CSCI315 – Operating Systems Design

Department of Computer Science
Bucknell University

File System Implementations 1

Ch 14.1-14.3

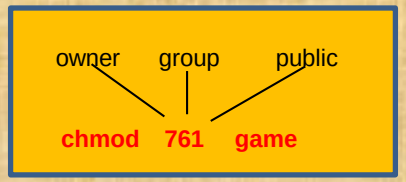
This set of notes is based on notes from the textbook authors, as well as L. Felipe Perrone, Joshua Stough, and other instructors.
Xiannong Meng, Fall 2020.

Access Lists and Groups

- Mode of access: **read, write, execute**
- Three classes of users

		RWX
a) **owner access**	7 ⇒	1 1 1
		RW
b) **group access**	6 ⇒	1 1 0
		X
c) **public access**	1 ⇒	0 0 1

- Ask manager to create a group (unique name), say G, and add some users to the group.
- For a particular file (say *game*) or subdirectory, define an appropriate access.



Associate a group with a file: `chgrp G game`

File Protection Example

protection bits 664 or ugo rw,rw,r

u: owner
g: group
o: world

6: 110
4: 100

600

changed so only owner can read/write

```
File  Edit  View  Search  Terminal  Help
[bash xmeng@linuxremote2 34-file-intro]$ ls -l
total 16
-rw-rw-r-- 1 xmeng cs 944 Oct 30 10:57 base.gif
-rw-rw-r-- 1 xmeng cs 125 Oct 30 11:10 base-small.png
-rw-rw-r-- 1 xmeng cs 494 Oct 30 09:31 file-basics.c
-rw-rw-r-- 1 xmeng cs 746 Oct 30 09:43 file-syscalls.c
-rw-rw-r-- 1 xmeng cs  26 Oct 30 09:42 hello.txt
[bash xmeng@linuxremote2 34-file-intro]$ chmod 600 base.gif
[bash xmeng@linuxremote2 34-file-intro]$ ls -l
total 16
-rw------- 1 xmeng cs 944 Oct 30 10:57 base.gif
-rw-rw-r-- 1 xmeng cs 125 Oct 30 11:10 base-small.png
-rw-rw-r-- 1 xmeng cs 494 Oct 30 09:31 file-basics.c
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-rw-rw-r-- 1 xmeng cs  26 Oct 30 09:42 hello.txt
[bash xmeng@linuxremote2 34-file-intro]$
```
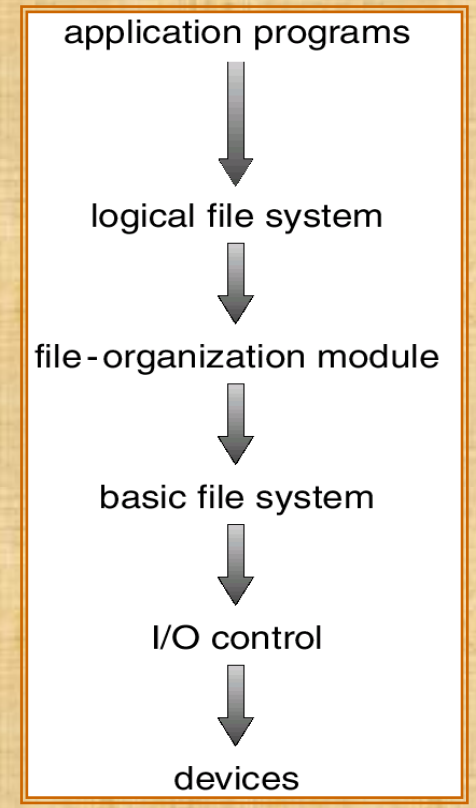

File-System Structure

- File structure:
  - Logical storage unit
  - Collection of related information
- File system resides on secondary storage (disks).
- File system is organized into layers.

