Contiguous Memory Allocation

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Project Overview

This project will involve managing a contiguous region of memory of size MAX where addresses may range from 0...MAX−1. Program must respond to four different requests:

1. Request for a contiguous block of memory
2. Release of a contiguous block of memory
3. Compact unused holes of memory into one single block
4. Report the regions of free and allocated memory

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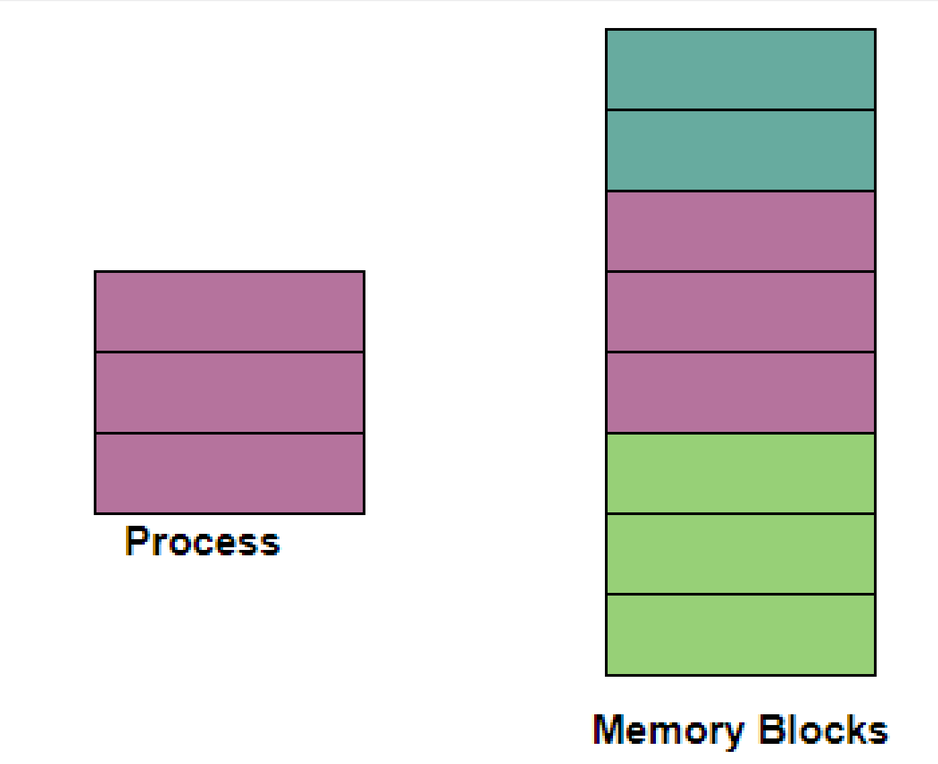
Advantages and Disadvantages

Definition:

- Contiguous Memory Allocation is a technique where the operating system allocates a single, continuous block of memory to a process.
- Advantages:
  - Simplifies memory management and access.
  - Ideal for systems with limited memory size where fast memory access is critical.

