CSE 410 - Computer Systems Homework 4

Assigned: Monday, December 3, 2001

Due: Monday, December 10, 2001 At the start of class

Your name: _____

- 1. Imagine that two students are working together on a project. Part of their work involves updating a single spreadsheet file. The file is located on a remote server that is accessible to both of them. Only one person can open the file in read/write mode at a time.
- a. Late Sunday night both students are working on the project and decide that they will update the spreadsheet with their latest work. Student A opens the spreadsheet with read/write access. Student B then attempts to open the spreadsheet, also in read/write mode, but access is denied because the file is already open in read/write mode. Student B cannot continue working until A closes the spreadsheet.

Is this a deadlock situation?

b. If yes, describe how each of the four necessary conditions for deadlock is true in this case. If no, describe one condition that is not true in this case.

2. Imagine that the students have also developed a text document that contains their summary statements. This document is shared on the same file server with the same read/write access limitations as the spreadsheet.

Student A opens the text document and starts to update it. Student B opens the spreadsheet and starts to update that.

Then Student B needs to update the text while developing the analysis and tries to open the text document, but is stopped because the text is already open by A. Student A needs to modify the numerical data while writing the summary, but is stopped because the spreadsheet is already open by B.

- a. Is this a deadlock situation?
- b. If yes, describe how each of the four necessary conditions for deadlock is true in this case. If no, describe one condition that is not true in this case.

- 3. Base and bounds registers can be used to provide a relatively simple method of mapping program virtual addresses to actual physical addresses, and providing memory protection at the same time. Consider slide 13 in the lecture of December 3. You can assume that the highest address in memory is 0xFFFFFF.
- a. Show the arithmetic and the comparison that justify the conclusion that Solitaire cannot reference location 0x1100C0.

b. If the OS, Word, and Solitaire are the only processes loaded in memory, describe a simple change that the OS might make in order to allocate an additional 0x50000 bytes to Word.

c. If the OS, Word, and Solitaire are the only processes loaded in memory, describe a more complex change that the OS might make in order to allocate an additional 0x150000 bytes to Word.

- 4. Fragmentation in a memory system refers to the waste of memory space either because it cannot be allocated (external) or because it is allocated and won't be used (internal).
- a. In a system using paged memory and a page size of 4096 bytes (4KB), what type of fragmentation will we see?
- b. What is the maximum possible amount of wasted space due to fragmentation in a single page on this system?
- 5. Consider a different system using multiple-partition contiguous allocation to manage 128 MB of memory available to user processes.
- a. What type of fragmentation will we see?

c. This system is running a 10MB user process and wants to load another 64MB process into user memory to run at the same time. Draw a diagram of a memory allocation in which it is not possible to load the second program due to fragmentation.

- 6. Consider a system using demand paging to manage memory allocation to processes.
- a. What is the meaning of the term "page fault" on this system?
- b. When a page fault occurs, what is the most time consuming portion of the work that the operating system must do before the user process can start running again?

- 7. When memory is full and a new page is needed, the OS must select a page to evict from memory to make room for the incoming page.
- a. The OPT page replacement algorithm is provably the best algorithm. What is the characteristic of the OPT algorithm that makes it impossible to implement?
- b. The second chance (or clock algorithm) degenerates to the FIFO algorithm if all the reference bits are set when a page fault occurs. Describe in general terms how a single program might cause this to happen on a system. (for example: describe the program memory size and reference locality characteristics.)

c. Do you think it is likely that the system in (7b) is thrashing? Why or why not?