

# 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