Memory Allocation

VMMs tend to have simple hardware memory allocation policies

- Static - VM gets 512 MB of hardware memory for life

- No dynamic adjustment based on load
  OSes not designed to handle changes in physical memory

- No swapping to disk

More sophistication - overcommit with balloon driver

- Balloon driver runs inside OS to consume hardware pages
  steals from virtual memory and file buffer cache (balloon grows)

- Gives hardware pages to other VMs (those balloons shrink)

Virtualizing I/O

OSes can no longer interact directly with I/O devices

Types of communication

- Special instruction – in/out

- Memory-mapped I/O

- Interrupts

- DMA

1. Make in/out trap into VMM and use tracing for memory-mapped I/O

2. Run simulation of I/O device

- Interrupt – tell CPU simulator to generate interrupt

- DMA – copy data to/from physical memory of virtual machine