GTU Department of Computer Engineering
CSE312/CSE504 - Spring 2021
Homework 4 Report(Part1)

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Problem Definition

The problem is to implement a simulated and simplified version **FAT12 File System** in C/C++.

Solution

In this Homework, I only implemented **part1 and part2 fully** because of time constraint and final week.

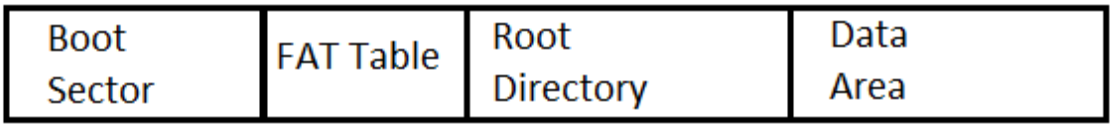
Design Issues

Before Starting to homework, we need to understand **FAT12 file system** very carefully so that we can see which **data structures** do we need?

1) Disk organization

In order to simulate disk, we have **.dat** file. Therefore, we need to organize this file.

Fat12 File System



Disk organization of the FAT12 file system

My Data Structures

1) Boot Sector

This Part of the system contains information about the file system such as Bytes per sector, Sectors per cluster, Number of reserved sectors. I will keep it simple. I will put information(superblock) according to block size as in figure.

Block size	FAT-12	FAT-16	FAT-32
0.5 KB	2 MB		
1 KB	4 MB		
2 KB	8 MB	128 MB	
4 KB	16 MB	256 MB	1 TB
8 KB		512 MB	2 TB
16 KB		1024 MB	2 TB
32 KB		2048 MB	2 TB

Figure 4-31. Maximum partition size for different block sizes.

My code for Boot Sector;

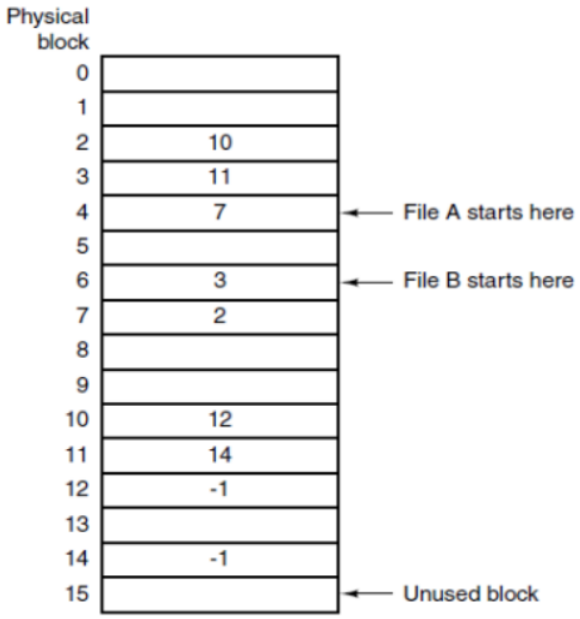
```
13
14  typedef  uint8_t  byte1;   // 1 byte
15  typedef  uint16_t  byte2; // 2 bytes
16  typedef  uint32_t  byte4; // 4 bytes
17
```

```
19  typedef struct __attribute__ ((__packed__)) BootSector{
20      char diskName[20];
21      byte4 diskSize;
22      float blockSize;
23      byte4 numberOfEntry;
24      byte4 numberOfBlock;
25      byte4 totalByte;
26      byte4 bootSectorPosition;
27      byte4 fatTablePosition;
28      byte4 rootDirPosition;
29      byte4 dataStartPosition;
30  }superBlock;
31
```

*Check data_structures.h file in part2 folder.

