

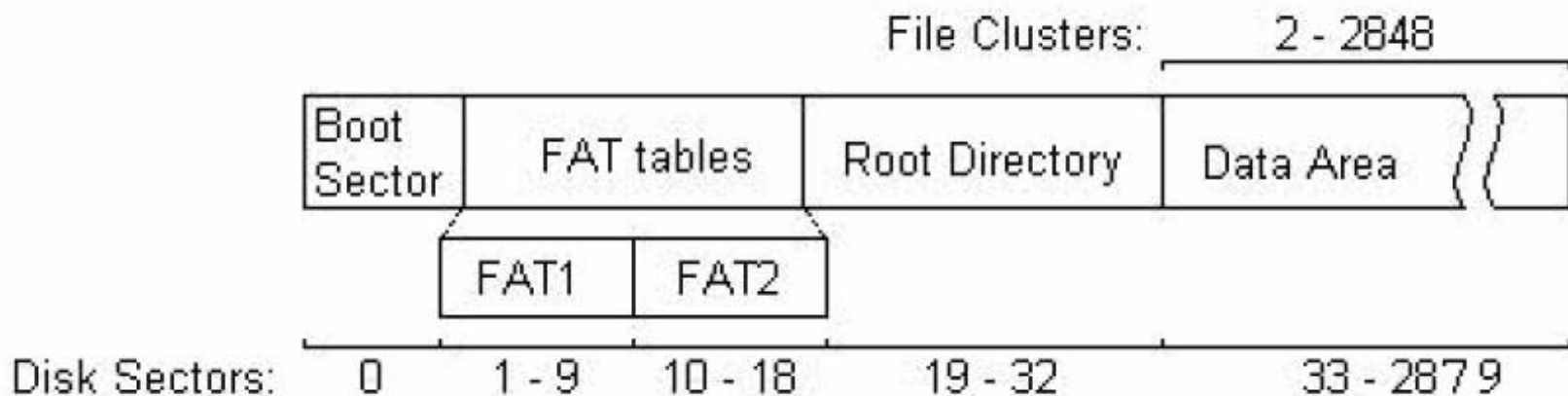
OS Tutorial 4: File System (FAT-12)

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FAT-12 Disk Organization

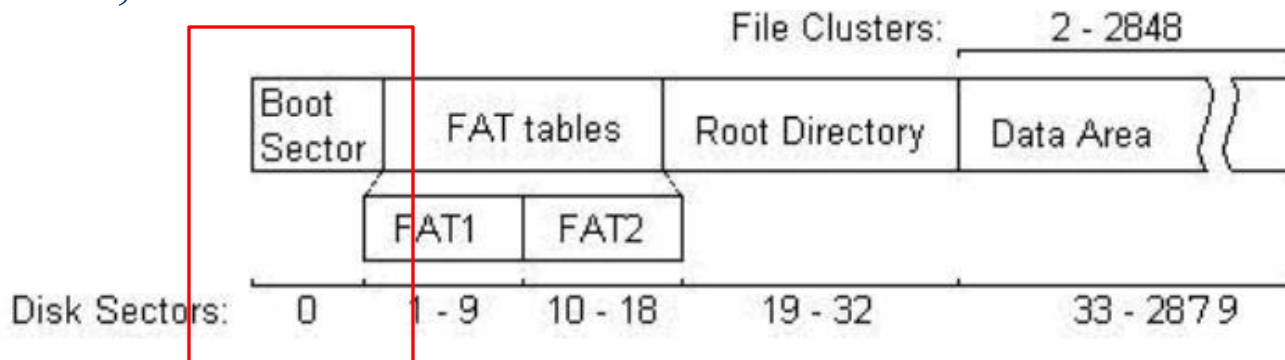
- * The **File Allocation Table (FAT)** is a table stored on a hard disk or floppy disk that indicates the status and location of all data clusters that are on the disk.
- * The FAT12 is the file system on a **floppy disk**. The number “12” is derived from the fact that the FAT consists of **12-bit entries**.
- * For the floppy disk, the number of sectors in a cluster is one. Also, the size of a sector (and hence a cluster) is 512 bytes for a floppy disk.

