Day 18

Task 1: Creating and Managing Threads
Write a program that starts two threads, where each thread prints numbers from 1 to 10 with a 1-second delay between each number

Program:

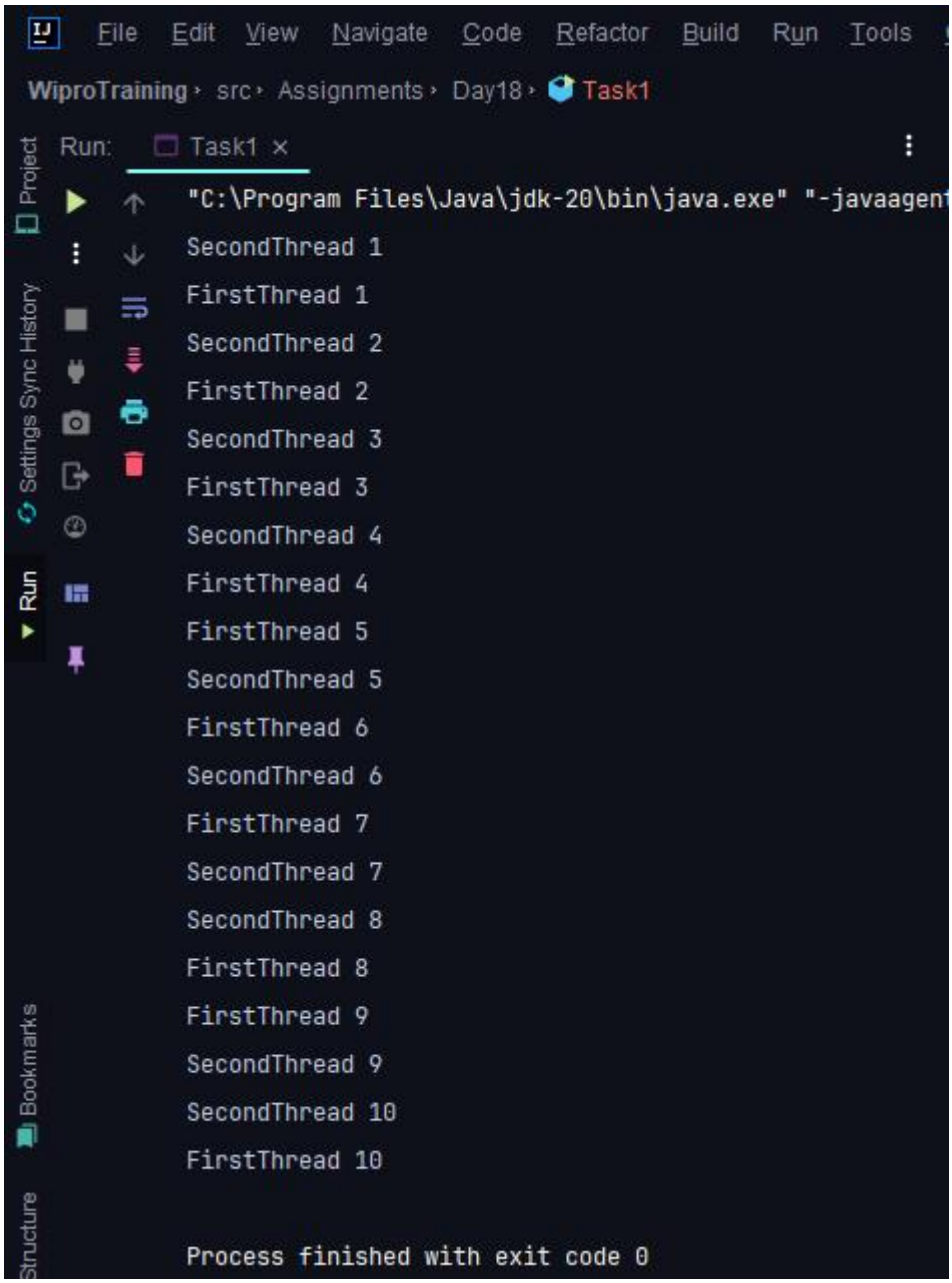
```
package Assignments.Day18;

public class Task1 implements Runnable {
    public static void main(String[] args) {
        Runnable r = new Task1();
        Thread t1 = new Thread(r);
        t1.setName("FirstThread");
        t1.setPriority(Thread.MIN_PRIORITY);
        Thread t2 = new Thread(r);
        t2.setName("SecondThread");
        t1.start();
        t2.start();
    }

    @Override
    public  void run() {
        for (int i = 1; i < 11; i++) {
            System.out.println(Thread.currentThread().getName() +" "+i);

            try {
                Thread.sleep(1000);
            } catch (InterruptedException e) {
                throw new RuntimeException(e);
            }
        }
    }
}
```

