Question 1.

实验二 Junit+eclemma+ant自动化测试

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一、实验目的

1) 掌握Junit的安装及其与Eclipse的集成。
2) 利用Junit进行单元测试。
3) 掌握Junit中常用annotation：@Before、@After、@Test、@Ignore、@BeforeClass、@AfterClass的用法，了解
4) 掌握Junit中套件测试和参数化测试的方法。
5) 掌握Eclemma的安装和使用。
6) 基于Eclemma的覆盖率测试对Junit单元测试覆盖分析，提升测试质量。
7) 利用Ant进行自动化测试的配置和执行

二、实验步骤

1. Junit的安装及其与Eclipse的集成。

(两种方法，(1)-(3)本地安装，(4)Eclipse集成安装)

(1)从Download Junit下载Junit压缩包，把Junit压缩包解压到一个物理路径

(2)记录Junit4.10.jar文件所在目录。

(3)设置环境变量CLASS_PATH。

(4)在Eclipse菜单“project”的子项“properties”中选择“Java Build Path”，单击“Libraries”标签，添加JAR，即选择junit.jar或
4.10.jar，单击打开，就完成了Junit的安装。

2. Junit单元测试

1. 实习题一

利用Junit Test Case生成测试用例的框架，在框架中设计测试代码，完成对下面类Practice_1中common_divisor，comm

```java
package pkg;


/**
 * @author pprp
 * @category 求解最大公约数和最小公倍数以及查找功能
 */
public class Practice_1 {
    public int common_divisor(int a, int b) { // 求最大公约数
        int c, r;
        if (a < b) {
            c = a;
            a = b;
            b = c;
        }
        r = 1;
        while (r != 0) {
            r = a % b;
            a = b;
            b = r;
        }
        return a;
    }

    public int common_multiple(int a, int b) { // 最小公倍数
        return a * b / common_divisor(a, b);
    }

    public boolean seek_1(int[] a, int x) { // 查找
        boolean flag = false;
        for (int i = 0; i < a.length; i++) {
            if (x == a[i])
            flag = true;
        }
        return flag;
    }

    public static void main(String arg[]) { // 主函数
        int b[] = { 10, 20, 15, 30, 25, 40, 35, 50 };
        int x, y, k;
        x = 12;
        y = 6;
        k = 40;
        Practice_1 a = new Practice_1();
        System.out.println("最大公约数为：" + a.common_divisor(x, y));
        System.out.println("最小公倍数为：" + a.common_multiple(x, y));
        System.out.println("查找结果为：" + a.seek_1(b, k));
    }
}
```

测试类：

```
package pkg;

import static org.junit.Assert.*;

import org.junit.AfterClass;
import org.junit.BeforeClass;
import org.junit.Test;

/**
 * @author pprp
 * @category 对Practice_1进行测试
 */
public class Practice_1Test {
    private static Practice_1 test1 = null;
    private static int num1;
    private static int num2;
    private static int arr[] = {1,4,3,2,5,4,55,3,22,44,77,100,22,43,21,55,24,126,4,3,4,2,4,23,4,234,23,42342,3423,2,544,46
    private static int find;
    @BeforeClass
    public static void setUpBeforeClass() throws Exception {
        test1 = new Practice_1();
        num1 = 12;
        num2 = 6;
        find = 55;
    }

    @AfterClass
    public static void tearDownAfterClass() throws Exception {

    }
    @Test
    public void testcommon_multiple() {
        assertEquals(12,test1.common_multiple(num1, num2));
    }

    @Test
    public void testcommon_divisor() {
        assertEquals(6,test1.common_divisor(num1,num2));
    }

    @Test
    public void testseek_1() {
        assertTrue(test1.seek_1(arr, find));
    }
}
```

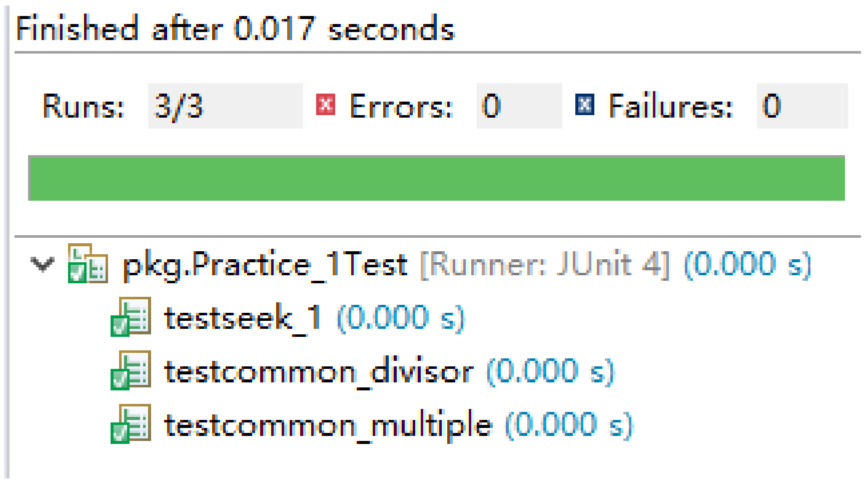
测试结果：

2. 实习题二

设计判断一个数是不是素数的程序，用基本断言类型实现测试，并用setup()初始化测试环境。参数化测试数据，并用Su

判断素数类：

```
package pkg2;

/**
 * @author pprp
```



```
Finished after 0.017 seconds
Runs: 3/3    Errors: 0    Failures: 0

pkg.Practice_1Test [Runner: JUnit 4] (0.000 s)
    testseek_1 (0.000 s)
    testcommon_divisor (0.000 s)
    testcommon_multiple (0.000 s)
```

