**Multithreading in [Java](https://www.javatpoint.com/java-tutorial)** is a process of executing multiple threads simultaneously.

Multiprocessing and multithreading, both are used to achieve multitasking.

we use multithreading than multiprocessing because threads use a shared memory area. They don't allocate separate memory area so saves memory, and context-switching between the threads takes less time than process.

Advantages of Java Multithreading

1) It **doesn't block the user** because threads are independent and you can perform multiple operations at the same time.

2) You **can perform many operations together, so it saves time**.

3) Threads are **independent**, so it doesn't affect other threads if an exception occurs in a single thread.

* Threads share the same address space.
* A thread is lightweight.
* Cost of communication between the thread is low.

## **What is Thread in java**

A thread is a lightweight subprocess, the smallest unit of processing. It is a separate path of execution.

Threads are independent. If there occurs exception in one thread, it doesn't affect other threads. It uses a shared memory area.

## **Java Thread class**

Java provides **Thread class** to achieve thread programming. Thread class provides constructors and methods to create and perform operations on a thread. Thread class extends Object class and implements Runnable interface.

## **Java Thread Methods**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.N.** | **Modifier and Type** | **Method** | **Description** |
| 1) | void | [start()](https://www.javatpoint.com/java-thread-start-method) | It is used to start the execution of the thread. |
| 2) | void | [run()](https://www.javatpoint.com/java-thread-run-method) | It is used to do an action for a thread. |
| 3) | static void | [sleep()](https://www.javatpoint.com/java-thread-sleep-method) | It sleeps a thread for the specified amount of time. |
| 4) | static Thread | [currentThread()](https://www.javatpoint.com/java-thread-currentthread-method) | It returns a reference to the currently executing thread object. |
| 5) | void | [join()](https://www.javatpoint.com/java-thread-join-method) | It waits for a thread to die. |
| 6) | int | [getPriority()](https://www.javatpoint.com/java-thread-getpriority-method) | It returns the priority of the thread. |
| 7) | void | [setPriority()](https://www.javatpoint.com/java-thread-setpriority-method) | It changes the priority of the thread. |
| 8) | String | [getName()](https://www.javatpoint.com/java-thread-getname-method) | It returns the name of the thread. |
| 9) | void | [setName()](https://www.javatpoint.com/java-thread-setname-method) | It changes the name of the thread. |
| 10) | long | [getId()](https://www.javatpoint.com/java-thread-getid-method) | It returns the id of the thread. |
| 11) | boolean | [isAlive()](https://www.javatpoint.com/java-thread-isalive-method) | It tests if the thread is alive. |
| 12) | static void | [yield()](https://www.javatpoint.com/java-thread-yield-method) | It causes the currently executing thread object to pause and allow other threads to execute temporarily. |
| 13) | void | [suspend()](https://www.javatpoint.com/java-thread-suspend-method) | It is used to suspend the thread. |
| 14) | void | [resume()](https://www.javatpoint.com/java-thread-resume-method) | It is used to resume the suspended thread. |
| 15) | void | [stop()](https://www.javatpoint.com/java-thread-stop-method) | It is used to stop the thread. |

# **Life cycle of a Thread (Thread States)**

In Java, a thread always exists in any one of the following states. These states are:

1. New
2. Active
3. Blocked / Waiting
4. Timed Waiting
5. Terminated

## **Explanation of Different Thread States**

**New:** Whenever a new thread is created, it is always in the new state. For a thread in the new state, the code has not been run yet and thus has not begun its execution.

**Active:** When a thread invokes the start() method, it moves from the new state to the active state. The active state contains two states within it: one is **runnable**, and the other is **running**.

* **Runnable:** A thread, that is ready to run is then moved to the runnable state.
* **Running:** When the thread gets the CPU, it moves from the runnable to the running state.

**Blocked or Waiting:** Whenever a thread is inactive for a span of time (not permanently) then, either the thread is in the blocked state or is in the waiting state.

**Timed Waiting:** Sometimes, waiting for leads to starvation. For example, a thread (its name is A) has entered the critical section of a code and is not willing to leave that critical section. In such a scenario, another thread (its name is B) has to wait forever, which leads to starvation. To avoid such scenario, a timed waiting state is given to thread B. Thus, thread lies in the waiting state for a specific span of time, and not forever. A real example of timed waiting is when we invoke the sleep() method on a specific thread. The sleep() method puts the thread in the timed wait state. After the time runs out, the thread wakes up and start its execution from when it has left earlier.

