Module 2.2 Thread

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Outline

- Thread
- Process Vs Thread
- Example

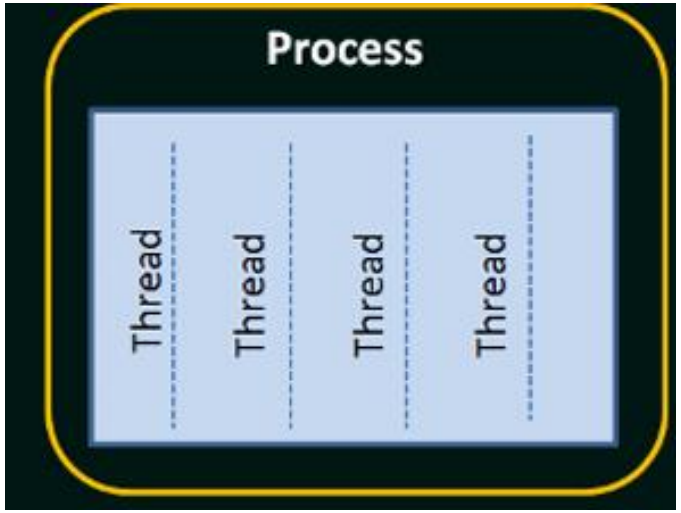
Thread

- Supports Parallelism with multiple threads of execution at a time
- A thread executes sequentially and is interrupt-able so that the processor can turn to another thread
- Does not need entire process context to execute so considered as lightweight.
- Includes the program counter and stack pointer) and its own data area for a stack
- Supports multiple parallel executions

  e.g. Notifications in background while you are using the app
- The idea is to **achieve parallelism by dividing a process into multiple threads.**

