Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree/Diploma

in

Information Technology

Final Examination

Year 2, Semester II (2018)

IE2050 – Operating Systems

Duration: 2 Hours

October 2017

Instructions to Candidates:

- This paper has 4 questions. Answer all questions.
- Total marks 100.
- This paper contains 5 pages including the cover page.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (25 marks)

a) Explain steps in machine cycle? You may use diagrams in your answer. (4 marks)

b) What are the three types of interrupts generated in operating systems? Explain each with examples. (6 marks)

c) "Multiprocessor systems growing in use and importance"

I. What are the two types of multiprocessor systems? (2 marks)
II. Describe the advantages of multiprocessor systems. (4 marks)

d) Write a system call sequence for copying a content of one file to another file. (Hint: State any assumptions you make) (4 marks)

e) Compare and contrast the layered approach and module approach in operating systems development. (5 marks)

Question 2 (25 marks)

a) Briefly explain the following terms in relation to the memory management:
i. Compile time address binding
ii. Base register

(4 marks)

b) Consider the following contiguous memory allocation system in figure 01 with the free memory segments of A,B,C,D with the size of 300KB, 100KB, 200KB and 100KB respectively.

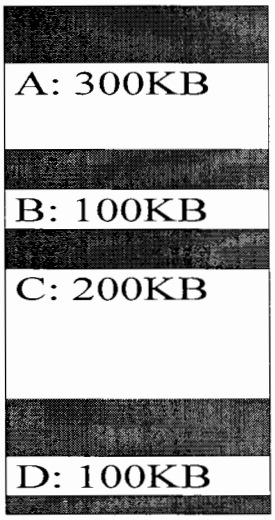


Figure 01

i. List the main two problems in contiguous memory allocation. (2 marks)

ii. If a new process has introduced into the system with the size of 600KB, briefly explain how the operating system allocates the memory (2 marks)

1) if the compaction is used
2) if the paging is used

Note: You can make any assumption in designing the paging solution

i. Which solution (compaction or paging) is used by the modern operating systems? (1 mark)

ii. Why does a system need a page table in paging system? (2 marks)

c) Consider a simple paging system with 2^{18} bytes of physical memory, 4096 pages of logical address space, and a page size of 8KB.

i. How many bits are there in the physical address? (1 mark)

ii. How many bits are there in the logical address? (1 mark)

iii. How long is the page table? (How many entries are there in the page table?) (2 mark)

iv. Assume each entry of a page table requires 16 bits information. How large is the page table (in bytes)? (2 mark)

v. When a process starts, the page table is copied to the hardware from memory at a speed of 200 nanoseconds per bytes. How long is the loading time? (3 mark)

vi. For this system, what is the minimum time slice (in millisecond) so that the system may have only less than 5% overhead from loading the page table? (1 mark)

d) Discuss the advantages and the disadvantages of using inverted-page-table. (2 marks)

e) Discuss the advantages and the disadvantages of using inverted-page-table (2 marks)

Question 3 (25 marks)

a) Briefly explain the following terms in relation to the process synchronization:

i. Critical Section
ii. Semaphore (2 marks)

b) List the tree requirements that must be satisfied by solution to critical section problem. (3 marks)

c) List the names of two atomic instructions. (2 marks)

d) Differentiate inter-process communication shared memory with inter process communication message queue. (You may use a diagram if necessary) (3 marks)

e) Explain the Producer Consumer Problem in Inter process communication shared memory. (Use a code segment where necessary). (5 marks)

f) Following code segment is for inter process communication for producer consumer problem. Find the issues in the code and discuss each. (10 marks)

Server

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>
#include <stdio.h>
#define SHMSZ 27

int main(){

        char c;
        int shmid;
        key_t key;
        char *shm, *s;

        key = 5678;

        if ((shmid = shmget(key, SHMSZ, 0666)) <
0){
                perror("shmget");
                exit(1);
        }

        if ((shm = shmat(shmid, NULL, 0)) ==
(char *) -1){
                perror("shmat");
                exit(1);
        }

        s = shm;

        for (c = 'a'; c <= 'z'; c++){
                *s++ = c;
                *s = NULL;
        }

        while (*shm != 'NULL')
                sleep(1);

        exit(0);
}
```

Client

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>
#include <stdio.h>
#define SHMSZ 27

int main(){

        int shmid;
        key_t key;
        char *shm, *s;

        key = 5679;

        if ((shmid = shmget(key, SHMSZ, IPC_CREAT |
0666)) < 0){
                perror("shmget");
                exit(1);
        }

        if ((shm = shmat(shmid, NULL, 0)) == (char *) -1){
                perror("shmat");
                exit(1);
        }

        for (s = shm; *s != NULL; s++)
                putchar(*s);

        putchar('\n');

        *shm = '*';
        exit(0);
}
```

Question 4 (25 marks)

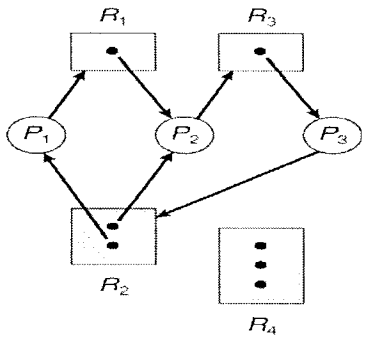
a) List the four necessary conditions to have a deadlock in a system. (3 marks)

b) Propose two solutions to prevent the deadlock by deny the hold and wait condition. (3 marks)

c) How does the modern general-purpose operating system solve the deadlock problem? Briefly explain. (3 marks)

d) Consider the following resource allocation graph for a system in graph 01

i. Why do we draw the resource allocation graph? (2 marks)
ii. Does the system is in a deadlock situation? Justify your answer. (4 marks)



Graph 01

e) Consider the following snapshot of a system:

Process	Allocation	Maximum Needs	Available
A	4	6	1
B	2	5	
C	1	5	
D	3	4	

Answer the following questions using the banker's algorithm:

i. What is the content of the matrix Need? (4 marks)
ii. Is the system in a safe state? (2 marks)
iii. If a request from process A arrives for 1 resource, can the request be granted immediately? (4 marks)