Output:


File Edit View Navigate Code Refactor Build Run Tools
WiproTraining › src › Assignments › Day18 › Task1
Run: Task1 ×
"C:\Program Files\Java\jdk-20\bin\java.exe" "-javaagent
SecondThread 1
FirstThread 1
SecondThread 2
FirstThread 2
SecondThread 3
FirstThread 3
SecondThread 4
FirstThread 4
FirstThread 5
SecondThread 5
FirstThread 6
SecondThread 6
FirstThread 7
SecondThread 7
SecondThread 8
FirstThread 8
FirstThread 9
SecondThread 9
SecondThread 10
FirstThread 10
Process finished with exit code 0
Project
Settings Sync History
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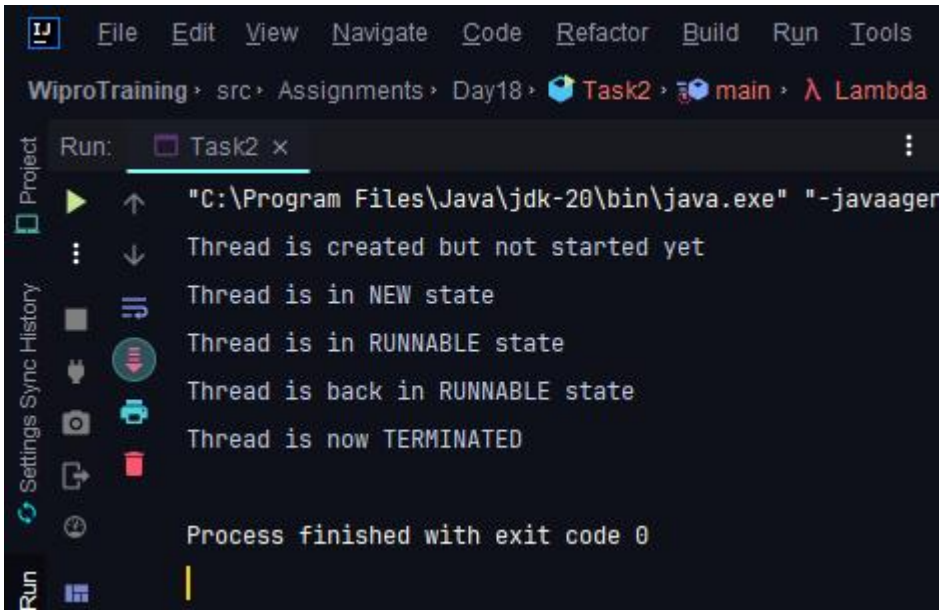
Task 2: States and Transitions
Create a Java class that simulates a thread going through different life-cycle states: NEW, RUNNABLE, WAITING, TIMED_WAITING, BLOCKED, and TERMINATED. Use methods like sleep(), wait(), notify(), and join() to demonstrate these states..

Program:

```
package Assignments.Day18;

public class Task2 {

    public static void main(String[] args) {
        Thread thread = new Thread(() -> {
            try {
                System.out.println("Thread is in NEW state");
                Thread.sleep(1000); // Sleep for 1 second (TIMED_WAITING)
                System.out.println("Thread is in RUNNABLE state");
                synchronized (Task2.class) {
                    Task2.class.wait(2000); // Wait  (wait for 2 seconds)
                }
                System.out.println("Thread is back in RUNNABLE state");
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        });

        System.out.println("Thread is created but not started yet");
        thread.start(); // Start the thread (RUNNABLE)

        try {
            Thread.sleep(200);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }

        synchronized (Task2.class) {
            Task2.class.notify(); // Notify the waiting thread
        }

        try {
            thread.join(); // Wait for the thread to finish (TERMINATED)
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
```

```
        System.out.println("Thread is now TERMINATED");
    }
}
```

Output:



Task 3: Synchronization and Inter-thread Communication
Implement a producer-consumer problem using wait() and notify() methods to handle the correct processing sequence between threads.