Figure 1: 1557386857969

```
 * @category 判断一个证书是否为素数
 */
public class Prime {

    public boolean isPrime(int num) {
        for (int i = 2; i < num; i++) {
            if (num % i == 0) {
                return false;
            }
        }
        return true;
    }

    public static void main(String[] args) {
        Prime a = new Prime();
        System.out.println(a.isPrime(9));
    }
}
```

测试类：

```
package pkg2;
```

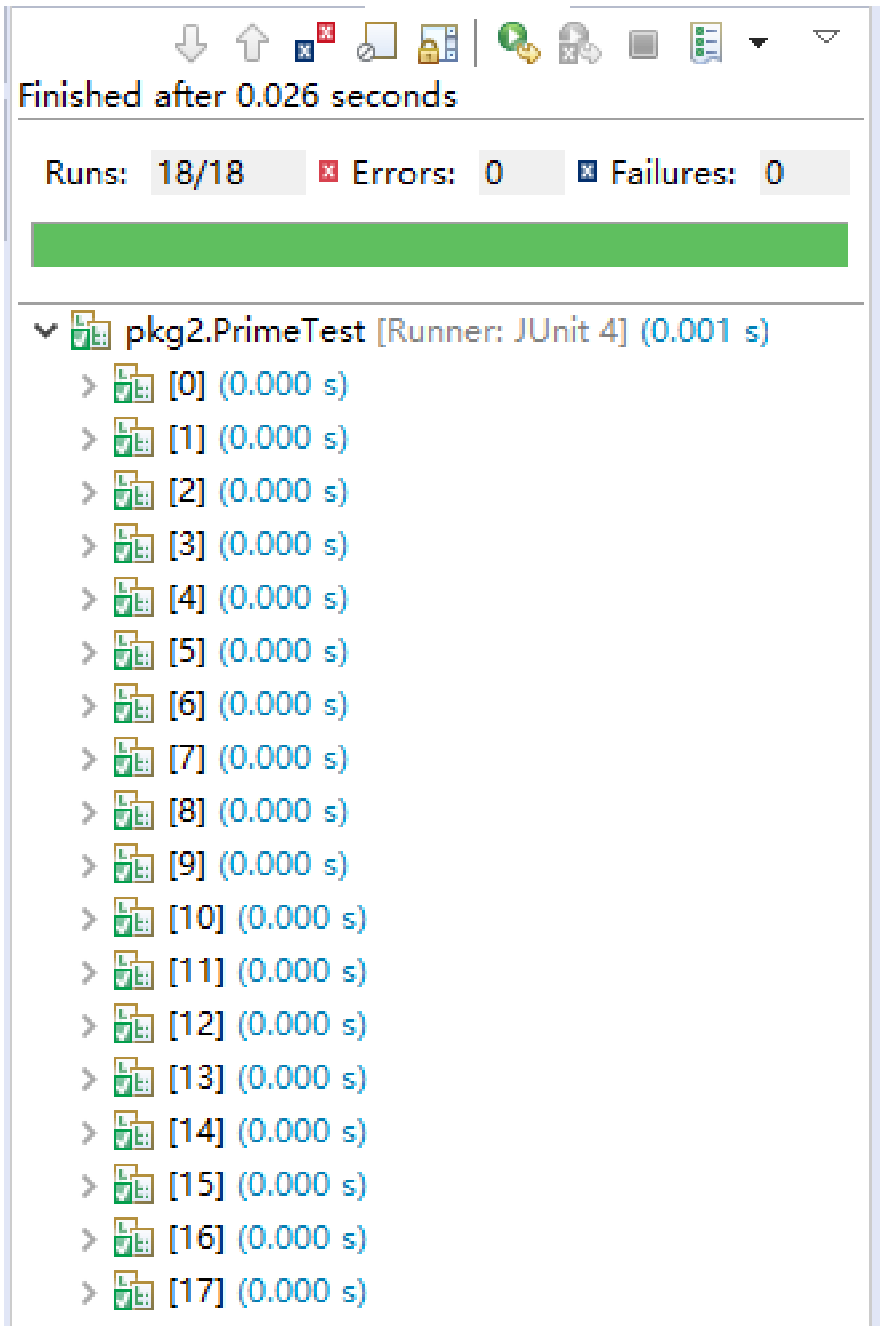
```
import static org.junit.Assert.*;

import java.util.Arrays;
import java.util.Collection;

import org.junit.After;
import org.junit.Before;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.junit.runners.Parameterized;
import org.junit.runners.Parameterized.Parameters;

/**
 * @author pprp
 * @category 参数化测试，测试素数
 */
@RunWith(Parameterized.class)
public class PrimeTest {

    private Prime test2;
    private int input;
    private boolean output;

    @Before
    public void setUp() throws Exception {
        test2 = new Prime();
    }

    @After
    public void tearDown() throws Exception {

    }

    @Parameters
    public static Collection<Object[]> data() {
        Object[][] object = { { 3, true }, { 7, true },{ 4, false },
         { 5, true },{ 8, false },{6, false },
         { 9, false },{ 10, false },{ 11, true },
        { 12, false },{ 13, true },{ 14, false },
        { 42, false },{ 41, true },{ 631, true },
        { 247, false },{ 996, false },{ 96, false }};
        return Arrays.asList(object);
    }

    public PrimeTest(int intput, boolean output) {
        this.input = intput;
        this.output = output;
    }

    @Test
    public void testisPrime() {
        assertEquals(output, test2.isPrime(input));
    }

}
```

