

System Administration

Week 03, Segment 3
The UNIX Filesystem

**Department of Computer Science
Stevens Institute of Technology**

Jan Schaumann

jschauma@stevens.edu

<https://stevens.netmeister.org/615/>

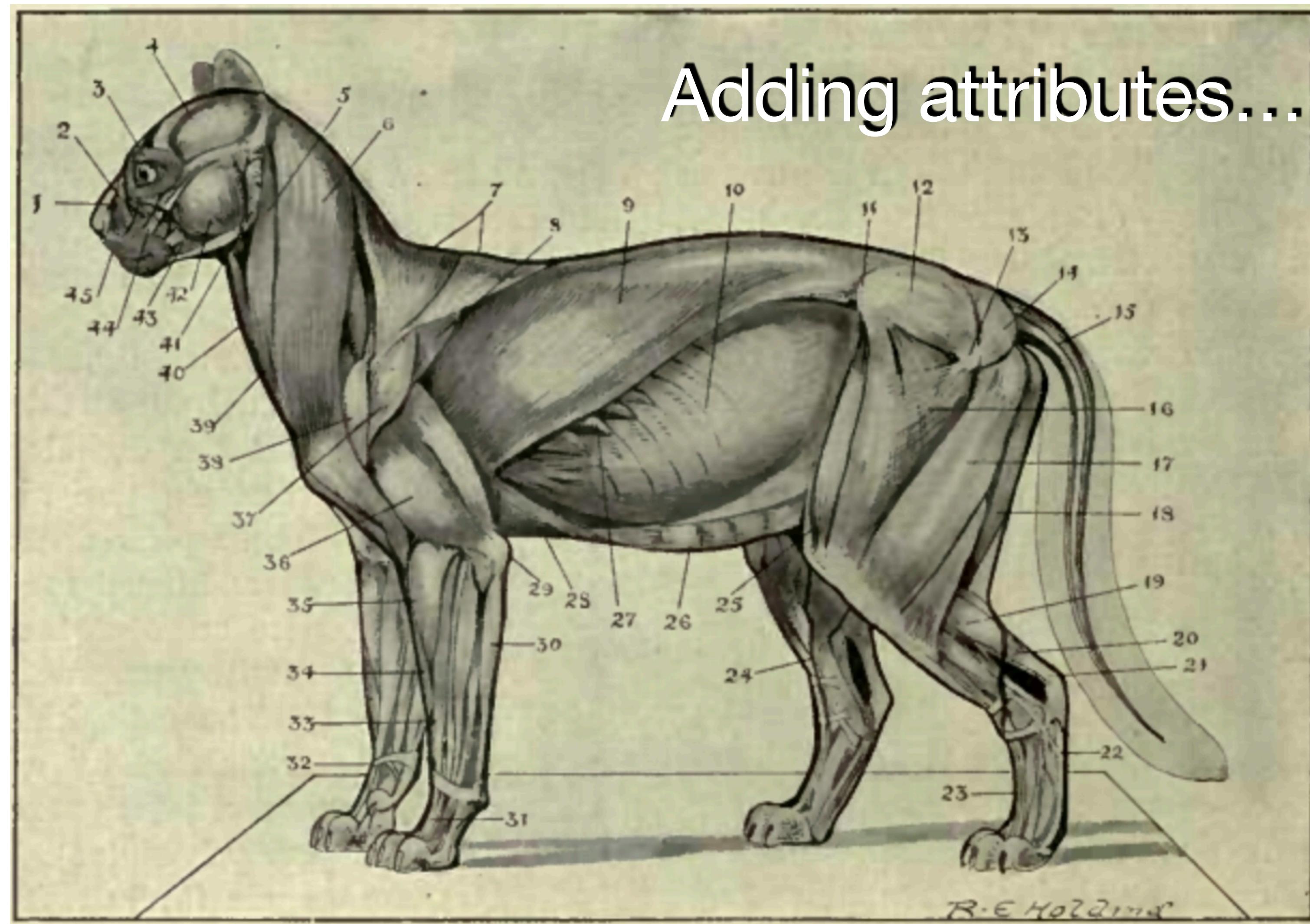
Let's pretend we're a filesystem...