FAT-12 Disk Organization



Boot Sector

- * The **boot sector** exists at sector 0 on the disk and contains the basic disk geometry.
- * Contains specific information about the rest of organization of the file system. E.g., how many copies of the FAT tables are present, how big a sector is, how many sectors in a cluster, etc.



Boot Sector

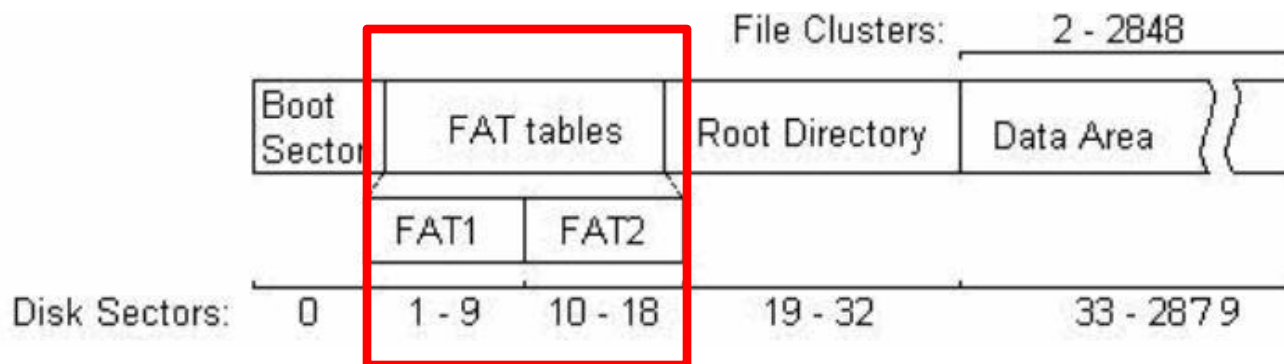
Starting byte	Length (in bytes)	Stored data
0	11	Ignore
11	2	Bytes per sector
13	1	Sectors per cluster
14	2	Number of reserved sectors
16	1	Number of FATs
17	2	Maximum number of root directory entries
19	2	Total sector count ^a
21	1	Ignore

Boot Sector

22	2	Sectors per FAT
24	2	Sectors per track
26	2	Number of heads
28	4	Ignore
32	4	Total sector count for FAT32 (0 for FAT12 and FAT16)
36	2	Ignore
38	1	Boot signature ^b
39	4	Volume id ^c
43	11	Volume label ^d
54	8	File system type (e.g. FAT12, FAT16) ^e
62	-	Rest of boot sector (ignore)

FAT (File Allocation Table)

- * Composed by a number of **FAT entries**.
- * Each entry in the FAT corresponds to a cluster (sector) of data on the disk.



FAT Entry

FAT entries (12 bits): The pointers to every clusters on disk.

The entries in positions 0 and 1 of the FAT are reserved.

Value	Meaning
0x00	Unused
0xFF0-0xFF6	Reserved cluster
0xFF7	Bad cluster
0xFF8-0xFFFF	Last cluster in a file
(anything else)	Number of the next cluster in the file

Directories

- * Directories (such as the root directory) exist like files on disk, in that they occupy one or more sectors.
- * Each sector (512 bytes) of a directory contains 16 directory entries (each of which is 32 bytes long).
- * Each directory entry contains the following information about a subdirectory or file:

