

《操作系统原理》课程期末考试试卷

考试日期: 年 月 日, 考试时间: 120 分钟 任课教师: _____

考生姓名: _____ 学号: _____ 所属院系: _____

题序	1-70	1	2	3	4	总 分
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[illegible]

Part One: Multiple Choice Questions (one mark each.)

Choose the best answer for the following questions. There is only one best answer for each question.

- Operating systems provide certain levels of interfaces. However, ____ is in general not provided by OS.
A. Application programming interface (API) B. Command line interpreter
C. Graphic user interface (GUI) D. System call
- A distributed system could be _____.
A. A client-server system
B. A peer-to-peer system
C. A clustering system
D. All the above
- When operating system says Resource, it could be
A. Memory space
B. Global variables
C. Network bandwidth
D. All the above
- Compared to the OSes with microkernel, the monolithic counterpart sometimes shows advantage in _____.
A. Scalability B. Modularity
C. Performance D. Readability
- Which of the functionalities listed below must be supported by the operating system for handheld devices.
A. Batch programming B. Virtual memory
C. Time sharing D. Networking
- Which of the following types of operating systems has the best job throughput ?
A. Time sharing B. Interactive
C. Batch D. Real time
- A CPU scheduler focuses on _____ scheduling.
A. mixture-term B. short-term
C. medium-term D. long-term
- The context-switch causes overhead by OS. The action affects many objects, but ____ is not included.
A. register B. global variable
C. stack D. memory
- Which of the following process state transitions is impossible to happen?
A. from ready state to running state B. from ready state to waiting state
C. from running state to ready state D. from waiting state to ready state

10. A process will change its state from "waiting" to "ready" when _____.
A. it has been selected for execution by scheduler
B. the event it had been waiting for has occurred
C. its time slice is finished
D. it waits for some event

11. The main difference between a process and a program is that _____.

- A. a process has its life cycle while a program has not.
B. a program has its life cycle while a process has not.
C. a program can own resources while a process cannot.
D. a process can own resources while a program cannot.

12. Using the program shown as following:

```
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>
int value = 10;
int main() {
    pid_t pid;
    pid = fork();
    value += 10;
    if(pid == 0) { /* child process */
        value += 5; }
    else if (pid > 0) { /* parent process */
        wait(NULL);
        printf("PARENT: value = %d", value); /* LINE A */
        exit(0);
    }
}
```

Which string will be output at Line A?

- A. PARENT: value =20
B. PARENT: value =10
C. PARENT: value =15
D. PARENT: value =25

13. A semaphore array in Linux is often used as _____.

- A. a kind of direct communication
B. a kind of low-level communication
C. a kind of symmetrical communication
D. a kind of inter-process communication

14. Which of the following statement is true ?

- A. Sometimes multithreading does not provide better performance than a single-threaded solution
- B. Sometimes multithreading does the same performance as a single-threaded solution
- C. Sometimes multithreading provides better performance than a single-threaded solution
- ☒ D. All the above are true

15. Threads in a process share the _____.

- A. Stack memory
- B. Heap memory
- C. Register values
- D. Global variables

16. In general, multithreading shows some features benefiting user applications. Even though an operating system does not support multithreading, those features could be brought with by use of _____.

- A. One to One Model
- B. Kernel level thread
- C. User level thread
- D. None

17. Which of the following scheduling algorithms could result in starvation ?

- A. First come first served
- B. Round robin
- C. Shortest job first
- D. Highest response_ratio next

18. Consider a variant of the RR scheduling algorithm in which the entries in the ready queue are pointers to the PCBs. If there are two pointers to the same PCB:

- A. It would not be the RR algorithm and be illegal.
- B. The time slice would have to be adjusted in order to rebalance the CPU load.
- C. The pointed process always gains twice the CPU time.
- D. The time interrupt should be smart enough which makes the OS kernel more complicated.

19. Suppose the system is dominated by processes with short burst-time, _____ is the most appropriate choice.

- A. Multilevel queues
- B. Multilevel feedback queues
- C. First come first served
- D. Round robin

20. Sometimes two scheduling criteria are conflict with each other, and not satisfied both. Which of the following pairs of scheduling criteria are ALWAYS non-conflicting?

