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北京邮电大学 2022——2023 学年第 1 学期

《操作系统》期末考试试题（B 卷）

考试注意事项	一、学生参加考试须带学生证或学院证明，未带者不准进入考场。学生必须按照监考教师指定座位就坐。 二、书本、参考资料、书包等物品一律放到考场指定位置。 三、学生不得另行携带、使用稿纸，要遵守《北京邮电大学考场规则》，有考场违纪或作弊行为者，按相应规定严肃处理。 四、学生必须将答题内容做在试题答卷上，做在试题及草稿纸上一律无效

考试课程	操作系统				考试时间			2023 年 2 月 15 日 9:00-11:00			
题号	1	2	3	4	5	6	7	8	9	10	总分
满分	15	15	15	15	10	15	15				100
得分											
阅卷教师											

1. (15 points)

Suppose that there are 4 processes in a computer system, they are assumed to have arrived in order 1,2,3,4 at time 0 and the estimated Burst time of each process are shown in the following table. The scheduling algorithm uses round-robin Scheduling algorithm（quantum = 2）.

Process	Burst Time
1	8
2	4
3	9
4	5

(1) Draw Gantt charts that illustrate the execution of these processes.

(2) Calculate the turnaround time of each process.

(3) Calculate the average turnaround time.

2. (15 points)

There are two concurrent processes in a system that communicate through mailboxes. Each process receives the email from the other through its own mailbox, processes the email, and sends a new mail to the other's mailbox to answer questions and ask new questions.

When there is mail in the mailbox, the process can pick up the mail, otherwise it will wait; When the other's mailbox is not full, the process can send mail, otherwise it will wait.

The sending and receiving operations on the same mailbox should be mutually exclusive. Suppose that the mailbox of process P1 can store up to m messages, and the mailbox of process P2 can store up to n messages.

Initially, there are a messages (0<a<m) in P1's mailbox and b messages (0<b<n) in P2's mailbox.

Please use the semaphore mechanism to achieve communication between the two processes.

(1) give out the definitions and initial values of semaphores, and

(2) write out the code structure of the processes respectively.

3. (15 points) A computer system is configured 110MB main memory and 5 I/O devices of same type. There are process P_1, P_2, P_3 and P_4 concurrently running in system. As shown below, they have been allocated some size of main memory and a number of I/O devices; the maximum/total size of main memory and the maximum/total number of I/O devices needed by each process during its lifetime are also given.

Process	Maximum Resources Needed		Resources Allocated	
	Memory	I/O device	Memory	I/O device
P_1	40MB	3	20MB	1
P_2	75MB	2	15MB	1
P_3	55MB	3	20MB	0
P_4	100MB	3	30MB	1

It is assumed that: (1) the resources, i.e. main memory and I/O devices, having been allocated to a process cannot be preempted by other processes; (2) swapping in and out of processes are not allowed.

Answer following questions, by means of the banker's algorithm.

(1) What are the resource allocation state defined by the matrix/vector Allocation, Max, Need and Available, for P_1, P_2, P_3 and P_4 ?

(2) Is the system now in a safe state, and why?

(3) If P_3 now requests 40M memory and 3 devices, can its request be granted immediately, and why?

4. (15 points) In a demand paging system, the page size is 4096 bytes, and the page table is as follows.

# frame	valid/invalid
12	i
22	v
8	v
9	v
18	i
67	i

Page table

(1) Which frames of the virtual addresses 1480 and 9000 (assuming use decimal values) are at? When will the page fault occur accessing the addresses?

(2) What is thrashing in the memory management? Illustrate some techniques to handle the thrashing in modern operating systems.

5. (10 points) An operating system uses demand paging to provide virtual memory. Consider a process which causes the following sequence of memory accesses:

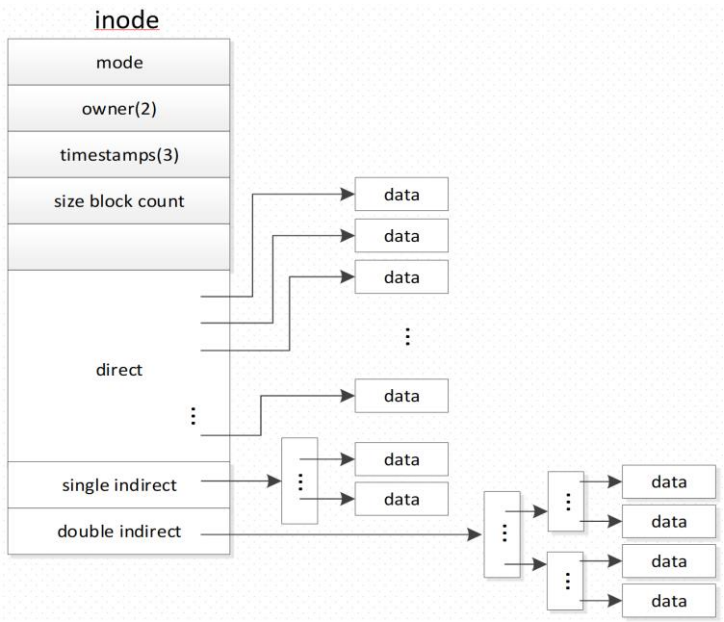
w = 6, 5, 4, 2, 1, 5, 3, 1, 5, 6, 7, 4, 1,6, 3, 7

The operating system uses 5 memory frames to provide the virtual memory for this process. The frames are unused when the process starts. The replacement procedure for each page in the string should be illustrated by a figure

1) **Determine the entries in the page table under the OPT page replacement strategy. What is the total number of page faults?**

2) **Determine the entries in the page table under the LRU page replacement strategy. What is the total number of page faults?**

6. (15 points) OS uses a bit map/vector of 64MB in size to manage disk space. A file system takes the indexed allocation scheme to allocate disk space for files on disk, and the following figure illustrates its index structures. In the index nodes (i.e. inode), there are 4 direct entries recording the addresses of data blocks of the file, one single indirect entry and one double indirect entry pointing to index blocks. The sizes of disk blocks that storing the index or data on disk are 2048 bytes; in the index block, a block number (i.e. the address of the index block or data block) occupies 8 bytes.
It is assumed that (a) a file record is with the size of 2048 bytes and is stored in only one block; (b) the inode has been loaded in main memory, but all the single and double indirect index blocks reside on disk.



Answer the following questions.
(1) What is the total size of disk space?
(2) How many bytes are there in the file with the maximum size that the file system can support?
(3) Given a file with the maximum size, if we want to retrieve a file record that may be located in an arbitrary data block of this file, how many disk blocks on average need

to be read from the disk?

7. (15 points) Suppose that a disk has 200 cylinders, numbered 0 to 199. The disk is currently serving a request at cylinder 43, and the previous request was at cylinder 25. The queue of pending requests in FIFO order is 115,65,107,158,194,5,193,68,21,Starting from the current head position, what is the scheduling order and the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk-scheduling algorithms? The moving trajectory of the disk head should be given.

(1) FCFS

(2) C-LOOK