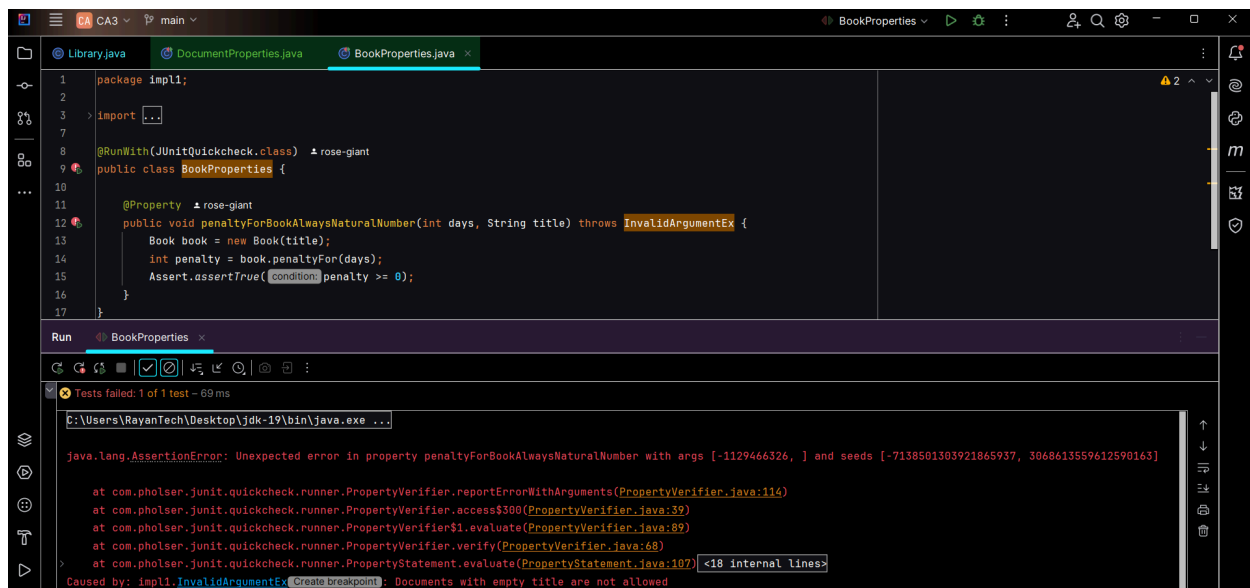System Properties:

1. Number of available documents >= 0
2. Number of borrowed documents (for all members) >= 0
3. Time step >= 0
4. Number of days a normal book is borrowed <= 30
5. Number of days a reference book is borrowed <= 15
6. Number of days a magazine is borrowed <= 2
7. Penalty >= 0
8. A professor's borrowed documents <= 5
9. A student's borrowed documents <= 2
10. Borrowed instances of a documents <= available instances of a documents
11. A normal book times of extension each time borrowed <= 2
12. A reference's times of extension each time borrowed <= 2

Book class #1 error:

Loan Class error #1:

Loan error #1
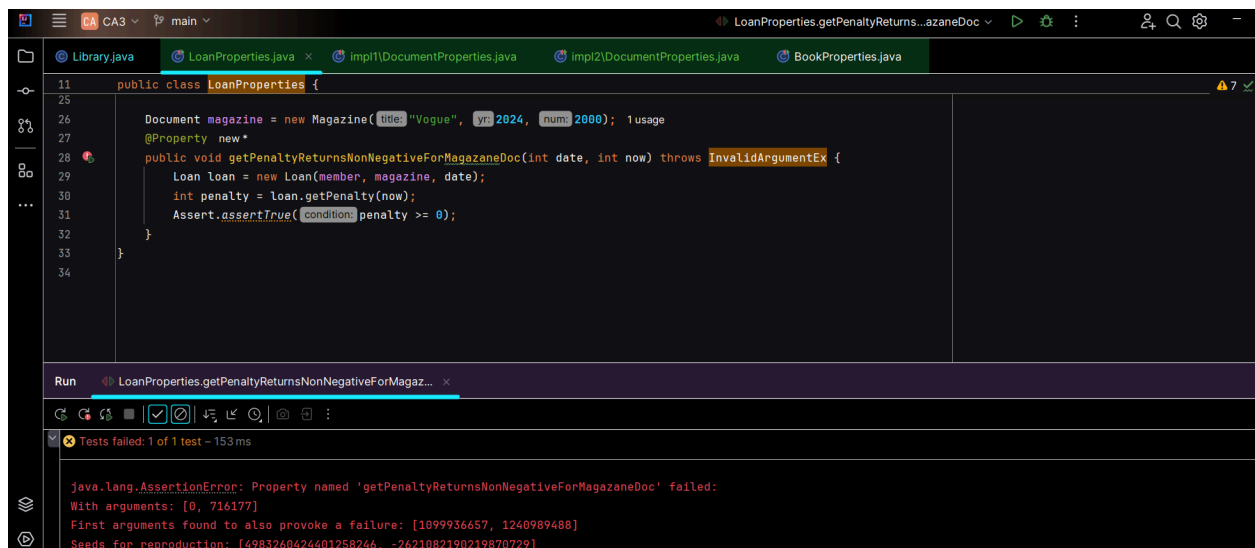
Loan error #1:

