

What is a File System?

15-213 / 15-513 / 14-513: Introduction to Computer Systems
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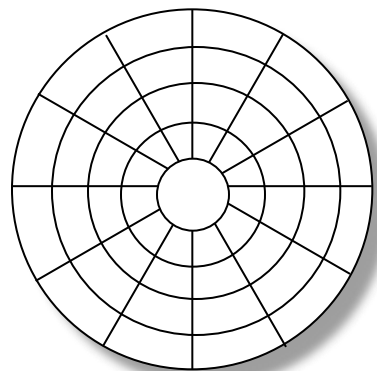
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Today

- **What is a File System?**
- **Managing a file system**
- **Common operations**

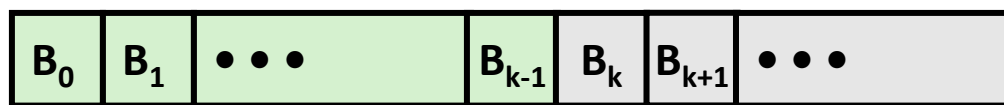
File System

- Manages disk blocks to provide a file abstraction



Surface* organized into tracks

Tracks divided into sectors



Current file position = k

*Durable storage has many architectures, but ultimately they expose “blocks”

Making a File System

- **File systems start by formatting raw disk blocks**
 - Designate one (or more) blocks as “super”
 - Record the rest of the blocks as free

Managing a File System

- **“Super” block is the master block with information**
 - Type information
 - Size
 - Root directory
 - Free blocks
- **SFS has a flat directory structure, so the root directory is part of the superblock**

Finding a File

- A directory is a special file
 - Maps strings to files
 - Those files could also be directories

Index in directory

Max files in directory

```
for (fileEntry = 0; (unsigned long)fileEntry < FILE_COUNT_LIMIT;
    fileEntry++) {
    if (superBlock->files[fileEntry].first_block != 0 &&
        strcmp(superBlock->files[fileEntry].name, fileName) == 0) {
        return addOpenFileEntry(fileEntry);
    }
}
```

Allocated?

Check name

Files and Names

- File contents are separate from the file's "name"
- File extensions do not set the "type" of the data
- Names are just a "key" to locate the data

Opening a File

- **Find the file**
- **Create the three table entries**
 - Find an available file descriptor
 - Allocate an open file table entry
 - Pos, permissions, etc
 - Load file info into memory
 - *SFS is always in-memory, so this is implicit

Reading a File

- The file system will map file pos to disk blocks
- Lots of ways to map
 - Contiguous
 - Linked / FAT ← SFS
 - Indexed

Writing a File

- **Like reading, but the file could grow**
 - SFS preallocates space
 - Interesting synchronization

Deleting a File

- **Like free(), but ...**
 - Can open files be deleted?

- **Two steps:**
 - Removing the mapping
 - Putting the blocks into the free list

SFS Specific Notes

■ “Shark” File System

- Uses mmap to bring the entire “disk” file into memory
- Treats the disk as an array of 512-byte blocks
- Block 0 is the superblock, other references to 0 are NULLs
- Flat directory structure