2

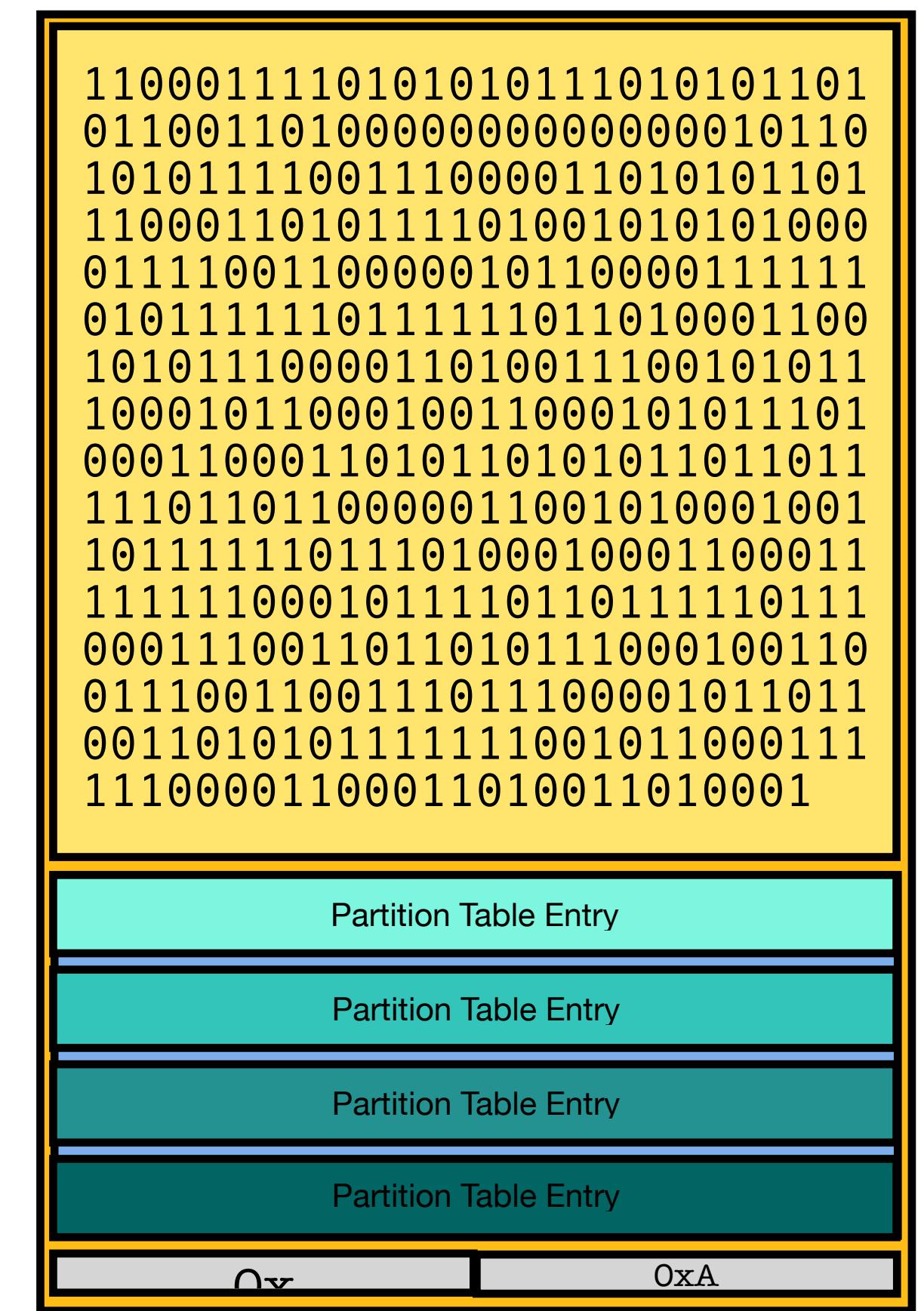
Photo by [Marina Khrapova](#) on [Unsplash](#)
<https://unsplash.com/photos/4Tjk111E4xw>

Let's pretend we're a filesystem...



