

**Operating Systems
V22.0202 Fall 2008**

Midterm Exam

1. **True/False.** Circle the appropriate choice.

- (a) **T F** In priority scheduling, I/O-bound processes should be given a higher priority than CPU-bound processes in order to make more efficient use of the CPU.
- (b) **T F** All computers must have at least two CPUs, since the operating system needs to execute at the same time as user programs.
- (c) **T F** A short quantum in a round-robin scheduler gives better response time for interactive users but less efficient use of the CPU than a longer quantum.
- (d) **T F** In a 2GHz Pentium, the clock interrupt occurs 2 billion times a second.
- (e) **T F** The main difference between the use of test&set and the use of semaphores is that semaphores require the OS to do the busy waiting rather than the user program.
- (f) **T F** Within a given virtual memory system, pages of varying sizes are used to avoid wasting space within partially-filled pages.
- (g) **T F** For a machine with 32-bit addresses, the use of a two-level page table allows for a larger virtual address space than a single-level page table.
- (h) **T F** A process is just the compiled version of a program.
- (i) **T F** A processor is generally put into kernel mode through the execution of a trap instruction.
- (j) **T F** The purpose of an operating system is to manage system resources and to provide a more convenient abstract machine for programming.

2. **Multiple Choice.** Circle the correct answer.

- (a) If addresses are 27 bits, the size of the space that can be addressed is:
 - 64KB
 - 128MB
 - 256MB
 - 4GB
- (b) If a 64TB (where TB=terabyte) address space is desired, then addresses must be at least:
 - 32 bits
 - 40 bits
 - 46 bits
 - 64 bits

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3. **Virtual Memory.** Put your (short!) answers in the blue book

- (a) Suppose, on a machine with 16-bit virtual and physical addresses and a page size of 256 bytes, a process is running and the TLB contains the following:

1	32	4F
1	1A	C3
1	89	22
0	42	B2

where, from left to right, the columns contain the valid bit, the virtual page number, and the page frame number. All numbers are given in hexadecimal. If the process issues the virtual address 1AF2 hex, what physical address (in hex) will the MMU issue? Show your work, but without giving a long explanation.

- (b) Why are multi-level page tables often used instead of ordinary (single-level) page tables? What is the added cost associated with using multi-level page tables?
- (c) Suppose there is a machine with 32-bit addresses and a two-level page table (in memory) such that the first 10 bits of an address is an index into the first level page table and the next 10 bits are an index into a second level page table. Suppose also that each entry in the page tables is 32-bits. How much space is occupied in memory by the page tables for a process that has 64Mb of actual virtual address space allocated. Show your work without giving a long explanation.

4. **Semaphores.** Put your answers in the blue book.

Suppose you were the implementor of an operating system that provided support for semaphores.

- (a) Describe how you would implement the down(S) and up(S) systems calls, where S is a semaphore.
- (b) How would you represent the semaphore S itself?
- (c) How would you keep track of the processes that are blocked because they performed a down(S)?

If it helps, you can give your description in terms of the simulated system from the programming project. Be sure to account for everything that happens when a down() or up() operation is performed.