Operating Systems Course	Deadline: June 15, 2008
Computer Engineering Department	Homework 4
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- 1. Define the following terminologies:
  - a. Overlaying
  - b. Internal Fragmentation
  - c. External Fragmentation
  - d. Thrashing
  - e. TLB
  - f. Local/Global Page Replacement
  - g. Working Set
- 2. Explain the difference between internal fragmentation and external fragmentation. Which one occurs in paging systems? Which one occurs in systems using pure segmentation?
- 3. An embedded computer provides each process with 65,536 bytes of address space divided into pages of 4096 bytes. A particular program has a text size of 32,768 bytes, a data size of 16,386 bytes, and a stack size of 15,870 bytes. Will this program fit in the address space? If the page size were 512 bytes, would it fit? Remember that a page may not contain parts of two different segments.
- 4. A small computer has four page frames. At the first clock tick, the R bits are 0111 (page 0 is 0, the rest are 1). At subsequent clock ticks, the values are 1011, 1010, 1101, 0010, 1010, 1100, and 0001. If the aging algorithm is used with an 8-bit counter, give the values of the four counters after the last tick.
- 5. If FIFO page replacement is used with four page frames and eight pages, how many page faults will occur with the reference string 0172327103 if the four frames are initially empty? Now repeat this problem for LRU.
- 6. Why in some operating systems the OS copies itself in the address space of each process?
- 7. The Intel 8086 processor does not support virtual memory. Nevertheless, some companies previously sold systems that contained an unmodified 8086 CPU and do paging. Make an educated guess as to how they did it. (Hint: think about the logical location of the MMU.)
- 8. Consider a paging system with the page table stored in memory.
  - a. If a memory reference takes 200 nanoseconds, how long does a paged memory reference take?
  - b. If we add TLBs, and 75 percent of all page-table references are found in the TLBs, what is the effective memory reference time? (Assume that finding a page-table entry in the TLBs takes zero time, if the entry is there.)
- 9. What is the effect of allowing two entries in a page table to point to the same page frame in memory? Explain how you could use this effect to decrease the amount of time needed to copy a large amount of memory from one place to another. What would the effect of updating some byte in the one page be on the other page?
- 10. Describe a mechanism by which one segment could belong to the address space of two different processes.