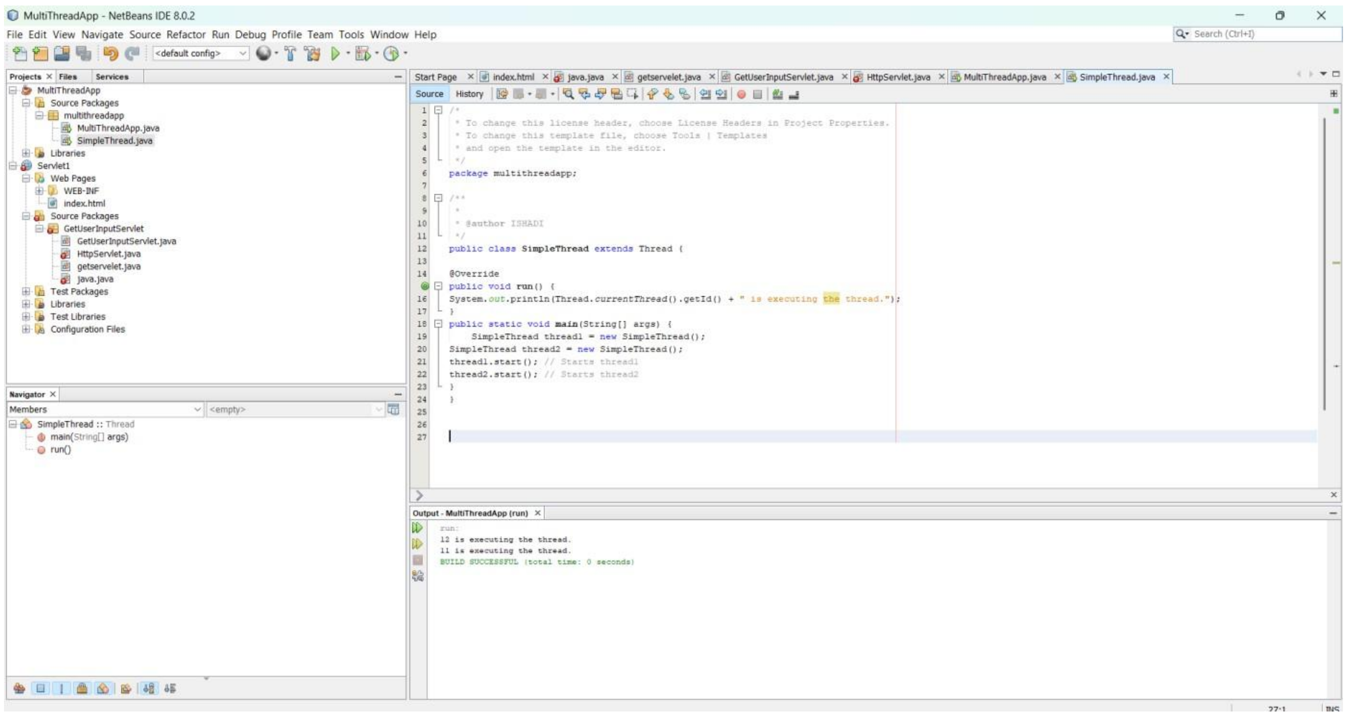
Lab Sheet 1 : Multi-threaded Java Application

1. Create a Simple Thread Class

   SimpleThread.java

```
public class SimpleThread extends Thread {
@Override
public void run() {
System.out.println(Thread.currentThread().getId() + " is executing
the thread.");
}
public static void main(String[] args) {
SimpleThread thread1 = new SimpleThread(); SimpleThread
thread2 = new SimpleThread();
thread1.start(); // Starts thread1 thread2.start();
// Starts thread2
}
}
```



```
/*
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 */
package multithreadapp;

/**
 *
 * @author ISHADI
 */
public class SimpleThread extends Thread {

@Override
public void run() {
System.out.println(Thread.currentThread().getId() + " is executing the thread.");
}
public static void main(String[] args) {
    SimpleThread thread1 = new SimpleThread();
SimpleThread thread2 = new SimpleThread();
thread1.start(); // Starts thread1
thread2.start(); // Starts thread2
}
}
```

Output - MultiThreadApp (run)

```
run:
12 is executing the thread.
11 is executing the thread.
BUILD SUCCESSFUL (total time: 0 seconds)
```

Output

11 is executing the thread.

