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Java

Program vs Process vs Thread

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Program vs Process vs Thread

Program:

- A program is an executable file containing a set of instructions passively stored on disk.

Process:

- A process is a program in execution.
- When a program is loaded into the memory and becomes active, the program becomes a process.
- A process requires some essential resources such including CPU time, program counter, stack, memory, files, and I/O devices — to accomplish its task.
- Program is a passive entity while process is an active entity.
- One program can have multiple processes.

Thread :

- A Thread is the smallest unit of execution within a process (or) basically it is a segment of a process .
- Thread is also known as lightweight process.
- There are two types of processes :
    1. Single Threaded Process
    2. Multi Threaded Process

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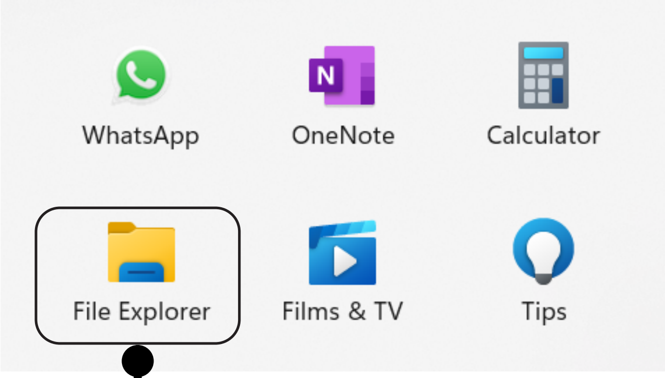
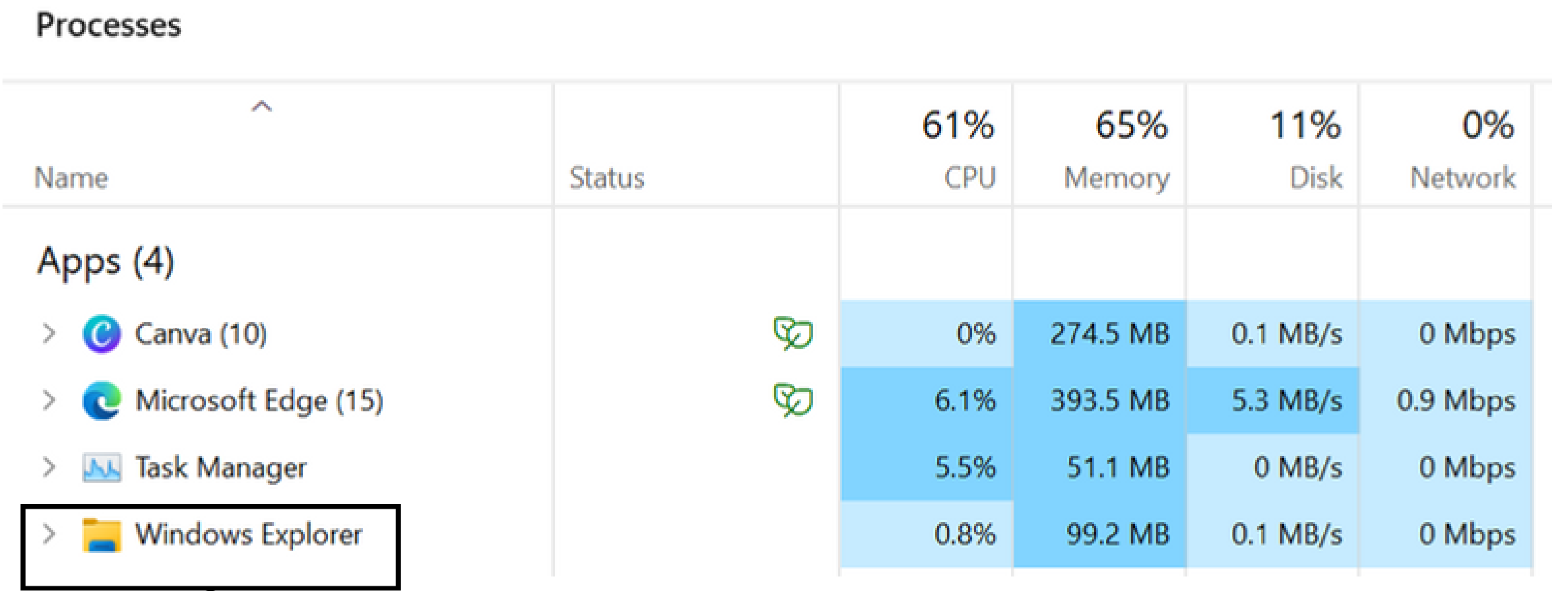
Program vs Process vs Thread

