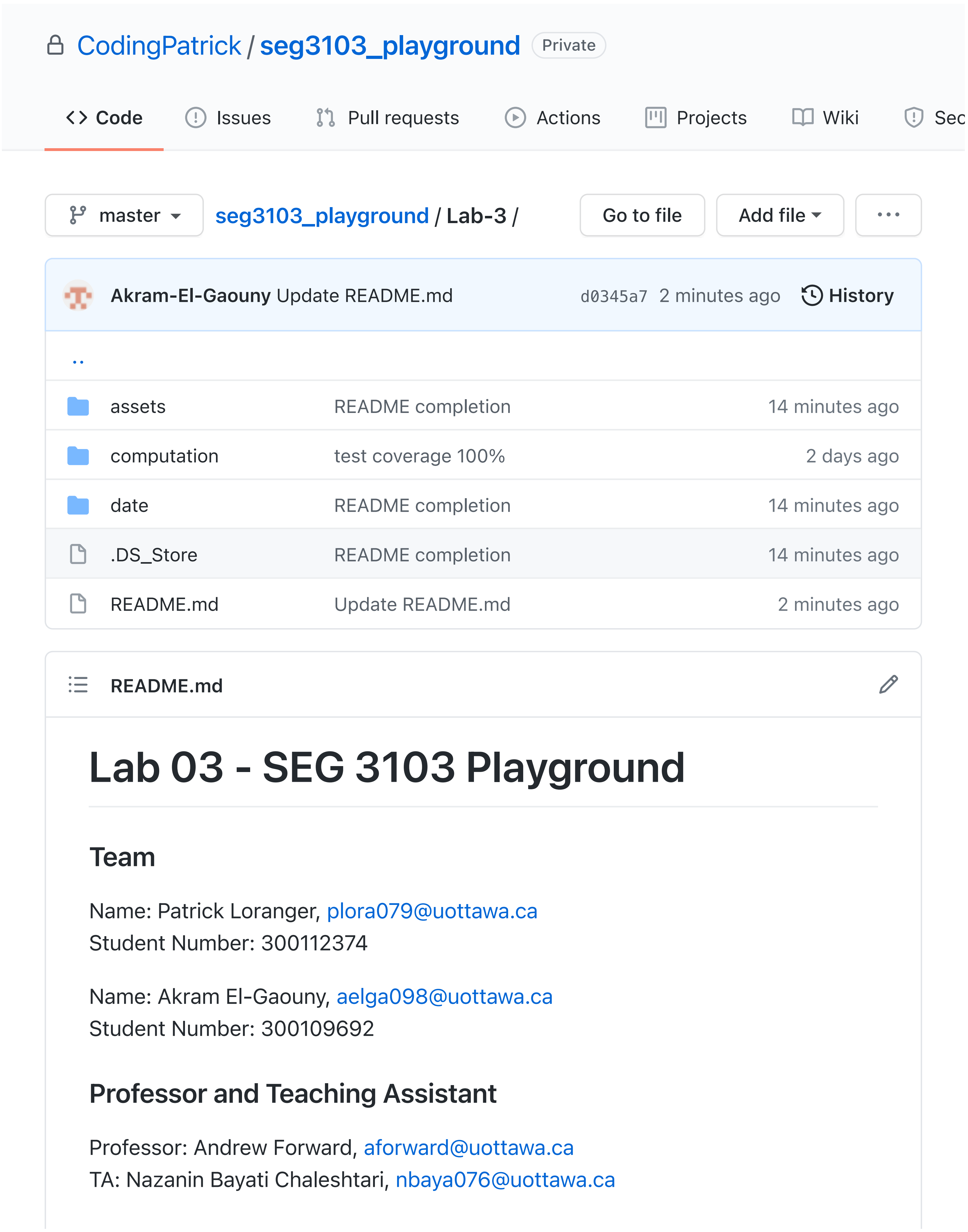

CodingPatrick / **seg3103_playground** Private

seg3103_playground / Lab-3 /

Akram-El-Gaouny Update README.md d0345a7 2 minutes ago **History**

..

assets	README completion	14 minutes ago
computation	test coverage 100%	2 days ago
date	README completion	14 minutes ago
.DS_Store	README completion	14 minutes ago
README.md	Update README.md	2 minutes ago

README.md

Lab 03 - SEG 3103 Playground

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Course: SEG 3103
Date: Thursday June 3, 2021

Link for deliverable

- https://github.com/CodingPatrick/seg3103_playground
- The pdf file of the screencapture is found in the submission folder in Brightspace

Exercise 1 - Computation

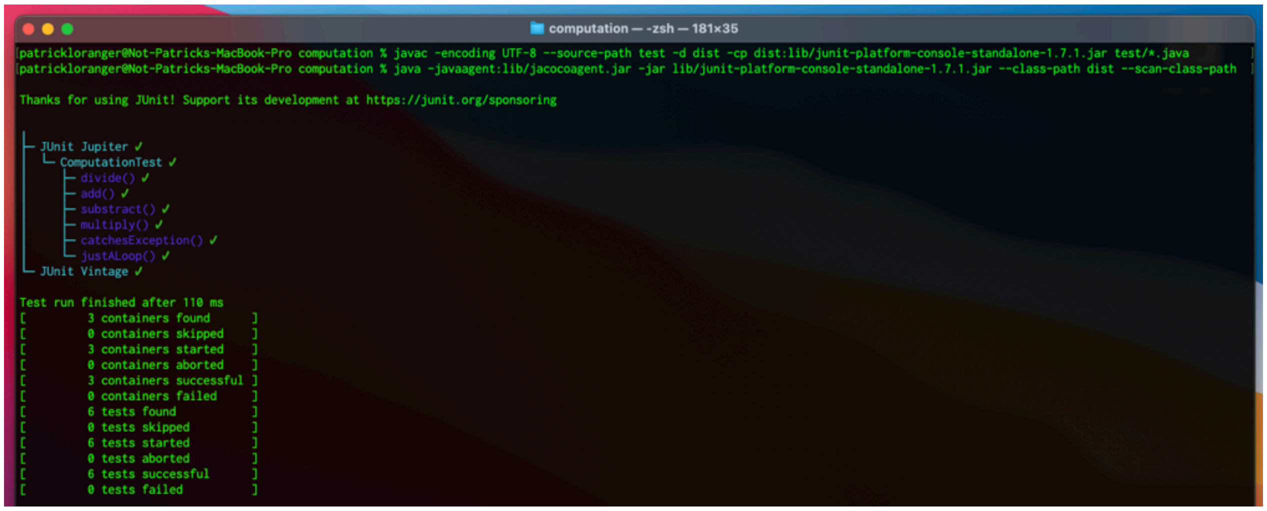
First we compile run the tests in the computation folder using these command lines:

```
javac -encoding UTF-8 --source-path src -d dist src/*.java
```

```
javac -encoding UTF-8 --source-path test -d dist -cp dist:lib/junit-
```

```
java -javaagent:lib/jacocoagent.jar -jar lib/junit-platform-console-
```

