Name: Toshiro Mendoza ID: 834872958 SOFTENG282 – Assignment 1

Program Documentation

1) --

The program description is outlined as: Given two positive integers A and B, write a program to calculate the greatest common divisor (GCD) of the sum of the first A Fibonacci numbers and the sum of the first B Fibonacci numbers. The program can be in either C or Java.

Input: Two positive integers A and B.

Output: The GCD of the sum of the first A Fibonacci numbers and the sum of the first B Fibonacci numbers.

FibonacciGCD.java

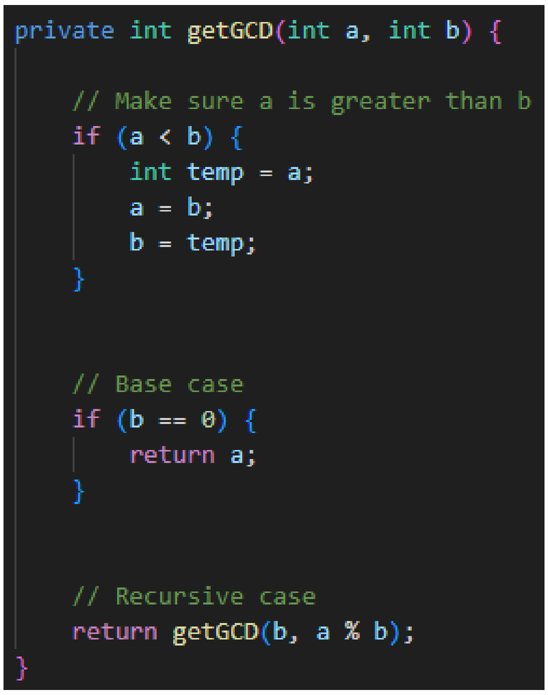
The programming language I chose to do this task is Java. I simply created the actual program that contains the algorithm under ‘FibonacciGCD.java’. I call the method that does the algorithm “computeGCD()”. For now, this is represented simply, before the logic is added:

```java
public class FibonacciGCD {
    public FibonacciGCD() {}

    public int computeGCD(int a, int b) {
        return -1;

    }
}
```

It is easier to first find the sum of the first N Fibonacci numbers, thus I first created a different method which first finds this very thing. I call this “sumOfFirstNFibonacciNumbers()”.

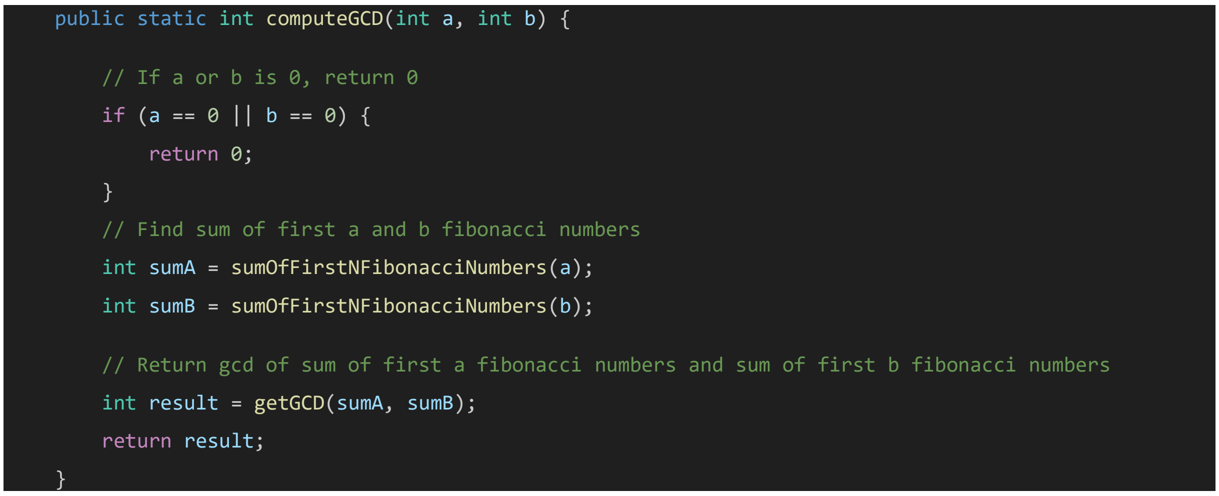
```java
private static int sumOfFirstNFibonacciNumbers(int n) {
        // Initialize tracking of Fibonacci numbers
        int sum = 0;
        int a = 0;
        int b = 1;
        // Loop to find first n Fibonacci numbers and add them to sum
        for (int i = 0; i < n; i++) {
            sum += a;
            int temp = a;
            a = b;
            b = temp + b;
        }
        // Return sum
        return sum;
    }
```

Next, it would also be very helpful if there is a method which finds the greatest common divisor between two numbers. Following the Euclidean Algorithm, we can create a recursive method. I called this method “getGCD()”.



```java
private int getGCD(int a, int b) {

    // Make sure a is greater than b
    if (a < b) {
        int temp = a;
        a = b;
        b = temp;
    }


    // Base case
    if (b == 0) {
        return a;
    }


    // Recursive case
    return getGCD(b, a % b);
}
```

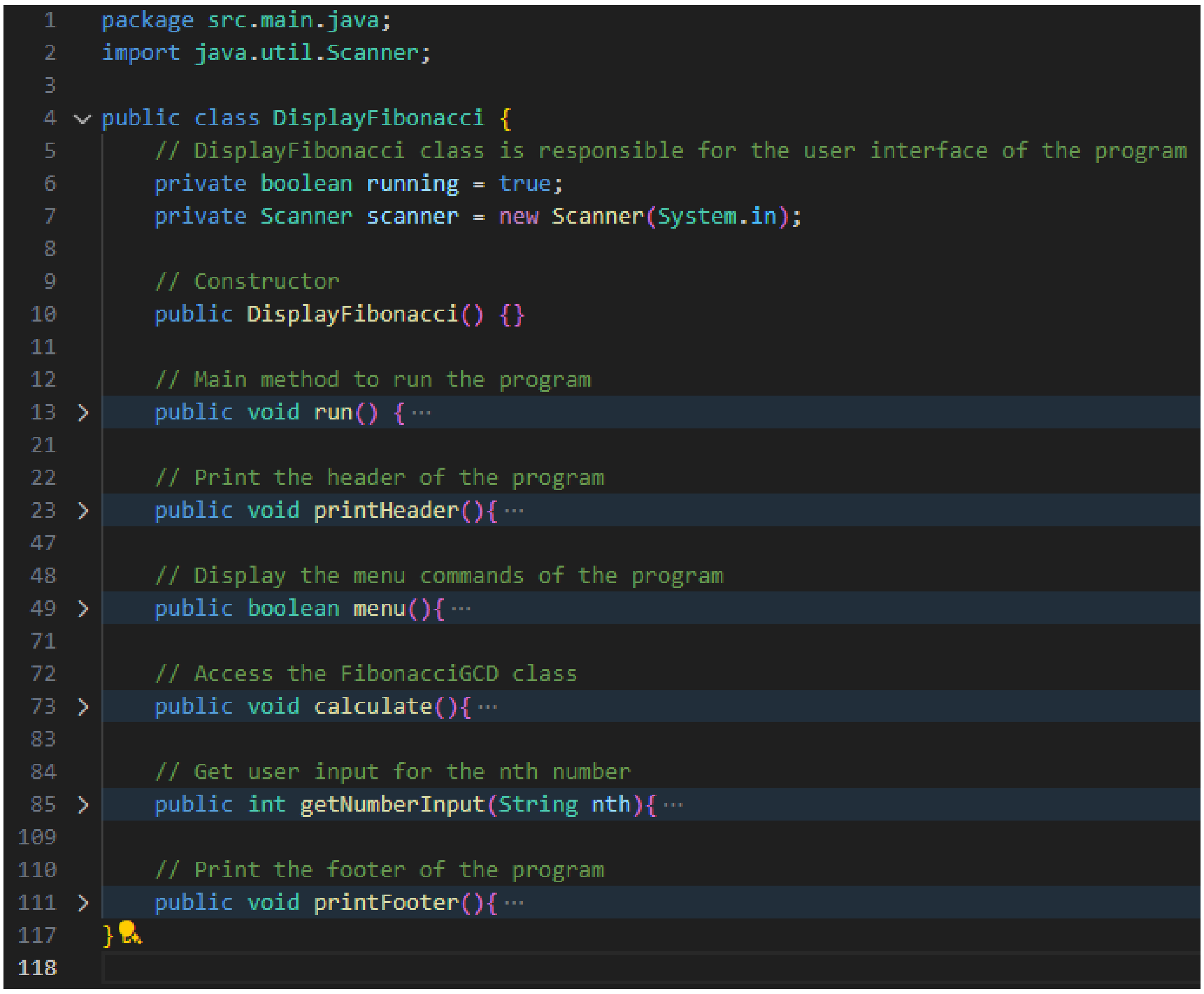
With these two methods in our grasps, it becomes very easy to find the GCD of the sum of the first A Fibonacci numbers and the sum of the first B Fibonacci numbers.



```java
    public static int computeGCD(int a, int b) {

        // If a or b is 0, return 0
        if (a == 0 || b == 0) {
            return 0;
        }
        // Find sum of first a and b fibonacci numbers
        int sumA = sumOfFirstNFibonacciNumbers(a);
        int sumB = sumOfFirstNFibonacciNumbers(b);

        // Return gcd of sum of first a fibonacci numbers and sum of first b fibonacci numbers
        int result = getGCD(sumA, sumB);
        return result;
    }
```