12 is executing the thread.

Part 2: Using Runnable Interface

RunnableTask.java public class

RunnableTask implements Runnable {

@Override

public void run() {

System.out.println(Thread.currentThread().getId() + " is executing the

runnable task.");

}

public static void main(String[] args) {

RunnableTask task1 = new RunnableTask();

RunnableTask task2 = new RunnableTask();

Thread thread1 = new Thread(task1); Thread

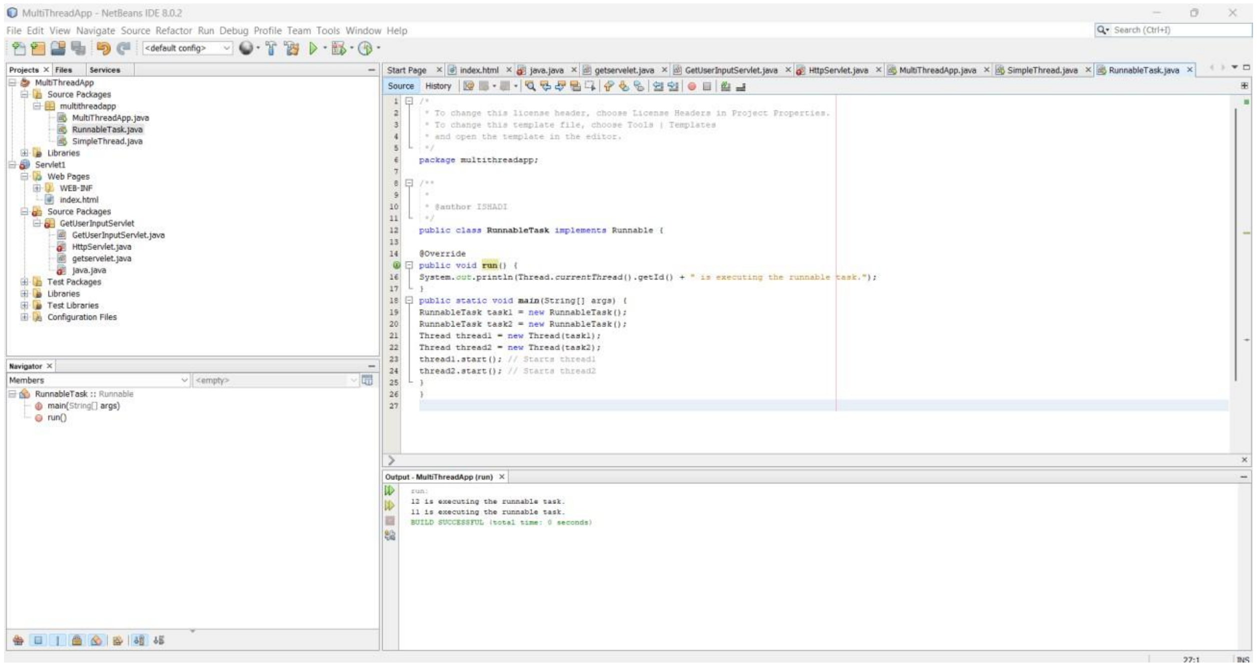
thread2 = new Thread(task2); thread1.start();

// Starts thread1 thread2.start(); // Starts

thread2

}

}



```
/*
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 * and open the template in the editor.
 */
package multithreadapp;

/**
 *
 * @author ISHADI
 */
public class RunnableTask implements Runnable {

@Override
public void run() {
System.out.println(Thread.currentThread().getId() + " is executing the runnable task.");
}
public static void main(String[] args) {
RunnableTask task1 = new RunnableTask();
RunnableTask task2 = new RunnableTask();
Thread thread1 = new Thread(task1);
Thread thread2 = new Thread(task2);
thread1.start(); // Starts thread1
thread2.start(); // Starts thread2
}
}
```

