

北京邮电大学2016——2017学年第一学期

《操作系统原理》期末考试试题A卷

考 试 注 意 事 项	<p>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。</p> <p>二、书本、参考资料、书包等与考试无关的东西一律放到考场指定位置。</p> <p>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。</p> <p>四、学生必须将答题内容写在试卷上，做在草稿纸上一律无效。</p> <p>五、第1题须用英文应答，中文答对得一半分。</p>								
题号	一	二	三	四	五	六	七	八	总分
满分	10	13	27	12	16	12	10		100
得分									
阅卷教师									

1.FILL IN BLANKS (1*10 points)

- (1) A time-shared computer system uses _____scheduling scheme and multiprogramming to provide each user with a small portion of CPU time.
- (2) To prevent users from performing illegal I/O, we define all I/O instruction to be_____ instructions, which can be executed only in monitor mode.
- (3) Considering OS interfaces, an application program can utilize_____ to acquire services provided by OS.
- (4) In operating systems, _____is the basic unit of resource-allocation for programs executing in computer systems.
- (5) If a system can deal with 3 real-time processes, 5 interactive processes and 2 batch processes in 400ms, then the throughput of this system is_____.

(6)_____ is a high level language construct for process synchronization, and is characterized by shared variables and a set of programmer-defined operations on the shared variables.

(7) With respect to deadlocks, a system is _____if the system can allocate resources to each process (up to its maximum) in some order and still avoid a deadlock.

(8) On a paging system with 2^{32} bytes of physical memory, 2^{11} 1024-byte pages of logical address space,_____ bits in the physical address specify the frame number:

(9) The file system consists of two distinct parts: a collection. of files and a _____, which organizes and provides information about all files in the system.

(10) Considering file access methods and file disk space allocation, access is adapt to the files of linked allocation

2. CHOICE (1* 13 points)

(1) Which one is not the main task of an operating system?_____

- A. Process management B. Language translation
- C. File management D. memory management

(2) Which of the following system has strict time constraint? _____

- A. batch system B. time-sharing system C. real-time system D. interactive system

(3) A starvation-free job-scheduling policy guarantees that no job waits indefinitely for service .Which of the following job-scheduling policies is starvation free? _____

- A. Round Robin B. Priority C. Shortest Job First D. None of the above

(4) In operating systems, the semaphore stands for instances of resource, it is a integer variable relevant to a queue, its value can only be changed by operation WAIT and SIGNAL .If a semaphore S is initialized to 5, now it's value is 2, how many processes is or are waiting in the queue relevant to S._____

- A.3 B.2 C.1 D.0

(5) The Banker Algorithm is used for_____.

- A. deadlock avoidance B. deadlock prevention
- C. deadlock detection. D. deadlock recovery

(6) With respect to binding of instructions and data to memory addresses, if address binding is done at_____, the hardware MMU is needed.

- A. Coding time B. compile time C. load time D. execution time

(7) Considering the following memory management schemes, _____ will maximize memory utilization.

A. fixed-sized partitions (MVT). B. paging C. segmentation will

(8) Consider a machine in which all memory-reference instructions have only one memory address, and one-level indirect addressing is allowed, if an instruction is assumed to be stored in one frame, then the minimum number of frames per process is_____.

A. one B. two C. three D. four

(9) The file system itself is generally composed of several different levels. In these levels, the_____ manages metadata and is responsible for protection and security.

A. logical file system B. file-organization module
C. basic file system D. I/O control

(10) Which allocation scheme would work best for a file system implemented on a device (e.g. a tape drive) that can only be accessed sequentially?_____

A. linked allocation B. contiguous allocation
C. index allocation D. none of them

(11) The disk free-space list is implemented as a bitmap. If the size of the disk space is 128 blocks, and each block is of 512 bytes, then _____bytes are needed to store the bitmap.

A. 128 B. 512 C. 16 D. 8192

(12) With respect to disk I/O operations, the _____executes IO instructions to control the disk controller to access data on disks

A. file system B. kernel I/O subsystem C. application process D. driver

(13) The following characteristics except _____are correct for disks.