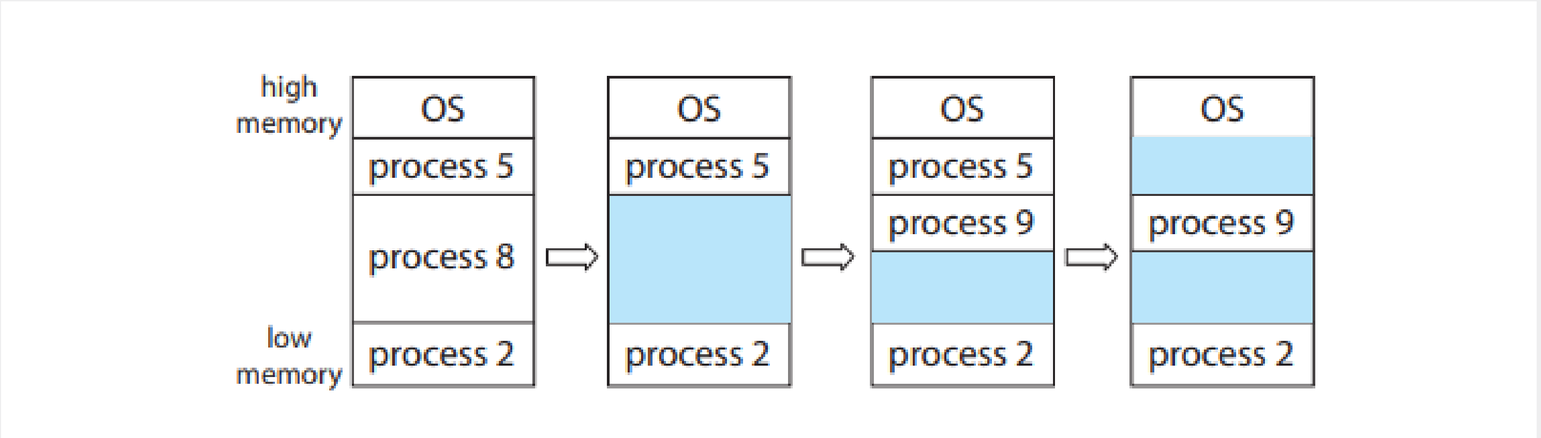


Memory Allocation

- A method of assigning processes to variably sized memory partitions, where each partition holds exactly one process.
- **Management:**
  - The operating system maintains a table to track available and occupied memory.
  - Memory starts as one large block ("hole") and becomes fragmented as processes are added and removed.

Partition Management

- **Initially:** Memory is a single large block ("hole").
- As processes arrive and leave: Holes of varying sizes are created.



Memory Allocation and Release

- **Allocation:**
  - The OS considers process requirements and available memory to allocate space.
- **Release:**
  - Upon completion, memory is freed and reused.
  - Insufficient memory:
    - Reject the process with an error message.
    - Place the process in a wait queue for later allocation.

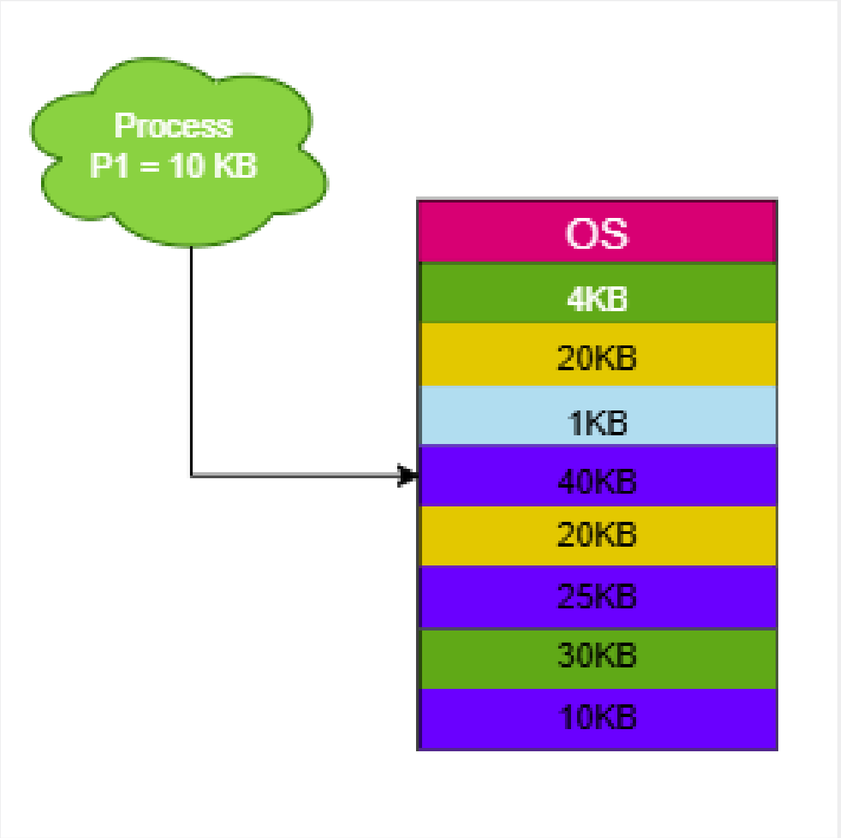
Free Space Management

- **Fragmentation:**
  - Memory holes of varying sizes are scattered throughout memory.
- **Handling Large Holes:**
  - If a hole is too large:
    - Split into allocated and free space.
  - Adjacent free holes:
    - Merged into a larger block.

Allocation Strategies:

- **Strategies to select memory holes:**
  - **First-fit:** Choose the first hole large enough.
  - **Best-fit:** Choose the smallest hole large enough.
  - **Worst-fit:** Choose the largest hole.
- **Comparison:**
  - First-fit and Best-fit are generally faster and more efficient than Worst-fit.