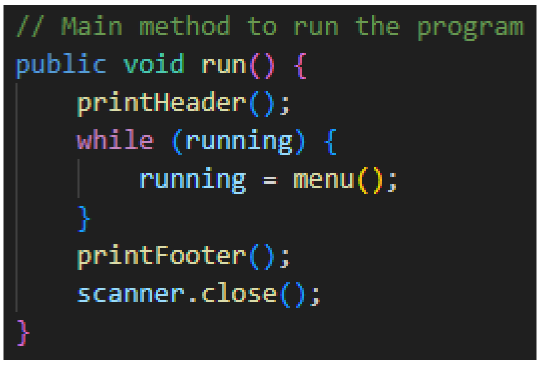
DisplayFibonacci.java

I also made DisplayFiboacci.java class. This class will contain the bulk of what will be shown on the program. That is, apart from the printed texts from FibonacciGCD.java. Thus, the main.java will have to simply call this class's method "run()" to run the entire program.



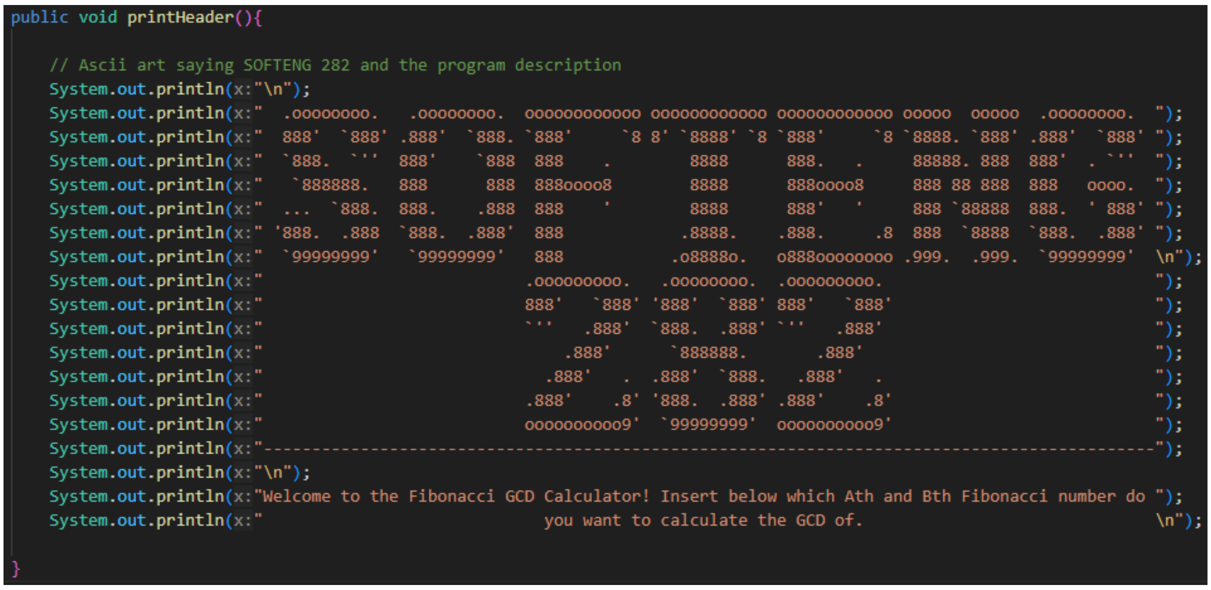
```java
package src.main.java;
import java.util.Scanner;

public class DisplayFibonacci {
    // DisplayFibonacci class is responsible for the user interface of the program
    private boolean running = true;
    private Scanner scanner = new Scanner(System.in);

    // Constructor
    public DisplayFibonacci() {}

    // Main method to run the program
    public void run() {···

    // Print the header of the program
    public void printHeader(){···

    // Display the menu commands of the program
    public boolean menu(){···

    // Access the FibonacciGCD class
    public void calculate(){···

    // Get user input for the nth number
    public int getNumberInput(String nth){···

    // Print the footer of the program
    public void printFooter(){···
}

```

The run() method simply calls on the other methods to run them in the correct order, by repeating the menu() method until the user uses the EXIT command.

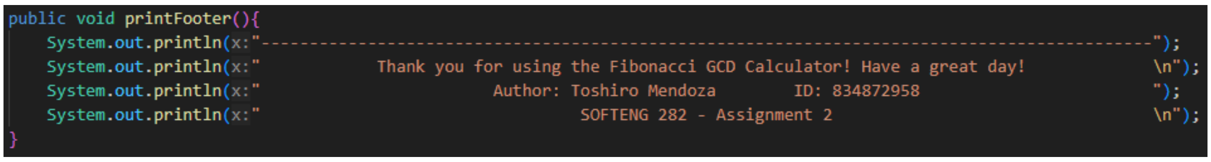


```java
// Main method to run the program
public void run() {
    printHeader();
    while (running) {
        running = menu();
    }
    printFooter();
    scanner.close();
}
```

The printHeader() and printFooter() methods simply prints out texts that indicates the start and end of the program. They are only made to make the program cleaner to look at; thus the ascii art for the header.



```java
public void printHeader(){

    // Ascii art saying SOFTENG 282 and the program description
    System.out.println(x:"\n");
    System.out.println(x:"  .oooooooo.   .oooooooo.  oooooooooooo oooooooooooo oooooooooooo ooooo  ooooo  .oooooooo.  ");
    System.out.println(x:"  888'  `888' .888'  `888. `888'     `8 8' `8888' `8 `888'     `8 `8888. `888' .888'  `888' ");
    System.out.println(x:"  `888.  `''  888'    `888  888    .        8888      888.   .     88888. 888  888'  . `''  ");
    System.out.println(x:"   `888888.   888      888  888oooo8        8888      888oooo8     888 88 888  888   oooo.  ");
    System.out.println(x:"  ...  `888.  888.    .888  888    '        8888      888'   '     888 `88888  888.  ' 888' ");
    System.out.println(x:" '888.  .888  `888.  .888'  888            .8888.     .888.     .8 888  `8888  `888.  .888' ");
    System.out.println(x:"  `99999999'   `99999999'   888           .o8888o.   o888ooooooooo .999.  .999.  `99999999'  \n");
    System.out.println(x:"                            .ooooooooo.   .oooooooo.  .ooooooooo.                            ");
    System.out.println(x:"                            888'   `888' '888'  `888' 888'   `888'                           ");
    System.out.println(x:"                            `''   .888'  `888.  .888' `''   .888'                            ");
    System.out.println(x:"                                .888'      `888888.       .888'                              ");
    System.out.println(x:"                              .888'   .  .888'  `888.   .888'   .                            ");
    System.out.println(x:"                            .888'    .8' '888.  .888' .888'    .8'                           ");
    System.out.println(x:"                            oooooooooo9'  `99999999'  oooooooooo9'                           ");
    System.out.println(x:"--------------------------------------------------------------------------------------------");
    System.out.println(x:"\n");
    System.out.println(x:"Welcome to the Fibonacci GCD Calculator! Insert below which Ath and Bth Fibonacci number do ");
    System.out.println(x:"                             you want to calculate the GCD of.                              \n");

}
```

