EXAM 2

CS 450 – Spring 2010

ANSWER KEY

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This is a closed book test. No notes or other resources are allowed. Read each question carefully and pace yourself. Put all answers on the exam paper, in the space provided.

1. (20 points: 2 each)

TRUE OR FALSE

a) Two memory management problems that cannot be solved without hardware assistance are protection and dynamic relocation. *TRUE*

b) The memory allocation strategy most likely to require blocks to be chained in order by size is the first fit strategy. *FALSE*

c) Most OSs maintain the current date as a count of the total days that have elapsed since the beginning of the year zero. *FALSE*

d) The system clock is the starting point for all time-of-day calculations. *FALSE*

e) In general, programming a serial port is more complex than programming a parallel port. *TRUE*

f) A computer which uses memory-mapped I/O requires no specific machine instructions for input and output. *TRUE*

g) Most file systems keep the entries in each directory in sorted order. *FALSE*

h) It is possible on some file systems to run out of directory space before running out of file space. *TRUE*

i) The use of a cache for page descriptors allows a virtual memory system to run faster than one with no mapping at all. *FALSE*

j) In a paged virtual memory system employing a reference flag, the flag is modified, but never examined, by the hardware. *TRUE*

2. (20 points: 4 each)

Explain briefly each of the following terms.

a) Fragmentation

The process by which allocatable memory gradually becomes broken up into many small pieces due to the continual splitting and merging that occurs when blocks of variable sizes must be allocated.

b) Timing queue

An operating system queue that maintains a list of processes to be made ready at a specific time. The queue is kept in order by time, and the timer interrupt handler checks the queue to see if any processes are now ready to run.

c) I/O Completion

The cleanup activities that are performed when an I/O transfer request has completed, such as releasing buffers and moving processes to different process queues or I/O queues.

d) Volume Control Block

A block near the beginning of a storage volume used to describe the overall structure of the volume.

e) Page Frame

A block in main memory into which pages of information may be stored.

3. (10 points)

The diagram below shows the memory map for a heap with some blocks allocated and some blocks free. Block A is at the lowest addresses. Assume that the last block to be allocated was block B. A request arrives to allocate a block of size 10K. Name the four allocation strategies studied, and identify the block that would be selected using each strategy.

First fit: This strategy would select block A, the first block from the beginning that is large enough.

Next fit: This strategy would select block C, the first block after the previous allocation that is large enough.

Best fit: This strategy woul dalso select block C, the smallest block that is large enough.

Worst fit: This strategy would select block G, the largest block of all.

4. (10 points: 2 each)

Identify five operations that an OS may provide related to virtual timers.

- *Allocate*
- *Free*
- *Start*
- *Stop*
- *Read*
- *Set Time*
- *Set Alarm*
- *Cancel Alarm*

5. (10 points)

Explain the purpose of the I/O interface (or controller) that connects devices to the processor. Why does this simplify the design of both the processor and the device?

The I/O interface is a physical unit that is connected between the processor and the device, and handles the details of communication between them. It relieves the processor and the device from the need to know each other in detail; each may view the other as simple abstract models.

6. (10 points)

We have studied three special techniques for buffer management: ring buffers, double buffering, and software caching. Select **one** of these techniques and fully explain it.

*For full credit, you should describe **exactly one** of these techniques.*

If you discuss the ring buffer, your answer should address its purpose (to hold input that occurs before a process is ready) and its usual implementation (as a circular array). You should also mention the handling of overflow.

If you discuss double buffering, you should describe the basic mechanism (two buffers alternating between input and output) and the purpose (to speed up a stream of block processing, usually involving disk transfers). You should also note why more buffers would not be as beneficial.

If you explain software caching, you should discuss the mechanism (maintaining a number of buffers to hold disk blocks in current use) and how it is implemented (save the blocks most recently accessed, discard those that have not been used recently). Your answer should briefly explain the principle of locality.

7. (10 points)

A straightforward blocked-indexed file organization would cause the size of descriptors to grow without bound for large files. Explain how the UNIX file directory information is organized to overcome this problem.

The UNIX file descriptor contains a fixed number of block addresses regardless of the size of the file. The first ten entries point directly to the first ten blocks. For larger files, there are three entries reserved for indirect pointers. The first points to an index block of addresses, and the second and third point to two-level and three-level indexes. Even for very large files, the size of the descriptor is fixed.

8. (10 points: 5 each)

a) Explain the difference between local and global page replacement algorithms in a virtual memory system.

A global page replacement algorithm considers all pages to be available for selection when a page is to be removed. A local replacement algorithm assigns a distinct set of pages to each process. When a process needs a page frame, a page is selected for removal from the pages held by that process.

b) Which type of page replacement (local or global) should be used in a multiprogrammed OS?

Local Page replacement (no explanation is necessary).