UNIVERSITI SAINS MALAYSIA

Stamford College

First Semester Examination
2002/2003 Academic Session
September 2002

External Degree Programme
Bachelor of Computer Science (Hons.)

CTS301 – Operating Systems

Duration : 3 hours

INSTRUCTIONS TO CANDIDATE:

- Please ensure that this examination paper contains **FOUR** questions in **FIVE** printed pages before you start the examination.
- Answer **ALL** questions.
- On each page, write *only your **Student ID***.

1. (a) Briefly explain the following OS strategies and state a situation where it is being used.

(i) Time sharing

(3 marks)

(ii) Real-time

(3 marks)

(b) (i) What is multiprogramming? Compare and contrast between multiprogramming and multiprocessing.

(5 marks)

(ii) Identify two advantages threads have over multiple processes. Suggest one application that would benefit from the use of threads.

(3 marks)

(iii) What are system calls? Briefly explain the system calls `fork`, `execv` and `wait` which are used to simulate Unix shell.

(6 marks)

(c) Given the following program:

```
while (TRUE) {                          while (TRUE){
while (turn != 0 )  /* wait* /;         while (turn != 1) / * wait */ ;
critical_section () ;                   critical_section ( ) ;
turn = 1 ;                              turn = 0;
non critical_section ( );               non critical_section( );
}                                       }
```

What is race condition? Does the above solution eliminate race condition?

(5 marks)

2. (a) The following algorithm relates to the consumer process in the producer-consumer problem. [Note: The variables *next, out, n* are integers, *in* is also an integer and is the index of the integer being produced by a producer process and that *buffer* is an array of integers of size *n*].

```
WHILE  in = out  DO  no-op
next  =  buffer[out]
out = out + 1 MOD n
consume the item in  next
```

(i) Why is this called a Bounded Buffer solution?

(2 marks)

(ii) Explain each of the above statements.

(3 marks)

(b) (i) Distinguish between pre-emptive and non-preemptive scheduling and give two example algorithms for each.

(5 marks)

(ii) Five jobs are waiting to be run. Their expected run times are 9, 6, 3, 5, and X. In what order should they be run to minimise average response time? Name the scheduling algorithm that will meet this objective.
[*Hint: Your answer will depend on X*].

(5 marks)

(c) Given the five processes below with their indicated burst time, answer the question that follows. Assume processes arrive in numerical order at time 0.

Processes	Burst time
P1	5
P2	4
P3	2
P4	1
P5	8

Show the scheduling order, waiting time, and turnaround time for these processes using First-Come-First-Served, Shortest-Job-First and Round Robin with the time quantum 2.

(10 marks)

3. (a) (i) A computer has four page frames. The time of loading, time of last access, and the *R* (Reference) and *M* (Modified) bits for each page are as shown below (the times are in clock ticks):

Page	Loaded	Last ref.	R	M
0	123	284	0	0
1	233	261	1	0
2	133	277	1	1
3	189	290	1	1

I. Which page will FIFO (First In First Out) replace?

II. Which page will LRU (Least Recently Used) replace?

III. Which page will MRU (Most Recently Used) replace?

(3 marks)

(ii) If FIFO page replacement is used with four page frames and eight pages, how many page faults will occur with the reference string 0172327103 if the four frames are initially empty? Now repeat this problem for LRU.

(6 marks)

(b) Assuming contiguous allocation with partitions of sizes 800K, 500K, 200K and 600K (in that order).

How would the following processes of size 100K, 400K, 500K and 700K be allocated using:

(i) Best fit algorithm?

(ii) Worst fit algorithm?

(iii) First fit algorithm?

(6 marks)

(c) (i) What is the difference between a flat directory architecture and a hierarchial one?

(2 marks)

(ii) Using suitable diagrams explain how a file can be allocated using indexed allocation-fixed block size and indexed allocation-variable block size.

(4 marks)

(iii) The following Access Control List was used in MULTICS operating system. Each file contains the names of the users and the access permission. Given the following access information, explain briefly the access permission of each file.

File	Access
File 1	USER1 (RW-), USER2 (R-X), USER4 (RWX), USER5 (--X)
File 2	USER2 (R-X), USER3 (R-X), USER4 (--X),
File 3	USER2 (RWX), USER4 (--X)
File 4	USER1 (R-X), USER5 (RWX)

(4 marks)

4. (a) What is deadlock? State the conditions for the deadlock to occur.

(6 marks)

(b) Consider the following allocation of a resource. Assume that there are a total of 10 instances of this resource.

Process	Number Used	Maximum
P1	1	6
P2	1	5
P3	2	4
P4	4	7

(i) If P4 requests one more instance of the resource, does this lead to safe or unsafe state? Why?

(4 marks)

(ii) What happens if the request for another resource comes from process P3 instead? Why?

(4 marks)

(c) (i) Briefly explain the client/server model.

(3 marks)

(ii) The client/server model is so popular in distributed systems. Name **two (2)** example applications that use the model. What is the new computing model that is emerging within distributed systems?

(4 marks)

(iii) With the help of a diagram explain briefly the functions of the layers of the ISO OSI model.

(4 marks)

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