测试结果：

使用Suite对以上两个测试类进行测试：

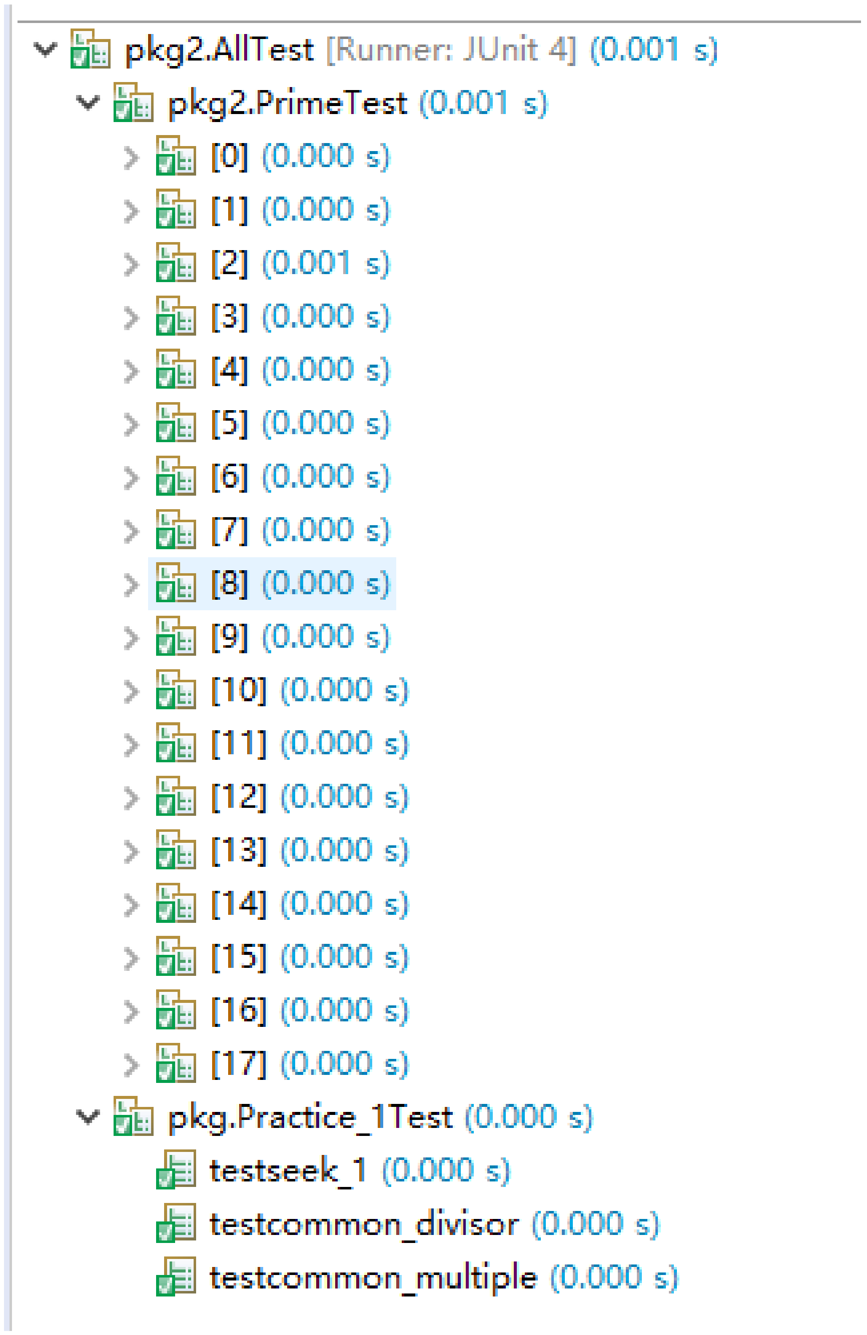
```
package pkg2;

import org.junit.runner.RunWith;
import org.junit.runners.Suite;
import org.junit.runners.Suite.SuiteClasses;

/**
 * @author pprp
 * @category 使用Suite进行批量测试，此处测试Practice_1和Prime的测试类
 */
@RunWith(Suite.class)
@SuiteClasses({PrimeTest.class,pkg.Practice_1Test.class})
public class AllTest {

}
```

测试结果为：



```
Finished after 0.026 seconds
Runs: 18/18   Errors: 0   Failures: 0

pkg2.PrimeTest [Runner: JUnit 4] (0.001 s)
    [0] (0.000 s)
    [1] (0.000 s)
    [2] (0.000 s)
    [3] (0.000 s)
    [4] (0.000 s)
    [5] (0.000 s)
    [6] (0.000 s)
    [7] (0.000 s)
    [8] (0.000 s)
    [9] (0.000 s)
    [10] (0.000 s)
    [11] (0.000 s)
    [12] (0.000 s)
    [13] (0.000 s)
    [14] (0.000 s)
    [15] (0.000 s)
    [16] (0.000 s)
    [17] (0.000 s)
```

