File Types

Types of files
Confusion: Text files vs. Binary Files

- **Text files (ASCII / UNICODE)**
  - *Bytes of data are organised as characters from respective character sets*
- **Binary files**
  - *Data in a specific format that requires interpretation.*
- **Text files vs. Binary Files**
  - *All files are in Binary*
  - *Text Files are formatted in chunks of 8 bits or 16 bits*
  - *Files in any other format are Binary Files*

File types

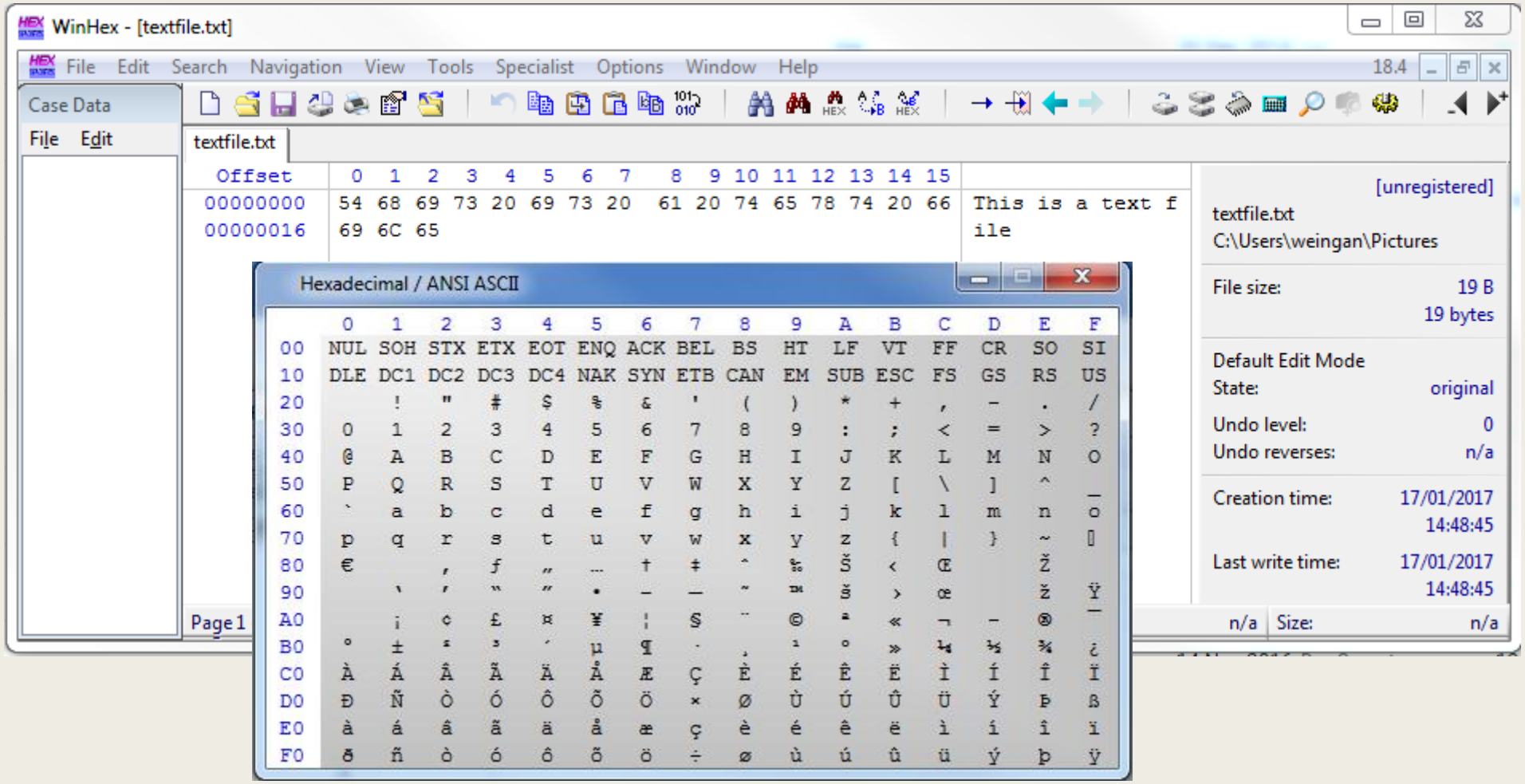
- Most files contain a specific types of information
  - *A Java program*
  - *A JPEG image*
  - *A BITMAP image*
  - *An MP3 clip*
- The kind of information is the **file type**
  - *So the File System knows which operations it can do*
  - *Most OS have associations between file types and applications*