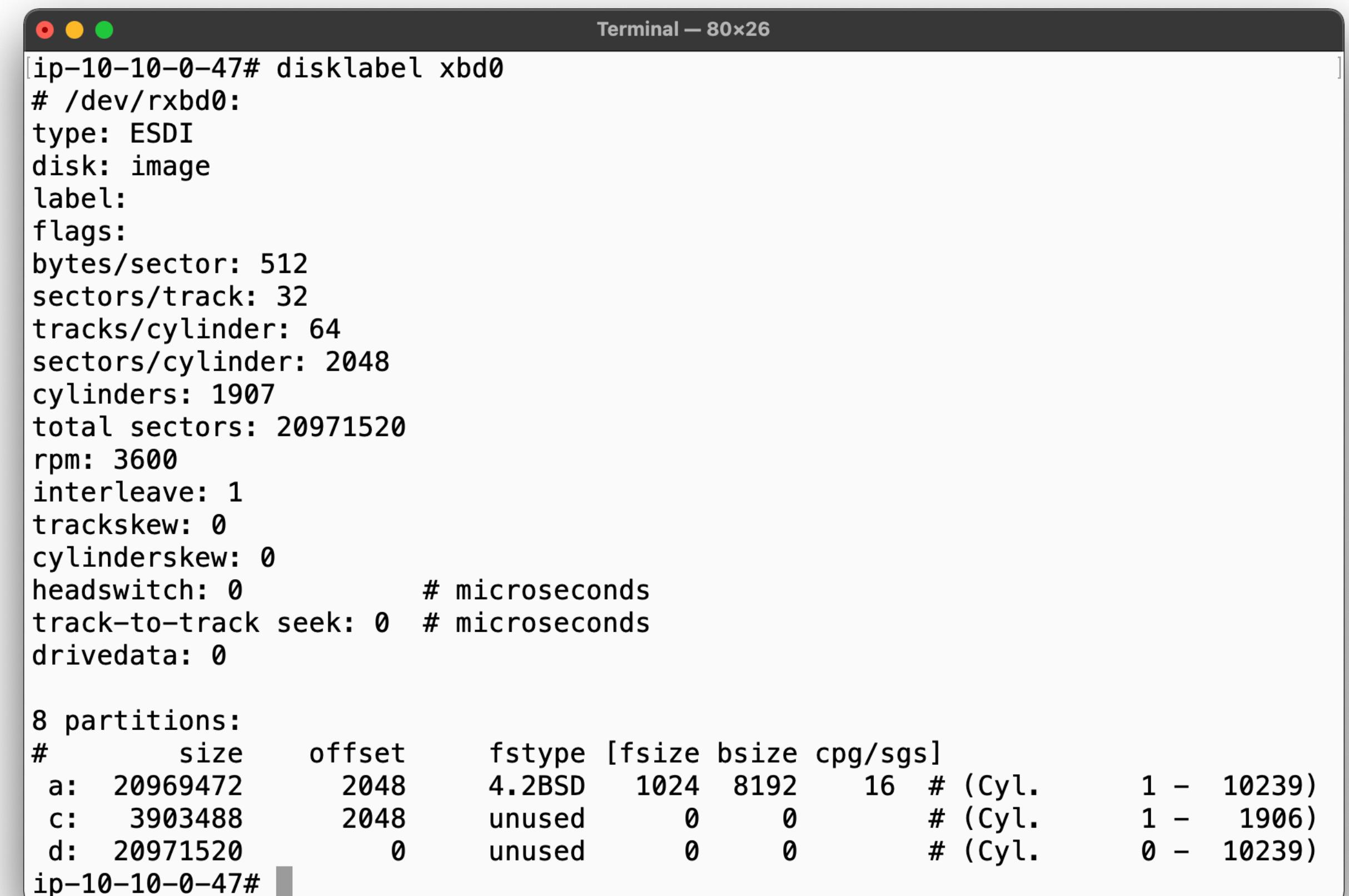
The UNIX Filesystem

- a disk can be divided into logical *partitions*, as described in e.g. the MBR



The UNIX Filesystem

- a disk can be divided into logical *partitions*, as described in e.g. the MBR
- a logical partition has a *disklabel*, describing the geometry of the disk and the filesystem partitions



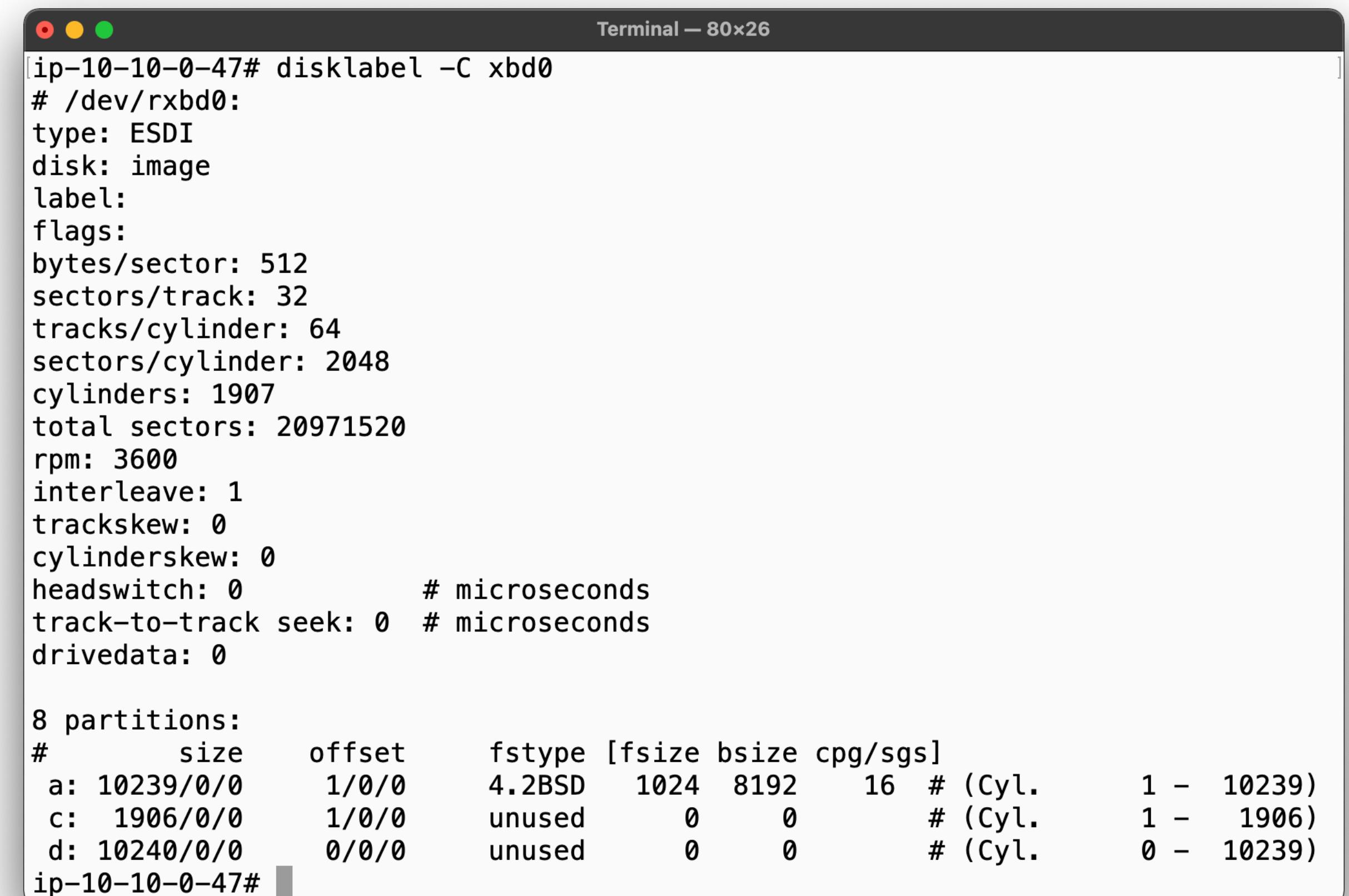
A screenshot of a Mac OS X terminal window titled "Terminal - 80x26". The window shows the output of the "disklabel" command on a disk labeled "xbd0". The output provides detailed disk geometry information and a table of 8 partitions.

```
[ip-10-10-0-47# disklabel xbd0
# /dev/rxbd0:
type: ESDI
disk: image
label:
flags:
bytes/sector: 512
sectors/track: 32
tracks/cylinder: 64
sectors/cylinder: 2048
cylinders: 1907
total sectors: 20971520
rpm: 3600
interleave: 1
trackskew: 0
cylinderskew: 0
headswitch: 0          # microseconds
track-to-track seek: 0 # microseconds
drivedata: 0

8 partitions:
#      size     offset   fstype [fsiz[bsize cpg/sgs]
  a: 20969472      2048    4.2BSD  1024  8192   16 # (Cyl.   1 - 10239)
  c: 3903488       2048  unused      0     0        # (Cyl.   1 - 1906)
  d: 20971520          0  unused      0     0        # (Cyl.   0 - 10239)
ip-10-10-0-47# ]
```