Output - MultiThreadApp (run)

```
run:
12 is executing the runnable task.
11 is executing the runnable task.
BUILD SUCCESSFUL (total time: 0 seconds)
```

Output

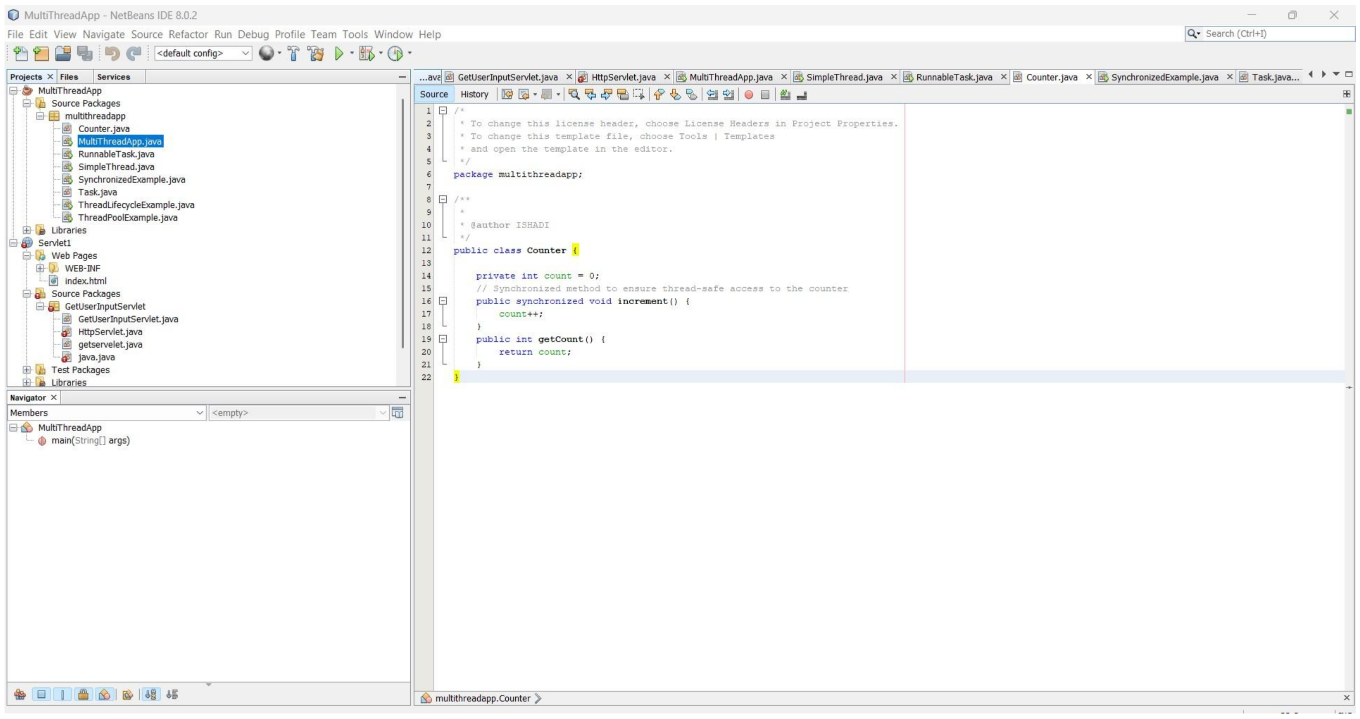
```
13 is executing the runnable task.
14 is executing the runnable task.
```

