

Resource Allocation

Resource allocation is the process of distributing system resources (such as CPU time, memory, disk space, and I/O devices) among multiple processes to ensure efficient execution.

1. Why is Resource Allocation Important?

Computers handle multiple processes simultaneously. To prevent conflicts and ensure smooth execution, the operating system manages and allocates resources **efficiently**.

Types of Resources in OS

- ❖ **CPU Time** ⏱ – Determines how long a process can run.
- ❖ **Memory (RAM)** 🧠 – Stores active programs and data.
- ❖ **Disk Space (Storage)** 💾 – Saves files and system data.
- ❖ **I/O Devices** 🖨️ – Controls access to peripherals like printers and microphones.

2. Methods of Resource Allocation

Different strategies are used to allocate resources based on system needs:

1. Static Allocation

- ❖ Resources are assigned **before execution**.
- ❖ Example: **Pre-assigned memory space for programs.**

2. Dynamic Allocation

- ❖ Resources are assigned **during execution** as needed.
- ❖ Example: **Increasing RAM usage dynamically while running a heavy application.**

3. Contiguous Allocation

- ❖ Assigns memory in a **continuous block**.
- ❖ Example: **Old file systems like FAT32 use contiguous storage.**

4. Non-Contiguous Allocation

- ❖ Allocates memory in **separate blocks**.
- ❖ Example: **Modern file systems like NTFS use fragmented storage to optimize space.**

5. Priority-Based Allocation

- ❖ High-priority tasks receive **more resources** than lower-priority ones.
- ❖ Example: **Real-time operating systems prioritize essential tasks like emergency signals.**

3. Resource Allocation Challenges

1. Deadlocks

- ❖ When two or more processes are stuck waiting for each other's resources.
- ❖ **Solution:** Deadlock prevention or detection (e.g., Banker's Algorithm).

2. Starvation

- ❖ Some processes **never get resources** because higher-priority tasks always take precedence.
- ❖ **Solution:** Use **fair scheduling algorithms** like Round-Robin.

3. Overhead Costs

- ❖ Constant resource allocation creates **extra system load**.
- ❖ **Solution:** Optimize resource management to **reduce processing delays**.

4. Resource Allocation Algorithms

Algorithm	Purpose	How It Works
Banker's Algorithm	Deadlock Avoidance	Ensures safe resource allocation
Round Robin	CPU Scheduling	Gives each process equal time to run

First-Come, First-Served (FCFS)	Simple allocation	Resources assigned in arrival order
Shortest Job Next (SJN)	Efficient processing	Smallest task gets completed first

5. Real-World Applications

- ✓ Used in cloud computing for **dynamic server resource distribution**.
- ✓ Helps in database management **allocating queries efficiently**.
- ✓ Ensures smooth system performance in **multitasking environments**.

Resource allocation is a **key function of operating systems**, ensuring **fair and efficient** use of system resources.