The UNIX Filesystem

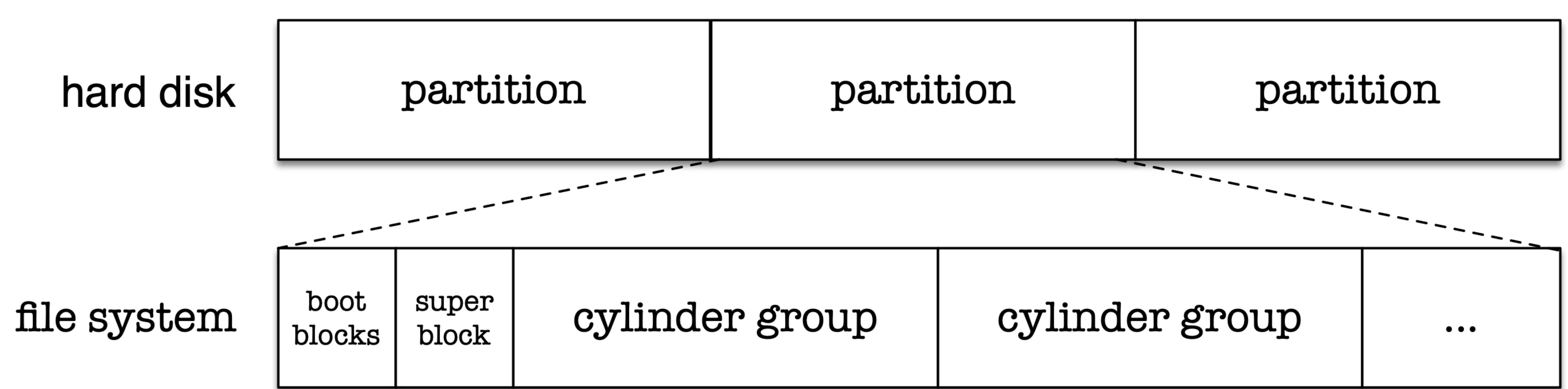
- a disk can be divided into logical *partitions*, as described in e.g. the MBR
- a logical partition has a *disklabel*, describing the geometry of the disk and the filesystem partitions
- a filesystem partition is a collection of *cylinder groups*, on which you can create a new filesystem

