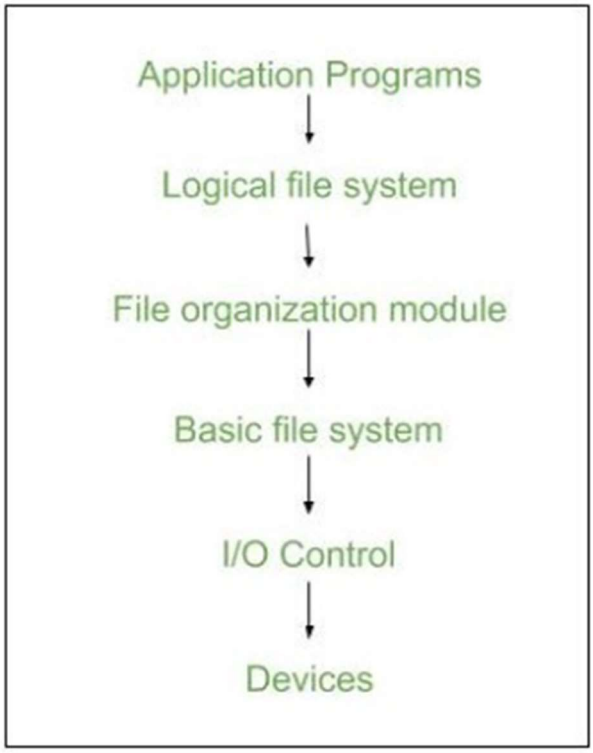
Assignment : 6

List of Topics: Simple File System (SFS)

The objective of this lab is to understand and implement how file systems are implemented.

A file is a collection of related information. The file system resides on secondary storage and provides efficient and convenient access to the disk by allowing data to be stored, located, and retrieved.

File system organized in many layers :



- **I/O Control level –**

  Device drivers acts as interface between devices and Os, they help to transfer data between disk and main memory. It takes block number a input and as output it gives low level hardware specific instruction.

- **Basic file system –**

  It Issues general commands to device driver to read and write physical blocks on disk.It manages the memory buffers and caches. A block in buffer can hold the contents of the disk block and cache stores frequently

used file system metadata.

- **File organization Module –**

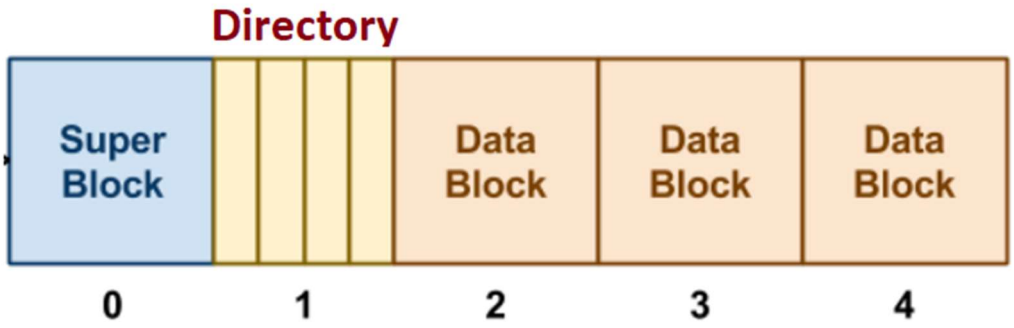
  It has information about files, location of files and their logical and physical blocks.Physical blocks do not match with logical numbers of logical block numbered from 0 to N. It also has a free space which tracks unallocated blocks.

- **Logical file system –**

  It manages metadata information about a file i.e includes all details about a file except the actual contents of file. It also maintains via file control blocks. File control block (FCB) has information about a file – owner, size, permissions, location of file contents.

File-System Implementation

File systems store several important data structures on the disk:



1. **Super Block**: The **master file table** in UNIX or the **superblock** in Windows, which contains information such as the partition table, number of blocks on each filesystem, and pointers to free blocks and free FCB (File Control Block) blocks.
   a. It generally store the metadata of the File System.
   b. Like Free-Space
   c. Directory Structure
   d. Block size
   e. File-System size.

2. **Directory**: containing file names and pointers to corresponding FCBs. UNIX uses inode numbers, and NTFS uses a master file table.

3. **Data Block**: File are stored in the form of data block in secondary storage.

Directory Implementation

Directories need to be fast to search, insert, and delete, with a minimum of wasted disk space.

