

CS140 Operating Systems and Systems Programming Final Exam

March 17, 2004

(Total time = 165 minutes, Total Points = 165)

Name: (please print) _____

In recognition of and in the spirit of the Stanford University Honor Code, I certify that I will neither give nor receive unpermitted aid on this exam.

Signature: _____

This examination is closed notes and closed book. You may not collaborate in any manner on this exam. You have 165 minutes (2 hours and 45 minutes) to complete the exam. Before starting, please check to make sure that you have all 19 pages.

1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8			
9			
10			
11		Total	

Name: _____

- (1) (12 points) Hard links in Unix are tracked using a reference count in the inode data structure. Describe what would happen to a file system if an error caused a reference count that was (a) too large? or (b) too small? Describe how the problem would likely manifest itself to the user of the system.

- (2) (10 points) In a virtual memory system with per-process replacement policy, can one thrashing process affect the performance of another process on the system? If so, how? If not, why not?

- (3) (9 points) Explain why you might want different parameters for a virtual circuit protocol that runs over a local Ethernet than ones that runs on an intercontinental satellite link.

- (4) (10 points) Some computer systems have been designed recently with a larger physical address space than they have virtual address space. In other words, they have fewer bits of virtual address space than physical memory address space. Explain why this is not a totally unreasonable design for a computer system. Be sure to indicate what limits the design imposes.

- (5) (9 points) Explain why worms frequently result in spoiler-type (i.e. denial of service) attacks.

- (6) (9 points) Give a plausible explanation why a system might contain a semaphore on which one thread only does P() operations on while another thread only does V() operations.

- (7) (10 points) In our discussion on file systems we noted that although most files are small, large files consume the majority of I/O operations and disk space. Describe the implications of these observations on file system design.

- (8) (10 points) Assume that you have been given a fancy disk scheduling algorithm that actually contains a simulation of the disk you are using. The algorithm works by using the simulation to test all permutations of the requests in the disk queue to determine which request can be processed the fastest (i.e. it computes the optimal schedule). Assuming that this algorithm can be made to work quickly enough, what are the disadvantages compared to something like the SCAN algorithm used in existing systems?

- (9) (12 points) Logging is frequently used to enhance the security of computer systems.
- (a) Describe two ways in which a log of events is helpful for security.
 - (b) Describe a way a log can actually harm security.

- (10) (8 points) Explain why some file system will try not to allocate sequential file blocks to sequential disk block even when it knows that the file will be access sequentially most of the time.

- (11) (9 points) Why is it bad to disable interrupts for long periods of time? Give an example of a problem it can cause.

- (12) (10 points) Describe tests for measuring (a) latency and (b) bandwidth of a file system. Give a description of what the test would do and how you would perform the measurements.

- (13) (10 points) You hear a user of a Unix system complain that the file cache provides no benefit for their workload. The files they access are much bigger than the file cache and by the time they re-access a file block there is little chance that it is still in the file cache. The user claims they should get rid of the file cache altogether. What would be the problems with this suggestion? Focus on problems that would occur even for the user's workload (i.e. big files).

(14) (9 points) How do *capabilities* differ from *access control lists*?

- (15) (10 points) Give two examples of architectural features of modern CPU that makes them not virtualizable (i.e. unable to support traditional virtual machine monitor techniques).

- (16) (10 points) Rank the following events in order of how long they take: The event with the shortest duration should have rank 1. You can assume the virtual memory page size and the file system block size are both four kilobytes. You can also assume an Unix-like operating system structure. Briefly justify your answer.
- (a) Read a file block that resides in the file cache.
 - (b) Execute a single instruction.
 - (c) Creation of a one block file.
 - (d) A system call (e.g. `getpid()`)
 - (e) Page fault in a page from disk.

- (17) (9 points) Will making a disk drive spin faster help non-sequential file access go faster? Justify your answer.

- (18) (9 points) Explain how a message digest of a file encrypted with a private key would be a useful item to send along with a file in an unencrypted email message.