02079

Sri Lanka Institute of Information Technology

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

Final Examination
Year 2, Semester I (2023)

IT2060 – Operating System and System Administration

Duration: 2 Hours

November 2023

Instructions to Candidates:

- This paper contains 5 pages including the cover page.
- This paper has 4 questions with a total of 100 marks.
- Students will be given 10 minutes additional reading time.
- 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 (Deadlock) (30 Marks)

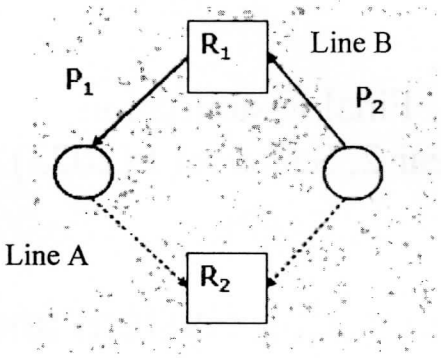
a) Briefly define what a deadlock is. (2 marks)

b) List four necessary conditions to create a deadlock in the system. (4 marks)

c) What is the method used by current operating systems to handle the deadlocks? (2 marks)

d) Resource Allocation Graph Algorithm is a deadlock avoidance technique for resources with single instances. What is the algorithm used for deadlock avoidance in resources with multiple instances? (2 marks)

e) Consider the Resource Allocation Graph given below and answer the questions. (8 marks)



i. What is the name given for Line A?
ii. What is the name given for Line B?
iii. Illustrate/ draw all the steps of determining the availability of deadlocks in this graph if P2 process requests for R2 resource.

f) Consider a system comprised of four processes P1 through P4. There are three resource types A (8 instances), B (4 instances), and C (3 instances). (12 marks)

Process	Allocation			Maximum Need			Current Need			Available		
	A	B	C	A	B	C	A	B	C	A	B	C
P1	2	0	0	6	1	0						
P2	1	1	0	2	2	1						
P3	0	2	1	1	4	2						
P4	2	0	1	3	0	3						

i. Complete the current need column.

ii. Is this system safe from deadlocks? Illustrate all the steps of your work.

iii. Determine whether the system is safe from deadlock if the process P3 requests an additional resource. Illustrate all the steps of your work.

Question 2 (Process Synchronization) (20 Marks)

a) Briefly define the following terms. (4 marks)
   i. Critical section
   ii. Atomic instructions

b) Consider two processes named P0 and P1. They are concurrently executing in a non-atomic computer system. Following are the pseudocodes of their programs. (8 marks)

P0

```
while (true) {
    while (counter == BUFFER_SIZE) ;
    buffer[in] = next_produced;
    in = (in + 1) % BUFFER_SIZE;
    counter++;
}
```

P1

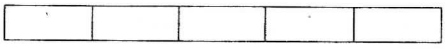
```
while (true) {
    while (counter == 0)
    next_consumed = buffer[out];
    out = (out + 1) % BUFFER_SIZE;
    counter--;

}
```

   i. Identify the critical sections of P0 and P1 respectively.
   ii. "Process P0 and P1 are facing the critical section problem". Briefly explain this statement.
   iii. Illustrate how the critical section problem of above processes can be solved using semaphores.
   iv. Give two examples for the incorrect use of semaphore in a process.

c) There are four processes named P0, P1, P2, and P3 in a system. Each of these processes are executing the following register operations concurrently. The initial value of a and b variables are 3 and 5 respectively.

```
R1= a
R2 = b
R1 = R1*R2
b = R1
```

There is a semaphore named *key* and it is initialized into 1. The process executions are synchronized with the semaphore key. Given below is the initial snapshot of the semaphore list. (8 marks)



