# THREADS (OPERATING SYSTEM)

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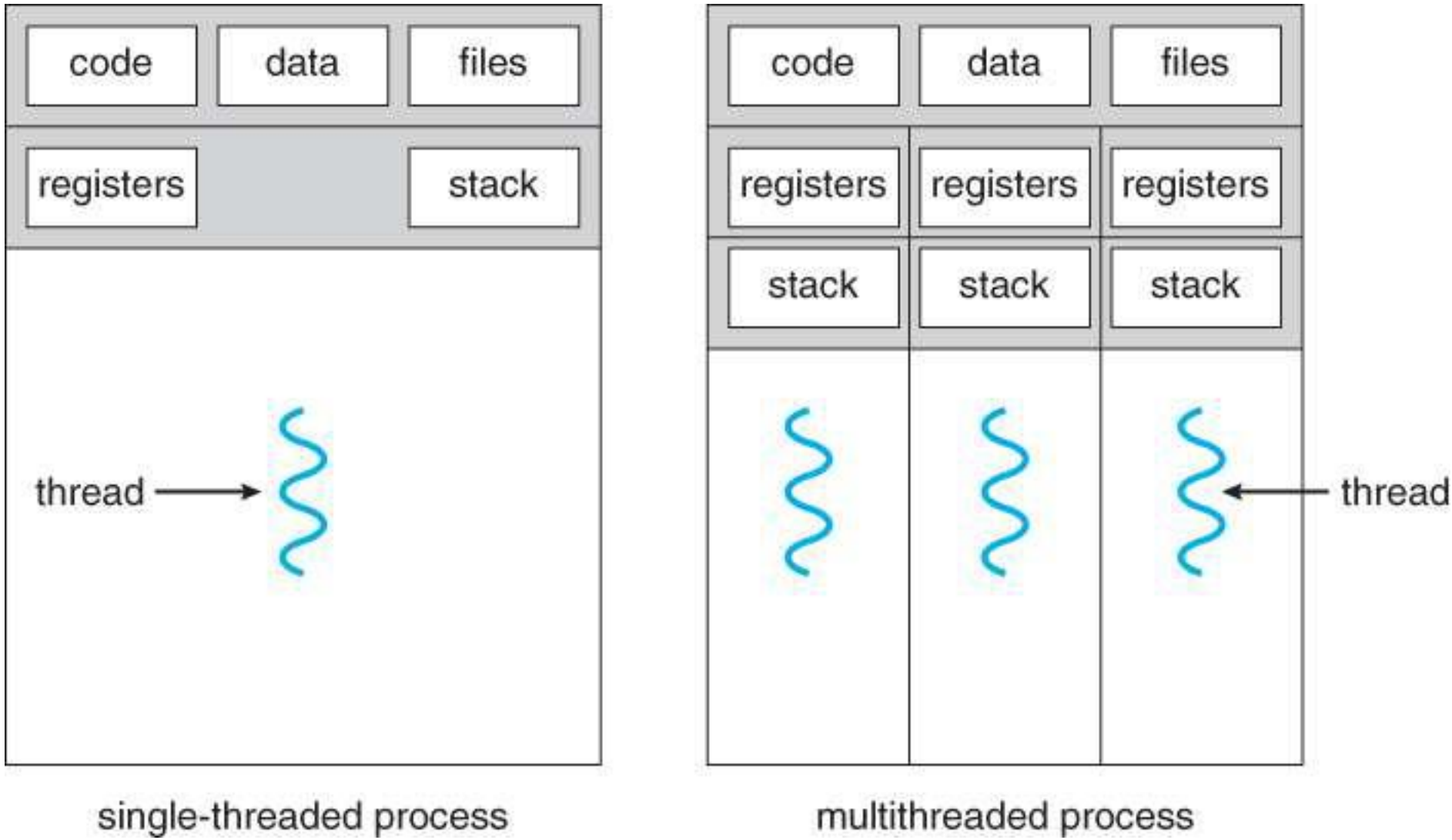
# What is Thread ?

- A thread is a flow of execution through the process code, with its own program counter, system registers and stack.
- A thread is also called a light weight process. Threads provide a way to improve application performance through parallelism.
- Each thread belongs to exactly one process and no thread can exist outside a process.