Library.java | LoanProperties.java | impl1\DocumentProperties.java | impl2\DocumentProperties.java | BookProperties.java

```java
11    public class LoanProperties {
33
34        Document reference = new Reference( title: "Encycopedia" ); 1 usage
35        @Property new*
36        public void getPenaltyReturnsNonNegativeForReferenceDoc(int date, int now) throws InvalidArgumentEx {
37            Loan loan = new Loan(member, reference, date);
38            int penalty = loan.getPenalty(now);
39            Assert.assertTrue( condition: penalty >= 0);
40        }
41    }
42
```

Run — LoanProperties.getPenaltyReturnsNonNegativeForRefere... ×

❌ Tests failed: 1 of 1 test – 109 ms

```
C:\Users\RayanTech\Desktop\jdk-19\bin\java.exe ...

java.lang.AssertionError: Property named 'getPenaltyReturnsNonNegativeForReferenceDoc' failed:
With arguments: [-589189, 0]
First arguments found to also provoke a failure: [-1017127004, -1016535552]
Seeds for reproduction: [5470036805956538888, -6360081834183010153]
```

Prof error #2

Library.java | ProfessorProperties.java

```java
10
11    @RunWith(JUnitQuickcheck.class) new*
12    public class ProfessorProperties {
13
14        @Property new*
15        public void lengthOfAvailableDocumentListNonNegative(int borrowedSize) {
16            ArrayList<Document> docsBorrow = new ArrayList<>();
17            for (int i = 0 ; i < borrowedSize ; i++) {
18                Random random = new Random();
19                int copies = random.nextInt( bound: 10000);
20                Document document = new Book( bookTitle: "Pride and Prejuce", copies);
21                docsBorrow.add(document);
22            }
23
24            Prof prof = new Prof( profName: "UnderPants");
25            if (docsBorrow.size() < 5) {
26                Assert.assertTrue(prof.canBorrow());
27            }
28
29            else {
30                Assert.assertFalse(prof.canBorrow());
31            }
32        }
```