Here is a screenshot of the terminal after running the tests with the command lines:



```
patrickloranger@Not-Patricks-MacBook-Pro computation % javac -encoding UTF-8 --source-path test -d dist -cp dist:lib/junit-platform-console-standalone-1.7.1.jar test/*.java
patrickloranger@Not-Patricks-MacBook-Pro computation % java -javaagent:lib/jacocoagent.jar -jar lib/junit-platform-console-standalone-1.7.1.jar --class-path dist --scan-class-path

Thanks for using JUnit! Support its development at https://junit.org/sponsoring

│
├─ JUnit Jupiter ✓
│  └─ ComputationTest ✓
│     ├─ divide() ✓
│     ├─ add() ✓
│     ├─ substract() ✓
│     ├─ multiply() ✓
│     ├─ catchesException() ✓
│     └─ justALoop() ✓
└─ JUnit Vintage ✓

Test run finished after 110 ms
[         3 containers found      ]
[         0 containers skipped    ]
[         3 containers started    ]
[         0 containers aborted    ]
[         3 containers successful ]
[         0 containers failed     ]
[         6 tests found           ]
[         0 tests skipped         ]
[         6 tests started         ]
[         0 tests aborted         ]
[         6 tests successful      ]
[         0 tests failed          ]
```

Here is the text output of the screenshot above (for clarity purposes)

```
Thanks for using JUnit! Support its development at https://junit.org
```

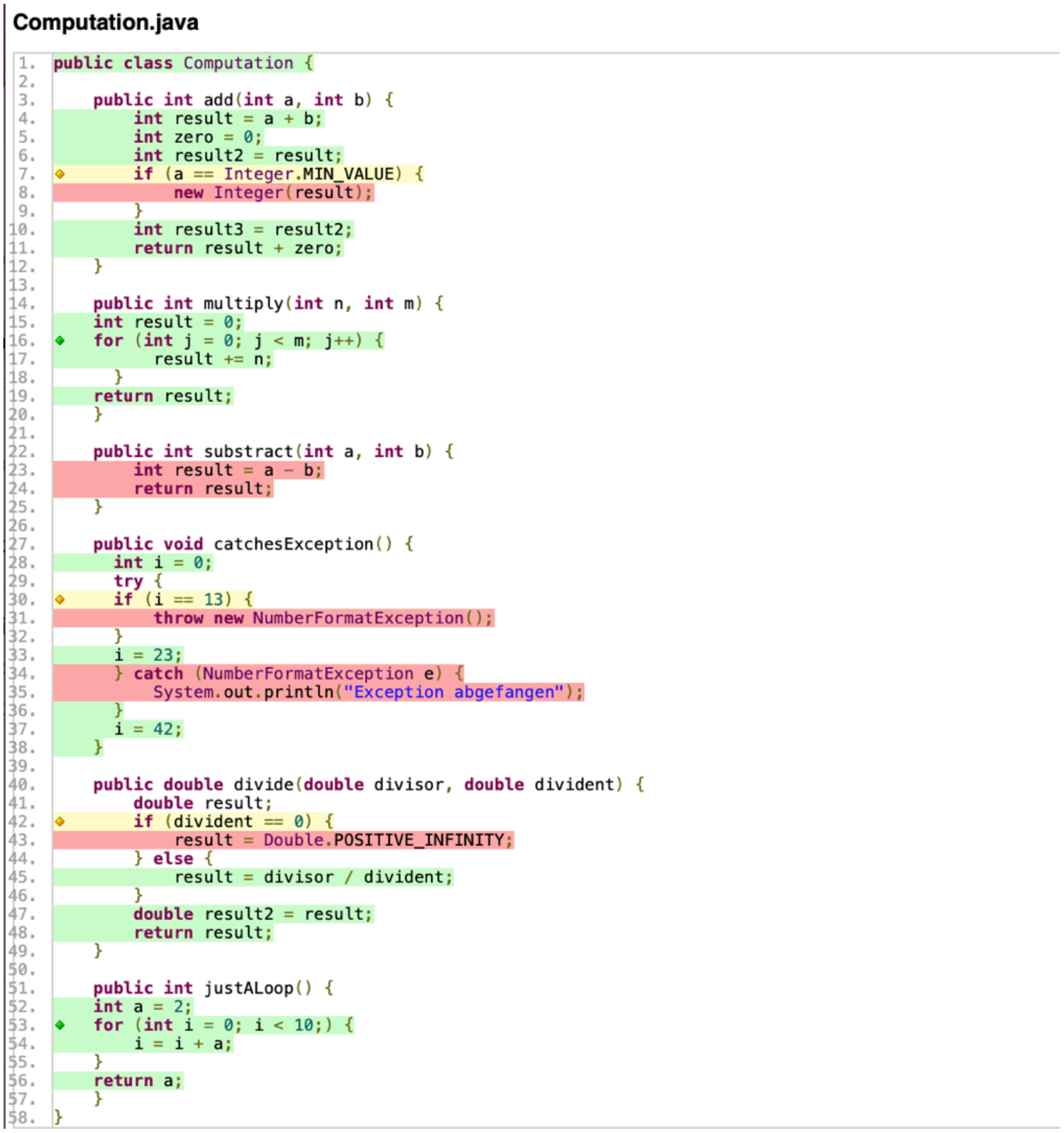
```
╷
├─ JUnit Jupiter ✔
│  └─ ComputationTest ✔
│     ├─ divide() ✔
│     ├─ add() ✔
│     ├─ substract() ✔
│     ├─ multiply() ✔
│     ├─ catchesException() ✔
│     └─ justALoop() ✔
└─ JUnit Vintage ✔

Test run finished after 110 ms
[         3 containers found      ]
[         0 containers skipped    ]
[         3 containers started    ]
[         0 containers aborted    ]
[         3 containers successful ]
[         0 containers failed     ]
[         6 tests found           ]
[         0 tests skipped         ]
[         6 tests started         ]
[         0 tests aborted         ]
[         6 tests successful      ]
[         0 tests failed          ]
```

