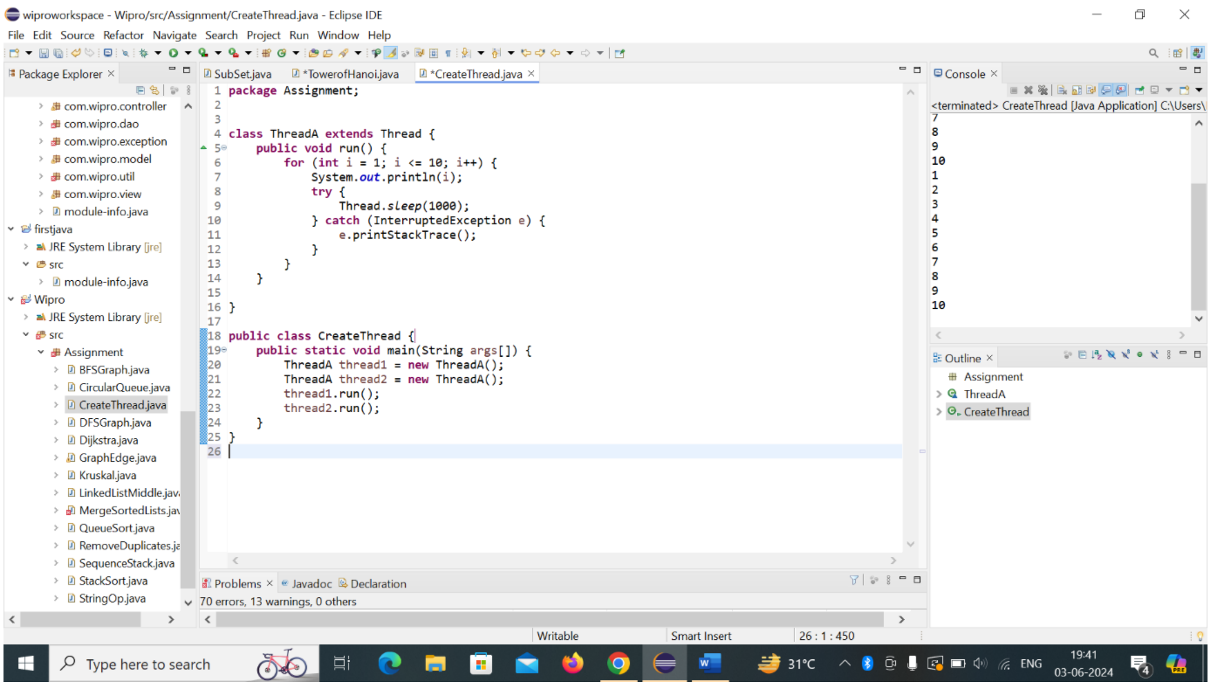
Day-18 THREADS

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

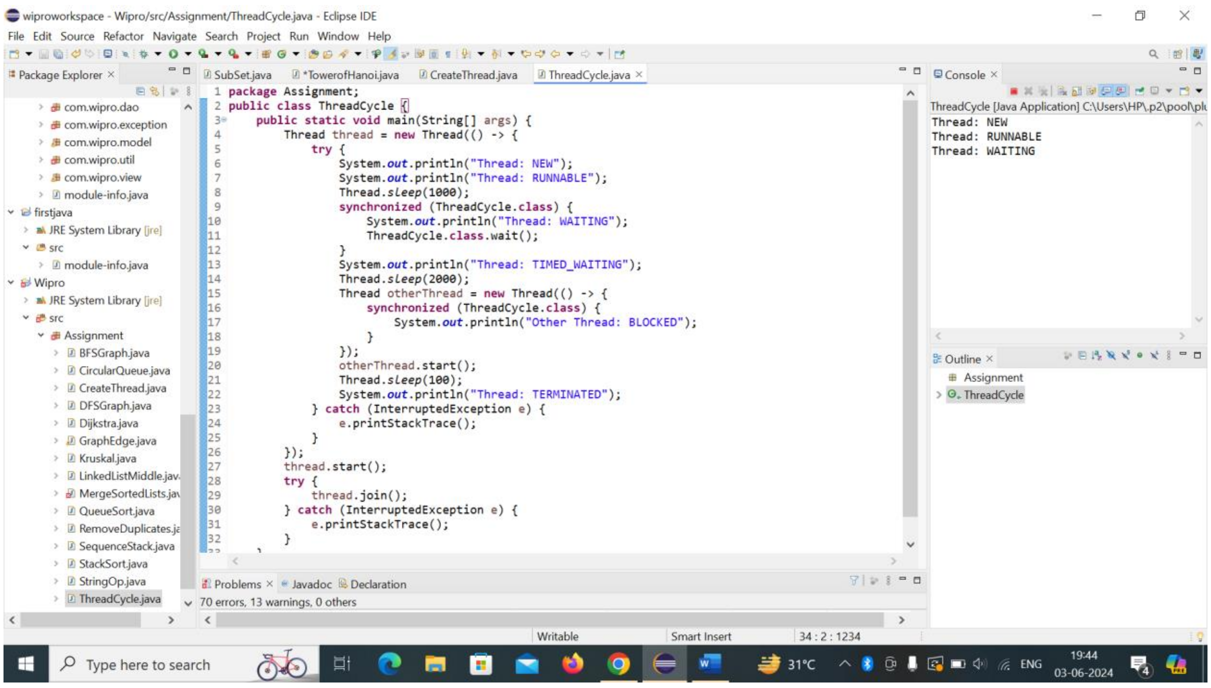


```java
package Assignment;


class ThreadA extends Thread {
    public void run() {
        for (int i = 1; i <= 10; i++) {
            System.out.println(i);
            try {
                Thread.sleep(1000);
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
    }
}

public class CreateThread {
    public static void main(String args[]) {
        ThreadA thread1 = new ThreadA();
        ThreadA thread2 = new ThreadA();
        thread1.run();
        thread2.run();
    }
}
```

```
<terminated> CreateThread [Java Application] C:\Users\
7
8
9
10
1
2
3
4
5
6
7
8
9
10
```