As shown in the figure, a thread is executed inside the process. There is context-switching between the threads. There can be multiple processes inside the OS, and one process can have multiple threads.



Program (Disk)

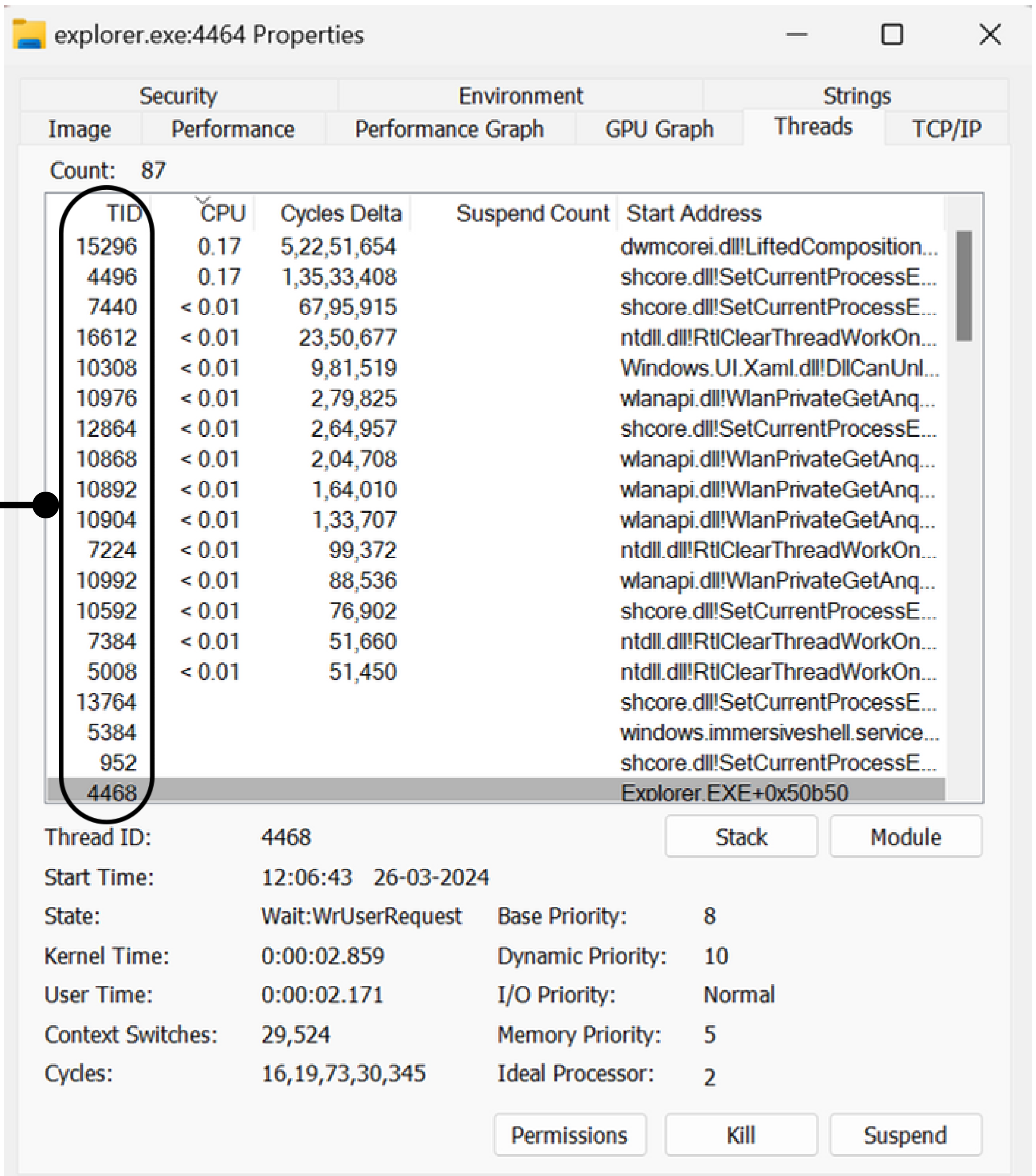


Processes

Name	Status	61% CPU	65% Memory	11% Disk	0% Network
Apps (4)					
Canva (10)		0%	274.5 MB	0.1 MB/s	0 Mbps
Microsoft Edge (15)		6.1%	393.5 MB	5.3 MB/s	0.9 Mbps
Task Manager		5.5%	51.1 MB	0 MB/s	0 Mbps
Windows Explorer		0.8%	99.2 MB	0.1 MB/s	0 Mbps

process (RAM)

Threads
TID - Thread id



explorer.exe:4464 Properties

Count: 87

TID	CPU	Cycles Delta	Suspend Count	Start Address
15296	0.17	5,22,51,654		dwmcorei.dll!LiftedComposition...
4496	0.17	1,35,33,408		shcore.dll!SetCurrentProcessE...
7440	< 0.01	67,95,915		shcore.dll!SetCurrentProcessE...
16612	< 0.01	23,50,677		ntdll.dll!RtlClearThreadWorkOn...
10308	< 0.01	9,81,519		Windows.UI.Xaml.dll!DllCanUnl...
10976	< 0.01	2,79,825		wlanapi.dll!WlanPrivateGetAnq...