Then after seeing if the tests work, generate and open a report for Jacoco using these two command lines:

```
java -jar lib/jacococli.jar report jacoco.exec --classfiles dist --s
```

```
open ./report/index.html
```

Here is proof that the report works and opens for computation:



Computation.java

```java
public class Computation {

    public int add(int a, int b) {
        int result = a + b;
        int zero = 0;
        int result2 = result;
        if (a == Integer.MIN_VALUE) {
            new Integer(result);
        }
        int result3 = result2;
        return result + zero;
    }

    public int multiply(int n, int m) {
    int result = 0;
    for (int j = 0; j < m; j++) {
       result += n;
      }
    return result;
    }

    public int substract(int a, int b) {
        int result = a - b;
        return result;
    }

    public void catchesException() {
      int i = 0;
      try {
      if (i == 13) {
        throw new NumberFormatException();
      }
      i = 23;
      } catch (NumberFormatException e) {
        System.out.println("Exception abgefangen");
      }
      i = 42;
    }

    public double divide(double divisor, double divident) {
        double result;
        if (divident == 0) {
            result = Double.POSITIVE_INFINITY;
        } else {
            result = divisor / divident;
        }
        double result2 = result;
        return result;
    }

    public int justALoop() {
    int a = 2;
    for (int i = 0; i < 10;) {
        i = i + a;
    }
    return a;
    }
}
```

Exercise 1 - Date Coverage

First we opened Jacoco to see the initial coverage.

Then we created some new tests in our attempt to receive 100% coverage for the program.
These tests can be found in the Date > Test > DateTest.java file.

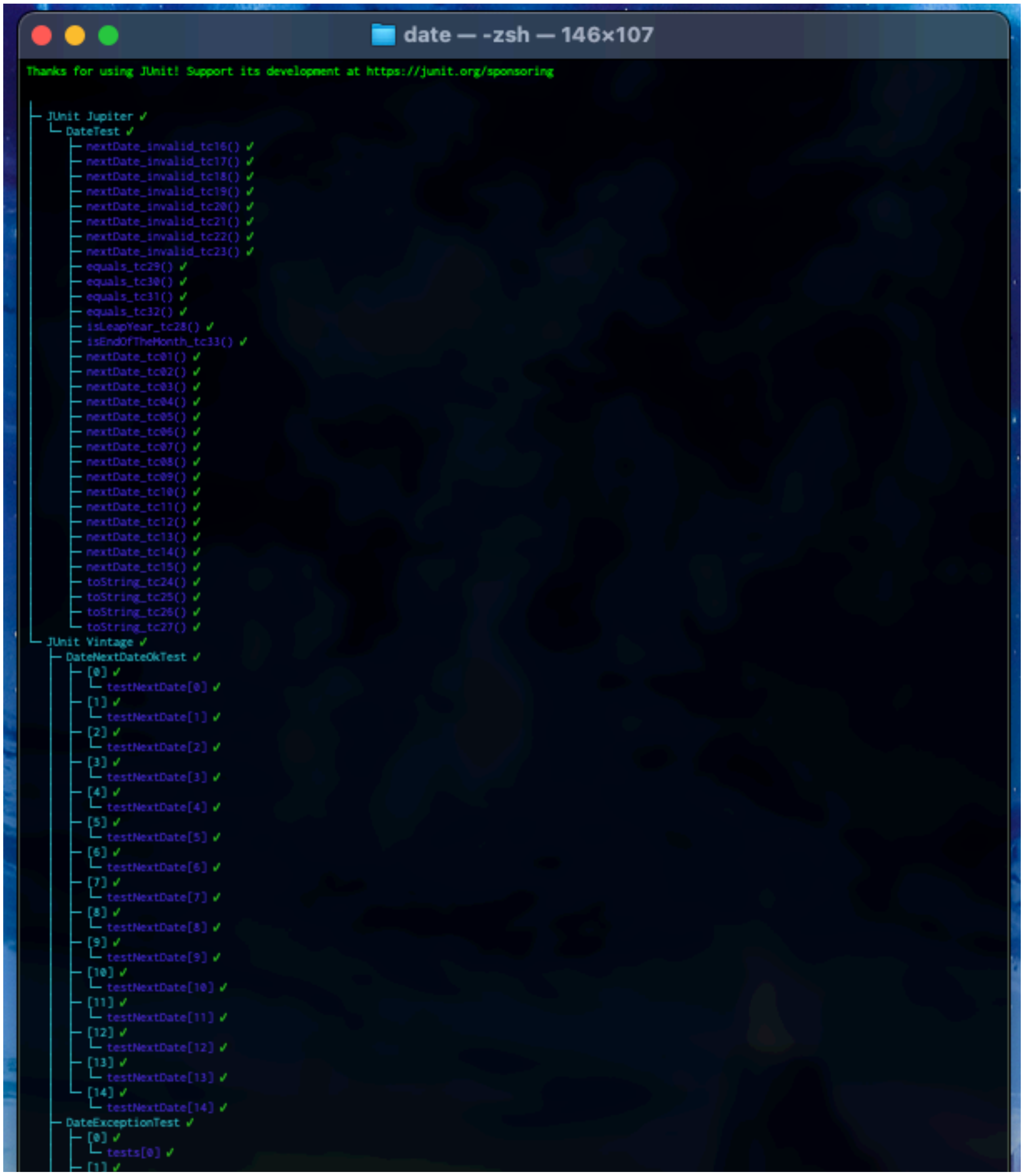
We ran the same three command lines to compile and run the tests:

```
javac -encoding UTF-8 --source-path src -d dist src/*.java
```

