Chapter 10 - Virtual Memory

- Programms seldom use all the memory allocated to them
- Many advantages when only portions of a process in memory
- Virtual memory separates logical and physical address space

Chapter 10 - Page Replacement

- Pager vs Swapper
- System must determine which pages will possibly be used by a process
- System must be aware which pages reside in primary and secondary memory
- Solution: Use validation bits
- Process executes until it generates a page fault

Example: Page Replacement

1. Process generates memory reference a located in page p
2. Page fault generated by CPU when a is valid, but p is not in the page table
3. Operating system reads contents of page and allocates a physical frame
4. New entry created in page table
5. Operating system reschedules the instruction that caused the fault
6. Effective access time?

Chapter 10 - Page Replacement

- System can allocate more pages than physical memory allows
- Choices with regards to page fault:
  1. Terminate process
  2. Swap process to secondary memory
  3. Replace a single page
- Access time degrades: Two disk operations required (load and store)
- Solution: Mark pages that have changed (dirty bit)

Chapter 10 - Page Replacement Algorithms

- First In, First Out (FIFO)
- Optimal algorithm: Only replace pages not accessed for the longest time
- LRU: Approximation of optimal algorithm
- Hardware that supports LRU
- Variation: History
- Second chance and improved second chance
- LFU and MFU

Chapter 10 - Allocation

- How should available memory be allocated?
- Minimum number of frames
- Equal vs proportional allocation
- Global vs local allocation

Chapter 10 - Thrashing

- Process spends more time swapping than executing
- Reasons
- Possible solutions: Working Set and Page Fault Frequency

Chapter 10 - Other Factors

- Prepaging: Load pages before process is executed
- Page size: What effect does this have on page table and I/O
- TLB size
- Program structure: Must be aware of how memory is organized
- Pages containing buffers used in incomplete I/O operations must remain in memory
- Real time