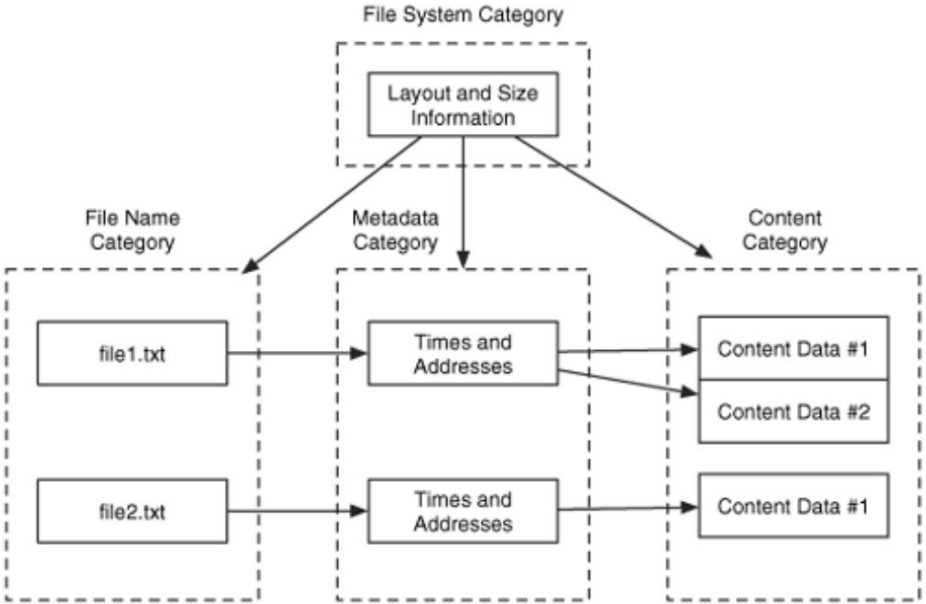
FAT Concepts and Analysis

Physical layout of a FAT file system.

All data in a file system belong to one of the categories:

1. file system
2. content
3. metadata
4. file name



Physical layout of a FAT file system.

Reserved area: Information regarding the size and layout of file system

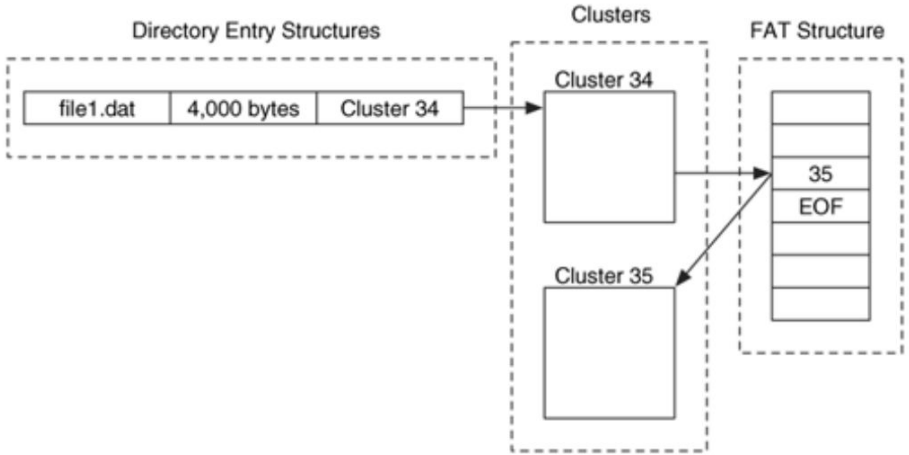
FAT area : It contains the primary and backup FAT (File Allocation Table) structures

Data area : Clusters that will be allocated to store file and directory content

Data Structure in FAT

File Allocation Table

Directory entries



File System Category

- **Boot sector data structure** contains the Layout and Size Information
- The boot sector is located in the first sector of the volume
- It is part of the reserved area of the file system

File System Category

Essential Boot Data

- Location of the three physical layout areas
  - The reserved area starts in sector 0 of the file system, and its size.
  - FSINFO data structure sector : It contains information about the location of the **next available cluster** and the total amount of free clusters
  - Data related to FAT area : Number of FAT structures and size of each FAT.
  - Data related to Data area :
    - Starting sector
    - Location of the root directory


```
File System Type: FAT32

OEM Name: mkfs.fat
Volume ID: 0xfaf94191
Volume Label (Boot Sector):
Volume Label (Root Directory):
File System Type Label: FAT32
Next Free Sector (FS Info): 29624
Free Sector Count (FS Info): 15150144

Sectors before file system: 2048

File System Layout (in sectors)
Total Range: 0 - 15179775
* Reserved: 0 - 31
** Boot Sector: 0
** FS Info Sector: 1
** Backup Boot Sector: 6
* FAT 0: 32 - 14827
* FAT 1: 14828 - 29623
* Data Area: 29624 - 15179775
** Cluster Area: 29624 - 15179775
*** Root Directory: 29624 - 29631

METADATA INFORMATION
------------------------------------------
Range: 2 - 242402438
Root Directory: 2

CONTENT INFORMATION
------------------------------------------
Sector Size: 512
Cluster Size: 4096
Total Cluster Range: 2 - 1893770

FAT CONTENTS (in sectors)
------------------------------------------
29624-29631 (8) -> EOF
```

