Lecture 20: finish LFS, start networking

- LFS
  - compaction
  - benefits

- Networking
  - Ethernet
  - layers
in UFS: directory contains disk addresses of nodes of files in directory

in LFS: directories contain hole map, need "hole map" mapping log node ids to phys. disk addresses

right not compact all segments:
right only compact if segment < 75% in use.
- need list of free segments.
Few bonus advantages of LFS:

- single file can be spread all over disk (assumed reads cached, least worry)
- actually all blocks written at same time in same segment
- usually read in same order as write

LFS great for SSDs:
- write to SSD (F whip): (≈1MB)
- clear (or flash) an entire large block of addresses
- can write over cleared space
- like to do lots of writes at once
- like to not have to do partial writes

SSD degrades after many writes:
- ideal: uniformly distribute writes over disk (throughout disk lifetime)
  "write balancing"

- Append-only data structure useful elsewhere:
  - Bitcoin (blockchain)
    - uses crypto to enforce append-only nature
  - Distributed systems
    hard to maintain consistency
Networking
- Want to connect multiple computers.
- Network "stack"
  - Physical layer: connecting computers to each other
    - Use: connect wireless computers
    - Ports: 802.11, Ethernet
  - Link layer: manages data that can be sent/received at any given time
    - Ethernet
  - Internetworking layer: IP (Internet protocol)
    - How do I forward data from one network to the other?
    - Instead of sending individual small messages, send blocks of data
  - Session layer: opening/closing connections
    - Session layer: sockets
  - Presentation layer: laying out data structures as bits
  - Application layer: what you're sending/receiving as application, how to respond to requests.
    - E.g. HTTP: how to request web pages
    - E.g. FTP: how to send files back and forth.
How to connect small # of computers (e.g. 7-5) (local area network / LAN)

- Clique
  - $\Theta(n^2)$
  - Wires/connections:
    - $\Theta(n)$
    - Each host: 1 connection (except F)
  - Centralized: F does a lot (needs dedicated device)
  - F is a single point of failure.

- Star topology

- Token ring: complicated