北京邮电大学 2013——2014 学年第 1 学期

《操作系统》期中考试试题

班级 2011211310 学号 2011211391 姓名 张强

题号	一	二	三	四	五	六	七	总分
满分	25	14	10	11	15	15	10	100
得分	24	7	7	8	15	12	4	78

一、FILL IN BLANKS (1 point * 25)

1. Programming interface provided by operating system is API或system calls.
2. kernel or privileged instructions refer to instructions that can only be executed by operating system.
3. To prevent user programs from interfering with the proper operation of the system, the hardware has two modes; they are The Hand User mode and ~~staff the bernel~~ or system, privileged, monitor, supervisor mode.
4. Programs loaded into and running in memory refers to Process. It needs certain resources, including CPU (CPU Time), Main memory (memory), files, and I/O devices to accomplish its task.
5. A trap is a software-generated interrupt caused either by an error or by a specific request from a user program that an operating system service be performed.
6. The most 3 basic states of processes are ready, running, and waiting.
7. The five CPU scheduling criteria are CPU utilization, waiting time, turnaround time, running time (CPU burst time), Thoughput and response time.
8. There are 3 jobs, their running time are 2, 5, and 3 hours. Assume they arrive at the same time, running on the same processor in single programming method; running sequence 2、3、5 (running time 短到长) will have the least average waiting time.
9. Two communication methods between processes are Memory-shared and message passed.
10. 3 conditions that a good solution for critical section problems should satisfy are Mutual Exclusion, progress, and Bounded waiting.
11. A time-shared computer system uses RR scheduling scheme and multiprogramming to provide each user with a small portion of CPU time.
12. Operations on semaphores are initialization、~~Add~~ wait, and 增 signal。The value of a semaphore specifies some meaning, if it's value is greater than or equal to zero, the value stands for the number of available resources，if it is less than zero, its absolute value stands for the number of process which is in waiting state.
13. ~~Semaphore~~ Semaphore ~~Monitor~~ Monitor 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.
14. With respect to deadlocks, a system is A safe state if the system can allocate resources to each process (up to its maximum) in some order and still avoid a deadlock.

二、Select the best answer for each blank (1 point * 14)

1. Contents of interrupt vector are_____.
   A. begin address of sub-programs
   B. begin addresses of interrupt handling programs
   C. the address of begin addresses of interrupt handling programs
   D. begin address of handling programs

D 2. In multiprogramming system, in order to guarantee the integrality of shared variable, processes should enter their critical section mutual exclusively. Critical section refers to _____.

A. a buffer B. a data segment
C. synchronous mechanism D. a code segment

3. User process creates a new process by calling system call fork(), before calling fork(), the user process is running in A; during running fork(), the user process is running in B.

A. kernel mode B. user mode
C. kernel mode or user mode D. internal mode

A 4. In multiprogramming systems, several processes can be running concurrently in memory and does not interfere with each other. This is implemented by using _____.

A. memory allocation B. memory protection
C. memory extension D. address mapping

C 5. Among the following migrations, _____is impossible.

A. running→ready B. running→waiting
C. waiting→running D. running→terminate

A 6. _____ is not included in the context of process?

A. code B. PCB C. interrupt vector D. kernel stack

D 7. Which of the following system has strict time constrain? _____

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

C 8. When does a process migrate from waiting state to ready state?_____

A. time slice is used up B. process is selected by scheduler
C. event that the process is waiting for occurs
D. the process is waiting for an event

D 9. Two concurrent processes are _____

A. Mutual Exclusion B. synchronous
C. independent D. either synchronous or mutual exclusion

B 10. In time-sharing Operating System, if time slice is given, in which case of the following, response time is more long?_____

A. the number of users is less B. the number of users is more
C. the memory space is less D. the memory space is more

A 11. 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

A 12. 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

C 13. The Banker Algorithm is used for_____

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

三、Judge the following statements, if right tick √, or X (1 point * 10)

1. (√) Modern Operating Systems are interrupt driven.
2. (X) Spooling technology can be used to increase the speed of slow peripheral equipments.
3. (X) The program stored in boot control block is initialization program for OS.
4. (√) The main memory is generally the only large storage device that the CPU is able to address and access directly.
5. (X) Switch between threads can not cause the switch between processes.
6. (X) The resources that a process needs when it is running are allocated to the process when it is created.
7. (√) If the time slice is too large, RR scheduling degenerates to FCFS policy.
8. (X) Both Monitor and semaphore are processes synchronization mechanisms provided by operating systems..
9. (X) A waiting process can not be waked up by itself.
10. (√) when a process is swapped out, the threads belongs to it are all swapped out at the same time.

四、Essay question (11 points)

1. (5 points) Please give the migration diagram of process with 5 states, and indicate the migration reasons.

states: new; ready; running; waiting; terminate

new → ready: admitted by OS

ready → running: schedule

running → waiting: I/O or wait for events occur

waiting → ready: I/O finish or events occur

running → terminate: finish or terminate

4

2. (4 points) explains the following terms

(1) critical section

它是进程之间共享的代码段，能被多个进程访问、却执行。最终的结果与访问、执行它的进程顺序有关。在进程同步中是关键部分

(2) deadlock

由于并发执行的

~~由于并发执行的~~

因互斥执行，持有等待，非抢占及循环等待队列的多个进程并发执行导致系统进入这个状态。在这个状态下，系统不会有任何变化，永远保持在这个状态上

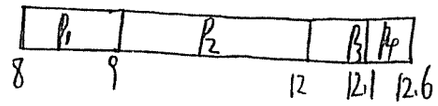
3. (2 points) Please write out the three classic problems of process synchronization described in the text book.

哲学家就餐问题；缓冲区问题

五、(15 points) Given processes as following:

	Arrival time	CPU burst time
P1	8.00	1.00
P2	8.30	3.00
P3	9.00	0.10
P4	9.30	0.50

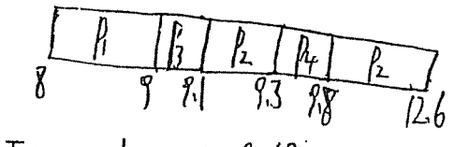
(1) Draw the Gantt chart for these processes with the FCFS scheduling algorithm. What is the average waiting time for these processes?



各进程的等待时间：P_1:0 P_2:(9-8.3)=0.7 P_3:(12-9)=3 P_4:(12.1-9.3)=2.8

Average waiting time = $\frac{1}{4}$(0+0.7+3+2.8)=1.625

(2) Draw the Gantt chart for these processes with preemptive SJF scheduling algorithm (SRTF). What is the average turnaround time for these processes?



Turnaround time for P_1: (9-8)=1

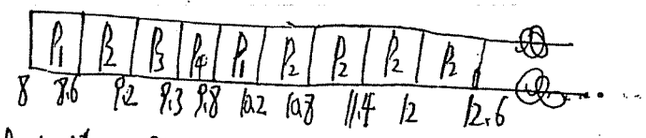
— P_2: (12.6-8.3)=4.3

— P_3: (9.1-9)=0.1

— P_4: (9.8-9.3)=0.5

Average turnaround time = $\frac{1}{4}$(4.3+0.1+0.5+1)=1.475

(3) Draw the Gantt chart for these processes with Round-Robin scheduling algorithm with time slice of 0.6 time units. What is the average waiting time for these processes?



P_1: (0+1.2)=1.2

P_2: (0.3+1)=1.3

P_3: 0.2

P_4: 0

Average waiting-time $= \frac{1}{4}(1.2+1.3+0.2) = 0.675$

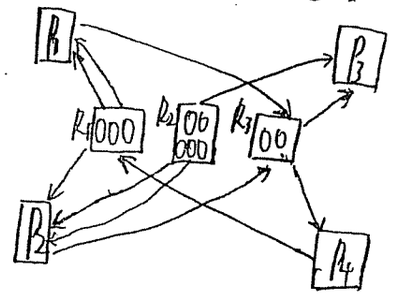
六、 (15 points) For the system described in the table below

process	Current allocation			Maximum needs			outstanding requests			Available		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
P_1	2	0	0	2	0	1	0	0	1	0	2	0
P_2	1	2	0	2	5	2	0	0	1			
P_3	0	1	1	1	4	2	0	0	0			
P_4	0	0	1	2	0	1	1	0	0			

a) How many instances are there for each type of resources?

R_1:3 R_2:5 R_3:2

b) Draw the resource-allocation graph



−1

c) Is the system in a safe or unsafe state? Specify your judging procedure.

The system is in a unsafe state.

~~若系统是非抢占式的~~

由资源的分配状态，资源的剩余量及各进程的最大资源需求数可看出，不存在进程顺序使各进程能继续执行下去，系统可能进入死锁状态。若系统是非抢占的，则会进入死锁；若系统是抢占式的，则不会。

−1

d) Is the system deadlocked? Specify your judging procedure.

由Deadlock Delete算法可知，系统可能处于死锁状态。

Finish[i]及Finish[4]为false, Finish[1]、Finish[2]为true. −1

若系统是非抢占式的，系统已经处于死锁状态。

若系统是抢占式的，则死锁不会发生

七. (10 points) There is a coop(笼子) that can hold only one tiger or two pigs.

A tiger-hunter hunts a tiger once a time and puts it into the coop; a pig-hunter hunts a pig once a time and puts it into the coop.

If one pig is already closed in the coop, another pig is allowed to be put into the coop.

The feeder(饲养员) takes the tiger from the coop and sends it to the park.