12864	< 0.01	2,64,957		shcore.dll!SetCurrentProcessE...
10868	< 0.01	2,04,708		wlanapi.dll!WlanPrivateGetAnq...
10892	< 0.01	1,64,010		wlanapi.dll!WlanPrivateGetAnq...
10904	< 0.01	1,33,707		wlanapi.dll!WlanPrivateGetAnq...
7224	< 0.01	99,372		ntdll.dll!RtlClearThreadWorkOn...
10992	< 0.01	88,536		wlanapi.dll!WlanPrivateGetAnq...
10592	< 0.01	76,902		shcore.dll!SetCurrentProcessE...
7384	< 0.01	51,660		ntdll.dll!RtlClearThreadWorkOn...
5008	< 0.01	51,450		ntdll.dll!RtlClearThreadWorkOn...
13764				shcore.dll!SetCurrentProcessE...
5384				windows.immersiveshell.service...
952				shcore.dll!SetCurrentProcessE...
4468				Explorer.EXE+0x50b50

Thread ID: 4468
Start Time: 12:06:43 26-03-2024
State: Wait:WrUserRequest
Kernel Time: 0:00:02.859
User Time: 0:00:02.171
Context Switches: 29,524
Cycles: 16,19,73,30,345
Base Priority: 8
Dynamic Priority: 10
I/O Priority: Normal
Memory Priority: 5
Ideal Processor: 2

Note: Install process explorer to see the threads and process.
https://process-explorer

