

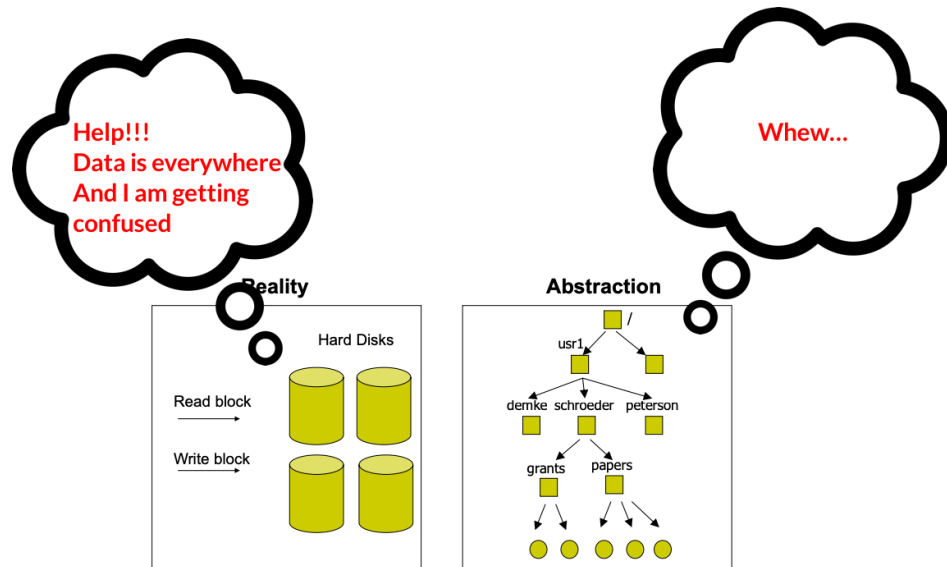
CSC369 Week 8 Notes

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- File Systems

- Is the part of operating system dealing with files ^[2]
- Controls how data is stored and retrieved. ^[1]
 - * Without a file system, data placed in a storage medium is one large body of data with no way to tell where it stops and the next begins



Refernces:

- 1) Wikipedia: File Systems, link
- 2) Tanebaum AS, Boss H. 2015. Modern Operating Systems. 4th Edition. New Jersey: Pearson Education, Inc.

- File Concept

- Files

- * Are logical units of information created by processes ^[1]
- * Is named collection of data with some attributes
 1. Name
 2. Owner
 3. Location
 4. Size
 5. Protection
 6. Creation Time
 7. Time of Last Access

References:

- 1) Tanenbaum AS, Bos H. 2015. Modern Operating Systems. 4th Edition. New Jersey: Pearson Education, Inc.