The Kitchener(厨师) takes a pig from the coop once a time and sends it to the restaurant.

The processes for the tiger-hunter, the pig-hunter, the feeder, and the Kitchener are shown as followings.

In order to synchronize these processes, please design semaphores and complete these processes by using wait and signal operations on semaphores.

Assume semaphores needed are defined and initialized as following.

SCOOP=1; Used for mutual exclusion use of the coop.

STIGER=0; Used for synchronization between the process tiger-hunter and feeder.

SPIG=0; Used for synchronization between the process pig-hunter and Kitchener.

MUTEX=1; Used for mutual exclusion operation on variable pig_count.

PIGROOM=2; Used to record the rooms left for keeping pigs.

VARIABLE

pig_count=0; used to record the number of pigs kept in the coop.

Write appropriate code segmentation for each place marked by number from (1) to (8).

tiger-hunter:	feeder:

while(true){
Catch a tiger;
(1) wait(SCOOP);
wait(STIGER);
Put the tiger into the coop;
(2) signal(SCOOP);
signal(STIGER);
}
	while(true){
	(3) ~~wait(SCOOP);~~
	wait(STIGER);
	Take the tiger from the coop;
	(4) signal(STIGER);
	signal(SCOOP);
	Send the tiger to the park;
	}

pig-hunter:
while(true){
Catch a pig;
(5) wait(SCOOP);
switch wait(PIGROOM);
~~Signal(SCOOP);~~
case 0: break;
case 1: ~~signal~~;
case 2: signal(SCOOP);
signal(SPIG);
Put the pig into the coop;
(6) signal(PIGROOM);
~~signal(SPIG);~~
signal(MUTEX);
}
	Kitchener:
	while(true){
	(7) ~~wait~~ wait(SPIG);
	Take a pig from the coop;
	(8) switch signal(MUTEX);
	case 0: signal(SCOOP);
	signal(PIGROOM);
	signal(SPIG);
	case 1: signal(PIGROOM);
	Send the pig to restaurant;
	}

北京邮电大学 2011——2012 学年第一学期

《操作系统》期中考试试题

Class No._____Student No._____Name_____

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，做在草稿纸上一律无效。 五、第 2 题须用英文应答，中文答对得一半分。				
考试课程	操作系统			考试时间 100 分钟	年 月 日
题号	一	二	三	四	总分
满分	20	20	30	30	
得分					
阅卷教师					

一、Choose the best answer and each blank has only one answer.

(1*20 points)

1. Which function does the operating system can not complete directly of the following four options? ( )
A. Managing computer's hard drive
B. Compile the program
C. Virtual memory
D. Delete files
2. Considering the function of the operating system, ( ) must give timely response for the external request within the specified time.
A. multi user time sharing system
B. real-time operating system
C. batch operating system
D. network operating system
3. A process can transform from waiting state to ready state relying on ( )
A. programmer command
B. system service
C. waiting for the next time slice
D. wake-up of the 'cooperation' process
4. As we all know, the process can be thought of as a program in execution. We can deal with the problem about ( ) easier after importing the concept of process.
A. exclusive resources
B. shared resources
C. executing in order
D. easy to execute
5. CPU-scheduling decisions may take place under the following circumstances except which one? ( )
A. When a process switches from the running state to the waiting state
B. When a process switches from the running state to the ready state
C. When a process switches from the waiting state to the ready state
D. When a process switches from the ready state to the waiting state
6. In the four common CPU scheduling algorithm, Which one is the best choice for the time-sharing system in general? ( )
A. FCFS scheduling algorithm
B. Priority scheduling algorithm
C. Round-robin scheduling algorithm
D. Shortest-job-first scheduling algorithm
7. If the initial value of semaphore S is 2 in a wait( ) and signal( )

operation，its current value is -1,that means there are ( ) processes are waiting.

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

8.Generally speaking, we can deal with deadlock problem in three ways. Deadlock prevention is based on ( )

A. allocate enough system resources

B. make a reasonable process

C. one of the destruction of the four necessary conditions

D. prevent the system go into a state of insecurity.

9.In the operating system，wait( ) and signal( ) operation is a kind of ( )

A. machine instruction

B. system calls

C. job controls command

D. low-level process communication primitives

10.In the job scheduling algorithms，if all jobs come at the same time，which algorithm has the shortest average waiting time? ( )

A. FCFS scheduling algorithm

B. Priority scheduling algorithm

C. Round-robin scheduling algorithm

D. Shortest-job-first scheduling algorithm

11. Which of the following scheduling algorithms could result in starvation? ( )

A. First-come, first-served

B. Multilevel queue scheduling

C. Round robin

D. Priority

12.Data in the critical area can be used for only one process in the same time once, one principle of operating system call for the critical area is ( )

A. when no process is in critical area

B. when there is a process in critical area

C. when the process is in the ready state

D. when the process is creating

13. There are N user processes in the system, then how many user processes are there in the ready queue at most?( )

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

14. Two travel agencies A and B are going to booking airline tickets in a airline company, then exclusive resources is ( ).

A. airline tickets

B. travel agency

C. airline company

D. both travel agency and airline company

15. If the system has five plotter, and every process is needed to use two plotter, every process can apply one plotter each time, then how many processes we can allow to participate in the competition at most and will not deadlock?( )

A. 5 B. 2 C. 3 D. 4

16.Primitive is a special system call, its feature is ( )

A.can not be interrupted when executing

B.it calls itself

C.can be called by the outer

D.strong function

17. If the time slice is fixed in a time sharing system, then ( ), the longer the response time is.

A.the more the number of users

B.the less the number of users

C.the more memory

D.the less memory

18. There are many reasons can cause the deadlock of a system, and the root cause of system deadlock is ( )

A.improper job scheduling

B.too many processes in system

C.exclusive resources

D.resource management and process promotion

19. Usually we do not use the way of ( ) to remove the deadlock.

A. Ending a deadlock process

B. Ending all the deadlock processes

C. Grabbing resources from the deadlock process

D. Grabbing resources from the non-deadlock process

20. A process must acquire a lock before entering a critical section; it releases the lock when it exits the critical section. One example

of a hardware solution to the critical section problem is: ( )

A Compare and Pray

B Banker's Algorithm

C Test and Set

D Compare and Shop

二、Fill in the blanks with the proper words. (1* 20 points)

1. A modern general-purpose computer system consists of one or more____and a number of device controllers connected through a common bus that provides access to shared memory.

2. _____is the only large storage area that the processor can access directly.

3. One of the most important aspects of operating systems is the ability to _____.A single user cannot, in general, keep either the CPU or the I/O devices busy all the time.

4. In modern operating systems, resource allocation unit is process, processor scheduling unit is _____.

5. From a view of static state, the process of a operating system consists of program block, data and _____.

6. The two basic features of modern operating system are concurrent and_____.

7. A _____is defined as an endpoint for communication. it is identified by an IP address concatenated with a port number.

8. The general idea behind a _____is to create a number of threads at process startup and place them into a pond, where they sit and wait for work.

9. There are many resources can only allow one process to use, if more than one process use these resources, it may cause confusion in the system, these resources are called _____.

10. When the process execution time slice runs out, the process convert from running state to_____state.

11. A major problem with priority scheduling algorithms is _____.

12. _____is a kind of relationship between processes restricting each other logically.

13. The interval from the time of submission of a process to the time of completion is the_____.

14. CPU scheduling is the task of selecting a waiting process from the ready queue and allocating the CPU to it. The CPU is allocated to the selected process by the _____.

15. A state is safe if the system can allocate resources to each process in some order and still avoid a deadlock. More formally, a system is in a safe state only if there exists a _____.

16. Two or more processes are waiting indefinitely for an event that can be caused only by one of the waiting processes, these processes are said to be _____.

17. Each time the wait() operation, the value of semaphore S reduce 1. If S>0, then the process continue , if S<0, the process_____.

18. There are two ways to avoid deadlock: static and dynamic, deadlock avoidance belongs to_____.

19. In RR scheduling algorithm, if the time slice is too large, RR scheduling degenerates to FCFS scheduling; if the time slice is too small, scheduling overload in the form of_____time becomes excessive.

20. Deadlock_____requires that the operating system be given in advance additional information concerning which resources a process will request and use during its lifetime.

三、**ESSAY QUESTIONS (5*6=30 points)**

1. Define the term 'operating system'. What basic functions does an OS perform?

2. Give a simple description of 'deadlock avoidance' and 'deadlock prevention'

3. What do you think are the main powers to promote the development of operating system? List at least three reasons.

4. What is the difference between a program and a process?

5. What are the reasons that cause the deadlock? What are the necessary conditions when the deadlock occurs ?

6. Explain the following terms:

(1) Multiprocessor system
(2) System calls
(3) Thread

四. ANSWER QUESTIONS (10*3=30 points)

1 There is a warehouse can store two products A and B, but it requires:

1) you can only store one kind of product(A or B)
2) -N<the number of product A-the number of product B<M

N and M is a positive integer.

Please define the semaphores and variables needed, explain their roles?, and give their initial values; and describe the process of A and B's storage with wait() and signal() operation.

2 Consider the following set of processes:

Process	server time slice	priority
A	8	3
B	1	1
C	3	3
D	2	4
E	5	2

The processes are assumed to have arrived in the order A、B、C、D、E.

1). Drew three Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, RR (time slice=1), SJF. (Does not consider the process switching time)

2). Give the turnaround time and average turnaround time of every process with the three scheduling algorithms. (Does not consider the process switching time).