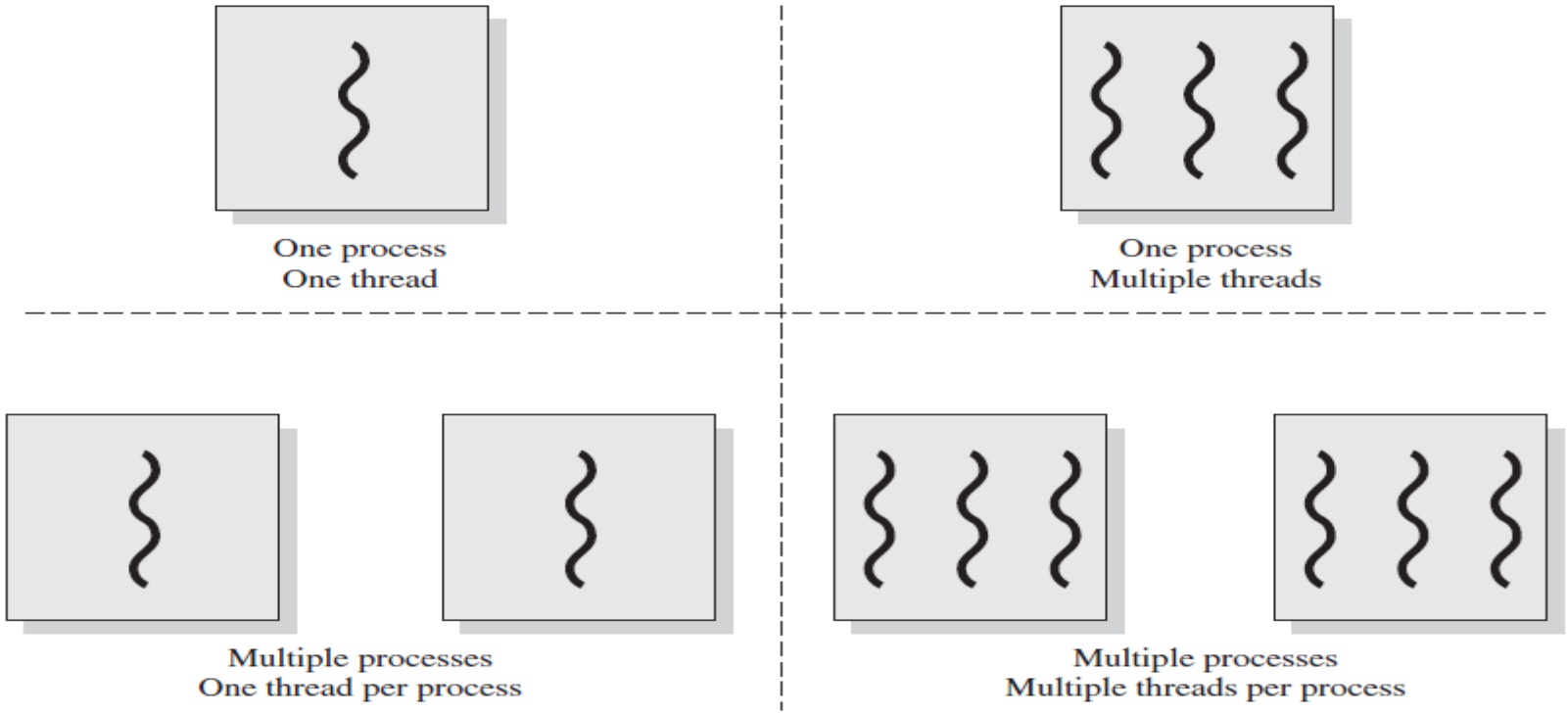
Process and Thread

- A process is an instance of a program in execution.
- It is a basic unit of work that can be scheduled and executed by the operating system.
- A thread is the unit of execution within a process.
- A process can have anywhere from just one thread to many threads.



Thread

- *Multithreading* refers to the ability of an OS to support multiple, concurrent paths of execution within a single process.