2) FAT(File Allocation Table)

FAT will be an **array** as in picture;

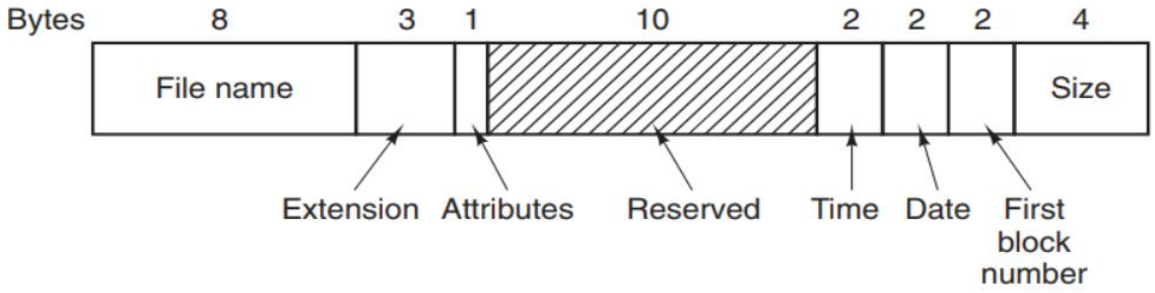


My code for FAT;

```
3   int *fat = NULL;
```
(integer array)

3) Root Directory and Directories

My Directory entries will be this and 32 bytes in total;



Note that in FAT12 File System First block number information 1,5 byte(12 bit). The others will be as it is in picture.

Attributes in Directory Entry

Bit	Attribute
0	Read-only
1	Hidden
2	System
3	Volume label
4	Subdirectory
5	Archive
6	Unused
7	Unused

My Code for Directory Entries

```
32
33  typedef struct __attribute__ ((__packed__)) directory{
34      char fileName[8]; //8 byte
35      char extension[3]; // 3 byte
36      byte1 attributes; // 1 byte
37      char reserved[10]; //10 byte
38      byte2 time; // 2 byte
39      byte2 date; // 2 byte
40      byte2 firstBlockNumber; // 2 byte
41      byte4 fileSize; // 4 byte
42  }entry;
```

```
47  extern entry *directories; // all directrioes in file system
```

Free Blocks in File System

In order to keep free blocks in file system I used **bitmap** data structure.

```
46  extern byte1 *freeBlocksBitmap; //bitmap array to keep free block information
```

Creating empty file system(disk)

In order to create an empty file(virtual disk), I used **open** and **ftruncate** functions in C.