	Turnaround time					Average turnaround time
process	A	B	C	D	E	
FCFS						
RR						
SJF						

3). Assumed that in the RR scheduling algorithm (time slice=1), please calculate the throughput. (Does not consider the process switching time)

10

3. Consider the following snapshot of a system:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	2	1	6	3	3	1	3	3	2	2
P1	2	1	1	1	2	2	2	1				
P2	3	0	2	1	9	0	2	6				
P3	2	0	0	1	3	2	2	2				
P4	0	1	0	0	7	5	3	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? If Yes, Show that safe state sequence, else describe the deadlock scenario.

3) If a request from process P1 arrives for (0,3,1,0), can the request be granted immediately?

北京邮电大学 2008——2009 学年第 1 学期

《操作系统》期中考试试题

题号	一	二	三	四	五	六	七	总分
满分	20	14	10	16	15	8	17	
得分								94

一、FILL IN BLANKS (1 point * 20)

1. Programming interface provided by operating system is system call.
2. Instructions that can only be executed by operating system are privilege instructions.
3. The most 3 basic states of processes are ready, running, and waiting.
4. To prevent user programs from interfering with the proper operation of the system, the hardware has two modes, they are user mode and kernel mode.
5. A trap is a software-generated interrupt caused either by an error or by a specific request from a user program that an operating system service be performed.
6. There are 3 jobs, their running time are 4, 7, and 5 hours. Assume they arrive at the same time, running on the same processor in single programming method; running sequence Job1, Job3, Job2 will have the least average turnaround time.
7. The value of a semaphore specifies some meaning, if it's value is greater than or equal to zero, the value stands for the number of available resources, if it is less than zero, its absolute value stands for the number of processes that waiting for this type of resource

Operations on semaphores are initialization、wait, and signal.

8. Three communication methods between processes are ~~memory share~~ shared memory, message passing, and ~~initialize~~ initialization, pipe-line.
9. Programs loaded into and running in memory refers to processes. It needs certain resources, including CPU, ~~memory~~, files, and I/O devices to accomplish its task.
10. 3 conditions that a good solution for critical section problems should satisfy are ~~that~~ Mutual exclution, Progress, and ~~bounded~~ waiting.
11. A time-shared computer system uses CPU scheduling scheme and multiprogramming to provide each user with a small portion of CPU time.
12. Monitor 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.
13. With respect to deadlocks, a system is safe if the system can allocate resources to each process (up to its maximum) in some order and still avoid a deadlock.

二、Select the best answer for each blank (1 point * 14)

1. Contents of interrupt vector are B.
   A. begin address of sub-programs
   B. begin addresses of interrupt handling programs
   C. the address of begin addresses of interrupt handling programs
   D. begin address of handling programs
2. In multiprogramming system, in order to guarantee the integrality of shared variable, processes should enter their critical section mutual

exclusively. Critical section refers to ___D___.

A. a buffer B. a data segment

C. synchronous mechanism D. a code segment

3. User process creates a new process by calling system call fork(), before calling fork(), the user process is running in ___B___; during running fork(), the user process is running in ___A___.

A. kernel mode B. user mode

C. kernel mode or user mode D. internal mode

4. In multiprogramming systems, several processes can be running concurrently in memory and does not interfere with each other. This is implemented by using ___B___.

A. memory allocation B. memory protection

C. memory extension D. address mapping

5. Among the following migrations, ___C___ is impossible.

A. running→ready B. running→waiting

C. waiting→running D. running→terminate

6. ___C___ is not included in the context of process?

A. Code B. PCB C. Interrupt vector D. Kernel stack

7. Which of the following system has strict time constrain? ___D___

A. distributed system B. time-sharing system

C. interactive system D. real time system

8. A process migrates from waiting state to ready state when ___C___

A. its time slice is used up

B. the process is selected by scheduler

C. the event that the process is waiting for occurs

D. the process is waiting for an event

9. Two concurrent processes are ___D___

A. Mutual Exclusion B. synchronous

C. independent D. either synchronous or mutual exclusion

10. In time-sharing Operating System, if time slice is given, ___B___, response time is more long.

A. the number of users is less B. the number of users is more

C. the memory space is less D. the memory space is more

11. 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~~ A

A. Round Robin B. Priority

C. Shortest Job First D. None of the above

12. In operating systems, the semaphore stands for instances of resource, it is a integer variable relevant to a queue. 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. ___D___

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

13. The Banker Algorithm is used for ___A___

A. deadlock avoidance B. deadlock prevention

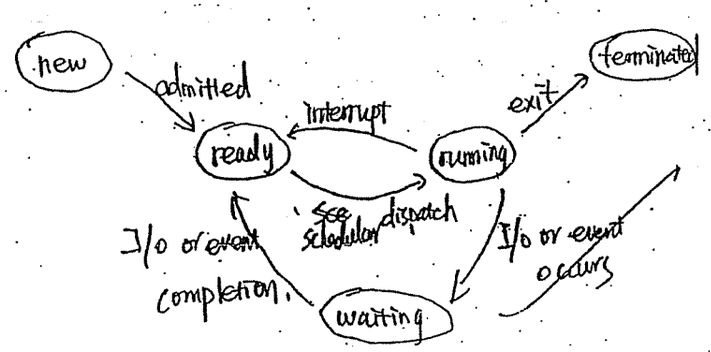
C. deadlock detection D. deadlock recovery

三、Judge the following statements, if right tick √, or X (1 point * 10)

1. (√) Modern Operating Systems are interrupt driven.
2. (X) Spooling technology can be used to increase the speed of slow peripheral equipments.
3. (X) The program stored in boot control block is initialization program for OS.
4. (√) The main memory is generally the only large storage device that the CPU is able to address and access directly.
5. (X) Switch between threads can not cause the switch between processes.
6. (X) The resources that a process needs when it is running are allocated to the process when it is created.
7. (√) If the time slice is too large, RR scheduling degenerates to FCFS policy.
8. (X) Both Monitor and semaphore are processes synchronization mechanisms provided by operating systems..
9. (√) A waiting process can not be waked up by itself.
10. (√) when a process is swapped out, the threads belongs to it are all swapped out at the same time.

四、Essay question (16 points)

1. (5 points) Please give the migration diagram of process with 5 states, and indicate the migration reasons.



2. (8 points) explains the following terms

(1) critical resources

The resources that can be only used by one process in a time.

(2) critical section?

Critical section is a process code segment ~~that~~ in which the critical resources ~~are accessed~~ are accessable

(3) deadlock

In a set of ProgProcess P_i, P_2占据了P_1节持的资源，P_3占据了P_2节持的资源，如此类推，P_n占据了P_{n-1}节持的资源，P_1占据了P_n节持的资源，那么这一系列Process都形成了死锁.

(4) interrupt

I/O或event向CPU发生中断请求 CPU就会停止进程来响应I/O或event提出的中断请求形成中断，

3. (3 points) Please list the three classic problems of process synchronization described in the text book.

Bounded-Buffer problem

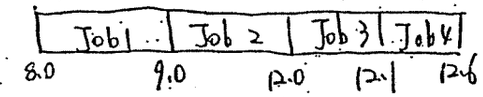
Reader-Writer problem

~~Dinner~~ 哲学家就餐问题.

五、(15 points) Given jobs as following:

	Arrival time	CPU burst time
Job1	8.0	1.
Job2	8.3	3.
Job3	9.0	0.1
Job4	9.3	0.5

(1) Draw the Gantt chart for these processes with the FCFS scheduling algorithm. What is the average turnaround time for these processes?



Job1 周转时间：1

Job2 周转时间：12.0-8.3=3.7

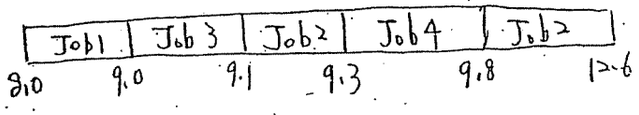
Job3 周转时间：12.1-9.0=3.1

Job4 周转时间：12.6-9.3=3.3

∴ the average turnaround time is

$\frac{1+3.7+3.1+3.3}{4} = \frac{11}{4} = 2.775$

(2) Draw the Gantt chart for these processes with preemptive SJF scheduling algorithm. What is the average waiting time for these processes?



Job1 等待时间：0

Job2 等待时间：9.1-8.3+9.8-9.3=0.8+0.5=1.3

Job3 等待时间：9-9=0

Job4 等待时间 9.3-9.3=0

∴ the ~~an~~ average waiting time is

$\frac{1.3}{4}=0.325$

(3) Draw the Gantt chart for these processes with Round-Robin scheduling algorithm with time slice of 0.6 time units. What is the average waiting time for these processes?

Job1 等待时间：~~0+9.8-8=1.8~~ 0+9.8-8.6=1.2 ×

8.0 1
8.3 3
9.0 0.1
9.3 0.5

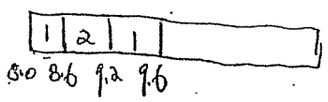
Job2 等待时间：8.6-8.3+10.2-9.2=0.3+1=1.3

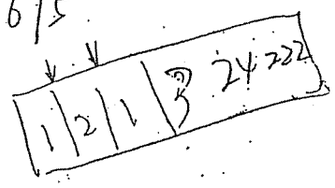
Job3 等待时间：9.2-9=0.2

Job4 等待时间：9.3-9.3=0

∴ the average waiting time is ~~$\frac{1.8+1.3+0.2}{4}=\frac{3.3}{4}=0.825$~~

$\frac{1.2+1.3+0.2}{4}=\frac{2.7}{4}=0.675$





六、(1 points*8) There are several procedures and consumers, assume they share a pool of buffer, and the pool of buffer consists of n buffers, each capable of holding one item.