File Types *Extensions*

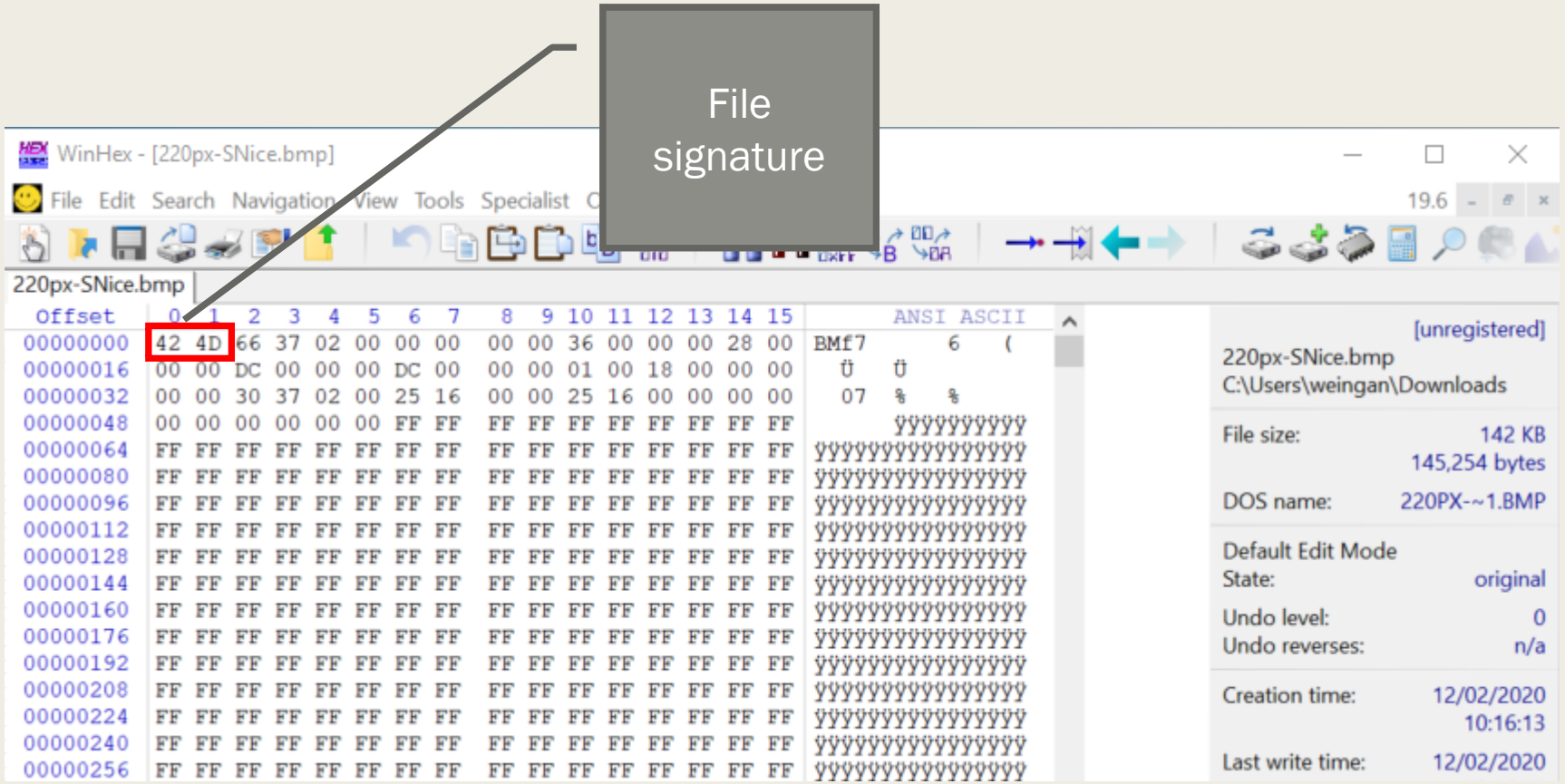
- File names are often separated by a full-stop into 2 parts
  - *Main name*
  - *File extension*
- The **file extension** was used by the OS to identify the type of file
  - *But is not necessarily the actual file type*
- Windows 10 will inspect the file to ascertain the actual file type
  - *Looking at the file header*

Extension	File Type
.txt	Text data file
.mp3, .au, .wav	Audio file
.gif , .tiff , .jpg	Image file
.doc , .odt	Word processing files
.java , .sql	Programming source file

Anatomy of an ASCII File

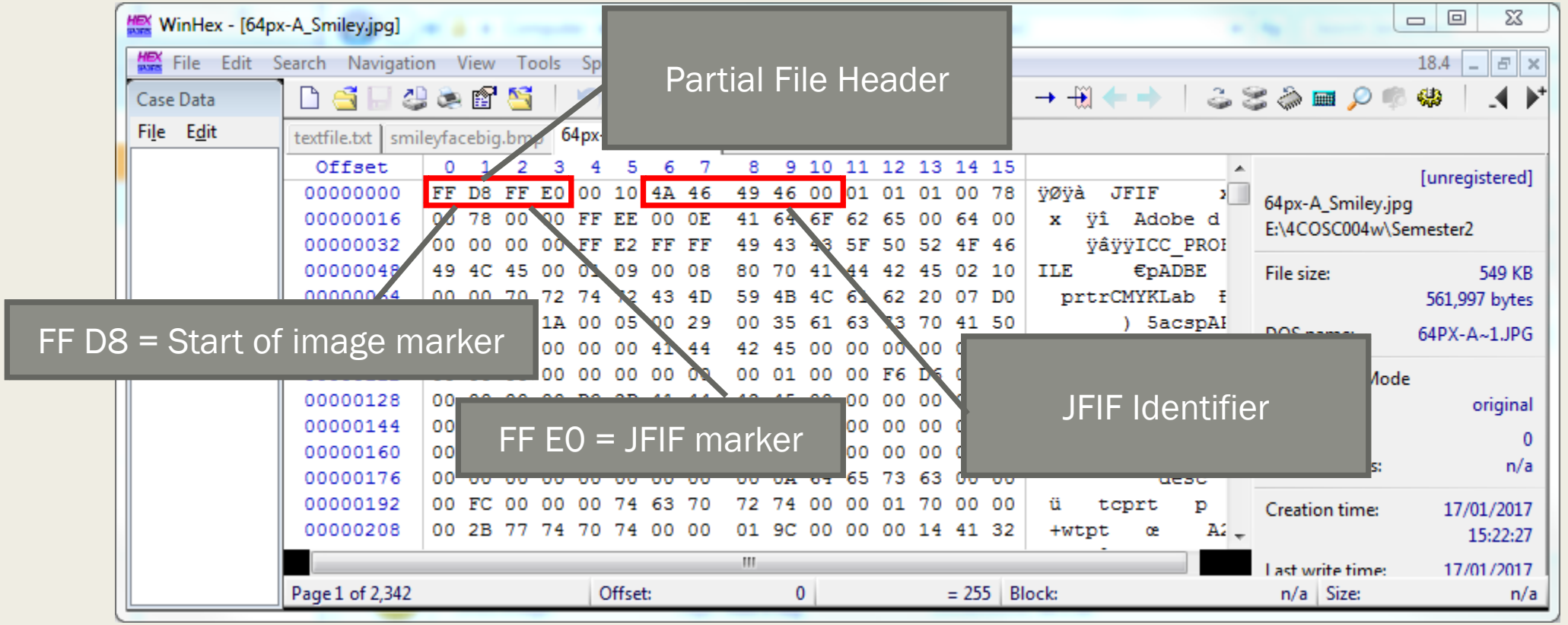


Revisiting BMP files



Anatomy of a Binary file (*jpeg*)
File Headers

(JFIF)
JPEG File Interchange Format



File signatures

- There file signature databases
  - *Filesignatures.net*
- Wikipedia often has high quality listings of the entire file header