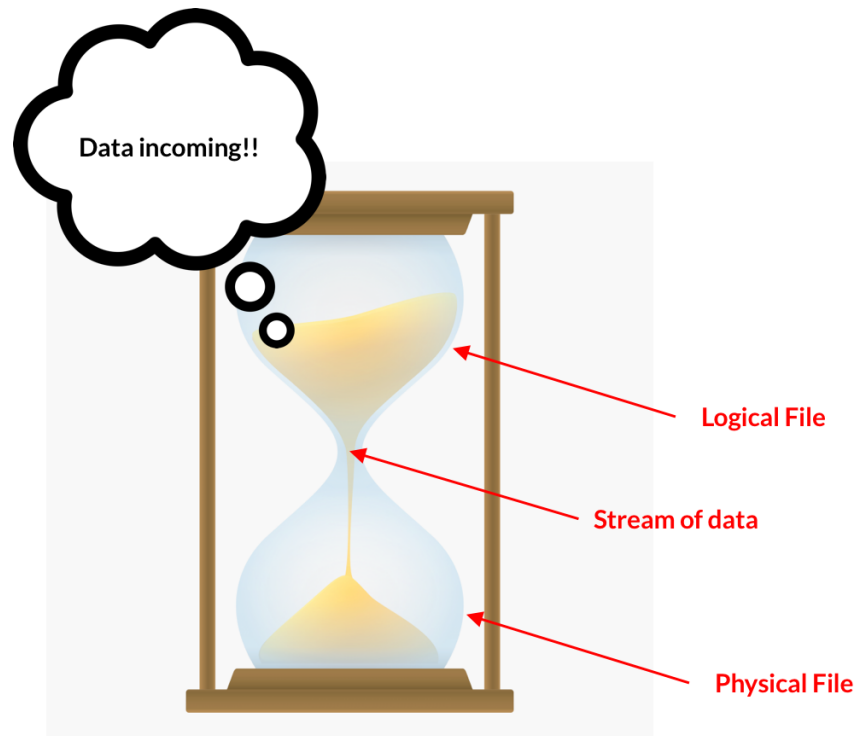
- Directories

- Are file system files for maintaining the structure of the file system ^[1]
- Serves multiple purposes
 - * *All* → Stores information about files (owner, permission, etc)
 - * *Users* → provides a structured way to organize files
 - * *File System* → provides a convenient naming interface that allows the implementation to separate **logical file** organization from **physical file** placement on the disk
- **Logical files:** Is a channel that connects the program to the physical file (Stream) ^[2]
- **Physical files:** A collection of bits stored in the secondary storage ^[2]

Example:

```
FILE* output;
output = fopen("sample.txt", "w");
```

Here, output is the logical file and sample.txt is the physical file



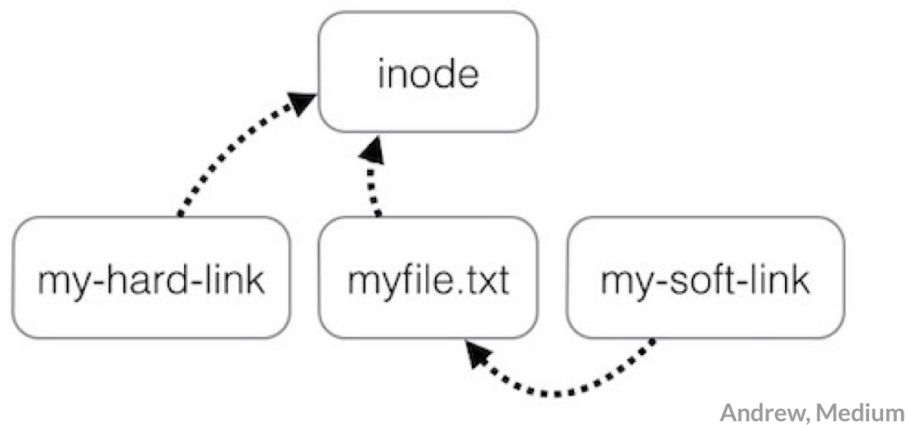
Refernces:

- 1) Tanenbaum AS, Bos H. 2015. Modern Operating Systems. 4th Edition. New Jersey: Pearson Education, Inc.
- 2) Kumar, S. (2010). *File structures* [PowerPoint Slides]. Slide Share link

- What is a Directory at the OS Level?

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- Operations on Directories
- Example Directory Operations
- Symbolic vs Hard Links