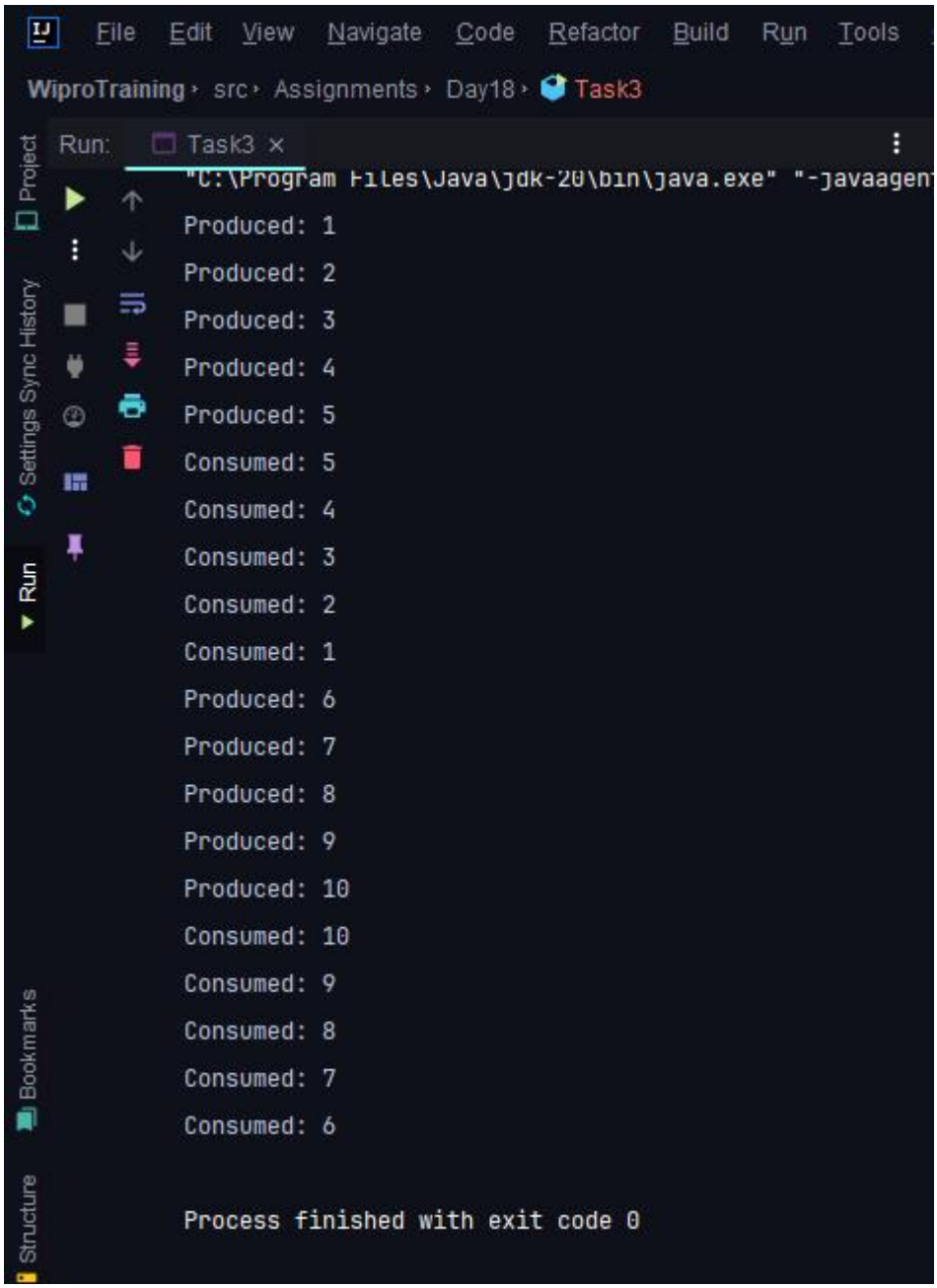
Program:

```
package Assignments.Day18;

public class Task3 {

    private static final int BUFFER_SIZE = 5;
    private static final Object lock = new Object();
    private static int[] buffer = new int[BUFFER_SIZE];
    private static int itemCount = 0;

    public static void main(String[] args) {
        Thread producerThread = new Thread(() -> {
            for (int i = 1; i <= 10; i++) {
                produce(i);
            }
        });

        Thread consumerThread = new Thread(() -> {
```

```
        for (int i = 1; i <= 10; i++) {
            consume();
        }
    });

    producerThread.start();
    consumerThread.start();

    try {
        producerThread.join();
        consumerThread.join();
    } catch (InterruptedException e) {
        e.printStackTrace();
    }
}

private static void produce(int item) {
    synchronized (lock) {
        while (itemCount == BUFFER_SIZE) {
            try {
                lock.wait(); // Buffer is full, wait for consumer
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
        buffer[itemCount] = item;
        itemCount++;
        System.out.println("Produced: " + item);
        lock.notify(); // Notify consumer
    }
}

private static void consume() {
    synchronized (lock) {
        while (itemCount == 0) {
            try {
                lock.wait(); // Buffer is empty, wait for producer
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
        int item = buffer[itemCount - 1];
        itemCount--;
        System.out.println("Consumed: " + item);
        lock.notify(); // Notify producer
    }
```

```
    }
}
```

