

資格考試科目：高等作業系統

1. Many criteria have been designed for comparing CPU scheduling algorithms such as throughput, waiting time, and CPU utilization. Consider four common scheduling algorithms, including first-come, first-served (FCFS) scheduling, shortest-job-first (SJF) scheduling, round-robin (RR) scheduling, and priority scheduling algorithms. Please answer the following questions.
 - a. Please explain why FCFS scheduling performs poorly in maximizing the throughput of a computer system that runs one CPU-bounded process and many IO-bounded processes. (6 pts)
 - b. How can priority scheduling alleviate the problem mentioned above? (6 pts)
 - c. Under what conditions could SJF scheduling be optimal in minimizing average waiting time for processes? Please prove your answer. (9 pts)
 - d. Consider a system running I/O-bound processes, which issue an I/O operation once every T milliseconds of CPU computing, and each I/O operation takes K milliseconds. Assume a context switch requires S milliseconds. What is the CPU utilization for RR scheduling with time quantum Q when $Q \geq T$, $Q < T$, and $Q = S$? The CPU utilization is defined as the percentage of the CPU time used by the processes. Your answers should give a formula for each condition. (9 pts)

2. Preventing deadlocks from occurring is very important in system software. Please answer the following questions.
 - a. What are the four necessary conditions that must hold for there to be a deadlock? Discuss how the four conditions indeed hold in the dining philosophers problem, where each philosopher acquires a fork or chopstick one at a time. (4 pts)
 - b. Discuss how deadlocks could be avoided by eliminating any one of the four conditions in the dining philosophers problem mentioned above? (8 pts)
 - c. Consider a system has n processes competing for 6 identical resources. Each process needs a maximum of 2 resources. For which values of n is the system deadlock free? Please explain your answer. (4 pts)
 - d. Consider a system has 4 processes and 5 allocatable resources (A to E). The current allocation and maximum needs are as follows:

	Allocated					Maximum					Available					
	Resource	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Process 1	1	0	2	1	1	1	1	2	1	3	0	0	x	1	1	
Process 2	2	0	1	1	0	2	2	2	1	0						
Process 3	1	1	0	1	0	2	1	3	1	0						
Process 4	1	1	1	1	0	1	1	2	2	1						

What is the smallest value of x such that the state is safe? (4 pts)

3. Given a computer system with a 64-bit virtual address, 2KB pages, and 4 bytes per page entry, suppose that the maximum physical memory size is 16TB, and the system is byte-addressable, where 1TB = 1024GB. Let paging be implemented for the system. Please answer the following questions: (18pts)
 - a. Is there any internal fragmentation for the above paging system? Please also define what internal fragmentation is.
 - b. What is the number of bits for logical addresses? What is the maximum number of frames for the system?
 - c. Suppose that TLB is adopted, and some multi-level paging is adopted. Let the memory access time and TLB access time be 100ns and 20ns, respectively. Suppose that the TLB hit ratio is 99%. Please tell us how many levels of the multi-level paging is. What is the effective memory access time?
4. Can thrashing happen for computer systems with application binding time at the compile time? You must explain why to receive any point. (8pts)
5. Consider the performance of different disk scheduling algorithms, where the number of completed requests per second is the performance criteria, and each request time consists of the seek time, rotational latency, and transfer time: Is it possible that the C-SCAN algorithm outperforms the shortest-seek-time-first algorithm? If so, please give me a scenario. If it is impossible, then please explain why. (10pts)
6. There are data structures maintained by the operating system for open files. The system-wide open-file table contains a copy of the file control block (FCB) of each open file, as well as other information. The per-process open-file table contains a pointer to the appropriate entry in the system-wide open-file table, as well as other information. Please answer the following questions: (8pts)
 - d. Which one of the two tables contain the file offset that serves as an index to the current location of a file for the next read and write operation?
 - e. Which one of the two tables contains the file size information?
7. Naming is a mapping between logical and physical objects. What is "location independence" in distributed file systems? (6pts)