Task 2: States and Transitions

Create a Java class that simulates a thread going through different lifecycle states: NEW, RUNNABLE, WAITING, TIMED_WAITING, BLOCKED, and TERMINATED. Use methods like sleep(), wait(), notify(), and join() to demonstrate these states.



```java
package Assignment;
public class ThreadCycle {
    public static void main(String[] args) {
        Thread thread = new Thread(() -> {
            try {
                System.out.println("Thread: NEW");
                System.out.println("Thread: RUNNABLE");
                Thread.sleep(1000);
                synchronized (ThreadCycle.class) {
                    System.out.println("Thread: WAITING");
                    ThreadCycle.class.wait();
                }
                System.out.println("Thread: TIMED_WAITING");
                Thread.sleep(2000);
                Thread otherThread = new Thread(() -> {
                    synchronized (ThreadCycle.class) {
                        System.out.println("Other Thread: BLOCKED");
                    }
                });
                otherThread.start();
                Thread.sleep(100);
                System.out.println("Thread: TERMINATED");
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        });
        thread.start();
        try {
            thread.join();
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
```

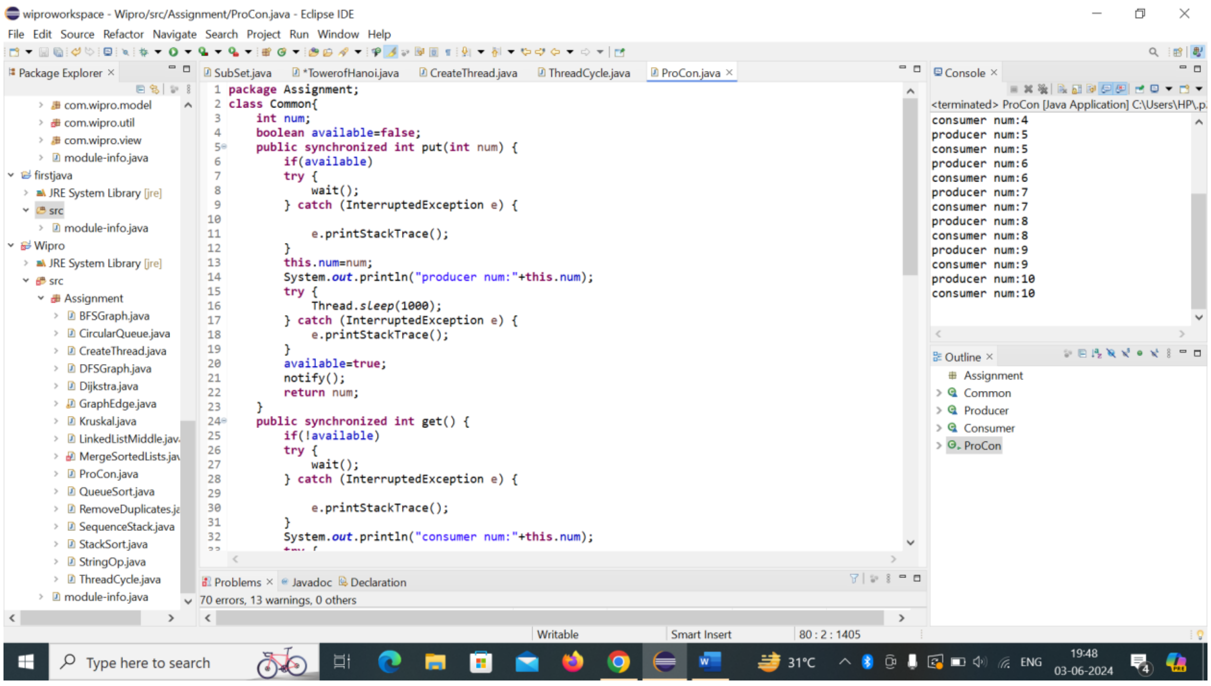
ThreadCycle [Java Application] C:\Users\HP\.p2\pool\plu

```
Thread: NEW
Thread: RUNNABLE
Thread: WAITING
```

70 errors, 13 warnings, 0 others

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.

