Final Exam Sample Questions

SAMPLE PROBLEMS

1. Consider a FAT-based (File Allocation Table) file system. Entries in the table are 16 bits wide. A user wants to install a disk with 131072 512-byte sectors.
   a. What is a potential problem?

   b. Describe a solution to this problem and explain the trade-offs involved.

2. Generally we've talked about each operating system component in isolation. This question asks you to think about ways in which they interoperate. For each pair of systems below, give a specific way that they interact (or that they could interact). Writing that the file system and I/O system interact because they both use the disk is not worth more than a point, and may be worth none. Writing that the file system and I/O system interact when they determine the mapping from logical blocks → physical blocks which impacts the size of file system structures, and the efficiency of the disk usage because larger logical blocks imply more internal fragmentation on the disk is a more complete answer.
   a. How does a demand paged, lazy loaded virtual memory system interact with the process scheduling and creation system?

   b. Name another way (not the example above) that the file system and the hard disk drivers in the I/O system interact.

3. On some computer, the clock interrupt handler needs 2 msec (including context switch overhead) per clock tick to execute, and the clock runs at 75 Hz. What fraction of the CPU time is devoted to the clock?

4. List the terms that best describe each of the following:
   a. Operating system code executed when an asynchronous device signals the CPU

   b. A type of disk arm scheduling policy

5. If the TCP transmission window for unacked bytes is 1000, the one-way latency of a cross-country network link is 50 milliseconds, and the bandwidth of the link is 100 Megabits/second, then how long does it take TCP to transmit 100,000 bytes across

the link? That is, how much time elapses from when the first byte is sent by the sender to when the sender *knows* that the last byte has been received by the receiver? You may assume that no packets are lost for this particular problem (but remember that TCP doesn't know that).

6. Security
   a. How would you use public-key encryption to implement secure remote procedure call (RPC) between an arbitrary client A and server B. Assume that A knows B's IP address and public key but that B does *not* know A's IP address and public key. Do not assume the existence of a "public key" server. "Secure RPC" means that no one other than A and B can understand the contents of either the request message or the response message. Please use a combination of English and pseudo-code of the form (*data*)^K to indicate that *data* is encrypted/decrypted using key K to answer the question.

b. Assume that there is a “public key” server, S, that stores IP addresses and public keys for everyone, including A and B. Suppose that both A and B know the IP address and public key for S, but do not know the IP address and public key of anyone else. How could A reach B and how could B authenticate A? By authenticate I mean: how could B be sure that an RPC request came from the client that it claims to have come from?

c. Explain how an intruder who can break into the public key server could snoop on and alter all RPC traffic in the system described in (b) without any of the RPC clients and servers being able to tell.

d. Explain how you would modify the system to prevent the problem identified in (c). Be sure to state any assumptions you make.

7. In class, we discussed copy-on-write for memory pages shared among multiple processes. We cannot apply this same concept blindly to process creation using Unix fork(), but instead are forced to copy some parts immediately while other parts can be delayed.
   a. Knowing the components of general processes, which parts must be copied immediately, and which parts can be delayed and copied-on-write?

   b. Why is copy-on-write potentially better than copying the entire process immediately upon creation?

8. Briefly describe the steps taken to read a block of data from the disk to the memory using DMA controlled I/O.

7. Explain what is symbolic link and list at least two of its drawbacks.