File System Category

Non-essential Boot Sector Data

- OEM name that may correspond to what system (Windows,Linux) was used to make the file system
- 4-byte volume serial number
- Eight-character type string that contains "FAT12," "FAT16," "FAT32,"

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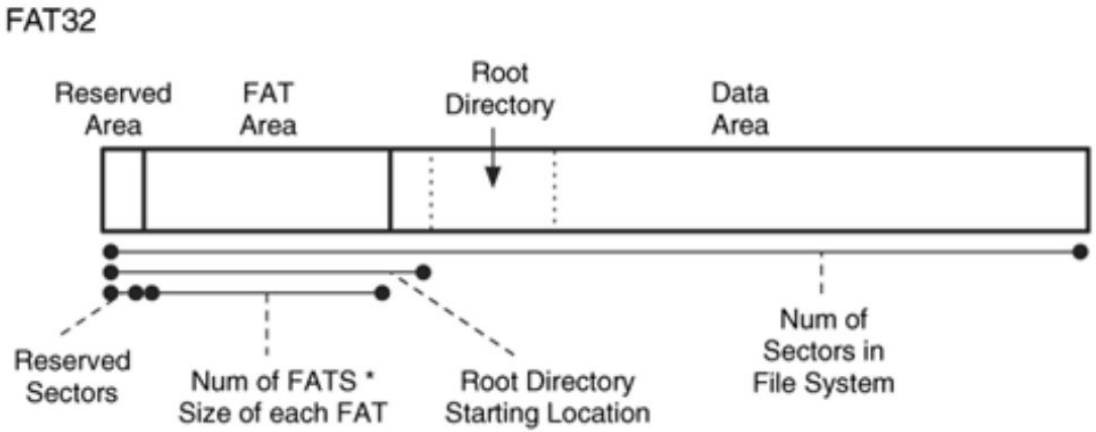
Content Category

- **The content category includes the data that comprise file or directory content.**
- A cluster is a group of consecutive sectors
- Each cluster is given an address, and the address of the first cluster is 2



Cluster Allocation Status

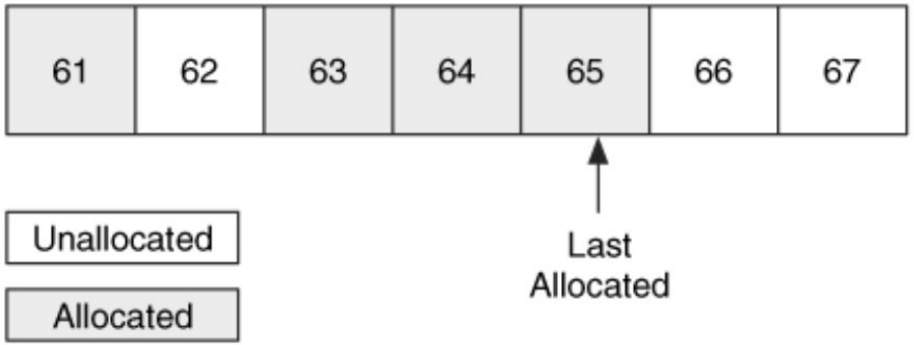
- Allocation status of a cluster is determined using the FAT structure
- If the table entry is 0, the cluster is not allocated to a file.
- If the table entry is 0xff7 for FAT12, 0xfff7 for FAT16, or 0x0fff fff7 for FAT32, the cluster has been marked as damaged and should not be allocated.

Allocation Algorithms

The **next available algorithm** searches for the first available cluster starting from the previously allocated cluster.

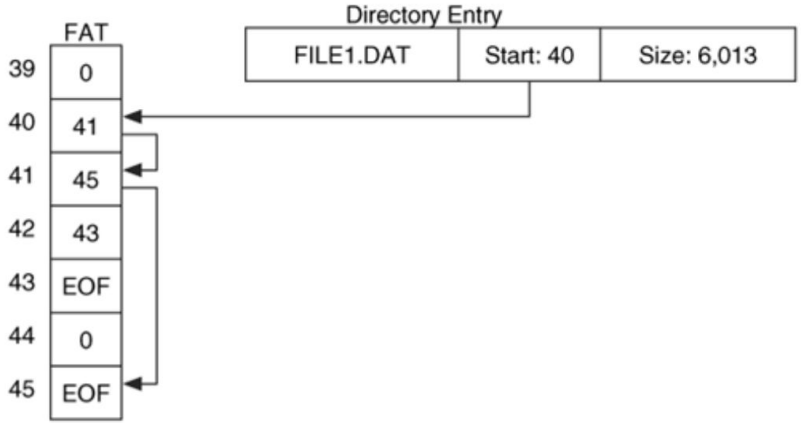
The **first-available allocation strategy** searches for the first available cluster starting from the start of the beginning cluster.