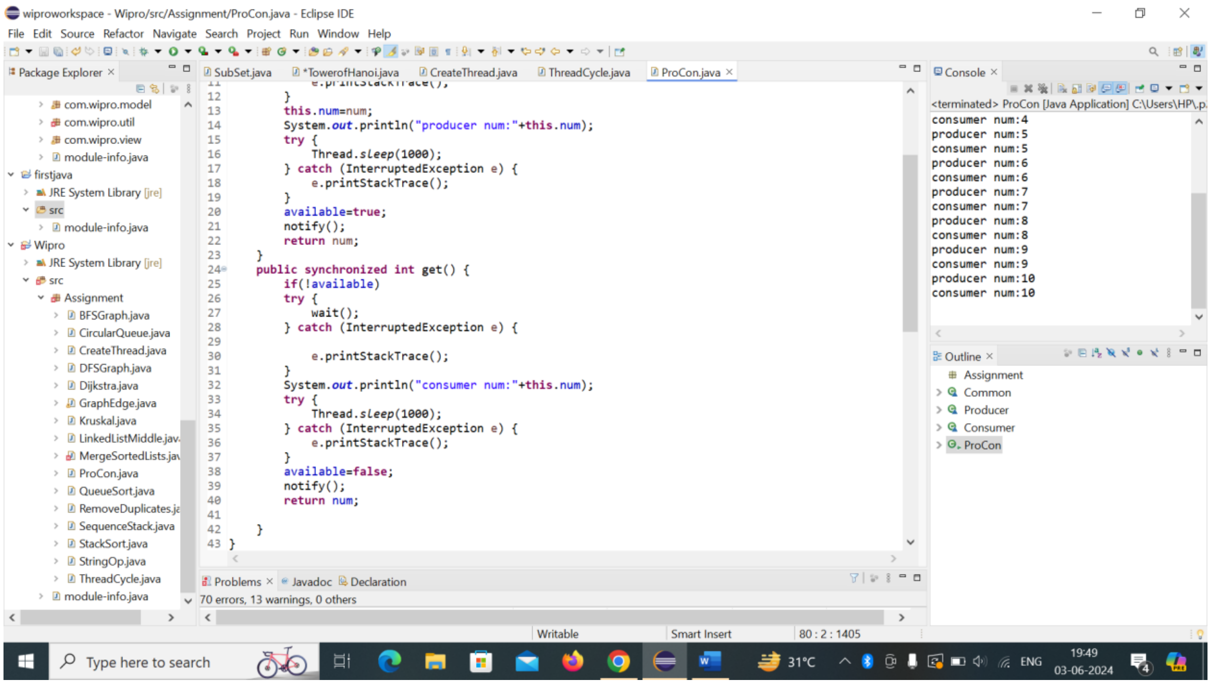


wiproworkspace - Wipro/src/Assignment/ProCon.java - Eclipse IDE

```java
package Assignment;
class Common{
    int num;
    boolean available=false;
    public synchronized int put(int num) {
        if(available)
        try {
            wait();
        } catch (InterruptedException e) {

            e.printStackTrace();
        }
        this.num=num;
        System.out.println("producer num:"+this.num);
        try {
            Thread.sleep(1000);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        available=true;
        notify();
        return num;
    }
    public synchronized int get() {
        if(!available)
        try {
            wait();
        } catch (InterruptedException e) {

            e.printStackTrace();
        }
        System.out.println("consumer num:"+this.num);
```

70 errors, 13 warnings, 0 others

```
<terminated> ProCon [Java Application] C:\Users\HP\.p
consumer num:4
producer num:5
consumer num:5
producer num:6
consumer num:6
producer num:7
consumer num:7
producer num:8
consumer num:8
producer num:9
consumer num:9
producer num:10
consumer num:10
```

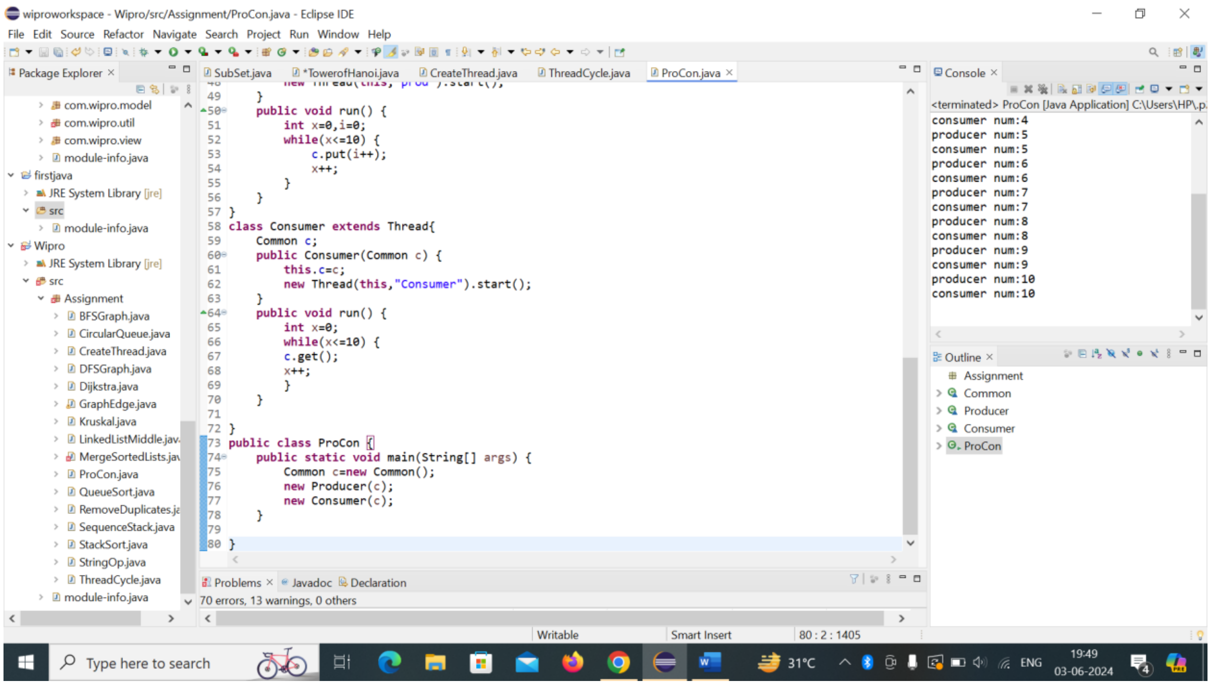


wiproworkspace - Wipro/src/Assignment/ProCon.java - Eclipse IDE

```java
        }
        this.num=num;
        System.out.println("producer num:"+this.num);
        try {
            Thread.sleep(1000);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        available=true;
        notify();
        return num;
    }
    public synchronized int get() {
        if(!available)
        try {
            wait();
        } catch (InterruptedException e) {

            e.printStackTrace();
        }
        System.out.println("consumer num:"+this.num);
        try {
            Thread.sleep(1000);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        available=false;
        notify();
        return num;

    }
}
```