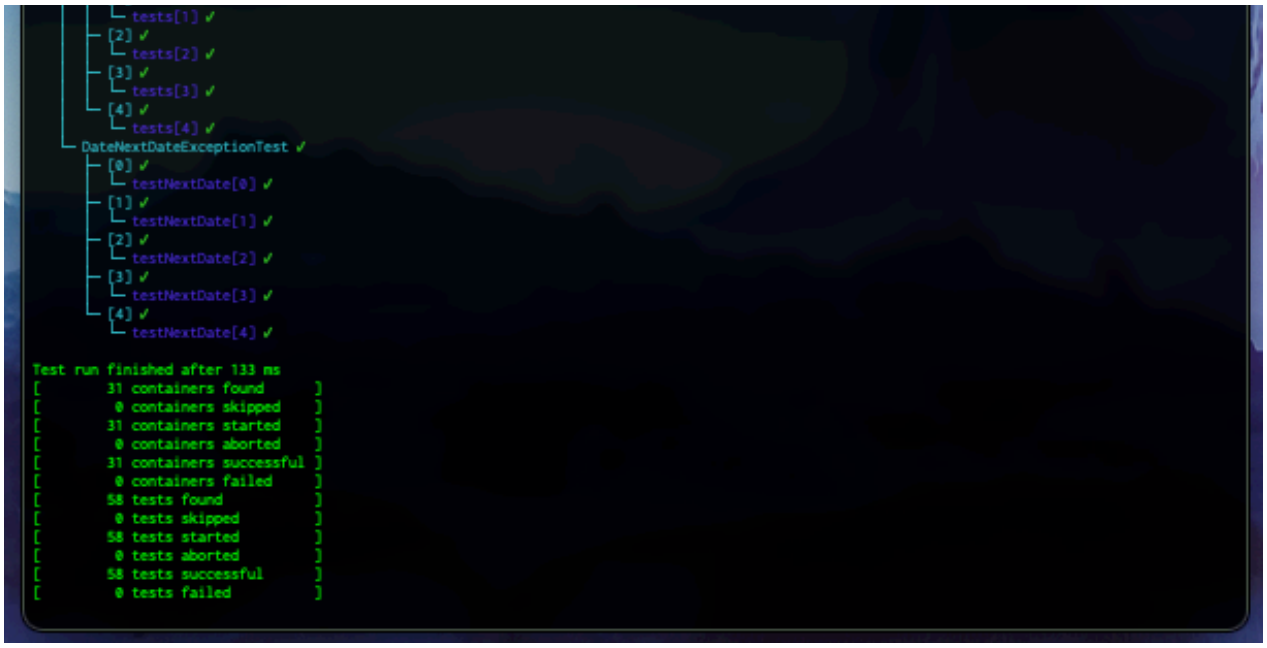
```
javac -encoding UTF-8 --source-path test -d dist -cp dist:lib/junit-
```

```
java -javaagent:lib/jacocoagent.jar -jar lib/junit-platform-console-
```

Here is a screenshot of the terminal after running the tests with the command lines:



```
Thanks for using JUnit! Support its development at https://junit.org/sponsoring

├─ JUnit Jupiter ✓
│  └─ DateTest ✓
│     ├─ nextDate_invalid_tc16() ✓
│     ├─ nextDate_invalid_tc17() ✓
│     ├─ nextDate_invalid_tc18() ✓
│     ├─ nextDate_invalid_tc19() ✓
│     ├─ nextDate_invalid_tc20() ✓
│     ├─ nextDate_invalid_tc21() ✓
│     ├─ nextDate_invalid_tc22() ✓
│     ├─ nextDate_invalid_tc23() ✓
│     ├─ equals_tc29() ✓
│     ├─ equals_tc30() ✓
│     ├─ equals_tc31() ✓
│     ├─ equals_tc32() ✓
│     ├─ isLeapYear_tc28() ✓
│     ├─ isEndOfTheMonth_tc33() ✓
│     ├─ nextDate_tc01() ✓
│     ├─ nextDate_tc02() ✓
│     ├─ nextDate_tc03() ✓
│     ├─ nextDate_tc04() ✓
│     ├─ nextDate_tc05() ✓
│     ├─ nextDate_tc06() ✓
│     ├─ nextDate_tc07() ✓
│     ├─ nextDate_tc08() ✓
│     ├─ nextDate_tc09() ✓
│     ├─ nextDate_tc10() ✓
│     ├─ nextDate_tc11() ✓
│     ├─ nextDate_tc12() ✓
│     ├─ nextDate_tc13() ✓
│     ├─ nextDate_tc14() ✓
│     ├─ nextDate_tc15() ✓
│     ├─ toString_tc24() ✓
│     ├─ toString_tc25() ✓
│     ├─ toString_tc26() ✓
│     └─ toString_tc27() ✓
└─ JUnit Vintage ✓
   ├─ DateNextDateOkTest ✓
   │  ├─ [0] ✓
   │  │  └─ testNextDate[0] ✓
   │  ├─ [1] ✓
   │  │  └─ testNextDate[1] ✓
   │  ├─ [2] ✓
   │  │  └─ testNextDate[2] ✓
   │  ├─ [3] ✓
   │  │  └─ testNextDate[3] ✓
   │  ├─ [4] ✓
   │  │  └─ testNextDate[4] ✓
   │  ├─ [5] ✓
   │  │  └─ testNextDate[5] ✓
   │  ├─ [6] ✓
   │  │  └─ testNextDate[6] ✓
   │  ├─ [7] ✓
   │  │  └─ testNextDate[7] ✓
   │  ├─ [8] ✓
   │  │  └─ testNextDate[8] ✓
   │  ├─ [9] ✓
   │  │  └─ testNextDate[9] ✓
   │  ├─ [10] ✓
   │  │  └─ testNextDate[10] ✓
   │  ├─ [11] ✓
   │  │  └─ testNextDate[11] ✓
   │  ├─ [12] ✓
   │  │  └─ testNextDate[12] ✓
   │  ├─ [13] ✓
   │  │  └─ testNextDate[13] ✓
   │  └─ [14] ✓
   │     └─ testNextDate[14] ✓
   ├─ DateExceptionTest ✓
   │  ├─ [0] ✓
   │  │  └─ tests[0] ✓
   │  ├─ [1] ✓
```



```
│   │   └─ tests[1] ✔
│   ├─ [2] ✔
│   │   └─ tests[2] ✔
│   ├─ [3] ✔
│   │   └─ tests[3] ✔
│   └─ [4] ✔
│       └─ tests[4] ✔
└─ DateNextDateExceptionTest ✔
   ├─ [0] ✔
   │   └─ testNextDate[0] ✔
   ├─ [1] ✔
   │   └─ testNextDate[1] ✔
   ├─ [2] ✔
   │   └─ testNextDate[2] ✔
   ├─ [3] ✔
   │   └─ testNextDate[3] ✔
   └─ [4] ✔
       └─ testNextDate[4] ✔

Test run finished after 133 ms
[        31 containers found      ]
[         0 containers skipped    ]
[        31 containers started    ]
[         0 containers aborted    ]
[        31 containers successful ]
[         0 containers failed     ]
[        58 tests found           ]
[         0 tests skipped         ]
[        58 tests started         ]
[         0 tests aborted         ]
[        58 tests successful      ]
[         0 tests failed          ]
```