Layered File System



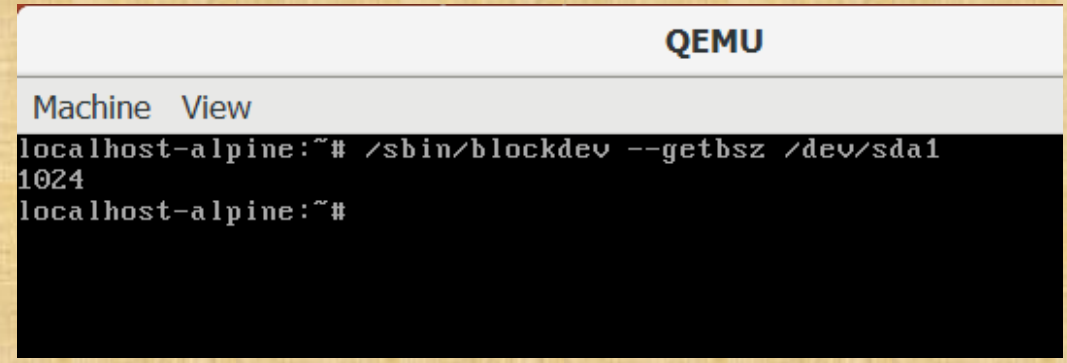
Layered Structure

- **File system** resides on secondary storage (e.g., disks)
  - Provides user interface to storage
  - Maps logical files to physical file structures
  - Provides efficient and convenient access to disk by allowing data to be stored, located retrieved easily

Lower Level Organization

- Disk provides in-place rewrite and random access
  - I/O transfers performed in **blocks** of **sectors** (usually 4096 bytes)
  - Find out block size (needs root access)
    - **`/sbin/blockdev --getbsz /dev/sda1`**
    - **`/sbin/dumpe2fs -h /dev/sda1`**
- **File control block** – storage structure consisting of information about a file, very similar to process control block for processes
- **Device driver** controls the physical device

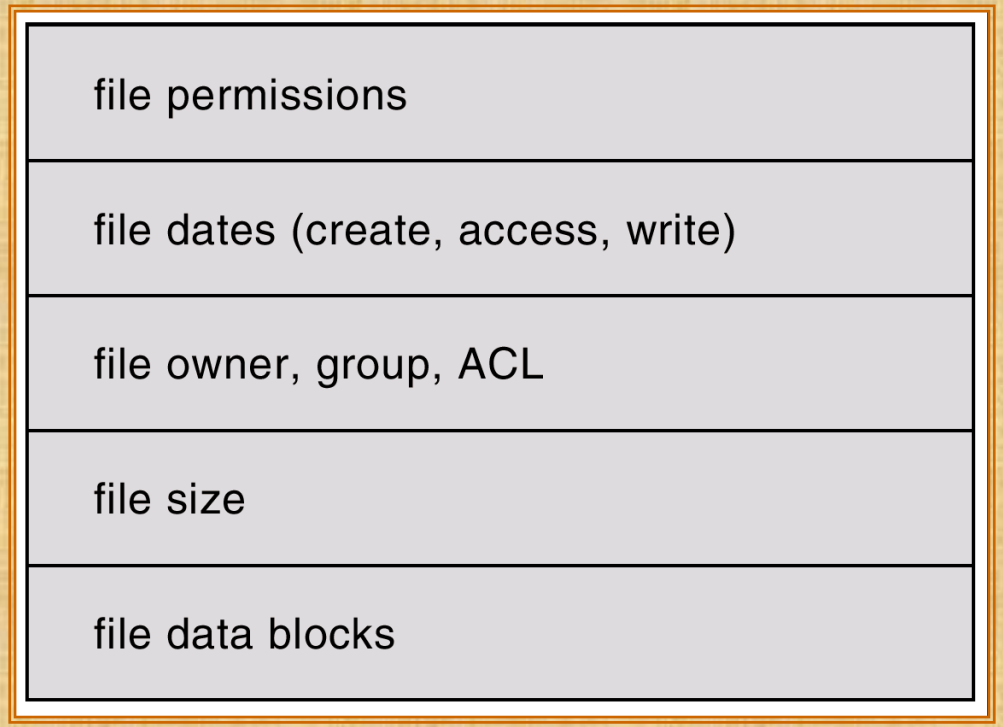
Example of Block Size



The above example shows the block size of 1024 bytes on my QEMU Linux emulator.

I don’t have root access on the school Linux systems so I can’t run the command. But the above example illustrates the block size.