A. secondary storage B. read-write devices
C. random-access devices D. character-stream devices

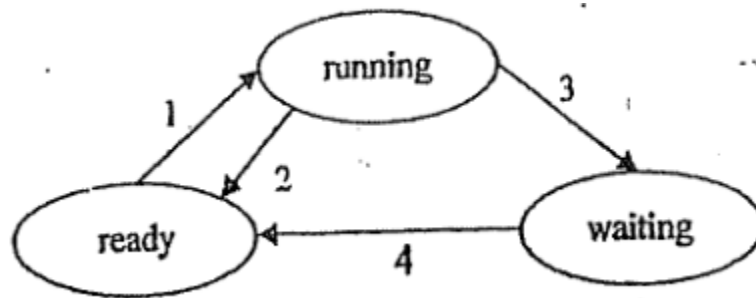
3. ESSAY QUESTIONS (27 points)

3.1 (6 points) Explain the following terms

1) deadlock (3 points)

(2) demand paging (3 points)

3.2 (6 points) In a multiprogramming system, consider the following diagram of process state transitions,



1) Is it possible that the transition 2 of a process can cause the transition 1 for a process?

If yes, give an example; If not, why? (3 points)

2) Is it possible that the transition 4 of a process can cause the transition 1 for a process?

If yes, give an example; If not, why? (3 points)

3.3 (4 points) In a paging system, the page table is stored in main memory, and the active page entries are also bold in high-speed associate memory TLB (translation look-aside buffer). If it takes 100 nanoseconds to search the TLB, and 180 nanoseconds to search page table in main memory. What must the TLB hit ratio be to achieve an effective access time (EAT) of 150ns?

3.4 (6 points) In the file system on a disk with physical block sizes of 512 bytes, a file is made up of 128-byte logical records, and each logical record cannot be separately stored in two different blocks. The disk space of the file is organized on the basis of indexed allocation, and a block address is stored in 4 bytes. Suppose that 2-level index blocks is used to manage the data blocks of the file, answer the following questions:

- 1) What is the largest size of the file? (3 points)
- 2) Given 2000, the number of a logical record the file, how to find out the physical address of the record 2000 in accordance with the 2-level index blocks (3 points)

3.5 (5 points) A file is made up of 128-byte fix-sized logical records and stored on the disk in the unit of the block that is of 1024 bytes. The size of the file is 1024 bytes. Physical I/O operations transfer data on the disk into an OS buffer in main memory, in terms of 1024-byte block. If a process issues read requests to read the file's records in the sequential access manner, what is the percentage of the read requests that will result in IO operations?

4. (12 points) Considering a real-time system, in which there are 4 real-time processes P1, P2, P3 and P4, that are aimed to react to 4 critical environmental events e1, e2, e3 and e4 in time respectively.

The arrival time of each event e_i , $1 \leq i \leq 4$, (that is, the arrival time of the process P_i), the length of the CPU burst time of each process P_i , and the deadline for each event e_i ; are given below. Here, the deadline for e_i is defined as the absolute time point before which the process P_i must be completed.

The priority for each event e_i (also for P_i) is also given, and a smaller priority number implies a higher priority.

Events	Process	Arrival Time	Burst Time	Priorities	Deadline
e1	P1	0.00	4.00	3	7.00
e2	P2	3.00	2.00	1	5.50
e3	P3	4.00	2.00	4	12.01
e4	P4	6.00	4.00	2	11.00

(1) Suppose that priority-based preemptive scheduling is employed, (6 points)

a) Draw a Gantt chart illustrating the execution of these processes

b) What are the average waiting time and the average turnaround time

c) Which event will be treated with in time, that is the process reacting to this event will be completed before its deadline?

(2) Suppose that FCFS scheduling is employed, (6 points)

- Draw a Gantt chart illustrating the execution of these processes
- What are the average waiting time and the average turnaround time
- Which event will be treated with in time?

5. (16 points) Here is a plate that can contain 3 fruits. The father puts apples and the mother puts oranges into the plate. The daughter takes apples and the son takes oranges from the plate to eat. The father, mother, daughter and son are permitted only to operate on the plate in a mutually exclusive mode, and only one apple or one orange can be put into or taken from the plate each time.

Please design four semaphore-based processes for the father, mother, daughter and son-to correctly operate on the plate.

Requirements:.

- Define the semaphores used to synchronize the processes, describe simply the role of each semaphore, and give their initial values. (4 points)
- Illustrate the structures of, processes for the father, mother, daughter and son.(12 points)

6. (12 points) Considering a system with five processes P0 through P4 and three resource types A, B and C. Resource types A has 4 instances, B has 3 instances and C has 6 instances. Suppose that, at time T0, we have the following resource-allocation state,

	Allocation			Request			Available		
	A	B	C	A	B	C	A	B	C
P0	1	0	0	2	3	2	1	1	2
P1	2	1	1	1	0	2			
P2	0	1	1	1	0	3			

P3	0 0 2	4 2 0	
P4	0 0 0	1 0 6	

Answer following questions by means of the deadlock-detection algorithm

(1) Is the system in a deadlocked state? and why? (6 points)

