Multithreading

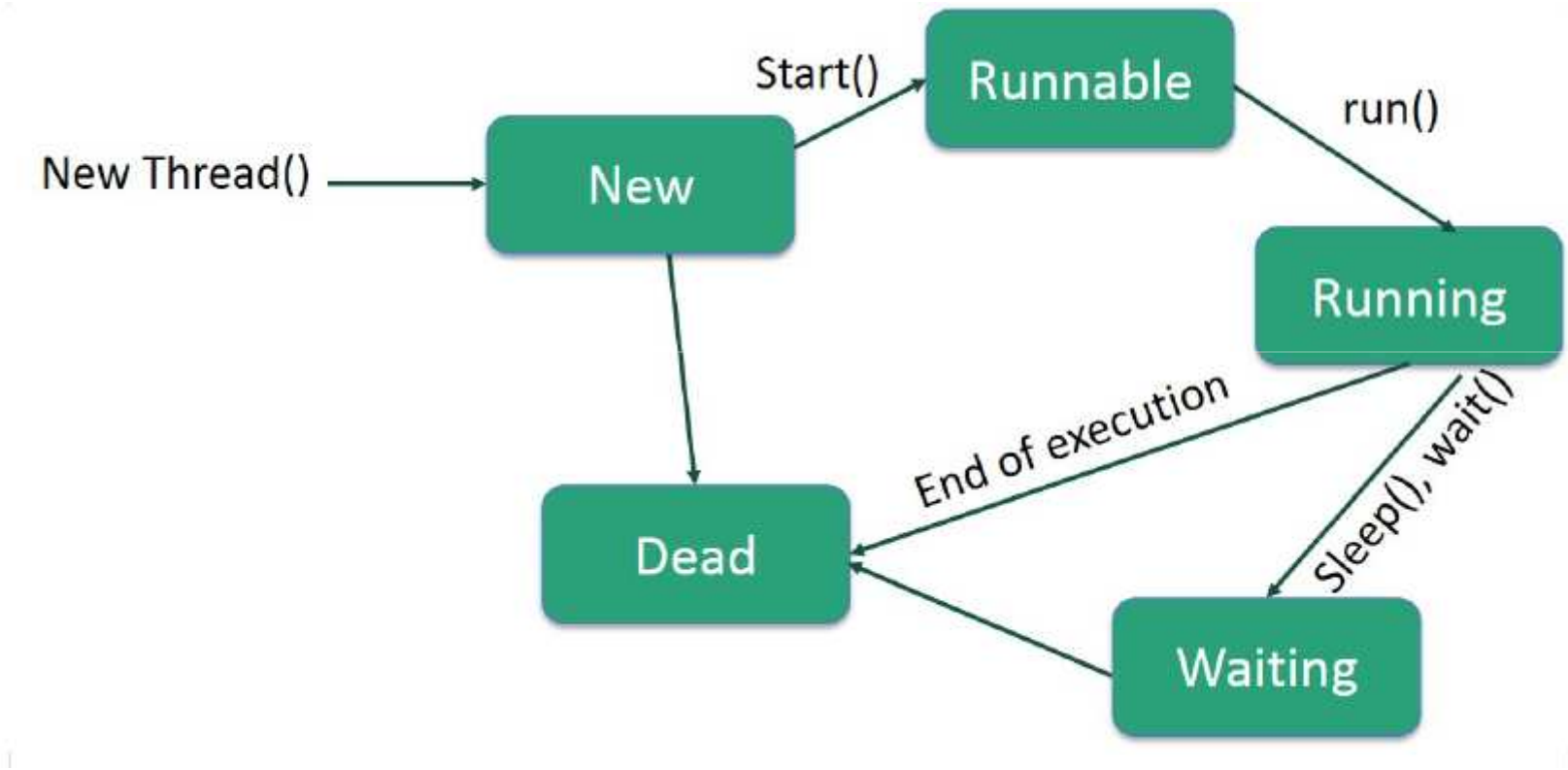
Introduction

- Java is a*multi threaded programming language which means we can develop multi threaded*

  program using Java.
- A multi threaded program contains two or more parts that can run concurrently and each part can handle different task at the same time making optimal use of the available resources specially when your computer has multiple CPUs.
- By definition multitasking is when multiple processes share common processing resources such as

  a CPU.
- Multi threading extends the idea of multitasking into applications where you can subdivide specific operations within a single application into individual threads. Each of the threads can run in parallel.
- The OS divides processing time not only among different applications, but also among each thread within an application.
- Multi threading enables you to write in a way where multiple activities can proceed concurrently in the same program.