Here is the text output of the screenshot above (for clarity purposes)

```
Thanks for using JUnit! Support its development at https://junit.org

╷
├─ JUnit Jupiter ✔
│  └─ DateTest ✔
│     ├─ nextDate_invalid_tc16() ✔
│     ├─ nextDate_invalid_tc17() ✔
│     ├─ nextDate_invalid_tc18() ✔
│     ├─ nextDate_invalid_tc19() ✔
│     ├─ nextDate_invalid_tc20() ✔
│     ├─ nextDate_invalid_tc21() ✔
│     ├─ nextDate_invalid_tc22() ✔
│     ├─ nextDate_invalid_tc23() ✔
│     ├─ equals_tc29() ✔
│     ├─ equals_tc30() ✔
│     ├─ equals_tc31() ✔
│     ├─ equals_tc32() ✔
│     ├─ isEndOfTheMonth_tc33() ✔
│     ├─ nextDate_tc01() ✔
│     ├─ nextDate_tc02() ✔
│     ├─ nextDate_tc03() ✔
│     ├─ nextDate_tc04() ✔
│     ├─ nextDate_tc05() ✔
│     ├─ nextDate_tc06() ✔
│     ├─ nextDate_tc07() ✔
│     ├─ nextDate_tc08() ✔
│       ├─ nextDate_tc09() ✔
│       ├─ nextDate_tc10() ✔
│       ├─ nextDate_tc11() ✔
│       ├─ nextDate_tc12() ✔
│       ├─ nextDate_tc13() ✔
│       ├─ nextDate_tc14() ✔
│       ├─ nextDate_tc15() ✔
│       ├─ toString_tc24() ✔
│       ├─ toString_tc25() ✔
│       ├─ toString_tc26() ✔
│       └─ toString_tc27() ✔
└─ JUnit Vintage ✔
   ├─ DateNextDateOkTest ✔
   │  ├─ [0] ✔
   │  │  └─ testNextDate[0] ✔
   │  ├─ [1] ✔
   │  │  └─ testNextDate[1] ✔
   │  ├─ [2] ✔
   │  │  └─ testNextDate[2] ✔
   │  ├─ [3] ✔
   │  │  └─ testNextDate[3] ✔
   │  ├─ [4] ✔
   │  │  └─ testNextDate[4] ✔
   │  ├─ [5] ✔
   │  │  └─ testNextDate[5] ✔
   │  ├─ [6] ✔
   │  │  └─ testNextDate[6] ✔
   │  ├─ [7] ✔
   │  │  └─ testNextDate[7] ✔
   │  ├─ [8] ✔
   │  │  └─ testNextDate[8] ✔
   │  ├─ [9] ✔
   │  │  └─ testNextDate[9] ✔
   │  ├─ [10] ✔
   │  │  └─ testNextDate[10] ✔
   │  ├─ [11] ✔
   │  │  └─ testNextDate[11] ✔
   │  ├─ [12] ✔
   │  │  └─ testNextDate[12] ✔
   │  ├─ [13] ✔
   │  │  └─ testNextDate[13] ✔
   │  └─ [14] ✔
   │     └─ testNextDate[14] ✔
   ├─ DateExceptionTest ✔
   │  ├─ [0] ✔
```

```
    │  │  └─ tests[0] ✔
    │  ├─ [1] ✔
    │  │  └─ tests[1] ✔
    │  ├─ [2] ✔
    │  │  └─ tests[2] ✔
    │  ├─ [3] ✔
    │  │  └─ tests[3] ✔
    │  └─ [4] ✔
    │     └─ tests[4] ✔
    └─ DateNextDateExceptionTest ✔
       ├─ [0] ✔
       │  └─ testNextDate[0] ✔
       ├─ [1] ✔
       │  └─ testNextDate[1] ✔
       ├─ [2] ✔
       │  └─ testNextDate[2] ✔
       ├─ [3] ✔
       │  └─ testNextDate[3] ✔
       └─ [4] ✔
          └─ testNextDate[4] ✔

Test run finished after 133 ms
[        31 containers found      ]
[         0 containers skipped    ]
[        31 containers started    ]
[         0 containers aborted    ]
[        31 containers successful ]
[         0 containers failed     ]
[        58 tests found           ]
[         0 tests skipped         ]
[        58 tests started         ]
[         0 tests aborted         ]
[        58 tests successful      ]
[         0 tests failed          ]
```

Answering the CODE COVERAGE Question

Then after seeing if the tests work, generate and open a report for Jacoco using these two command lines:

```
java -jar lib/jacococli.jar report jacoco.exec --classfiles dist --s
```

```
open ./report/index.html
```

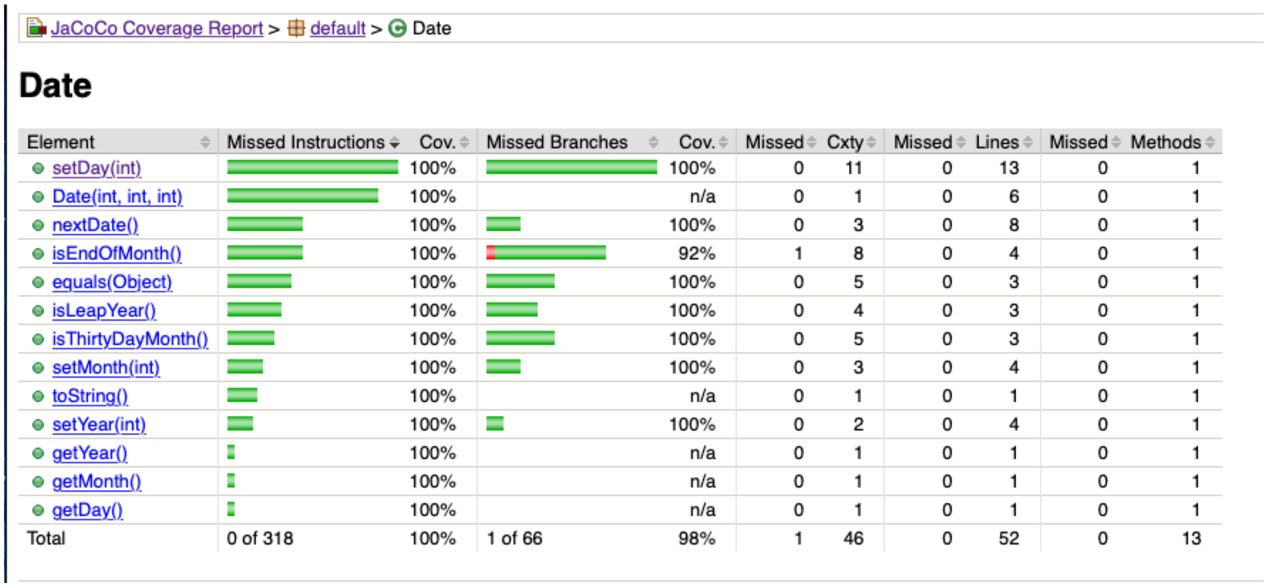
After adding aditional tests to try to achieve 100% coverage, we believe it is possible because we have 100% coverage in our screenshots below.

We have 100% instruction coverage and 98% branch coverage. The only line that is missing a branch is:

```
if (day == 31 || (day == 30 && isThirtyDayMonth()) || (this.month ==
```

This line is missing 1 of 14 branches. It was refactored to reduce the number of branches from 16 to 14 to get more coverage.

Here is proof of our coverage when opening the report:



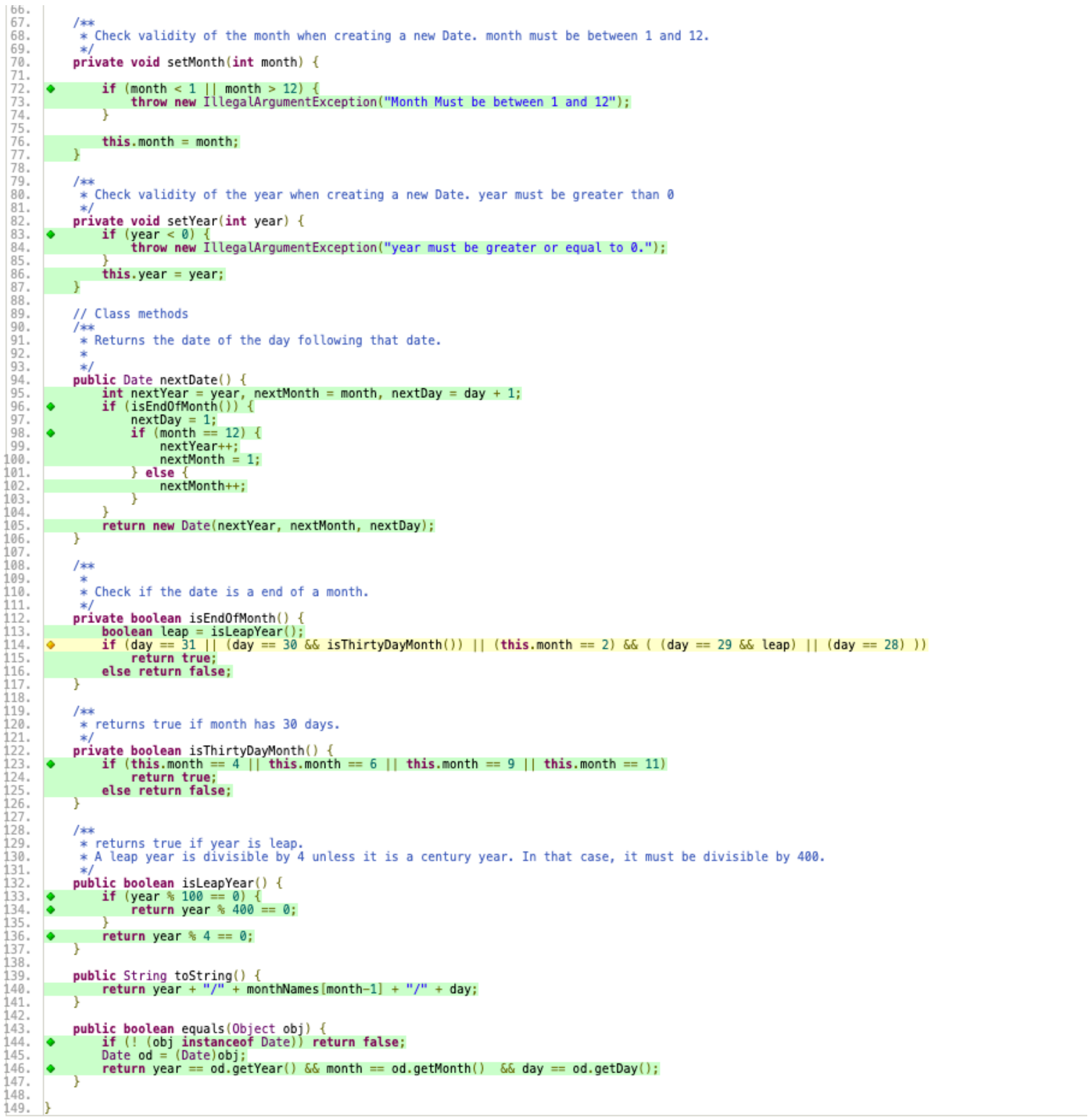
JaCoCo Coverage Report > default > Date

Date

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods
setDay(int)		100%		100%	0	11	0	13	0	1
Date(int, int, int)		100%		n/a	0	1	0	6	0	1
nextDate()		100%		100%	0	3	0	8	0	1
isEndOfMonth()		100%		92%	1	8	0	4	0	1
equals(Object)		100%		100%	0	5	0	3	0	1
isLeapYear()		100%		100%	0	4	0	3	0	1
isThirtyDayMonth()		100%		100%	0	5	0	3	0	1
setMonth(int)		100%		100%	0	3	0	4	0	1
toString()		100%		n/a	0	1	0	1	0	1
setYear(int)		100%		100%	0	2	0	4	0	1
getYear()		100%		n/a	0	1	0	1	0	1
getMonth()		100%		n/a	0	1	0	1	0	1
getDay()		100%		n/a	0	1	0	1	0	1
Total	0 of 318	100%	1 of 66	98%	1	46	0	52	0	13

