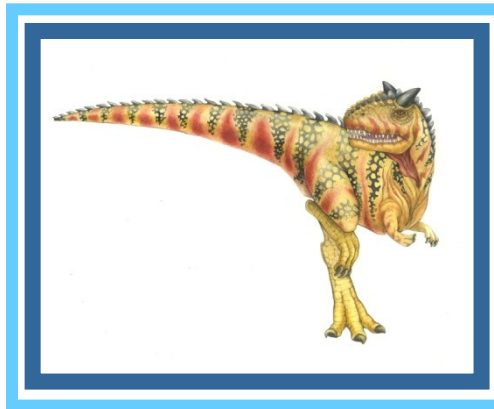


Chapter 11:

File-System Interface





Chapter 11: File-System Interface

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





Objectives

- To explain the function of file systems
- To describe the interfaces to file systems
- To discuss file-system design tradeoffs, including access methods, file sharing, file locking, and directory structures
- To explore file-system protection





File Concept

- Contiguous logical address space
- Types:
 - Data
 - ▶ numeric
 - ▶ character
 - ▶ binary
 - Program
- Contents defined by file's creator
 - Many types
 - ▶ Consider **text file, source file, executable file**





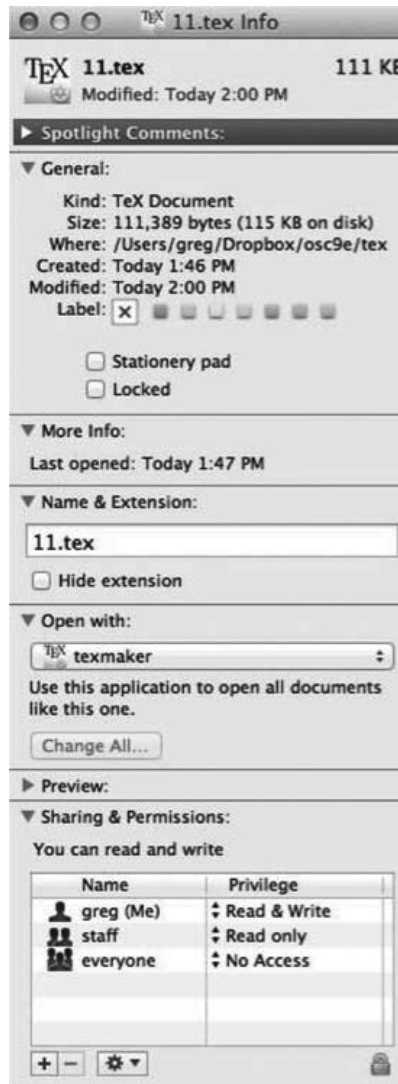
File Attributes

- **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
- Many variations, including extended file attributes such as file checksum
- Information kept in the directory structure





File info Window on Mac OS X





File Operations

- File is an **abstract data type**
- **Create**
- **Write** – at **write pointer** location
- **Read** – at **read pointer** location
- **Reposition within file - seek**
- **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:
 - **Open-file table**: tracks 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
 - Similar to reader-writer locks
 - **Shared lock** similar to reader lock – several processes can acquire concurrently
 - **Exclusive lock** similar to writer lock
- 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





File Types – Name, Extension

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





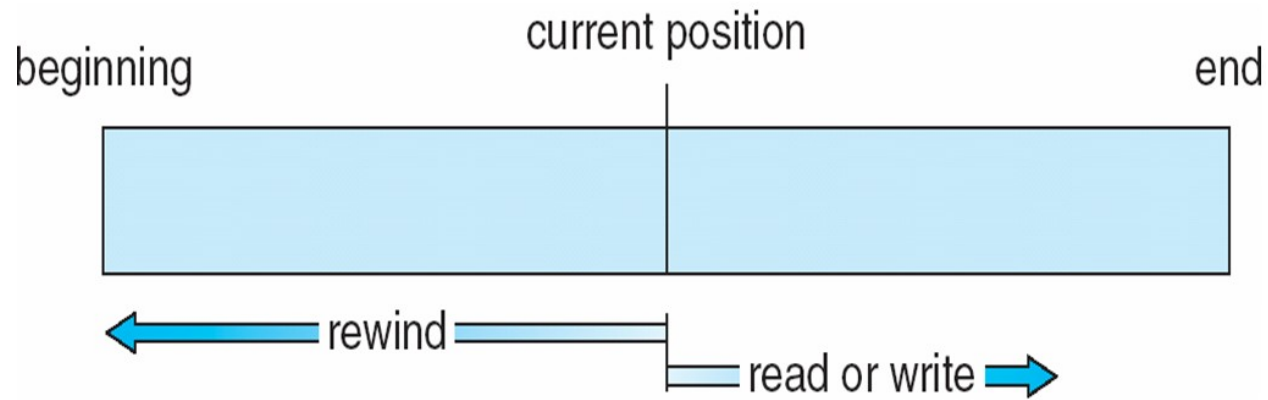
File Structure

- 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





Sequential-access File





Access Methods

□ Sequential Access

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

□ Direct Access – file is fixed length [logical records](#)