Life Cycle of a Thread:



Create Thread by Implementing Runnable Interface

If your class is intended to be executed as a thread then you can achieve this by implementing **Runnable** interface. You will need to follow three basic steps:

Step 1:

As a first step you need to implement a run method provided by **Runnable** interface. This method provides entry point for the thread and you will put you complete business logic inside this method. Following is simple syntax of run method:

```
public void run( )
```

Step 2:

At second step you will instantiate a **Thread** object using the following constructor:

```
Thread(Runnable threadObj, String threadName);
```

Where, *threadObj* is an instance of a class that implements the **Runnable** interface and **threadName** is the name given to the new thread.

Step 3

Once Thread object is created, you can start it by calling **start** method, which executes a call to run method. Following is simple syntax of start method:

```
void start( );
```

Example

```
class RunnableDemo implements Runnable {
   private Thread t;
   private String threadName;

   RunnableDemo( String name){
       threadName = name;
       System.out.println("Creating " +  threadName );
   }
   public void run() {
      System.out.println("Running " +  threadName );
      try {
         for(int i = 4; i > 0; i--) {
            System.out.println("Thread: " + threadName + ", " + i);
            // Let the thread sleep for a while.
            Thread.sleep(50);
         }
      } catch (InterruptedException e) {
         System.out.println("Thread " +  threadName + " interrupted.");
      }
      System.out.println("Thread " +  threadName + " exiting.");
   }

   public void start ()
   {
      System.out.println("Starting " +  threadName );
      if (t == null)
      {
         t = new Thread (this, threadName);
         t.start ();
      }
   }

}
```

```
public class TestThread {
   public static void main(String args[]) {

      RunnableDemo R1 = new RunnableDemo( "Thread-1");
      R1.start();

      RunnableDemo R2 = new RunnableDemo( "Thread-2");
      R2.start();
   }
}
```

This would produce the following result:

```
Creating Thread-1
Starting Thread-1
Creating Thread-2
Starting Thread-2
Running Thread-1
Thread: Thread-1, 4
Running Thread-2
Thread: Thread-2, 4
Thread: Thread-1, 3
Thread: Thread-2, 3
Thread: Thread-1, 2
Thread: Thread-2, 2
Thread: Thread-1, 1
Thread: Thread-2, 1
Thread Thread-1 exiting.
Thread Thread-2 exiting.
```

Create Thread by Extending Thread Class

The second way to create a thread is to create a new class that extends **Thread** class using the following two simple steps. This approach provides more flexibility in handling multiple threads created using available methods in Thread class.

Step 1

You will need to override **run** method available in Thread class. This method provides entry point for the thread and you will put you complete business logic inside this method. Following is simple syntax of run method:

```
public void run( )
```

Step 2

Once Thread object is created, you can start it by calling **start** method, which executes a call to run method. Following is simple syntax of start method:

```
void start( );
```

Example

```
class ThreadDemo extends Thread {
   private Thread t;
   private String threadName;

   ThreadDemo( String name){
       threadName = name;
       System.out.println("Creating " +  threadName );
   }
   public void run() {
      System.out.println("Running " +  threadName );
      try {
         for(int i = 4; i > 0; i--) {
            System.out.println("Thread: " + threadName + ", " + i);
            // Let the thread sleep for a while.
            Thread.sleep(50);
         }
     } catch (InterruptedException e) {
         System.out.println("Thread " +  threadName + " interrupted.");
     }
     System.out.println("Thread " +  threadName + " exiting.");
   }

   public void start ()
   {
      System.out.println("Starting " +  threadName );
      if (t == null)
      {
         t = new Thread (this, threadName);
         t.start ();
      }
   }

}
```

```
public class TestThread {
   public static void main(String args[]) {

      ThreadDemo T1 = new ThreadDemo( "Thread-1");
      T1.start();

      ThreadDemo T2 = new ThreadDemo( "Thread-2");
      T2.start();
   }
}
```

This would produce the following result:

```
Creating Thread-1
Starting Thread-1
Creating Thread-2
Starting Thread-2
Running Thread-1
Thread: Thread-1, 4
Running Thread-2
Thread: Thread-2, 4
Thread: Thread-1, 3
Thread: Thread-2, 3
Thread: Thread-1, 2
Thread: Thread-2, 2
Thread: Thread-1, 1
Thread: Thread-2, 1
Thread Thread-1 exiting.
Thread Thread-2 exiting.
```

Need for Synchronization

- When we start two or more threads within a program, there may be a situation when multiple threads try to access the same resource and finally they can produce unforeseen result due to concurrency issue.
- For example if multiple threads try to write within a same file then they may corrupt the data because one of the threads can overwrite data or while one thread is opening the same file at the same time another thread might be closing the same file.

How to synchronise?

- This is implemented using a concept called **monitors**.
- Each object in Java is associated with a monitor, which a thread can lock or unlock.
- Only one thread at a time may hold a lock on a monitor.
- Java programming language provides a very handy way of creating threads and synchronizing their task by using **synchronized** blocks.
- You keep shared resources within this block.