File operations

- Create a file
- Delete a file
- Open a file
- Close a file
- Read data from a file
- Write data to a file
- Reposition the current file pointer in a file
- Append data to the end of a file
- Truncate a file
  - *ie. delete all or part of it*
- Rename a file
- Copy a file

File protection

- Multi-user Systems
- Access control
  - *Controls who can access files*
    - Who can read
    - Who can write
    - Who can execute

Cyber-security triad

- Three dimensions of cyber-security:
  - ***C****onfidentiality*
  - ***I****ntegrity*
  - ***A****ccessibility*

Confidentiality:
- Preventing access
- Keep the *bad-guy* out

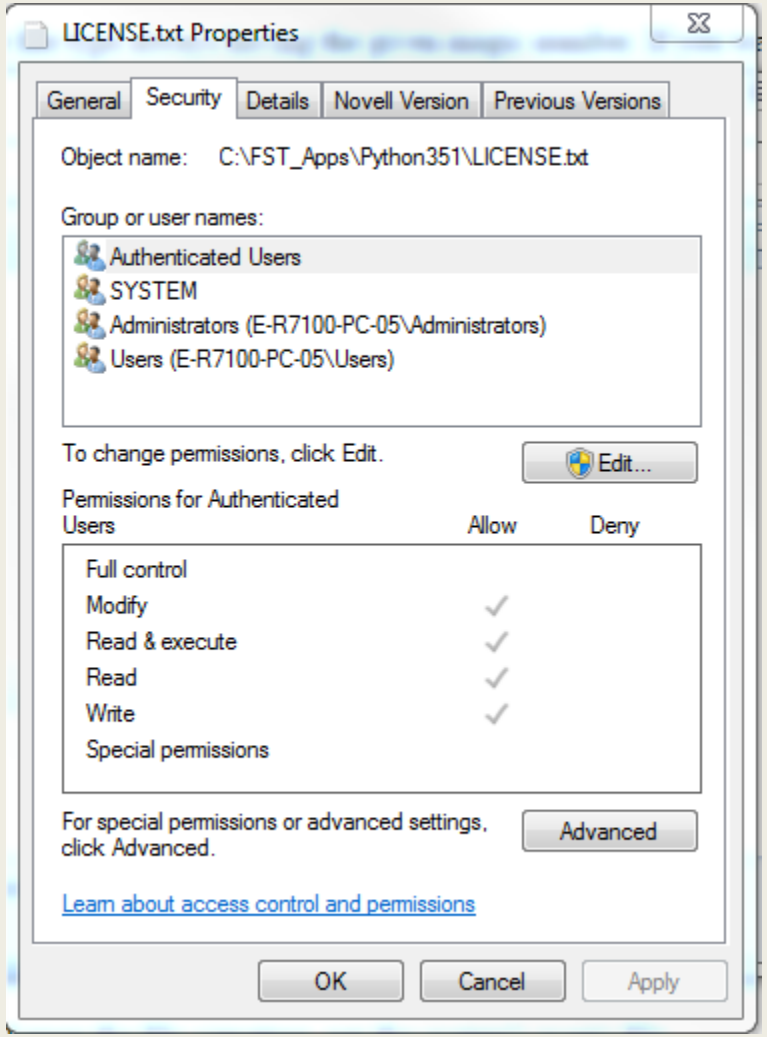
Accessibility:
- Ensure access
- Make sure the *good-guy* can access the data

Integrity:
- Keep control of any changes made to the data
- Who can change it
- Keep track of any changes

File permissions (windows)

- **NTFS:**
  - *Access Control Lists (ACL's)*
    - Each file has list of user identities with permissions
  - *Explorer*
    - File Permissions
    - Security
      - *Different user, different permissions*

- No multi-user security for FAT32



Windows permissions classifications

- Full control
  - *File can be written to/read from*
  - *Permissions can be read and modified*
  - *Ownership can be changed*
  - *Folder can be listed and entries deleted*
- Modify
  - *Same as Full control*
  - *But cannot change permissions or ownership*

Windows permissions classifications

- Read/Execute
  - *File can be read or executed as a program*
  - *Folder can be listed and traversed*
- Read
  - *File can be read*
    - But not executed
  - *Folder can be listed*
    - But not traversed
- Write
  - *File can be modified*
  - *Files/subfolders can be created in a folder*
    - But NOT deleted
- List folder contents (for folders only)
  - *Same as Read/Execute, but not available for files, and only inherited by folders*

