

15-213

“The course that gives CMU its Zip!”

Virtual Memory

March 18, 2004

Topics

- Motivations for VM
- Address translation
- Accelerating translation with TLBs

Classic Motivations for Virtual Memory

Use Physical DRAM as a Cache for the Disk

- Address space of a process can exceed physical memory size
- Sum of address spaces of multiple processes can exceed physical memory

Simplify Memory Management

- Multiple processes resident in main memory.
Each process has its own address space
- Only “active” code and data is actually in memory
Allocate more memory to process as needed.

Provide Protection

- One process can't interfere with another.
Because they operate in different address spaces.
- User process cannot access privileged information
Different sections of address spaces have different permissions.

Modern Motivations for VM

- **Memory sharing and control**
 - Copy on write: share physical memory among multiple processes until a process tries to write to it. At that point make a copy. For example, this eliminates the need for `vfork()`
 - Shared libraries
 - Protection (debugging) via Segment-Drivers (Solaris)
- **Sparse address space support (64bit systems)**
- **Memory as a fast communication device**
 - Part of memory is shared by multiple processes
- **Multiprocessing (beyond the scope of 15-213)**