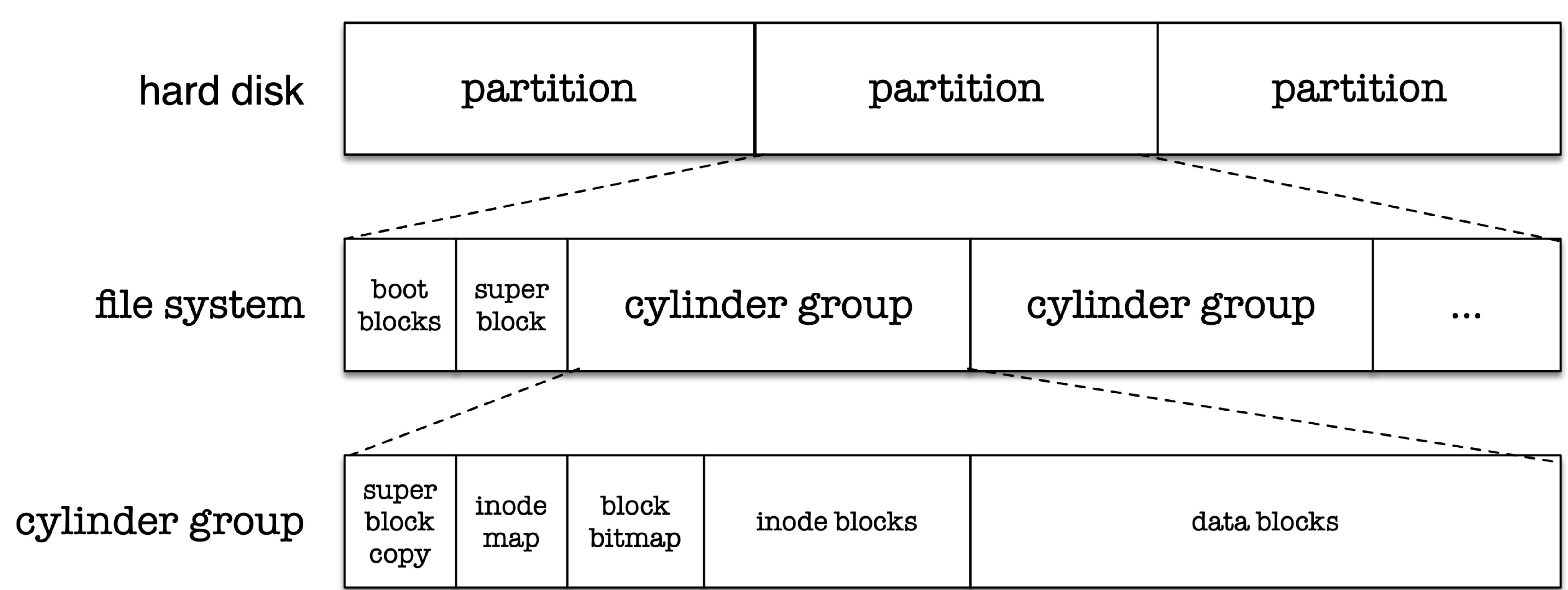


A screenshot of a Mac OS X terminal window titled "Terminal – 80x26". The window displays the output of the command "disklabel -C xbd0". The output shows the disk geometry and details of 8 partitions. The geometry includes 1907 cylinders, 2048 sectors/cylinder, and 3600 rpm. The partitions are labeled a, c, and d, with sizes of 10239, 1906, and 10240 respectively. The first partition (a) is mounted at / and uses the 4.2BSD filesystem.

