UNIX inodes and files

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- Everything's a file in UNIX: directories, hard drives, network devices, pipes, `stdin/stdout`, etc.
- But in the UNIX shell we spend a lot of our time interacting with inodes, not with files.

What's an inode?

- An *inode* is a data structure that represents a file (specifically the file's metadata).
- "Index" node (maybe?)
- Stored on disk, references the actual location of the file.

Metadata fields

- User & group ownership
- Type: regular, directory, character device, block device, or FIFO pipe
- Access permissions
- Access times: file accessed, file modified, inode modified
- Number of hard links to the file
- Addresses of disk blocks containing data
- File size

Note that the inode *doesn't* include the file paths.

Example inode

- owner: hrs
- group: wheel
- type: regular file
- permissions: rwxr-xr-x
- accessed: Jan 02 2015 1:30 PM
- modified: Dec 31 2014 2:45 PM
- inode: Dec 31 2014 4:40 PM
- size: 6030 bytes
- (disk addresses)

Viewing inode numbers

```
[~/Desktop/inode-presentation (master *)] $ ls -li
total 32
20171797 -rw-r--r--  1 hrs  staff   375B Jan  2 10:42 Makefile
20171798 -rw-r--r--  1 hrs  staff   1.3K Jan  2 10:42 README.md
20171799 drwxr-xr-x  5 hrs  staff   170B Jan  2 11:24 images
20171801 -rw-r--r--  1 hrs  staff   890B Jan  2 10:55 presentation.bib
20171802 -rw-r--r--  1 hrs  staff   2.1K Jan  2 11:25 presentation.tex
```

Finding a file by inode number

```
[~/Desktop/inode-presentation (master *)] $ find . -inum 20171798
./README.md
```

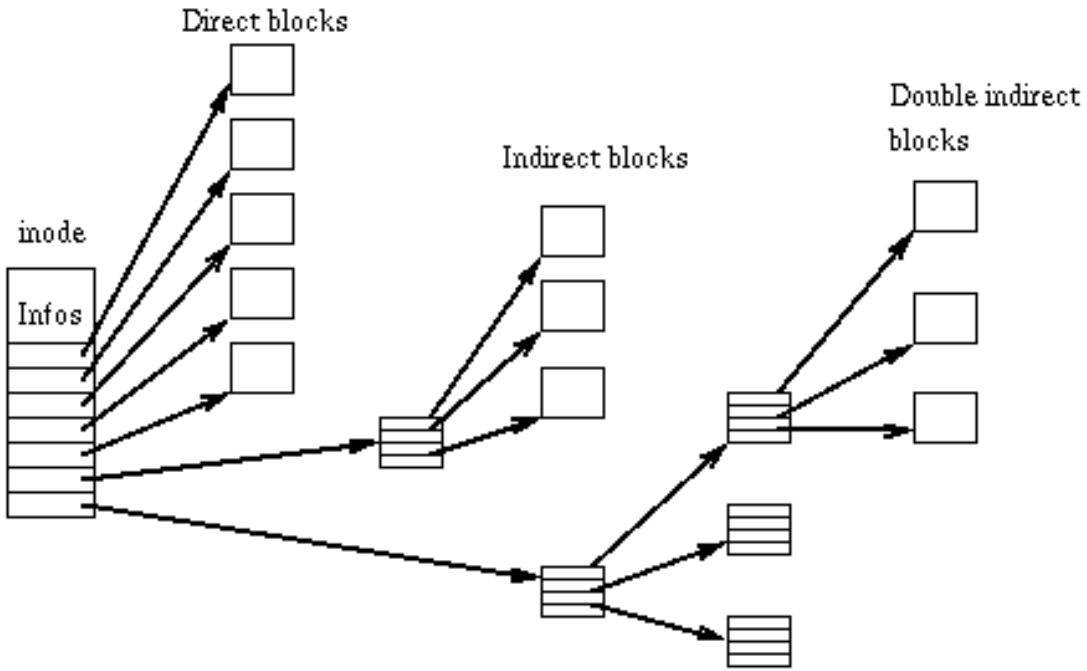
Hard links (creating)

```
[~/Desktop/inode-presentation (master *)] $ ls -li
total 32
20171797 -rw-r--r--  1 hrs  staff   375B Jan  2 10:42 Makefile
20171798 -rw-r--r--  1 hrs  staff   1.3K Jan  2 11:44 README.md
20171799 drwxr-xr-x  6 hrs  staff   204B Jan  2 11:42 images
20171801 -rw-r--r--  1 hrs  staff   890B Jan  2 10:55 presentation.bib
20171802 -rw-r--r--  1 hrs  staff   2.4K Jan  2 11:43 presentation.tex
[~/Desktop/inode-presentation (master *)] $ ln README.md README-new.md
README-new.md => README.md
[~/Desktop/inode-presentation (master *)] $ ls -li
total 40
20171797 -rw-r--r--  1 hrs  staff   375B Jan  2 10:42 Makefile
20171798 -rw-r--r--  2 hrs  staff   1.3K Jan  2 11:44 README-new.md
20171798 -rw-r--r--  2 hrs  staff   1.3K Jan  2 11:44 README.md
20171799 drwxr-xr-x  6 hrs  staff   204B Jan  2 11:42 images
20171801 -rw-r--r--  1 hrs  staff   890B Jan  2 10:55 presentation.bib
20171802 -rw-r--r--  1 hrs  staff   2.4K Jan  2 11:43 presentation.tex
```

Hard links (deleting)

```
[~/Desktop/inode-presentation (master *)] $ ls -li
total 40
20171797 -rw-r--r--  1 hrs  staff   375B Jan  2 10:42 Makefile
20171798 -rw-r--r--  2 hrs  staff   1.3K Jan  2 11:44 README-new.md
20171798 -rw-r--r--  2 hrs  staff   1.3K Jan  2 11:44 README.md
20171799 drwxr-xr-x  7 hrs  staff   238B Jan  2 11:47 images
20171801 -rw-r--r--  1 hrs  staff   890B Jan  2 10:55 presentation.bib
20171802 -rw-r--r--  1 hrs  staff   2.7K Jan  2 11:49 presentation.tex
[~/Desktop/inode-presentation (master *)] $ rm README-new.md
[~/Desktop/inode-presentation (master *)] $ ls -li
total 32
20171797 -rw-r--r--  1 hrs  staff   375B Jan  2 10:42 Makefile
20171798 -rw-r--r--  1 hrs  staff   1.3K Jan  2 11:44 README.md
20171799 drwxr-xr-x  7 hrs  staff   238B Jan  2 11:47 images
20171801 -rw-r--r--  1 hrs  staff   890B Jan  2 10:55 presentation.bib
20171802 -rw-r--r--  1 hrs  staff   2.7K Jan  2 11:49 presentation.tex
```

Disk addresses



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