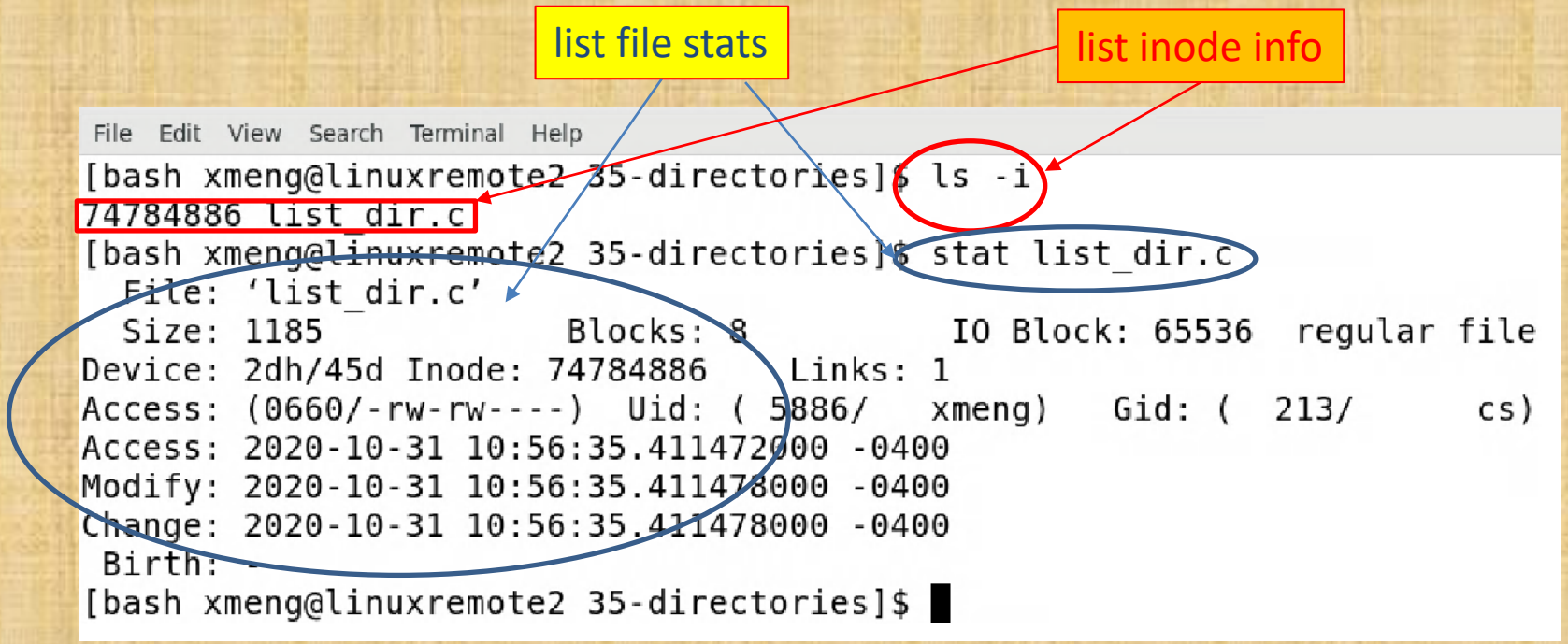
A General File Control Block



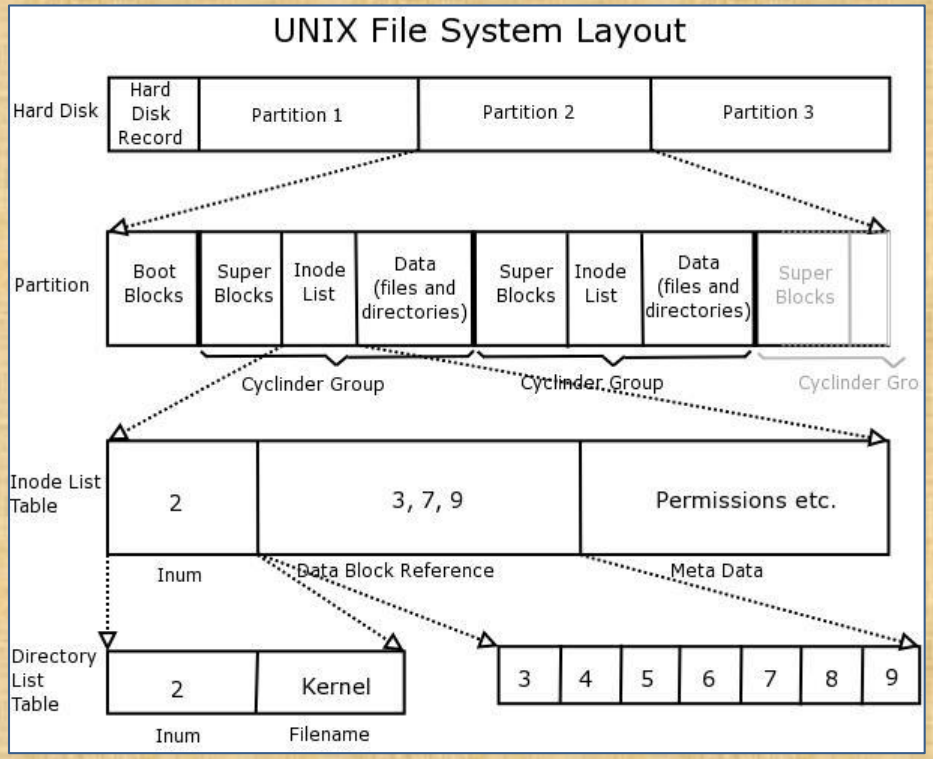
inode in Linux/Unix

- File control blocks in Linux are called **inode** (has nothing to do with Apple) meaning *index node*.
  - http://www.tldp.org/LDP/tlk/ds/ds.html search for the keyword “inode” to find the inode data structure
- Each file in Linux has a unique control block (inode)
