

北京邮电大学 2022——2023 学年第一学期

《操作系统》期末考试试题

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考试课程	操作系统				考试时间		2022 年 12 月 19 日		
题号	一	二	三	四	五	六	七	八	总分
得分	10	10	14	14	12	12	14	14	100
阅卷 教师									

- 一. (10 points) Fill in the blanks
1. Modern operating systems usually provide users with several kinds of interfaces including CLI, \_\_\_\_\_, and system calls/API, etc.
2. The four necessary conditions for arising a deadlock include mutual exclusion, \_\_\_\_\_, no preemption, and circular wait.
3. The \_\_\_\_\_ model maps each user thread to a kernel thread. It provides more concurrency than the many-to-one model by allowing another thread to run when a thread makes a blocking system call; it also allows multiple threads to run in parallel on multiprocessors.

4. File system interfaces provide user-oriented file access methods, including \_\_\_\_\_ access, direct access and index-based access.
5. There are 11 printers in a system, and X processes share these printers. Each process can use up to 3 printers. Then the maximum value of X that will not cause deadlock is \_\_\_\_\_.
6. If the initial value of a semaphore is 5 and its value changes to -3 after many wait and signal operations, then the number of processes waiting to enter the critical zone is \_\_\_\_\_.
7. As a main-memory-management scheme, paging divides a logical address into two parts, i.e. page number and \_\_\_\_\_.
8. The file system consists of two distinct parts: a collection of files, which stores related data, and a \_\_\_\_\_ structure which organizes and provides information about all the files in the system.
9. \_\_\_\_\_ can simulate an exclusive device (such as a printer) as multiple shared devices, so that multiple users can simultaneously use the exclusive device, thus improving device utilization and system efficiency.
10. I/O subsystem is a component of OS that includes \_\_\_\_\_ and drivers.

二. (10 points) Select the best answer for each blank.

1. A process can produce some output fairly early and can continue computing new results while previous results are being outputted to the user. Thus, a measure refers to the time from the submission of a request to the first response is produced, and this measure is called \_\_\_\_\_.

A. response time                      B. waiting time  
C. I/O time                              D. turnaround time

2. In the following disk I/O scheduling algorithms, \_\_\_\_\_ may cause starvation of some requests.

A. FCFS scheduling                      B. SSTF scheduling  
C. SCAN scheduling                      D. LOOK scheduling

3. Commonly used disk free-space management schemes are as follows except \_\_\_\_\_.

A. bit map                                      B. linked list  
C. file control block                      D. grouping

4. Which of the following page replacement algorithms may suffer from Belady's anomaly? \_\_\_\_\_
- A. FIFO  
B. Optimal  
C. LRU  
D. Second-Chance
5. In file systems, multilevel directory structure is used to achieve the following functions except \_\_\_\_\_
- A. to group information  
B. to save storage space  
C. to solve file naming collision  
D. to locate a file quickly
6. In the following changes of process states, \_\_\_\_\_ will not happen.
- A. running to ready  
B. running to waiting  
C. waiting to running  
D. waiting to ready
7. In time sharing system, \_\_\_\_\_ is commonly used for process scheduling.
- A. FIFO  
B. Priority scheduling  
C. Round Robin  
D. HRRF
8. The procedure that maps logical address space to physical address space is called \_\_\_\_\_
- A. Compiling  
B. Linkage  
C. Executing of programs  
D. Address binding
9. In Linux system, system call \_\_\_\_\_ is used for creating a new process.
- A. pipe  
B. fork  
C. exit  
D. read
10. An OS adopts the Banker's algorithm for handling deadlock, which of the following is right? \_\_\_\_\_
- A. If the system is in an unsafe state, a deadlock must occur.  
B. If the system is in an unsafe state, a deadlock may occur.  
C. If the system is in a safe state, a deadlock may occur.  
D. If the system is in a safe state, a deadlock must occur.

三. (14 points) Consider the processes  $P_0$ ,  $P_1$ ,  $P_2$ ,  $P_3$  and  $P_4$ . For  $0 \leq i \leq 4$ , the arrival time, the length of the CPU burst time, and the priority number of each  $P_i$  are given as below.

Name	Arrival Time	Burst Time	Priority Number
$P_0$	0	6	4
$P_1$	1	4	1
$P_2$	1.5	2	3
$P_3$	2	3	2
$P_4$	5	2	5

For the snapshot shown above, the smaller priority number implies a higher priority.

- (1) Draw the Gantt chart to illustrate the execution of these processes using preemptive SJF scheduling.
- (2) What is the average response time for the scheduling in (1)?

四. (14 points) Consider the following snapshot of a system:

	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P1	1	1	3	1	2	3	0	1	0
P2	1	1	2	2	3	2			
P3	1	0	1	3	2	1			
P4	2	1	0	3	1	6			

Answer the following questions using the banker's algorithm.

- (1) What is the content of the matrix Need?
- (2) Is the system in a safe state? Why?
- (3) If the Available resources in the system are (1, 1, 0) and a request from P2 arrives for (1, 0, 0), can the request be granted immediately? Why?

五. (12 points) A bank has only 1 salesman (营业员) and provides 10 seats (座位) for customers (顾客) to wait. When a customer arrives at the bank, if there is an unoccupied seat, the customer will take a number on the number-generating machine and sit on the seat waiting for the call of the salesman. The number-generating machine can only be used by one customer at a time. When the salesman is free, he will select a customer by calling a number and serve him. The activity process of customers and salesman are described as follows:

```
cobegin
{
    Process customer i
    {
        take a number from number-generating machine;
        wait for the call of salesman;
        get service;
    }

    Process salesman
    {
        While (TRUE)
        {
            call a number;
            serve a customer;
        }
    }
}coend
```

Please use semaphores and wait(), signal() operations to ensure that the above processes can execute concurrently and correctly.

- (1) Give the definitions and initial values of semaphores.
- (2) Write the whole code of customer process and salesman process.

六. (12 points) Assume that a virtual memory system uses LRU algorithm for management. The size of a page is 4KB. A memory reference takes 100 ns. It takes 20 ns to access the TLB, and it takes 25 ms to process a page fault interrupt. Now a 30 KB process P entered the system. The system allocates 3 frames to process P, and all pages of process P are loaded dynamically at runtime. For process P, the hit ratio of TLB is 20%, and the corresponding page access sequence is as follows,

7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1

- (1) Give the scheduling results of LRU algorithm and the page-fault rate.
- (2) Compute the average effective access time.

七. (14 points) There are two text files A and B in the file system. The size of the file A is 20MB, and the size of the file B is 10KB. When using the linked allocation scheme, each block's size is 2048B, and the block address in the block is of 4 bytes length. The directory entries are already in main memory.

- (1) What is the size of the maximum file in this file system?
- (2) When the file A will be revised, how many disk I/O operations are required if the information in the 10273th byte in the file A is to be revised?
- (3) How many blocks does file B contain? If we add a new block between the 2<sup>nd</sup> and the 3<sup>rd</sup> block of file B, then how many disk I/O operations are required?

八. (14 points) On a disk drive with 2000 cylinders, numbered from 0 to 1999, and the head is at cylinder 871. The queue of pending request, in FIFO order, is 981, 727, 1018, 1620, 18, 1345, 1942, 1461, 226.

- (1) Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests in the queue, for the SSTF disk scheduling algorithm?
- (2) Illustrate the procedure of the arm moving to serve the requests by a figure.