Module 5: Critical Thinking

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Virtual Memory and Its Impact

Virtual memory is an essential part of modern operating systems that allows them to use disk space as an extension of physical random access memory(RAM). Which enables computers to run applications that exceed the available physical memory by temporarily transferring data from the RAM to the hard drive. However, the optimal configuration of virtual memory settings is crucial to ensure system performance and stability. This paper will examine the virtual memory settings on my system, exploring their impact on performance when modified.

The system used for this analysis is running Windows 11, with a 64-bit architecture. The hardware includes an Intel Core i7-10700K processor, 16 GB of RAM, and a 512 GB SSD. The default virtual memory settings, including both the initial and maximum page file size, are configured automatically by the operating system based on the size of the installed RAM. This page file is located on the SSD, allowing the system to temporarily offload data from RAM when it is under heavy usage.

The optimal virtual memory size depends on the amount of installed RAM and the type of tasks the computer is expected to handle. Generally, Windows recommends a paging file size that is 1.5 to 3 times the size of the system’s RAM. For example, on my 16 GB system, the default page file size was set to 24 GB (1.5 times the installed RAM). Windows automatically adjusts the page file size based on system performance, but it is adjustable.

When I checked the virtual memory settings on my system, the configuration appeared to be optimal. The automatic setting allows Windows to adjust the size of the page file based on the system's current needs. In this configuration, the system ensures that there is enough virtual memory to handle memory-intensive applications without compromising performance.

Increasing the virtual memory size to double the current setting (48 GB) resulted in noticeable changes in system behavior. In the short term, there were no immediate signs of improved performance for standard applications. However, when I ran multiple resource-intensive applications simultaneously, such as Adobe for video editing and a virtual machine, the system showed better responsiveness. The increased virtual memory gave the operating system more space to offload tasks that would otherwise demand too much RAM. This likely helped prevent the system from slowing down or crashing when running applications that needed more memory than was technically available.

When I turned off virtual memory entirely, the system operated without any page file. At first, it seemed fine. However, when I attempted to run multiple applications or a resource-heavy task, like video editing, the system quickly ran into memory shortages. This resulted in slowdowns, freezing, and forced termination of applications, as there was no extra virtual memory available to offload data from RAM. In extreme cases, the operating system displayed error messages indicating insufficient memory, leading to application crashes or failures to load. This experiment illustrated that turning off virtual memory could severely impact performance, particularly with resource-demanding tasks.

The size of the RAM plays a critical role in determining the optimal virtual memory settings. For systems with larger amounts of RAM, the need for a large virtual memory paging file diminishes. Windows might set a smaller virtual memory size, as the physical RAM is more capable of handling heavy workloads. Conversely, systems with limited RAM benefit from a larger page file to compensate for the lack of physical memory. For my system with 16 GB of RAM, the default virtual memory setting was appropriate for the tasks I regularly perform, but more intensive applications, such as 3D rendering or running virtual machines, would likely benefit from a larger paging file.

Resource intensive applications are most affected by virtual memory settings. For instance, when running Adobe Premiere Pro, which demands substantial RAM for video editing, increasing the virtual memory size helped ensure that the program did not encounter memory shortages during large renderings. Similarly, virtualization software such as VirtualBox also benefits from adequate virtual memory. Without sufficient virtual memory, these applications may fail to run smoothly or even crash, particularly if the physical RAM is exhausted.

On the other hand, less resource-intensive applications, such as word processors, are not significantly impacted by virtual memory settings. These applications generally do not consume enough memory to trigger the need for virtual memory, and their performance remains stable even with lower virtual memory sizes or no virtual memory.

In conclusion, the settings for virtual memory in an operating system are vital for maintaining the performance and stability of a computer. While the default settings for virtual memory on Windows 11 were optimized for my system, adjusting the page file size can influence system responsiveness, especially under heavy workloads. Increasing the virtual memory size can help with resource-intensive applications but may introduce delays due to the slower speed of the SSD. Turning off virtual memory entirely is detrimental to performance, especially for systems with lower amounts of RAM. Ultimately, the optimal virtual memory size should be determined by the amount of RAM in the system and the specific resource demands of the software being used.

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### References

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