Part 3: Synchronizing Threads

Counter.java AND SynchronizedExample.java

Counter.java

```
class Counter { private
int count = 0;
// Synchronized method to ensure thread-safe access to the counter
public synchronized void increment() { count++; } public int
getCount() { return count;
}
}
public class SynchronizedExample extends Thread {
private Counter counter; public
SynchronizedExample(Counter counter) {
this.counter = counter;
}
@Override
public void run() { for (int i
= 0; i < 1000; i++) {
counter.increment();
} } public static void main(String[] args) throws
InterruptedException {
Counter counter = new Counter();
// Create and start multiple threads
Thread thread1 = new SynchronizedExample(counter);
Thread thread2 = new
SynchronizedExample(counter); thread1.start();
thread2.start(); // Wait for threads to finish
thread1.join(); thread2.join();
System.out.println("Final counter value: " + counter.getCount());
}
}
```



```java
/*
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 * and open the template in the editor.
 */
package multithreadapp;

/**
 *
 * @author ISHADI
 */
public class Counter {

    private int count = 0;
    // Synchronized method to ensure thread-safe access to the counter
    public synchronized void increment() {
        count++;
    }
    public int getCount() {
        return count;
    }
}
```
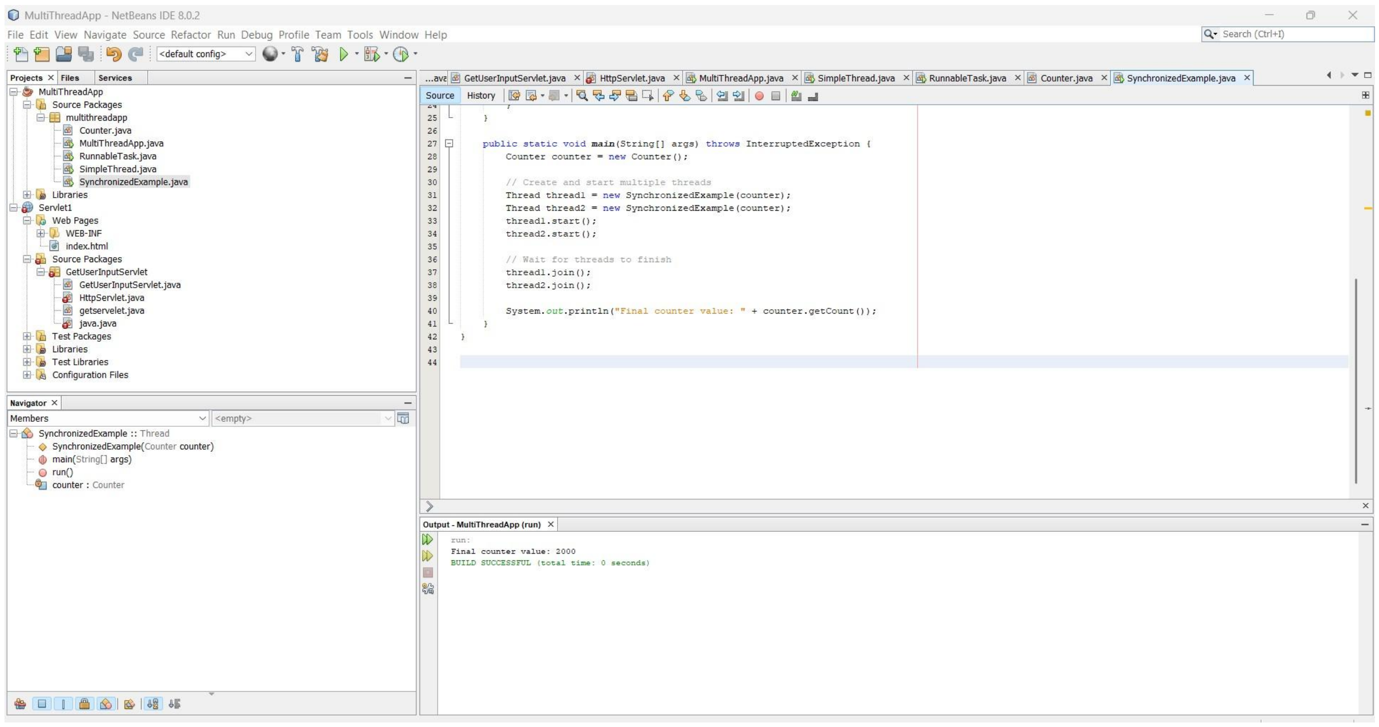

