

# Virtual Memory

Questions answered in this lecture:

How to run process when not enough physical memory?

When should a page be moved from disk to memory?

What page in memory should be replaced?

How can the LRU page be approximated efficiently?

# Motivation

OS goal: Support processes when not enough physical memory

- Single process with very large address space
- Multiple processes with combined address spaces

User code should be independent of amount of physical memory

- Correctness, if not performance

Virtual memory: OS provides illusion of more physical memory

Why does this work?

- Relies on key properties of user processes (workload) and machine architecture (hardware)

# Locality of Reference

Leverage **locality of reference** within processes

- **Spatial**: reference memory addresses near previously referenced addresses
- **Temporal**: reference memory addresses that have referenced in the past
- Processes spend majority of time in small portion of code
  - Estimate: 90% of time in 10% of code

Implication:

- Process only uses small amount of address space at any moment
- Only small amount of address space must be resident in physical memory