Thread

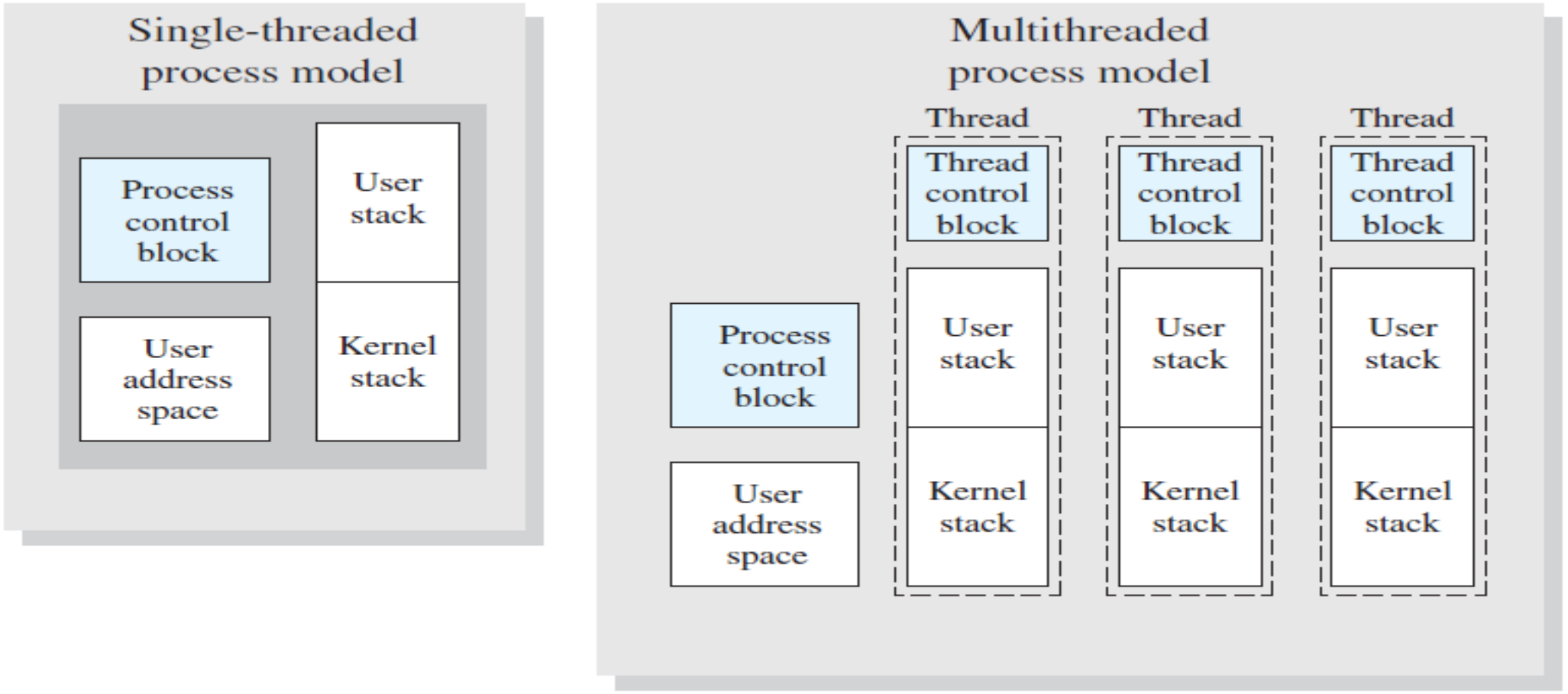


Figure 4.2 **Single Threaded and Multithreaded Process Models**

The key benefits of threads

- It takes far less time to create a new thread in an existing process than to create a brand-new process.
- It takes less time to terminate a thread than a process.

Types of threads

- Kernel level threads : managed by kernel
- User level threads : managed by user with support from programming languages and libraries
- Hybrid threads

Thread

- Thread libraries provide programmers with API for the creation and management of threads.
- Three types of Thread
  - **POSIX Pitheads** may be provided as either a user or kernel library, as an extension to the POSIX standard.
  - **Win32 threads** are provided as a kernel-level library on Windows systems.
  - **Java threads**: Since Java generally runs on a Java Virtual Machine, the implementation of threads is based upon whatever OS and hardware the JVM is running on, i.e. either Pitheads or Win32 threads depending on the system.

Thread

- Create
- Join
- Terminate

Create, Start and Join

- A thread can be created using the **Thread class** provided by the threading module. Using this class, you can create an instance of the Thread and then start it using the **.start()** method.

Create & Start

```python
import threading

# Creating Target Function
def num_gen(num):
    for n in range(num):
        print("Thread: ", n)

# Main Code of the Program
if __name__ == "__main__":
    print("Statement: Creating and Starting a Thread.")
    thread = threading.Thread(target=num_gen, args=(3,))
    thread.start()
    print("Statement: Thread Execution Finished.")
```

- 1st execution

```
Statement: Creating and Starting a Thread.
Thread:  0
Statement: Thread Execution Finished.
Thread:  1
Thread:  2
```

- 2nd execution

```
Statement: Creating and Starting a Thread.
Thread:  0
Thread:  1
Statement: Thread Execution Finished.
Thread:  2
```

Join() Method

- The join() method is used in that situation, it doesn't let e**xecute the code further until the current thread terminates**.

```
import threading

# Creating Target Function
def num_gen(num):
    for n in range(num):
        print("Thread: ", n)

# Main Code of the Program
if __name__ == "__main__":
    print("Statement: Creating and Starting a Thread.")
    thread = threading.Thread(target=num_gen, args=(3,))
    thread.start()
    thread.join()
    print("Statement: Thread Execution Finished.")
```

```
Statement: Creating and Starting a Thread.
Thread:  0
Thread:  1
Thread:  2
Statement: Thread Execution Finished.
```

Assignment

- ULT vs KLT
- Pthread
- POSIX

Question ?