Date.java

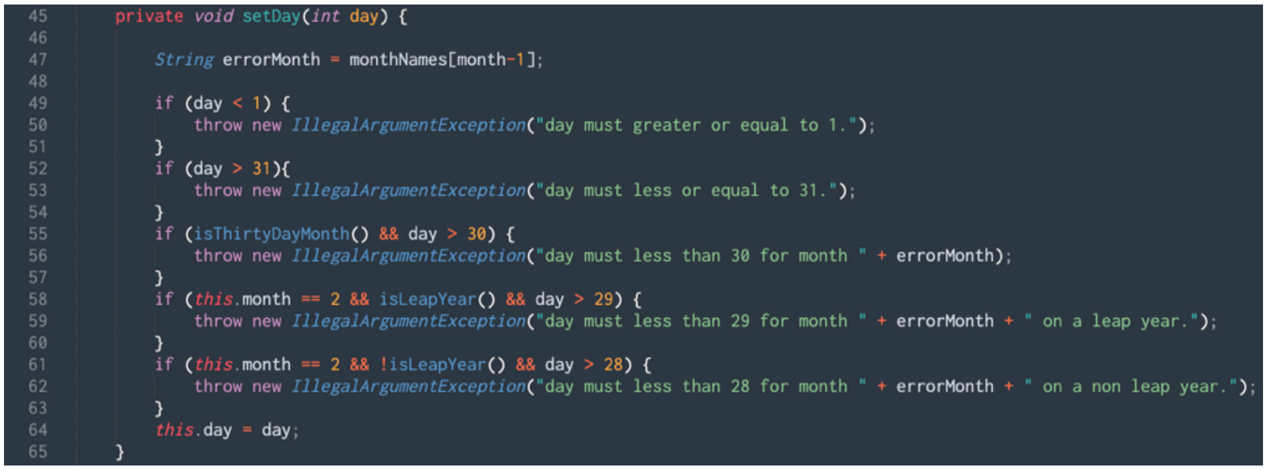
```java
public class Date {

    /* Data fields */
    private int year;
    private int month;
    private int day;

    /* String correspondent used for displaying months */
    String[] monthNames = {
        "January", "February", "March",
        "April", "May", "June",
        "July", "August", "September",
        "October", "November", "December"
    };

    //
    // CONSTRUCTOR
    //
    public Date(int year, int month, int day) {
        setYear(year);
        setMonth(month);
        setDay(day);
    }

    public int getYear() {
        return year;
    }

    public int getMonth() {
        return month;
    }

    public int getDay() {
        return day;
    }

    /**
     * Check validity of the day when creating a new Date.
     * day must be greater or equal to 1 and
     *   - less or equal to 31 for months with 31 days
     *   - less or equal to 30 for months with 30 days,
     *   - less or equal to 29 for February if year is leap
     *   - less or equal to 30 for February if year is non-leap
     */
    private void setDay(int day) {

        String errorMonth = monthNames[month-1];

        if (day < 1) {
            throw new IllegalArgumentException("day must greater or equal to 1.");
        }
        if (day > 31){
            throw new IllegalArgumentException("day must less or equal to 31.");
        }
        if (isThirtyDayMonth() && day > 30) {
            throw new IllegalArgumentException("day must less than 30 for month " + errorMonth);
        }
        if (this.month == 2 && isLeapYear() && day > 29) {
            throw new IllegalArgumentException("day must less than 29 for month " + errorMonth + " on a leap year.");
        }
        if (this.month == 2 && !isLeapYear() && day > 28) {
            throw new IllegalArgumentException("day must less than 28 for month " + errorMonth + " on a non leap year.");
        }
        this.day = day;
    }

```



```java

    /**
     * Check validity of the month when creating a new Date. month must be between 1 and 12.
     */
    private void setMonth(int month) {

        if (month < 1 || month > 12) {
            throw new IllegalArgumentException("Month Must be between 1 and 12");
        }

        this.month = month;
    }

    /**
     * Check validity of the year when creating a new Date. year must be greater than 0
     */
    private void setYear(int year) {
        if (year < 0) {
            throw new IllegalArgumentException("year must be greater or equal to 0.");
        }
        this.year = year;
    }

    // Class methods
    /**
     * Returns the date of the day following that date.
     *
     */
    public Date nextDate() {
        int nextYear = year, nextMonth = month, nextDay = day + 1;
        if (isEndOfMonth()) {
            nextDay = 1;
            if (month == 12) {
                nextYear++;
                nextMonth = 1;
            } else {
                nextMonth++;
            }
        }
        return new Date(nextYear, nextMonth, nextDay);
    }

    /**
     *
     * Check if the date is a end of a month.
     */
    private boolean isEndOfMonth() {
        boolean leap = isLeapYear();
        if (day == 31 || (day == 30 && isThirtyDayMonth()) || (this.month == 2) && ( (day == 29 && leap) || (day == 28) ))
            return true;
        else return false;
    }

    /**
     * returns true if month has 30 days.
     */
    private boolean isThirtyDayMonth() {
        if (this.month == 4 || this.month == 6 || this.month == 9 || this.month == 11)
            return true;
        else return false;
    }

    /**
     * returns true if year is leap.
     * A leap year is divisible by 4 unless it is a century year. In that case, it must be divisible by 400.
     */
    public boolean isLeapYear() {
        if (year % 100 == 0) {
            return year % 400 == 0;
        }
        return year % 4 == 0;
    }

    public String toString() {
        return year + "/" + monthNames[month-1] + "/" + day;
    }

    public boolean equals(Object obj) {
        if (! (obj instanceof Date)) return false;
        Date od = (Date)obj;
        return year == od.getYear() && month == od.getMonth()  && day == od.getDay();
    }

}
```

