VMs, Datacenters
(and bears, oh my!)

15-440

You know VMs...

- You used one for project 2!
- History: IBM sold big mainframe computers; companies would buy one; wanted to run apps designed for different OSes.
  - When you can only afford one computer...
  - Add a level of indirection!
    - The Virtual Machine Monitor, or VMM
    - VM/370 ... in 1972.
    - Yes, fire had been discovered back then. So had computers.

Re-emergence of VMs

- the PC took over: You could have your own computer. This was pretty revolutionary from the time-sharing days of old.
- But then...
  - Compatibility (old app - old OS, how do you run it?)
  - Many OSes, each with some advantages
  - Debugging & Development (you’ve seen this!)
  - Enterprises: Consolidation (legacy servers running on old slow hardware that you can’t move to a newer OS)
    - Sharing: An 8-core i7 machine with 32GB of DRAM can serve a heck of a lot of small websites... stack ‘em deep and sell ‘em cheap! And you get...
    - Security & isolation -- who cares if you hack my windows if it’s just a dedicated VM isolated from my other stuff?
    - Migration: Moving running OS images from one machine to another, without shutdown.
Common theme

- Manipulating applications & services
- At the granularity of a ‘machine’
- The OS, libraries, apps, etc. are all just an installable and moveable package.
- You can pickle up the entire machine state (and move it, save it, copy it, etc) -- running code, registers, etc.

VMM Requirements

- Fidelity
  - OSes and applications work the same without modification
    - (although we may modify the OS a bit)
- Isolation
  - VMM protects resources and VMs from each other
- Performance
  - VMM is another layer of software… and therefore overhead
    - As with OS, want to minimize this overhead
  - VMware:
    - CPU-intensive apps: 2-10% overhead
    - I/O-intensive apps: 25-60% overhead