JAVA - THREAD 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 overrite data or while one thread is opening the same file at the same time another thread might be closing the same file.

So there is a need to synchronize the action of multiple threads and make sure that only one thread can access the resource at a given point in time. 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. Following is the general form of the synchronized statement:

```
synchronized(objectidentifier) {
   // Access shared variables and other shared resources
}
```

Here, the **objectidentifier** is a reference to an object whose lock associates with the monitor that the synchronized statement represents. Now we are going to see two examples where we will print a counter using two different threads. When threads are not synchronized, they print counter value which is not in sequence, but when we print counter by putting inside synchronized block, then it prints counter very much in sequence for both the threads.

Multithreading example without Synchronization:

Here is a simple example which may or may not print counter value in sequence and every time we run it, it produces different result based on CPU availability to a thread.

```
class PrintDemo {
   public void printCount(){
    try {
         for(int i = 5; i > 0; i--) {
            System.out.println("Counter   ---   "  + i );
         }
     } catch (Exception e) {
         System.out.println("Thread  interrupted.");
     }
   }

}

class ThreadDemo extends Thread {
   private Thread t;
   private String threadName;
   PrintDemo  PD;

   ThreadDemo( String name,  PrintDemo pd){
       threadName = name;
        PD = pd;
   }
   public void run() {
     PD.printCount();
     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[]) {

      PrintDemo PD = new PrintDemo();

      ThreadDemo T1 = new ThreadDemo( "Thread - 1 ", PD );
      ThreadDemo T2 = new ThreadDemo( "Thread - 2 ", PD );

      T1.start();
      T2.start();

      // wait for threads to end
      try {
         T1.join();
         T2.join();
      } catch( Exception e) {
         System.out.println("Interrupted");
      }
   }
}
```

This produces different result every time you run this program:

```
Starting Thread - 1
Starting Thread - 2
Counter   ---   5
Counter   ---   4
Counter   ---   3
Counter   ---   5
Counter   ---   2
Counter   ---   1
Counter   ---   4
Thread Thread - 1  exiting.
Counter   ---   3
Counter   ---   2
Counter   ---   1
Thread Thread - 2  exiting.
```

Multithreading example with Synchronization:

Here is the same example which prints counter value in sequence and every time we run it, it produces same result.

```
class PrintDemo {
   public void printCount(){
    try {
         for(int i = 5; i > 0; i--) {
            System.out.println("Counter   ---   "  + i );
         }
     } catch (Exception e) {
         System.out.println("Thread  interrupted.");
     }
   }

}

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

```
   ThreadDemo( String name,  PrintDemo pd){
       threadName = name;
       PD = pd;
   }
   public void run() {
     synchronized(PD) {
        PD.printCount();
     }
     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[]) {

      PrintDemo PD = new PrintDemo();

      ThreadDemo T1 = new ThreadDemo( "Thread - 1 ", PD );
      ThreadDemo T2 = new ThreadDemo( "Thread - 2 ", PD );

      T1.start();
      T2.start();

      // wait for threads to end
      try {
         T1.join();
         T2.join();
      } catch( Exception e) {
         System.out.println("Interrupted");
      }
   }
}
```

This produces same result every time you run this program:

```
Starting Thread - 1
Starting Thread - 2
Counter   ---   5
Counter   ---   4
Counter   ---   3
Counter   ---   2
Counter   ---   1
Thread Thread - 1  exiting.
Counter   ---   5
Counter   ---   4
Counter   ---   3
Counter   ---   2
Counter   ---   1
Thread Thread - 2  exiting.
```