Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree/Diploma
in
Information Technology

Final Examination
Year 2, Semester I/II (2022)

IE2061 – Operating System and System Administration

Duration: 2 Hours

Instructions to Candidates:
- ♦ This paper contains 6 pages including the cover page.
- ♦ This paper has 4 questions with a total of 100 marks.
- ♦ Answer all questions in the booklet given.
- ♦ Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1   (25 Marks)

a) Briefly explain the following.   (3 marks)

     i.   Busy waiting
     ii.   Atomic operations
     iii.   Semaphore

b) Consider the following program which creates two threads.   (12 Marks)

```c
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#define MAX 10
int count;
pthread_mutex_t thr;
pthread_cond_t cond;

void *calc_me(void *arg){
    while(count < MAX) {
        pthread_mutex_lock(&thr);
        while(count % 2 != 0) {
            pthread_cond_wait(&cond, &thr);   ← Line A
        }
        count = count + 1
        printf("%d ", count);
        pthread_mutex_unlock(&thr);
        pthread_cond_signal(&cond);
    }
    pthread_exit(0);
}

int main(){
    pthread_t tdaA;
    pthread_t tdaB;
    pthread_mutex_init(&thr, 0);
    pthread_cond_init(&cond, 0);
    pthread_create(&tdaA, 0, &calc_me, NULL);
    pthread_create(&tdaB, 0, &calc_me, NULL);
    pthread_join(thread1, 0);
    pthread_join(thread2, 0);

    return 0;
}
```

     i.   Which function creates the threads?

     ii.   Which function is executed by the threads?

     iii.   What is the shared variable?

     iv.   Find and write the critical section of the code?

     v.   What is the purpose of the function *pthread_join()?*

     vi.   What is the purpose of the line A?

c) Consider the following code segment for the consumer processes: (10 marks)

```
Do {
  wait(full);
  wait(mutex);
    . . .
  /* remove an item from buffer to next_consumed */
    . . .
  signal(mutex);
  signal(empty);
    . . .
  /* consume the item in next consumed */
    . . .
} while (true);
```

    i.   List the semaphores used in this code.

    ii.   What are the initial value of mutex, empty and full variables?

    iii.   Complete the producer code for producer process using the above variables.

Question 2   (25 Marks)

a) Define what a deadlock is.   (2 marks)

b) What are the necessary conditions to create a deadlock in the system?   (4 marks)

c) In a system 3 process named P1, P2, and P3 are available. There are 2 printers and 1 tape drive in the system. P1 process is currently holding a printer and requesting for a tape drive. P2 process is holding only a printer. P3 process is holding a tape drive and requesting for a printer.

    i.   Draw the resource allocation graph for above scenario using the correct symbols.

    ii. Is there a deadlock in this system? Justify your answer.   (8 marks)

d) Consider a system with 12 resources of the same type, and 3 processes with the following resource needs and allocation.
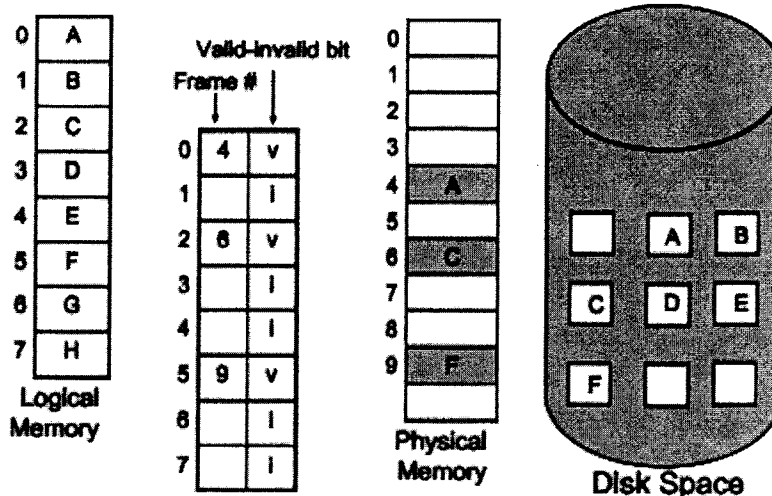
Process	Current Need	Allocation	Max. Need
P0	5	5	
P1	2	2	
P2	7	2	

i.   Compute the maximum need (Max. Need) of resources for each process. (3 marks)

ii.   Is the system safe? Justify your answer.
        (3marks)

iii.   If P2 requests for additional three resources should the request be granted?
        Justify your answer.

(5 marks)

Question 3   (25 Marks)

a) Briefly explain the followings.   (2 marks)
    i.   Internal fragmentation
    ii. External fragmentation

b) List the two solutions to overcome external fragmentation.   (2 marks)

c) Consider a simple paging system with 2^{19} bytes of physical memory, 4096 pages of logical
   address space, and a page size of 4KB. Answer the following.   (10 marks)

    i.   What is the difference between logical and physical addresses?

    ii.   How many bits are in the physical address?

    iii.   How many bits are in the logical address?

    iv.   Where does the page table store in the computer?

    v.   How long is the page table mentioned above?

d) Virtual memory is a technique that allows the execution of processes that are not completely in memory.

i. List two advantages of virtual memory. (2 Marks)

ii. How can the system distinguish between the pages that are in main memory from the pages that are on the disk? (2 Marks)

iii. Consider the page reference sequence given below and find the number of page faults using FIFO algorithm. Assume that there are three frames available, and they are initially empty.
(7 marks)

Page reference sequence: 7,0,1, 2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Question 4 (25 Marks)

a) List the three methods of allocating disk blocks to files. (3 Marks)

b) In a disk drive, Disk requests are generated for cylinders 9, 17, 2, 40, 8, and 90, in the order. It takes 5 msec for a cylinder movement. Assuming that the arm head is initially at cylinder 20 (the previous request was at cylinder 5) for a disk with 100 cylinders (1 to 100). How much seek time is needed for the following algorithms?

   i. LOOK

   ii. SCAN

   iii. C-SCAN?

(15 Marks)

c) Consider a file currently consisting of 100 blocks. Assume that the file control block is already in memory. Calculate how many disk I/O operations are required for linked allocation strategy if:

    I.   The second block from the beginning is removed.

    II.   One block is added at the beginning.

<div align="right">(7 Marks)</div>