Run — ProfessorProperties ×

❌ Tests failed: 1 of 1 test – 13 sec 19 ms

```
C:\Users\RayanTech\Desktop\jdk-19\bin\java.exe ...

java.lang.AssertionError: Unexpected error in property lengthOfAvailableDocumentListNonNegative with args [1676493964] and seeds [3180273110181312036]

    at com.pholser.junit.quickcheck.runner.PropertyVerifier.reportErrorWithArguments(PropertyVerifier.java:114)
    at com.pholser.junit.quickcheck.runner.PropertyVerifier.access$300(PropertyVerifier.java:39)
```
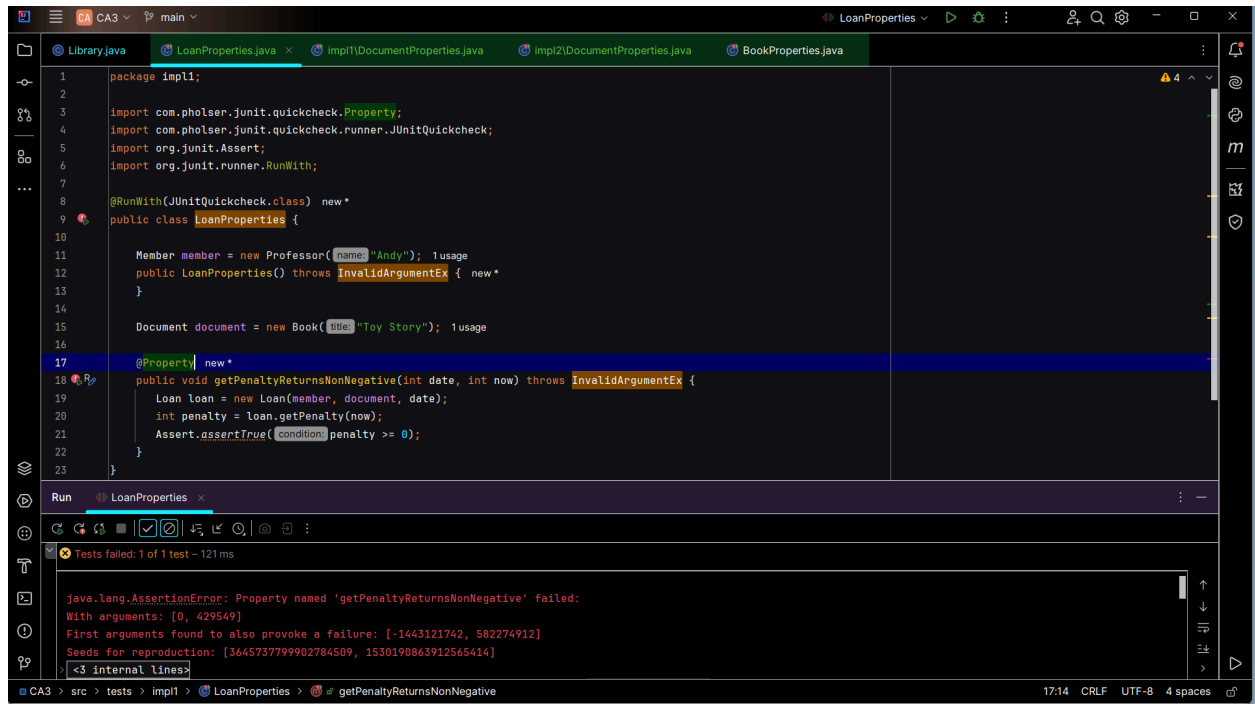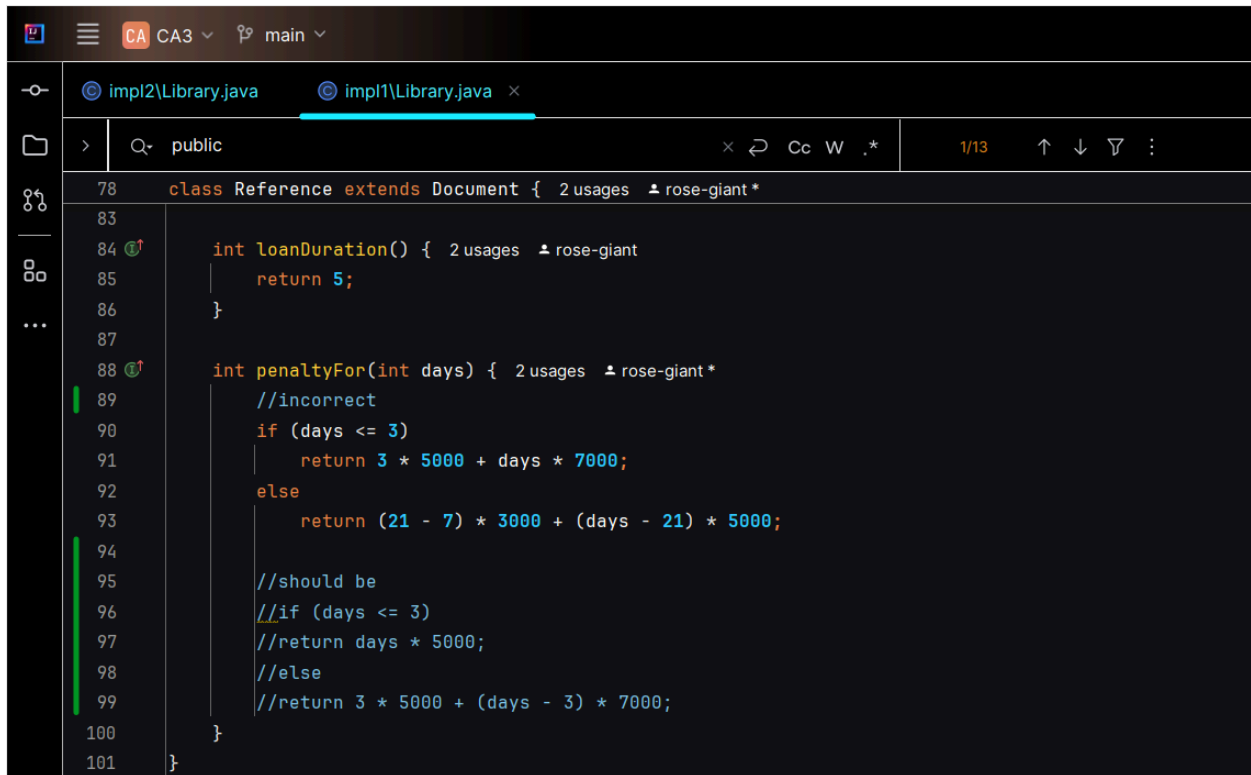
Student error #2

