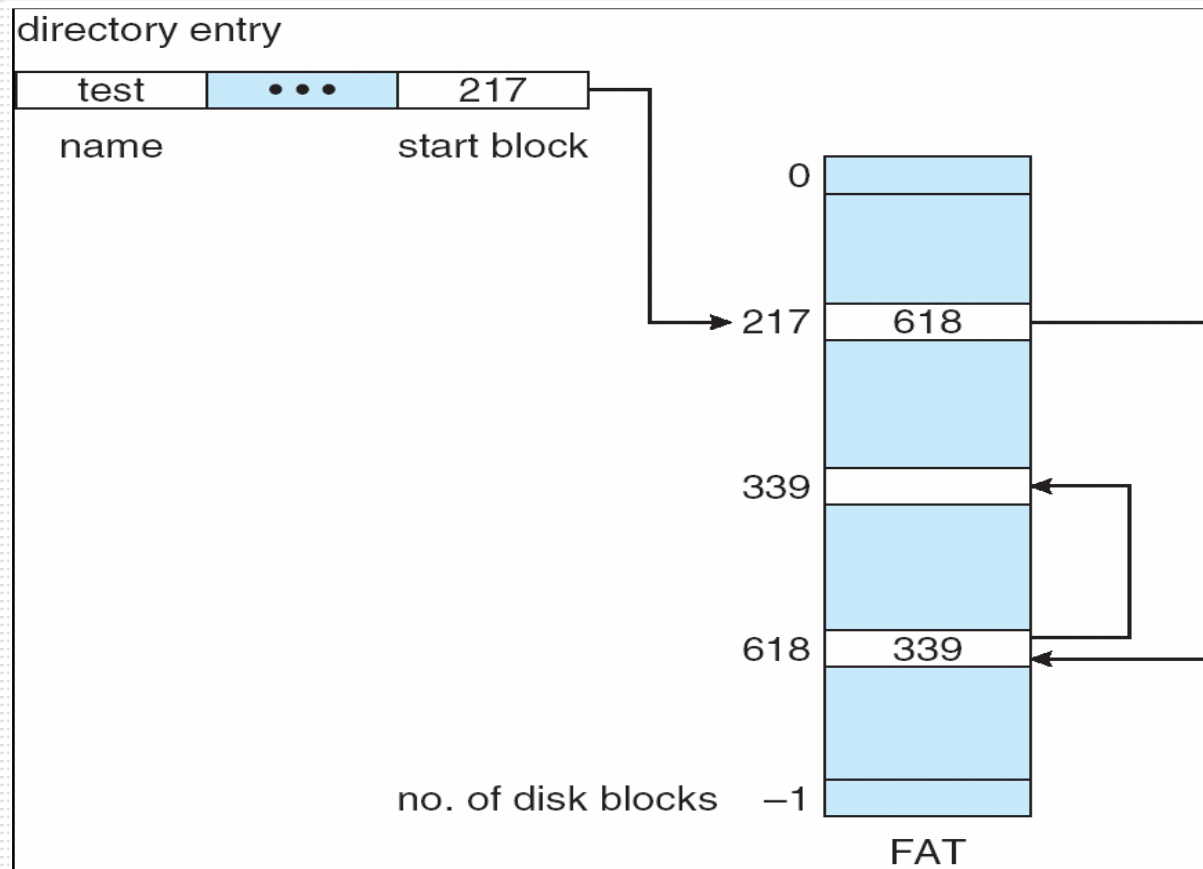


Linked Allocation (Cont.)

PROBLEMS ?

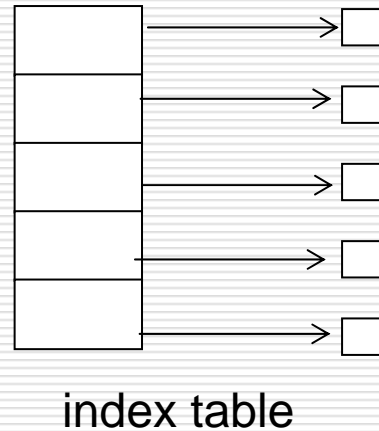
- ❑ It can be used effectively only for [sequential-access](#) files
 - ❑ Space required for the pointer
 - ❑ Reliability
-

File-Allocation Table

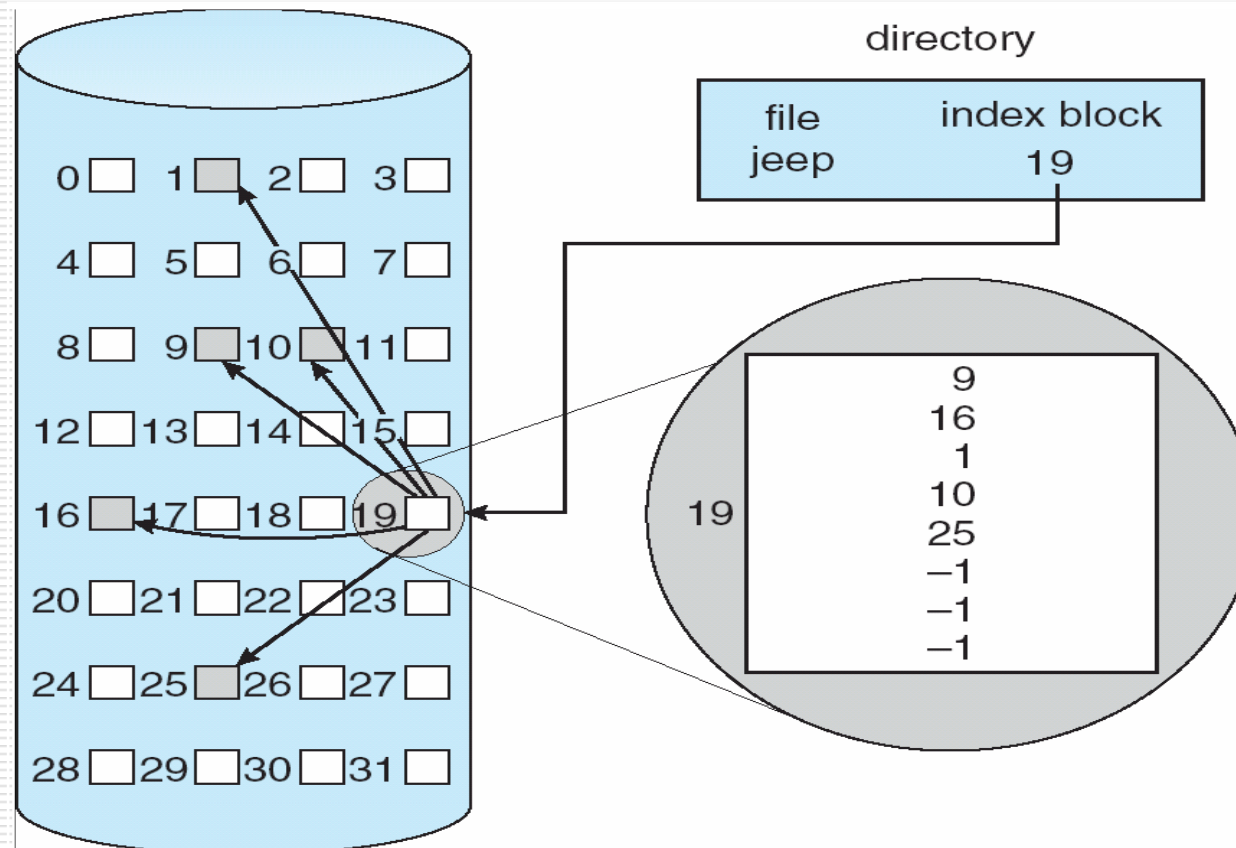


Indexed Allocation

- ❑ Brings all pointers together into the *index block*.
- ❑ Logical view.



Example of Indexed Allocation



Indexed Allocation (Cont.)

- Need index table
 - Random access
 - Dynamic access without external fragmentation
-

Indexed Allocation (Cont.)

Linked scheme

- Index block is normally one disk block.
 - it can be read and written directly by itself

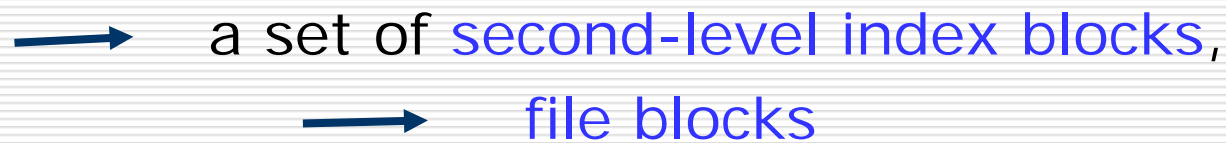
 - To allow for large files

 - we can link together several index blocks
(no limit on size).
-

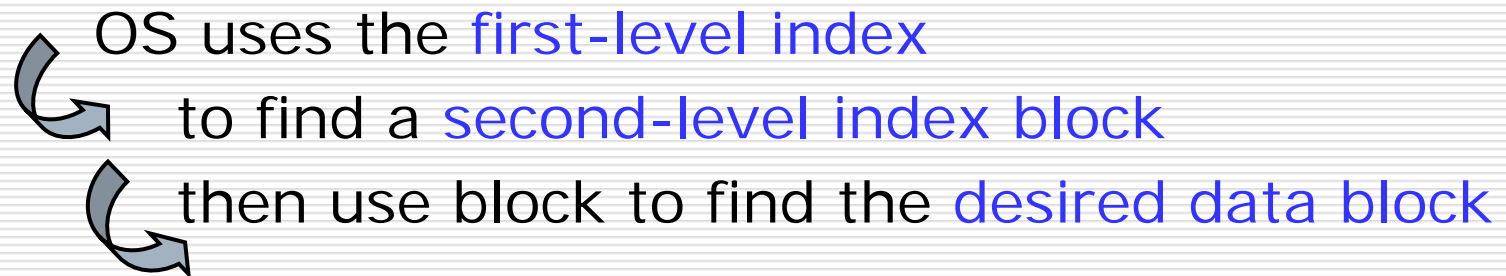
Indexed Allocation (Cont.)