- A. CPU utilization and response time
- B. Average turnaround time and average waiting time
- C. Average turnaround time and maximum waiting time
- D. I/O device utilization and CPU utilization

21. Talking about the scheduling for CPU burst cycle vs I/O burst cycle, which statement is true.

- A. A scheduler does not care the process either in CPU burst cycle or I/O burst cycle
- B. A process is either CPU burst or I/O burst
- C. A process with CPU burst cycle is preferred
- D. A process with I/O burst cycle is preferred

For the next 3 questions, considering the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Arrival time	Burst time
P1	0	3
P2	2	5
P3	4	1
P4	5	4
P5	8	1

22. For the FCFS scheduling algorithm, the **average waiting time** is _____.
 A. 14/5 B. 25/5
 C. 44/5 D. 33/5
23. For the SJF scheduling algorithm, the **average waiting time** is _____.
 A. 11/5 B. 22/5
 C. 41/5 D. 30/5
24. For the Round Robin (quantum is 2) scheduling algorithm, the **average waiting time** is _____.
 A. 44/5 B. 34/5
 C. 29/5 D. 15/5
25. The critical section in an OS is _____.
 A. a process scheduler B. a data section
 C. a synchronization mechanism D. a segment of code
26. Which of the following statements is incorrect regarding Busy Waiting?
 A. Busy waiting makes worse CPU throughput.
 B. Busy waiting could be avoided by proper CPU scheduling.
 C. Busy waiting does not just come with Critical Section Problem.
 D. If a solution to the Critical Section Problem causes busy waiting, the solution is incorrect.
27. Which of the following statements is correct?
 A. Critical section is a piece of code in a process for mutual exclusion.
 B. Critical section is a piece of code in a process for process synchronization.
 C. Critical section is a piece of code in a process for inter-process communication.
 D. Critical section is a piece of code in a process for accessing critical (shared) resources.
- ☒ 28. For two-process Critical Section(CS) problem solution, the Progress condition does not mean that _____.
 A. Only processes wish to enter the section are the candidates.
 B. If and only if there are some processes wish to enter the critical section, the Progress condition applies.
 C. The decision to enter the critical section should be made within limited time, even though there exists a process running in its critical section.
 D. A process is allowed to enter its critical section many times while the others keep waiting.

29. Which one of the following statements is correct about spinlock?

- A. Spinlock is appropriate for single-processor systems
- B. Spinlock is often used in multiprocessor systems
- C. Spinlock could be used in single-processor systems
- D. Spinlock is not often used in multiprocessor systems

30. Which one of the following statements is correct about synchronization primitives ?

- A. The primitive could be implemented by disabling interrupts, even in single-processor systems.
- B. The primitive could not implemented by disabling interrupts, neither in single-processor systems nor in multiprocessor systems.
- C. The primitive could only be implemented by disabling interrupts for multiprocessor systems.
- D. If used in user-level programs, the primitive could be implemented by disabling interrupts.

31. Hope the server limits its number to be concurrently connected no more than N clients. One solution will be

- A. A semaphore for resource sharing purpose, with the initial value N
- B. A semaphore for resource sharing purpose, with the initial value 1
- C. A semaphore for synchronization purpose, with the initial value N
- D. A semaphore for synchronization purpose, with the initial value 1

32. Which one of the following is not the necessary condition for a deadlock to occur?

- A. Starvation
- B. Mutual exclusion
- C. Hold and wait
- D. NO Preemption

33. Which of the following methods can prevent the deadlock from the very beginning?

- A. Resource allocation in an increasing order of enumeration
- B. Banker's algorithm
- C. Deadlock detection
- D. Deadlock avoidance

34. Consider the following snapshot of a system:

	<u>Allocation</u>	<u>Max</u>	<u>Available</u>
	<u>ABCD</u>	<u>ABCD</u>	<u>ABCD</u>
P_0	0 0 1 2	0 0 1 2	1 5 2 0
P_1	1 0 0 0	1 7 5 0	
P_2	1 3 5 4	2 3 5 6	
P_3	0 6 3 2	0 6 5 2	
P_4	0 0 1 4	0 6 5 6	

Which one is the safe sequence for the system?

- A. $\langle P_0, P_3, P_4, P_2, P_1 \rangle$
- B. $\langle P_1, P_2, P_4, P_3, P_0 \rangle$

- C. $\langle P_2, P_0, P_4, P_1, P_3 \rangle$ D. $\langle P_4, P_3, P_1, P_2, P_0 \rangle$

35. The address binding could be by the way of

- A. The variables in source codes converted to the binary
- B. The variables in source codes compiled into object modules
- C. Several object modules are linked together into a single program
- D. All the above

36. An unsafe state implies _____.

- A. the existence of deadlock
- B. that deadlock will eventually occur
- C. that some unfortunate sequence of events might lead to a deadlock
- D. The scenario that the Dining Philosophers Problem described

37. In a real computer system, neither the resources available nor the demands of processes for resources are consistent over long periods (months). Resources break or are replaced, new processes come and go, new resources are bought and added to the system. If deadlock is controlled by the banker's algorithm, which of the following changes can be made safely (without introducing the possibility of deadlock) ?

