1. Experimental requirements

1. Install Junit(4.12), Hamcrest(1.3), Eclemma or Jacoco(newest) in Eclipse (done by last lab) or IDEA (follow the new instruction).
2. Write a java program for the given problem and test the program with ***Advanced Junit Usage***.

a) Add `@Before`, `@BeforeClass`, `@After`, `@AfterClass` to different functions, and write logs in each function, observe the execution order.

b) Given the input list `testinput.txt`, each line with a test input and expected output, separated by comma, eg. `10,36` means `10 = 3 + 3 + 4` and the result should be `3 * 3 * 4 = 36`. Each line only contains one test case. Use `@RunWith(Parameterized.class)` to load the test file, and test all test cases.

3. Use Eclemma or Jacoco to produce coverage.

a) Description of the problem:

Given a positive integer N, split it into the sum of at least two positive integers, and maximize the product of these integers. Returns the largest product value M.

Input:

N a positive integer

Output:

M the largest product value

Sample Input:

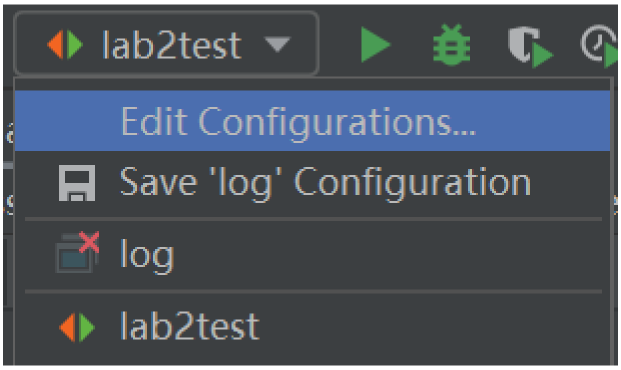
10

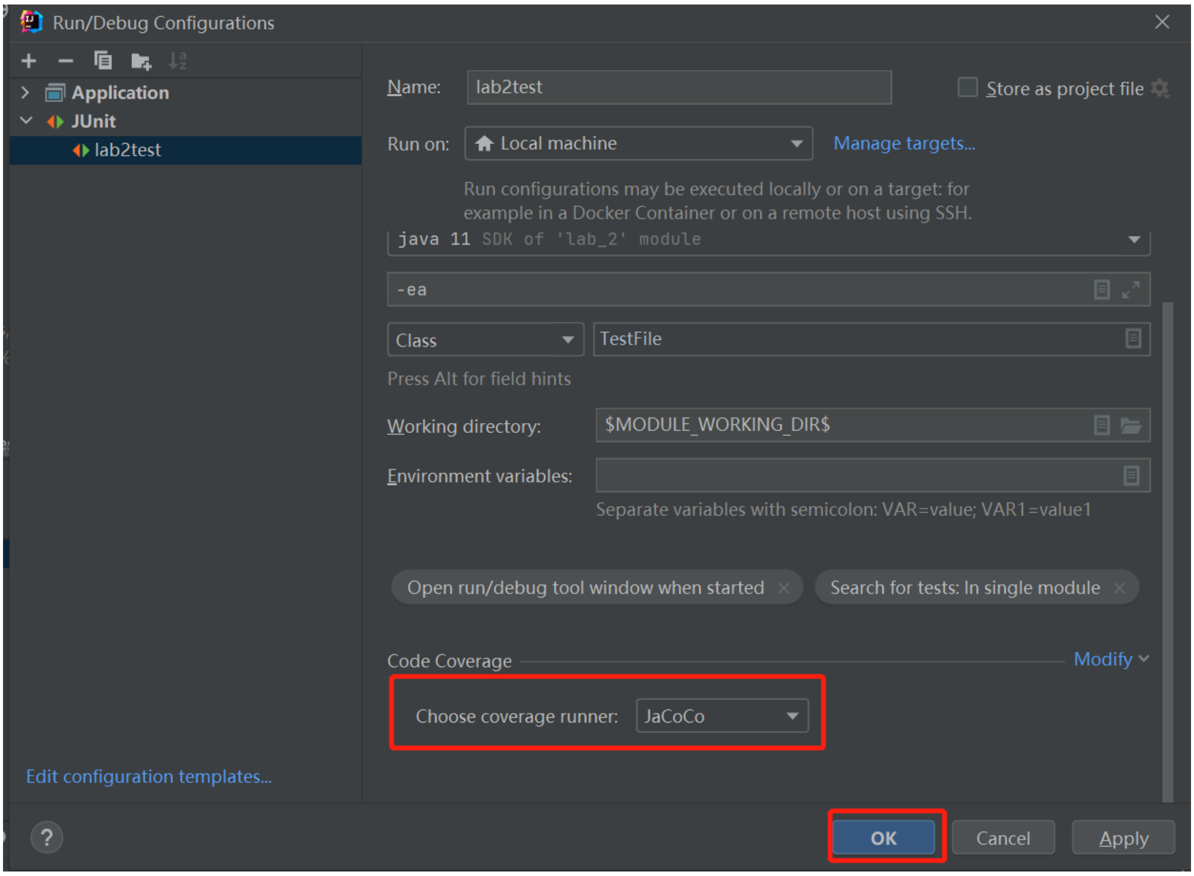
Sample Output：

36 (10 = 3 + 4 + 4， 3 *3*4 = 36)

2. Configuration

在IDEA上使用Jacoco，使用Maven管理，创建项目，根据 Junit Usage文件，如图





Name: lab2test

Run on: Local machine

Run configurations may be executed locally or on a target: for example in a Docker Container or on a remote host using SSH.

java 11 SDK of 'lab_2' module

-ea

Class TestFile

Press Alt for field hints

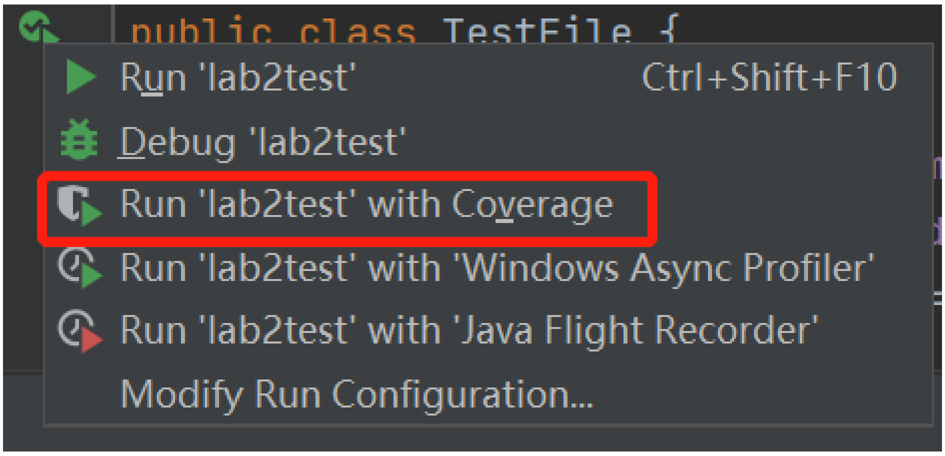
Working directory: $MODULE_WORKING_DIR$

Environment variables:

