

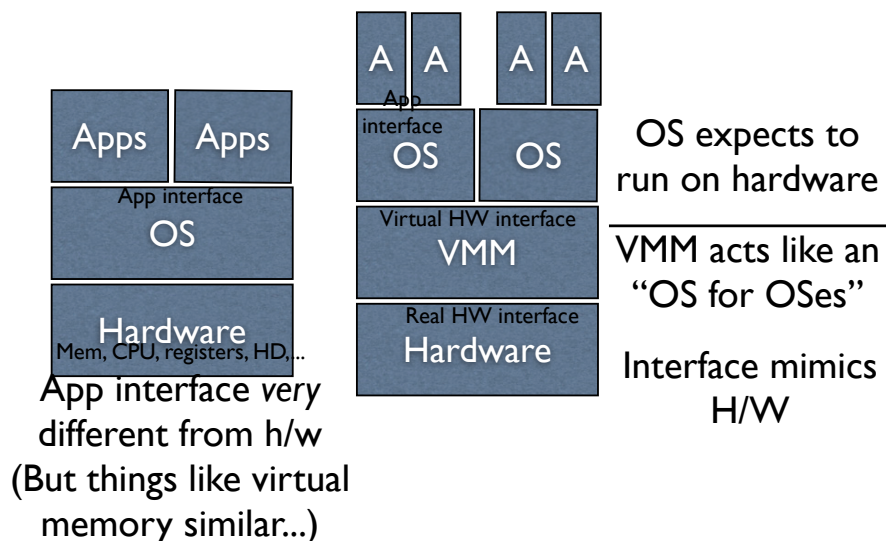
VMs, Datacenters

(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