- A. Increase the number of processes.
- B. Increase *Max* for one process (the process needs more resources than allowed, it may want more)
- C. Increase *Available* (new resources added).
- D. Decrease *Available* (resource permanently removed from system)

38. Which of the following memory management method helps to share a code segment across processes?

- A. Contiguous memory allocation B. Pure segmentation
- C. Pure paging D. None of above

39. Which of the following memory management method has no impact in terms of internal fragmentation?

- A. Two-level paging ☒ B. Segmentation
- C. Paging D. Linux paging strategy

40. To apply the demand paging memory management, the CPU with powerful MMU is a must. However, ___ is NOT a necessity.

- A. Interrupt B. Present bit defined in the segment table entry
- C. TLB D. Page table

41. Assume that you are monitoring the rate at which the pointer in the clock algorithm (which indicates the candidate page for replacement) moves. What can you say about the system if you notice the pointer is moving fast ?

- A. the program is accessing a large number of pages simultaneously
- B. the operation finding candidate pages for replacement is efficient
- C. the virtual memory system is extremely efficient
- D. that indicates many of the resident pages are not being accessed

42. Suppose that a machine provides instructions that can access memory locations using the one-level indirect addressing scheme. How many page faults incurred when all of the pages of a program are currently non-resident and the first instruction of the program is an indirect memory load operation ?

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

43. A certain computer provides its users with a virtual-memory space of 2^{32} bytes. The computer has 2^{18} bytes of physical memory. The virtual memory is implemented by paging, and the page size is 4096 bytes. A user process generates the virtual address 11123456, actually its page number is ____

- A. 69923
- B. 2715
- C. 1110
- D. 11123456

44. Consider a demand-paging system with the following time-measured utilizations:

CPU utilization 20%

Paging disk 97.7%

Other I/O devices 5%

Which of the following will improve CPU utilization ?

- A. Increase the degree of multiprogramming
- ☒ B. Decrease the degree of multiprogramming
- C. Install a faster CPU
- D. Install a bigger paging disk

45. Which of the following indicates that the system performs well

- A. A process suffers deadlock
- B. A process suffers starvation
- C. A process suffers bad turnaround time
- D. A process suffers thrashing

46. Virtual memory management with paging does not require ____

- A. the page replacement
- B. to process the page fault interrupt
- C. to load some code or data into the contiguous memory space
- D. none of the above

47. In order for a virtual memory management performing well, it is preferred that

- A. processes do not have too much I/O operations
- B. the program size should not be bigger than the whole memory space
- C. there are some large size contiguous memory space
- D. the locality of processes is well featured

56. The per-process open-file table is ____
- A. unique and maintained by OS for all users
 - B. one of OS data structure for better performance of file system management
 - C. claimed by each process and for its own purpose
 - D. an accounting data structure to tell how many files opened by the process
57. As to the way accessing data of a file,
- A. The sequential manner is better than the random one.
 - B. The random access is better than the sequential one.
 - C. Both the sequential and the random access are the right way.
 - D. Either the sequential or the random access is replaced by DBMS.
58. Which of the following design is practical by operating systems.
- A. Automatically open a file while referenced for the first time, and close the file when the job terminates.
 - B. The user has to open and close the file explicitly.
 - C. The user has to open the file explicitly, but the file is closed automatically when the job terminates.
 - D. All the above
59. Regarding the file access permission, which of the following statements is NOT correct.
- A. The "Cloud" providing SaaS is an example facilitated the file system to write once but read many times
 - B. Some file systems are read only, not allowing any write operation.
 - C. Some file systems are dedicated to write only once but read many times
 - D. The web site providing search service is an example facilitated the file system to write once but read many times
60. USB flash drive is popular nowadays. Usually it is not formatted with ____
- A. btrfs
 - B. ISO 9660
 - C. FAT
 - D. EXT2
61. None of the disk-scheduling disciplines could avoid starvation, except ____.
- A. FCFS
 - B. SSTF
 - C. C-SCAN
 - D. C-LOOK
62. Overheads are always associated with an interrupt service, resulting in worse performance. However, they do not include the cost of ____
- A. saving process state
 - B. executing the instruction just next the interrupt point
 - C. restoring process state
 - D. flushing the instruction pipeline

63. Look at the fact that requests are not usually uniformly distributed. For example, a cylinder containing the file system FAT can be expected to be accessed more frequently than a cylinder that only contains files. And the fact that file systems typically find data blocks via an indirection table, such as a FAT in DOS. Which of the following ways would take advantage of this indirection to improve disk performance ?

