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COMP 3000B: Operating Systems

Winter 2007 Mid-Term Exam (Selected Questions)

February 15, 2007

1. "Zombie" processes are caused by:
   (a) An execve of a non-existent program
   (b) A failure to wait for terminating processes
   (c) A fork when system resources are low
   (d) All of the above

2. When a regular process is running on a single-CPU system, all of the following are true **except**:
   (a) The kernel is not running.
   (b) Disks can be writing data to memory.
   (c) The CPU will generate an exception (software interrupt) if certain addresses are accessed.
   (d) The CPU is in supervisor mode.

3. Monitors:
   (a) use condition variables for synchronization
   (b) prevent multiple threads from executing monitor code at the same time
   (c) hide mutual exclusion details from calling routines
   (d) all of the above

4. System calls must be used to:
   (a) modify global variables
   (b) call a user-written function
   (c) write to a file
   (d) All of the above

5. Which of the following is an example of a bounded-buffer producer consumer problem?
   (a) UNIX pipes, e.g. the command "ls | more"
   (b) two threads sharing access to `struct foo`
   (c) browsing and buying a plane ticket online
   (d) All of the above

6. A modern monolithic operating system kernel typically implements
   (a) scheduling & address space management
   (b) some device drivers
   (c) a TCP/IP stack
   (d) All of the above
7. When a UNIX shell such as bash executes an external command (such as ls), what system calls does it typically execute?
   (a) fork
   (b) wait
   (c) Both (a) and (b)
   (d) None of the above
8. A typical executing application is best described as a:
   (a) kernel
   (b) process
   (c) thread
   (d) system call
9. Special machine instructions such as "test and set" can be used to protect data structures shared between:
   (a) processes running on multiple networked computers
   (b) threads running on a single CPU
   (c) both (a) and (b)
   (d) none of the above
10. Pipelining. . .
   (a) . . .involves dividing machine instructions into smaller units of work.
   (b) . . .allows modern CPUs to execute more than one instruction in parallel.
   (c) . . .slows down context switches and increases interrupt latency.
   (d) All of the above
11. A batch system shares CPU resources by executing programs one at a time, with each running to completion. Compared with a timesharing OS system, batch operating systems:
   (a) make more efficient use of CPU resources (i.e. less is wasted in overhead)
   (b) are easier to implement
   (c) are used today on mainframe systems
   (d) All of the above

12. When choosing whether to implement a device driver as a block or a serial device, which of the following information about the new device is **most** relevant?

    (a) The same data is likely to be read multiple times.
    (b) The device returns data in fixed-sized chunks.
    (c) The device is fast.
    (d) The device is attached by USB.

13. When a running program X requests data from a file F whose contents are on disk, the OS will:

    (a) save X's current state
    (b) schedule a disk request for F's data blocks
    (c) load the state of another ready-to-run program Y (which may be X)
    (d) All of the above

14. Which UNIX command will show you a list of currently running processes?

    (a) chmod
    (b) ps
    (c) more
    (d) ls

15. When a web browser requests a web page, it is performing a type of inter-process communication. This communication is best described as:

    (a) message passing
    (b) shared memory IPC
    (c) semaphore-based synchronization
    (d) None of the above

16. Disabled interrupts are effective at enforcing mutual exclusion in which of the following contexts?

    (a) an OS kernel on a a symmetric multiprocessor (SMP) system
    (b) an OS kernel on a cluster of networked computers
    (c) an OS kernel on a single processor system
    (d) a web-based distributed application

17. "Elevator" scheduling is used by:

    (a) Ethernet cards
    (b) Flash drive controllers
    (c) Hard disk controllers
    (d) Operating system CPU schedulers

18. Producer/consumer programs use mutual exclusion mechanisms (semaphores, monitors, etc.) to:

    (a) slow down consumers that run faster than producers
    (b) slow down producers that run faster than consumers
    (c) prevent the shared queue from becoming corrupted
    (d) all of the above

19. "ls -l hello" outputs the following:

```
-rw-r-xr--  2 soma sys 82021 2005-11-20 10:06 hello
```

    Based on this information, which of the following is true about hello?

    (a) The user soma may execute hello.
    (b) Members of the group "sys" may execute hello.
    (c) The file hello was created on November 20, 2005.
    (d) All of the above

20. [4] A system administrator would like to allow an apache web server process to log incoming requests; however, she also wants to configure the system such that if the web server process is compromised by an attacker, that attacker won't be able to modify or erase past transactions.

    (a) [2] What UNIX permission(s) would the web server process need on its logfile? What Windows permission(s) would it need?

    (b) [2] Would these permissions prevent a compromised web server from erasing the log of past events? Explain.

21. [2] What is the primary advantage to placing windowing system code in the OS kernel? What is the primary disadvantage?

22. [2] UNIX pipes are an example of a bounded-buffer producer consumer problem. On what system call will the producing process block when it gets ahead of the consumer? On what system call will the consumer block when it gets ahead of the producer? (Hint: what system calls are used when a process accesses a pipe?)

23. [3] Answer the following questions on semaphores:

    (a) [1] What is the basic strategy for using a binary semaphore (mutex) to prevent concurrent access to a shared data structure?

    (b) [2] If the semaphore is used incorrectly, what problems can arise? State two simple errors and the problems these errors can cause with the execution of concurrent threads and/or the state of the shared data structure.

24. [4] Answer the following questions on UNIX environment variables.

    (a) [1] Who ultimately determines the value of a new process's environment variables?

    (b) [1] Can UNIX environment variables such as PATH be changed by a process at runtime, or are they constants?

(c) [2] Where do you think UNIX environment variables stored—in kernel memory, or in the address space of individual processes? Explain how you came to this conclusion (or give evidence for why your answer is correct).

25. [5] Briefly answer the following questions on process and thread management:

(a) [1] A running program consists of one or more execution contexts plus an address space. In terms of execution contexts and address spaces, what is a process? What is a thread?

(b) [2] When a thread exits, does a process exit? When a process exits, does a thread exit? Explain.

(c) [2] Kernels in many operating systems support mulitple execution contexts within the kernel, i.e. part of the kernel may be blocked waiting for an I/O event while another is processing a system call. Are these "execution contexts" best thought of as threads or processes? Why?

26. [4] Most current portable electronics devices do not run modern operating systems. However, Apple has stated that the iPhone will run Mac OS X, which is a modern OS.

    (a) [1] What key piece of hardware will the iPhone need that other portable devices do not?

    (b) [1] What is one compelling reason for Apple to choose a modern OS foundation for the iPhone?

    (c) [2] Apple has stated that the iPhone is to be a "closed" device, meaning that users will not be able to install arbitrary applications on it; instead, they will only be able to install Apple-supplied (or authorized) programs.

    What are two capabilities that Apple will need to restrict on the iPhone that are available to users of conventional modern, personal operating systems (e.g. Windows XP, regular versions of Mac OS X)?