70 errors, 13 warnings, 0 others

```
<terminated> ProCon [Java Application] C:\Users\HP\.p
consumer num:4
producer num:5
consumer num:5
producer num:6
consumer num:6
producer num:7
consumer num:7
producer num:8
consumer num:8
producer num:9
consumer num:9
producer num:10
consumer num:10
```

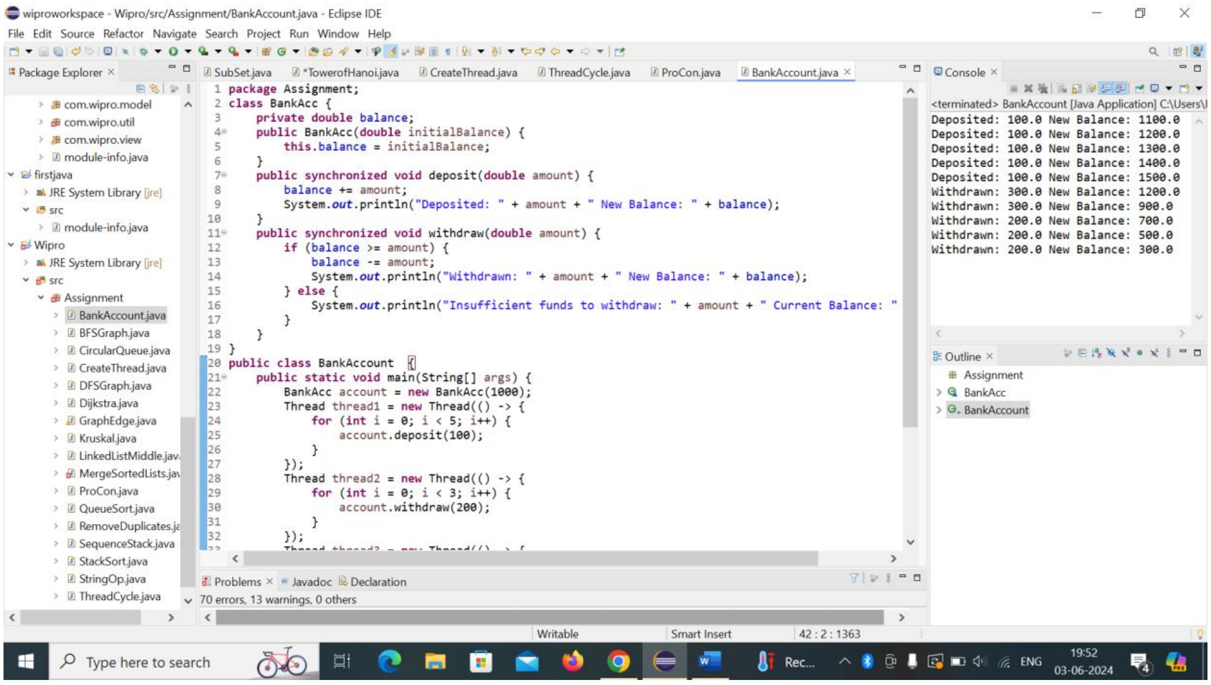


```java
    }
    public void run() {
        int x=0,i=0;
        while(x<=10) {
            c.put(i++);
            x++;
        }
    }
}
class Consumer extends Thread{
    Common c;
    public Consumer(Common c) {
        this.c=c;
        new Thread(this,"Consumer").start();
    }
    public void run() {
        int x=0;
        while(x<=10) {
        c.get();
        x++;
        }
    }

}
public class ProCon {
    public static void main(String[] args) {
        Common c=new Common();
        new Producer(c);
        new Consumer(c);
    }

}
```

```
<terminated> ProCon [Java Application] C:\Users\HP\.p
consumer num:4
producer num:5
consumer num:5
producer num:6
consumer num:6
producer num:7
consumer num:7
producer num:8
consumer num:8
producer num:9
consumer num:9
producer num:10
consumer num:10
```