Figure 2: 1557387035056



```
pkg2.AllTest [Runner: JUnit 4] (0.001 s)
  pkg2.PrimeTest (0.001 s)
    [0] (0.000 s)
    [1] (0.000 s)
    [2] (0.001 s)
    [3] (0.000 s)
    [4] (0.000 s)
    [5] (0.000 s)
    [6] (0.000 s)
    [7] (0.000 s)
    [8] (0.000 s)
    [9] (0.000 s)
    [10] (0.000 s)
    [11] (0.000 s)
    [12] (0.000 s)
    [13] (0.000 s)
    [14] (0.000 s)
    [15] (0.000 s)
    [16] (0.000 s)
    [17] (0.000 s)
  pkg.Practice_1Test (0.000 s)
    testseek_1 (0.000 s)
    testcommon_divisor (0.000 s)
    testcommon_multiple (0.000 s)
```

Figure 3: 1557387103442

3. 实习题三

下面是使用BitSet来跟踪一年中的那些天是节假日的程序。

```java
package pkg3;

import java.util.BitSet;

/**
 * @author pprp
 * @category 判断一个数是否存在于这个列表
 */
public class HolidaySked {
    BitSet sked;

    public HolidaySked() {
        sked = new BitSet(365);
        int[] holiday = { 1, 20, 43, 48, 53, 115, 131, 146, 165, 166, 185, 244, 286, 315, 327, 359 };
        // 集合中假日是随机设定的，可根据今年的情况自行调整
        for (int i = 0; i < holiday.length; i++) {
            addHoliday(holiday[i]);
        }
    }

    public void addHoliday(int daytoAdd) {
        sked.set(daytoAdd);
    }

    public boolean isHoliday(int dayToCheck) {
        boolean result = sked.get(dayToCheck);
        return result;
    }

    public static void main(String[] arguments) {
        HolidaySked cal = new HolidaySked();
        if (arguments.length > 0) {
            try {
                int whichDay = Integer.parseInt(arguments[0]);
                if (cal.isHoliday(whichDay)) {
```

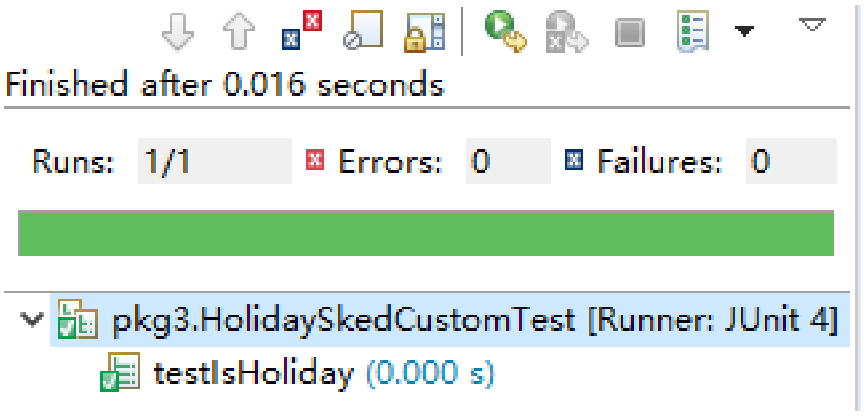
```
                System.out.println(whichDay + "is a holiday.");
            } else {
                System.out.println(whichDay + "is not a holiday.");
            }

        } catch (NumberFormatException nfe) {
            System.out.println("Error: " + nfe.getMessage());
        }
    }
  }
}
```

(1) 请用TestCase方法对程序中的isHoliday()方法进行Junit测试；

```
package pkg3;

import junit.framework.TestCase;

/**
 * @author pprp
 * @category 用TestCase方法对程序中的isHoliday()方法进行Junit测试
 */
public class HolidaySkedCustomTest extends TestCase {
    private HolidaySked cal;
    private int whichDay = 12;

    public void testIsHoliday() {
        cal = new HolidaySked();
        try {
            if (cal.isHoliday(whichDay)) {
                System.out.println(whichDay + "is a holiday.");
            } else {
                System.out.println(whichDay + "is not a holiday.");
            }

        } catch (NumberFormatException nfe) {
            System.out.println("Error: " + nfe.getMessage());
        }
    }
```

}

测试结果：



Finished after 0.016 seconds

Runs: 1/1 Errors: 0 Failures: 0

pkg3.HolidaySkedCustomTest [Runner: JUnit 4]
testIsHoliday (0.000 s)