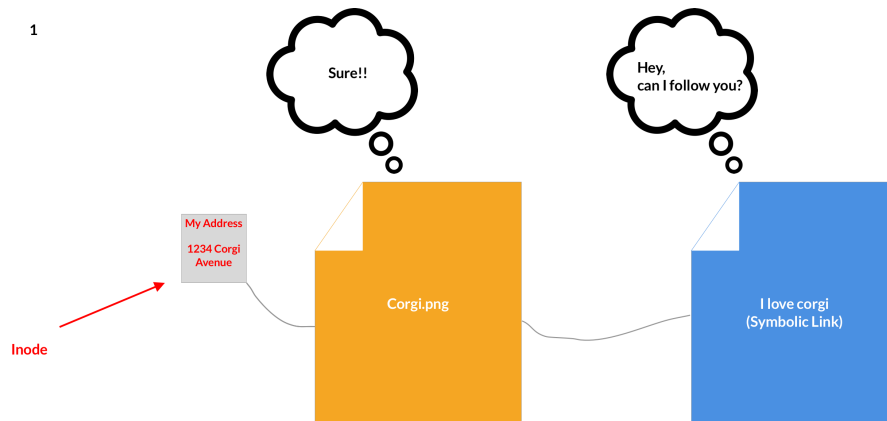


– Inode

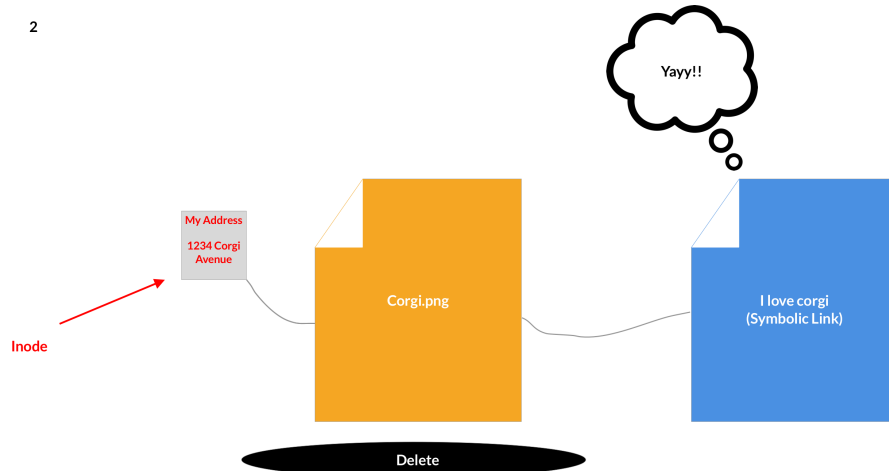
- * Is a database structure in a UNIX-style file system that describes a file system object such as a file or a directory ^[1]
- * Contains disk block location of the object's data ^[1]
- * Is a numerical equivalent of a full address ^[2]

– Symbolic Link:

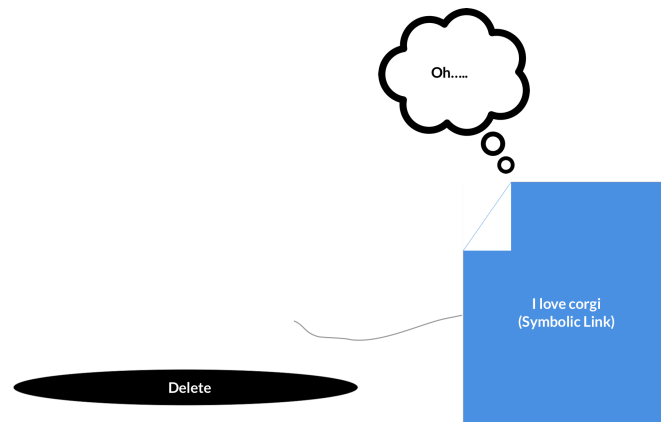
- * Is directory entry containing "true" path to the file
- * Is a shortcut that reference to a file instead of inode value ^[2]



2



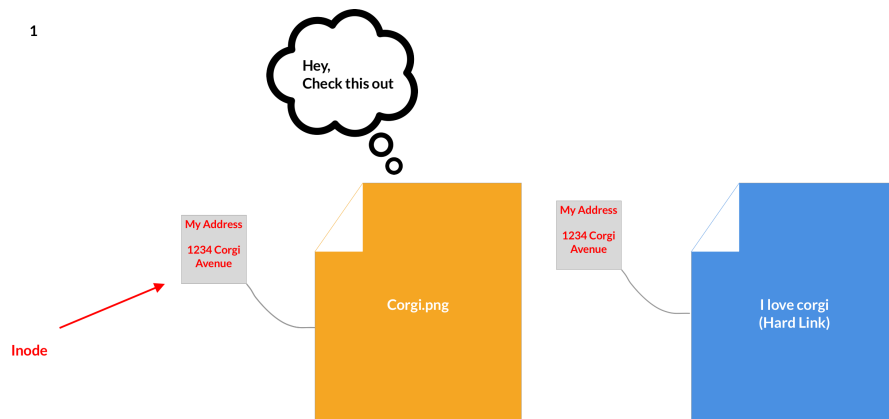
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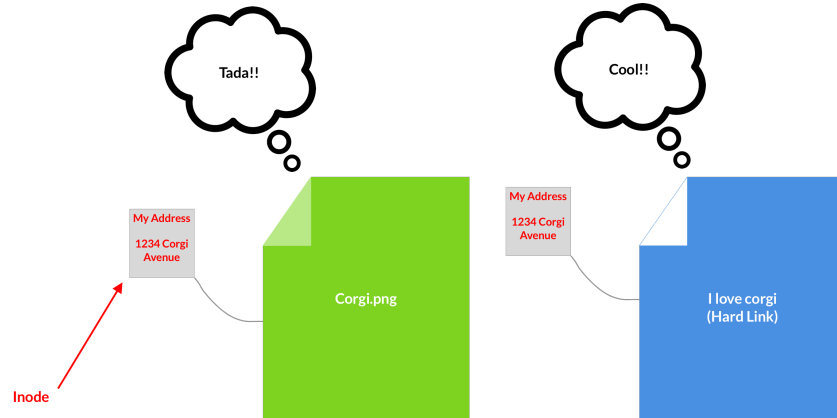
– Hard Link:

- * Is a direct reference to a file via its inode [2]
- * Is second directory entry identical to first

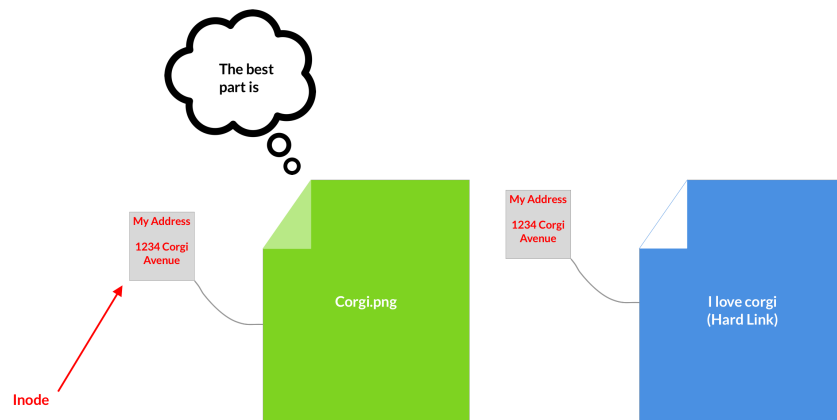
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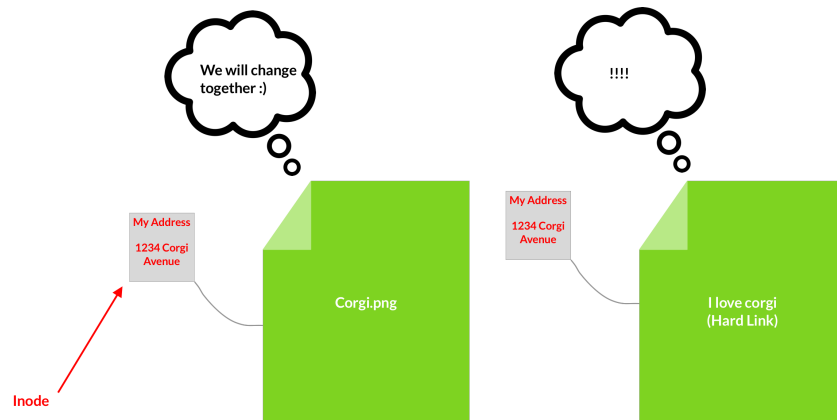
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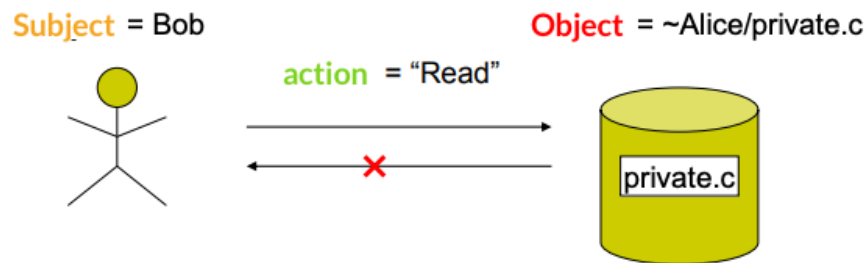


Refernces:

- 1) Wikipedia: inode, link

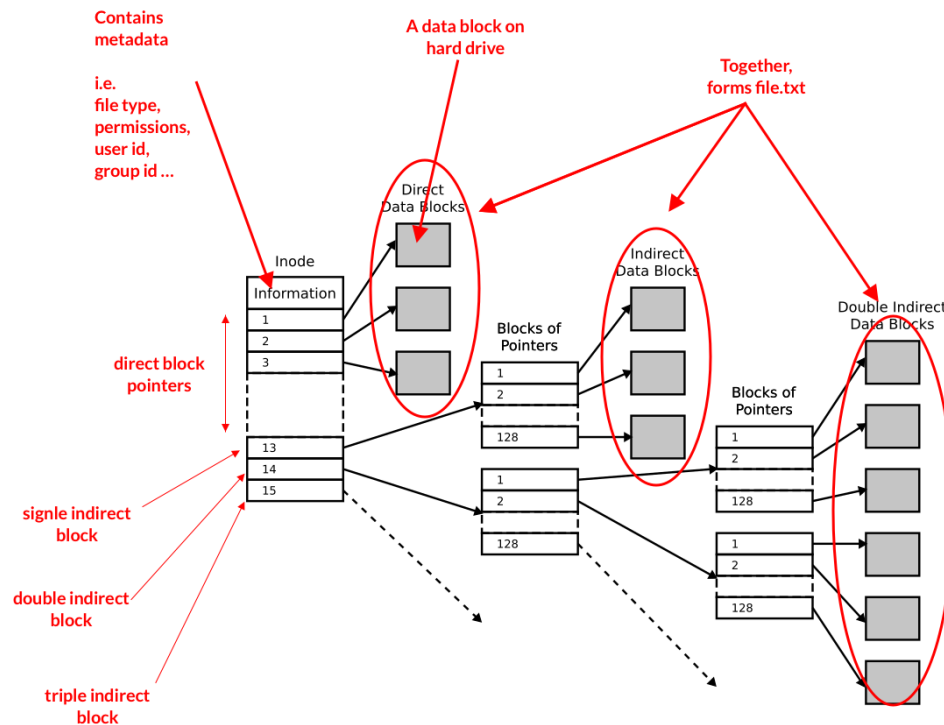
2) Andrew. (2018, January 16). *Hard links and Symbolic links — A comparison.* Medium. link

- File Sharing
- Protection
 - File systems implement some kind of protection system
 - * Who can access a file
 - * How they can access it
 - Protection system dictates whether given **action** by a given **subject** on a given **object** should be allowed
 - * You can read and/or write your files, but others cannot
 - * You can read "etc/motd", but you cannot write it



- Types of Access
- Representing Protection
- ACLs and Capabilities
- File System Implementation
- Directory Implementation
- Disk Layout Strategies
- Contiguous Allocation
- Linked Allocation
- Indexed Allocation: Unix Inodes
 - Each inode contains 15 block pointers
 - * First 12 are direct block pointers
 - Stops here if files are small

* Then single, double and triple indirect



References:

- 1) Wikipedia: Inode Pointer Structure, [link](#)
- 2) Udacity (2015). *Inode Structure* [online]. Available at: [link](#) (Accessed May 28th, 2020)

• Unix Inodes and Path Search

– Unix Inodes

* Is what we see on typing 'ls -li' command in terminal

```
moegu@MacBook-Pro-5 week_8 % ls -li
total 1672
4387765714 drwxr-xr-x  10 moegu staff   320 May 28 04:04 images
4387796480 -rw-r--r--    1 moegu staff    734 May 28 05:14 week_8_notes.aux
4387796481 -rw-r--r--    1 moegu staff  19768 May 28 05:14 week_8_notes.fdb_latexmk
4387796489 -rw-r--r--    1 moegu staff  29745 May 28 05:14 week_8_notes.fls
4387796483 -rw-r--r--    1 moegu staff  37177 May 28 05:14 week_8_notes.log
4387796485 -rw-r--r--    1 moegu staff     0 May 28 05:14 week_8_notes.out
4387683803 -rw-r--r--    1 moegu staff 670884 May 28 05:14 week_8_notes.pdf
4387813350 -rw-r--r--    1 moegu staff  16837 May 28 05:14 week_8_notes.synctex.gz
4387675739 -rw-r--r--    1 moegu staff   9040 May 28 05:13 week_8_notes.tex
```

inode number :)

* Describes where on the disk the blocks for a file are placed

* inode information is loaded to main memory ^[1]

- Only for the corresponding files that are open
- NOT all are loaded

Refernces:

- 1) Tanebaum AS, Boss H. 2015. Modern Operating Systems. 4th Edition. New Jersey: Pearson Education, Inc.

- File Buffer Cache

- Reads information from disk only once and then stores retrieved file blocks in memory until no longer needed □
 - * Because reading from disk is slow
 - * Is common to read same part of disk multiple times

Example:

1. Reading email message, read the message for an edit, and read the message again when copying to folder

Refernces:

- 1) Linux System Administrators Guide: Chapter 6. Memory Management, link