Security inheritance

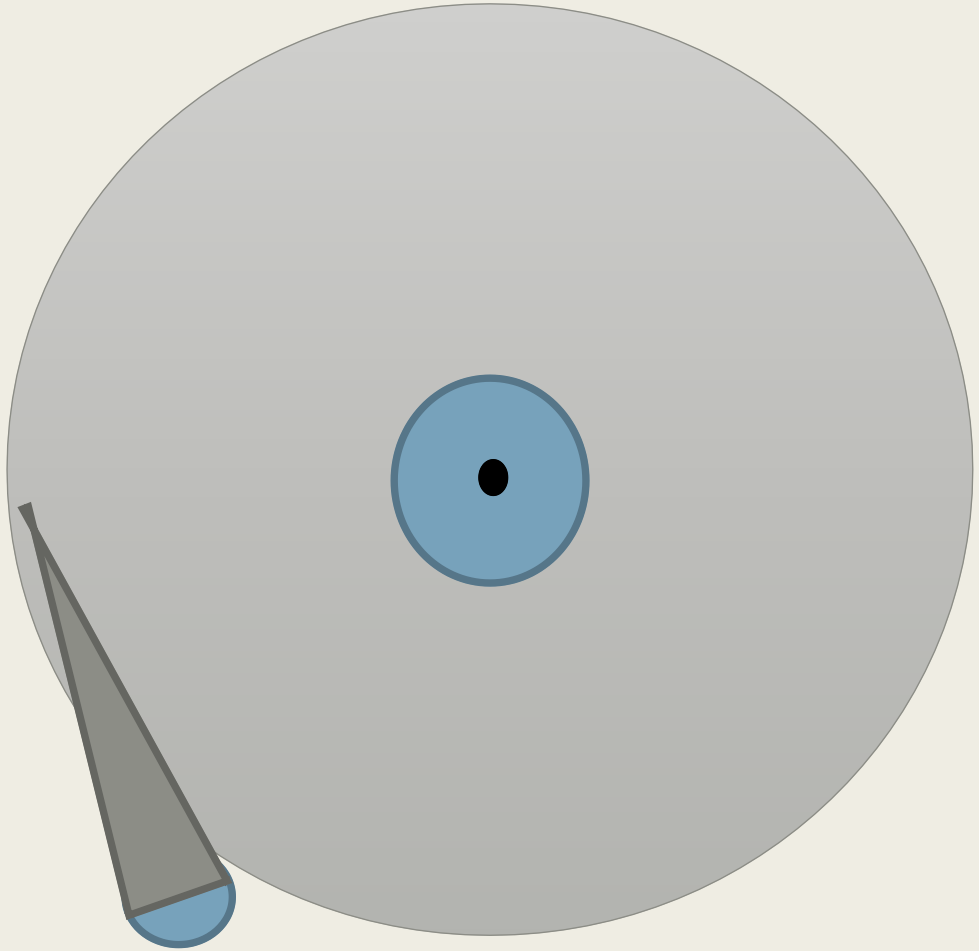
- Windows:
  - *New file or subfolder created, will inherit it's parent's permissions by default*
  - *You can override*
- Unix:
  - *Permissions are not inherited for newly created files*
  - *Based on user's* `umask`
  - *Mask of permissions specific to that user – octal absolute format*

Disk scheduling

Disk scheduling

- Must be efficient
- Multiple processes, multiple requests to access disk
- Disk scheduling techniques to manage request:
  - ***First-come, first-served (FCFS):*** *Requests are serviced in the order they arrive, irrespective of positions of heads*
  - ***Shortest-Seek-Time-first (SSTF):*** *Minimise movement of disk heads*
  - ***SCAN:*** *Disk heads continuously move in and out, servicing requests as the locations are found.*
  - ***C-SCAN :*** *Circular scan*
  - ***Look :*** *Like SCAN, but does not scan all the way to edge*
  - ***C-Look :*** *Like C-SCAN*

Remember Anatomy of a disk



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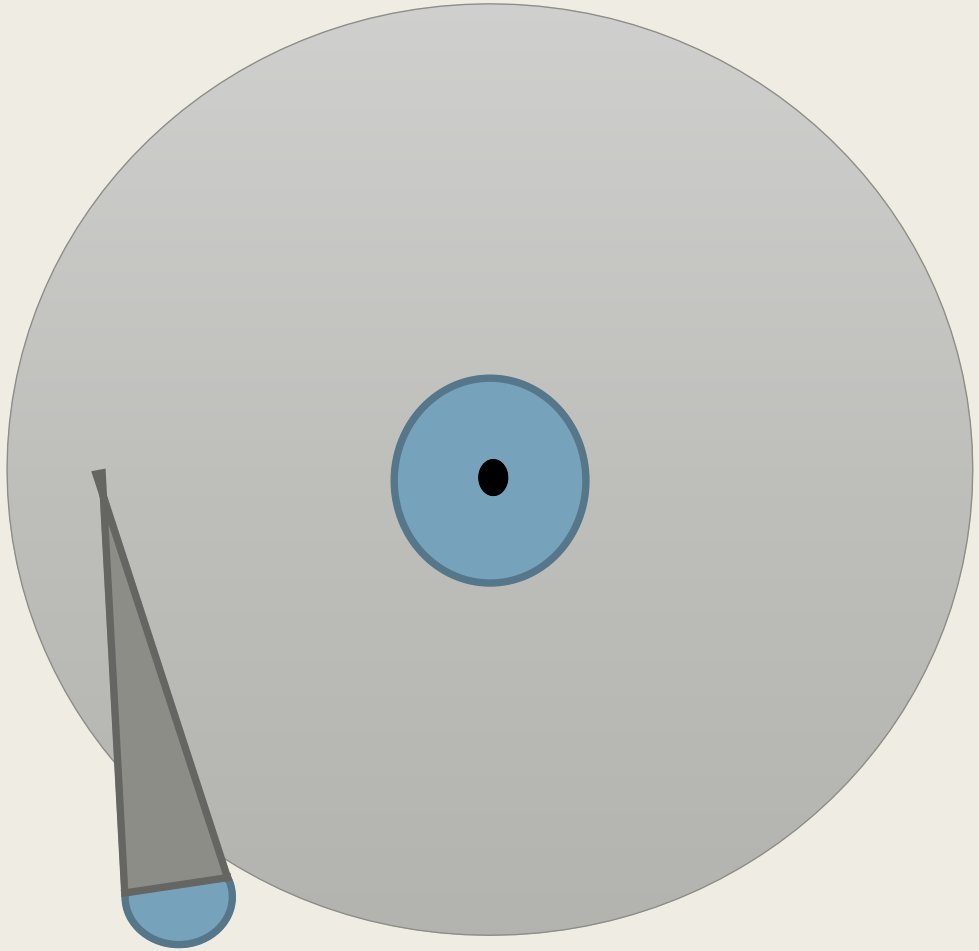