Output:


File Edit View Navigate Code Refactor Build Run Tools
WiproTraining › src › Assignments › Day18 › Task3
Run: Task3 ×
"C:\Program Files\Java\jdk-20\bin\java.exe" "-javaagent
Produced: 1
Produced: 2
Produced: 3
Produced: 4
Produced: 5
Consumed: 5
Consumed: 4
Consumed: 3
Consumed: 2
Consumed: 1
Produced: 6
Produced: 7
Produced: 8
Produced: 9
Produced: 10
Consumed: 10
Consumed: 9
Consumed: 8
Consumed: 7
Consumed: 6
Process finished with exit code 0
Project
Settings Sync History
Run
Bookmarks
Structure

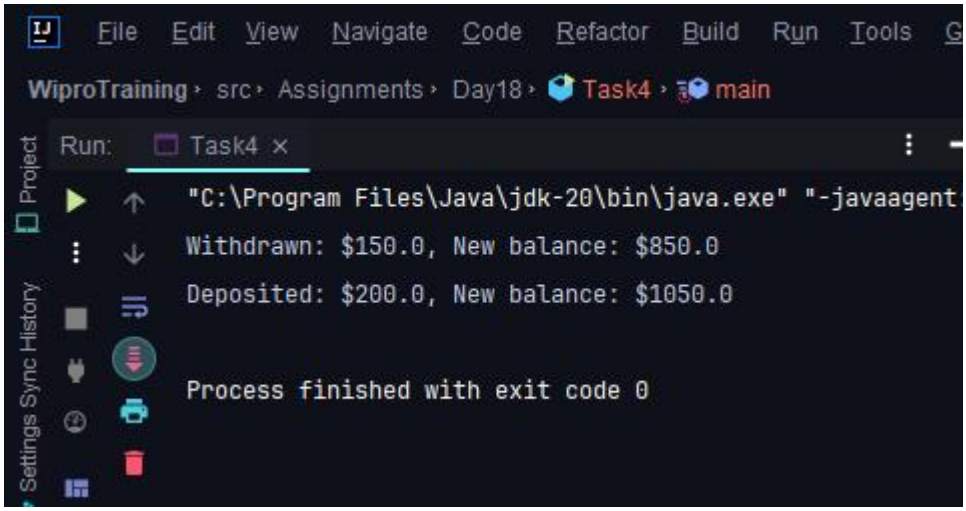
Task 4: Synchronized Blocks and Methods
Write a program that simulates a bank account being accessed by multiple threads to perform deposits and withdrawals using synchronized methods to prevent race conditions.

Program:

```
package Assignments.Day18;

public class Task4 {
   private double balance;

   public Task4(double initialBalance) {
      this.balance = initialBalance;
   }

   public synchronized void deposit(double amount) {
      balance += amount;
      System.out.println("Deposited: $" + amount + ", New balance: $" +
balance);
   }

   public synchronized void withdraw(double amount) {
      if (balance >= amount) {
         balance -= amount;
         System.out.println("Withdrawn: $" + amount + ", New balance: $" +
balance);
      } else {
         System.out.println("Insufficient funds for withdrawal.");
      }
   }

   public static void main(String[] args) {
      Task4 account = new Task4(1000.0);

      // Simulate multiple threads accessing the account
      Thread thread1 = new Thread(() -> account.deposit(200.0));
      Thread thread2 = new Thread(() -> account.withdraw(150.0));

      thread1.start();
      thread2.start();

      try {
         thread1.join();
         thread2.join();
      } catch (InterruptedException e) {
```

```
            e.printStackTrace();
        }
    }
}
```