The mutex semaphore provides mutual exclusion for accesses to the buffer pool and is initialized to the value 1. The empty and full semaphores count the number of empty and full buffers, respectively. The semaphore empty is initialized to the value n; the semaphore full is initialized to the value 0.

Complete the following program with wait and signal operations on *empty, full,* and *mutex*;

```
Var full, empty, mutex: semaphore;
Begin
    Full:=0;    Empty:=n;    Mutex:=1;
Parbegin
    Producer:
    Do{
        ...
        produce an item in nextp;
        ...
        (1)    wait(empty)  wait(empty)
        (2)    signal(mutex)  signal(mutex)  wait(mutex)
        add nextp to buffer;
        (3)    wait(mutex)  wait(mutex)
        (4)    signal(full)  signal(full)
    } while(1);
Consumer:
    Do{
        (5)    wait(full)
        (6)    signal(mutex)
        ...
        remove an item from buffer to nextc;
```

...

(7)
(8)

signal (mutex)

signal (empty)

Consume the item in nextc;

} while(1);

parend;

end.

七、 (17 points) For the system described in the table below

process	Current allocation			Maximum needs			outstanding requests			Available		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
P_1	2	0	0	2	0	1	0	0	1	0	2	0
P_2	1	2	0	2	5	2	0	0	1			
P_3	0	1	1	1	4	2	0	0	0			
P_4	0	0	1	2	0	1	1	0	0			

a) How many instances are there for each type of resources?

R_1: 3

R_2: 5

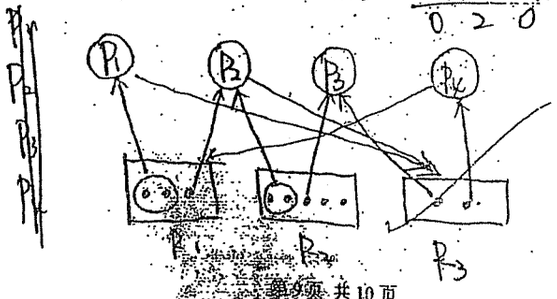
R_3: 2.

b) Draw the resource-allocation graph.

Allocation Max Available Need

R_1 R_2 R_3 R_1 R_2 R_3 P_1 R_2 R_3 R_1 R_2 R_3

0 2 0



c) Is the system in a safe or unsafe state? Specify your judging procedure.

Available

0 2 0

P_3 0 3 1

A max

Need Available

R_1 R_2 R_3 R_1 R_2 R_3

P_1 0 0 1 0 2 0

P_2 1 3 2

P_3 1 3 1

P_4 2 0 0

∵ Need ≤ Available 不成立

∴ 是不安全的.

d) Is the system deadlocked? Specify your judging procedure.

Available

0 2 0

P_3 0 3 1

P_1 2 3 1

P_2 3 5 1

P_4 3 5 2

~~0不是无穷大~~

∴ <P_3, P_1, P_2, P_4> 序列

∴ 不是死锁.

班级：0544　　班内序号 07　　姓名：张静

北京邮电大学 2007——2008 学年第 1 学期

《操作系统》期中考试试题

注意事项	一、学生必须按照监考教师指定座位就坐。 二、书本、参考资料、书包等与考试无关的东西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卷上，做在草稿纸上一律无效。

题号	一	二	三	四	五	六	七	总分
满分	20	14	10	16	15	8	17	100
得分								

一、FILL IN BLANKS (1 point * 20)

1. Programming interface provided by operating system is system call.
2. Instructions that can only be executed by operating system are privileged (特权) instructions.
3. The most 3 basic states of processes are ready, running, and waiting.
4. To prevent user programs from interfering with the proper operation of the system, the hardware has two modes, they are user mode and monitor (kernel) mode.
5. A trap is a software-generated interrupt caused either by an error or by a specific request from a user program that an operating system service be performed.
6. There are 3 jobs, their running time are 2, 5, and 3 hours. Assume they arrive at the same time, running on the same processor in single programming method; running sequence (2,3,5) will have the least average turnaround time. (1+3+2)
7. The value of a semaphore specifies some meaning, if it's value is greater than or equal to zero, the value stands for the number of available resources, if it is less than zero, its absolute value stands for the number of process waiting for this type of resource. Operations on semaphores are initialization, wait, and signal.
8. Two communication methods between processes are message passing and shared memory.
9. Programs loaded into and running in memory refers to processes. It needs certain resources, including CPU, memory, files, and I/O devices to accomplish its task.
10. 3 conditions that a good solution for critical section problems should satisfy are Mutual Exclusion, Progress, and Bounded-waiting.
11. A time-shared computer system uses Round-Robin (CPU) scheduling scheme and multiprogramming to provide each user with a small portion of CPU time.
12. Monitor 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.
13. With respect to deadlocks, a system is safe if the system can allocate resources to each process (up to its maximum) in some order and still avoid a deadlock.

二、Select the best answer for each blank (1 point * 14)

1. Contents of interrupt vector are ___B___.
   A. begin address of sub-programs
   B. begin addresses of interrupt handling programs
   C. the address of begin addresses of interrupt handling programs
   D. begin address of handling programs

2. In multiprogramming system, in order to guarantee the integrality of shared variable, processes should enter their critical section mutual exclusively. Critical section refers to ___D___.
   A. a buffer B. a data segment
   C. synchronous mechanism D. a code segment

3. User process creates a new process by calling system call fork(), before calling fork(), the user process is running in ___B___; during running fork(), the user process is running in ___A___.
   A. kernel mode B. user mode
   C. kernel mode or user mode D. internal mode

4. In multiprogramming systems, several processes can be running concurrently in memory and does not interfere each other. This is implemented by using ___B___.
   A. memory allocation B. memory protection
   C. memory extension D. address mapping

5. Among the following migrations, ___C___ is impossible?
   A. running→ready B. running→waiting
   C. waiting→running D. running→terminate

6. ___C___ is not included in the context of process?
   A. code B. PCB C. interrupt vector D. kernel stack

7. Which of the following system has strict time constrain? ___D___
   A. distributed system B. time-sharing system
   C. interactive system D. real time system

8. When does a process migrate from waiting state to ready state? ___B C___
   A. time slice is used up B. process is selected by scheduler
   C. event that the process is waiting for occurs
   D. the process is waiting for an event

9. Two concurrent processes are ___D___
   A. Mutual Exclusion B. synchronous
   C. independent D. either synchronous or mutual exclusion

10. In time-sharing Operating System, if time slice is given, in which case of the following, response time is more long? ___C B___
    A. the number of users is less B. the number of users is more
    C. the memory space is less D. the memory space is more

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

12. 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. ___D___
    A. 3 B. 2 C. 1 D. 0

13. The Banker Algorithm is used for ___A___
    A. deadlock avoidance B. deadlock prevention
    C. deadlock detection D. deadlock recovery

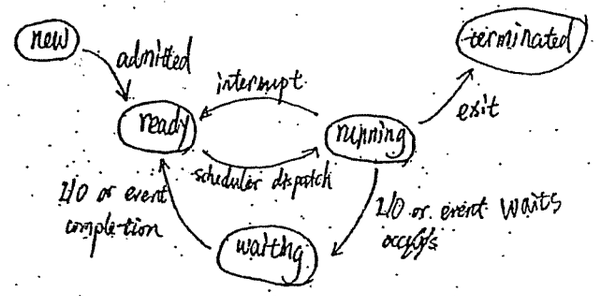
三、Judge the following statements, if right tick √, or X (1 point * 10)

1. (√) Modern Operating Systems are interrupt driven.
2. (X) Spooling technology can be used to increase the speed of slow peripheral equipments.
3. (X) The program stored in boot control block is initialization program for OS.
4. (√) The main memory is generally the only large storage device that the CPU is able to address and access directly.
5. (X) Switch between threads can not cause the switch between processes.
6. (X) The resources that a process needs when it is running are allocated to the process when it is created.

7. (√) If the time slice is too large, RR scheduling degenerates to FCFS policy.
8. (×) Both Monitor and semaphore are processes synchronization mechanisms provided by operating systems..
9. (√) A waiting process can not be waked up by itself.
10. (√) when a process is swapped out, the threads belongs to it are all swapped out at the same time.

四、Essay question (16 points)

1. (5 points) Please give the migration diagram of process with 5 states, and indicate the migration reasons.



2. (8 points) explains the following terms

(i) critical resources

The critical resource is one that can be used by only one process at a time.

(2) critical section?

The critical section is a code segment in which the critical resource is accessed. program

(3) deadlock

If a set of Processes P_i, each process is hold and wait, and P_2 hold the resource P_1 is waiting; P_3 hold the resource P_2 is waiting ---, P_i hold the resource P_{i-1} is waiting, P_1 hold the resource P_i is waiting, then the set of Processes deadlocked.

(4) interrupt

The hardware or I/O devices send a request to CPU and CPU paused the process which is running; to response the request refers to interrupt.

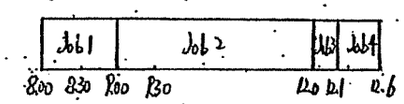
3. (3 points) Please list the three classic problems of process synchronization described in the text book.

