

# COMP 3000: Operating Systems: Fall 2011 Test 1 Solutions

October 5, 2011

1. To improve VM performance one often installs “guest additions.” Guest additions can:
  - (a) Improve disk I/O performance
  - (b) Allow the mouse pointer to seamlessly move between guest and host OS windows
  - (c) provide time synchronization
  - (d) **All of the above**
2. Which of the following could be virtualized on an x86-based computer?
  - (a) NetBSD for PowerPC
  - (b) **Android for x86**
  - (c) Debian GNU/Linux for SPARC
  - (d) Windows 8 for ARM
3. Mainframes are better at virtualization than x86 commodity PCs (i.e., they can support more concurrent guest OSs) because:
  - (a) Mainframe CPUs support interrupt virtualization while x86 CPUs do not.
  - (b) Mainframe CPUs support memory virtualization while x86 CPUs do not.
  - (c) **Mainframe devices support virtualization while x86 CPUs do not.** (should say x86 *devices* do not)
  - (d) **Mainframe software is better optimized for virtualization.**
4. What CPU mode does the kernel normally run in (i.e., without virtualization)?
  - (a) **Supervisor mode**
  - (b) Hypervisor mode
  - (c) User mode
  - (d) None of the above
5. Why doesn't `ldd` report all the libraries that are listed in `/proc/<PID>/maps`?
  - (a) `ldd` only reports system libraries, not user-developed ones.
  - (b) **Processes can load additional libraries as they run.**
  - (c) The kernel adds libraries to processes on its own.
  - (d) `ldd` is buggy.
6. Are environment variables “global” variables? Specifically, if you change the value of an environment variable X in one process, will the value of X change in all of the other processes on the system? **no**
7. If a CPU does not support hardware virtualization, can you still run a hypervisor? **yes**
8. Can Xen run on a CPU that does not support hardware virtualization? **yes**

9. On a system with a hypervisor (say, Xen) and three operating system kernels (Windows, Linux, and FreeBSD), at a minimum how many CPU schedulers are running “at the same time” (i.e., are scheduling processes on the system)? **Ans: 4**
10. Hypervisors multiplex computer hardware between what kind of programs? **Ans: operating system kernels**
11. Typically, what does a guest OS’s hard disk look like to the host OS? **Ans: a file**
12. Under hardware virtualization, when an interrupt happens, which normally runs first - a hypervisor or a kernel? **hypervisor**
13. In UNIX, there are three permissions associated with the user, the user’s group, and everyone else. What are those three permissions? **Ans: read, write, execute**
14. If you see a zombie process during normal system operation, how can you get rid of it?  
**Ans: kill its parent**
15. How can I hide a file in standard directory listings?  
**Ans: rename the file to start with a dot.**
16. A thread can be defined as an execution context in an address space. Given this definition, what is a process (in terms of execution contexts and address spaces)?  
**Ans: an address space with one or more execution contexts**
17. Does static or dynamic linking produce smaller executable files? **Ans: dynamic**
18. Which conserves memory better when running many programs? **Ans: dynamic linking**
19. I can copy a file using I/O redirection as follows: `cat /bin/ls > bar`. If I now type `./bar`, it won’t run. However, if I run another command before typing `./bar`, I will get a file listing. What needed to be changed to get `bar` to run?  
**Ans: bar needs to be made executable with chmod**
20. System calls cannot normally be made using standard function calls. What CPU mechanism is used by regular processes to invoke kernel functionality?  
**Ans: software interrupts**
21. **Bonus (2 pts):** Which of the following prints `cat` twice in a bash shell?
  - (a) `echo "cat" > cat && cat < cat cat`
  - (b) **Ans:** `echo cat > cat && cat < cat cat cat`
  - (c) `echo "cat" 1>&2`
  - (d) `echo "cat" > cat && cat cat | cat cat`