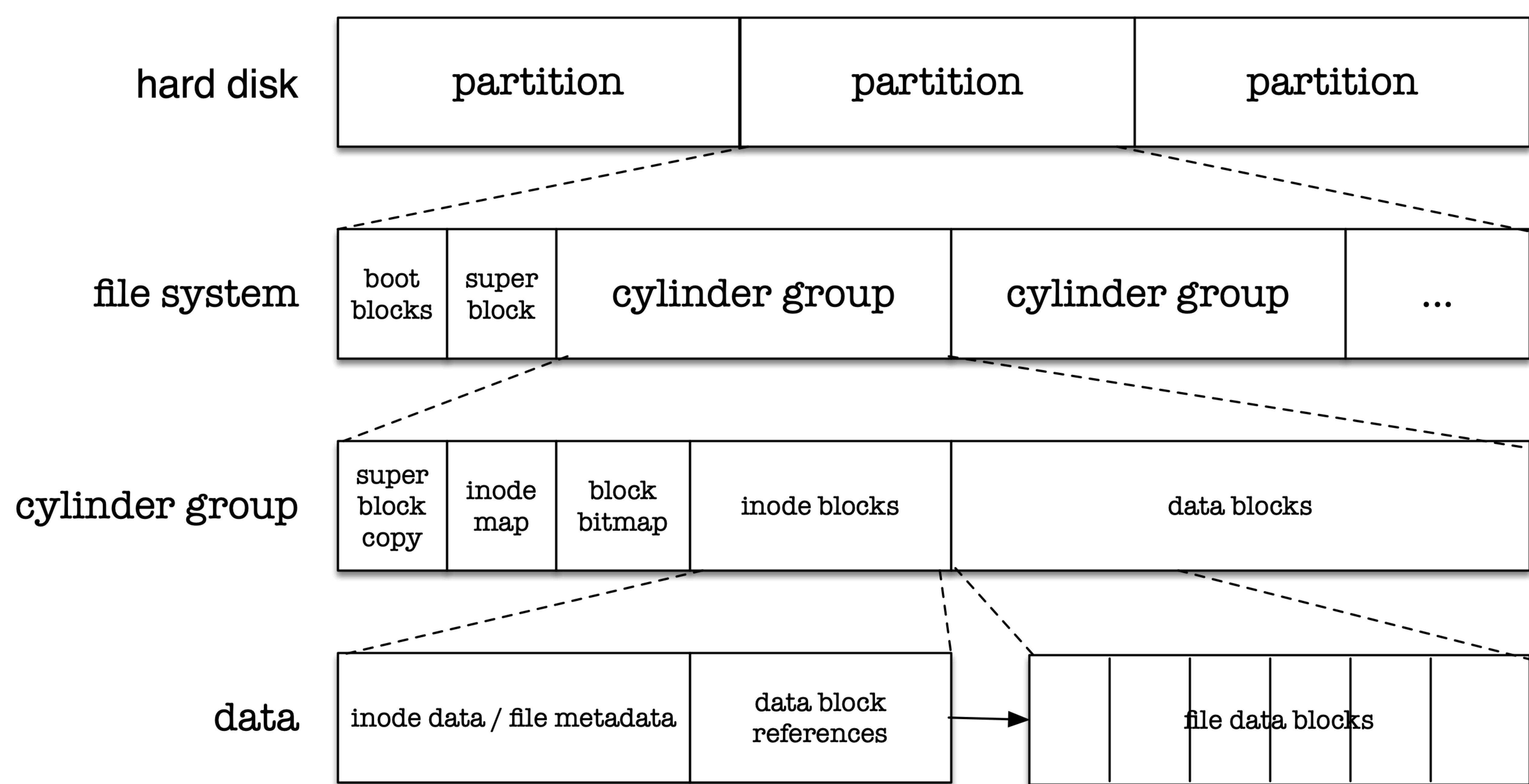
```
[ip-10-10-0-47# disklabel -C xbd0
# /dev/rxbd0:
type: ESDI
disk: image
label:
flags:
bytes/sector: 512
sectors/track: 32
tracks/cylinder: 64
sectors/cylinder: 2048
cylinders: 1907
total sectors: 20971520
rpm: 3600
interleave: 1
trackskew: 0
cylinderskew: 0
headswitch: 0          # microseconds
track-to-track seek: 0 # microseconds
drivedata: 0

8 partitions:
#      size      offset    fstype [fsize bsize cpg/sgs]
a: 10239/0/0      1/0/0    4.2BSD   1024   8192    16  # (Cyl.   1 -  10239)
c: 1906/0/0      1/0/0    unused     0     0      # (Cyl.   1 -  1906)
d: 10240/0/0      0/0/0    unused     0     0      # (Cyl.   0 -  10239)
ip-10-10-0-47# ]
```





