Name: ______________________________ ID: ____________ Section: ____

Department of Computer Science and Engineering

CSE321: Operating Systems

Spring 2024

Quiz-4, A

Full Marks: 15 Time: 20 Mins

1. What are the main challenges associated with dynamic memory allocation in operating systems, and how can they be mitigated? **5**

Answer: One challenge is memory fragmentation, where free memory becomes divided into small, unusable chunks over time. This can be mitigated through memory compaction techniques or by implementing advanced memory management algorithms like buddy allocation or slab allocation. Another challenge is memory leaks, where allocated memory is not properly deallocated after use, leading to a gradual depletion of available memory. This can be addressed through rigorous testing and memory leak detection tools.

2. A multi-user operating system is experiencing high memory demand from multiple processes running concurrently. One process frequently allocates and deallocates memory dynamically. However, over time, the system's performance degrades, and memory fragmentation becomes a concern. How can the operating system address this issue while maintaining efficient memory allocation for all processes? **5**

Answer: The operating system can implement memory compaction techniques to consolidate fragmented memory blocks periodically. By rearranging memory and filling in the gaps between allocated blocks, compaction reduces external fragmentation and optimizes memory utilization. Additionally, the OS can employ dynamic memory allocation algorithms like buddy allocation or slab allocation, which allocate memory in fixed-size or variable-size blocks to minimize fragmentation. These techniques ensure that memory is allocated efficiently to all processes while mitigating fragmentation concerns.

3. A desktop operating system is running multiple applications simultaneously, including a web browser, a document editor, and a multimedia player. Each application requires a significant amount of memory to operate efficiently, but the system's physical memory is limited. Users are complaining about sluggish performance and frequent delays when switching between applications. How can the operating system leverage paging to enhance multitasking performance and responsiveness? **5**

Answer: The operating system can use paging to create virtual memory spaces for each application, allowing them to access a larger address space than the physical memory available. When physical memory becomes scarce, the OS can use paging to swap out inactive pages of memory to disk, freeing up space for more critical tasks. By intelligently managing page swapping and prioritizing pages based on application activity and user interactions, the OS can improve multitasking performance and responsiveness. Additionally, the OS can implement memory compression techniques to reduce the need for page swapping and minimize performance overhead.

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Quiz-4, B

Full Marks: 15 Time: 20 Mins

1. How does dynamic memory allocation contribute to external fragmentation in an operating system? **5**

   Answer: Dynamic memory allocation allows the operating system to allocate memory to processes as needed, improving resource utilization by allocating memory dynamically based on current demands. However, it can also introduce overhead due to memory fragmentation and management, potentially affecting system performance.

2. A mobile operating system is running low on memory due to the simultaneous execution of several memory-intensive applications. The system's performance has degraded significantly, and users are experiencing frequent crashes and slowdowns. How can the operating system optimize memory usage and alleviate the memory pressure to improve overall system performance? **5**

   Answer: The operating system can implement memory management techniques such as memory paging or swapping to optimize memory usage. Paging involves dividing memory into fixed-size blocks (pages) and swapping inactive pages to secondary storage (e.g., disk) when memory demand exceeds available physical memory. Swapping allows the operating system to free up physical memory for active processes, reducing memory pressure and improving system responsiveness. Additionally, the OS can prioritize memory allocation based on application importance or user interaction, ensuring critical processes receive sufficient memory resources to maintain smooth operation.

3. An embedded operating system is deployed in a resource-constrained IoT device with limited RAM. The device needs to handle various sensor data processing tasks while ensuring efficient memory utilization. How can the operating system utilize paging to manage memory effectively in this constrained environment? **5**

   Answer: The operating system can employ paging to create a virtual memory space for handling sensor data processing tasks on the IoT device. By using demand paging, the OS can load only the necessary portions of code and data into memory when needed, conserving precious RAM resources. Additionally, the OS can implement memory-mapping techniques to map portions of secondary storage, such as flash memory or external storage, into the virtual memory space, further extending the available memory capacity. By leveraging paging and memory-mapping, the operating system can efficiently manage memory in the resource-constrained IoT device and ensure reliable operation without exhausting available RAM.