DEPARTMENT OF AIML

23CST202- OPERATING SYSTEMS

II YEAR IV SEM AIML-A

UNIT 3-MEMORY MANAGEMENT

TOPIC –SWAPPING,CONTIGUOUS MEMORY ALLOCATION

SWAPPING

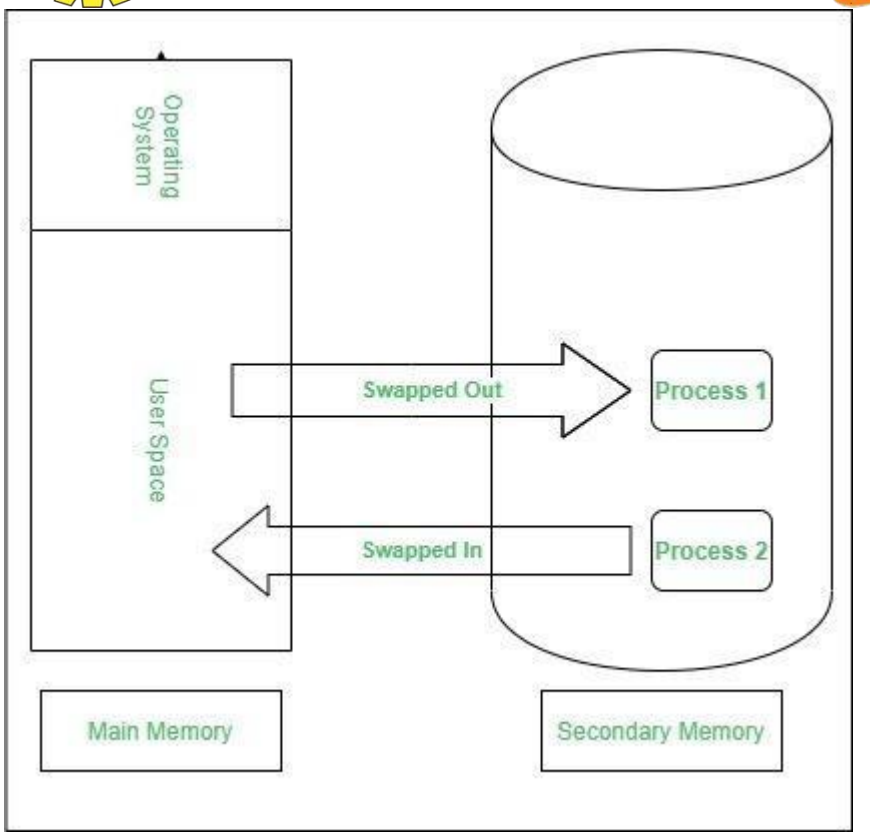
To increase CPU utilization in multiprogramming, a memory management scheme known as swapping can be used. Swapping is the process of bringing a process into memory and then temporarily copying it to the disc after it has run for a while. The purpose of swapping in an operating system is to access data on a hard disc and move it to RAM so that application programs can use it.

What is Swapping in the Operating System?

Swapping in an operating system is a process that moves data or programs between the computer's main memory (RAM) and a secondary storage (usually a hard disk or SSD). This helps manage the limited space in RAM and allows the system to run more programs than it could otherwise handle simultaneously.

It's important to remember that swapping is only used when data isn't available in RAM. Although the swapping process degrades system performance, it allows larger and multiple processes to run concurrently. Because of this, swapping is also known as memory compaction.

The CPU scheduler determines which processes are swapped in and which are swapped out. Consider a multiprogramming environment that employs a priority- based scheduling algorithm. When a high-priority process enters the input queue, a low-priority process is swapped out so the high-priority process can be loaded and executed. When this process terminates, the low-priority process is swapped back into memory to continue its execution. The below figure shows the swapping process in the operating system:



Swapping has been subdivided into two concepts: swap-in and swap-out.

- Swap-out is a technique for moving a process from RAM to the hard disc.
- Swap-in is a method of transferring a program from a hard disc to main memory, or RAM.

Process of Swapping

- When the RAM is full and a new program needs to run, the operating system selects a program or data that is currently in RAM but not actively being used.
- The selected data is moved to secondary storage, freeing up space in RAM for the new program
- When the swapped-out program is needed again, it can be swapped back into RAM, replacing another inactive program or data if necessary.

Advantages

- Swapping minimizes the waiting time for processes to be executed by using the swap space as an extension of RAM, allowing the CPU to keep working efficiently without long delays due to memory limitations.
- Swapping allows the operating system to free up space in the main memory (RAM) by moving inactive or less critical data to secondary storage (like a hard drive or SSD). This ensures that the available RAM is used for the most active processes and applications, which need it the most for optimal performance.
- Using only single main memory, multiple process can be run by CPU using swap partition.
- It allows larger programs or applications to run on systems with limited physical memory by swapping less critical data to secondary storage and loading the necessary parts into RAM.

- By swapping out inactive processes, the operating system can prevent the system from becoming overloaded, ensuring that the most important and active processes have access to enough memory for smooth execution.

Disadvantages

- Risk of data loss during swapping arises because of the dependency on secondary storage for temporary data retention. If the system loses power before this data is safely written back into RAM or saved properly, it can result in the loss of important data, files, or system states.
- The **number of** page faults increases as the system frequently swaps pages in and out of memory, which directly impacts performance because fetching data from the disk (or swap space) is much slower than accessing it from RAM.
- If the system Swaps-in and out too often, the performance of system can severely decline as CPU will spend more time swapping then executing processes.

Only one process occupies the user program area of memory in a single tasking operating system and remains in memory until the process is completed.
When all of the active processes in a multitasking operating system cannot coordinate in main memory, a process is swapped out of main memory so that other processes can enter it.

CONTIGUOUS MEMORY ALLOCATION

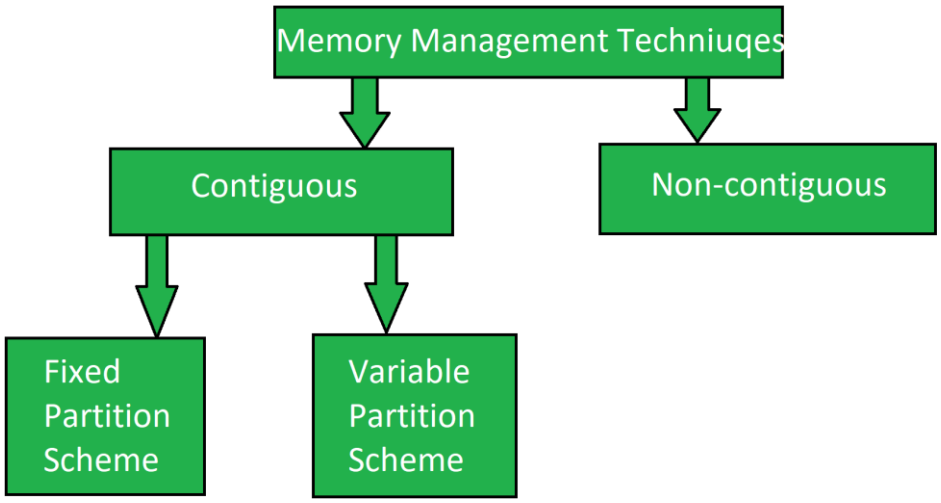
Memory Management Techniques are basic techniques that are used in managing the memory in the operating system. Memory Management Techniques are classified broadly into two categories:

- Contiguous
- Non-contiguous

What is Contiguous Memory Management?

Contiguous memory allocation is a memory allocation strategy. As the name implies, we utilize this technique to assign contiguous blocks of memory to each task. Thus, whenever a process asks to access the main memory, we allocate a continuous segment from the empty region to the process based on its size. In this technique, memory is allotted in a continuous way to the processes. Contiguous Memory Management has two types:

- Fixed(or Static) Partition
- Variable(or Dynamic) Partitioning

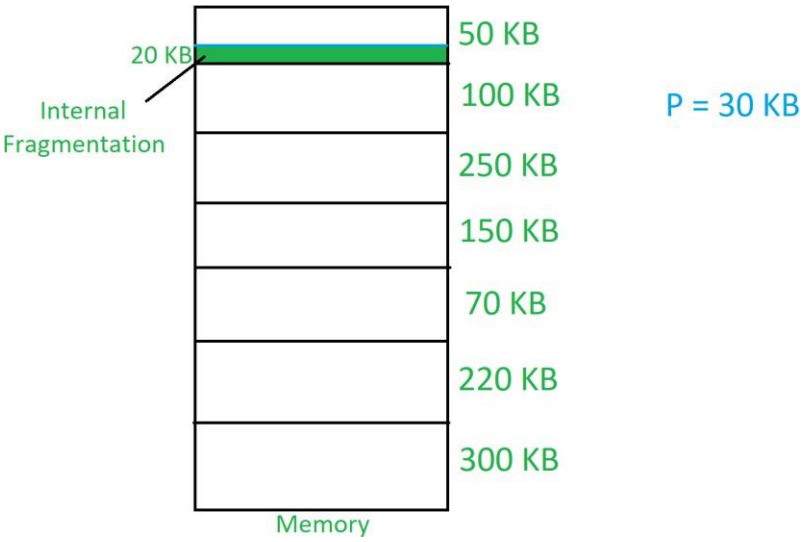


Contiguous Memory Management Techniques
Below are two Contiguous Memory Management Techniques. Lets understand these in detail.