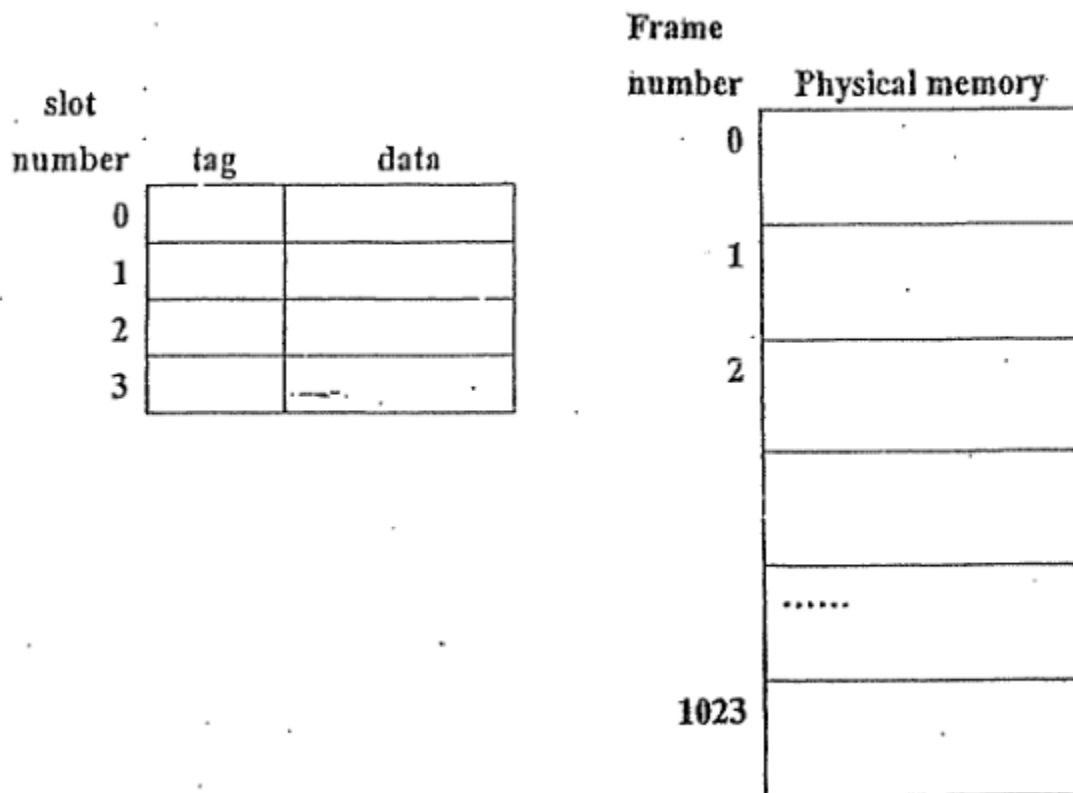
(2) If P0 requests one additional instance of type B; what is the Request Matrix?

Is there a deadlock in the system? and why? (6 points)

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7. (10 points) A cache is a region of faster memory that holds copies of data. Most systems have one or more high-speed data caches in the memory hierarchy. Information (e.g. the instruction or data) is normally kept in main memory. As it is used, it is copied-into the cache. When a particular piece of information is-needed, we first check whether it is in the cache. If it is, we use the information directly from the cache; if it is not, we use the information from the main memory and put a copy in the cache under the assumption that we will need it again soon.

In a paging system, the-main memory is divided into 1024 frames. Refer to the following figure. It is supposed that a cache in the system consists of 4 slots and each slot can hold only one frame. There is also a tag field in each slot to record the number of the frame kept in this slot.



When a frame is needed to be copied to the cache but there is no free slot to hold it, slot replacement occurs. The system uses the slot replacement algorithm to select a victim frame already in the cache and then replace the victim by this frame.

Assuming that all of 4 slots in the cache are free initially, and CPU references the memory according to the following sequence of memory frame numbers

1, 0, 2, 1, 7, 6, 7, 0, 1, 2, 0, 4, 5, 1, 5

(1) If FIRO replacement algorithm is used, illustrate the frame number kept in each cache slot successively, and give the cache hit ratio (5 points)

(2) If LRU replacement algorithm is used, illustrate the frame number kept in each cache slot successively, and give the cache a hit ratio. (5 points)

Note:

- 1. The scheme of slot replacement between the cache and the main memory is similar to that of page replacement between the main memory and the disk**
- 2. The cache hit ratio is defined as the percentage of times that the frames referenced by CPU can be found in the cache.**