What is a File System?

15-213 / 15-513: Introduction to Computer Systems
Other Lecture, July 17, 2024

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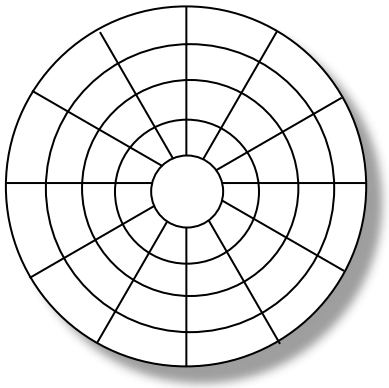
Today

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

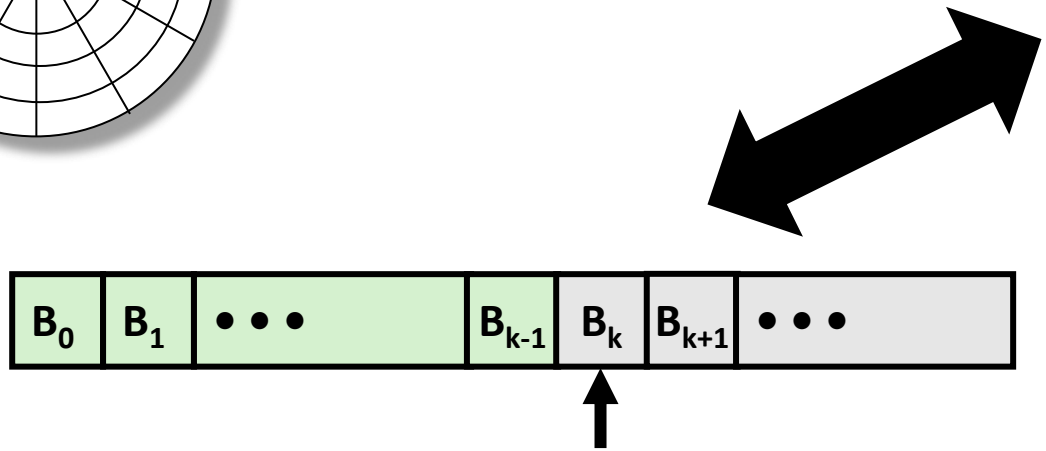
File System

- Manages disk blocks to provide a file abstraction



Surface* organized into tracks

Tracks divided into sectors



*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

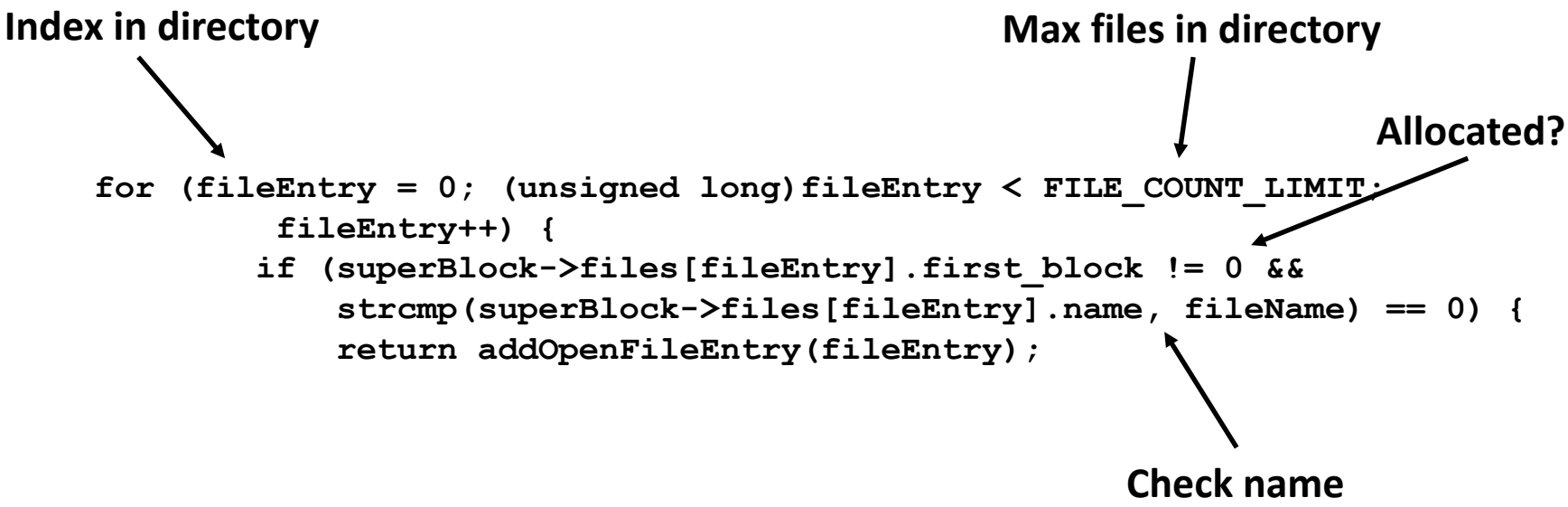
Managing a File System

- **"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



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