Library.java   ProfessorProperties.java   StudentProperties.java ×

```java
10
11  @RunWith(JUnitQuickcheck.class)  new*
12  public class StudentProperties {
13      @Property  new*
14      public void lengthOfAvailableDocumentListNonNegative(int borrowedSize) {
15          ArrayList<Document> docsBorrow = new ArrayList<>();
16          for (int i = 0 ; i < borrowedSize ; i++) {
17              Random random = new Random();
18              int copies = random.nextInt( bound: 10000);
19              Document document = new Book( bookTitle: "Pride and Prejuce", copies);
20              docsBorrow.add(document);
21          }
22
23          Student student = new Student( studentId: "810199419", studentName: "rose giant");
24          if (docsBorrow.size() < 5) {
25              Assert.assertTrue(student.canBorrow());
26          }
27
28          else {
29              Assert.assertFalse(student.canBorrow());
30          }
31      }
32  }
```

Run   ◀▶ StudentProperties ×

❯ ⊗ Studen ⊗ Tests failed: 1 of 1 test – 13 sec 524 ms
   ⊗ leng
         C:\Users\RayanTech\Desktop\jdk-19\bin\java.exe ...

         java.lang.AssertionError: Unexpected error in property lengthOfAvailableDocumentListNonNegative with args [504277706] and seeds [3109550888419563992]