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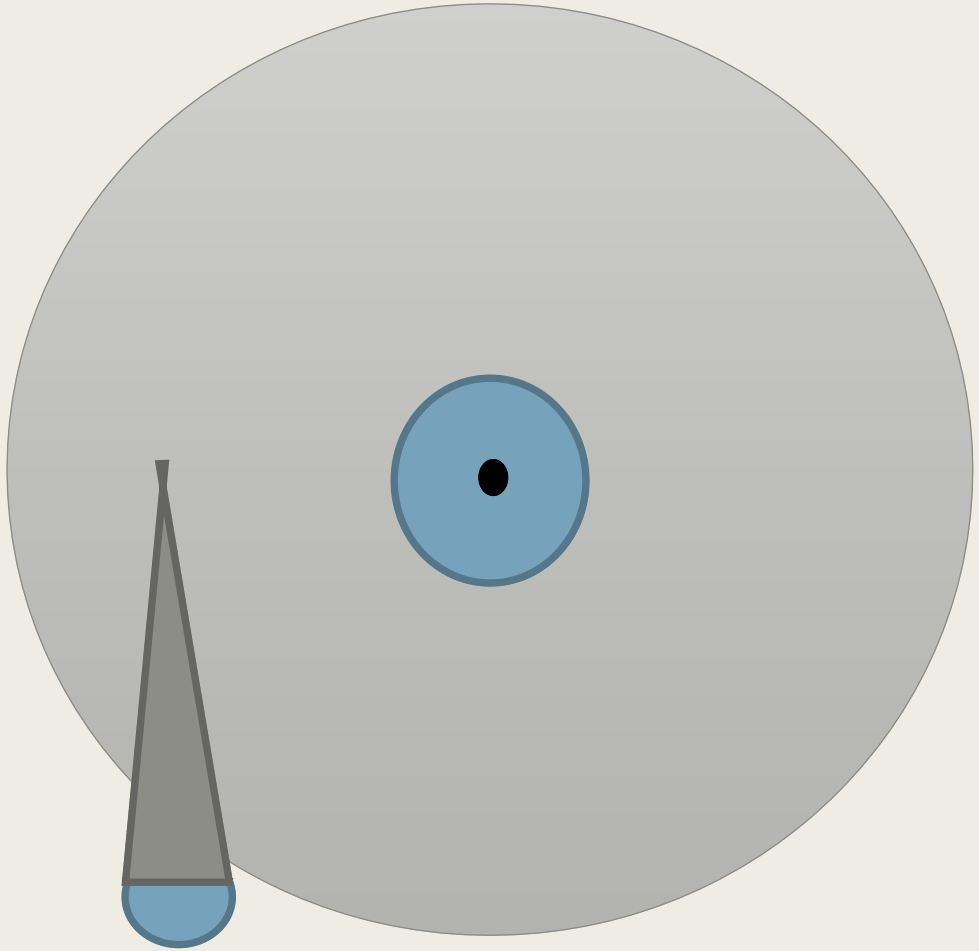

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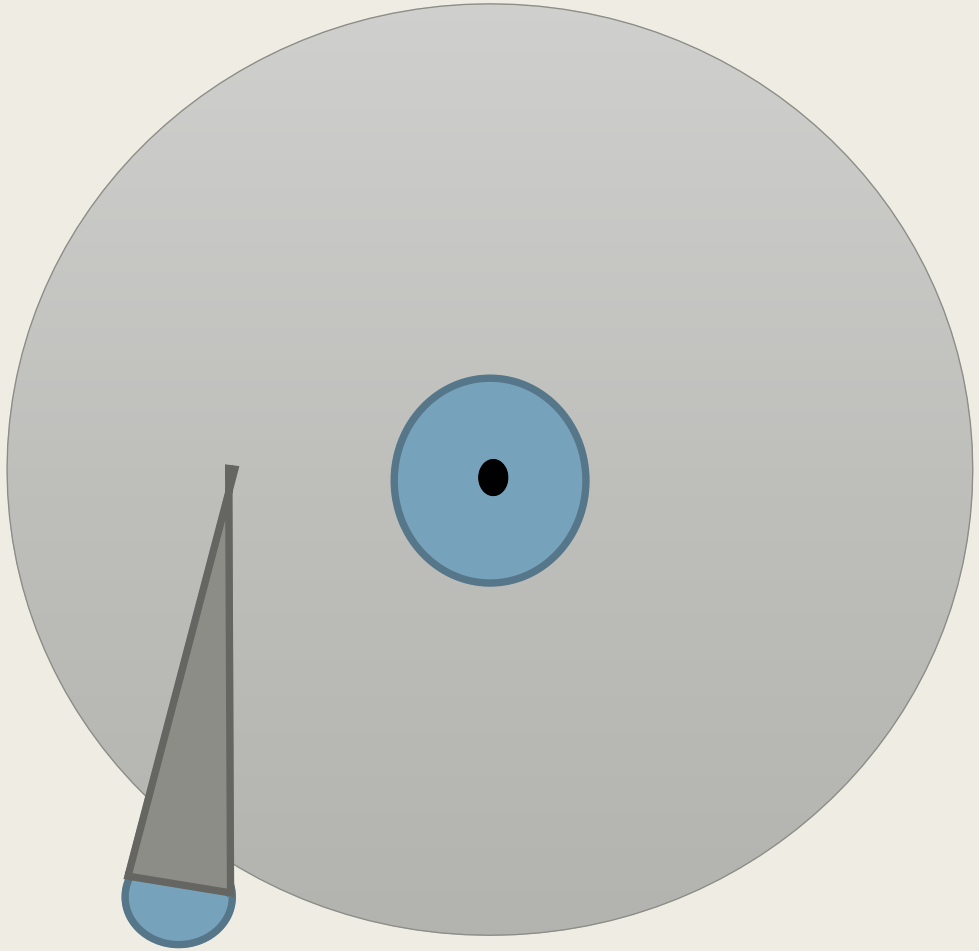

