

**PhD Comprehensive Examination**  
**Systems Core Exam**  
**Sample Questions**

**INSTRUCTIONS:**

Answer the questions on the paper provided. Clearly label your answer to each part of the questions. Staple your pages to the back of the examination paper when you have completed your work and submit the package to the exam proctor. You have up to **three** hours to complete your work on this examination.

Answer **FIVE** of the following ten questions. Do not submit answers for more.

**PROBLEMS:**

Synchronization.

A. Semaphore implementations have two basic steps, or parts, that are atomic. In general, what are these two parts. B. Why must there be two parts (as opposed to one or three parts) and C. why must it be atomic.

File systems.

Compare and contrast the file systems of Unix/Linux and Windows 2000.

Data structures.

Most operating systems cache disk data to reduce input/output latency. However, the cache is not a simple pool of disk blocks. A. Describe three ways the blocks are ordered (three block lists) and B. why each of these lists are needed. C. The block pool could be organized as an array, or members of a linked list. Describe the tradeoff between the two designs.

Memory management.

The Intel Architecture (IA) offers programmers a segmentation memory model or a paging memory model. In the past, Microsoft Windows has employed a segmentation model however Unix-like operating systems have always ported their pre-existing paging implementations to the IA. A. Which memory model scheme offers faster memory access on the IA and B. why? C. How does the IA attempt to improve the memory access speed of the slower model? Over time, it appears that operating systems implementations are moving to the slower memory model. D. What is the basic advantage that the slower model has over the faster model that makes it the programmer's first choice? (There are actually several, but give us the one you think is most important.)

Security.

A. Describe the fundamental vulnerability of open source software to widespread exploits by unscrupulous agents. B. Describe in detail how to exploit such a vulnerability. C. Provide an opinion, supported with details on program development and program usage patterns, how one could or could not defend against such an attack. D. Provide an opinion, supported with facts about how open source software is made, distributed and used, as to whether such a widespread attack is plausible.

Security.

A. Describe the general goal of a virus versus a worm. B. Describe at least two (the more

the better) basic operating system mechanisms that provide security against these types of attacks.

General OS.

Every time the computer industry come up with a new operating system function, the open source developers seem to create a new daemon. For example: removable media (autotmountd and pcmciad), automatic power management (apmd), direct CD (directcd), networking (dhcpcd, inetd, ntpd, ircd, isdnd, named, smbd, httpd), and on and on. A. Describe the effect this has on the system. B. Give the design tradeoff. C. Describe the long term trend of how these functions are/will be implemented.