

1. Process Management (35pts)

- I. What is the difference between “time sharing” and “multiprogramming”? (5pts)
- II. Consider several operating systems executing over a virtual machine software. Please briefly describe the procedure for a task that runs over an operating system to make a system call to read a data block on a disk. (12pts)
- III. Preemptive CPU scheduling is often considered better than non-preemptive scheduling. Please give me one situation, where preemptive CPU scheduling is no better than non-preemptive CPU scheduling. (8pts)
- IV. Consider round-robin scheduling and scheduling criterion being “average waiting time”. Will the system performance becomes better with a smaller time quantum? You must explain why. (10pts)

2. Process Synchronization (15pts)

- I. Consider any solution for the first readers-writers problem, where the first readers-writers problem requires that no reader will be kept waiting unless a writer has already obtained permission to use the shared object. Is there any solution without the starvation problem? You must explain why. (8pts)
- II. Consider old versions of Unix in which no CPU re-scheduling is done during a system call unless the call itself volunteers to give up the CPU. Assume that all system resources are only accessed by system calls. Could we have deadlocks among tasks in accessing system resources? You must explain why. (7pts)

3. Synchronous and Asynchronous IO (10pts)

For the following terms, please (1) provide short definition for each of them and (2) give an example of when it would be used and explain the reason, make sure you differentiate between receive and transmit operation.

- I. Blocking or Synchronous I/O: (2pts for the definition and 3 pts for the correct example.)
- II. Non-blocking or Synchronous I/O: (2pts for the definition and 3 pts for the correct example.)

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NOTE: Question 4 to 7: You only need to choose **TWO** questions out of the four questions to answer. If you answer more than two questions, only the first two answers will be graded. **CROSS** your answers if they should not be graded.

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4. Secondary Storage Management (20pts)

There are several available disk scheduling algorithms. Each of them is designed for different load patterns. Please describe the best algorithms for the following load patterns and explain your answer.

- I. Heavily loaded system which rarely has an empty request queue. (10pts)
- II. Lightly loaded system which gets an occasional burst of activity. (10pts)

5. Memory Management (20pts)

Consider a demand-paging system with a paging disk that has an average access and transfer time of 20 milliseconds. Addresses are translated through a page table in main memory, with an access time of 1 microsecond per memory access. Thus, each memory reference through the page table takes two accesses. To improve memory access time, we can add associative registers or translation look-aside buffers (TLBs) to reduce memory access time.

- I. Please describe how the associate registers or TLBs can be used to shorten the memory access time. (10pts)
- II. What is the effective memory access time? Assume that 80 percent of the accesses are in the associative registers and that of the remaining, 10 percent (or 2 percent of the total) cause page faults. (10pts)

6. Distributed Systems (20pts):

When using a distributed file system, the server may be either stateless or stateful.

- I. Please give a short description for stateless and stateful distributed file server. (10pts)
- II. Please describe the impact of each of these two mechanisms when the file server crashes and recovers later. (10pts)

7. File Management (20pts)

In most file systems, an updated block is written back to its original block on disk. Alice designs a new block update scheme and claims that the new scheme can provide better performance. In the new scheme, the system stores the updated block in an available disk block that is nearby the current disk head position, and modifies the i-node file to point to the new block. Answer the following questions.

- I. Please briefly describe the advantage and disadvantage of this scheme. (10pts)
- II. Can this scheme provide better performance? Please explain your answer. (10pts)