- A. Keep the metadata in the nearest corner of cylinders
- B. Cache the metadata in primary memory
- C. Back up the metadata
- D. Redesign the file system by discarding the indirection

64. Which scheme of disk array provides no data redundancy ?

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

65. Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Starting from the current head position, what is the sequence of cylinder number that the disk arm moves to satisfy all the pending requests, for the SSTF algorithms?

- A. 143, 913, 948, 1022, 1470, 1509, 1750, 1774, 4999, 130, 86
- B. 143, 913, 948, 1022, 1470, 1509, 1750, 1774, 130, 86
- C. 143, 130, 86, 913, 948, 1022, 1470, 1509, 1750, 1774
- D. 143, 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

66. Some file systems allow disk storage to be allocated at different levels of granularity. For example, a file system could allocate 4KB of disk space as a single block, or as four 1024-byte blocks. Do you think the example is

- A. Absolutely nonsense
- B. Probably true, but it is only for academic research
- C. Practical, because there exists a popular file system using the scheme
- D. Absolutely true, all file systems use the scheme

67. Which of the following statements is wrong from the operating system view?

- A. Memory sometimes is used as a disk
- B. Memory sometimes is used as read only
- C. Memory sometimes is used as a USB flash drive
- D. Memory sometimes is used as a disk cache

68. A logical address is _____

- A. the address in an object file
- B. the address in an executable file
- C. the address in a CPU instruction together with operator
- D. All the above

69. A file system uses a scheme with support for extents. A file is a collection of extents, with each extent corresponding to a contiguous set of blocks. This file system is called_____
- Contiguous allocation
 - Linked allocation
 - Indexed allocation
 - None of above
70. Which reason does not make sense: The operating system generally treats removable disks as shared file systems but assigns a tape drive to only one application at a time, because
- Disks have fast random-access time, so they give good performance for interleaved access streams. By contrast, tapes have high positioning time
 - The owner of the Tape cartridge may wish to store the cartridge off-site (far away from the computer) to keep a copy of the data safe from a fire at the location of the computer
 - Historically tape cartridges are often used to send large volumes of data from a producer to the consumer. Such a tape cartridge is reserved for that particular data transfer
 - None of above

Part Two: (30 marks)

1. (12 marks) Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5 , all at time 0. Suppose it is used FCFS, SJF, a non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling.

- What is the turnaround time of each process for each of the scheduling algorithms ?
- Which of the schedules results in the minimal average waiting time (over all processes)?

2. (6 marks) Lamport's bakery algorithm is intended to improve the safety in the usage of shared resources among multiple [threads](#) by means of [mutual exclusion](#), briefed as following.

```

1 lock(integer i) {
2   Choosing[i] = true;

```

```

3   Number[i] = 1 + max(Number[1], ..., Number[NUM_THREADS]);
4   Choosing[i] = false;
5   for (j = 1; j <= NUM_THREADS; j++) {
6       // Wait until thread j receives its number.
7       while (Choosing[j]) { /* nothing */ }
8       // Wait until all threads with smaller numbers or with the same
9       // number, but with higher priority, finish their work.
10      while ((Number[j] != 0) && ((Number[j], j) < (Number[i], i))) {
11          /* nothing */
12      }
13  }
14}

15 //critical section
16 unlock(integer i) {
17     Number[i] = 0;
18 }
19
20 Thread(integer i) {
21     while (true) {
22         lock(i);
23         // The critical section goes here...
24         unlock(i);

```

25 *// non-critical section...*

26 }

27 }

(1) Suppose Thread(i) and Thread(j) are running concurrently, will they occasionally get the same Number[] ?
i.e. Number[i] == Number[j]. If so, please give a scenario.

(2) If the Choosing array is not applied, i.e. Line 2, Line 4 and Line 7 are deleted, will the algorithm conflict with Critical Section Requirements of Mutual Exclusion, Progress and Bounded Waiting. If so, please give a scenario.

3. (4 marks) Assume we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds?

4. (8 marks) The EXT2 file system defines an index array with 15 pointers to locate all data blocks of a file.

(1) The first 12 items of the index array accommodate the locations of the first 12 data block.

(2) The 13th item points to an index block called the indirect block, which contains index entries, each being a pointer to a data block.

(3) The 14th item points to an index block containing entries, where each entry is a pointer to yet another indirect block as described in (2).

(4) The 15th item points to an index block containing entries where each entry is a pointer to another index block as described in (3).

Suppose the EXT2 data block is of size 4096 bytes, and an index entry is of size 4 bytes. Please answer how would be the maximal size of a file ?