Homework 3

CmpSci 377: Operating Systems

1. Most systems allow programs to allocate additional memory during execution. Data allocated in the heap segments of programs are an example of such allocated memory. What is required to support dynamic memory allocation in the following schemes:

a. contiguous-memory allocation

b. pure segmentation

c. pure paging

2. On a system with paging, a process cannot access memory that it does not own; why? How could the operating system allow access to memory not belonging to the process? Why is this functionality useful?

3. Consider a paging system where 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 associative registers, and 75 percent of all page-table references are found in the associative registers, what is the effective memory reference time? (Assume that finding a page-table entry in the associative registers takes zero time if the entry is there.)

4. Given an example where the least frequently used page-replacement algorithm generates fewer page faults than the least recently used page replacement algorithm.

5. Consider a demand-paging system with the following time-measured utilizations:

CPU utilization 20%

Paging disk 97.7%

Other I/O devices 5%

Which (if any) of the following will (probably) improve CPU utilization? Explain your answer.

a. Install a faster CPU.

b. Install a bigger paging disk.

c. Increase the degree of multiprogramming.

d. Decrease the degree of multiprogramming.

e. Install more main memory.

f. Install a faster hard disk or multiple controllers with multiple hard disks.

g. Add pre-paging to the page fetch algorithms.

6. None of the disk-scheduling disciplines, except FCFS, are truly fair (starvation may occur).

a. Explain why this assertion is true.

b. Describe a way to modify algorithms such as SCAN to ensure fairness.

c. Explain why fairness is an important goal in a time-sharing system.

d. Give two examples of scenarios where is important that the operating system be *unfair* in serving I/O requests.

7. Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms?

a. FCFS

b. SSTF

c. SCAN

d. C-SCAN

8. Consider a file system that uses a modified contiguous-allocation scheme with support for extents. A file is a collection of extents, with each extent corresponding to a contiguous set of blocks. A key issue in such systems is the degree of variability in the size of the extents. What are the advantages and disadvantages of the following schemes?

a. All extents are of the same size, and the size is predetermined.

b. Extents can be of any size and are allocated dynamically.

c. Extents can be of a few fixed sizes, and these sizes are predetermined.