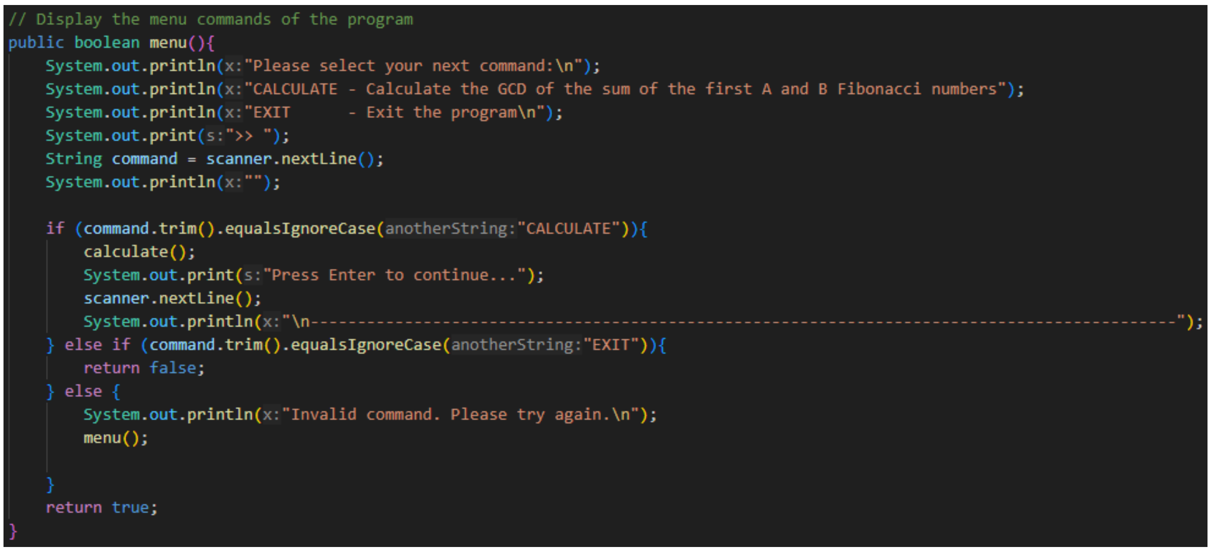


```java
public void printFooter(){
    System.out.println(x:"--------------------------------------------------------------------------------------------");
    System.out.println(x:"            Thank you for using the Fibonacci GCD Calculator! Have a great day!             \n");
    System.out.println(x:"                        Author: Toshiro Mendoza        ID: 834872958                        ");
    System.out.println(x:"                                 SOFTENG 282 - Assignment 2                                 \n");
}
```

The menu() method asks the user which command they want to use. The repeating nature of this method in the run() method makes it possible for the user to use this program again and again until satisfied of calculating all they need to calculate. The two available commands are:

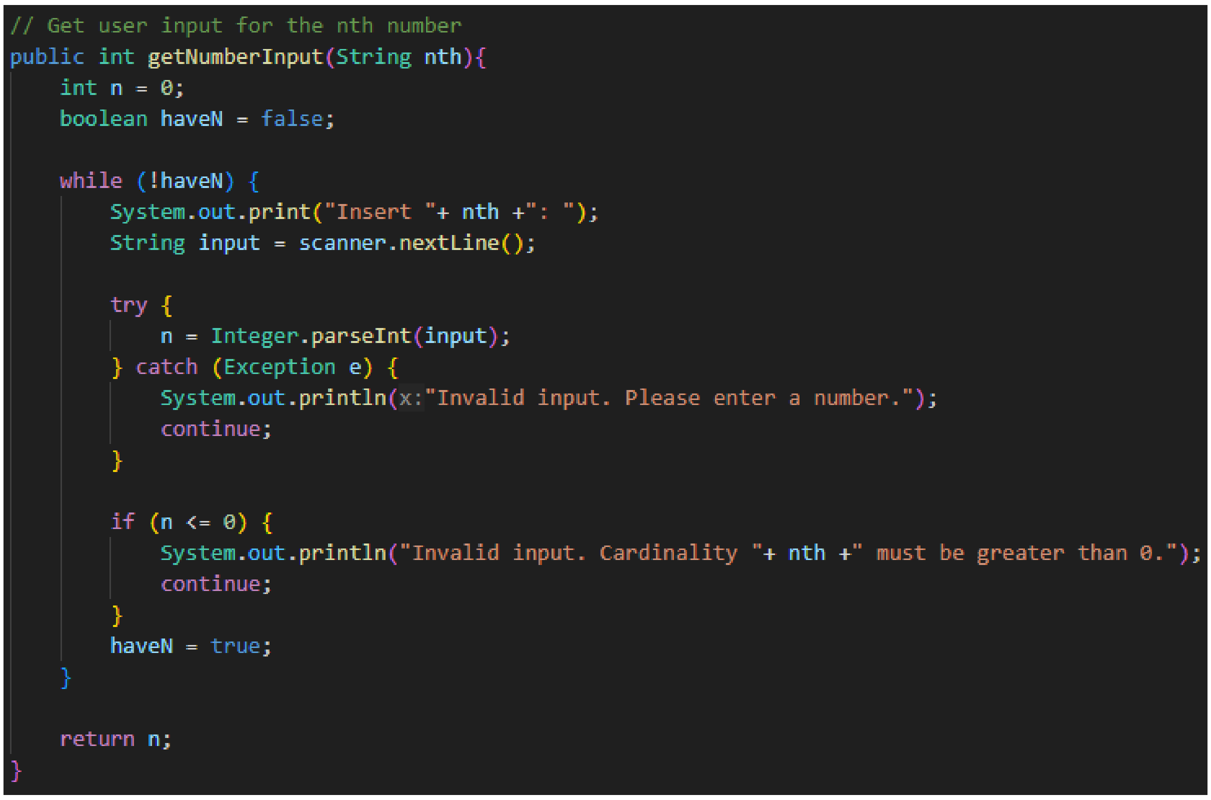
CALCULATE: Calculate the GCD of the sum of the first A and B Fibonacci numbers.

EXIT: Exit the program.



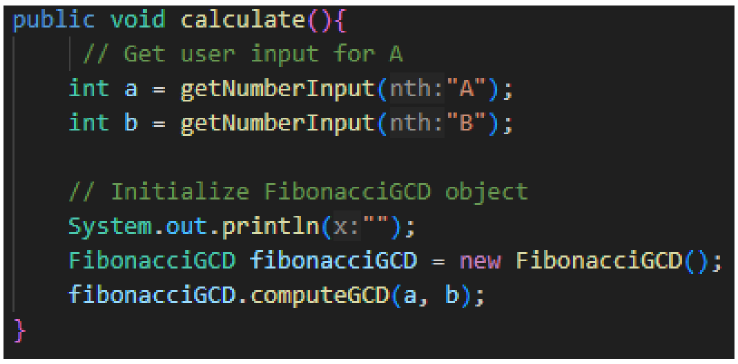
```java
// Display the menu commands of the program
public boolean menu(){
    System.out.println(x:"Please select your next command:\n");
    System.out.println(x:"CALCULATE - Calculate the GCD of the sum of the first A and B Fibonacci numbers");
    System.out.println(x:"EXIT      - Exit the program\n");
    System.out.print(s:">> ");
    String command = scanner.nextLine();
    System.out.println(x:"");

    if (command.trim().equalsIgnoreCase(anotherString:"CALCULATE")){
        calculate();
        System.out.print(s:"Press Enter to continue...");
        scanner.nextLine();
        System.out.println(x:"\n--------------------------------------------------------------------------------------------");
    } else if (command.trim().equalsIgnoreCase(anotherString:"EXIT")){
        return false;
    } else {
        System.out.println(x:"Invalid command. Please try again.\n");
        menu();

    }
    return true;
}
```

The getNumberInput() method is the method that obtains the desired A and B needed to calculate the GCD of the sum of the first A and B Fibonacci numbers. This method specifically needs a string input which specifies whether the number being obtained is for number “A” or “B”.