SynchronizedExample.java

```
public class SynchronizedExample extends Thread {
private Counter counter;


   public SynchronizedExample(Counter counter) {
this.counter = counter;
   }


   @Override     public void run()
{         for (int i = 0; i < 1000; i++)
{             counter.increment();
       }
   }
```

```
    public static void main(String[] args) throws InterruptedException {
        Counter counter = new Counter();


        // Create and start multiple threads
        Thread thread1 = new SynchronizedExample(counter);
        Thread thread2 = new SynchronizedExample(counter);
        thread1.start();
thread2.start();


        // Wait for threads to finish
thread1.join();         thread2.join();


        System.out.println("Final counter value: " + counter.getCount());
    } }
```



```
    }

    public static void main(String[] args) throws InterruptedException {
        Counter counter = new Counter();

        // Create and start multiple threads
        Thread thread1 = new SynchronizedExample(counter);
        Thread thread2 = new SynchronizedExample(counter);
        thread1.start();
        thread2.start();

        // Wait for threads to finish
        thread1.join();
        thread2.join();

        System.out.println("Final counter value: " + counter.getCount());
    }
}
```

```
run:
Final counter value: 2000
BUILD SUCCESSFUL (total time: 0 seconds)
```

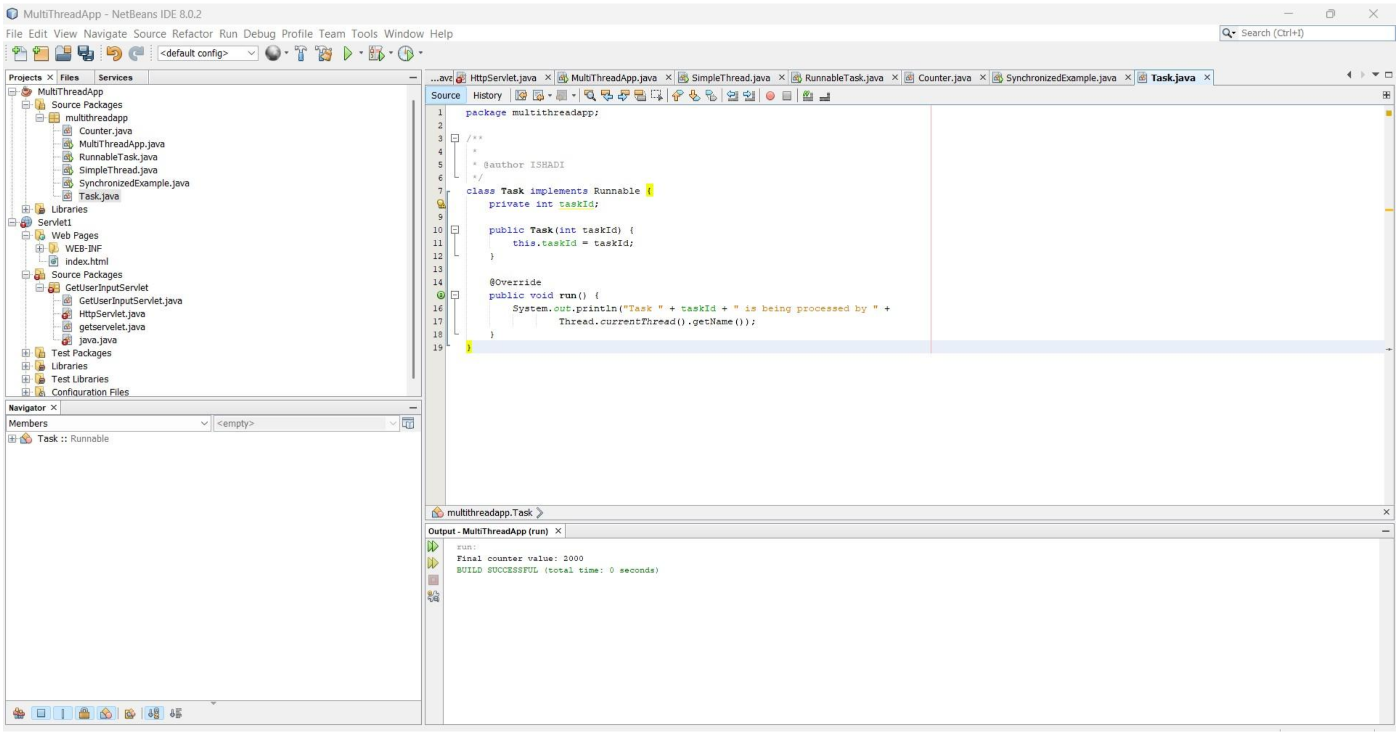
Output

Final counter value: 2000

Part 4: Thread Pooling

- Task.java AND ThreadPoolExample.java

```
 Task.java package
multithreadapp;


/**
 *
 * @author Anjalee
 */
class Task implements Runnable {
   private int taskId;


   public Task(int taskId) {
this.taskId = taskId;
   }


   @Override
public void run() {
      System.out.println("Task " + taskId + " is being processed by " +
            Thread.currentThread().getName());
   }
}
```



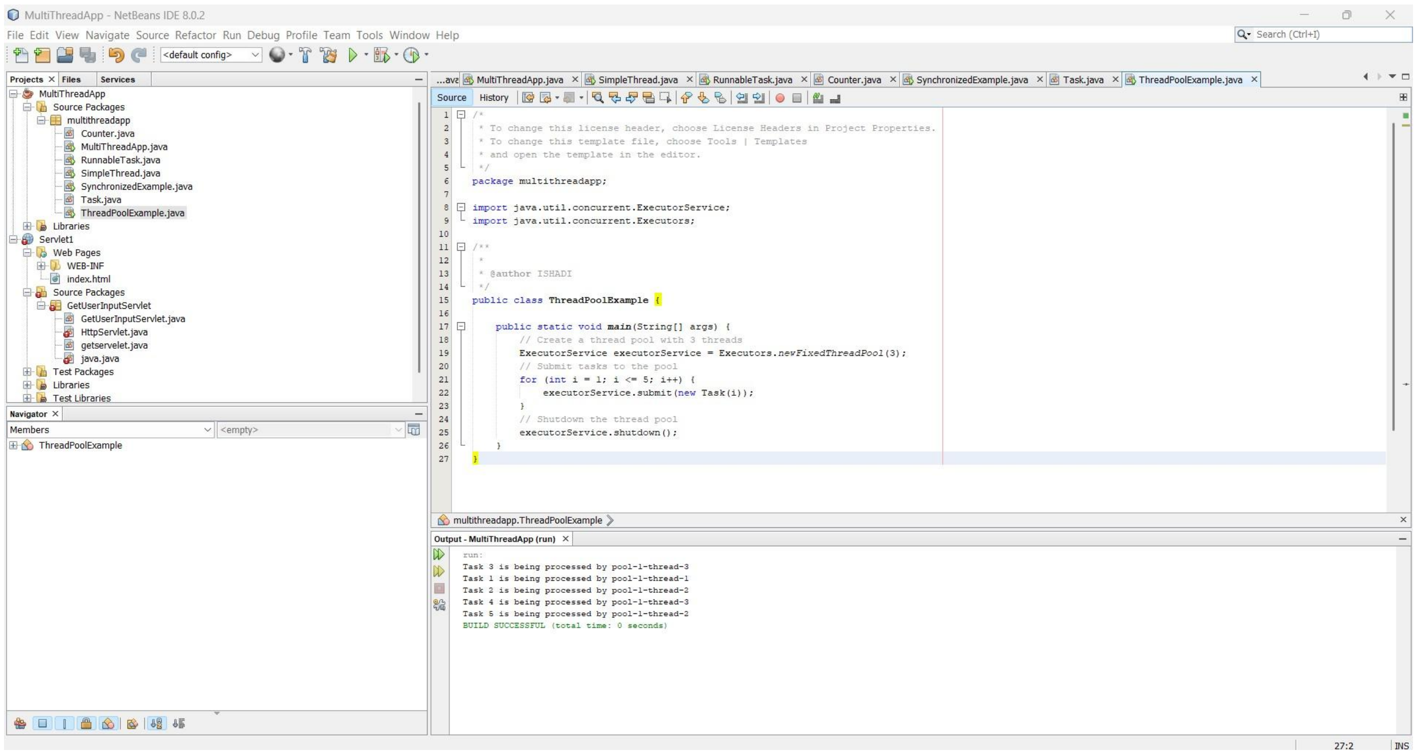
```java
package multithreadapp;

/**
 *
 * @author ISHADI
 */
class Task implements Runnable {
    private int taskId;

    public Task(int taskId) {
        this.taskId = taskId;
    }

    @Override
    public void run() {
        System.out.println("Task " + taskId + " is being processed by " +
                Thread.currentThread().getName());
    }
}
```

```
run:
Final counter value: 2000
BUILD SUCCESSFUL (total time: 0 seconds)
```