Separate variables with semicolon: VAR=value; VAR1=value1

Choose coverage runner: JaCoCo

选择Jacoco

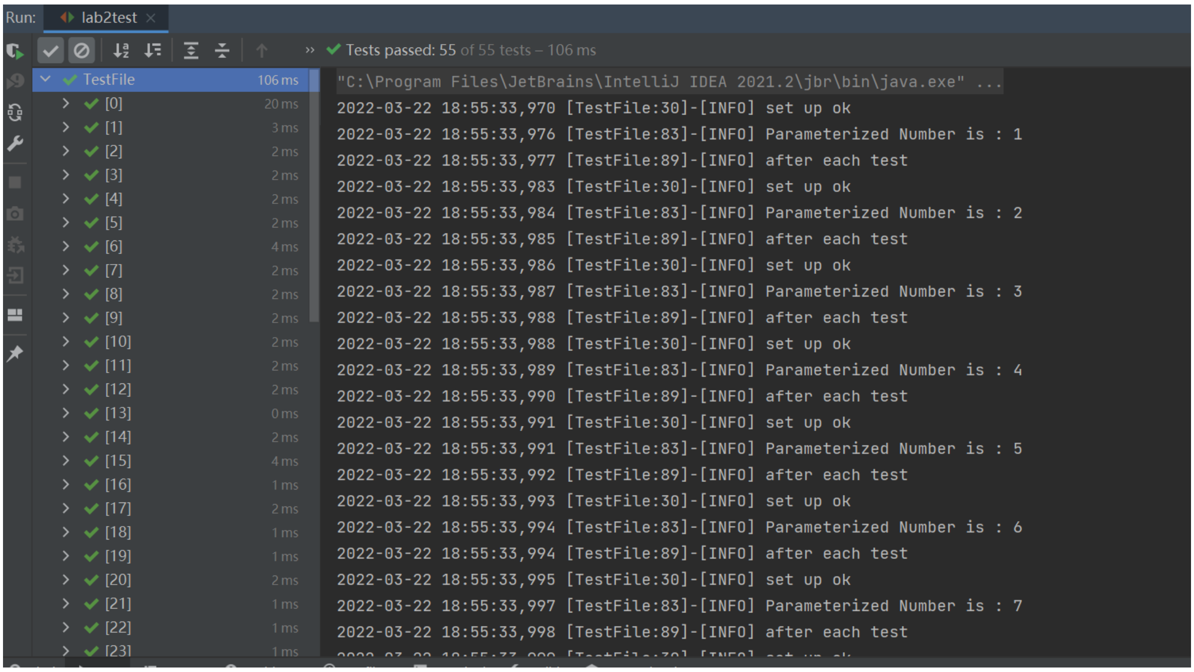


进行测试，即可使用Jacoco

3. Result analysis

题目分析：用动态规划的方法

结果截图



```
"C:\Program Files\JetBrains\IntelliJ IDEA 2021.2\jbr\bin\java.exe" ...
2022-03-22 18:55:33,970 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,976 [TestFile:83]-[INFO] Parameterized Number is : 1
2022-03-22 18:55:33,977 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,983 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,984 [TestFile:83]-[INFO] Parameterized Number is : 2
2022-03-22 18:55:33,985 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,986 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,987 [TestFile:83]-[INFO] Parameterized Number is : 3
2022-03-22 18:55:33,988 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,988 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,989 [TestFile:83]-[INFO] Parameterized Number is : 4
2022-03-22 18:55:33,990 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,991 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,991 [TestFile:83]-[INFO] Parameterized Number is : 5
2022-03-22 18:55:33,992 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,993 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,994 [TestFile:83]-[INFO] Parameterized Number is : 6
2022-03-22 18:55:33,994 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33,995 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33,997 [TestFile:83]-[INFO] Parameterized Number is : 7
2022-03-22 18:55:33,998 [TestFile:89]-[INFO] after each test
```

日志文件，打印到文件中，使@BeforeClass和@AfterClass的顺序正确

```
2022-03-22 18:55:33 [TestFile:22]-[INFO] before class ok
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 1
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 2
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 3
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 4
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 5
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 6
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:33 [TestFile:83]-[INFO] Parameterized Number is : 7
2022-03-22 18:55:33 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:33 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 8
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 9
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 10
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 11
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 12
```