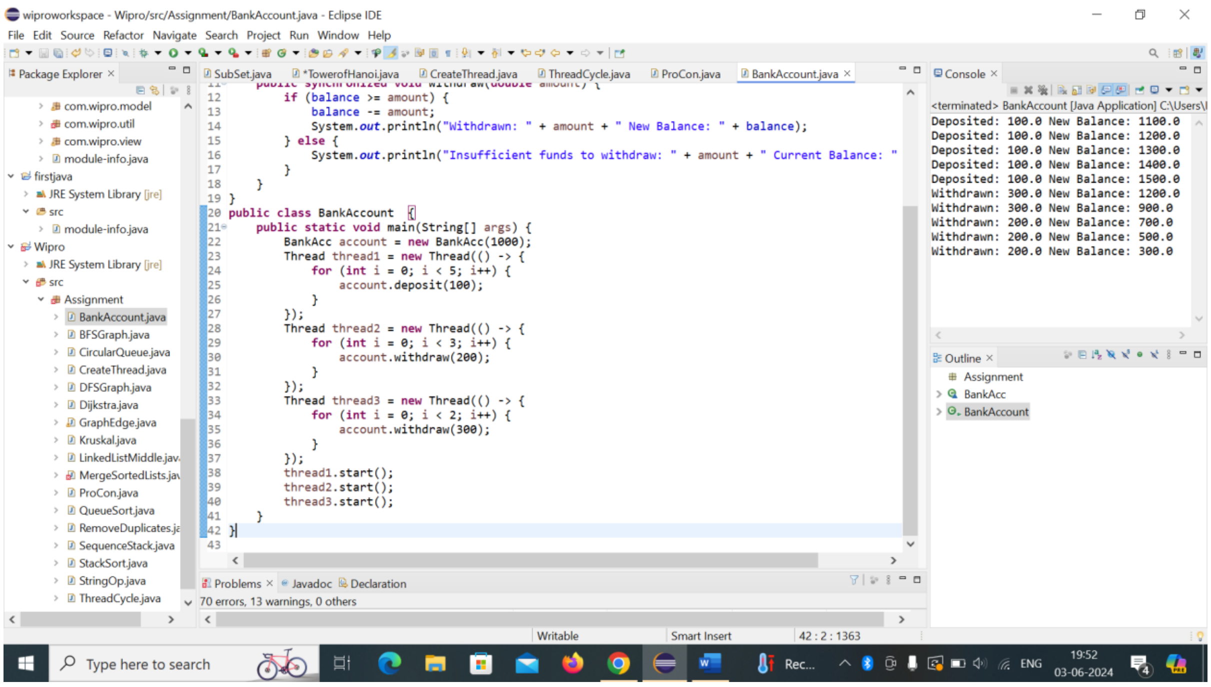
Task 4: Synchronized Blocks and Methods

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



```java
package Assignment;
class BankAcc {
    private double balance;
    public BankAcc(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 to withdraw: " + amount + " Current Balance: "
        }
    }
}
public class BankAccount {
    public static void main(String[] args) {
        BankAcc account = new BankAcc(1000);
        Thread thread1 = new Thread(() -> {
            for (int i = 0; i < 5; i++) {
                account.deposit(100);
            }
        });
        Thread thread2 = new Thread(() -> {
            for (int i = 0; i < 3; i++) {
                account.withdraw(200);
            }
        });
```

```
<terminated> BankAccount [Java Application] C:\Users\
Deposited: 100.0 New Balance: 1100.0
Deposited: 100.0 New Balance: 1200.0
Deposited: 100.0 New Balance: 1300.0
Deposited: 100.0 New Balance: 1400.0
Deposited: 100.0 New Balance: 1500.0
Withdrawn: 300.0 New Balance: 1200.0
Withdrawn: 300.0 New Balance: 900.0
Withdrawn: 200.0 New Balance: 700.0
Withdrawn: 200.0 New Balance: 500.0
Withdrawn: 200.0 New Balance: 300.0
```

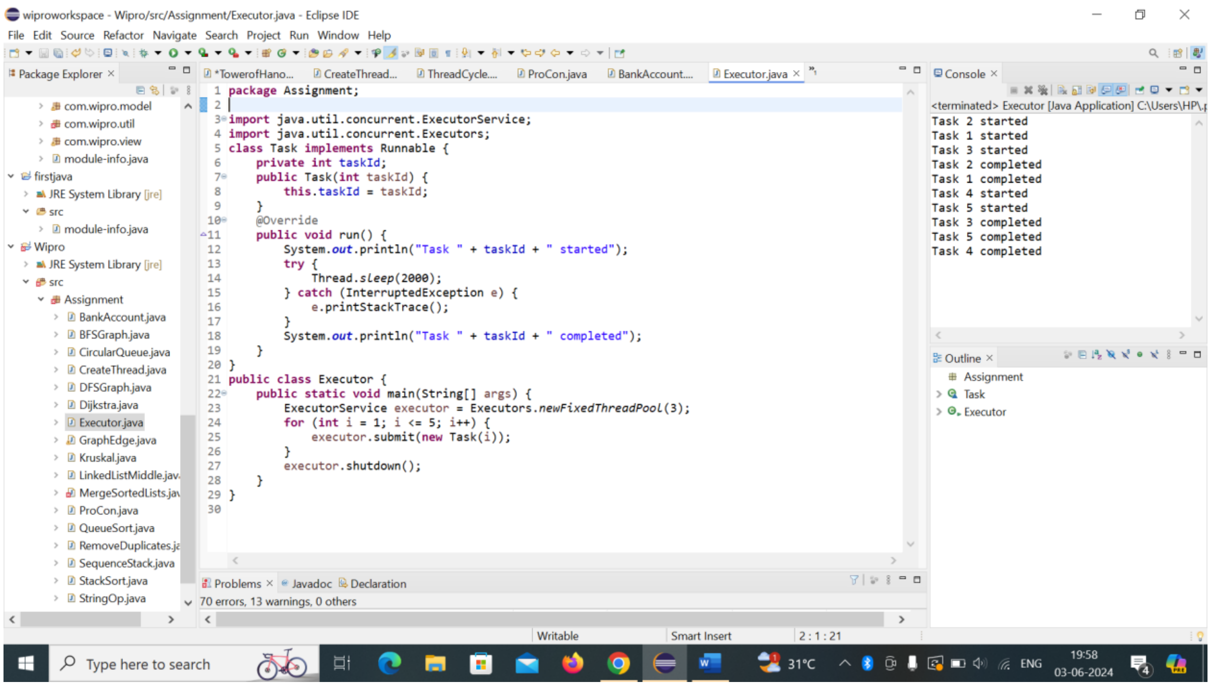


```java
    public synchronized void withdraw(double amount) {
        if (balance >= amount) {
            balance -= amount;
            System.out.println("Withdrawn: " + amount + " New Balance: " + balance);
        } else {
            System.out.println("Insufficient funds to withdraw: " + amount + " Current Balance: "
        }
    }
}
public class BankAccount  {
    public static void main(String[] args) {
        BankAcc account = new BankAcc(1000);
        Thread thread1 = new Thread(() -> {
            for (int i = 0; i < 5; i++) {
                account.deposit(100);
            }
        });
        Thread thread2 = new Thread(() -> {
            for (int i = 0; i < 3; i++) {
                account.withdraw(200);
            }
        });
        Thread thread3 = new Thread(() -> {
            for (int i = 0; i < 2; i++) {
                account.withdraw(300);
            }
        });
        thread1.start();
        thread2.start();
        thread3.start();
    }
}
```

```
<terminated> BankAccount [Java Application] C:\Users\
Deposited: 100.0 New Balance: 1100.0
Deposited: 100.0 New Balance: 1200.0
Deposited: 100.0 New Balance: 1300.0
Deposited: 100.0 New Balance: 1400.0
Deposited: 100.0 New Balance: 1500.0
Withdrawn: 300.0 New Balance: 1200.0
Withdrawn: 300.0 New Balance: 900.0
Withdrawn: 200.0 New Balance: 700.0
Withdrawn: 200.0 New Balance: 500.0
Withdrawn: 200.0 New Balance: 300.0
```

