CISC 3595 Operating Systems

Fall 2022

Assignment #6

Out 12/06; back 12/12

Q1. Consider a logical address space of 256 pages of 2048 words each, mapped onto a physical memory of 128 frames.

(a) How many bits are there in the logical address? (3)

(b) How many bits are there in the physical address? (3)

Q2. Compare the memory organization schemes of contiguous memory allocation, pure paging and pure segmentation with respect to the following issues:

- a. External fragmentation (3)
- b. Internal fragmentation (3)
- c. Ability/ease of sharing code across processes. (3)

Q3. Assuming a 1-KB page size, what are the page numbers and offsets for the following address references (provided as whole numbers): (5 pts)

(a) 4378; (b) 19566; (c) 30000; (d) 258; (e) 16388

Q4. Consider a system that uses pure demand paging. (10 pts)

- a. When a process first starts executing, how would you characterize the page fault rate?
- b. Once the working set for the process is loaded into memory, how would you characterize the page fault rate?
- c. Assume that a process changes its locality and the size of the new working set is too large in available free memory. Identify some options system designers could choose from to handle this situation.

- Q5. Answer all the following questions for paged memory: (15)
 - (a) Given a logical address space of 32 bits, and a page offset of 26 bits, how many pages are possible?
 - (b) For the example in (a) above, list the addresses of the first three frames in physical memory.
 - (c) For the example in (a) above, what is the smallest space that could be allocated for a page table?
 - (d) Given a 256 entry page table, and a logical address space of 48 bits, how big must each physical memory frame be?

Q6. Consider a demand-paging implementation with 3 frames, all initially empty. Demonstrate the sequence of page replacements that would occur for the reference sequence below for (a) First-In-First-Out (FIFO) and (b) Least Recently Used (LRU). For both cases, calculate the total number of page faults. (15)

Reference String: 5054205023253153

Q7. Assume that we have a demand-paged memory. The page table is held in registers. It takes 5 milliseconds to service a page fault if an empty frame is available or if the replaced page is not modified and 25 milliseconds if the replaced page is modified. Memory-access time is 120 nanoseconds. Assume that the page to be replaced is modified 85 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds? (10)