Figure 4: 1557387228219

(2) 用参数化的方法重新设计本题和实验题1的测试用例。

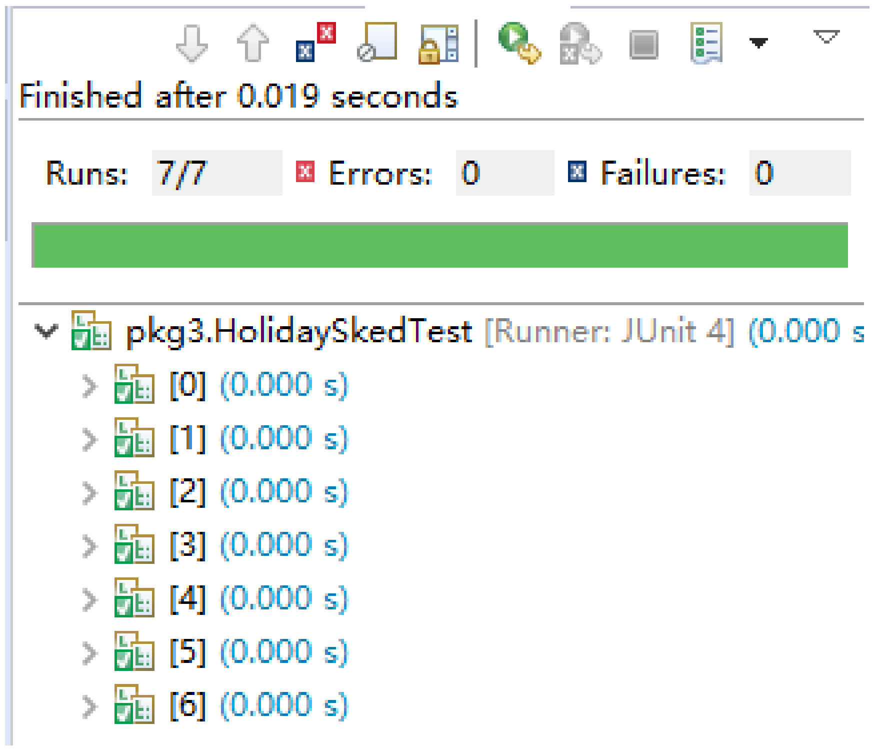
本题测试用例：

```
package pkg3;

import static org.junit.Assert.*;

import java.util.Arrays;
import java.util.Collection;

import org.junit.Test;
import org.junit.runner.RunWith;
import org.junit.runners.Parameterized;
import org.junit.runners.Parameterized.Parameters;

/**
 * @author pprp
 * @category 用参数化方法进行测试
 */
@RunWith(Parameterized.class)
public class HolidaySkedTest {
    private int whichday;
    private boolean judge;

    private HolidaySked hs;
    public HolidaySkedTest(int day,boolean judge)
    {
        this.whichday = day;
        this.judge = judge;
        hs = new HolidaySked();
    }

    @Test
    public void test() {
        assertEquals(judge,hs.isHoliday(whichday));
    }
    @Parameters
    public static Collection<Object[]> data() {//1, 20, 43
        Object[][] object = { { 1, true }, { 7, false },{ 4, false },
                              { 20, true },{ 8, false },{6, false }, {43,true}};
        return Arrays.asList(object);
    }
}
```

实验1测试用例：(由于参数的异构，所以需要分为两个部分进行测试)

第一部分：最大公约数和最小公倍数

```
package pkg3;



import static org.junit.Assert.assertEquals;

import java.util.Arrays;
import java.util.Collection;
import org.junit.After;
import org.junit.Before;
import org.junit.Test;
import org.junit.runner.RunWith;
```


Finished after 0.019 seconds

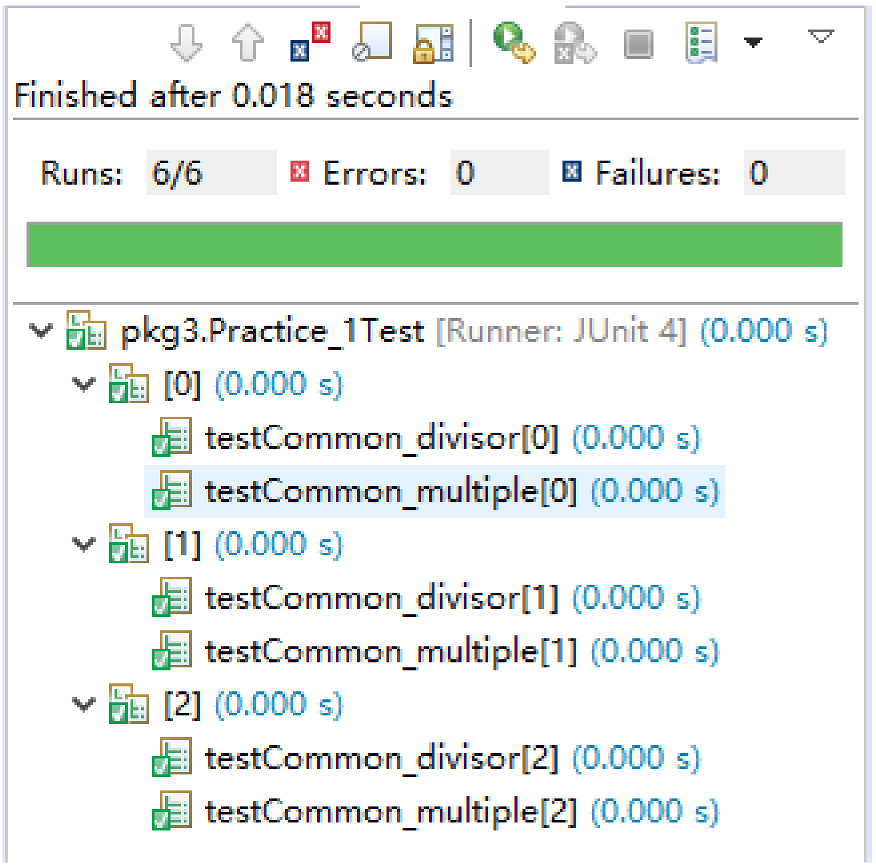
Runs: 7/7 Errors: 0 Failures: 0

pkg3.HolidaySkedTest [Runner: JUnit 4] (0.000 s
[0] (0.000 s)
[1] (0.000 s)
[2] (0.000 s)
[3] (0.000 s)
[4] (0.000 s)
[5] (0.000 s)
[6] (0.000 s)

Figure 5: 1557387644744

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

import pkg.Practice_1;

/**
 * @author PC
 * @category 主要用来测试common_multiple 和 common_divisor 两个方法,用参数化的方法重新设计本题
 */