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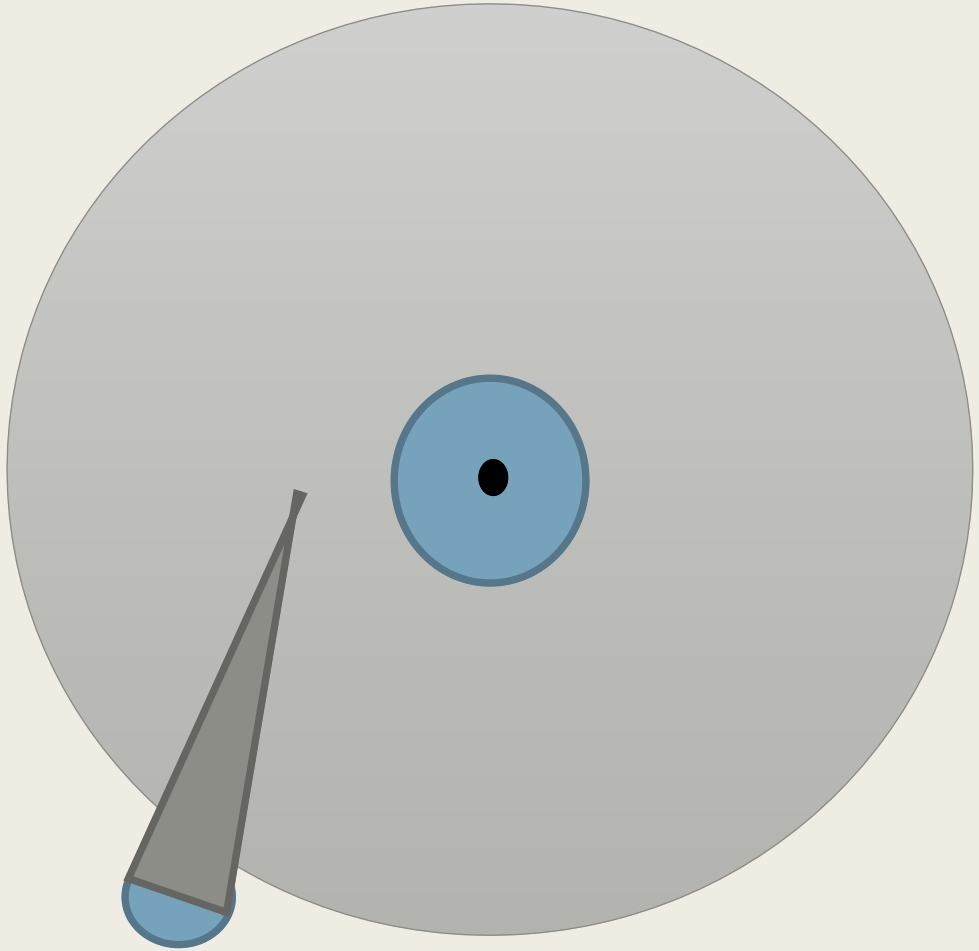

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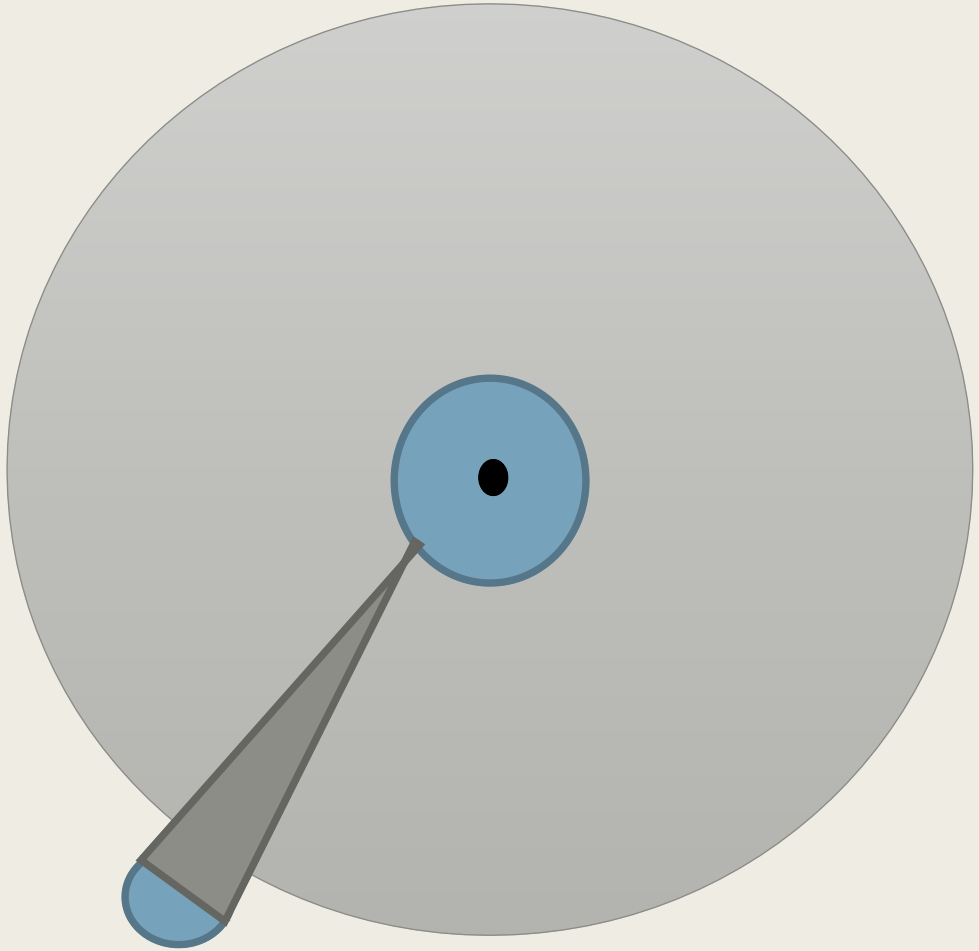