Bounded-Buffer Problem
Writer-Reader Problem
Dinner-Philosopher Problem

五、(15 points). Given jobs as following:

	Arrival time	CPU burst time
Job1	8.00	1.00
Job2	8.30	3.00
Job3	9.00	0.10
Job4	9.30	0.50

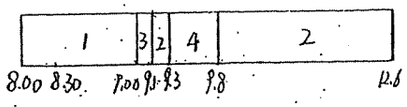
(1) Draw the Gantt chart for these processes with the FCFS scheduling algorithm. What is the average turnaround time for these processes?



turnaround time: Job1: 9.00-8.00 = 1.00.
Job2: 10.0-8.30 = 3.30
Job3: 10.1-9.00 = 3.10
Job4: 10.6-9.30 = 3.30

∴ The average turnaround time is: $\frac{1.00+3.30+3.10+3.30}{4} = 2.78$

(2) Draw the Gantt chart for these processes with preemptive SJF scheduling algorithm. What is the average waiting time for these processes?



waiting time: Job1: 0

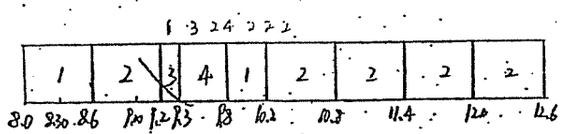
Job2: (9.1-8.3)+(9.8-9.3) = 0.8+0.5=1.3

Job3: 0

Job4: 0

∴ The average waiting time is $\frac{1.3}{4}$ = 0.325 ≈0.33

(3) Draw the Gantt chart for these processes with Round-Robin scheduling algorithm with time slice of 0.6 time units. What is the average waiting time for these processes?



waiting time: Job1: 0+(9.8-8.6) = 1.2

Job2: (8.6-8.3)+(10.2-9.2) = 1.3

Job3: 9.2-9.0 = 0.2

Job4: 0

∴ The average waiting time: $\frac{1.2+1.3+0.2}{4}$ = 0.675 ≈0.68

六、(1 points*8) There are several procedures and consumers, assume they share a pool of buffer, and the pool of buffer consists of n buffers, each capable of holding one item.

The mutex semaphore provides mutual exclusion for accesses to the buffer pool and is initialized to the value 1.The empty and full semaphores count the number of empty and full buffers, respectively. The semaphore empty is initialized to the value n; the semaphore full is initialized to the value 0.

Complete the following program with wait and signal operations on *empty, full,* and *mutex*.

```
Var full, empty, mutex: semaphore;
Begin
   Full:=0;   Empty:=n;   Mutex:=1;
Parbegin
   Producer:
      Do{
         ...
      produce an item in nextp;
      ...
```

(1) wait (empty);

(2) wait(mutex);

```
      add nextp to buffer;
```

(3) signal (mutex);

(4) signal (full);

```
      } while(1);
```

```
Consumer:
   Do{
```

(5) wait (full);

(6) wait (mutex);

```
      ...
      remove an item from buffer to nextc;
```

...

(7) signal (mutex);

(8) signal (empty);

Consume the item in nextc;

} while(1);

parend;

end.

七、 (17 points) For the system described in the table below

process	Current allocation			Maximum needs			outstanding requests			Available		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
P_1	2	0	0	2	0	1	0	0	1	0	2	0
P_2	1	2	0	2	5	2	0	0	1			
P_3	0	1	1	1	4	2	0	0	0			
P_4	0	0	1	2	0	1	1	0	0			

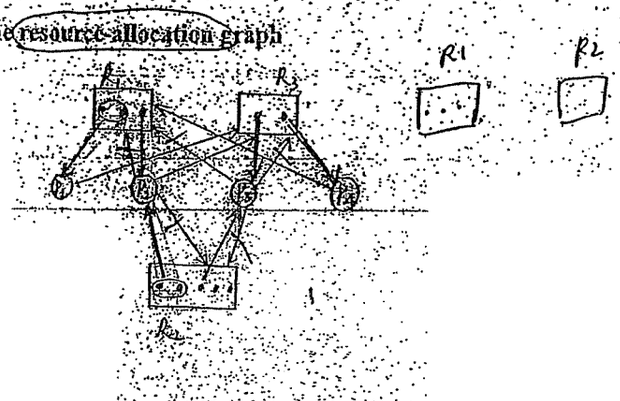
a) How many instances are there for each type of resources?

R_1: 3

R_2: 5

R_3: 2

b) Draw the resource-allocation graph



c) Is the system in a safe or unsafe state? Specify your judging procedure.

The matrix of Need,

	Need			Available		
	R_1	R_2	R_3	R_1	R_2	R_3
P_1	0	0	1	0	2	0
P_2	1	3	2			
P_3	1	3	1			
P_4	2	0	0			

The condition Need ≤ Available can't be statify, so the system is in an unsafe state.

d) Is the system deadlocked? Specify your judging procedure.

	Requests			Available		
	R_1	R_2	R_3	R_1	R_2	R_3
P_1	0	0	1	0	2	0
P_2	0	0	1			
P_3	0	0	0			
P_4	1	0	0			

So, Now, the available resource can't only exist of sequence $\langle P_3, P_1, P_2, P_4 \rangle$ the processes P_1, P_2, P_4 are deadlocked, due to allocated, so the system is not deadlocked.

	0	2	0
P_3	0	3	1
P_1	2	3	1
P_2	3	5	1
P_4	3	5	2

北京邮电大学 2009–2010 学年第一学期

计算机科学与技术学院(07405~07408)

"Operating Systems" Test（1）

注 意 事项	第 1 题须用英文应答，中文答对得一半分。

Class 07406 No 26 Name 姜正刚

1. Fill in blanks. (1×11 points)

(1) The programming interface provided by OS is called system call.

(2) A software generated interrupts caused by an error or by specific request from user program that an operation system service be performed is called trap.

(3) There are two common models of process communications, i.e. massage passing and memory sharing communications

(4) A signal is used in Unix systems to notify a process that a particular event has occurred.

(5) To protect the OS and all other programs and their data from any malfunctioning program, hardware protection is needed. Two separate CPU modes of operation: monitor mode, and user mode are provided.

(6) To manage the process executing, OS records the state and other information (e.g. the priority) of the process in PCB.

(7) The scheduling criteria include CPU utilization, throughput, turnaround time, waiting time, and responsing time.

(8) There are 3 jobs (i.e. J1, J2, J3), their running time are 7, 2, and 4 seconds respectively. Assume they arrive at the same time, running on the same processor in single programming method; running seqnence J2, J3, J1, will have the least average turnaround time.

(9) For *n* concurrent processes that mutual exclusively use some resources, the code segmentations, in which the processes access the resources, are called critical section.

(10) When a computer is powered on, the procedure of starting a computer by loading the OS kernel is known as booting the system.

(11) The number of process in main memory is defined as degree of multiprogram.

2. Choice (1× 23 points)

(1) Which one of the following operating systems belongs to the Unix-based OS? C

A. Mac OS　　B. DOS

C. Sun Solaris2　　D. Redhat

(2) Point out the architecture characteristics of the following operating systems

A. micro-kerne　　B. layered

C. ill/simple-structured　　D. kernel

Unix: (D)　　Mac: (A)

DOS: (C)　　OS/2: (B)

(3) Which one of the following OS belongs to the single-user operating system? B

A. Sun Solaris2　B. DOS　D. Fedral　C. Windows NT

(4) Considering the virtual machine modes, VMware belongs to C

A. hardware virtualization　　B. logical virtualization

C. software virtualization　　D. application virtualization

(5) Which one is not the main task of an operating system? C

A. Process management　　B. File management

C. Language compilation　　D. memory management

(6) D. systems have well defined, fixed time constraints. Processing must be done within the defined constrains, or the system will fail.

A. Multi-processor B. Network C. Clustered D. Real-time

(7) Which one of the following is not considered as the main advantages of multiprocessor system? C.

A. Increased throughput B. Increased reliability

C. More convenience D. Economy of scale

(8) A multiple-processor system has *n* processors and supports multiple-thread programming, the maximum number of threads being in the running states is B.

A. n/2 B. n C. 2n D. not limited

(9) Considering m processes, which mutual exclusively use the resource type A of n instances (m>n). A semaphore S is designed to synchronize these processes. The maximum and minimal values are B. respectively.

A. $m, -m+n$ B. $n, -m+n$ C. $n, -m$ D. m, n

(10) 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

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

(11) With respect to the following descriptions about CPU scheduling,

i) Round Robin scheduling is fit for the real-time systems.

ii) with respect to the throughput for a given set of processes, SJF is optimal.

iii) the preemptive priority algorithm is starvation-free, guaranteeing that no process waits indefinitely for service.

iv) medium-term scheduling is responsible for process swapping.

, the correct statements are D

A. i), ii) B. iii), iv)

C. i) ii), iii) D. iv)

(12) Here are some statements about processes and threads,

i) The thread is the basic unit of memory allocation for program execution in computer systems.

ii) For process state transitions, the migration from waiting to running is impossible

iii) When CPU switch from process to process, the contents of CPU registers are not saved in PCB

iv) An I/O-bound process spends more of its time doing I/O operation than it spends doing computation.

, the correct descriptions are B. :

A. i), ii) B. ii), iv)

C. i), iii) D. iii), iv)

(13) Considering the following statements,

i) Banker Algorithm is used for deadlock prevention, applicable to the systems with multiple instances of each resources.

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

iii) the current value of a counting semaphore S is -3, then there are 3 process waiting in the queue relevant to S.

iv) denying the mutual-exclusion condition is a good choice for deadlock prevention.