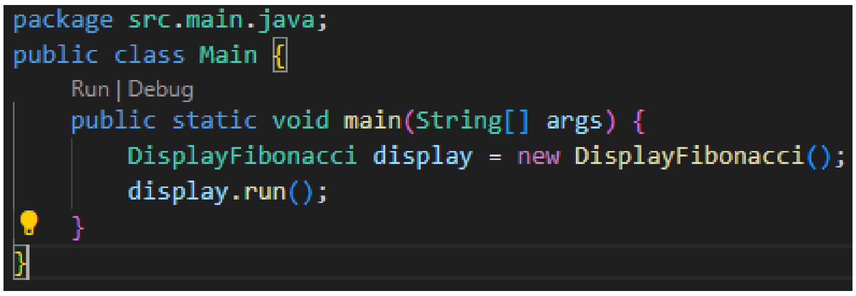
```
// Get user input for the nth number
public int getNumberInput(String nth){
    int n = 0;
    boolean haveN = false;

    while (!haveN) {
        System.out.print("Insert "+ nth +": ");
        String input = scanner.nextLine();

        try {
            n = Integer.parseInt(input);
        } catch (Exception e) {
            System.out.println(x:"Invalid input. Please enter a number.");
            continue;
        }

        if (n <= 0) {
            System.out.println("Invalid input. Cardinality "+ nth +" must be greater than 0.");
            continue;
        }
        haveN = true;
    }

    return n;
}
```

Then lastly, the calculate() method uses the getNumberInput() function to obtain A and B, then uses it to calculate the desired output by calling the FibonacciGCD class which contains the desired algorithm.



```
public void calculate(){
     // Get user input for A
    int a = getNumberInput(nth:"A");
    int b = getNumberInput(nth:"B");

    // Initialize FibonacciGCD object
    System.out.println(x:"");
    FibonacciGCD fibonacciGCD = new FibonacciGCD();
    fibonacciGCD.computeGCD(a, b);
}
```

The Main.java class thus then simply looks like:

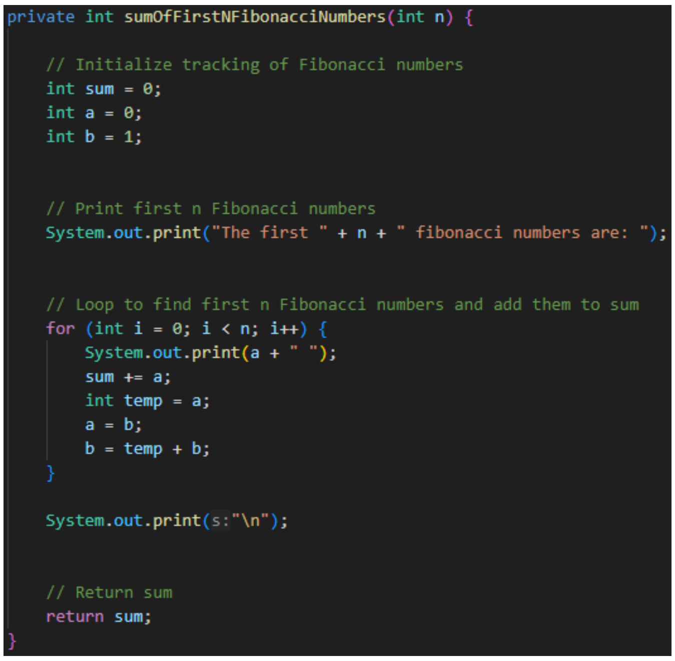


```
package src.main.java;
public class Main {
    Run | Debug
    public static void main(String[] args) {
        DisplayFibonacci display = new DisplayFibonacci();
        display.run();
    }
}
```

2) ---

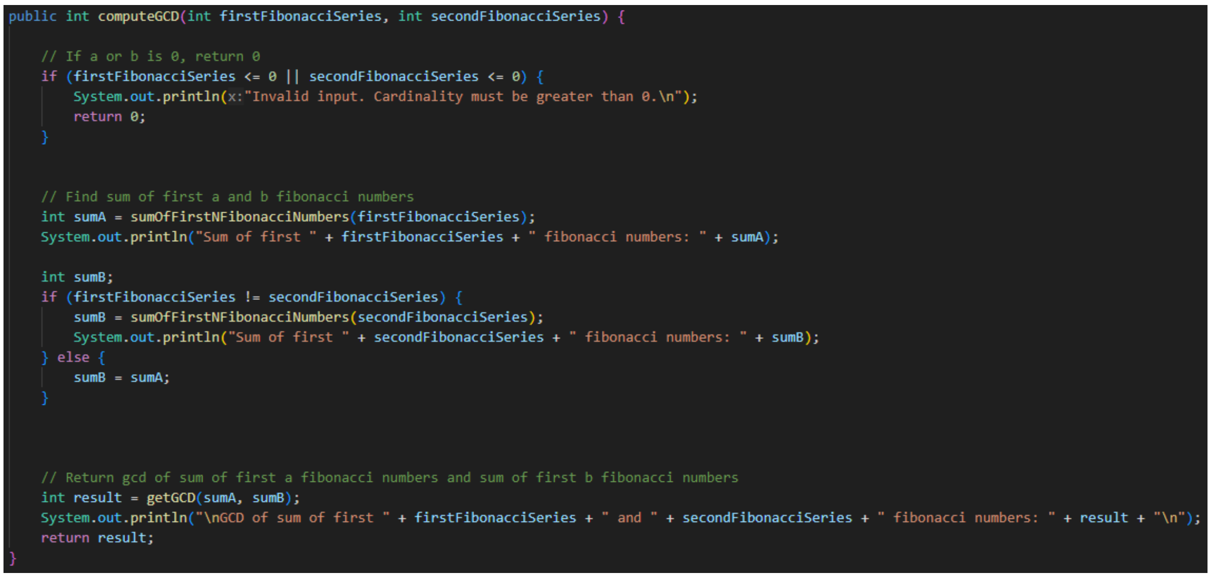
Next task to do is the following: Add suitable output commands to the GCD algorithm that show the progress of the algorithm.

We can print into the command line the Fibonacci numbers as they are being added into the sums. This tells us the progress of the sumOfFirstNFibonacciNumbers(). Thus, I rewrote this method as:



```java
private int sumOfFirstNFibonacciNumbers(int n) {

    // Initialize tracking of Fibonacci numbers
    int sum = 0;
    int a = 0;
    int b = 1;


    // Print first n Fibonacci numbers
    System.out.print("The first " + n + " fibonacci numbers are: ");


    // Loop to find first n Fibonacci numbers and add them to sum
    for (int i = 0; i < n; i++) {
        System.out.print(a + " ");
        sum += a;
        int temp = a;
        a = b;
        b = temp + b;
    }

    System.out.print(s:"\n");


    // Return sum
    return sum;
}
```

I also modified the computeGCD() method to track what the sums are and display what the resulting GCDs are.



```java
public int computeGCD(int firstFibonacciSeries, int secondFibonacciSeries) {

    // If a or b is 0, return 0
    if (firstFibonacciSeries <= 0 || secondFibonacciSeries <= 0) {
        System.out.println(x:"Invalid input. Cardinality must be greater than 0.\n");
        return 0;
    }


    // Find sum of first a and b fibonacci numbers
    int sumA = sumOfFirstNFibonacciNumbers(firstFibonacciSeries);
    System.out.println("Sum of first " + firstFibonacciSeries + " fibonacci numbers: " + sumA);

    int sumB;
    if (firstFibonacciSeries != secondFibonacciSeries) {
        sumB = sumOfFirstNFibonacciNumbers(secondFibonacciSeries);
        System.out.println("Sum of first " + secondFibonacciSeries + " fibonacci numbers: " + sumB);
    } else {
        sumB = sumA;
    }



    // Return gcd of sum of first a fibonacci numbers and sum of first b fibonacci numbers
    int result = getGCD(sumA, sumB);
    System.out.println("\nGCD of sum of first " + firstFibonacciSeries + " and " + secondFibonacciSeries + " fibonacci numbers: " + result + "\n");
    return result;
}
```

3) --

Next task to do is the following: Add suitable comments to your code that would help a code reviewer.

4) --

Next task to do is the following: Provide a readme file that explains your solution to a reader with sample output similar to the output shown in the question above and contains other instructions i.e. how to compile and run the program.

