CS 423/523 Assignment 1

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Due:  

Total: 40 points

Please upload your solutions to classes\*v2. To do so, please enter classes\*v2, then click the “Assignment” button on your left-hand toolbar, and finally click “Assignment1” to upload your assignment.

If you know you are going to submit your assignment late, please let us know in advance (send an email to cs423ta@cs.yale.edu). Solutions will be posted 4 days after the deadline.

Any and all resources may be used as long as you cite them, with the exception of collaborating with other people. Please do not copypasta your definitions from Wiki.

If you have ANY questions, please do not hesitate to let us know (email, office hours, etc.)
Part 1: OS definitions (1-3 line answers, 7 x 2 points each = 14 points)

1. Operating system
   A program that acts as an intermediary between a user of computer and the computer hardware.

2. Kernel
   The one program that runs at all times on the computer, and acts as a layer between the hardware and the system call interface.

3. Interrupt
   Hopefully, they answer something around the following sentence “An interrupt should be a signal (from hardware device or software program) that causes the operating system to stop and figure out what to do next”.

4. Real-time OS
   A real-time OS should guarantee a certain capability (e.g., data process) within a specified time constraints.

5. System call
   Programming interfaces to the services offered by the OS.

6. Layered OS
   An OS that is written as a number of layers. Each layer should rely only those layers below them to implement its functionality.

7. Microkernel System Structure
   An OS that minimizes the kernel, and moves as much functionality as possible into user space.

Part 2: Multiple choice (9 x 2 points each = 18 points)

1. Which one is not the goal of an operating system:
   a. Making the computer system convenient to use
   b. Using the computer hardware in an efficient way
   c. Enhancing the capability of computer hardware
   d. Executing user programs and make solving user problems easier

2. An advantages of a multiprocessor OS is:
   a. Increased throughput
b. Increased memory space
c. None of the above
d. Both of the above

3. The size of a word is:
a. 8 bits
b. 8 bytes
c. 1024 bytes
d. Dependent on the system in question

4. Which is not the scope of OS security:
a. Access control
b. Denial-of-Service (DoS) defense
c. Worm detector
d. None of the above (Either accepted)

5. What is the benefit of a microkernel:
a. Less code is running in kernel mode
b. Services are better isolated - if one crashes, the others remain unaffected
c. None of the above
d. Both of the above

6. A real-time OS
a. Must start up very quickly
b. Must be able to reboot without losing any information
c. None of the above
d. Both of the above

7. Which one is the task of memory management:
a. Track which blocks of memory are being used
b. Allocate memory space
c. Decide which processes should be moved into memory
d. All of the above

8. When an interrupt occurs, the OS should:
a. Preserve the state of the CPU
b. Determine the type of interrupt
c. None of the above
d. Both of the above

9. Virtualization and emulation are similar, but emulation, as opposed to virtualization:
a. Is considerably faster
b. Simulates hardware in software
c. None of the above
d. Both of the above

Part 3: Longer questions (2 points for #1; 3 points for #2, 3 = 8 points)
The above figure shows a realistic cloud service scenario. A user, Alice, rents a virtual machine, VM1, in Amazon EC2 service. If Alice wants to access her application, App1, the request should go through the following “path”: Internet -> Firewall -> Machine Hardware -> VM Monitor -> VM1 -> OS1 -> App1. Please answer the following questions:

1. Why does Amazon need a firewall?

Any reasonable answer is accepted. For example, Amazon needs to use firewall to filter some malicious network traffic, or they need to protect their inner-network.

2. Assume OS1 is a normal Linux system (e.g., Ubuntu 12.04). What types of system calls does it have? (Give at least 4 broad categories, and broadly describe each)

Linux system calls should follow POSIX APIs, including 1) process control, 2) file manipulation, 3) device manipulation, 4) information maintenance, 5) communications and 6) protections.

0.5 for each type of system calls
0.5 for writing anything relevant

3. Suppose Bob rents another virtual machine, VM2, running on the same hardware machine with Alice. What problems may affect the applications of Alice and Bob simultaneously?

Because the two VMs are running on the same physical machine and the same VM monitor, a software problem within VM monitor or hardware problem in that physical machine would make both VMs failures simultaneously.