, the correct descriptions are D :

A. i), ii) , iv) B. ii), iii), iv)

C. i), iii) D. ii), iii)

(14) In which condition, the scheduler *will not* take the control of CPU and then make scheduling decisions, that is, CPU scheduling *will not* occur : C.

A. the running process switches from running to waiting state. (I/O requests)

B. the running process terminates

C. the running process switches to execute a system call.

D. the running process switches from running to ready state (for example, interrupts occurs)

(15) Which of the following information are not contained in PCB? C.

A. Process state B. Program counter

C. User data D. CPU registers

(16) C is the set of processes waiting for an I/O device.

A. Ready queue B. Job queue C. Device queues

(17) For an interactive time-sharing system, which one of the following scheduling algorithms is a best choice? C.

A. FSFS B. SJF C. Round Robin D. priority-based scheduling

(18) A A spends more of its time doing I/O operation than it spends doing computation.

A. I/O-bound process B. CPU-bound process

C. cooperating process D. independent process

(19) If a real-time system can deal with 5 real-time processes and 5 non real-time processes in 500ms, the throughput of this system is C.

(F)

500/ms. 10×2

2

A. 25/s B. 40 /s C. 20/s D. 10/s

(20) In which condition, switching from user mode to kernel mode will not occur?

A. interrupts B. traps C. subroutine calls D. system calls

3. Judgments: True or False (1×6 points) 5

(1) System calls provide programming interfaces between processes and the operating system kernels. (T)

(2) Each thread shares with other threads belonging to the same process its code section, data section, and other resources (e.g. I/O devices). (T)

(3) The cost of thread context switching is less than that of process context switching. (T)

(4) A good interactive system should maximize response times. (F)

(5) HT (acronym for Hyper Thread) is one technique of speeding up of program executing, provided by OS (T) X

(6) Given *n* processes that entering into the systems at same time, for the scheduling algorithms FCFS, priority-based scheduling, SJF and round robin, the throughputs for these four algorithms are different. (F)

4. Describe the principle of signals, what is the difference between the signal and interrupt? (8 points)

Answers: A signal is generated by the occurance of a particular event, a generated signal is delivered to a process. once delivered, the signal must be handled.

interrupt: When some events occur, the programs currently running on the CPU are interrupted, CPU control is transferred to the interrupt service routine to handle the events.

Difference: The signal is processed by the OS. The interrupts are processed by the CPU.

5. (5 points) Describe the principle of pipe-based inter-process communications.

Answer: 相互通信的进程由一个共享文件(管道)连接.
管道是用于连接读进程和写进程以实现它们之间通信的软件,向管道提供输入的发送进程以字符流形式将大量数据送入管道.而接收管道输出的接收进程则从管道中接收数据。

6. (15 points) In a computer system, the users submit to the system their computational tasks as jobs, and all these jobs are then stored as the standby jobs on the disk.

The job scheduler (also known as *long-term scheduler*) selects the standby jobs on the disk, creates new processes in memory for them, and then starts executing these processes. Each job's ID is the same as that of the process created for it, for example, J_i and P_i.

When the number of concurrent processes in memory is lower than *three*, the job scheduler takes the FCFS algorithm to select a standby job on the disk to create a new process. Otherwise, the processes should wait in the disk.

For the processes in memory, the process scheduler (also known as *short-term scheduler*) takes the non-preemptive priority-based algorithm to select a process and allocates the CPU to it.

It is assumed the system costs resulting from job and process scheduling are omitted.

Consider the following set of Jobs J_1, J_2, J_3 , J_4 and J_5. For $1 \le i \le 5$, the arrival time of each J_i , the length of the CPU burst time of each process P_i, and the priority number for each J_i/P_i are given as below, and a smaller priority number implies a higher priority.

Job	Arrival Time	Burst Time (minute)	Priority Number
J_1	14:00	40	4
J_2	14:20	30.01	2
J_3	14:30	50.01	3
J_4	14:50	20.01	5
J_5	15:05	10.01	5

14:40 3. J4 J1 J2

(1) Illustrate the execution of each job/process by charts.

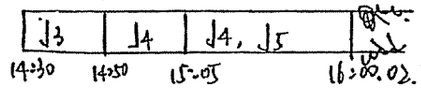
(2) What is the turnaround time of each job?

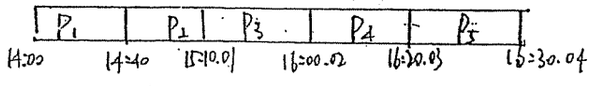
(3) What is the waiting time of each job?

Note: The waiting time of a job includes the time it waits on the disk and that it waits in memory.

14

Answer: (1).





(2). 周转时间: P_1的周转时间: 40. P_3周转时间: 90.02 P_5周转时间: 85.04
P_2的周转时间: 50.01. P_4周转时间: 90.03

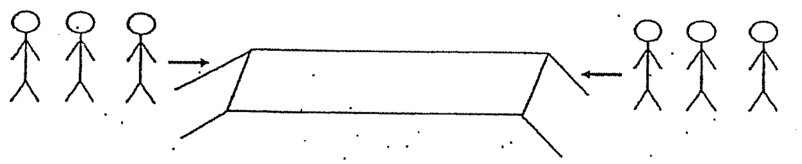
鞠治神

学五复印店 $J_1=0$, $J_2=20$, $J_3=40.01$, $J_4=70.02$, $J_5=(X)75.03$

鞠治神

7. (15 points) As illustrated in the figure, on the two sides of a one-plank bridge(独木桥), there are two groups of soldiers that are composed of *m* and *n* people respectively and need to cross the bridge, but the narrow bridge allows only one group of the soldiers in the same direction to cross at the same time. One group of the soldiers is permitted to cross as long as there are no people on the bridge. Once one group of the soldiers begins walking on the bridge, the other group should be waiting to start crossing until all members of the first group have passed the bridge.

12



Please design two semaphore-based processes to describe the crossing actions of the soldiers in the two groups. It is required

(1) to define the semaphores and variables needed, explain their roles?, and give their initial values; and

(2) to illustrate the structures of processes for the soldiers in each group.

Answers: Define semaphore mutex1 = mutex2 = 1. 对应m.n.两队伍.
signal. bridge = 1. 对应桥.
int ~~count1 = count2 = 0. 对应上桥人数.~~
count1 = m. count2 = n;

P1 { ~~(对应方边)~~ // 对应方边.
count1 = count1 + 1;
~~if(count==1) then P(bridge);~~
V(mutex1);
~~过独木桥;~~
P(mutex1);

count1 = count1 - 1;
if(count1==0) then V(bridge);
V(mutex);

P2: (对应方边)
count2 = count2 + 1;
if(count2==1) then P(bridge);
V(mutex2);

过桥:
P(mutex2);
count2 = count2 - 1;
if(count2==0) then V(bridge);
V(mutex2);

P(mutex1)
count1 = count1 - 1;
if(count1 == m-1)
P(bridge);
V(mutex1);
过桥.
if(count1 > 0)
~~P(mutex1)~~ (P1)

if(count ==0)
V(bridge);
}
P2 { ~~对应方边工~~ // 对应方边.
P(mutex2);
count2 = count2 - 1;
if(count2 == n-1)
P(bridge);
V(mutex2);
过桥
if(count2 > 0)
P
if(count ==0)
V(bridge);
V(mutex2);
}.

当P1的第一个人上桥获得控制权后,
保证所有人都过桥,才放开控制权
的人过桥

8. (7 points) Describe the Bakery Algorithm for synchronization among n (>2) processes.

Answer: Define: (a, b) < (c, d). if (a<c) || (a==c && b<d)
max(a[0], ..., a[n-1]) · k ≥ ai for i=0, ..., n-1

boolean choosing[n]; // 申请
int number[n]; // 票号
do {
choosing[i] = true; // 开始申请
num[i] = max(num[0], num[1], ..., num[n-1]); // 得到票号
choosing[i] = false; // 结束申请
for(j=0; j<=n; j++)
{
while(choosing[j]); // 等待所有进程申请完
while(number[j] && (number[j], j) < (number[i], i)); // 等待所有票号小于自身的进程访问结束
}
critical section,
number[i] = 0; // 退出临界区

remember section

学五复印店

9. (10 points) Consider the following snapshot of a system

	Allocation			Max			Need			Available		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
P_1	1	0	0	3	2	2	2	2	2	2	1	2
P_2	4	1	1	6	1	3	2	0	2			
P_3	2	1	1	3	1	4	1	0	3			
P_4	0	0	2	4	2	2	4	2	0			

(1) Fill in the contents of the matrix *Need* for each process in the space above.

(2) Is the system in a safe state? If it is safe, give the safe sequence.

(3) If both P_1 and P_2 make resource requests of <1, 0, 1>, how should we grant the requests while keeping the system in a safe state?

Answers: (2). Safe sequence: Available.

P_2 6 2 3.
P_1 7 2 3
P_3 9 3 4
P_4 9 3 6.

(3). If we first grant the P_1's request, it shouldn't be a safe state, since: request (1, 0, 1) < need, (2, 2, 2)
request (1, 0, 1) < available (2, 1, 2)
and then the modifies available = (1, 1, 1)
the condition Need < Available doesn't be satisfied.

So, we first grant the P_2's request.
request (1, 0, 1) < Need, (2, 0, 2)
request (1, 0, 1) < Available (2, 1, 2)
then the modifies Available = (1, 1, 1)
Need, = (1, 0, 1)
Allocation, = (3, 1, 2)
So we can get the safe sequence: P_2, P_1, P_3, P_4. 将给 P_2 下.
then we ~~dig~~ to grant the P_1's request.
request (1, 0, 1) < Need, (1, 2, 2)
request (1, 0, 1) < Available (1, 1, 1)
then the modifies Available = (~~1, 0,~~ 0, 1, ~~1~~)
~~the condition Need < Available doesn't be satisfied.~~
So we can ~~not~~ keeping the system is a safe state.

北京邮电大学 2012--2013 学年第一学期

计算机科学与技术学院

"Operating Systems" Test（1）

Class_____No_____Name_____

1. Choices（21 points）

(09：3)

23. 单处理机系统中，可并行的是（D）

I. 进程与进程 II. 处理机与设备 III.处理机与通道 IV. 设备与设备

A. I, II, III B. I, II, IV C. I, III, IV D. II, III, IV

24. 下列进程调度算法中，综合考虑进程等待时间和执行时间的是（D）

A. 时间片轮转法调度 B. 短进程优先调度

C. 先来先服务调度 D. 高响应比优先调度

25. 某计算机系统有 8 台打印机，有 K 个进程竞争使用，每个进程最多需要 3 台打印机。该系统可能会发生死锁的 K 的最小值是（B）

A. 2 B. 3 C. 4 D. 5

(10：5)

23. 下列选项中，操作系统提供给应用程序的接口是（A）

A. 系统调用 B. 中断 C. 库函数 D. 原语

24. 下列选项中，导致创建新进程的操作是（D）

I. 用户成功登陆 II。设备分配 III. 启动程序执行

A. 仅 I, II B. 仅 II, III C. 仅 I, III D. 仅 I, II, III

25. 设与某资源相关联的信号量初值为 3，当前值为 1。若 M 表示该资源的可用个数，N 表示等待资源的进程数，则 M, N 分别是 B

A. 0,1 B. 1, 0 C. 1, 2 D. 2, 0

26. 下列选项中，降低进程优先级的合理时机是（A）

A. 进程时间片用完 B. 进程刚完成 I/O，进入就绪队列

C. 进程长期处于就绪队列中 D. 进程从就绪态转为运行态

27. 进程 P0、P1 的共享变量及其初值为

```
boolean flag [2];
int turn=0;
flag [0] =false; flag [1] = false
```

进程 P0、P1 访问临界资源的类 C 代码实现如下：

```
Void P0() // 进程 P0
{While (TRUE){
flag[0]=true; turn=1;
   while (flag[1]&&turn==1)
临界区;
flag[0]=false;
}
}
```

```
Void P1() // 进程 P1
{While (TRUE)}
 flag[1]= true; turn=1;
   while (flag[1]&&turn==1)
临界区;
flag[1]=false;
}
}
```

则并发执行 P0 和 P1 时产生的情况是（D）

A. 不能保证进程互斥进入临界区，会出现“饥饿”现象；

B. 不能保证进程互斥进入临界区，不会出现“饥饿”现象；

C. 能保证进程互斥进入临界区，会出现“饥饿”现象；

D. 能保证进程互斥进入临界区，不会出现“饥饿”现象；

(11：3)

23. 下列选项中，满足短任务优先且不会发生饥饿现象的调度算法是（B）

A. 先来先服务 B. 高响应比优先

C. 时间片轮转法 D. 非抢占式短任务优先

24. 下列选项中，在用户态执行的是（A）

A. 命令解释程序　　B. 缺页处理程序

C. 进程调度程序　　D. 时钟中断处理程序

25. 在支持多线程的系统中，进程 P 创建的若干个线程不能共享的是（D）

A. 进程 P 的代码段　　B. 进程 P 中打开的文件

C. 进程 P 的全局变量　　D. 进程 P 中某线程的栈指针

(12：5)

27. 假设 5 个进程 P0、P1、P2、P3、P4、P5 共享三类资源 R1、R2、R3，这些资源总数分别为 18、6、22。T0 时刻的资源分配情况如下表所示，此时存在的一个安全序列是（D）

进程	已分配资源 Allocation			资源最大需求 Max		
	R1	R2	R3	R1	R2	R3
P0	3	2	3	5	5	10
P1	4	0	3	5	3	6
P2	4	0	5	4	0	11
P3	2	0	4	4	2	5
P4	3	1	4	4	2	4

A. P0, P2, P4, P1, P3　　B. P1, P0, P3, P4, P2

C. P2, P1, P0, P3, P4　　D. P3, P4, P2, P1, P0

28. 若一个用户进程通过 read 系统调用读取一个磁盘文件中的数据，则关于此过程的叙述中，正确的是（C）

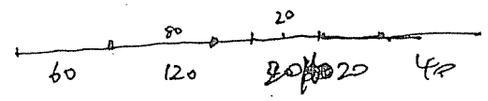
I. 若该文件不在内存，则该进程进入睡眠等待状态

II. 请求 read 系统调用会导致 CPU 从用户态切换到核心态

III. Read 系统调用的参数应包含文件的名称或标识

A. 仅 I、II　　B. 仅 I、III　　C. 仅 II、III　　D. I、II、III

29. 一个多道批处理系统中仅有 P1 和 P2 两个作业，P2 比 P1 晚 5ms 到达，它们的计算和 I/O 操作顺序如下：



P1：计算 60ms，I/O 80ms，计算 20ms

P2：计算 120ms，I/O 40ms，计算 40ms

若不考虑调度和切换时间，则完成两个作业需要的时间最少是（B）

A. 240ms　　B. 260ms　　C. 340ms　　D. 360ms

30. 若某单处理器多进程系统中有多个就绪态进程，则下列关于处理机调度的叙述中错误的是（C）

A. 在进程结束时能进行处理机调度

B. 创建新进程后能进行处理机调度

C. 在进程处于临界区时不能进行处理机调度

D. 在系统调用完成并返回用户态时能进行处理机调度

31. 下列关于进程和线程的叙述中，正确的是（A）

A. 不管系统是否支持线程，进程都是系统资源分配的基本单位

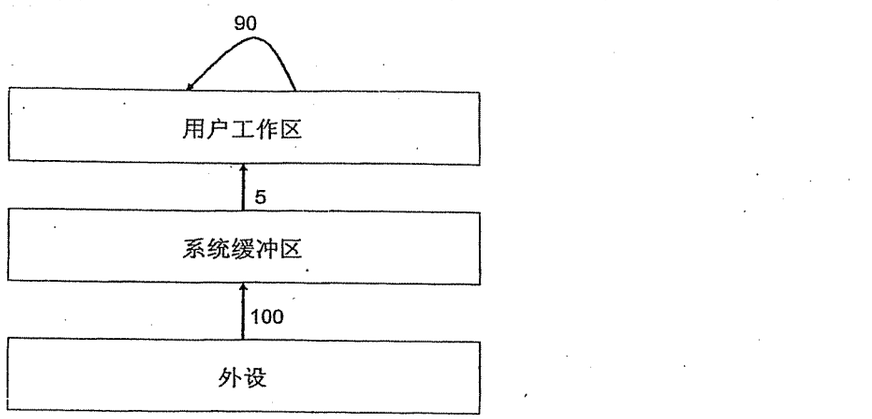
B. 线程是资源分配的基本单位，进程是调度的基本单位

C. 系统级线程和用户级线程的切换都需要内核的支持

D. 同一进程中的各个线程拥有各自不一的地址空间

(13：5)

32. 设系统缓冲区和用户工作区均采用单缓冲区，从外设读入 1 个数据块到系统缓冲区的时间为 100，从系统缓冲区读入 1 个数据块到用户工作区的时间为 5，对用户工作区中的 1 个数据进行分析的时间为 90（如下图所示），进程从外设读入并分析 2 个数据块的最短时间是（B）



A. 200　B. 295　C. 300　D. 390

28. 下列选项中，能导致用户进程从用户态切换到内核态的操作是（　）

Ⅰ. 整数除零　Ⅱ. sin()函数调用　Ⅲ. read 系统调用

A. 仅 Ⅰ、Ⅱ　B. 仅 Ⅰ、Ⅲ　C. 仅 Ⅱ、Ⅲ　D. Ⅰ、Ⅱ、Ⅲ

29. 计算机开机后，操作系统最终被加载到（　）

A. BIOS　B. ROM　C. EPROM　D. RAM

31. 某系统正在执行三个进程 P1、P2 和 P3，各进程的计算（CPU）时间和 I/O 时间比例如下

进程	计算时间	I/O 时间
P1	90%	10%
P2	50%	50%
P3	15%	85%

为提高系统资源利用率，合理的进程优先级设置应为（　）

A. P1>P2>P3　B. P3>P2>P1　C. P2>P1=P3　D. P1>P2=P3

32. 下列关于银行家算法的叙述中，正确的是（　）

A. 银行家算法可以预防死锁

B. 当系统处于安全状态时，系统中一定无死锁进程

C. 当系统处于不安全状态时，系统中一定会出现死锁进程

D. 银行家算法破坏了死锁必要条件中的“请求和保持”条件

2. (25 points) In a computer system, the users submit to the system their computational tasks as jobs, and all these jobs are then stored as the standby jobs on the disk.

The job scheduler (also known as *long-term scheduler*) selects a standby job J_i on the disk, creates a new process P_i in memory, and then enables P_i to run.