@RunWith(Parameterized.class)
public class Practice_1Test {
    private Practice_1 test2;
    private int num1, num2;
    private int output1,output2; // multiple 公倍数 and divisor 公约数

    public Practice_1Test(int num1, int num2,int output1,int output2)
    {
        this.num1 = num1;
        this.num2 = num2;
        this.output1 = output1;
        this.output2 = output2;
    }

    @Parameters
    public static Collection<Object[]> data() {
        Object[][] object = { { 6,12,12,6 }, { 3,4,12,1 },{ 6,8,24,2 }};
        return Arrays.asList(object);
    }

    @Before
    public void setUp() throws Exception {
        test2 = new Practice_1();
    }

    @After
    public void tearDown() throws Exception {
    }
    @Test
    public void testCommon_divisor() {
        assertEquals(output2,test2.common_divisor(num1, num2));
    }

    @Test
    public void testCommon_multiple() {
        assertEquals(output1,test2.common_multiple(num1, num2));
    }
}
```

测试结果：



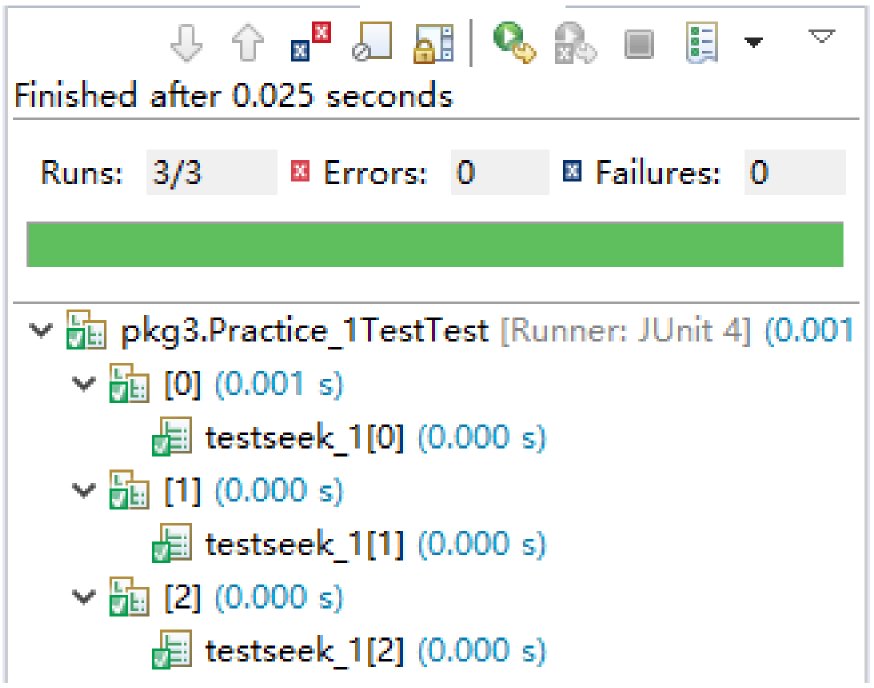
```
Finished after 0.018 seconds

Runs: 6/6    Errors: 0    Failures: 0

pkg3.Practice_1Test [Runner: JUnit 4] (0.000 s)
    [0] (0.000 s)
        testCommon_divisor[0] (0.000 s)
        testCommon_multiple[0] (0.000 s)
    [1] (0.000 s)
        testCommon_divisor[1] (0.000 s)
        testCommon_multiple[1] (0.000 s)
    [2] (0.000 s)
        testCommon_divisor[2] (0.000 s)
        testCommon_multiple[2] (0.000 s)
```

Figure 6: 1557387755721

第二部分：查找功能

```
package pkg3;

import static org.junit.Assert.*;

import java.util.Arrays;
import java.util.Collection;

import org.junit.After;
import org.junit.Before;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.junit.runners.Parameterized;
import org.junit.runners.Parameterized.Parameters;

import pkg.Practice_1;

@RunWith(Parameterized.class)
public class Practice_1TestTest {
    private int arr[] = {1,2,3, 22,44,66, 345,765,432, 1234,6435,7544,8654};
    private int input;
    private Practice_1 test3;

    public Practice_1TestTest(int input) {
        this.input = input;
    }
    @Parameters
    public static Collection<Object[]> data() {
        Object[][] object = {
                { 3 },
                { 22 },
                { 345 }};
        return Arrays.asList(object);
    }
    @Before
    public void setUp() throws Exception {
        test3 = new Practice_1();
    }