- `read n`
- `write n`
- `position to n`
 - `read next`
 - `write next`
- `rewrite n`

n = [relative block number](#)

□ Relative block numbers allow OS to decide where file should be placed

- See [allocation problem](#) in Ch 12





Simulation of Sequential Access on Direct-access File

sequential access	implementation for direct access
<i>reset</i>	$cp = 0;$
<i>read next</i>	$read\ cp;$ $cp = cp + 1;$
<i>write next</i>	$write\ cp;$ $cp = cp + 1;$





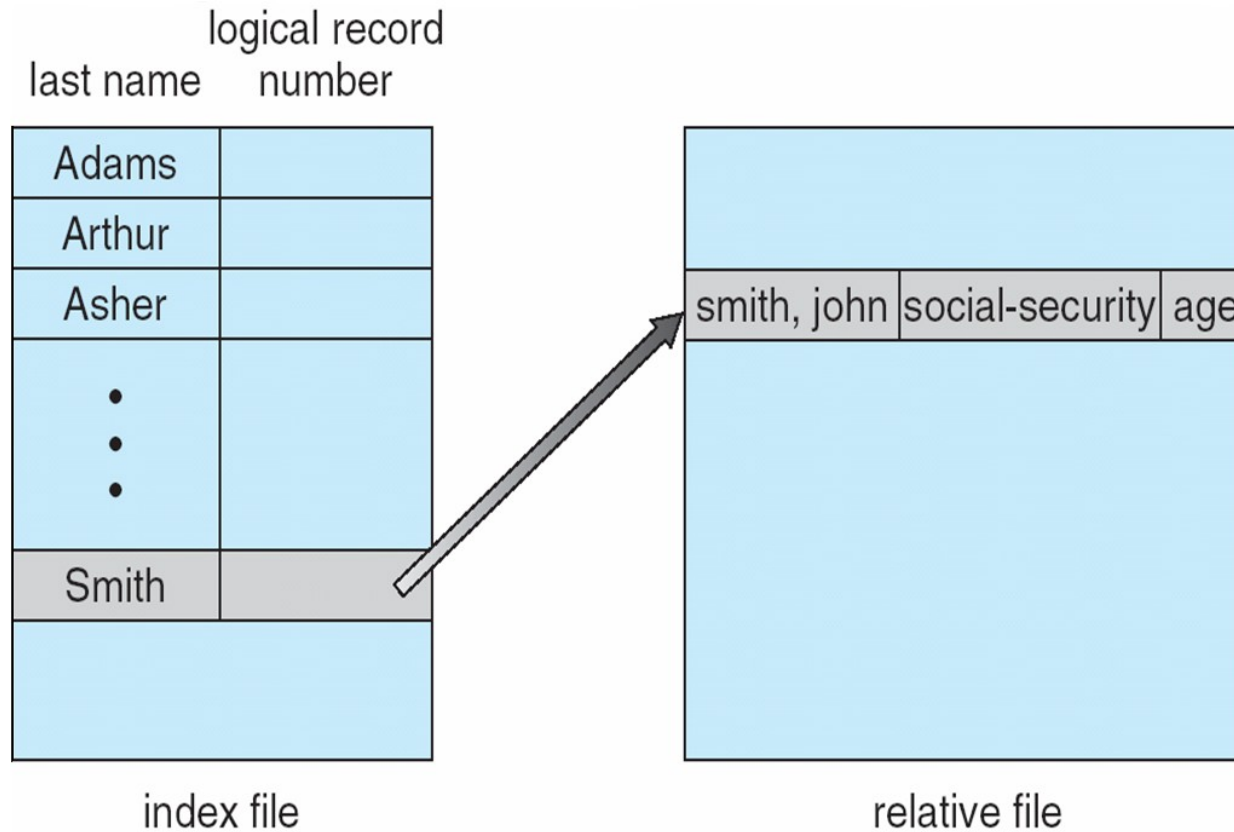
Other Access Methods

- Can be built on top of base methods
- General involve creation of an **index** for the file
- Keep index in memory for fast determination of location of data to be operated on (consider UPC code plus record of data about that item)
- If too large, index (in memory) of the index (on disk)
- IBM indexed sequential-access method (ISAM)
 - Small master index, points to disk blocks of secondary index
 - File kept sorted on a defined key
 - All done by the OS
- VMS operating system provides index and relative files as another example (see next slide)





Example of Index and Relative Files





Types of File Systems

We mostly talk of general-purpose file systems

But systems frequently have many file systems, some general- and some special- purpose

Consider Solaris has

tmpfs – memory-based volatile FS for fast, temporary I/O

objfs – interface into kernel memory to get kernel symbols for debugging

ctfs – contract file system for managing daemons

lofs – loopback file system allows one FS to be accessed in place of another

procfs – kernel interface to process structures

ufs, zfs – general purpose file systems





Operations Performed on Directory

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



End of Chapter 11