When the number of concurrent processes in memory is lower than *three*, the job scheduler *immedietly* takes the FCFS algorithm to load a standby job on the disk into memory and create a new process. Otherwise, the jobs should wait on the disk.

For the processes in memory, the process scheduler (also known as *short-term scheduler*) takes the non-preemptive priority-based algorithm to select a process and allocates the CPU to it.

It is assumed the system costs resulting from job and process scheduling are omitted.

Consider the following set of Jobs J_1, J_2, J_3 , J_4 and J_5. For $1 \le i \le 5$, the arrival time of each J_i, the length of the CPU burst time of each process P_i, and the priority number for each J_i/P_i are given as below, and a smaller priority number implies a higher priority.

Job	Arrival Time	Burst Time (minute)	Priority Number	
J_1	14:00	50.01 ≈50	4	20
J_2	14:30	20.01 ≈20	2	0
J_3	14:40	50.01 ≈50	3	
J_4	14:50	20.01 ≈20	5	
J_5	15:05	20.01 ≈20	2	

(1) Illustrate the execution of each job/process by charts.

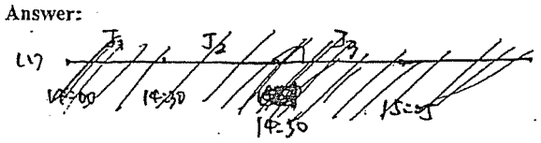
(2) What is the turnaround time of each job?

(3) What is the waiting time of each job?

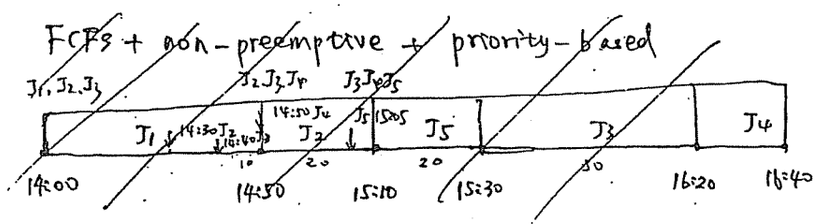
Note: The waiting time of a job J_i includes the time it waits on the disk and the time the process P_i waits in memory.

Answer:

(1)



FCFS + non-preemptive + priority-based



(2) $T_{J_1} = 50$ minute

$T_{J_2} = 20 + 20 = 40$ min

$T_{J_3} = 10 + 20 + 20 + 50 = 100$ min

$T_{J_4} = 20 + 20 + 50 + 20 = 110$ min

$T_{J_5} = 5 + 20 = 25$ min

(3) $W_{J_1} = 0$

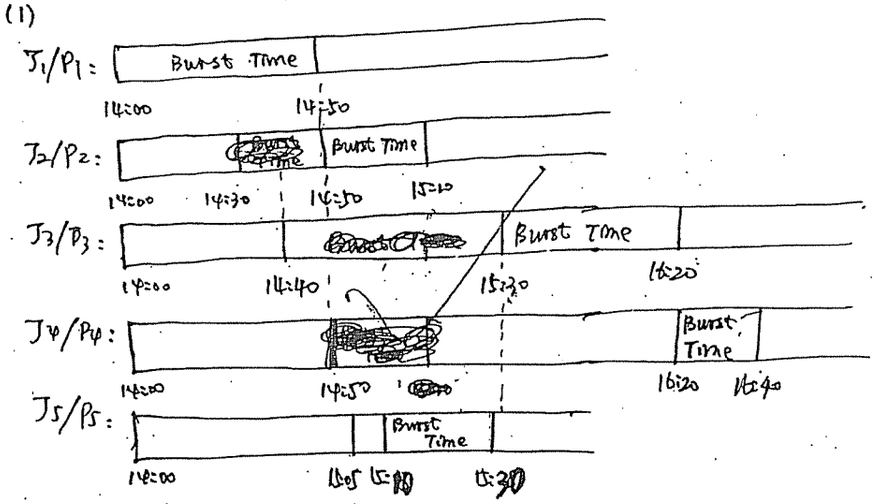
$W_{J_2} = 20 + 50 = 70$ min

$W_{J_3} = 50 + 20 + 20 + 10 + 20 + 20 = 140$ min

$W_{J_4} = [20 + 20 + 50] * 2 = 180$ min

$W_{J_5} = 5$ min

(1)



(2) $T_{J_1} = 50$ min $T_{J_2} = 40$ min

$T_{J_3} = 100$ min $T_{J_4} = 110$ min

$T_{J_5} = 25$ min

(3) $W_{J_1} = 0$ min $W_{J_2} = 20$ min $W_{J_3} = 50$ min

$W_{J_4} = 30$ min $W_{J_5} = 5$ min

3. (24 points) A computer system has one *CPU*, one *input processor* and one *printer*. Two processes A and B enter the system sequentially, and A is scheduled by the CPU scheduler at first. The execution traces of A and B are as follows:

A: CPU burst lasting 50ms, I/O burst of 100ms on the input processor, CPU burst lasting 50ms, exiting

B: CPU burst lasting 50ms, I/O burst of 80ms on the printer, CPU burst lasting 100ms, exiting

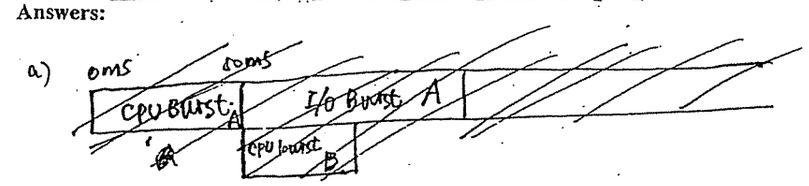
a) Draw the Gantt chart to describe the resource usage of A and B on the CPU, the input processor and the printer.

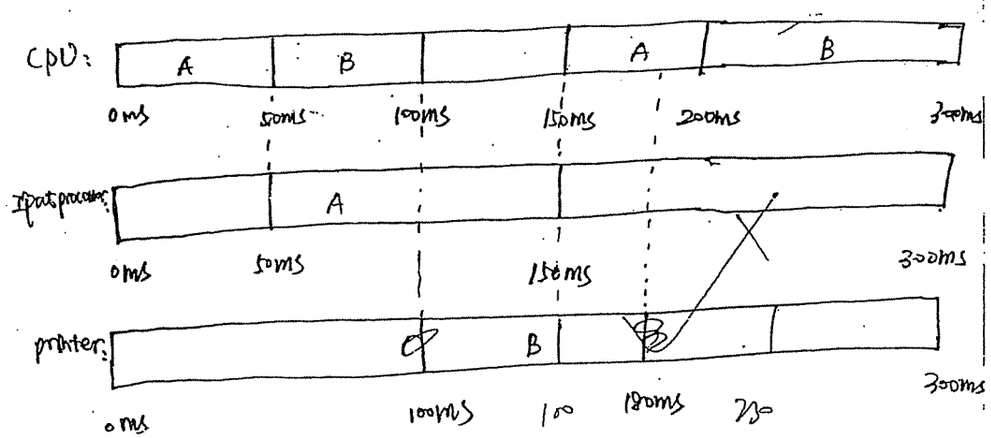
b) Calculate the waiting time and turnaround time for process A and B respectively.

Note: a process's waiting time includes the time it waits for the CPU to be available plus the time it waits for using the input processor or the printer.

Answers:

a)





b)

	Waiting time	turnaround time
A	100+0+50=150ms ✗	200ms ✓
B	50+100+100=250ms ✓	~~300ms~~ 250ms ✓

4. (30 points) Here are one keeper(保管员) and two groups of students. The keeper is responsible for managing pencils and pieces of paper. Each student in group A owns some pieces of paper, while every student in group B possesses pencils; for a student, holding pencil and paper enables him to write a letter, so the student in group A tries to gain a pencil, and the student in group B attempts to acquire a piece of paper.

There is also a little box that can contain only one pencil or one piece of paper. The box is initially empty, and the keeper *arbitrarily* put a pencil or a piece of paper into the box, then one student is permitted to fetch item he/she needs from the box. Once the student takes away a pencil or a piece of paper from the box, the keeper is allowed to supplement a new pencil or a piece of paper to the empty box. At one time, only one person is permitted to operate on the box.

(1) (20 points) Design three semaphore-based processes to describe the behaviors of the keeper, the students in group A and B.

It is required that

i) definitions and initial values of the semaphores should be given, and

ii) the structures of processes for the keeper and two groups of students should be presented.

(2) (10 points) Design a monitor-based mechanism to control the behaviors of the keeper and the students.

14

Answer:

(1) Semaphores hasspace=1, haspencil=0, haspaper=0, mutex1=1, mutex2=1;

Pkeeper:

Wait(hasspace);

① 若放笔

signal(haspencil);

② 若放纸

signal(haspaper)

PgroupA:

wait(haspencil);
wait(mutex1);
取笔;
signal(hasspace);
signal(mutex2);

PgroupB:

wait(haspaper);
wait(mutex2);
取纸;
signal(hasspace);
signal(mutex1);

(2)

monitor keeper_and_students

{

int haspencil=0, haspaper=0, count=0;

condition groupA, groupB, hasspace;

void KEEPER

{

while(count==1)

{

hasspace.wait();

count++;

若放笔:

haspencil++;

若放纸:

haspaper++;

}

}

void GROUPB

{

if(haspaper==0)

{

groupB.wait();

count--;

haspaper--;

}

}

void GROUPA

{

if(haspencil==0)

{

groupA.wait();

count--;

haspencil--;

}

}