FIRST-FIT



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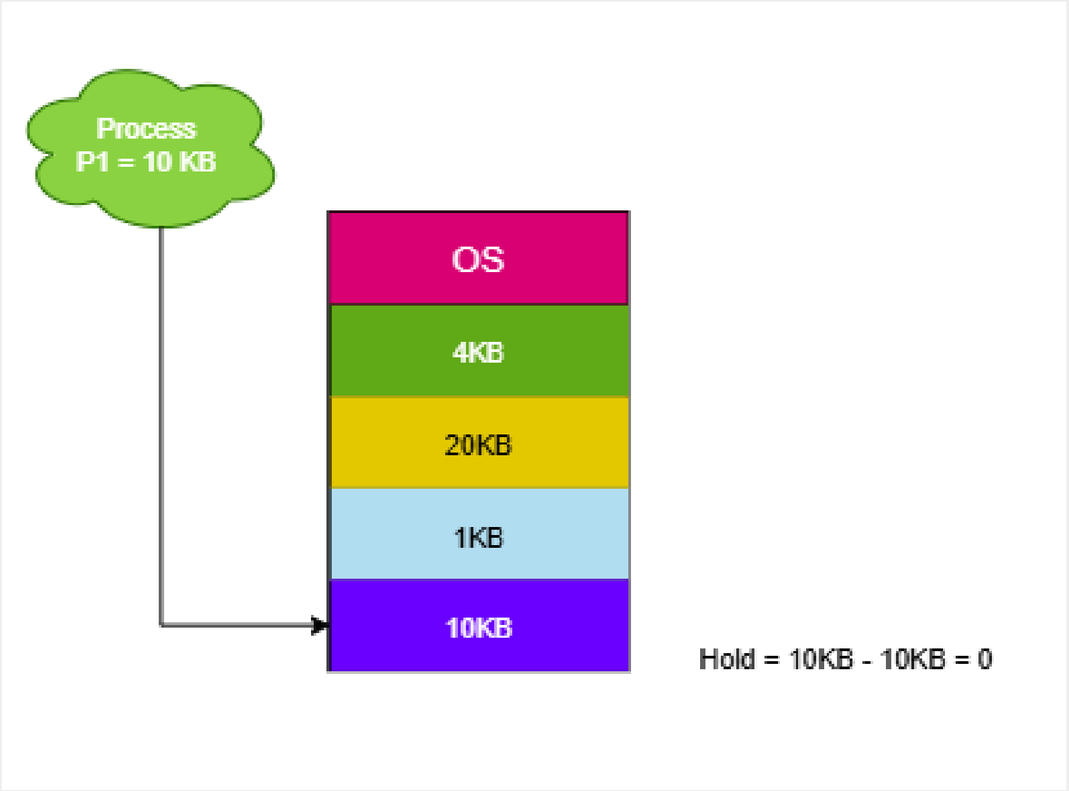
BEST-FIT



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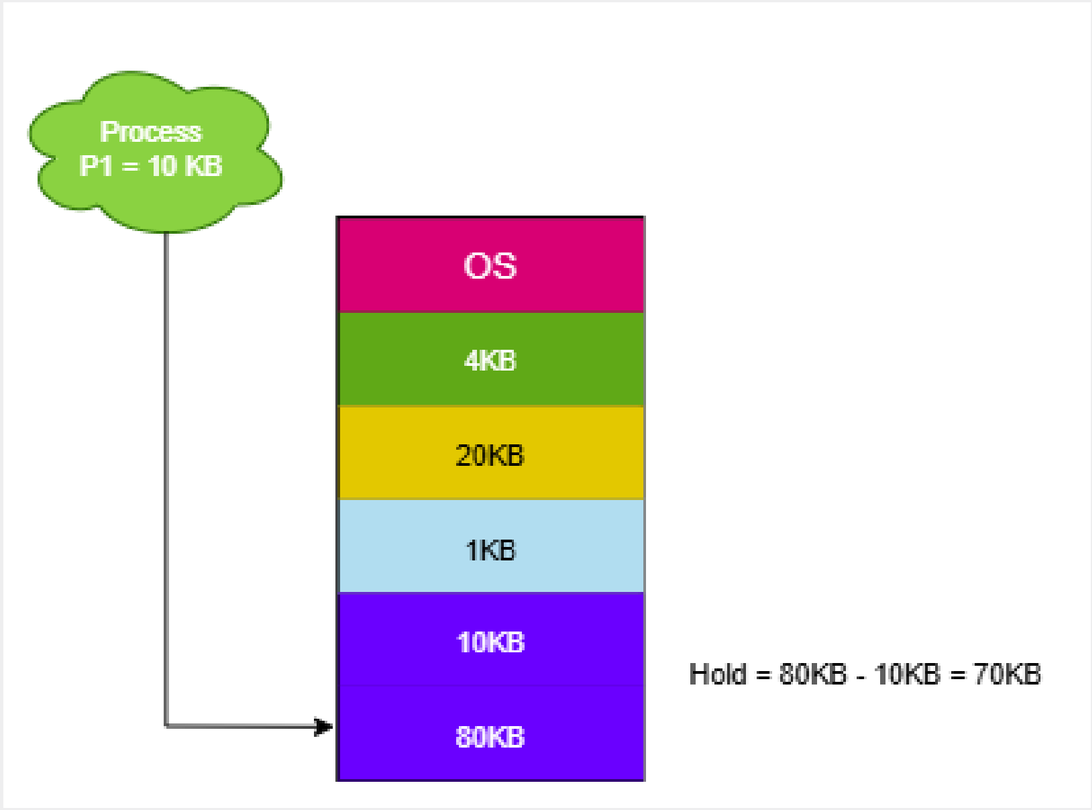
WORST-FIT