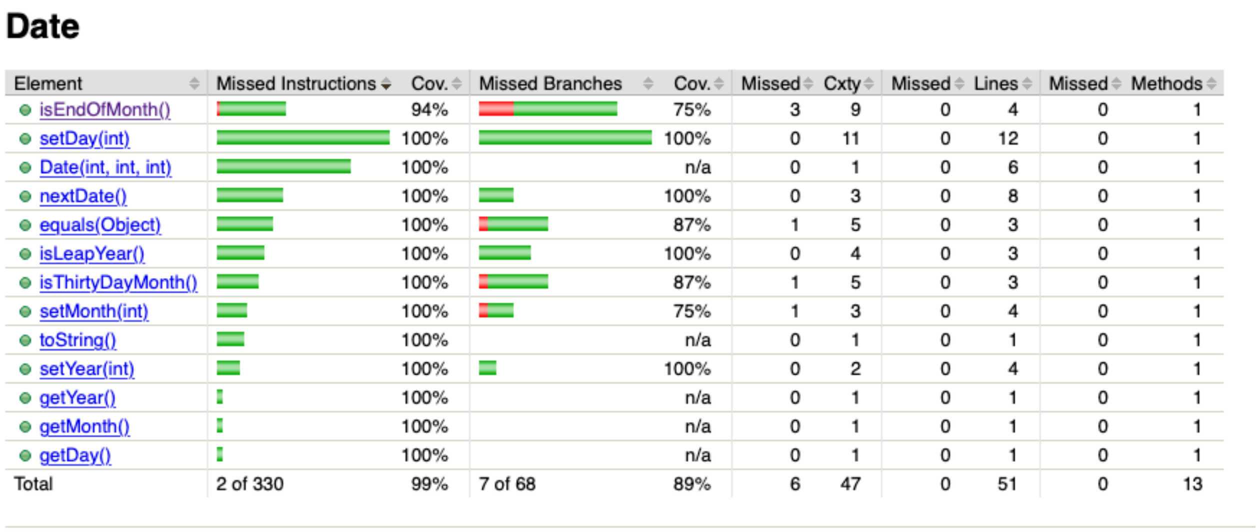
Answering the REFACTORING Question

After refactoring our code our coverage improved. To refactor our code, as mentionned above, we changed one of the if statements to reduce the total number of branches from 16 to 14. We also refactored the setDay() function. It has many calls to monthNames[month-1]. We made a new String variable to reduce the amount of times the code has to compute monthNames[month-1] as seen in the screenshot below.



```java
    private void setDay(int day) {

        String errorMonth = monthNames[month-1];

        if (day < 1) {
            throw new IllegalArgumentException("day must greater or equal to 1.");
        }
        if (day > 31){
            throw new IllegalArgumentException("day must less or equal to 31.");
        }
        if (isThirtyDayMonth() && day > 30) {
            throw new IllegalArgumentException("day must less than 30 for month " + errorMonth);
        }
        if (this.month == 2 && isLeapYear() && day > 29) {
            throw new IllegalArgumentException("day must less than 29 for month " + errorMonth + " on a leap year.");
        }
        if (this.month == 2 && !isLeapYear() && day > 28) {
            throw new IllegalArgumentException("day must less than 28 for month " + errorMonth + " on a non leap year.");
        }
        this.day = day;
    }
```

Also, for your reference, this was our Jacoco report before refactoring and before making condition coverage tests. As you can see in comparison to the screenshots above, there were a lot less branches covered. We managed to go from 99% instruction coverage and 89% branch coverage to 100% instruction coverage and 98% branch coverage.



Date

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods
isEndOfMonth()		94%		75%	3	9	0	4	0	1
setDay(int)		100%		100%	0	11	0	12	0	1
Date(int, int, int)		100%		n/a	0	1	0	6	0	1
nextDate()		100%		100%	0	3	0	8	0	1
equals(Object)		100%		87%	1	5	0	3	0	1
isLeapYear()		100%		100%	0	4	0	3	0	1
isThirtyDayMonth()		100%		87%	1	5	0	3	0	1
setMonth(int)		100%		75%	1	3	0	4	0	1
toString()		100%		n/a	0	1	0	1	0	1
setYear(int)		100%		100%	0	2	0	4	0	1
getYear()		100%		n/a	0	1	0	1	0	1
getMonth()		100%		n/a	0	1	0	1	0	1
getDay()		100%		n/a	0	1	0	1	0	1
Total	2 of 330	99%	7 of 68	89%	6	47	0	51	0	13

```java
    /**
     * Check validity of the month when creating a new Date. month must be between 1 and 12.
     */
    private void setMonth(int month) {
        if (month < 1 || month > 12) {
            throw new IllegalArgumentException("month must be between 1 and 12.");
        }
        this.month = month;
    }

    /**
     * Check validity of the year when creating a new Date. year must be greater than 0
     */
    private void setYear(int year) {
        if (year < 0) {
            throw new IllegalArgumentException("year must be greater or equal to 0.");
        }
        this.year = year;
    }

    // Class methods
    /**
     * Returns the date of the day following that date.
     *
     */
    public Date nextDate() {
        int nextYear = year, nextMonth = month, nextDay = day + 1;
        if (isEndOfMonth()) {
            nextDay = 1;
            if (month == 12) {
                nextYear++;
                nextMonth = 1;
            } else {
                nextMonth++;
            }
        }
        return new Date(nextYear, nextMonth, nextDay);
    }

    /**
     *
     * Check if the date is a end of a month.
     */
    private boolean isEndOfMonth() {
        boolean leap = isLeapYear();
        if (day == 31 || (day == 30 && isThirtyDayMonth()) || (this.month == 2 && ((day == 29 && leap) || (day == 28 && !leap))))
            return true;
        else return false;
    }

    /**
     * returns true if month has 30 days.
     */
    private boolean isThirtyDayMonth() {
        if (this.month == 4 || this.month == 6 || this.month == 9 || this.month == 11)
            return true;
        else return false;
    }

    /**
     * returns true if year is leap.
     * A leap year is divisible by 4 unless it is a century year. In that case, it must be divisible by 400.
     */
    public boolean isLeapYear() {
        if (year % 100 == 0) {
            return year % 400 == 0;
        }
        return year % 4 == 0;
    }

    public String toString() {
        return year + "/" + monthNames[month-1] + "/" + day;
    }

    public boolean equals(Object obj) {
        if (! (obj instanceof Date)) return false;
        Date od = (Date)obj;
        return year == od.getYear() && month == od.getMonth()  && day == od.getDay();
    }

}
```