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

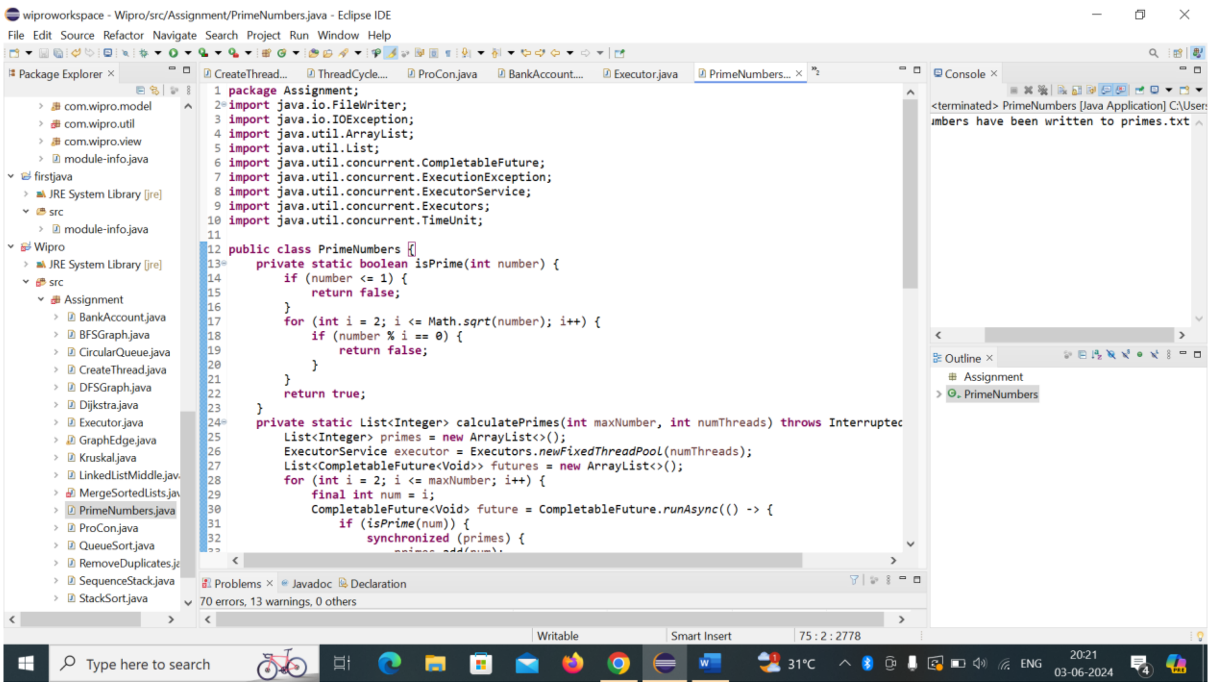


```java
package Assignment;

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 + " started");
        try {
            Thread.sleep(2000);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        System.out.println("Task " + taskId + " completed");
    }
}
public class Executor {
    public static void main(String[] args) {
        ExecutorService executor = Executors.newFixedThreadPool(3);
        for (int i = 1; i <= 5; i++) {
            executor.submit(new Task(i));
        }
        executor.shutdown();
    }
}
```

```
<terminated> Executor [Java Application] C:\Users\HP\.
Task 2 started
Task 1 started
Task 3 started
Task 2 completed
Task 1 completed
Task 4 started
Task 5 started
Task 3 completed
Task 5 completed
Task 4 completed
```