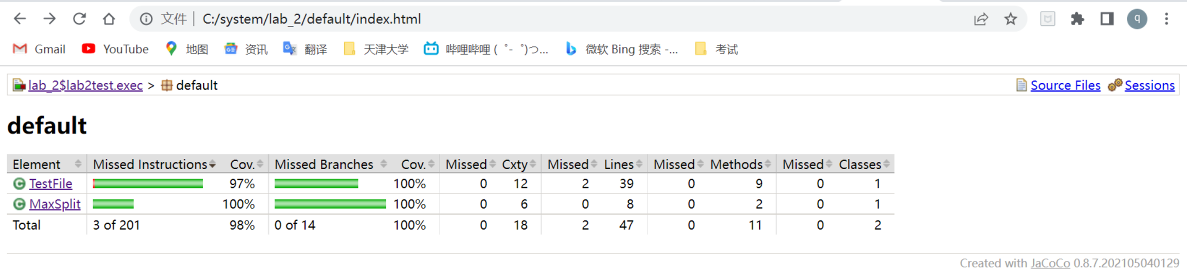
```
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 13
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 14
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 15
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 16
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 17
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 18
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 19
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 20
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 21
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 22
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 23
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 24
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 25
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 26
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 27
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 28
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 29
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 30
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 31
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
```

```
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 32
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 33
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 34
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 35
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 36
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 37
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 38
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 39
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 40
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 41
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 42
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 43
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 44
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 45
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 46
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 47
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 48
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 49
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 50
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
```

```
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 51
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 52
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 53
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 54
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:30]-[INFO] set up ok
2022-03-22 18:55:34 [TestFile:83]-[INFO] Parameterized Number is : 55
2022-03-22 18:55:34 [TestFile:89]-[INFO] after each test
2022-03-22 18:55:34 [TestFile:92]-[INFO] after class ok

```

覆盖测试截图

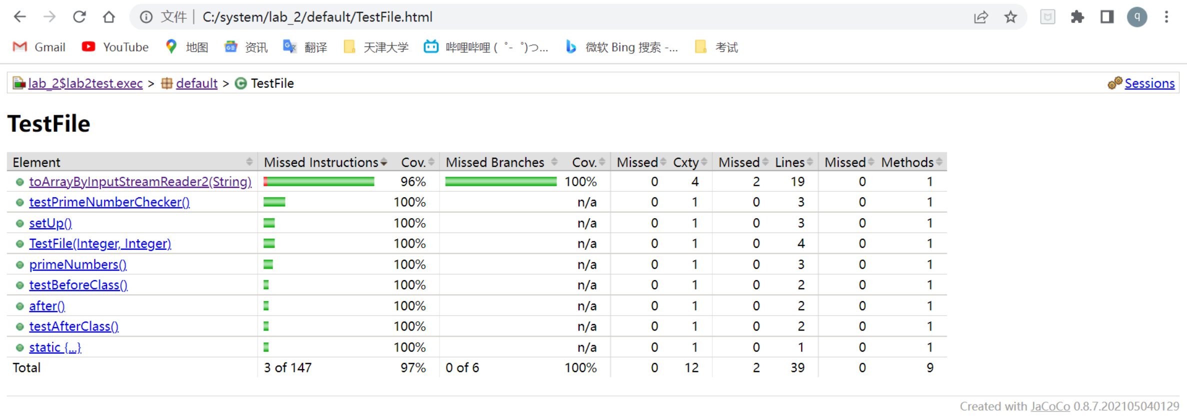


lab_2$lab2test.exec > default

default

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods	Missed	Classes
TestFile		97%		100%	0	12	2	39	0	9	0	1
MaxSplit		100%		100%	0	6	0	8	0	2	0	1
Total	3 of 201	98%	0 of 14	100%	0	18	2	47	0	11	0	2

