

# **EC 440 – Introduction to Operating Systems Project 5 – Discussion**

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# Simple Filesystem

## Capabilities:

- Create
- Write
- Read
- Delete
- ... files

# “Constraints” from the Description

- One 32Mb underlying “virtual disk” (i.e., a file)
  - Consisting of 8192 4K blocks
  - At least 4096 blocks (i.e., 16Mb) must be available for file storage (i.e., you can use up to 50% of the disk capacity for meta-data)
- You can only access *individual* and *entire* blocks through the interface (i.e., `block_read`, `block_write`)

## **“Constraints” from the Description (2)**

- Max 64 files at any given time
- Exactly 1 directory (that contains all files)
- Max 15 character filenames

# How To Organize File Contents?

**s.t. files can be**

- created
- arbitrary in size
- grow/shrink
- be deleted

Let's store file contents in a series of *not necessarily* consecutive blocks on disk!

**Why list of blocks?**

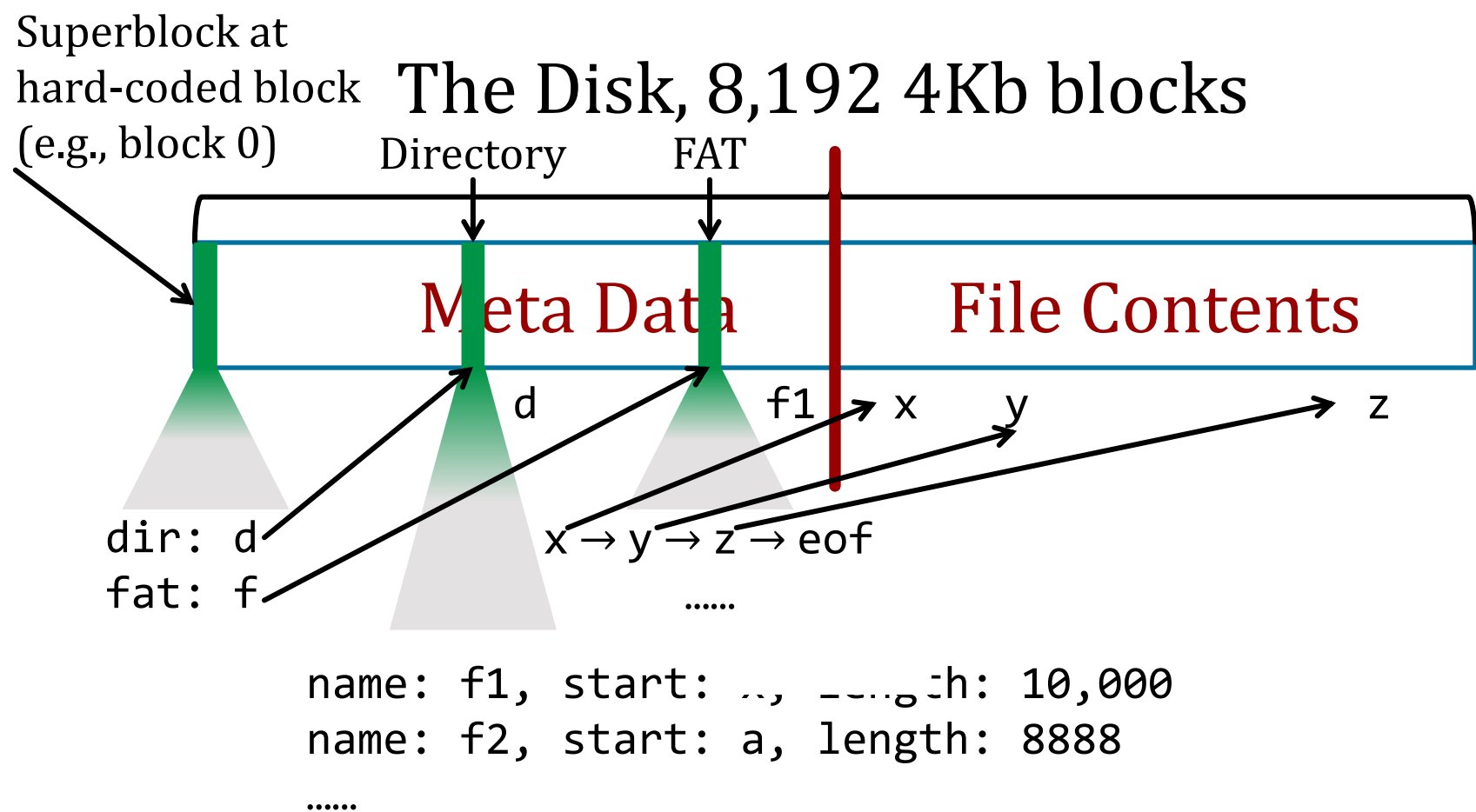
- Flexible, easy to grow shrink

**Why not necessarily consecutive?**

- Fragmentation might happen (e.g., middle of three files might shrink → block becomes free)