**Terminated:** A thread reaches the termination state because of the following reasons:

* When a thread has finished its job, then it exists or terminates normally.
* **Abnormal termination:** It occurs when some unusual events such as an unhandled exception or segmentation fault.

A terminated thread means the thread is no more in the system. In other words, the thread is dead, and there is no way one can respawn (active after kill) the dead thread.

# **Java Threads | How to create a thread in Java**

There are two ways to create a thread:

1. By extending Thread class
2. By implementing Runnable interface.

### Thread class:

Thread class provide constructors and methods to create and perform operations on a thread.Thread class extends Object class and implements Runnable interface.

Runnable interface:

The Runnable interface should be implemented by any class whose instances are intended to be executed by a thread. Runnable interface have only one method named run().

1. **public void run():** is used to perform action for a thread.

1) Java Thread Example by extending Thread class

**FileName:** Multi.java

1. **class** Multi **extends** Thread{
2. **public** **void** run(){
3. System.out.println("thread is running...");
4. }
5. **public** **static** **void** main(String args[]){
6. Multi t1=**new** Multi();
7. t1.start();
8. }
9. }

**Output:**

thread is running...

2) Java Thread Example by implementing Runnable interface

**FileName:** Multi3.java

**class** Multi3 **implements** Runnable{

**public** **void** run(){

System.out.println("thread is running...");

}

**public** **static** **void** main(String args[]){

Multi3 m1=**new** Multi3();

Thread t1 =**new** Thread(m1);   // Using the constructor Thread(Runnable r)

t1.start();

 }

}

**Output:**

thread is running...

If you are not extending the Thread class, your class object would not be treated as a thread object. So you need to explicitly create the Thread class object. We are passing the object of your class that implements Runnable so that your class run() method may execute.

**import** java.lang.Thread;

A component of Java that decides which thread to run or execute and which thread to wait is called a **thread scheduler in Java**

There are two factors for scheduling a thread i.e. **Priority** and **Time of arrival**.

## **Thread Scheduler Algorithms**

1. First Come First Serve Scheduling
2. Etc…..

Example of the sleep() method in Java : on the custom thread

The following example shows how one can use the sleep() method on the custom thread.

**FileName:** TestSleepMethod1.java

1. **class** TestSleepMethod1 **extends** Thread{
2. **public** **void** run(){
3. **for**(**int** i=1;i<5;i++){
4. // the thread will sleep for the 500 milli seconds
5. **try**{Thread.sleep(500);}**catch**(InterruptedException e){System.out.println(e);}
6. System.out.println(i);
7. }
8. }
9. **public** **static** **void** main(String args[]){
10. TestSleepMethod1 t1=**new** TestSleepMethod1();
11. TestSleepMethod1 t2=**new** TestSleepMethod1();
13. t1.start();
14. t2.start();     }    }

**Output:**

1

1

2

2

3

3

4

4

Method run should be always public for Implementing Thread class/runnable interface

As you know well that at a time only one thread is executed. If you sleep a thread for the specified time, the thread scheduler picks up another thread and so on.

# **What if we call Java run() method directly instead start() method?**

As we can see in the above program that there is no context-switching because here t1 and t2 will be treated as normal object not thread object.

# What if we call Java run() method directly instead start() method?

* Each thread starts in a separate call stack.
* Invoking the run() method from the main thread, the run() method goes onto the current call stack rather than at the beginning of a new call stack.

# **Synchronization in Java**

Synchronization in Java is the capability to control the access of multiple threads to any shared resource.

Java Synchronization is better option where we want to allow only one thread to access the shared resource.

### Why use Synchronization?

The synchronization is mainly used to

1. To prevent thread interference.
2. To prevent consistency problem.

# **Deadlock in Java**

Deadlock in Java is a part of multithreading. Deadlock can occur in a situation when a thread is waiting for an object lock, that is acquired by another thread and second thread is waiting for an object lock that is acquired by first thread. Since, both threads are waiting for each other to release the lock, the condition is called deadlock.



### Concept of Lock in Java

Synchronization is built around an internal entity known as the lock or monitor. Every object has a lock associated with it. By convention, a thread that needs consistent access to an object's fields has to acquire the object's lock before accessing them, and then release the lock when it's done with them.

From Java 5 the package java.util.concurrent.locks contains several lock implementations.

1. What is multithreding and what is thread?
2. Explain thread states
3. How to create thread and code it?
4. Synchronization and deadlock in java?