Created with JaCoCo 0.8.7.202105040129

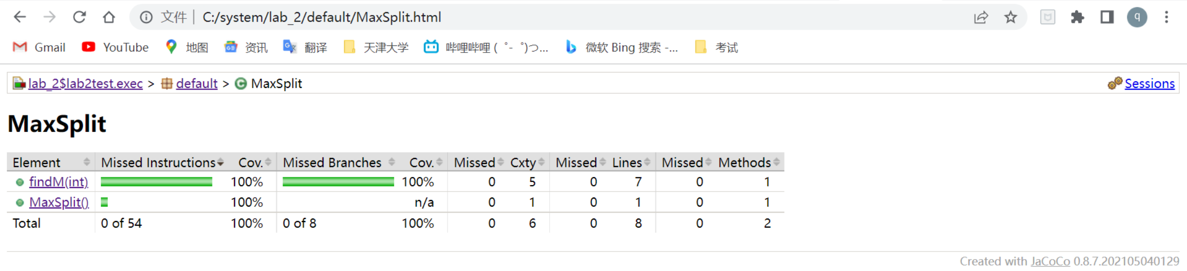


lab_2$lab2test.exec > default > TestFile

TestFile

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods
toArrayByInputStreamReader2(String)		96%		100%	0	4	2	19	0	1
testPrimeNumberChecker()		100%		n/a	0	1	0	3	0	1
setUp()		100%		n/a	0	1	0	3	0	1
TestFile(Integer, Integer)		100%		n/a	0	1	0	4	0	1
primeNumbers()		100%		n/a	0	1	0	3	0	1
testBeforeClass()		100%		n/a	0	1	0	2	0	1
after()		100%		n/a	0	1	0	2	0	1
testAfterClass()		100%		n/a	0	1	0	2	0	1
static {...}		100%		n/a	0	1	0	1	0	1
Total	3 of 147	97%	0 of 6	100%	0	12	2	39	0	9

Created with JaCoCo 0.8.7.202105040129



lab_2$lab2test.exec > default > MaxSplit

MaxSplit

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods
findM(int)		100%		100%	0	5	0	7	0	1
MaxSplit()		100%		n/a	0	1	0	1	0	1
Total	0 of 54	100%	0 of 8	100%	0	6	0	8	0	2

Created with JaCoCo 0.8.7.202105040129

4. Source code

MaxSplit.java

```java
public class MaxSplit {

    public static int findM(int n)  {
        int[] memo = new int[n+1];
        if (n == 2|| n== 1)
```

```java
            return 1;
        for (int i = 3 ;i<=n;i++) {
            for (int j = 2; j<i;j++) {
                memo[i] = Math.max(Math.max(memo[i], j * (i-j)), j * memo[i-j]);
            }
        }
        return memo[n];
    }


}

```

TestFile.java

```java
import org.junit.runners.Parameterized;

import java.io.*;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Collection;

@RunWith(Parameterized.class)
public class TestFile {

    private final Integer inputNumber;
    private final Integer expectedResult;
    private static Logger logger = Logger.getLogger(TestFile.class);
    private MaxSplit maxSplit;

    @BeforeClass
    public static void testBeforeClass(){

        logger.info("before class ok");
//          System.out.println("before class ok");

    }

    @Before
    public void setUp(){
        maxSplit = new MaxSplit();
        logger.info("set up ok");
    }

    public TestFile(Integer inputNumber, Integer expectedResult) {
        this.inputNumber = inputNumber;
        this.expectedResult = expectedResult;
    }

    //读取文件
    public static Object[][] toArrayByInputStreamReader2(String name) {
        // 使用ArrayList来存储每行读取到的字符串

        ArrayList<String> arrayList = new ArrayList<>();
        try {
            File file = new File(name);
```

```
            InputStreamReader input = new InputStreamReader(new FileInputStream(file));
            BufferedReader bf = new BufferedReader(input);
            // 按行读取字符串
            String str;
            while ((str = bf.readLine()) != null) {
                arrayList.add(str);
            }
            bf.close();
            input.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
        // 对ArrayList中存储的字符串进行处理
        int length = arrayList.size();
        int width = arrayList.get(0).split(",").length;
        Object[][] array = new Object[length][width];
        for (int i = 0; i < length; i++) {
            for (int j = 0; j < width; j++) {
                String s = arrayList.get(i).split(",")[j];
                array[i][j] = Integer.parseInt(s);
            }
        }
        // 返回数组
        return array;
    }

    @Parameterized.Parameters
    public static Collection primeNumbers() {
//        File filename = new File(path);
        Object[][] array ;
        String path = "C:\\system\\lab_2\\src\\testinput.txt";
        array =  TestFile.toArrayByInputStreamReader2(path);
        return Arrays.asList(array);
    }

    @Test
    public void testPrimeNumberChecker() {

        logger.info("Parameterized Number is : " + inputNumber);
        Assert.assertEquals(expectedResult, (Integer) maxSplit.findM(inputNumber));
    }

    @After
    public void after(){
        logger.info("after each test");
    }
    @AfterClass
    public static void testAfterClass(){logger.info("after class ok");
    }


}

```