Task 6: Executors, Concurrent Collections, CompletableFuture

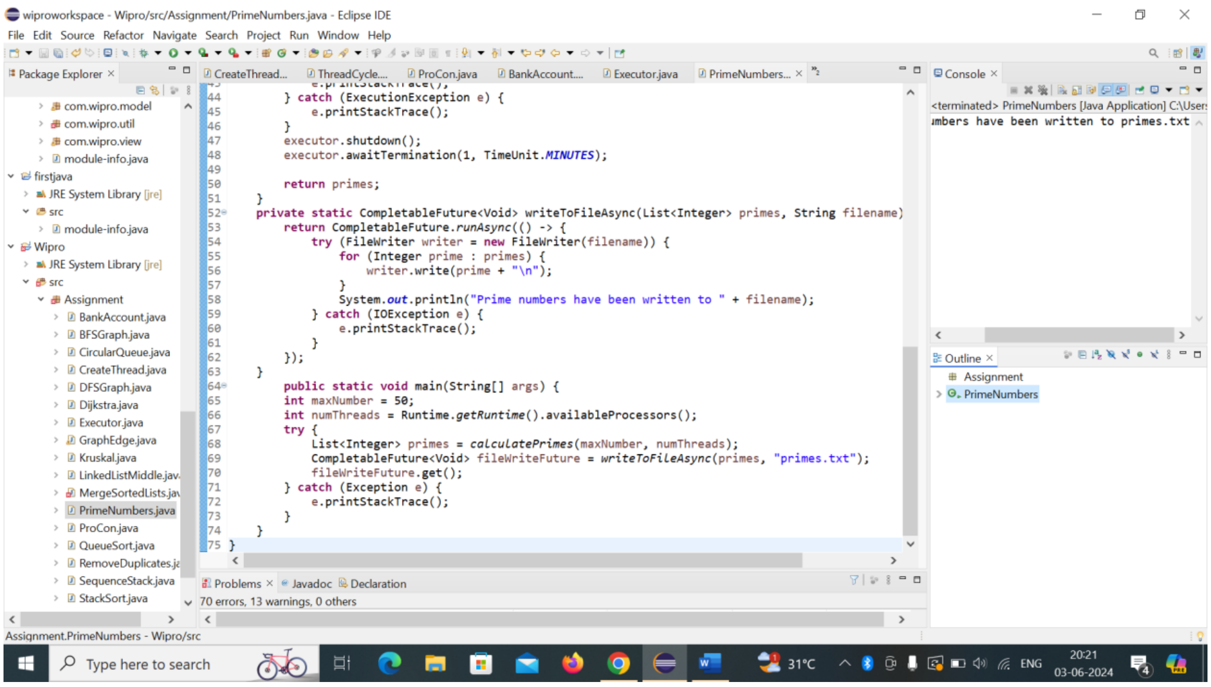
Use an ExecutorService to parallelize a task that calculates prime numbers up to a given number and then use CompletableFuture to write the results to a file asynchronously.



```java
package Assignment;
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.ExecutionException;
import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;
import java.util.concurrent.TimeUnit;

public class PrimeNumbers {
    private static boolean isPrime(int number) {
        if (number <= 1) {
            return false;
        }
        for (int i = 2; i <= Math.sqrt(number); i++) {
            if (number % i == 0) {
                return false;
            }
        }
        return true;
    }
    private static List<Integer> calculatePrimes(int maxNumber, int numThreads) throws Interruptec
        List<Integer> primes = new ArrayList<>();
        ExecutorService executor = Executors.newFixedThreadPool(numThreads);
        List<CompletableFuture<Void>> futures = new ArrayList<>();
        for (int i = 2; i <= maxNumber; i++) {
            final int num = i;
            CompletableFuture<Void> future = CompletableFuture.runAsync(() -> {
                if (isPrime(num)) {
                    synchronized (primes) {
```

```
<terminated> PrimeNumbers [Java Application] C:\Users
ımbers have been written to primes.txt
```

70 errors, 13 warnings, 0 others



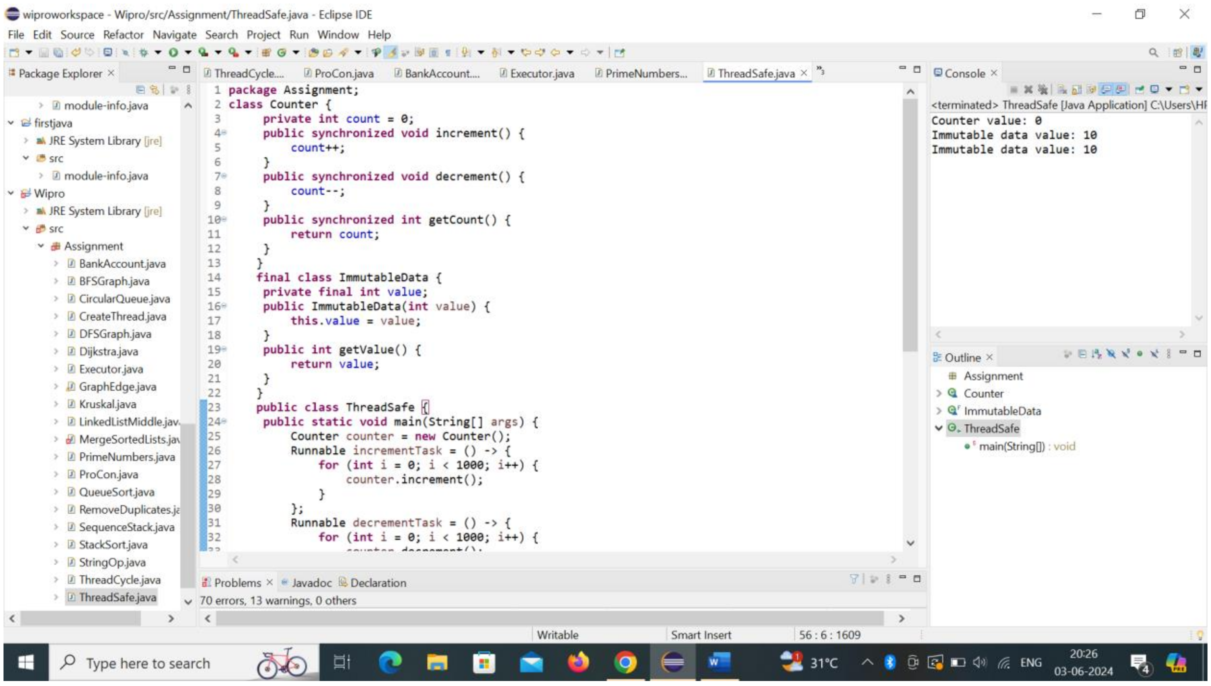
```java
        } catch (ExecutionException e) {
            e.printStackTrace();
        }
        executor.shutdown();
        executor.awaitTermination(1, TimeUnit.MINUTES);

        return primes;
    }
    private static CompletableFuture<Void> writeToFileAsync(List<Integer> primes, String filename)
        return CompletableFuture.runAsync(() -> {
            try (FileWriter writer = new FileWriter(filename)) {
                for (Integer prime : primes) {
                    writer.write(prime + "\n");
                }
                System.out.println("Prime numbers have been written to " + filename);
            } catch (IOException e) {
                e.printStackTrace();
            }
        });
    }
        public static void main(String[] args) {
        int maxNumber = 50;
        int numThreads = Runtime.getRuntime().availableProcessors();
        try {
            List<Integer> primes = calculatePrimes(maxNumber, numThreads);
            CompletableFuture<Void> fileWriteFuture = writeToFileAsync(primes, "primes.txt");
            fileWriteFuture.get();
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