- each *cylinder group* contains a list of *inodes* as well as the actual *directory-* and *data* blocks



Terminal — 118x26

	inode	mode	nlink	size	ctime.nsec	flags	blocks	generation	uid	gid
21498:	0	0	0	0	0.000000000	0	0	7e196a8b	0	0
21499:	0	0	0	0	0.000000000	0	0	1319321f	0	0
21500:	0	0	0	0	0.000000000	0	0	77139d63	0	0
21501:	0	0	0	0	0.000000000	0	0	5c8c0a06	0	0
21502:	0	0	0	0	0.000000000	0	0	3a6da664	0	0
21503:	0	0	0	0	0.000000000	0	0	1870213f	0	0
inode	mode	nlink		size	ctime.nsec	flags	blocks	generation	uid	gid
21504:	0	0	0	0	0.000000000	0	0	3f68cb0c	0	0
21505:	0	0	0	0	0.000000000	0	0	692fd60d	0	0
21506:	0	0	0	0	0.000000000	0	0	a8b1585	0	0
21507:	0	0	0	0	0.000000000	0	0	6b23ac27	0	0
21508:	0	0	0	0	0.000000000	0	0	5467ac5a	0	0
21509:	0	0	0	0	0.000000000	0	0	3c88ac3e	0	0
21510:	0	0	0	0	0.000000000	0	0	1c429a42	0	0
21511:	0	0	0	0	0.000000000	0	0	4054d1c6	0	0
21512:	0	0	0	0	0.000000000	0	0	5dadeec7	0	0
21513:	0	0	0	0	0.000000000	0	0	19474344	0	0
21514:	0	0	0	0	0.000000000	0	0	2df63089	0	0
21515:	0	0	0	0	0.000000000	0	0	247e56ed	0	0
21516:	0	0	0	0	0.000000000	0	0	31dcfcfd8	0	0
21517:	0	0	0	0	0.000000000	0	0	72d195a1	0	0
21518:	0	0	0	0	0.000000000	0	0	1911000b	0	0
21519:	0	0	0	0	0.000000000	0	0	6582eb99	0	0
21520:	0	0	0	0	0.000000000	0	0	65a5d925	0	0
21521:	0	0	0	0	0.000000000	0	0	6a4a0c46	0	0

The UNIX Filesystem

- divided into cylinder groups
- filesystem metadata replicated in superblocks in each cylinder group
- filesystem block size can be different from physical block size
- inodes separated from data blocks
- inode density is fixed at filesystem creation time
- various options allow tuning of filesystem to accommodate anticipated use

Next time: file types and mount points

Links

File Systems and Storage Models:

<https://www.netmeister.org/book/04-file-systems.pdf>

A Fast File System for UNIX:

<https://people.eecs.berkeley.edu/~brewer/cs262/FFS.pdf>

CS631 Video on the Unix Filesystem:

<https://youtu.be/kY4JAXYyByQ>

Manual pages:

`fs(5), dumps(8), newfs(8)`