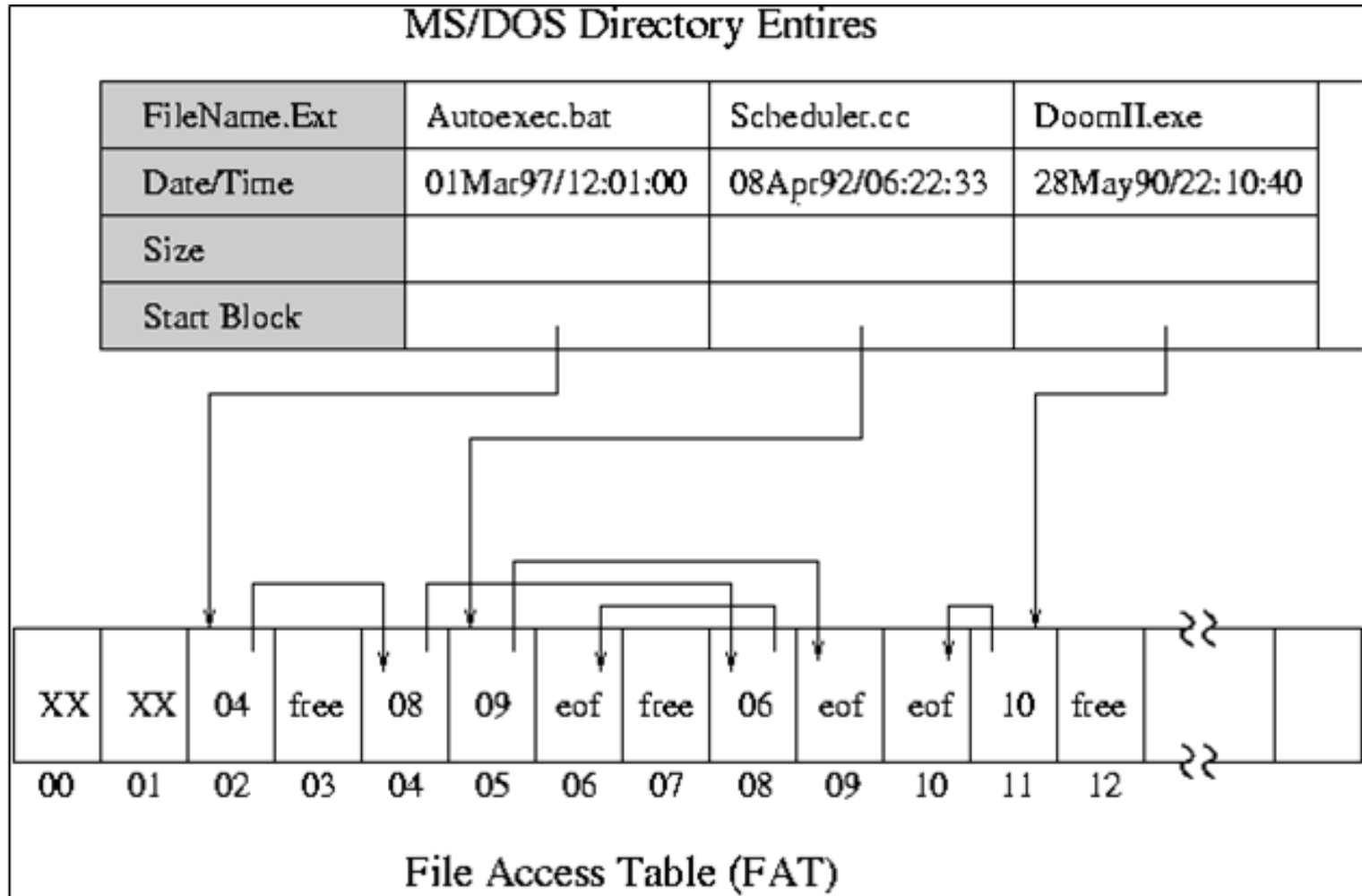
Cool! But *HOW?!*

# Mental Picture of the Virtual Disk



Make a file (f1) of size 3 blocks (e.g., 10,000 bytes)

# Directory Entries (aka Files) & Content



# Want Some Data Structures?

## **Superblock**

- Refers to a number of blocks for directory information (dir\_idx, dir\_len)
- Refers to a number of blocks that contains the FAT (fat\_idx, fat\_len)
- Reference to first block of file data (data\_idx)

## **Directory**

- Array of dir\_entry-s

## **dir\_entry**

- Filename
- Filesize
- First Block

## **FAT**

- Array of block\_idx'es (or eof, or free)



# Superblock

```
struct super_block {  
    int fat_idx; // First block of the FAT  
    int fat_len; // Length of FAT in blocks  
    int dir_idx; // First block of directory  
    int dir_len; // Length of directory in blocks  
    int data_idx; // First block of file-data  
}
```

# Directory Entry (File Metadata)

```
struct dir_entry {  
    int used;        // Is this file-"slot" in use  
    char name [MAX_F_NAME + 1]; // DOH!  
    int size;        // file size  
    int head;        // first data block of file  
    int ref_cnt;  
    // how many open file descriptors are there?  
    // ref_cnt > 0 -> cannot delete file  
}
```

# File Descriptor

```
struct file_descriptor {  
    int used;        // fd in use  
    int file;        // the first block of the file  