The **best-available allocation strategy** searches for the first available cluster starting from the start of the beginning cluster.



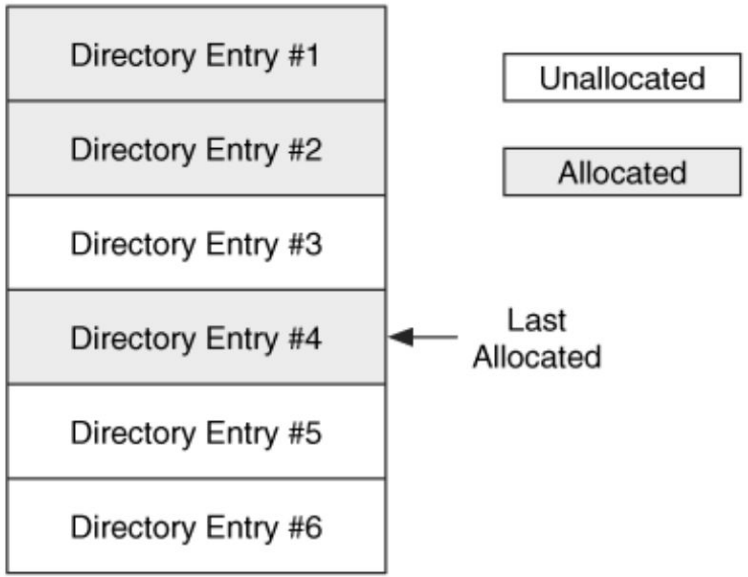
Metadata Category

- The metadata category includes the data that describe a file or directory, including the locations where the content is stored, dates and times, and permissions
  - The directory entry is a data structure that is allocated for every file and directory.
  - The FAT structure also is used to store metadata information about the layout of a file or directory

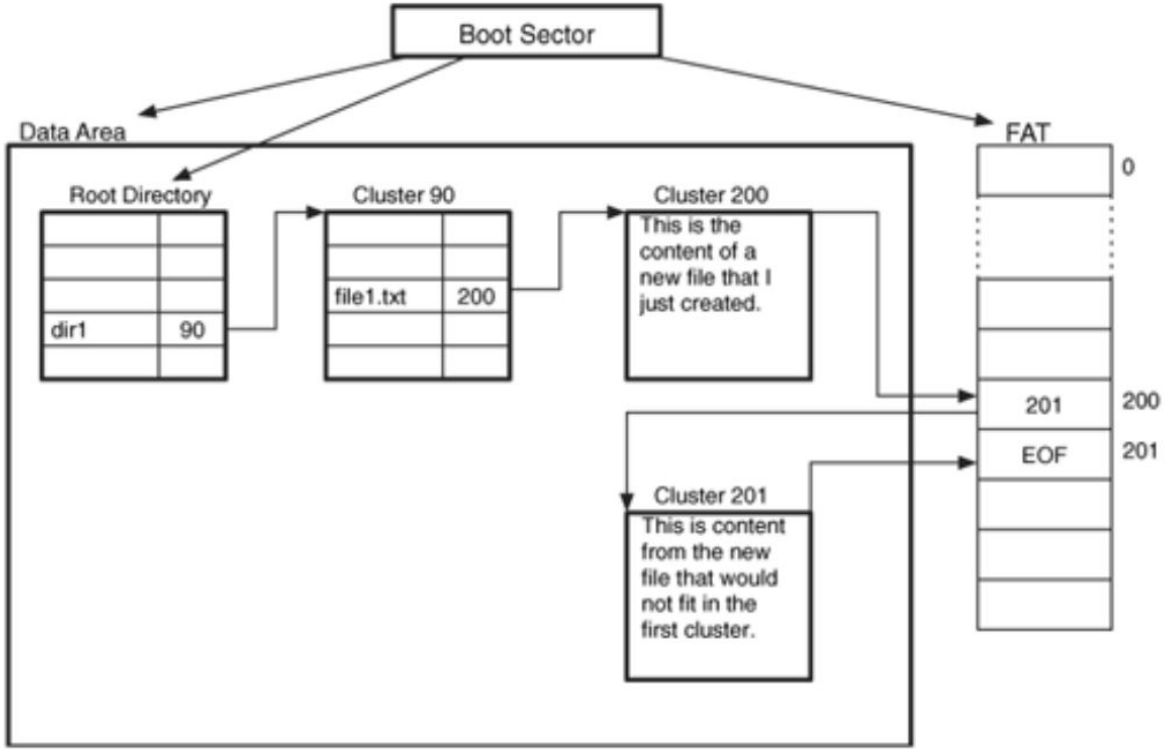


Allocation Algorithms

- First-available allocation method
- Next-available allocation method
- Best -available allocation method



File Allocation Example



File Deletion Example