```
<terminated> PrimeNumbers [Java Application] C:\Users
ımbers have been written to primes.txt
```

70 errors, 13 warnings, 0 others

Task 7: Writing Thread-Safe Code, Immutable Objects

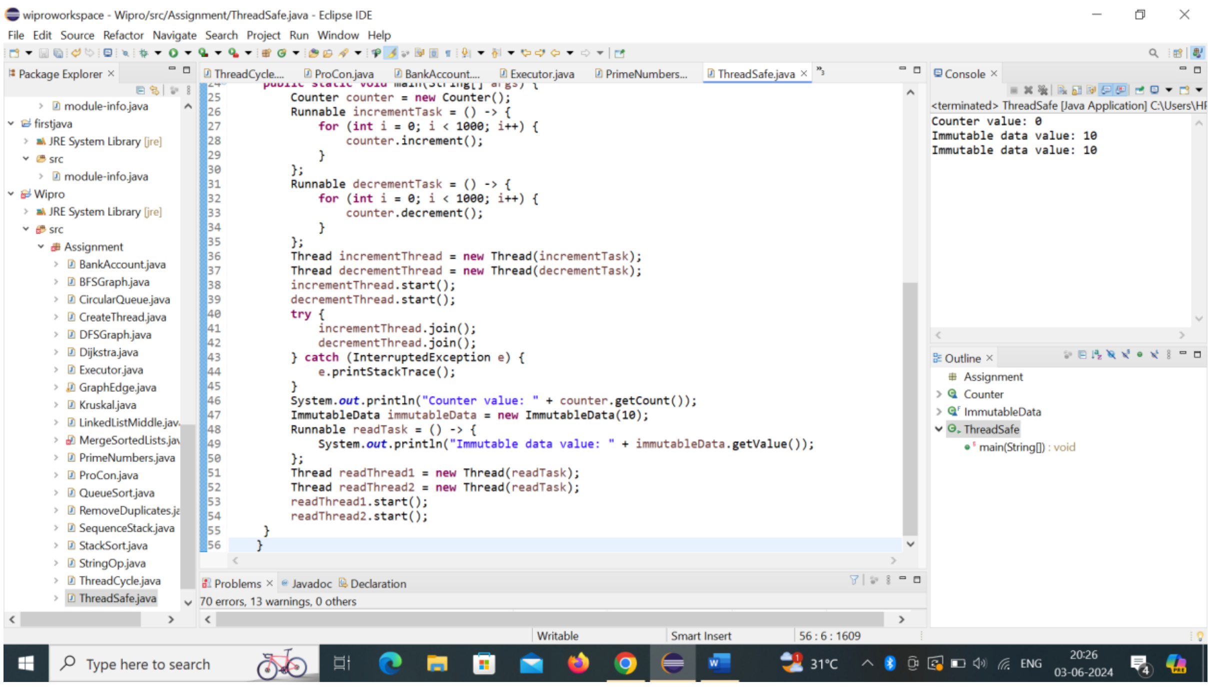
Design a thread-safe Counter class with increment and decrement methods. Then demonstrate its usage from multiple threads. Also, implement and use an immutable class to share data between threads


wiproworkspace - Wipro/src/Assignment/ThreadSafe.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
ThreadSafe.java
Console
Outline
Problems Javadoc Declaration
Writable Smart Insert 56 : 6 : 1609

```java
package Assignment;
class Counter {
    private int count = 0;
    public synchronized void increment() {
        count++;
    }
    public synchronized void decrement() {
        count--;
    }
    public synchronized int getCount() {
        return count;
    }
}
final class ImmutableData {
    private final int value;
    public ImmutableData(int value) {
        this.value = value;
    }
    public int getValue() {
        return value;
    }
}
public class ThreadSafe {
    public static void main(String[] args) {
        Counter counter = new Counter();
        Runnable incrementTask = () -> {
            for (int i = 0; i < 1000; i++) {
                counter.increment();
            }
        };
        Runnable decrementTask = () -> {
            for (int i = 0; i < 1000; i++) {
```

```
<terminated> ThreadSafe [Java Application] C:\Users\HI
Counter value: 0
Immutable data value: 10
Immutable data value: 10
```

70 errors, 13 warnings, 0 others


wiproworkspace - Wipro/src/Assignment/ThreadSafe.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
ThreadSafe.java
Console
Outline
Problems Javadoc Declaration
Writable Smart Insert 56 : 6 : 1609

```java
        Counter counter = new Counter();
        Runnable incrementTask = () -> {
            for (int i = 0; i < 1000; i++) {
                counter.increment();
            }
        };
        Runnable decrementTask = () -> {
            for (int i = 0; i < 1000; i++) {
                counter.decrement();
            }
        };
        Thread incrementThread = new Thread(incrementTask);
        Thread decrementThread = new Thread(decrementTask);
        incrementThread.start();
        decrementThread.start();
        try {
            incrementThread.join();
            decrementThread.join();
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        System.out.println("Counter value: " + counter.getCount());
        ImmutableData immutableData = new ImmutableData(10);
        Runnable readTask = () -> {
            System.out.println("Immutable data value: " + immutableData.getValue());
        };
        Thread readThread1 = new Thread(readTask);
        Thread readThread2 = new Thread(readTask);
        readThread1.start();
        readThread2.start();
    }
}
```

```
<terminated> ThreadSafe [Java Application] C:\Users\HI
Counter value: 0
Immutable data value: 10
Immutable data value: 10
```

70 errors, 13 warnings, 0 others