    @After
    public void tearDown() throws Exception {
    }

    @Test
    public void testseek_1() {
        assertTrue(test3.seek_1(arr, input));
    }
}
```

测试结果：



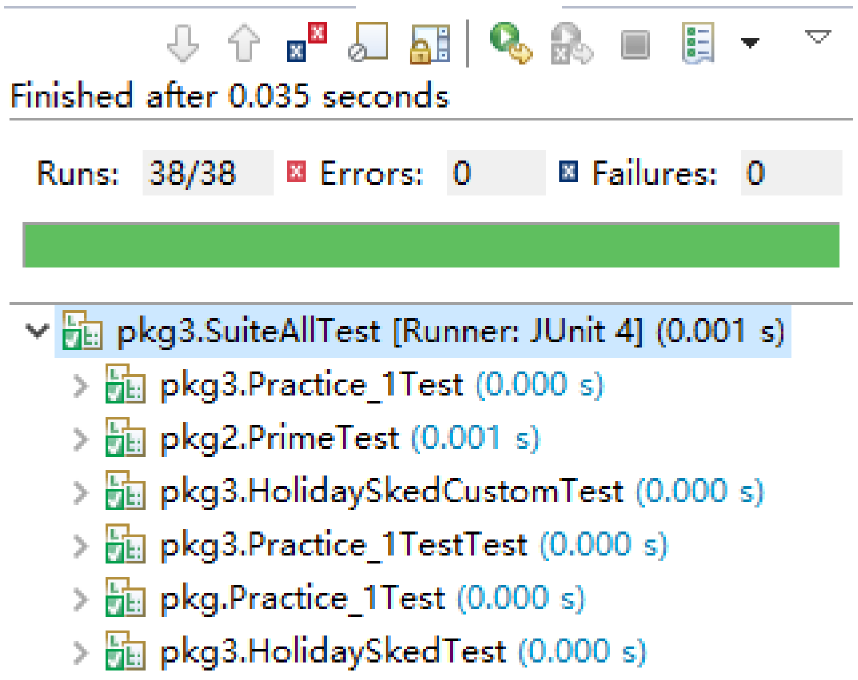
```
Finished after 0.025 seconds

Runs: 3/3    Errors: 0    Failures: 0

pkg3.Practice_1TestTest [Runner: JUnit 4] (0.001
  [0] (0.001 s)
    testseek_1[0] (0.000 s)
  [1] (0.000 s)
    testseek_1[1] (0.000 s)
  [2] (0.000 s)
    testseek_1[2] (0.000 s)
```

Figure 7: 1557387795760

(3)再用Suite方法对实验1-3的所有单个测试类组装进行套件测试。

```
package pkg3;

import org.junit.runner.RunWith;
import org.junit.runners.Suite;
import org.junit.runners.Suite.SuiteClasses;

import pkg2.PrimeTest;

@RunWith(Suite.class)
@SuiteClasses({Practice_1Test.class,
        PrimeTest.class,
        HolidaySkedCustomTest.class,
        Practice_1TestTest.class,
        pkg.Practice_1Test.class,
        HolidaySkedTest.class})
public class SuiteAllTest {

