OPERATING SYSTEM

Process vs Threads

Process

Definition

A process is an independent program in execution.
It has its own memory space, resources, and system state.

Characteristics

- Own address space (code, data, heap, stack)
- Heavyweight
- More secure (isolated from other processes)
- Created using system calls like `fork()`

Example

Running two applications like **Chrome** and **VS Code** are two separate processes.

Thread

Definition

A thread is the smallest unit of execution within a process.
Multiple threads exist inside a single process and share resources.

Characteristics

- Shares memory and resources with other threads
- Lightweight
- Faster creation and communication
- Created using threading libraries

Example

A web browser tab using:

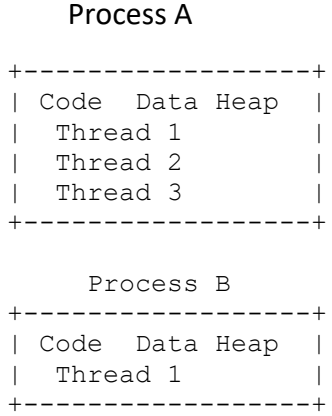
- One thread for UI

- One thread for downloading
- One thread for rendering

Differences Between Process and Thread

Feature	Process	Thread
Definition	Independent program in execution	Smallest unit of execution
Memory Space	Separate memory	Shared memory
Communication	IPC (pipes, sockets)	Shared variables
Creation Cost	High	Low
Context Switching	Slower	Faster
Failure Impact	One process crash doesn't affect others	One thread crash can affect entire process
Security	More secure	Less secure

Process vs Thread Diagram



When to Use What

Use **processes** when:

- High security and isolation is required
- Applications are independent

Use **threads** when:

- Fast execution is needed
- Tasks share data
- Parallel work inside the same application