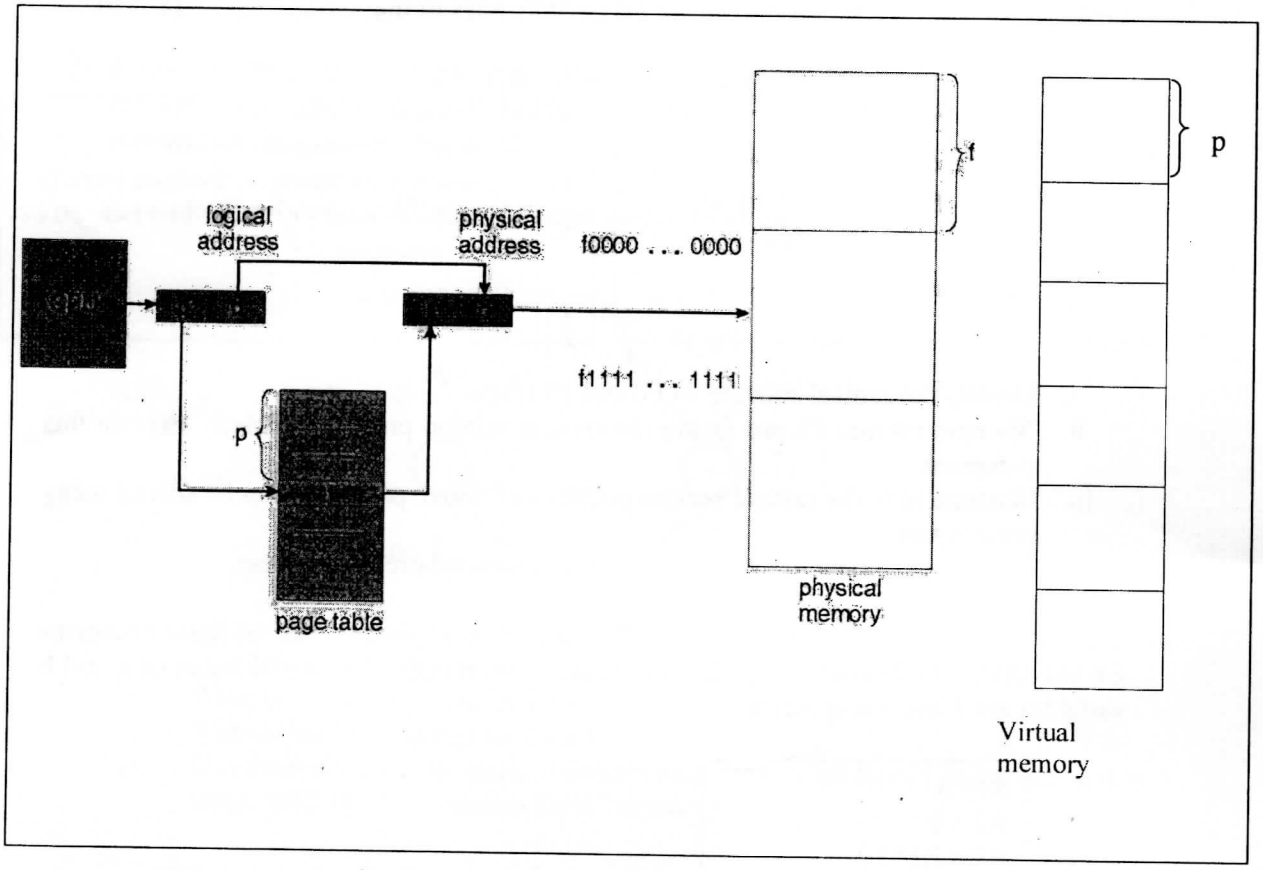
Semaphore list

   i. What is the type of semaphore *key*?
   ii. Draw the content of the semaphore list assuming the process execution order is P0, P1, P2 and P3.
   iii. How many processes are in their critical sections?
   iv. List one advantage and a disadvantage of this semaphore implementation.

Question 3 (Memory Management) (30 Marks)

a) Briefly define the following with aid of a diagram (4 marks)
   i. Internal fragmentation
   ii. External fragmentation

b) Consider the diagram given below and answer the questions. (14 marks)



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

ii. Calculate the number of bits used in the physical address, if the capacity of the physical memory is 512MB.

iii. Calculate the number of bits used in the logical address, if the capacity of the virtual memory is 4GB.

iv. Calculate the size of a frame if the offset is 12 bits.

v. What is the additional column added to the page table for the memory protection purpose?

vi. Calculate the effective memory access time for a system which a TLB is using. The time taken to access the TLB is 20ns, the percentage of entries that can be resolved is 99% and 100ns for memory access.

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

i. What is a page fault? (2 Marks)

ii. What is a victim page and why a victim page is selecting? (2 marks)

iii. Consider the page reference sequence given below and calculate the number of page faults occurring using Least Recently Used algorithm. Assume that there are three frames available, and they are initially empty. (8 marks)

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

Question 4 (Protection, Disk and File Management) (20 Marks)

a) List the four security measure levels. (4 marks)

b) In a disk drive, Disk requests are generated for cylinders 10, 8, 15, 12, 20, 2, and 19, in the order. It takes 10 msec for a cylinder movement. Assuming that the arm head is initially at cylinder 22 (the previous request was at cylinder 20) for a disk with 25 cylinders (1 to 25). How much seek time is needed for the following algorithms? (10 marks)

i. SCAN

ii. LOOK

c) Consider a file currently consisting of 50 blocks. Assume that the file control block is already in memory. Calculate how many disks I/O operations are required for linked allocation strategy if:

i. The second block from the beginning is removed.
ii. One block is added as the fourth block.

(6 Marks)

*** End of Paper ***