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Project

Advantages and Disadvantages

Contiguous Memory Allocation

- **Purpose:**
  - Simulate memory allocation and management processes.
  - Handle requests, releases, and compaction of memory dynamically.
- **Initialization Command:**

  `/allocator 1048576`

  -> Allocates 1 MB (1,048,576 bytes) of memory.
- **User Interaction Prompt:**

  `allocator>`

Commands

- **RQ (Request):**
  - Request memory for a process.
  - Syntax: *RQ <Process> <Bytes> <Strategy>*
    - Example: *RQ P0 40000 W* (Worst-fit)
- **RL (Release):**
  - Release memory allocated to a process.
  - Syntax: *RL <Process>*
    - Example: *RL P0*
- **STAT (Status Report):**
  - Display allocated and unused memory regions.
  - Syntax: *STAT*
- **X (Exit):**
  - Terminate the program.

```
allocator>RQ P0 20 F
allocator>RQ P1 45 W
allocator>STAT
Addresses [0:19] Process P0
Addresses [20:64] Process P1
Addresses [65:199] Unused
allocator>RL P0
allocator>STAT
Addresses [0:19] Unused
Addresses [20:64] Process P1
Addresses [65:199] Unused
allocator>C
allocator>STAT
Addresses [0:44] Process P1
Addresses [45:199] Unused
allocator>X
Bye
```

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Advantages and Disadvantages

Advantages:

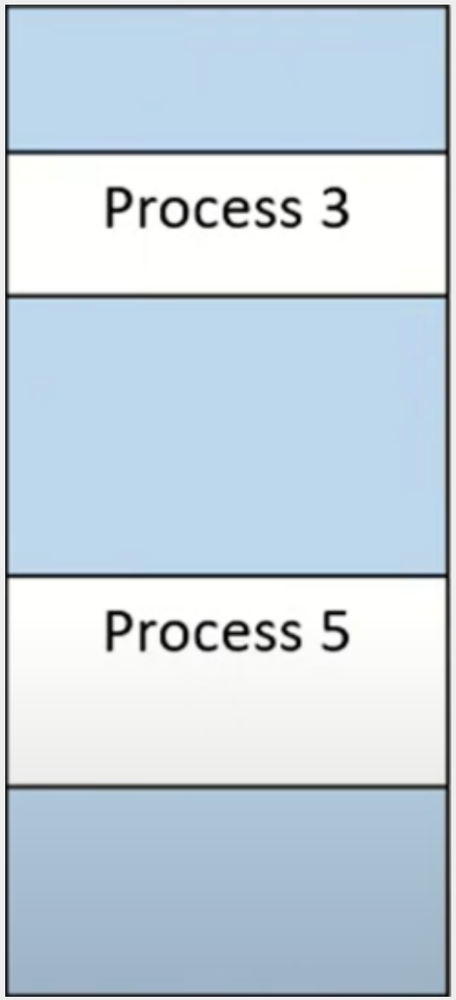
- **Simplicity**
- **Efficiency**
- **Low Fragmentation**

Disadvantages:

- **Limited Flexibility**
- **Memory Wastage**
- **Difficulty Managing Larger Memory Sizes**

External Fragmentation:

- Occurs with both first-fit and best-fit strategies.
- Leads to fragmented, non-contiguous free regions.
- The "50-percent rule": 1/3 of memory can remain unused.



Q&A

Thank You