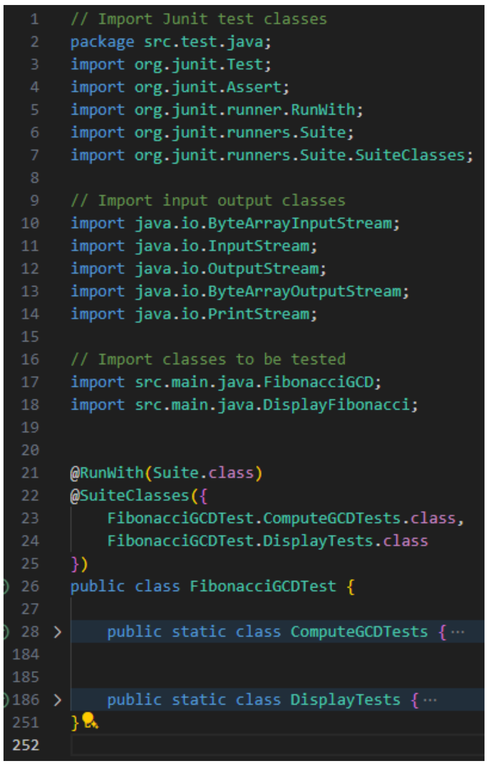
Proper and adequate comments on how the program works are added during the programming process already. The README.md file should be submitted to the same folder as this document.

5) --

Next task to do is the following: Test your code and document this. Introduce, if useful, bounds for the input.

FibonacciGCDTest.java

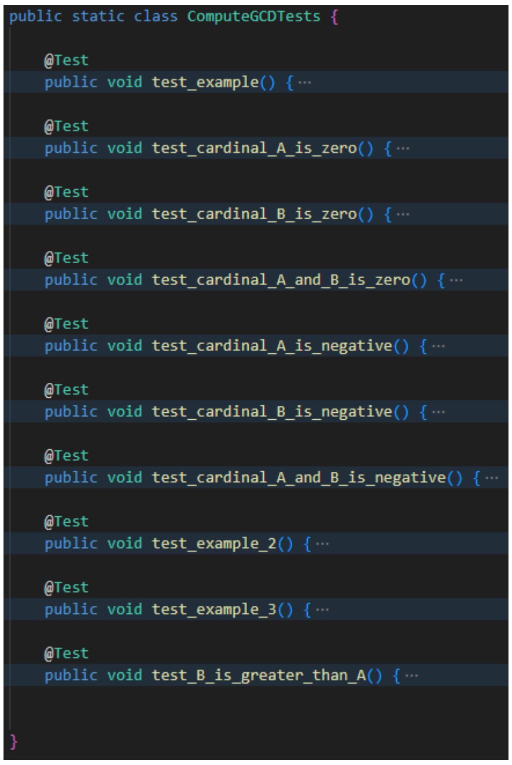
For the test, I created FibonacciGCDTest.java class. This test is divided into two subclasses. The first tests the algorithm itself. While the second tests what is displayed when commands are used.



```java
// Import Junit test classes
package src.test.java;
import org.junit.Test;
import org.junit.Assert;
import org.junit.runner.RunWith;
import org.junit.runners.Suite;
import org.junit.runners.Suite.SuiteClasses;

// Import input output classes
import java.io.ByteArrayInputStream;
import java.io.InputStream;
import java.io.OutputStream;
import java.io.ByteArrayOutputStream;
import java.io.PrintStream;

// Import classes to be tested
import src.main.java.FibonacciGCD;
import src.main.java.DisplayFibonacci;


@RunWith(Suite.class)
@SuiteClasses({
    FibonacciGCDTest.ComputeGCDTests.class,
    FibonacciGCDTest.DisplayTests.class
})
public class FibonacciGCDTest {

    public static class ComputeGCDTests {…


    public static class DisplayTests {…
}
```

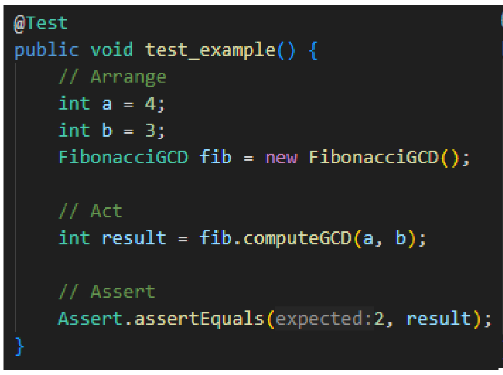
ComputeGCDTests Class

The first test subclass is called ComputeGCDTests and is composed of 11 test cases.

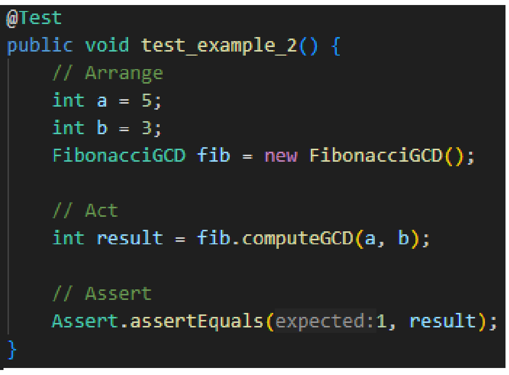


```java
public static class ComputeGCDTests {

    @Test
    public void test_example() {···

    @Test
    public void test_cardinal_A_is_zero() {···

    @Test
    public void test_cardinal_B_is_zero() {···

    @Test
    public void test_cardinal_A_and_B_is_zero() {···

    @Test
    public void test_cardinal_A_is_negative() {···

    @Test
    public void test_cardinal_B_is_negative() {···

    @Test
    public void test_cardinal_A_and_B_is_negative() {···

    @Test
    public void test_example_2() {···

    @Test
    public void test_example_3() {···

    @Test
    public void test_B_is_greater_than_A() {···


}
```

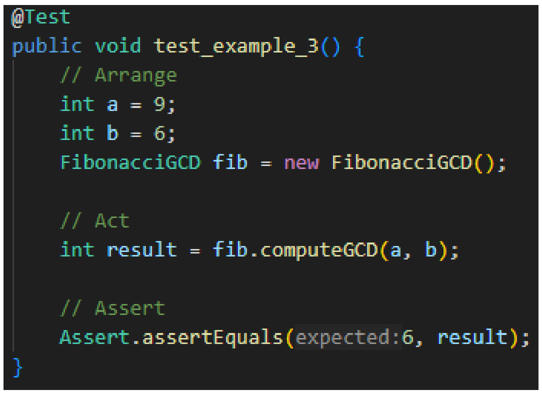
The test methods test_example(), test_example_2(), and test_example_3() are all test cases where the inputs are valid and checks whether the output GCD of sum of first A and B Fibonacci numbers are correct. The first one being the example given in the task specification.



```java
@Test
public void test_example() {
    // Arrange
    int a = 4;
    int b = 3;
    FibonacciGCD fib = new FibonacciGCD();

    // Act
    int result = fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals(expected:2, result);
}
```

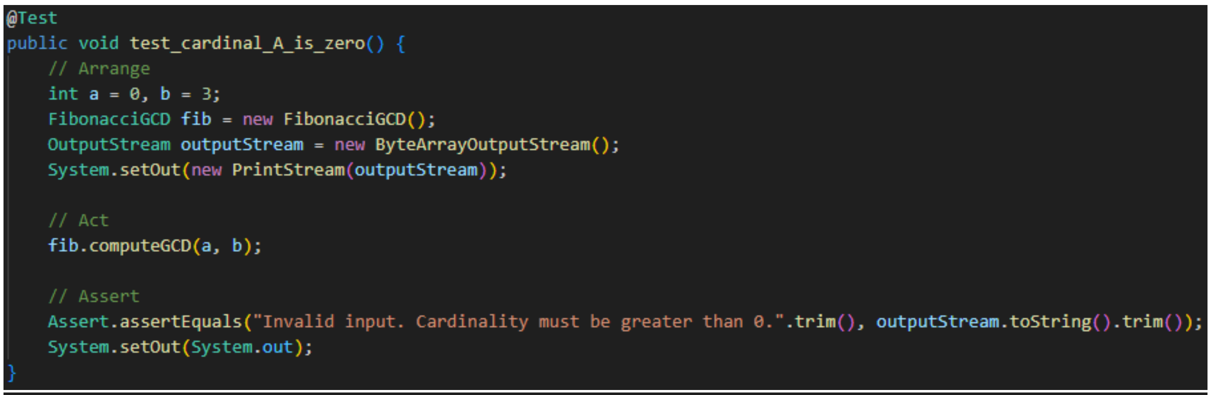


```java
@Test
public void test_example_2() {
    // Arrange
    int a = 5;
    int b = 3;
    FibonacciGCD fib = new FibonacciGCD();

    // Act
    int result = fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals(expected:1, result);
}
```

