

CITY UNIVERSITY OF HONG KONG

Course code & title : CS3103 Operating Systems

Session : Semester B 2004-2005

Time allowed : Two hours

This paper has FIVE pages including this page.

1. This paper consists of 5 questions.
2. Answer any FOUR questions.

Answer any FOUR questions. ALL questions carry 25 marks.

Question 1

a) Given the following :

Process	Arrival Time	Burst Time
p1	0	8
p2	1	4
p3	2	9
p4	3	5

i) what are the average turnaround times for these processes with the Round Robin scheduling algorithm, setting the quantum to 2 and 5 ?

(5 marks)

ii) with reference to (i) discuss how the quantum should be set

(3 marks)

iii) what are the average turnaround times for these processes with the nonpreemptive SJF and preemptive SJF scheduling algorithms ?

(6 marks)

iv) with reference to the above discuss the advantages and disadvantages of using preemptive or nonpreemptive algorithms

(3 marks)

b) Many CPU scheduling algorithms can be parameterized and different sets of algorithms can be related through parameterization. What relation holds between the following pairs of sets of algorithms ?

i) Priority based and SJF

ii) Multilevel feedback queue and FCFS

iii) Priority based and FCFS

iv) Round Robin and FCFS

(8 marks)

Question 2

a) You are given a processor that uses 16-bits address and the memory hardware can support 256 bytes frames or 4096 bytes segments. The processor also has a cache of 64 bytes to support high performance table lookup. You are asked to give FOUR proposals consisted of two paging and two segmentation addressing schemes. Your proposals have to include the address format, address translation mechanisms as well as the strength and weakness.

(16 marks)

b) Give a brief explanation of the following :

i) thrashing

ii) external fragmentation

iii) working set

(9 marks)

Question 3

- a) Consider the following pseudo codes where codes inside PARBEGIN and PAREND can execute in parallel :

i)	PARBEGIN	ii)	PARBEGIN
	x = x + 1		t1 = a + b
	x = x + 1		t2 = c + d
	PAREND		x = t1 + t2
			PAREND

Explain why unpredictable results may occur. By defining and applying the concepts of mutual exclusion and synchronization, suggest a solution for each of them.

(8 marks)

- b) Explain the behaviour of the operations Wait(S) and Signal(S) if S is :

- i) a binary semaphore
- ii) a counting semaphore

(4 marks)

The bounded-buffer problem is defined as :-

A buffer can hold a maximum of N items and it cannot be accessed by more than one process at the same time. A *Producer* process will add items to the buffer and will block when the buffer is full. A *Consumer* process will remove items from the buffer and will block when the buffer is empty.

Given the following pseudo codes :

<u>Producer</u>	<u>Consumer</u>
While (true) {	While (true) {
...	...
... produce an item	...
wait(s1)	wait(s3)
...	wait(s2)
... add item to buffer	...
...	... remove item from buffer
signal(s2)	...
...	... consume the item
}	}

- iii) fix the errors in both the Producer and Consumer processes by putting in additional wait() and signal() operations

(4 marks)

- iv) point out the type (i.e. counting or binary) and usage of the three semaphores s1, s2 and s3

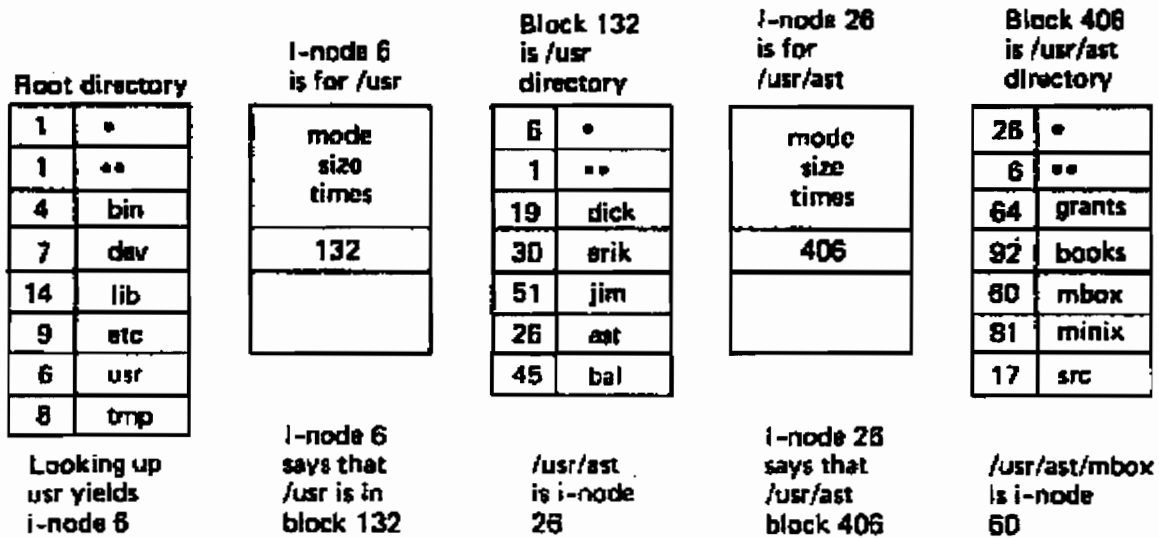
(6 marks)

- v) what are the initial values of the three semaphores so that the codes will work correctly ?

(3 marks)

Question 4

a) The following diagram shows the content of some directories in a Unix file system (S5) :



- i) Draw the directory tree that represents the above organization (2 marks)
 - ii) Which data structure in the above diagram represents the pointer in your directory tree? Briefly explain its use. (5 marks)
 - iii) Suppose /usr/ast/mobx is a file and another file name /usr/mbox is given to the same file. Show the change in your directory tree and in the directory content of the above diagram (2 marks)
 - iv) What are the strength and weakness of using a tree and a graph to implement a directory organization? (4 marks)
- b) Consider a hard disk of size 512 Mbytes has a block size of 512 bytes, calculate the following and give the answers in bytes :
- i) the size of the File Allocation Table (FAT) (2 marks)
 - ii) the size of bit map to control free and used space (2 marks)
 - iii) the size of space used by pointers if linked lists are used to control free and used space (2 marks)
 - iv) discuss the advantages and disadvantages of using the above (i) to (iii) techniques in managing BOTH free and used space (6 marks)

(Hint : you should consider the size of a pointer in bits that can address all the blocks)

Question 5

- a) The following is a C program creating a new process :

```
void main(int argc, char *argv[])
{
int pid, a = 0, b = 0;
pid = fork();
if (pid == 0 ) {
    /* location A */
    a = a + 1;
    execlp("/bin/ls", "ls", NULL);
}
else {
    b = b + 1;
    /* location B */
    wait(NULL);
    exit(0);
}
}
```

- i) what are the values of the integers pid, a and b at location A and B marked in the program source ?
(5 marks)
 - ii) justify your answers in (i) by giving a description of actions taken by the OS (Unix) in handling the fork() system call
(4 marks)
 - iii) what is the implication if the execlp() is replaced by system()?
(2 marks)
 - iv) if the above C program is a SHELL program, is it running in foreground or background mode? Explain. How can you change the mode?
(3 marks)
 - v) add codes to create a sibling process, you have to specify the location to add the coding
(2 marks)
- b) There are a number of ways to obtain system services. Some examples extracted from a search of the Unix manual about time related functions are :
- i) User Commands – times(1)
 - ii) System Calls – times(2)
 - iii) Standard C Library Functions – ctime(3C)

Explain how each type of the services is provided. Your explanation should cover activities involved starting from the service request up to the completion.

(9 marks)

*** END ***