- ThreadPoolExample.java

```
import java.util.concurrent.ExecutorService;

import java.util.concurrent.Executors; class

Task implements Runnable { private int

taskId; public Task(int taskId) { this.taskId

= taskId;

}

@Override

public void run() {

System.out.println("Task " + taskId + " is being processed by " +

Thread.currentThread().getName());

}

} public class ThreadPoolExample {

public static void main(String[] args)

{

// Create a thread pool with 3 threads

ExecutorService executorService = Executors.newFixedThreadPool(3);

// Submit tasks to the pool for (int i =

1; i <= 5; i++) {

executorService.submit(new Task(i));

}

// Shutdown the thread pool

executorService.shutdown();

}
```

}



```java
/*
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 * and open the template in the editor.
 */
package multithreadapp;

import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;

/**
 *
 * @author ISHADI
 */
public class ThreadPoolExample {

    public static void main(String[] args) {
        // Create a thread pool with 3 threads
        ExecutorService executorService = Executors.newFixedThreadPool(3);
        // Submit tasks to the pool
        for (int i = 1; i <= 5; i++) {
            executorService.submit(new Task(i));
        }
        // Shutdown the thread pool
        executorService.shutdown();
    }
}
```

```
run:
Task 3 is being processed by pool-1-thread-3
Task 1 is being processed by pool-1-thread-1
Task 2 is being processed by pool-1-thread-2
Task 4 is being processed by pool-1-thread-3
Task 5 is being processed by pool-1-thread-2
BUILD SUCCESSFUL (total time: 0 seconds)
```

