Q.5 i. Discuss the concept of virtual memory and its significance in modern operating systems. How does virtual memory enhance system performance and manage memory resources effectively? **4**

ii. If a system has a total physical memory of 8 GB and employs virtual memory with a page size of 4 KB, how many pages can be accommodated in the virtual address space? **6**

OR iii. Consider a system with a page fault rate of 10,000 per second and an effective access time of 1 millisecond. Determine whether the system is experiencing thrashing or not. **6**

Q.6 Attempt any two:

i. Discuss the significance of disk scheduling in operating systems. Explain various disk scheduling algorithms with suitable examples. **5**

ii. Compare and contrast different file organization methods used in operating systems, highlighting their strengths and weaknesses. **5**

iii. Discuss the implementation issues associated with file sharing in operating systems, particularly focusing on challenges and solutions in a Linux environment. **5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering / Science
End Sem Examination May-2024
CS3CO36 / BC3CO62 Operating Systems

Programme: B.Tech./ B.Sc. Branch/Specialisation: CSE All / CS

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Which of the following is not a type of operating system? **1**

(a) Multi-threaded (b) Batch
(c) Distributed (d) Graphical User Interface (GUI)

ii. Which of the following is an example of inter-process communication mechanism? **1**

(a) Threads (b) Semaphores
(c) Precedence graphs (d) Critical section problem

iii. What are the criteria used for CPU scheduling? **1**

(a) Speed and efficiency (b) Priority and burst time
(c) First come first served (d) All of these

iv. How can deadlock be prevented in an operating system? **1**

(a) Ignoring the deadlock
(b) Using synchronization primitives
(c) Allowing infinite resources
(d) Increasing system complexity

v. What is the purpose of memory management in an operating system? **1**

(a) To store user data only
(b) To provide a virtual memory space
(c) To manage physical memory efficiently
(d) To enhance processor speed

vi. The first fit, best fit and worst fit are strategies to select a _____. **1**

(a) Process from a queue to put in memory
(b) Processor to run the next process
(c) Free hole from a set of available holes
(d) All of these

vii. What is demand paging? **1**
(a) A method of loading all pages into memory at once
(b) A method of loading pages into memory only when needed
(c) A method of swapping processes between memory and disk
(d) A method of partitioning memory into fixed-size sections

viii. What role does the operating system play in system security? **1**
(a) It provides physical security for the hardware
(b) It prevents unauthorized access to system resources
(c) It manages network connections only
(d) It updates software automatically

ix. Which file organization method allows for the fastest access time? **1**
(a) Sequential
(b) Indexed
(c) Direct
(d) Linked

x. How does file management in Linux differ from other operating systems? **1**
(a) Linux does not support file management
(b) Linux uses a hierarchical directory structure
(c) Linux does not support file sharing
(d) Linux does not have file protection mechanisms

Q.2 i. Define critical section problem in the context of operating systems. Describe how semaphores are utilized to address this problem. **2**

ii. Explain the concept of processes in operating systems. How do processes contribute to the efficient utilization of system resources? **3**

iii. Differentiate between batch, multi-programmed, time-sharing, real-time, distributed, and parallel operating systems. Provide examples of scenarios where each type of operating system would be most suitable. **5**

OR iv. Explain the concept of threads in the context of operating systems. Discuss their advantages and how they enhance the efficiency of process execution. **5**

Q.3 i. Compare: deadlock prevention, deadlock avoidance, deadlock detection. **2**

ii. Consider the set of 5 processes whose arrival time and burst time (in ms) are given below- **8**

Process Id	Arrival time	Burst time
P1	3	1
P2	1	4
P3	4	2
P4	0	6
P5	2	3

If the CPU scheduling policy is SJF pre-emptive, calculate the average waiting time and average turnaround time.

OR iii. Consider the set of 5 processes whose arrival time and burst time (in ms) are given below- **8**

Process Id	Arrival time	Burst time
P1	3	1
P2	1	4
P3	4	2
P4	0	6
P5	2	3

If the CPU scheduling policy is SJF non-preemptive, calculate the average waiting time and average turnaround time.

Q.4 i. Explain the principles behind paging and segmentation in memory management. **3**

ii. Consider a system with TLB access time 20 ns and main memory access time 100 ns. Calculate effective memory access time if TLB hit ratio is 95%. **7**

OR iii. Request from the processes is 300k, 25k, 125k, and 50k , respectively (in order). **7**

The above request could be satisfied with (Assume variable partition scheme)-
(a) Best fit but not first fit
(b) First fit but not best fit
(c) Both best and first fit
(d) Neither best nor first fit

Scheme of Marking

Operating Systems-CS3CO36(T)- BC3CO62(T)