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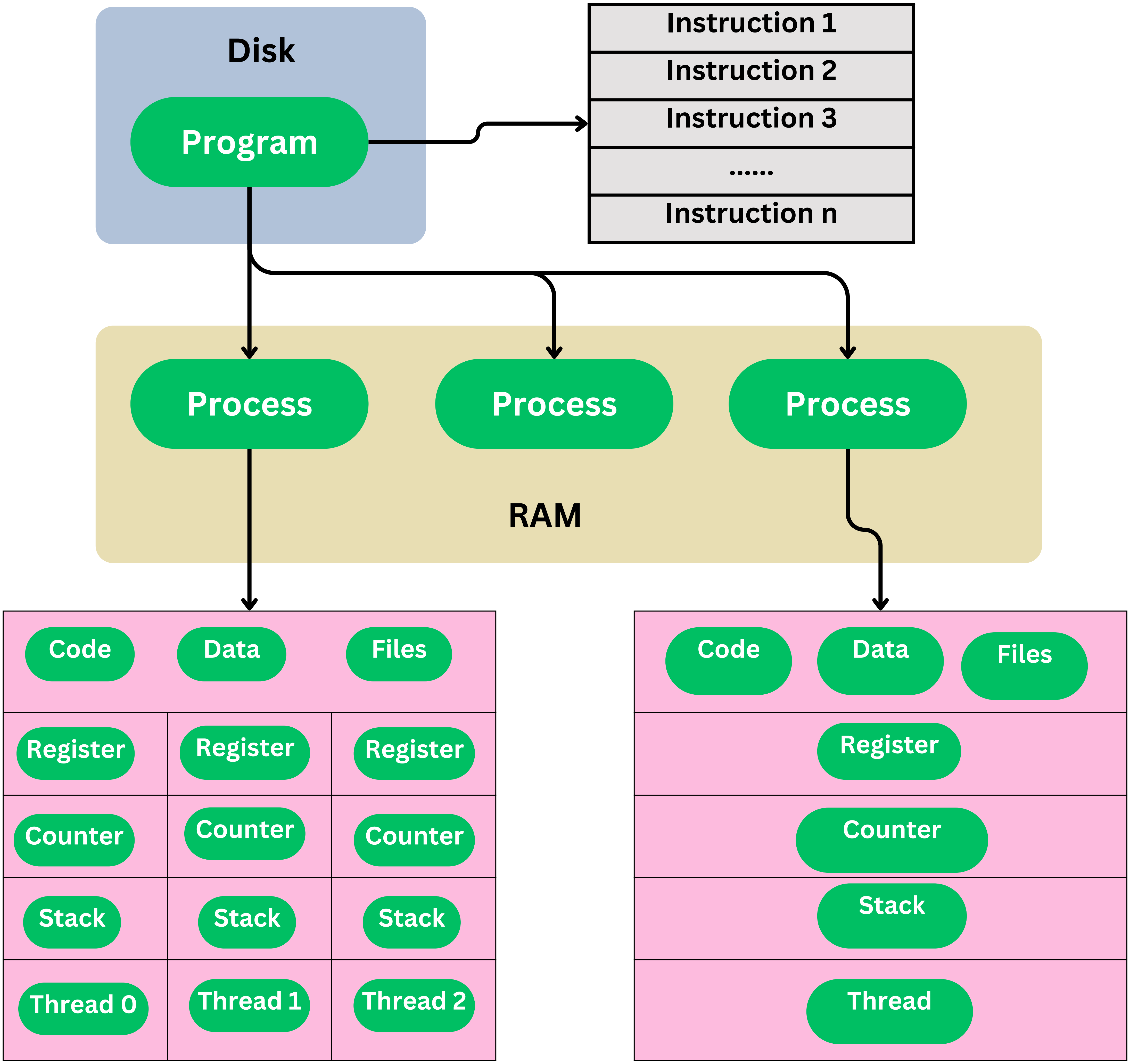
Program vs Process vs Thread



Instruction 1
Instruction 2
Instruction 3
......
Instruction n

Code	Data	Files
Register	Register	Register
Counter	Counter	Counter
Stack	Stack	Stack
Thread 0	Thread 1	Thread 2

Multi Threaded Process

Code	Data	Files
Register		
Counter		
Stack		
Thread		

Single Threaded Process

Single Threaded Process

- A single thread executes the instructions line by line from beginning to end.
- A single-threaded process has one program counter specifying the next instruction to execute.
- The execution of such a process must be sequential — the CPU executes one instruction after another, until the process completes.

Multi Threaded Process

- Multithreading is a model of program execution that allows for multiple threads to be created within a process, executing independently but concurrently sharing the process resources like data, memory, resources, files, etc with their peer threads within a process.
- Each thread has it’s own its own stack, register and program counters .
- Threads can directly communicate with each other as they share the same address space.

Thank you!

vishal-bramhankar

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Vishal0317