}
```

测试结果：

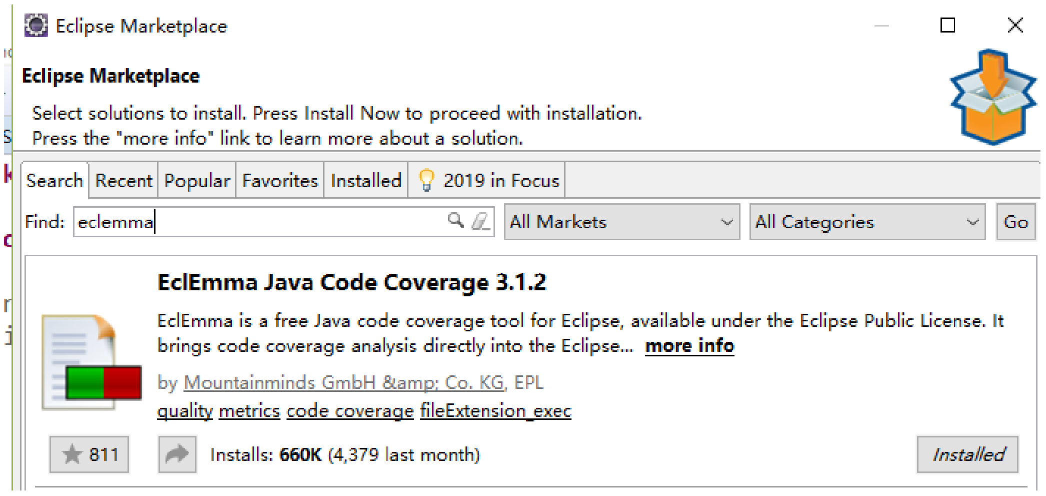


```
Finished after 0.035 seconds

Runs: 38/38    Errors: 0    Failures: 0

pkg3.SuiteAllTest [Runner: JUnit 4] (0.001 s)
    pkg3.Practice_1Test (0.000 s)
    pkg2.PrimeTest (0.001 s)
    pkg3.HolidaySkedCustomTest (0.000 s)
    pkg3.Practice_1TestTest (0.000 s)
    pkg.Practice_1Test (0.000 s)
    pkg3.HolidaySkedTest (0.000 s)
```

Figure 8: 1557387868226

4. 实习题四

对课本P56页的示例程序利用语句覆盖、判定-条件覆盖、条件组合及路径覆盖的角度分别设计测试用例进行自动化测试



Eclipse Marketplace

Eclipse Marketplace

Select solutions to install. Press Install Now to proceed with installation.
Press the "more info" link to learn more about a solution.

Find: eclemma | All Markets | All Categories | Go

EclEmma Java Code Coverage 3.1.2

EclEmma is a free Java code coverage tool for Eclipse, available under the Eclipse Public License. It brings code coverage analysis directly into the Eclipse... **more info**

by Mountainminds GmbH &amp; Co. KG, EPL

quality metrics code coverage fileExtension_exec

811 Installs: **660K** (4,379 last month) *Installed*

Figure 9: 1557973897890

已安装好Eclemma

IMG_20190516_110655

5. 实习题五

针对静态测试试验中选择排序，三角形问题，隔一日问题的代码，或者自己开发实现的综合性Java项目，在所学测试方

针对每一个类使用Junit进行自动化测试，然后使用Suite方法调用所有单个测试类，以下是执行的结果：

代码见附件

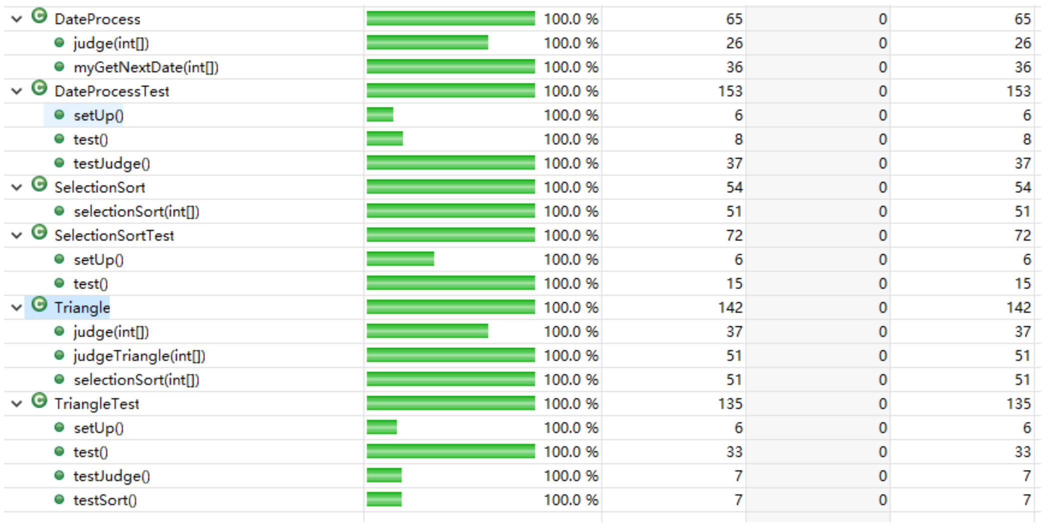
6. 实习题六

针对实验5的Java项目，利用ant结合junit进行自动化测试构建运行。

通过使用export将build.xml文件生成，然后运行即可。

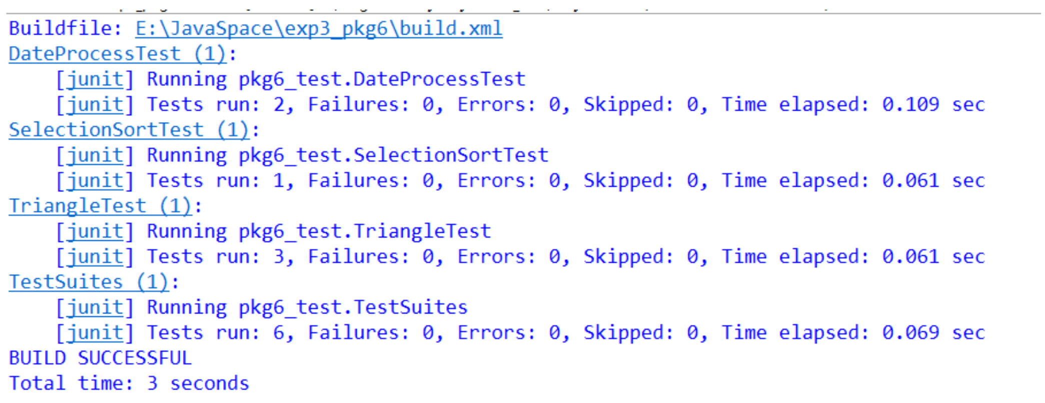
在这个过程中遇到了一个比较大的问题，一开始将这些文件组织到一个新的工程中的时候，选择将其复制到工程中，然

二、实验步骤



DateProcess	100.0 %	65	0	65
judge(int[])	100.0 %	26	0	26
myGetNextDate(int[])	100.0 %	36	0	36
DateProcessTest	100.0 %	153	0	153
setUp()	100.0 %	6	0	6
test()	100.0 %	8	0	8
testJudge()	100.0 %	37	0	37
SelectionSort	100.0 %	54	0	54
selectionSort(int[])	100.0 %	51	0	51
SelectionSortTest	100.0 %	72	0	72
setUp()	100.0 %	6	0	6
test()	100.0 %	15	0	15
Triangle	100.0 %	142	0	142
judge(int[])	100.0 %	37	0	37
judgeTriangle(int[])	100.0 %	51	0	51
selectionSort(int[])	100.0 %	51	0	51
TriangleTest	100.0 %	135	0	135
setUp()	100.0 %	6	0	6
test()	100.0 %	33	0	33
testJudge()	100.0 %	7	0	7
testSort()	100.0 %	7	0	7

Figure 10: 1558599502366



```
Buildfile: E:\JavaSpace\exp3_pkg6\build.xml
DateProcessTest (1):
    [junit] Running pkg6_test.DateProcessTest
    [junit] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.109 sec
SelectionSortTest (1):
    [junit] Running pkg6_test.SelectionSortTest
    [junit] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.061 sec
TriangleTest (1):
    [junit] Running pkg6_test.TriangleTest
    [junit] Tests run: 3, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.061 sec
TestSuites (1):
    [junit] Running pkg6_test.TestSuites
    [junit] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.069 sec
BUILD SUCCESSFUL
Total time: 3 seconds
```

Figure 11: 1558605140118

三、 总结

本次实习经历的时间比较长，前半部分做的比较快，后半部分由于一些环境配置还有其他奇奇怪怪的原因导致了代码无