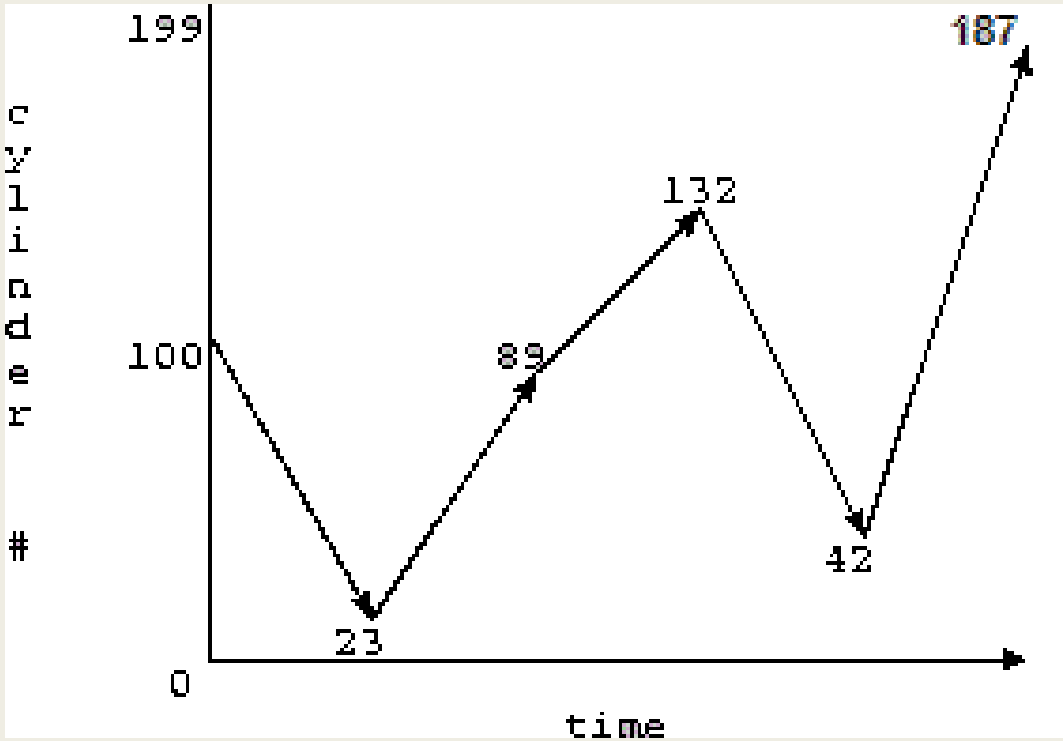
Example:

- Work queue: 23, 89, 132, 42, 187
- There are 200 cylinders 0-199
- The disk head starts at number 100

First-Come-First-Served:

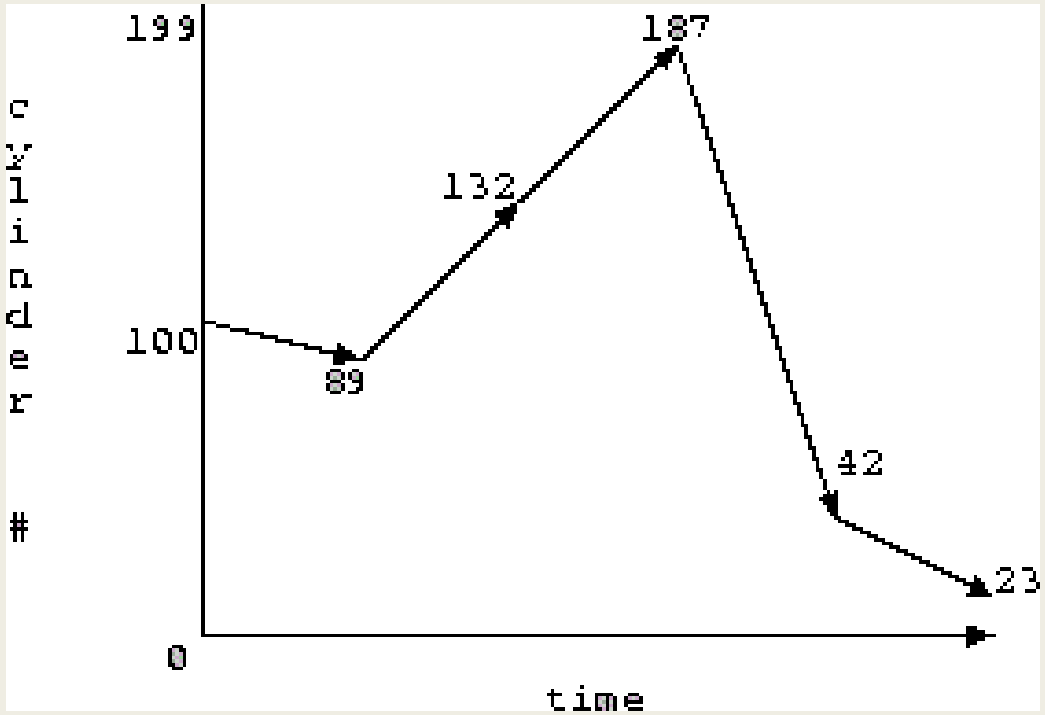
- Work queue: 23, 89, 132, 42, 187
- Total seek length:

$$|23 - 100| + |89 - 23| + |132 - 89| + |132 - 89| + |42 - 132| + |187 - 42| = 421$$