1. Fixed Partition Scheme

In the fixed partition scheme, memory is divided into fixed number of partitions. Fixed means number of partitions are fixed in the memory. In the fixed partition, in every partition only one process will be accommodated. Degree of multi- programming is restricted by number of partitions in the memory. Maximum size of the process is restricted by maximum size of the partition. Every partition is associated with the limit registers.

- **Limit Registers:** It has two limit:
- **Lower Limit:** Starting address of the partition.
- **Upper Limit:** Ending address of the partition.



Internal Fragmentation is found in fixed partition scheme. To overcome the problem of internal fragmentation, instead of fixed partition scheme, variable partition scheme is used.

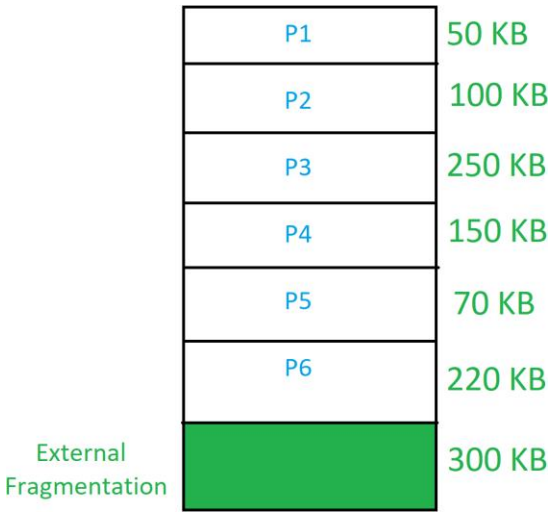
Disadvantages Fix partition scheme

- Maximum process size <= Maximum partition size.
- The degree of multiprogramming is directly proportional to the number of partitions.
- Internal fragmentation which is discussed above is present.
- If a process of 19kb wants to allocate and we have free space which is not continuous we are not able to allocate the space.

2. Variable Partition Scheme

In the variable partition scheme, initially memory will be single continuous free block. Whenever the request by the process arrives, accordingly partition will be made in the memory. If the smaller processes keep on coming then the larger partitions will be made into smaller partitions.

- In variable partition schema initially, the memory will be full contiguous free block
- Memory divided into partitions according to the process size where process size will vary.
- One partition is allocated to each active partition.



External Fragmentation is found in variable partition scheme. To overcome the problem of external fragmentation, compaction technique is used or non-contiguous memory management techniques are used.

Solution of External Fragmentation

1. Compaction

Moving all the processes toward the top or towards the bottom to make free available memory in a single continuous place is called compaction. Compaction is undesirable to implement because it interrupts all the running processes in the memory.

Disadvantage of Compaction

- Page fault can occur.
- It consumes CPU time (overhead).

2. Non-contiguous memory allocation

1. **Physical address space:** Main memory (physical memory) is divided into blocks of the same size called frames. frame size is defined by the operating system by comparing it with the size of the process.
2. **Logical Address space:** Logical memory is divided into blocks of the same size called process pages. page size is defined by hardware system and these pages are stored in the main memory during the process in non-contiguous frames.

Advantages of Variable Partition Scheme

- Portion size = process size
- There is no internal fragmentation (which is the drawback of fixed partition schema).
- Degree of multiprogramming varies and is directly proportional to a number of processes.

Disadvantage Variable Partition Scheme

- External fragmentation is still there.

Advantages of Contiguous Memory Management

- It's simple to monitor how many memory blocks are still available for use, which determines how many more processes can be allocated RAM.
- Considering that the complete file can be read from the disc in a single session, contiguous memory allocation offers good read performance.
- Contiguous allocation is simple to set up and functions well.

Disadvantages of Contiguous Memory Management

- Fragmentation is not a problem. Since new files can be written to the disk after older ones.
- To select the appropriate hole size while creating a new file, it needs know its final size.
- The extra space in the holes would need to be reduced or used once the disk is full.