Multilevel index

- Use a **first-level index block**



- To access a block

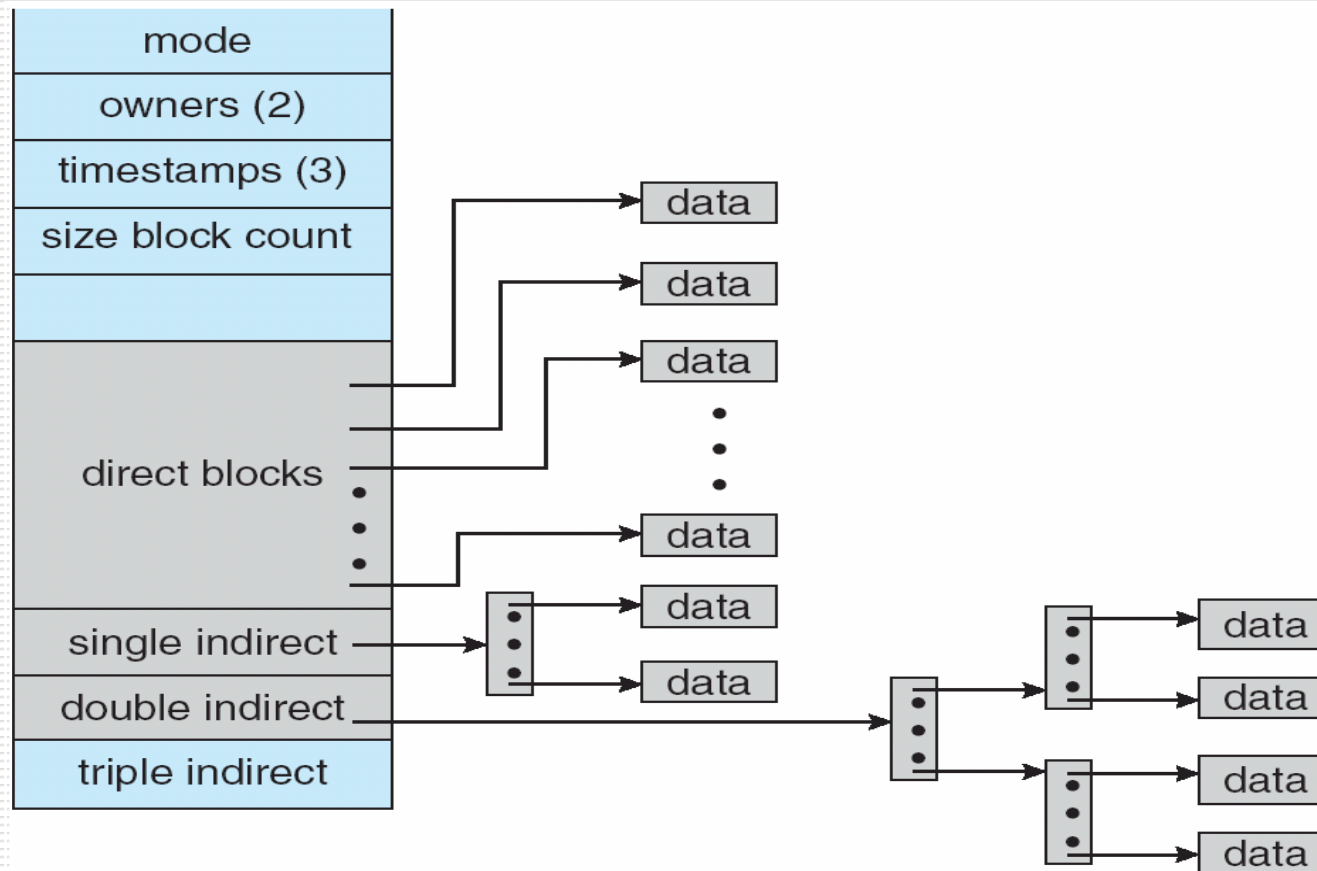


Indexed Allocation (Cont.)

Combined Scheme

- used in the UFS
- Keep 15 pointers of the index block in the file's mode.
 - First 12 pointers point to **direct blocks** contain **addresses of blocks** that contain **data** of the file.
 - Next 3 pointers point to **indirect blocks**.
 - first points to a **single indirect block**, which is an index block containing **no data** but the addresses of blocks that do **contain data**.
 - second points to a **double indirect block** which contains the **address** of a block that contains the addresses of blocks that contain pointers to the **actual data blocks**.
 - last pointer contains the address of a **triple indirect block**.

Combined Scheme: UNIX (4K bytes per block)



Chapter 11
Operation System Principles
A.Silberschatz
7th edition

Thank YOU