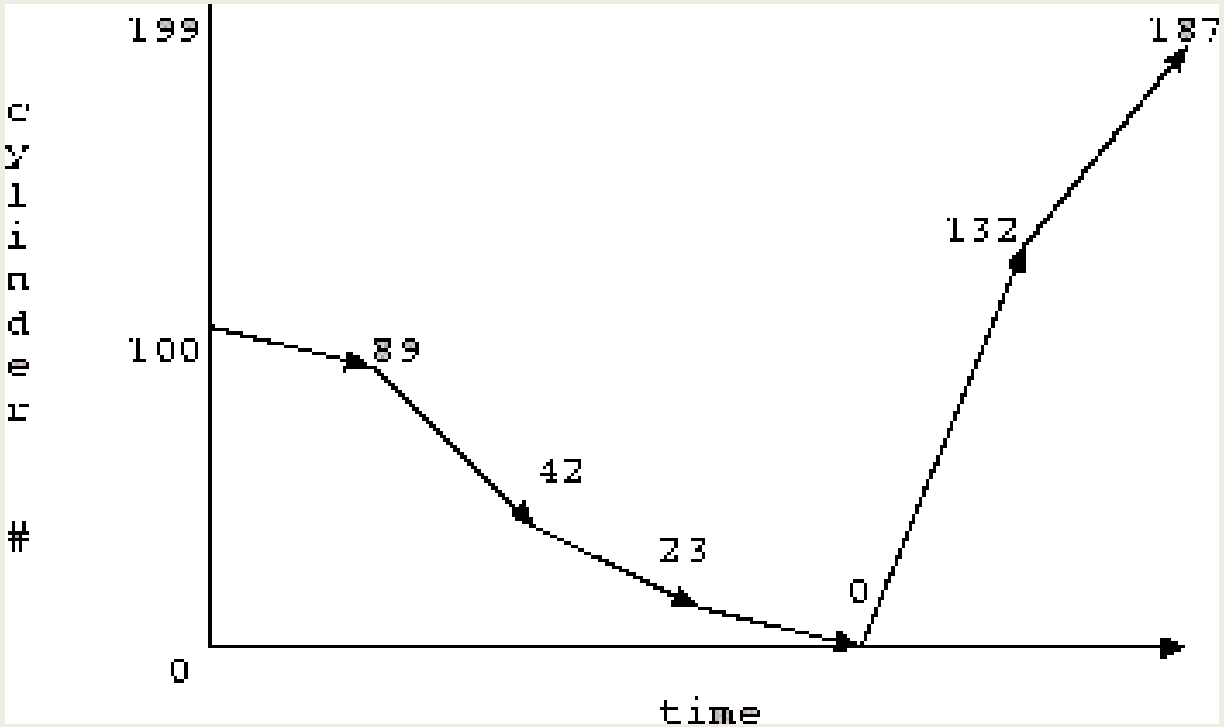
Shortest-Seek-Time-First:

- Work queue: 23, 89, 132, 42, 187
- Can be inefficient
  - *Multiple changing directions*
  - *Starvation*



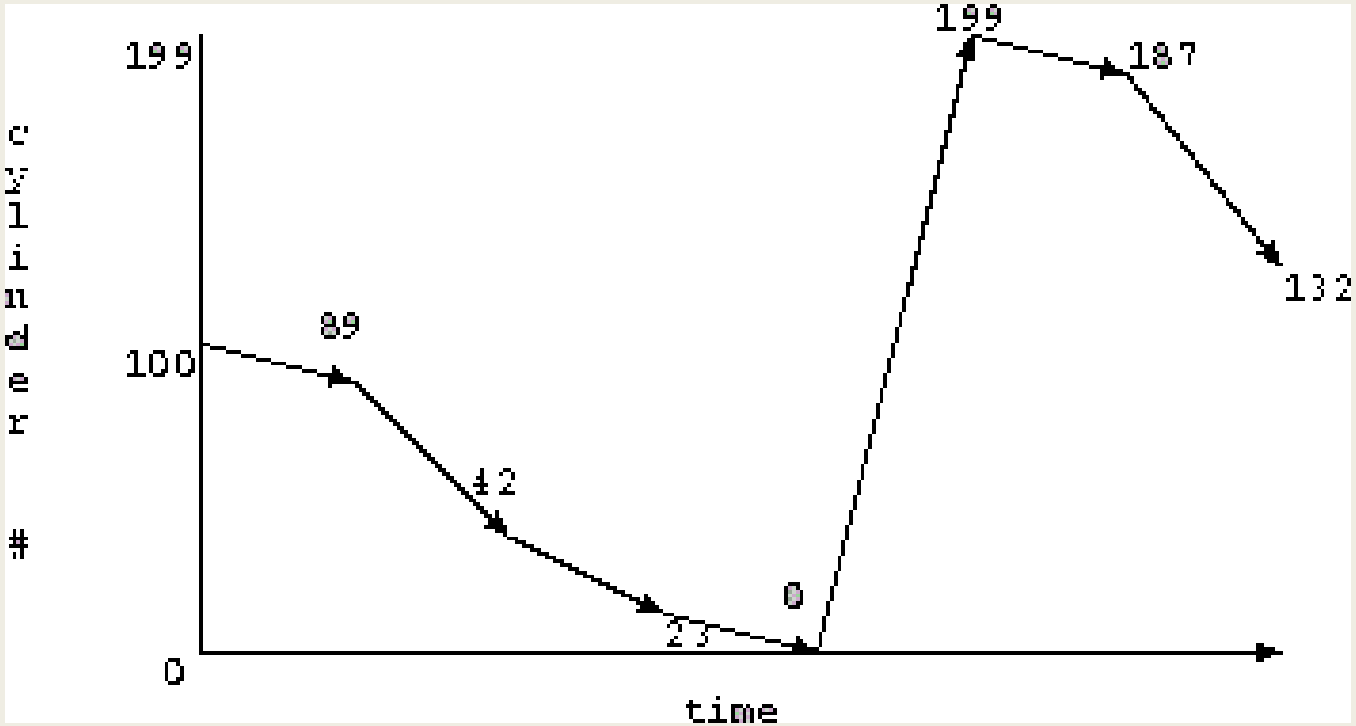
SCAN:

- Work queue: 23, 89, 132, 42, 187
- Elevator
- Sweeps the disk, to-and-fro
- LOOK is similar



C-SCAN:

- Work queue: 23, 89, 132, 42, 187
- Elevator
- Sweeps the disk, but one-direction



Performance:

- Depends on number of requests
- SCAN & C-SCAN are good for systems that place a heavy load on the disk, less likely to cause starvation
- Default: SSTF or LOOK
  - *PRIORITY*

What we covered:

- Partition Sector Zero
  - *FAT16*
  - *Reading & understanding*
- Volumes & Partitions
- Windows & Unix partitions
- Directory structures & terminology
  - *Root Directory*
  - *Parent Directory & Subdirectory*
  - *Absolute Path Names & Relative Path Names*
- File types
- File operations
- Unix file systems
- Disk scheduling

Further reading:

- File signatures reference:
  - *https://filesignatures.net/*
  - *http://www.garykessler.net/library/file_sigs.html*
- Indexing & Disk scheduling:
  - *Operating Systems: Internals & Design Principles, Williams Stalling (7th ed.)*
    - PP. 550-552 & 510-512
    - Online, see Reading List

Tutorial exercise:

- File Types:
  - *How to establish exactly what the file type of a file is*
  - *Even if the extension is wrong*

Thank you