                    // (f) to which fd refers too  
    int offset;      // position of fd within f  
}
```

# Some Globals You'll Want

```
struct super_block fs;  
struct file_descriptor fildes[MAX_FILDES]; // 32  
int *FAT; // Will be populated with the FAT data  
struct dir_entry *DIR; // Will be populated with  
                        //the directory data
```

## An Aside:

The project is restricted (i.e., simple) enough that you can calculate the size of FAT[] and DIR[] in advance.

# Deliverables

- make must produce an `fs.o`
- Do not modify `disk.h`
  - If you need additional header files, make new ones (e.g., `mydisk.h`)
- Do not re-define symbols defined in `disk.h/disk.c` in your own code!
- Do not include the source of the functions from `disk.c` in your source code

# Extra Credit Opportunity

- Minimum requirement of storage is 16MB
- We'll try storing more data in your FS
- For every  $x$  MB  $> 16$ MB ( $x \geq 1$ ) that your FS can store, you get  $\text{floor}(\text{ld}(x)) + 1$  points extra credit (capped at 5 points max)

16 + 1 MB  $\rightarrow \text{ld}(1) + 1 = 1$  point

16 + 2 MB  $\rightarrow \text{ld}(2) + 1 = 2$  points

16 + 4 MB  $\rightarrow \text{ld}(4) + 1 = 3$  points

16 + 8 MB  $\rightarrow \text{ld}(5) + 1 = 4$  points

16 + 16 MB  $\rightarrow \text{ld}(16) + 1 = 5$  points

**Questions?**