             at com.pholser.junit.quickcheck.runner.PropertyVerifier.reportErrorWithArguments(PropertyVerifier.java:114)
             at com.pholser.junit.quickcheck.runner.PropertyVerifier.access$300(PropertyVerifier.java:39)
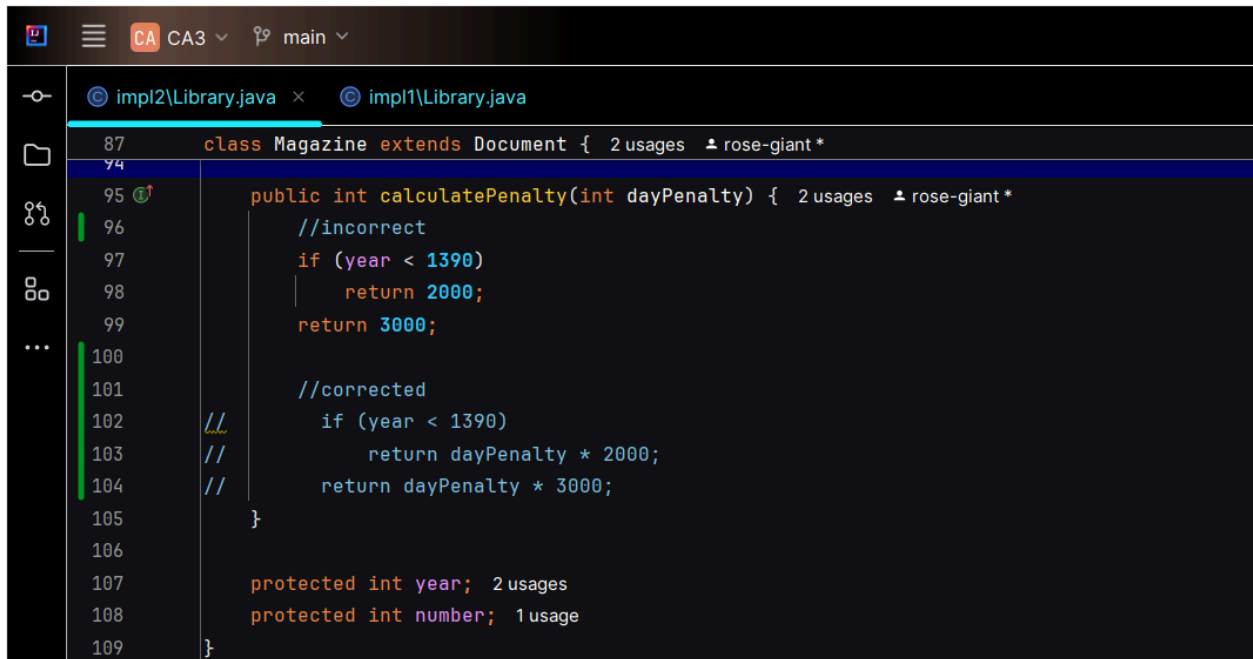
2. Specification Violations:

imp#1

imp#2

impl2\Library.java ×   impl1\Library.java

Q▾ calculatePenalty   × ⤸ Cc W .*   4/5   ↑ ↓ ▽ ⋮

```java
42      class Book extends Document {  6 usages   ▲ rose-giant *
43          public Book(String bookTitle, int bookCopies) {  4 usages   ▲ rose-giant
44              super(bookTitle, bookCopies);
45              day = 10;
46          }
47
48          public int calculatePenalty(int dayPenalty) {  2 usages   ▲ rose-giant *
49              //incorrect
50              dayPenalty = dayPenalty * -1;
51              if (dayPenalty <= 7)
52                  return 2000;
53              if (dayPenalty <= 21)
54                  return 3000;
55              return 2000;
56
57              //corrected
58      //        if (dayPenalty <= 7)
59      //            return dayPenalty * 2000;
60      //        else if (dayPenalty <= 21 && dayPenalty > 7)
61      //            return (14000 + (dayPenalty - 7) * 3000);
62      //        else
63      //            return (14000 + 42000 + (dayPenalty - 21) * 5000 );
64          }
65      }
```

impl2\Library.java ×   impl1\Library.java

Q▾ calculatePenalty   × ⤸ Cc W .*   4/5   ↑ ↓ ▽ ⋮

```java
67      class Reference extends Document {  2 usages   ▲ rose-giant *
68          Reference(String referenceTitle, int referenceCopies) {  1 usage   ▲ rose-giant
69              super(referenceTitle, referenceCopies);
70              day = 5;
71          }
72
73          public int calculatePenalty(int dayPenalty) {  2 usages   ▲ rose-giant *
74              //incorrect
75              dayPenalty = dayPenalty * -1;
76              if (dayPenalty <= 3)
77                  return 5000;
78              return 7000;
79
80              //corrected
81      //        if (dayPenalty <= 3)
82      //            return dayPenalty * 5000;
83      //        return (15000 + (dayPenalty - 3) * 7000);
84          }
85      }
```

impl2\Library.java ×   impl1\Library.java

```java
 87          class Magazine extends Document {  2 usages  rose-giant *
 94
 95              public int calculatePenalty(int dayPenalty) {  2 usages  rose-giant *
 96                  //incorrect
 97                  if (year < 1390)
 98                      return 2000;
 99                  return 3000;
100
101                  //corrected
102      //          if (year < 1390)
103      //              return dayPenalty * 2000;
104      //          return dayPenalty * 3000;
105              }
106
107              protected int year;  2 usages
108              protected int number;  1 usage
109          }
```