

OPERATING SYSTEM

Virtual Memory

Definition

Virtual memory is a memory management technique that allows a computer to **execute programs larger than the available physical memory (RAM)** by using **secondary storage (disk)** as an extension of main memory.

The operating system loads **only the required parts of a program into RAM**, while the rest remains on disk.

Why Virtual Memory is Needed

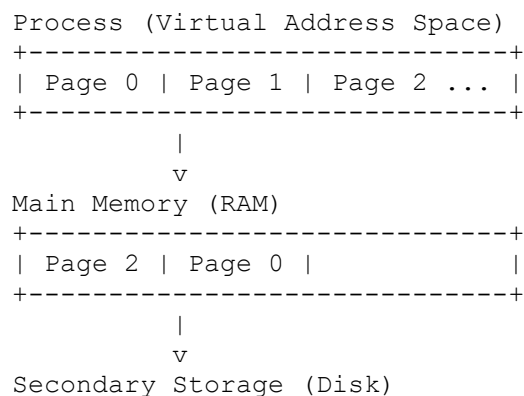
- Physical memory is limited and expensive
- Multiple programs run simultaneously
- Large applications require more memory
- Efficient memory utilization is required

👉 Virtual memory provides the **illusion of a large memory space** to programs.

How Virtual Memory Works

1. Program is divided into **pages**
2. Pages are stored on **disk**
3. When a page is needed:
 - a. If present in RAM → execution continues
 - b. If not present → **page fault occurs**
4. OS brings required page from disk to RAM
5. Execution resumes

Virtual Memory Diagram



Key Concepts in Virtual Memory

- **Page Fault** – Requested page not in memory
- **Page Table** – Maps virtual pages to physical frames
- **Replacement Algorithm** – Decides which page to remove
- **Thrashing** – Excessive paging causing performance drop

Advantages of Virtual Memory

- Programs can be larger than RAM
- Better memory utilization
- Supports multiprogramming
- Improves system flexibility

Disadvantages of Virtual Memory

- Slower than physical memory access
- Page fault overhead
- Thrashing if poorly managed

Virtual Memory vs Physical Memory

Feature	Physical Memory	Virtual Memory
Size	Limited	Large (logical)
Speed	Fast	Slower
Cost	Expensive	Uses disk
Program Size	Limited	Large programs supported

Virtual memory is a memory management technique that uses secondary storage to give the illusion of a large main memory, allowing programs larger than physical memory to run efficiently.

👉 *Virtual memory allows efficient execution of large programs by loading only required parts into RAM.*