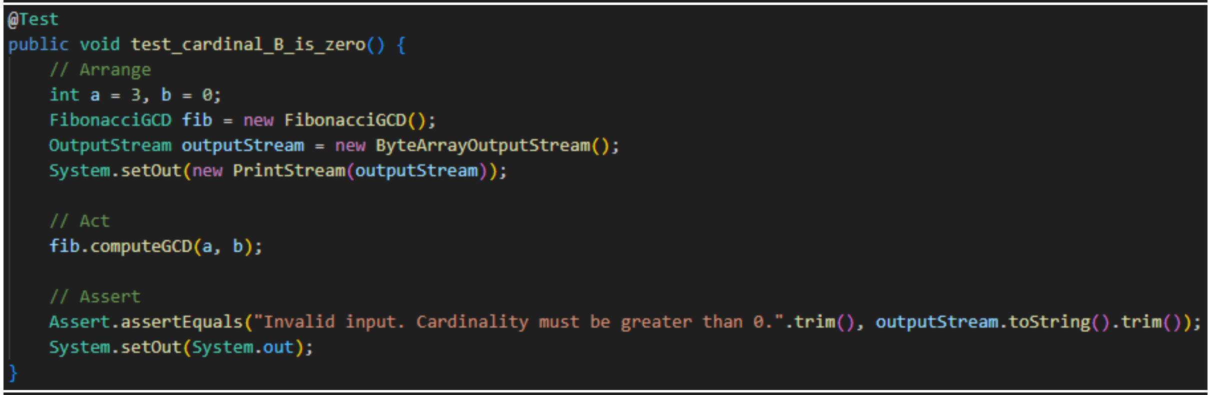


```java
@Test
public void test_example_3() {
    // Arrange
    int a = 9;
    int b = 6;
    FibonacciGCD fib = new FibonacciGCD();

    // Act
    int result = fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals(expected:6, result);
}
```

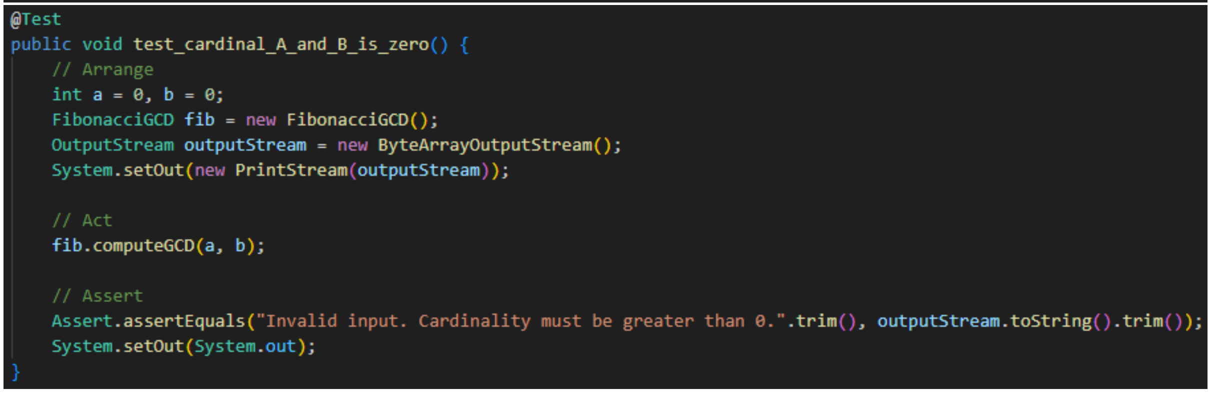
The test methods test_cardinal_A_is_zero(), test_cardinal_B_is_zero(), and test_cardinal_A_and_B_is_zero(), are all tests which looks on what happens if at least on of the input numbers to the algorithm is 0. This should cause the algorithm to stop as there is no “0th” Fibonacci.



```java
@Test
public void test_cardinal_A_is_zero() {
    // Arrange
    int a = 0, b = 3;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

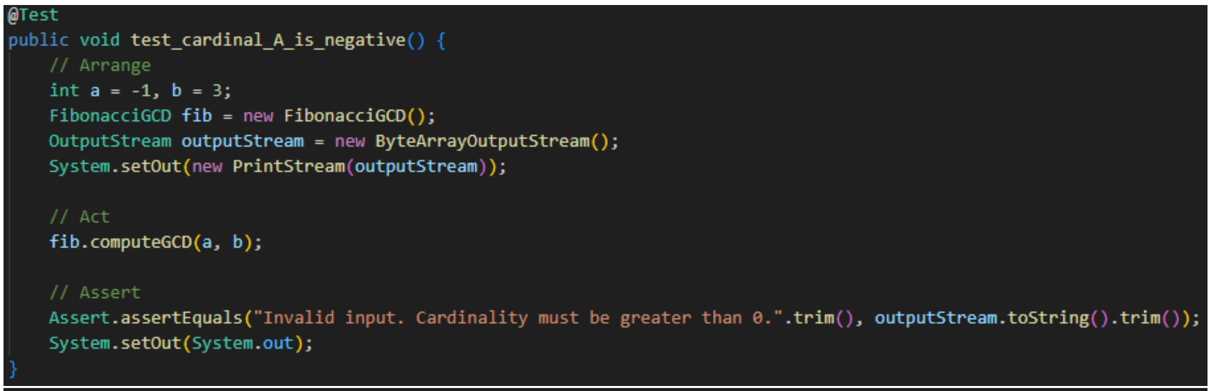


```java
@Test
public void test_cardinal_B_is_zero() {
    // Arrange
    int a = 3, b = 0;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

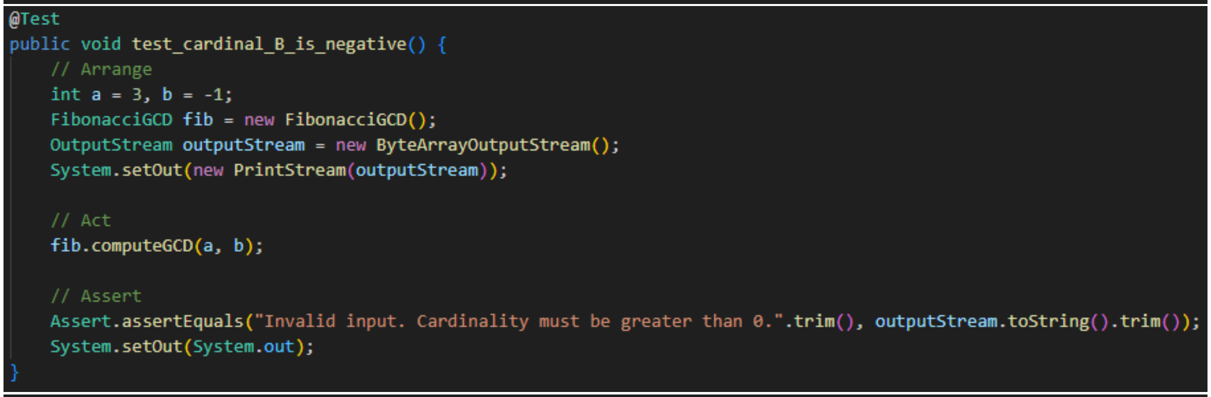


```java
@Test
public void test_cardinal_A_and_B_is_zero() {
    // Arrange
    int a = 0, b = 0;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

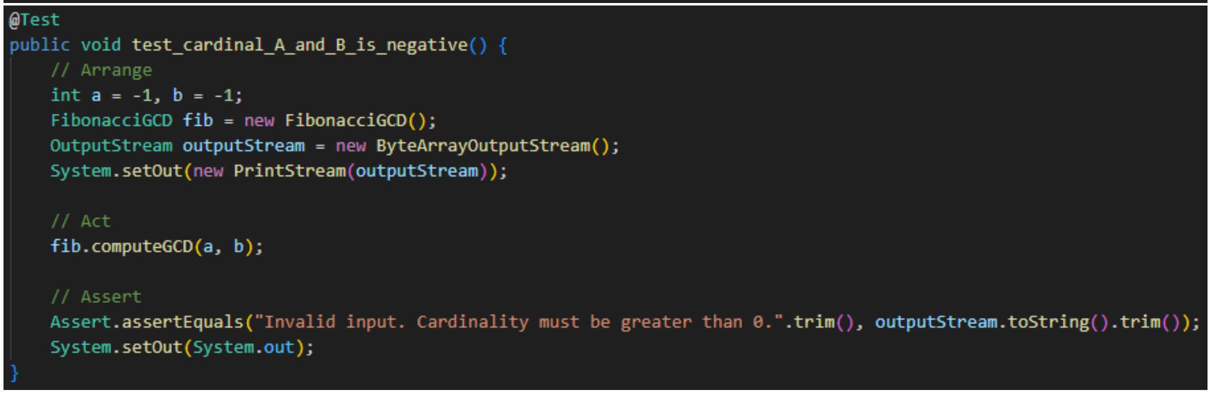
This is followed by the test_cardinal_A_is_negative(), test_cardinal_B_is_negative(), and test_cardinal_A_and_B_is_negative(), which are methods that tests what happens to the algorithm if he input is negative. In such cases, the result should be the same when inputs are zero as there is no “Negative Nth” Fibonacci number.