# Single threaded Process and Multi-threaded Process



# Difference between Process and Threads :

| S.N. | Process | Threads |
|---|---|---|
| 1. | Process is heavy weight or resource intensive. | Thread is light weight taking lesser resources than a process. |
| 2. | Process switching needs interaction with operating system. | Thread switching does not need to interact with operating system. |
| 3. | In multiple processing environments each process executes the same code but has its own memory and file resources. | All threads can share same set of open files, child processes. |
| 4. | If one process is blocked then no other process can execute until the first process is unblocked. | While one thread is blocked and waiting, second thread in the same task can run. |
| 5. | Multiple processes without using threads use more resources. | Multiple threaded processes use fewer resources. |
| **6.** | In multiple processes each process operates independently of the others. | One thread can read, write or change another thread's data. |

# Advantages of Threads

- Thread minimizes context switching time.
- Use of threads provides concurrency within a process.
- Efficient communication.
- Economy- It is more economical to create and context switch threads.
- Utilization of multiprocessor architectures to a greater scale and efficiency.

# Disadvantages of Threads

- Blocking of parent threads will stop all child thread.
- Security.

# Types of Threads

- Threads are implemented in following two ways :
  - User Level Threads (ULT)
  - Kernel Level Threads (KLT)

# User Level Threads (ULT)

- User level thread implement in user level libraries, so thread switching does not need to call operating system and to cause
- interrupt to the kernel.
- In fact, the kernel knows nothing about user level threads and manages them as if they were single-threaded process.

# User Level Threads (ULT)

- Advantages of ULT
  - User level threads does not require modification to operating system.
  - Easy to represent and manage.
  - User level thread can run on any operating system.
  - User level threads are fast and efficient.
- Disadvantages of ULT :
  - There is a lack of coordination between threads and operating system kernel.
  - ULT require non-blocking system call (i.e. Multithreaded kernel)

# Kernel Level Threads (KLT)

- In this method, the kernel knows about and manages the threads.
- No runtime system is needed in this case.
- Operating system kernel provides system call to create and manage threads.

# Kernel Level Threads (KLT)

- Advantages of KLT :
  - Kernel can simultaneously schedule multiple threads from the same process on multiple processes.
  - If one thread in a process is blocked the kernel can schedule another thread of the same process.
  - Kernel routines themselves can multithreaded.

- Disadvantages of KLT :
  - Kernel thread are generally slower to create and manage than the user threads.
  - Kernel requires Thread Control Block (TCB) for each thread in the pool, hence complexity increases.

# Difference between ULT and KLT

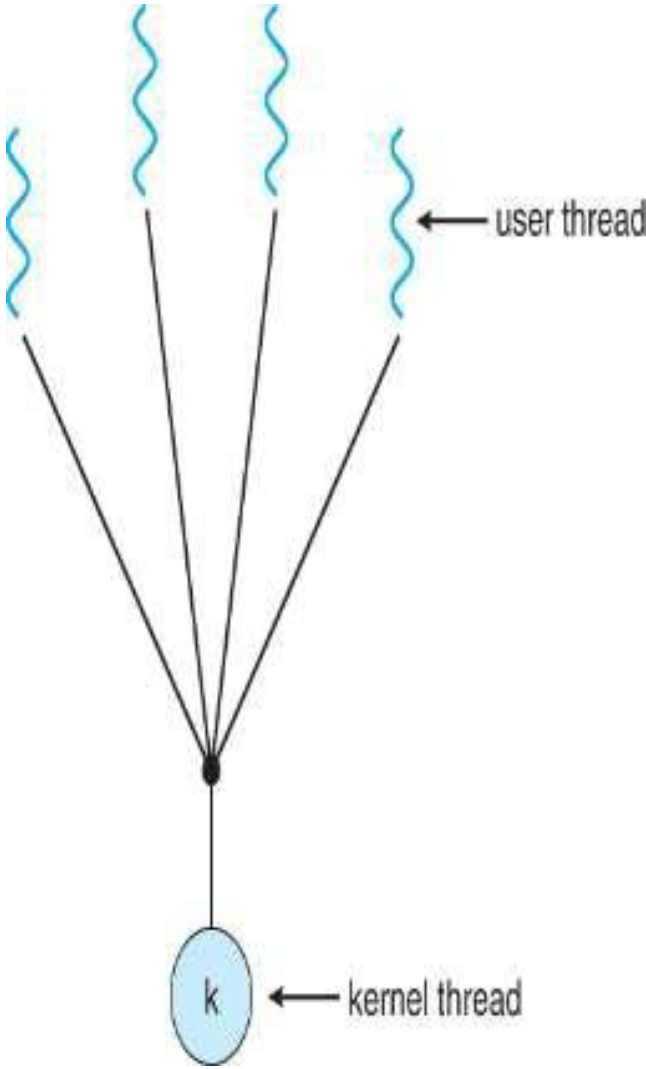
| S.N. | User Level Thread | Kernel Level Thread |
|---|---|---|
| 1. | User level thread are faster to create and manage. | Kernel level thread are slower to create and manage. |
| 2. | Implementation is by a thread library at the user level. | Operating system supports creation of kernel level threads. |
| 3. | ULT is generic and can run on any operating system. | KLT is specific to the operating system. |
| **4.** | Multi-Threaded can not take advantages of multiprocessing. | Kernel routines themselves can be multithreaded. |