Output

Task 1 is being processed by pool-1-thread-1

Task 2 is being processed by pool-1-thread-2

Task 3 is being processed by pool-1-thread-3

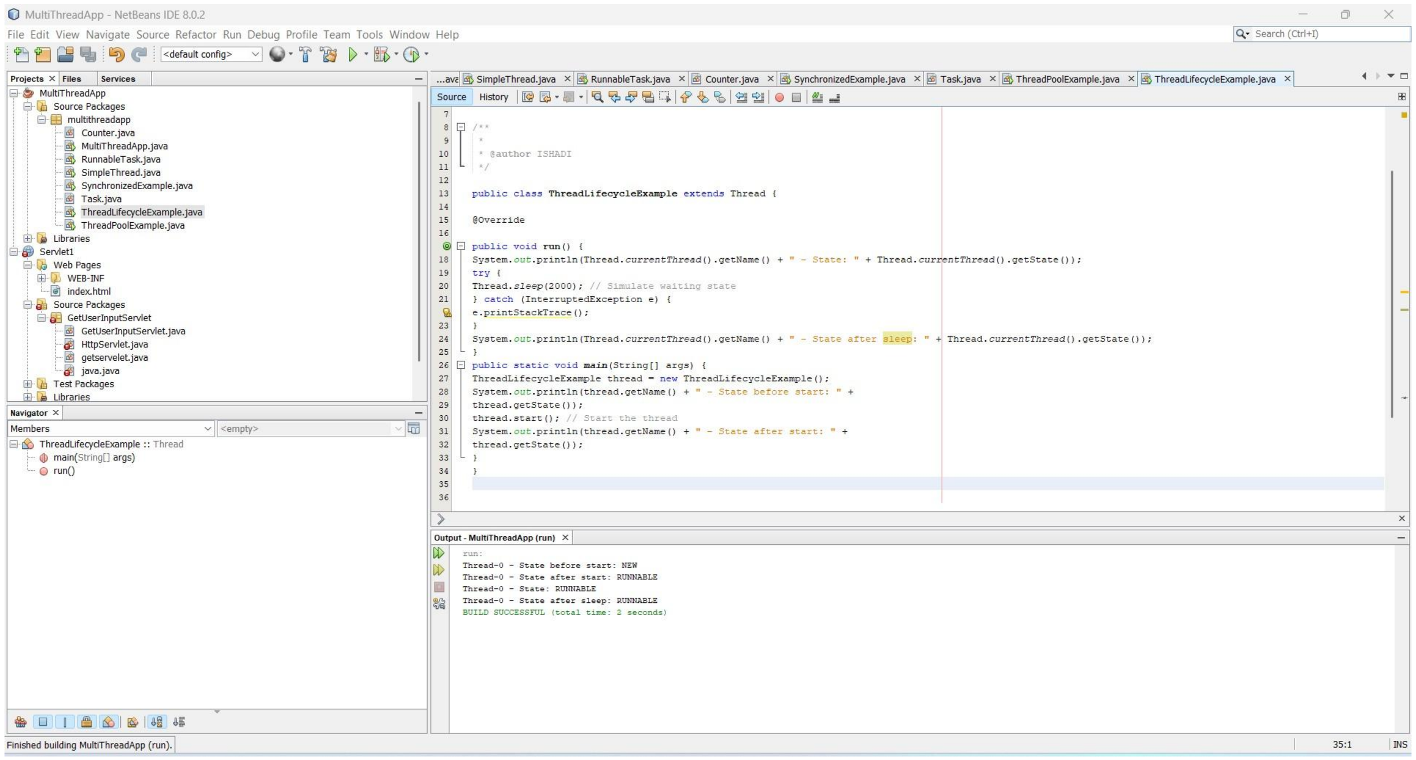
Task 4 is being processed by pool-1-thread-1

Task 5 is being processed by pool-1-thread-2

Part 5: Thread Lifecycle and States

- ThreadLifecycleExample.java.

```
public class ThreadLifecycleExample extends Thread {
@Override
public void run() {
System.out.println(Thread.currentThread().getName() + " - State: " +
Thread.currentThread().getState()); try {
Thread.sleep(2000); // Simulate waiting state }
catch (InterruptedException e) {
e.printStackTrace();
}
System.out.println(Thread.currentThread().getName() + " - State after sleep:
" + Thread.currentThread().getState());
} public static void main(String[] args)
{
ThreadLifecycleExample thread = new ThreadLifecycleExample();
System.out.println(thread.getName() + " - State before start: " +
thread.getState()); thread.start(); // Start the thread
System.out.println(thread.getName() + " - State after start: " +
thread.getState());
}
}
```



```java
/**
 *
 * @author ISHADI
 */

public class ThreadLifecycleExample extends Thread {

@Override

public void run() {
System.out.println(Thread.currentThread().getName() + " - State: " + Thread.currentThread().getState());
try {
Thread.sleep(2000); // Simulate waiting state
} catch (InterruptedException e) {
e.printStackTrace();
}
System.out.println(Thread.currentThread().getName() + " - State after sleep: " + Thread.currentThread().getState());
}
public static void main(String[] args) {
ThreadLifecycleExample thread = new ThreadLifecycleExample();
System.out.println(thread.getName() + " - State before start: " +
thread.getState());
thread.start(); // Start the thread
System.out.println(thread.getName() + " - State after start: " +
thread.getState());
}
}
```

```
run:
Thread-0 - State before start: NEW
Thread-0 - State after start: RUNNABLE
Thread-0 - State: RUNNABLE
Thread-0 - State after sleep: RUNNABLE
BUILD SUCCESSFUL (total time: 2 seconds)
```

Output

Thread-0 - State before start: NEW

Thread-0 - State after start: RUNNABLE

Thread-0 - State: RUNNABLE

Thread-0 - State during sleep: TIMED_WAITING

Thread-0 - State after sleep: RUNNABLE

Thread-0 - State after finish: TERMINATED