```java
@Test
public void test_cardinal_A_is_negative() {
    // Arrange
    int a = -1, b = 3;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

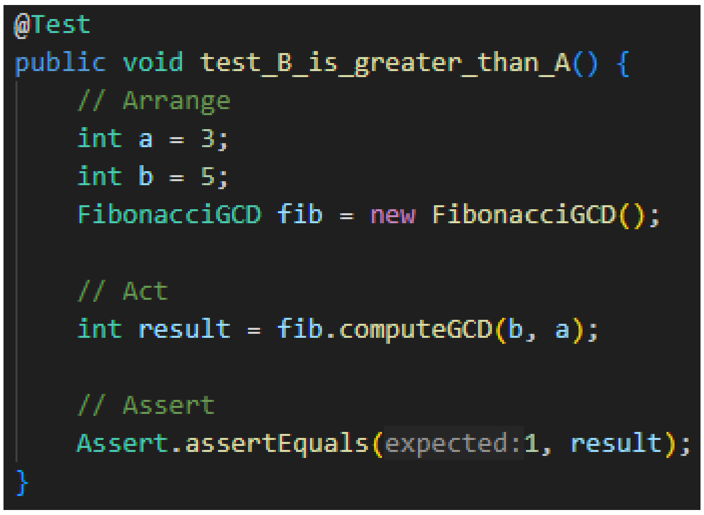


```java
@Test
public void test_cardinal_B_is_negative() {
    // Arrange
    int a = 3, b = -1;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```



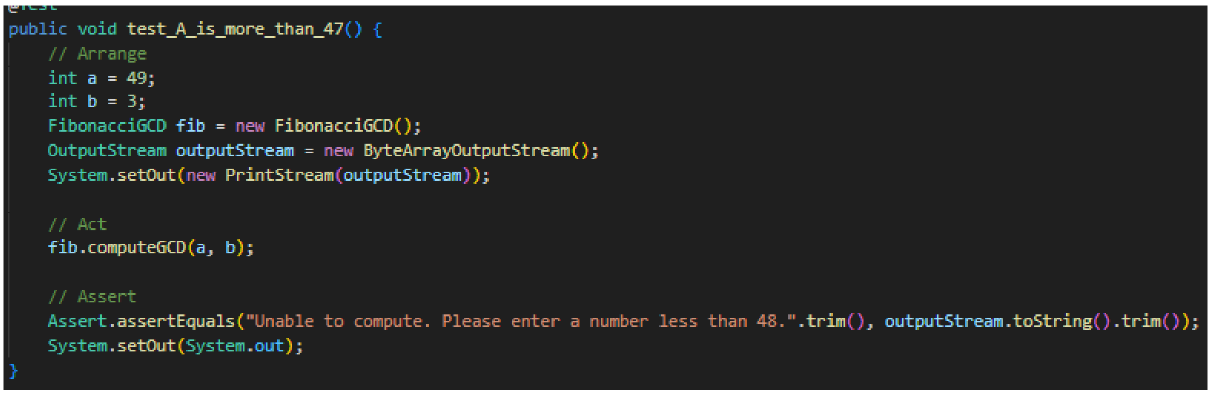
```java
@Test
public void test_cardinal_A_and_B_is_negative() {
    // Arrange
    int a = -1, b = -1;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Invalid input. Cardinality must be greater than 0.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

Then, there is the test_B_is_greater_than_A() method which just checks what happens if numbers A and B are flipped instead of A>B from other tests.



```java
@Test
public void test_B_is_greater_than_A() {
    // Arrange
    int a = 3;
    int b = 5;
    FibonacciGCD fib = new FibonacciGCD();

    // Act
    int result = fib.computeGCD(b, a);

    // Assert
    Assert.assertEquals(expected:1, result);
}
```

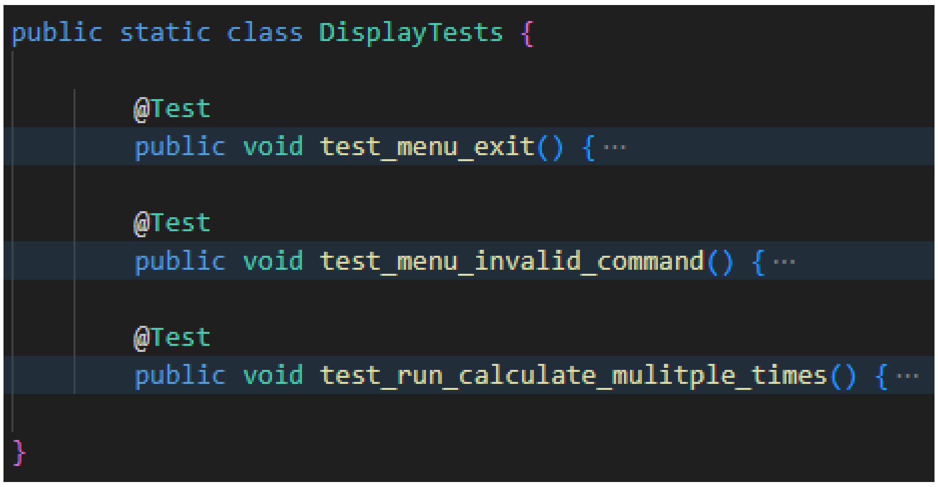
Then lastly there is test_A_is_more_than_47() method which just checks that the output is correct when the input is more than 47 as this will cause an overflow if not managed.



```java
public void test_A_is_more_than_47() {
    // Arrange
    int a = 49;
    int b = 3;
    FibonacciGCD fib = new FibonacciGCD();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    fib.computeGCD(a, b);

    // Assert
    Assert.assertEquals("Unable to compute. Please enter a number less than 48.".trim(), outputStream.toString().trim());
    System.setOut(System.out);
}
```

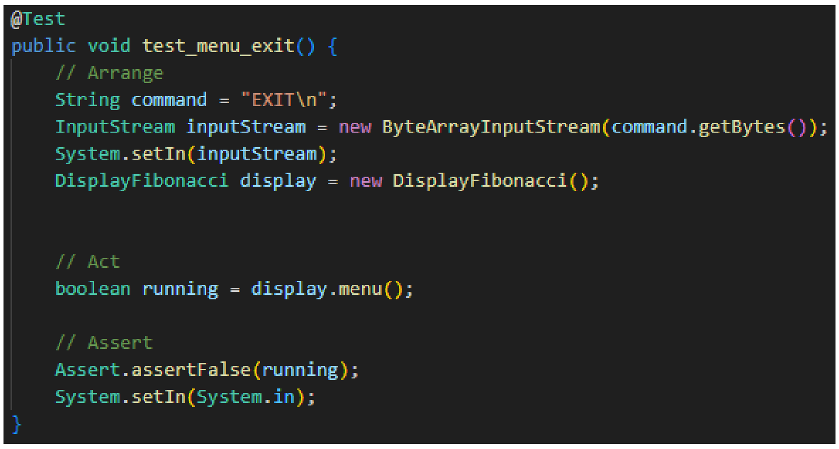
DisplayTests Class

The second test subclass is called DisplayTests and is composed of 3 test cases.