Test Results

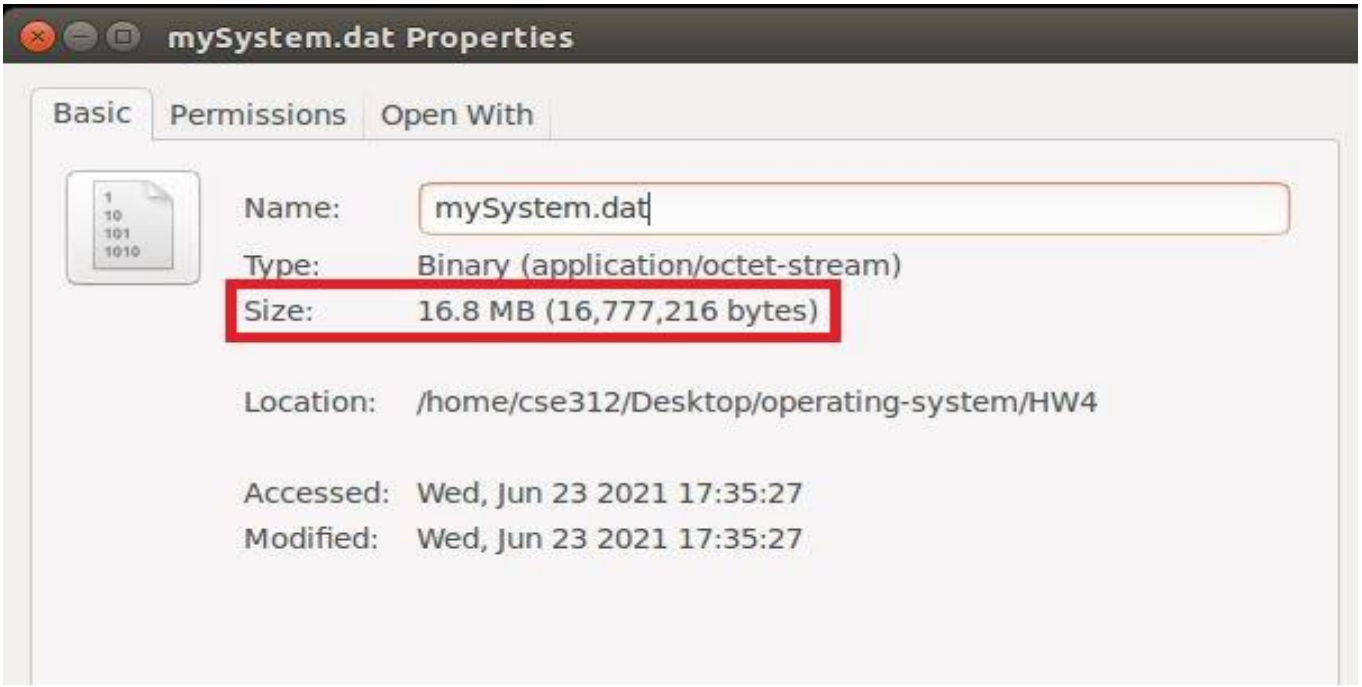
Followings are my simple test results;

```
cse312@ubuntu:~/Desktop/operating-system/HW4$ ./makeFileSystem 4 mySystem.dat

        ****Virtual Disk Has Created!****
-----------------------------------------------------
Disk Name: mySystem.dat
Disk Size: 16MB
Block Size: 4.0KB
Number of Block: 4096
Boot Sector Start Adress: 0
FAT Table Start Adress: 57
Root Directory Start Adress: 73784
Data Region Start Adress: 73817
-----------------------------------------------------

cse312@ubuntu:~/Desktop/operating-system/HW4$
```

Block Size is 4



File Size

```
cse312@ubuntu:~/Desktop/operating-system/HW4$ ./makeFileSystem 2 mySystem.dat

        ****Virtual Disk Has Created!****
---------------------------------------------------
Disk Name: mySystem.dat
Disk Size: 8MB
Block Size: 2.0KB
Number of Block: 4096
Boot Sector Start Adress: 0
FAT Table Start Adress: 57
Root Directory Start Adress: 36920
Data Region Start Adress: 36953
---------------------------------------------------

cse312@ubuntu:~/Desktop/operating-system/HW4$
```

Block Size is 2

```
cse312@ubuntu:~/Desktop/operating-system/HW4$ ./makeFileSystem 1 mySystem.dat

        ****Virtual Disk Has Created!****
---------------------------------------------------
Disk Name: mySystem.dat
Disk Size: 4MB
Block Size: 1.0KB
Number of Block: 4096
Boot Sector Start Adress: 0
FAT Table Start Adress: 57
Root Directory Start Adress: 18488
Data Region Start Adress: 18521
---------------------------------------------------

cse312@ubuntu:~/Desktop/operating-system/HW4$
```

Block Size is 1

```
cse312@ubuntu:~/Desktop/operating-system/HW4$ ./makeFileSystem 0.5 mySystem.dat

        ****Virtual Disk Has Created!****
-------------------------------------------------
Disk Name: mySystem.dat
Disk Size: 2MB
Block Size: 0.5KB
Number of Block: 4096
Boot Sector Start Adress: 0
FAT Table Start Adress: 57
Root Directory Start Adress: 9272
Data Region Start Adress: 9305
-------------------------------------------------

cse312@ubuntu:~/Desktop/operating-system/HW4$
```

Block Size is 0.5

```
cse312@ubuntu:~/Desktop/operating-system/HW4$ ./makeFileSystem 3 mySystem.dat
Wrong block Size, Try Again!
cse312@ubuntu:~/Desktop/operating-system/HW4$
```

With Wrong Block size