Linear List

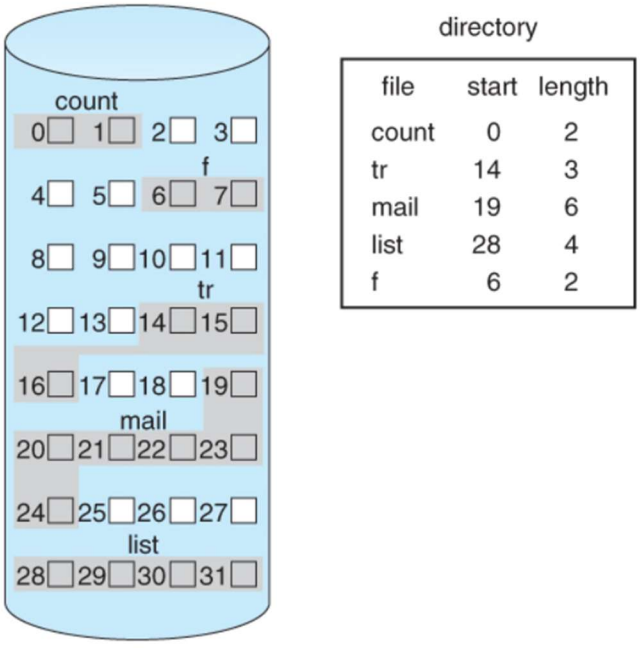
- A linear list is the simplest and easiest directory structure to set up, but it does have some drawbacks.
- Finding a file (or verifying one does not already exist upon creation) requires a linear search.

Hash Table

- A hash table can also be used to speed up searches.
- Hash tables are generally implemented in addition to a linear or other structure

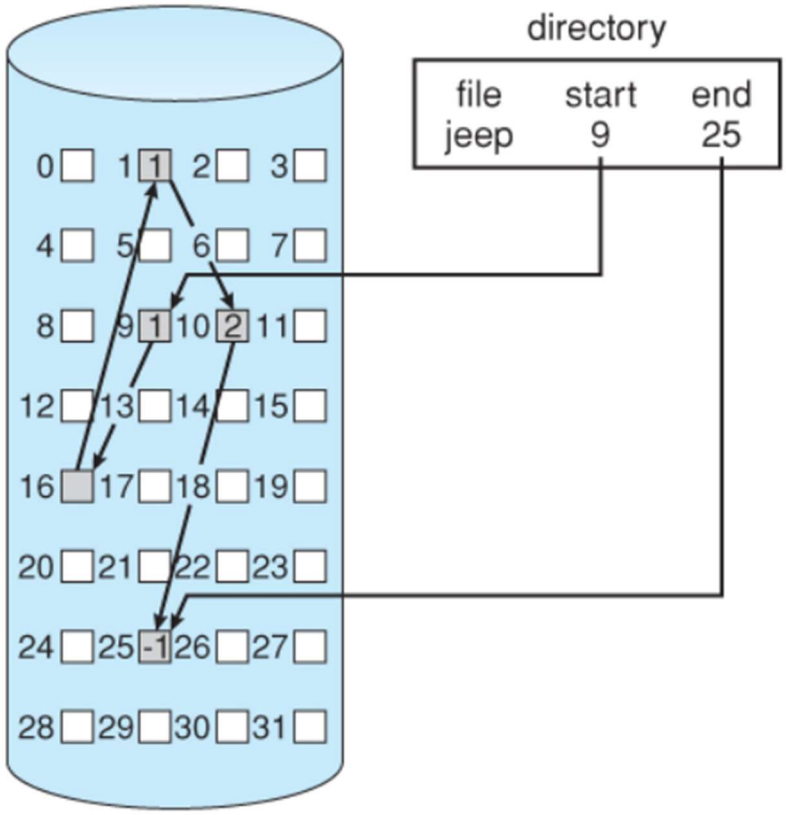
Allocation Methods:

1. **Contiguous Allocation**



Contiguous Allocation

2. **Linked Allocation**



Linked allocation of disk space.

Free-Space Management

Another important aspect of disk management is keeping track of and allocating free space.

1. Bit Vector
    a. One simple approach is to use a bit vector, in which each bit represents a disk block, set to 1 if free or 0 if allocated.
    b. Fast algorithms exist for quickly finding contiguous blocks of a given size

2. Linked List
    a. A linked list can also be used to keep track of all free blocks.
    b. Traversing the list and/or finding a contiguous block of a given size are not easy, but fortunately are not frequently needed operations. Generally the system just adds and removes single blocks from the beginning of the list.
    c. The FAT table keeps track of the free list as just one more linked list on the table.

Exercise :

- You have to implement simple file system called CFS(continuous File System)
- For that assume
    - There is single level directory
    - Files are stored in contiguous fashion
- Your First task is to create approx 40MB file called CFS.data and based on that file implement File system.
- Divide this file into 3 parts
    - super block structure,
    - directory structure and,
    - files are stored in form of blocks.
- For this implementation you can use read/write with seek system call for access and write data into various parts of the disks(here treat CFS.data as disk).

Submission :

1. Submit assignment with the report consists of an input file and output file with proper explanation of each output of all the exercises in pdf format.

2. Add all the outputs and a brief description of the commands used in the given demo scripts in the report.

3. Submitted code in a report

5. **Submission Deadline: (Monday, 10-Oct-2022), 23:59:00**
6. Late submission will result in 0 scores.