Output:



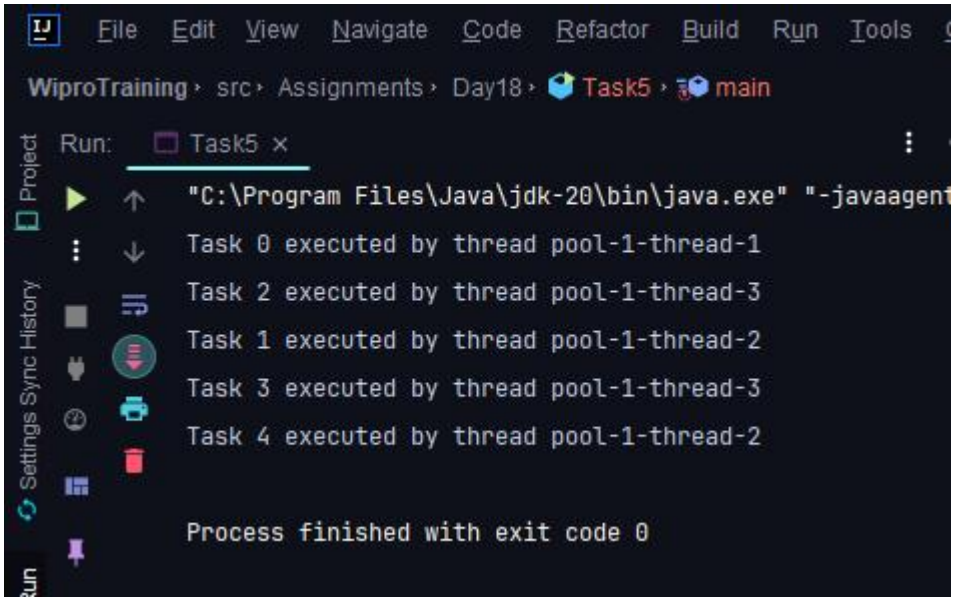
Task 5: Thread Pools and Concurrency Utilities
Create a fixed-size thread pool and submit multiple tasks that perform complex calculations or I/O operations and observe the execution.

Program:

```
package Assignments.Day18;

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

public class Task5 {

    public static void main(String[] args) {
        int numThreads = 3;

        ExecutorService executor = Executors.newFixedThreadPool(numThreads);

        for (int i = 0; i < 5; i++) {
            int taskId = i;
            executor.submit(() -> {
                System.out.println("Task " + taskId + " executed by thread " +
Thread.currentThread().getName());
            });
        }
```

```
        executor.shutdown();
    }
}
```

Output:



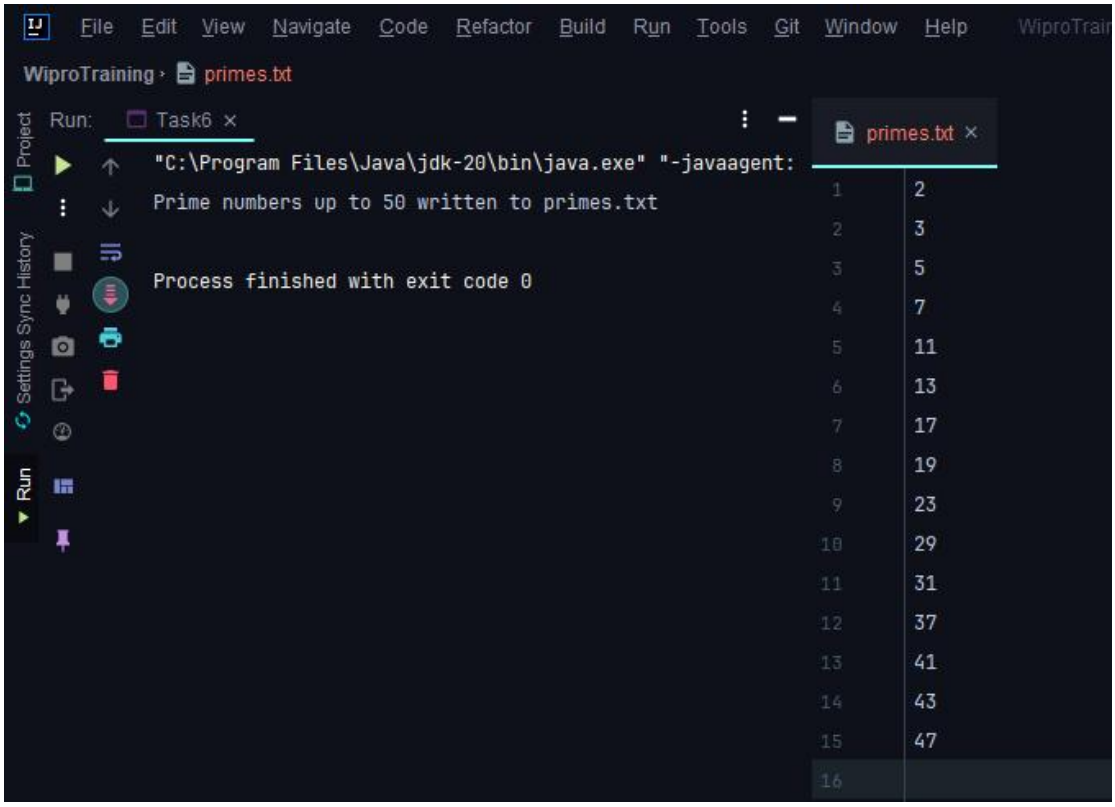
Task 6: Executors, Concurrent Collections, CompletableFuture
Use an ExecutorService to parallelize a task that calculates prime numbers up to a given number and then use CompletableFuture to write the results to a file asynchronously.

