

Final Exam for CSE 153 (Winter 2014)

15th March 2014

Name:

Student ID:

Instructions:

- * This exam is out of a total of 20 points, with an additional 5 points for extra credit.
- * Be brief in your answers. You will be graded for correctness, not on the length of your answers.
- * Make sure to write legibly. Incomprehensible writing will be assumed to be incorrect.
- * Read all questions carefully. Every word is in there for a reason.

I. For each of the 4 questions below, select the correct options by clearly making an X mark next to the options that you think are correct. Every question has at least one correct option, and may have multiple correct options. (4 x 1 = 4 points)

1. In which of the following cases can LFS potentially offer poorer write performance than FFS?

- Files are often deleted
- The amount of memory on the machine is low
- Utilization of disk space is low

2. What information does each TLB entry need to contain in order to ensure that the TLB need not be flushed when a context switch is performed between processes?

- Valid/invalid bits
- Process ID
- Reference bit

3. In the UNIX file system, what information does a directory contain for a file in that directory?

- Logical address on the disk of the beginning of the file
- Logical address on the disk of the file's inode
- Logical addresses on the disk of the beginning and end of the file

4. What are the benefits of using variable sized partitioning to allocate virtual address spaces as compared to using paging?

- No internal fragmentation
- Context switches are faster
- Latency for translating a virtual address to a physical address is lower

II. Name three pieces of information that the Interface Description for an RPC must include?

(3 points)

III. Compare the pros and cons of the manner in which VMware and Xen implement virtual machine monitors? (2 points)

IV. Answer each of the following questions in a couple of sentences. (3 x 1 = 3 points)

a) Why can an OS run on top of a virtual machine monitor (VMM) but an OS cannot run on top of another OS?

b) What drawback in the SSTF disk scheduling policy does the SCAN scheduling policy fix?

c) List one drawback each of i) Approximate LRU, and ii) LRU clock page replacement policies?

V. The single-threaded version of your program has a runtime of 10 seconds. To speed it up, you parallelize the program's execution into two threads. However, you find that the program's runtime now increases to 20 seconds. Give three possible reasons (based on how virtual memory management works and how disks work) for this slowdown after multi-threading. (3 points)

VI. Consider a machine with a CPU that supports 32-bit addressing. The OS installed on this machine uses two-level paging, with a page size of 4 KB, to support a 32-bit virtual address space.

(2 + 1 + 1 + 1 = 5 points)

a) When the machine first boots up, a new process A is created. Initially, process A's address space only includes the whole program associated with the process, where the size of the program is 3 MB. How much memory does the OS need to allocate to represent process A's address space?

b) Process A then allocates an array Z of size 9 MB. How much additional memory does the OS now need to allocate?

c) Process A then issues a `fork()` system call to create a child process B. If the OS uses copy-on-write to optimize memory usage, how much additional memory does the OS have to allocate to execute the `fork()` call?

d) After the child process B is created, it modifies the content of the first 5 MB in array Z? How much additional memory does the OS have to now allocate?

Extra Credit:

VII. Provide a formal proof as to why the LRU page replacement policy does not suffer from Belady's anomaly. Note: An example is not a proof. (5 points)