

**CS414 Assignment 1**  
**10 points per answer (100 max). Due Wednesday February 1**

**Short-answer questions (just a sentence or two each, please).**

1. Hardware interrupts support a concept of *priority*: an integer between 0 and 7. The rule is that when the CPU is running code at priority  $k$  (zero is the default), an interrupt of level  $l > k$  can occur. When the CPU is at level  $l$  or above, the interrupt must wait until the handler has finished and the priority drops again.
  - a. Thinking about the devices connected to a typical PC (other than the processor clock), give an example of two devices where it would be best from a system performance perspective for one to interrupt at a higher priority and the other at a lower priority, and explain your reasoning.
  - b. Usually, the system clock is the highest priority device: it interrupts at priority level 6 and no other device uses priority 6 or 7. Explain why this makes a lot of sense
  - c. Priority 7 is reserved for “trap” instructions, such as illegal instruction handlers, memory references to unallocated or protected memory, etc. Why is the highest level needed for this class of events?
  - d. What do you think would happen if the CPU was running in the kernel at priority 7 and the code tried to dereference a null pointer?
2. Early operating systems were designed as libraries of procedures to which application programs were linked directly – there was no separation of kernel and user mode. Then, with the evolution of time-sharing and multi-processing, it became preferable to have a single shared OS kernel running in kernel mode, with applications living in user mode.
  - a. Give a reason why a computer is less likely to crash if it uses a kernel-mode OS rather than a user-mode library.
  - b. When building an operating system for a modern mobile cellular telephone (the kind that can connect to your agenda, surf the internet, take pictures, etc) would you favor reverting to the older style of library or would you favor sticking with this OS kernel model, in which applications run in user mode?
3. Which instructions should only be permitted while in kernel mode?
  - a. Initiate DMA I/O (a read or write) to a disk
  - b. Disable all interrupts
  - c. Perform a trap
  - d. Execute a “return from interrupt” instruction