Program:

```
package Assignments.Day18;

import java.io.BufferedWriter;
import java.io.FileWriter;
import java.io.IOException;
import java.util.ArrayList;
import java.util.List;
import java.util.concurrent.CompletableFuture;
import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;

public class Task6 {

    public static boolean isPrime(int num) {
        if (num <= 1) {
```

```
            return false;
        }
        for (int i = 2; i * i <= num; i++) {
            if (num % i == 0) {
                return false;
            }
        }
        return true;
    }

    public static List<Integer> calculatePrimes(int maxNumber) {
        List<Integer> primes = new ArrayList<>();
        for (int i = 2; i <= maxNumber; i++) {
            if (isPrime(i)) {
                primes.add(i);
            }
        }
        return primes;
    }

    public static void main(String[] args) throws IOException {
        int maxNumber = 100;
        List<Integer> primes = calculatePrimes(maxNumber);

        // Write primes to a file asynchronously
        CompletableFuture<Void> writeToFileFuture = CompletableFuture.runAsync(() -> {
            try (BufferedWriter writer = new BufferedWriter(new FileWriter("primes.txt"))) {
                for (int prime : primes) {
                    writer.write(prime + "\n");
                }
            } catch (IOException e) {
                e.printStackTrace();
            }
        });

        // Wait for the write operation to complete
        writeToFileFuture.join();

        System.out.println("Prime numbers up to " + maxNumber + " written to primes.txt");
    }
}
```

Output:



Task 7: Writing Thread-Safe Code, Immutable Objects
Design a thread-safe Counter class with increment and decrement methods. Then demonstrate its usage from multiple threads. Also, implement and use an immutable class to share data between threads.

Program:

```
package Assignments.Day18;

// Thread-safe Counter class
class Counter {
    private int value = 0;

    public synchronized void increment() {
        value++;
    }

    public synchronized void decrement() {
        value--;
    }

    public synchronized int getValue() {
```

```
        return value;
    }
}

// Immutable class for shared data
final class SharedData {
    private final String data;

    public SharedData(String data) {
        this.data = data;
    }

    public String getData() {
        return data;
    }
}

public class Task7 {
    public static void main(String[] args) {
        Counter counter = new Counter();

        //multiple threads to demonstrate counter usage

        Thread incrementThread = new Thread(() -> {
            for (int i = 0; i < 1000; i++) {
                counter.increment();
            }
        });

        Thread decrementThread = new Thread(() -> {
            for (int i = 0; i < 1000; i++) {
                counter.decrement();
            }
        });

        incrementThread.start();
        decrementThread.start();

        try {
            incrementThread.join();
            decrementThread.join();
        } catch (InterruptedException e) {
            e.printStackTrace();
        }

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

```
        SharedData sharedData = new SharedData("Hello, world!");

        Thread readThread1 = new Thread(() -> {
            System.out.println("Thread 1: " + sharedData.getData());
        });

        Thread readThread2 = new Thread(() -> {
            System.out.println("Thread 2: " + sharedData.getData());
        });

        readThread1.start();
        readThread2.start();
    }
}
```

Output: