EECS 343: Homework 1 - Solutions

Introduction to Operating Systems and Processes

Fall 2014

Important Dates

Out: October 6, 2014.

Due: October 14, 2014, 11:59PM CDT.

Submitting your assignment: Please use the course submission site. There is a link to it from the class site. **Submit only ASCII text files.**

Problems

1. List three hardware features that enable the implementation of operating system functionality and explain the significance of each. For instance, a fixed rate clock allows the creation of a variable timer for timesharing.

   Answer: *Other examples include: protection hardware (mode bit) that enabled timesharing; special registers to support virtual memory (e.g. base and limit); atomic test-and-set-lock instruction; DMA; protected instructions; ...*

2. For the computer that you are using, how should OS designers prioritize among reliability, security, portability and performance? Explain why.

   Answer: *This is yours*

3. To a programmer, a system call looks like any other call to a library procedure. Is it important that a programmer know which library procedures result in system calls? Under what circumstances and why?

   Answer: *As far as program logic is concerned it does not matter, but in terms of performance there is a big difference. Every system call involves overhead time in switching from the user context to the kernel context. Furthermore, on a multiuser system the operating system may schedule another process to run when a system call completes, further slowing the progress in real time of a calling process.*

4. How do user programs and system services interact in a microkernel architecture? What are the advantages/disadvantages of the microkernel approach to system design?

Answer: *User programs and systems interact by using interprocess communication mechanisms such as messaging. These messages are conveyed by the operating system. Benefits typically include (a) adding a new service does not require modifying the kernel, (b) it is more secure as more operations are done in user mode than in kernel mode, (c) a simpler kernel design and functionality typically results in a more reliable operating system. The primary disadvantage of the microkernel architecture are the overheads associated with IPC and the frequent use of the OS's messaging functions in order to enable the user process and the system service to interact with each other.*

5. When a process creates a new process using the `fork()` operation, which of the following states is shared between the parent and child processes?

   (a) Stack

   (b) Heap

   (c) Shared memory segments

   Answer: *In Unix a new process is created by the `fork()` system call. The new process consists of a copy of the parent's data space, heap and stack, but these are copies - parent and child do not share them. Children created by calls to `fork()` inherit attached, shared segments (`shmget,shmat`); they can detach the shared memory segment, of course.*

6. Consider the following set of processes, their arrival times and expected running times. For each of the following scheduling algorithms, determine the mean process turnaround time and mean waiting time. Ignore process switching overhead.

   (a) Round Robin ($q = 10$)

   (b) First-Come, First-Served (run in alphabetical order)

   (c) Shortest Job First

Process	ERT	Arrival
A	85	0
B	30	10
C	35	15
D	20	80
E	50	85

   Answer:

   (a) Round Robin: *Mean turnaround time: 121*
       Mean waiting time: 77

   (b) FCFS: *Mean turnaround time: 110*
       Mean waiting time: 66

   (c) SJF: *Mean turnaround time: 105*
       Mean waiting time: 61