# Multi-Threading Models

- Some operating system provides a combined user level thread and kernel level thread facility.
- Solaris is a good example of this combined approach.
- Multi-Threading models are three types.
  - Many-to-One Model
  - One-to-One Model
  - Many-to-Many Model

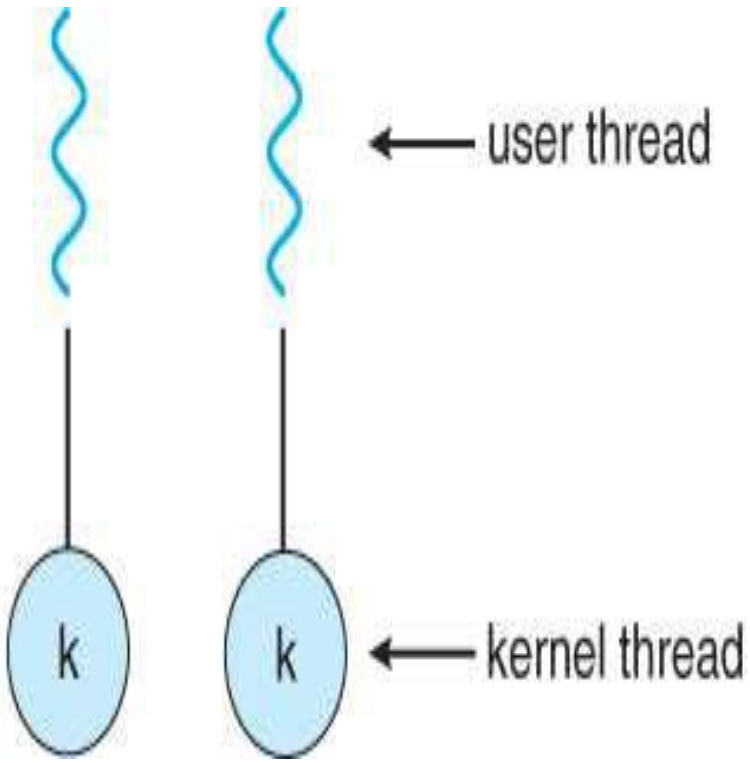
# Many-to-One Model

- Implementation of the many-to-one model (many user level thread to one kernel level thread) allow the application to create any number of threads that can execute concurrently.
- In this implementation, all threads activity is restricted to user space.
- Additionally only one thread can access the kernel at a time, so only one schedulable entity is known to the os.



# One-to-One Model

- The one-to-one model (one user level thread to one kernel level thread) is among the earliest implementations of true multithreading.
- In this implementation, each ULT created by the application is known to the kernel and all threads can access the kernel at the same time.



# Many-to-Many Model

- The many-to-many model (many user level thread to many kernel level thread) avoids many of the
- limitations of the one-to-one model, while extending multithreading
- capabilities even further. The many-to-many model also called two-level model, minimize programing effort while reducing the cost and weight of each thread.