Unit: III
Lecture: 4
(Memory Management)
Memory Allocation Techniques (Part-I)

The main memory should oblige both the operating system and the different client processes. Thus, the allocation of memory becomes an important task in the operating system.

The memory is usually divided into two portions:

- one for the resident operating system and
- one for the user processes

We normally need several user processes to reside in memory simultaneously. Therefore, we need to consider how to allocate available memory to the processes that are in the input queue waiting to be brought into the memory. Main memory is divided into non-overlapping memory regions called partitions.

The main memory can be broadly allocated in two ways:

- **Contiguous memory allocation**
- **Non-contiguous memory allocation**

Contiguous Memory Allocation:

In this type of allocation, the processes are allocated contiguous memory blocks in the RAM.

Contiguous memory allocation can be categorized into two ways:

- **Fixed Partition Scheme**
- **Variable Partition Scheme**

In Contiguous memory allocation, memory is divided into partitions (fixed or variable). Each partition contains exactly one process.

- When a partition is free, a process is selected from the input queue and loaded into it.
- **The free blocks of memory are known as holes.**
- The set of holes is searched to determine which hole is best to allocate.

Fixed Partition Scheme:

In the fixed partition scheme, memory is divided *into fixed number of partitions i.e. number of partitions in RAM is fixed but the size of each partition may or may not be the same*.

- Degree of multi-programming is restricted by number of partitions in the memory.
  - In every partition only one process will be accommodated.
- Here partitions are made before execution or during system configure.

Advantages of Fixed Partitioning:

- Easy to implement:
  - It simply requires putting a process into a certain partition without focusing on the emergence of Internal and External Fragmentation.

Disadvantages of Fixed Partitioning:

- Internal Fragmentation:
  - Main memory use is inefficient. Any program, no matter how small occupies an entire partition.
- External Fragmentation:
  - The total unused space of various partitions cannot be used to load the processes even though there is space available but not in the contiguous form.
- Limit process size:
  - Process of size greater than the size of the partition in main memory cannot be accommodated.
  - The partition size cannot be varied according to the size of the incoming process size.
- Limitation on Degree of Multiprogramming:
  - Partitions in main memory are made before execution or during system configure.
  - Thus, number of processes greater than the number of partitions in RAM is invalid.

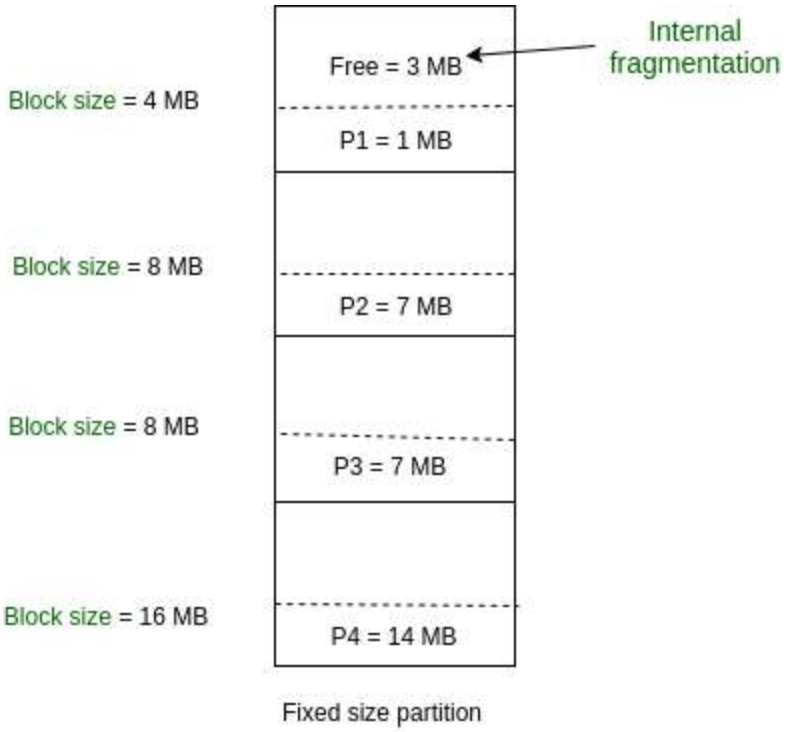
Fragmentation:

A fragmentation is defined as when the process is loaded and removed after execution from memory, it creates a small free hole. ***Fragmentation is generally termed as the inability to use the available memory.***

There are two types of fragmentation:

- **Internal Fragmentation:**
  - Internal fragmentation occurs when memory blocks are allocated to the process more than their requested size. Due to this some unused space is leftover and creates and internal fragmentation problem i.e. the memory that is internal to a partition but is of no use.

- **External Fragmentation:**
  - In external fragmentation, we have free memory blocks (holes), but we cannot assign it to a process because blocks are not contiguous i.e. the memory is fragmented into large number of small holes.



Example: As illustrated in above figure, first process is only consuming 1MB out of 4MB in main memory.

Hence, internal fragmentation in first block is (4-1) = 3MB

Sum of Internal Fragmentation in every block = (4-1) + (8-7)+(8-7)+(16-14)

= 3+1+1+2 = 7MB

Suppose process P5 of size 7MB comes. But this process cannot be accommodated in spite of available free space because of contiguous allocation.

Hence, 7 MB becomes part of external fragmentation.