  - “`ls -i`” shows the **inode** number of the files
  - “stat file_name” shows **inode** number and other information

Example of inode Information

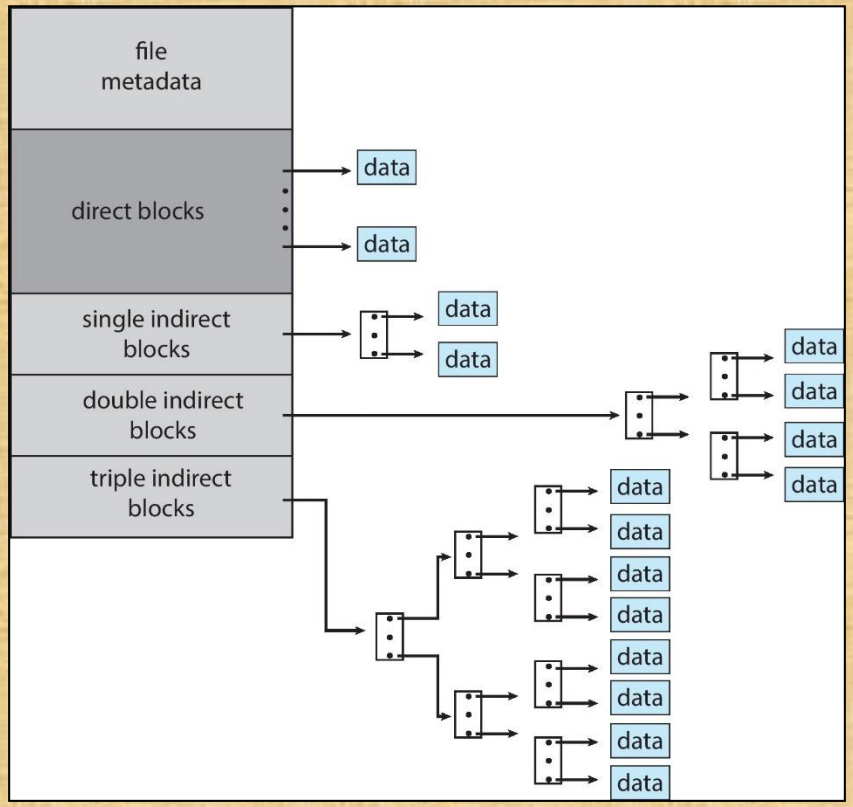


Linux File System Structure



http://www.learnlinux.org.za/courses/build/internals/ch08s04.html

Linux inode Structure



SGG 10th edition

In-Memory File System Structures