OPERATING SYSTEM

Memory Management in Operating System

Definition

Memory management is a function of the operating system that controls and coordinates the use of main memory (RAM).
It keeps track of which part of memory is in use, which is free, and allocates and deallocates memory to processes as needed.

Why Memory Management is Needed

- To allow **multiple processes** to run simultaneously
- To ensure **efficient use of memory**
- To prevent one process from **accessing another process's memory**
- To improve overall **system performance**

Functions of Memory Management

1. **Memory Allocation**
   Assigns memory space to processes.
2. **Memory Deallocation**
   Frees memory when a process finishes.
3. **Address Mapping**
   Converts logical (virtual) addresses to physical addresses.
4. **Memory Protection**
   Prevents illegal memory access between processes.
5. **Sharing**
   Allows processes to share memory safely when required.

Types of Memory Management in Operating System

Memory management techniques are mainly classified into **two types** based on how memory is allocated to processes:

1. **Contiguous Memory Allocation**
2. **Non-Contiguous Memory Allocation**

1. Contiguous Memory Allocation

Definition

In **contiguous memory allocation**, **each process is allocated a single continuous block of memory**.

All the memory assigned to a process lies **next to each other** in physical memory.

Characteristics

- Simple to implement
- Fast access
- Each process occupies one continuous memory block

Types of Contiguous Allocation

- **Fixed Partitioning**
- **Variable Partitioning**

Advantages

- Simple memory management
- Easy address calculation

Disadvantages

- **External fragmentation**
- Memory wastage
- Limited flexibility

Example

If a process needs 100 KB, the OS must find **one free block of 100 KB** in memory.

2. Non-Contiguous Memory Allocation

Definition

In **non-contiguous memory allocation**, a process is **divided into smaller parts**, and these parts are stored in **different locations in memory**.

The memory blocks **do not need to be adjacent**.

Characteristics

- More flexible
- Better memory utilization
- Uses tables to keep track of memory locations

Types of Non-Contiguous Allocation

- **Paging**
- **Segmentation**
- **Paged Segmentation**

Advantages

- Eliminates external fragmentation
- Efficient use of memory

- Supports virtual memory

Disadvantages

- More complex
- Requires extra hardware (MMU)
- Slight overhead in address translation

Example

A process is divided into pages and stored in **any available free frames** in memory.