

### An Overview on Memory Management

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#### Abstract

In this era of modernization and urbanization Computer Science is dealing with several theoretical foundations of information and computation together with practical techniques for implementation and approximation of these foundations. In order to perform several tasks an optimal utilization of memory is required i.e. memory management. Since memory management has several aspects of its own, it is significant to understand the need of Virtual Memory. Memory management is one of the most important features of the operating system because it directly affects the time of the operation. An efficient memory management system ensures the accuracy, availability and consistency of data imported from secondary memory to main memory management revolves around Segmentation, Paging and various algorithms. So in this paper we will discuss one of the important characteristic of Memory management i.e. paging along with Replacement of Pages by using various algorithms and their pros and cons. We will also discuss about basic mechanism to deal with anomaly of Page Fault.

**Keywords:** Memory Management, Virtual Memory, Paging and Page Fault.

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#### Introduction

As it is important to know, how Operating System manages memory, most of the computers have memory hierarchy. Memory management system can be classified into two divisions, those which leads to swap in and swap out between disk and main memory and those that do not. CPU communicates with main memory for the execution of each and every program. The Cache memory provides the speed and maps data present in main memory. Since the memory space of main memory is limited, in order to deal with this problem main memory converts some part of Auxiliary memory into itself but temporarily. This temporary main memory is termed as Virtual Memory. Memory management is the process of controlling and coordinating computer memory, allocating parts called blocks for different drivers to improve overall system performance. Memory management lies in hardware, the operating system (operating system), and programs and applications. Memory management is one of the most important features of the operating system because it directly affects the time of the operation. An efficient memory management system ensures the accuracy, availability and consistency of data imported from secondary memory to main memory. Memory management is a form of resource management applied to computer memory. The prerequisite for memory management is to provide means for dynamically allocating portions of memory to programs on demand and freeing them for reuse when they are not needed. This is necessary for any advanced computer system as more than one process may be in progress at any time. Several methods have been devised to increase the efficiency of memory management. Virtual memory systems separate the memory addresses the process uses from the actual physical addresses, allowing to separate processes and increase the size of the virtual address space beyond the amount of RAM available to the user. Use pagination or switch

to secondary storage. The quality of the virtual memory manager can have a major impact on the overall performance of the system.

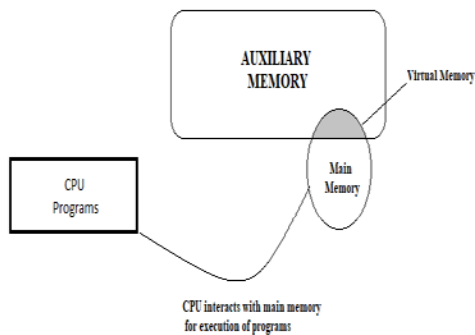


Figure 1: Pictorial representation of the formation of Virtual Memory

### Paging Concepts

The logical memory constitutes information, this stored information gets converted into pages. Paging involves the breaking of physical memory into blocks of fixed size. The blocks of the fixed size are called as Frames. A Process is basically the program in execution. Paging has its hardware support which is accomplished by page number and its offset. The address formed by the CPU consists of these two fields. In the page table the page number acts as an index. An additional bit is attached with each entry in page table is a valid-invalid bit as discussed in [1]. Every page table consists of some protection bits which defines a page is to be read-write or read only. When this bit is set to valid then the associated page is in logical address space and is considered as a legal page. Invalid bit refers that the page is not in process. Paging can be classified into two types- Pure and Demand paging. For the process to get executed some pages are required. In Pure paging the page table consists of all the pages which are not even needed by the process, hence it comprises of all the pages. In Demand paging, only entailed pages will exist in the page table.

### Page Fault

When a program attempts to access a block of memory that is not stored in the physical memory or RAM as mentioned in [2] is termed as a Page Fault. There exists a special, small and fast lookup hardware Cache, which is known as translation look-aside buffer (TLB). The TLB contains only few page table entries. The page number is presented to the TLB when the logical address is initiated by CPU. If the required page number is not in the TLB then that condition is known as TLB miss. We modify the page-fault service routine to include page replacement by taking help of [3]:

- 1) Find the location of the desired page on the disk.
- 2) Find a free frame.
- 3) If there is a free frame, use it.
- 4) If there is no free frame, use a page-replacement algorithm to select a victim frame.
- 5) Write the victim page to the disk; change the page and frame tables accordingly.
- 6) Read the desired page into the (newly) free frame; change the page and frame tables.
- 7) Restart the user process.

The figure given below shows the steps needed in order to handle a Page Fault.

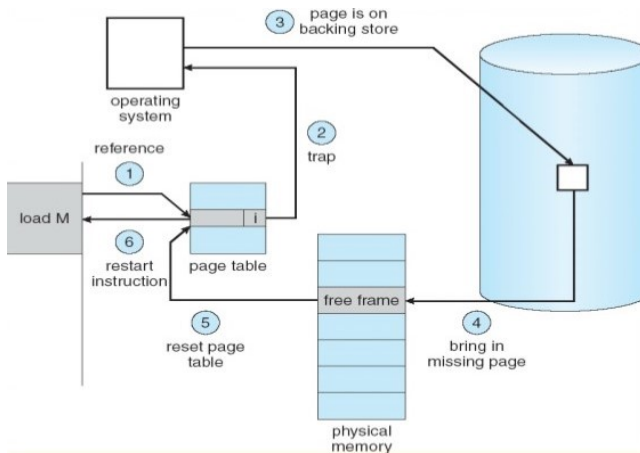


Figure 2: Steps in handling a Page Fault

### Conclusion

Memory in computer system is used for storing information either permanently or temporarily. Its allocation is a process by which different programs are allotted with physical or virtual memory space as the memory allocation retains the partial or complete of computer memory for execution of different processes. Paging being a memory management scheme permits the physical address space of a process to be non-contiguous. Page replacement algorithms are used to prevent the over allocation of memory by minimizing the page fault service routine to include the page replacement.

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