

CS140 Operating Systems and Systems Programming Final Exam

March 24, 2006

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 180 minutes (3 hours) to complete the exam. Before starting, please check to make sure that you have all 14 pages.

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11		Total	

- (1) (14 points) In class we talked about the link count in the inode of the Unix file system being incorrect after a crash. The reference count can either be either too high or too low.
- (a) Which of these two conditions (high or low) is considered more serious? Justify your answer.
 - (b) Describe the worst-case problem of the less serious of the two conditions.

- (2) (12 points) A recent CNN news headline reported a potential Internet denial of service attack that used “the Internet Traffic Cop” to launch the attack. The article itself refers to the Traffic Cop as the top-level Internet Domain Name Servers (DNS). The dictionary defines Traffic Cop as “a policeman who controls the flow of automobile traffic.” Do you think Traffic Cop is an appropriate metaphor of the DNS? Justify your answer.

- (3) (18 points) In order to safely run software in a virtual machine, a virtual machine monitor (VMM) must intercept modifications of privileged CPU state such as the interrupt disable flag.
- (a) Describe why this interception is necessary.
 - (b) Describe why reads of this privilege state as well as writes need to be intercepted.

- (4) (20 points) The following are names given to several fields in the Internet protocol (IP) packet header. For each field describe its likely purpose:
- (a) Header checksum
 - (b) Time to live (TTL)
 - (c) IP fragment offset
 - (d) Protocol

- (5) (10 points) Why can an Ethernet get away with a flat address of 48bits while the Internet with a smaller 32bit address needed to go to a hierarchical organization?

(6) (10 points) What is meant by the trusted computing base (TCB) of a system? Give an example.

- (7) (12 points) One of the hassles of the web today is all the websites that require you to use a password to authenticate yourself. If you use the same password for every website then one bad website can access your other websites. Suppose you had the same password for every website but instead of directly using the password you compute a secure hash of the password concatenated with the website name to form the real password. In other words a website's password would be set to `SecureHash(password concat websiteName)`; Would this use of a secure hash prevent a bad website from gaining access to other websites? Justify your answer.

- (8) (12 points) Could a workload on a file system with write-ahead logging that used physical blocks ever use less log bandwidth than a similar file system that used logical logging? Justify your answer.

- (9) (20 points) For each of the following security attacks say if public key encryption can help prevent the attack. Be sure to justify your answer.
- (a) Abuse of valid privileges
 - (b) Spoiler/Denial of Service attack
 - (c) Listener or eavesdropper attack.
 - (d) Trojan Horse
 - (e) Buffer overflow attack

- (10) (16 points) Assume your Pintos file system needed to update a multiple sector long data structure on disk.
- (a) Describe how you might arrange to detect if your system failed in the middle of writing the data structure.
 - (b) Describe how you might build your system to recover from such a failure.

- (11) (10 points) Describe which file system buffer cache write back policy you would suggest for a file system that employed write-ahead logging for both user data and metadata. Justify your policy.

- (12) (10 points) Assume your system uses SCAN or elevator algorithm as a disk-scheduling algorithm. How would you modify this algorithm if rather than having a single disk your storage device was a RAID-4.

- (13) (16 points) For each of the following file descriptor data structures, order them from the most to the least amount of space consumed when mapping a very large file.
- (I) Index files
 - (II) Linked files
 - (II) Extent base files.
- Repeat the ordering but this time for very small files (less than a disk sector in size).
Be sure to justify your answer.