Q.1	i)	d) Graphical User Interface (GUI)	**1**
	ii)	b) Semaphores	**1**
	iii)	d) All of the above	**1**
	iv)	b) Using synchronization primitives	**1**
	v)	c) To manage physical memory efficiently	**1**
	vi)	c) Disk space used as an extension of RAM	**1**
	vii)	b) A method of loading pages into memory only when needed	**1**
	viii)	b) It prevents unauthorized access to system resources	**1**
	ix)	c) Direct	**1**
	x)	b) Linux uses a hierarchical directory structure	**1**
Q.2	i.	Define critical section problem – 1MARKS Describe how semaphores are utilized to address this problem-1 MARKS	**2**
	ii.	Explain the concept of processes in operating systems -2 MARKS How do processes contribute to the efficient utilization of system resources -1 MARKS	**3**
	iii.	Differentiate between batch, multi-programmed, time-sharing, real-time, distributed, and parallel operating systems -3 MARKS EXAMPLES OF EACH – 2 MARKS	
OR	iv.	Explain the concept of threads in the context of operating systems.-2 MARKS Discuss their advantages and how they enhance the efficiency of process execution. – 3 MARKS	
Q.3	i.	Compare : deadlock prevention, deadlock avoidance, deadlock detection. 2 POINTS EACH CONTAIN 1 MARK	**2**
	ii.	Gantt chart -1 marks Process Table-1 marks Average Turn Around time = (1 + 5 + 4 + 16 + 9) / 5 = 35 / 5 = 7 unit -3 marks Average waiting time = (0 + 1 + 2 + 10 + 6) / 5 = 19 / 5 = 3.8 unit -3 marks	**8**
OR	iii.	Gantt chart -1 marks Process Table-1 marks Average Turn Around time = (4 + 15 + 5 + 6 + 10) / 5 = 40 / 5 = 8 unit -3 marks	**8**
		Average waiting time = (3 + 11 + 3 + 0 + 7) / 5 = 24 / 5 = 4.8 unit – 3marks	
Q.4	i.	Explain the principles behind paging -1.5 marks and segmentation in memory management.- 1.5 marks	**3**
	ii.	Given that C = 20ns, M = 100ns, X = 95%. Without TLB effective memory access time	**7**

EMAT = 2M = 2 * 100 = 200ns

With TLB, effective memory access time

EMAT = X(C + M) + (1- X) (C + 2M)

= 0.95(20 + 100) + (1 – 0.95) (20 + 2 * 100)

= 114 + 11 = 125ns

OR	iii.	We have to check only for two algorithms best fit and first fit(as given in question). Let discuss by considering one algorithm at a time, as follows:	**7**

Best Fit:

First of all, 300k jobs will use 350k slot. Free slot will be =350-300=50k.

Next process of 25k will use remaining 50k slot (available as free from the operation above), as per the best fit algorithm. So, the free space left = 50-25= 25k.

The third process of 125k will be accommodated by 150k space, so we are left with 150-125= 25k.

Fourth process requires 50k. Now, we have two slots of 25k left but our last process is of 50k size.

Therefore, the need of all the process is not satisfied.

First fit

First process is of 300k will be use 350k slot. Remaining free space will be = 350-300= 50k.

Next process of 25k will use remaining 150k slot (as per first fit

algorithm). So, free space left = 150-25= 125k.

The third process is of 125k will be accommodating by 125k slot which is left free after the allocation of the memory to second process.

Now, we have only one slot of 50k left and our process requires 50k memory.

Observing the execution of the algorithms, we can say that by using the first fit algorithm, all the processes can be executed. Therefore option (B) is the correct answer.

Q.5 i. Discuss the concept of virtual memory and its significance in modern operating systems – 2marks **4**
How does virtual memory enhance system performance and manage memory resources effectively – 2 marks

ii. Number of pages = Total virtual address space / Page size **6**

Total virtual address space can be calculated by considering the maximum addressable memory in a system. For a 32-bit system, the maximum virtual address space is 2^32 bytes, and for a 64-bit system, it is 2^64 bytes. Since the provided information doesn't specify whether it's a 32-bit or 64-bit system, let's assume it's a 64-bit system.

Total virtual address space for a 64-bit system = 2^64 bytes

Now, let's calculate the number of pages:

Total virtual address space = 2^64 bytes
Page size = 4 KB = 4 * 1024 bytes

Number of pages = (2^64 bytes) / (4 * 1024 bytes/page)
≈ (2^64) / (2^12) pages
= 2^(64-12) pages
= 2^52 pages

So, the system can accommodate approximately 2^52 pages in the virtual address space.

OR iii. Page fault rate = 10,000 per second **6**
Effective access time (EAT) = 1 millisecond = 0.001 seconds

We can use the following formula to calculate the effective access

time (EAT) when considering page faults:

EAT = (1 - p) * memory access time + p * page fault overhead
where:
p = page fault rate

We can rearrange this formula to solve for the page fault overhead:

page fault overhead = (EAT - (1 - p) * memory access time) / p

Substituting the given values:
page fault overhead = (0.001 - (1 - 10,000 * 0.001)) / 10,000

Solving:
page fault overhead = (0.001 - (1 - 10)) / 10,000
= (0.001 - (-9)) / 10,000
= (0.001 + 9) / 10,000
= 9.001 / 10,000
= 0.0009001 seconds

The calculated page fault overhead is 0.0009001 seconds.

Now, we compare this overhead with the memory access time:

If the page fault overhead is significantly smaller than the memory access time, then the system is not experiencing thrashing. However, if the page fault overhead is comparable to or larger than the memory access time, then the system is likely experiencing thrashing.

In this case, since the page fault overhead (0.0009001 seconds) is significantly smaller than the memory access time (0.001 seconds), the system is not experiencing thrashing.

Q.6
i. Discuss the significance of disk scheduling in operating systems. - 1 marks **5**

Explain various disk scheduling algorithms with suitable examples. – 4marks

ii. Compare and contrast different file organization methods used in operating systems, highlighting their strengths and weaknesses Minimum 2 points **5**

iii. Discuss the implementation issues associated with file sharing in operating systems, particularly focusing on challenges and solutions in a Linux environment. **5**

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