Directory Entry

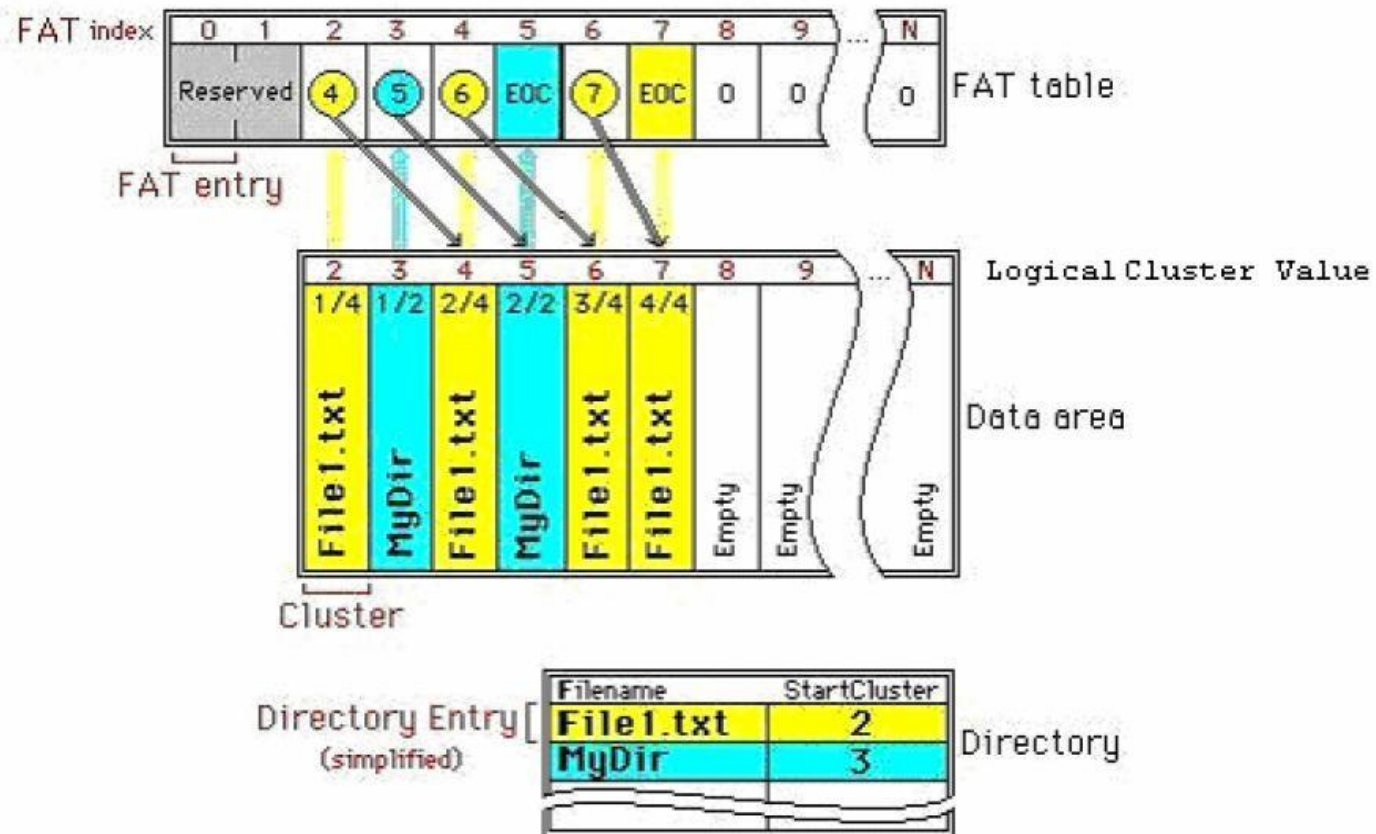
Offset (in bytes)	Length (in bytes)	Description
0	8	Filename (but see notes below about the first byte in this field)
8	3	Extension
11	1	Attributes (see details below)
12	2	Reserved
14	2	Creation Time
16	2	Creation Date
18	2	Last Access Date
20	2	Ignore in FAT12
22	2	Last Write Time
24	2	Last Write Date
26	2	First Logical Cluster
28	4	File Size (in bytes)

Directory Entry (Name & Attribute Field)

If the first byte of the Filename field is 0xE5, then the directory entry is *free* (i.e., currently unused), and hence there is no file or subdirectory associated with the directory entry. If the first byte of the Filename field is 0x00, then this directory entry is free and all the remaining directory entries in this directory are also free.

Bit	Mask	Attribute
0	0x01	Read-only
1	0x02	Hidden
2	0x04	System
3	0x08	Volume label
4	0x10	Subdirectory
5	0x20	Archive
6	0x40	Unused
7	0x80	Unused

Example: How to Use FAT



FAT Packing

The space on a floppy disk = 1.44 Mbytes.

The number of bytes in a sector = 512

The number of sectors in 1.44 Mbytes = $x \approx 2812$

Therefore, the minimum number of bits required to address “x” sectors = 12 bits ($2^{11} < 2812 < 2^{12}$)

- * For FAT-12 File System:

- * 1 FAT entry \rightarrow 12 bits \rightarrow 1.5 Bytes

- * 2 FAT entries \rightarrow 24 bits \rightarrow **3 bytes**