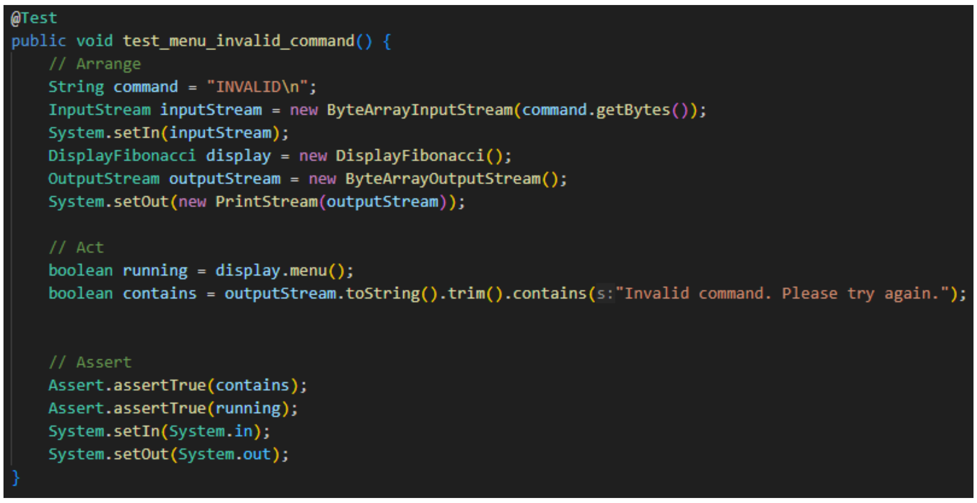
```java
public static class DisplayTests {

    @Test
    public void test_menu_exit() {…

    @Test
    public void test_menu_invalid_command() {…

    @Test
    public void test_run_calculate_mulitple_times() {…

}
```

The first test method called test_menu_exit() tests if the program properly if the EXIT command is selected by the user.



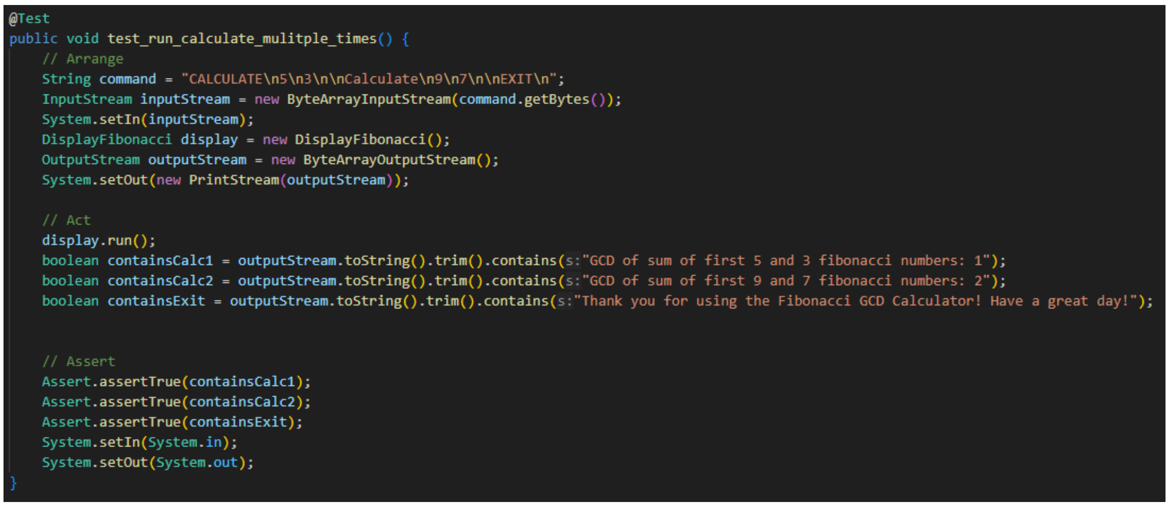
```java
@Test
public void test_menu_exit() {
    // Arrange
    String command = "EXIT\n";
    InputStream inputStream = new ByteArrayInputStream(command.getBytes());
    System.setIn(inputStream);
    DisplayFibonacci display = new DisplayFibonacci();


    // Act
    boolean running = display.menu();

    // Assert
    Assert.assertFalse(running);
    System.setIn(System.in);
}
```

The second test method is called test_menu_invalid_command() which tests if the program would show “Invalid command. Please try again…”.



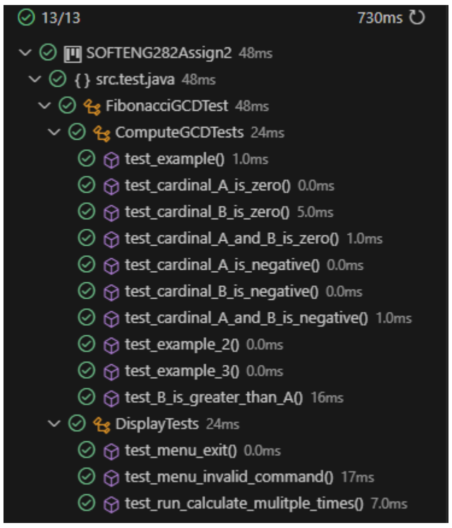
```java
@Test
public void test_menu_invalid_command() {
    // Arrange
    String command = "INVALID\n";
    InputStream inputStream = new ByteArrayInputStream(command.getBytes());
    System.setIn(inputStream);
    DisplayFibonacci display = new DisplayFibonacci();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    boolean running = display.menu();
    boolean contains = outputStream.toString().trim().contains(s:"Invalid command. Please try again.");


    // Assert
    Assert.assertTrue(contains);
    Assert.assertTrue(running);
    System.setIn(System.in);
    System.setOut(System.out);
}
```

The last test method is the test_run_calculate_multiple_times(). This fully uses the run() method instead of just one pass through menu(). This checks if the program would let the user calculate different wanted GCD and be able to exit.



```
@Test
public void test_run_calculate_mulitple_times() {
    // Arrange
    String command = "CALCULATE\n5\n3\n\nCalculate\n9\n7\n\nEXIT\n";
    InputStream inputStream = new ByteArrayInputStream(command.getBytes());
    System.setIn(inputStream);
    DisplayFibonacci display = new DisplayFibonacci();
    OutputStream outputStream = new ByteArrayOutputStream();
    System.setOut(new PrintStream(outputStream));

    // Act
    display.run();
    boolean containsCalc1 = outputStream.toString().trim().contains(s:"GCD of sum of first 5 and 3 fibonacci numbers: 1");
    boolean containsCalc2 = outputStream.toString().trim().contains(s:"GCD of sum of first 9 and 7 fibonacci numbers: 2");
    boolean containsExit = outputStream.toString().trim().contains(s:"Thank you for using the Fibonacci GCD Calculator! Have a great day!");


    // Assert
    Assert.assertTrue(containsCalc1);
    Assert.assertTrue(containsCalc2);
    Assert.assertTrue(containsExit);
    System.setIn(System.in);
    System.setOut(System.out);
}
```

After making sure that all the test cases are passed we can say that the task is complete!



```
13/13                                              730ms
SOFTENG282Assign2 48ms
  {} src.test.java 48ms
    FibonacciGCDTest 48ms
      ComputeGCDTests 24ms
        test_example() 1.0ms
        test_cardinal_A_is_zero() 0.0ms
        test_cardinal_B_is_zero() 5.0ms
        test_cardinal_A_and_B_is_zero() 1.0ms
        test_cardinal_A_is_negative() 0.0ms
        test_cardinal_B_is_negative() 0.0ms
        test_cardinal_A_and_B_is_negative() 1.0ms
        test_example_2() 0.0ms
        test_example_3() 0.0ms
        test_B_is_greater_than_A() 16ms
      DisplayTests 24ms
        test_menu_exit() 0.0ms
        test_menu_invalid_command() 17ms
        test_run_calculate_mulitple_times() 7.0ms
```