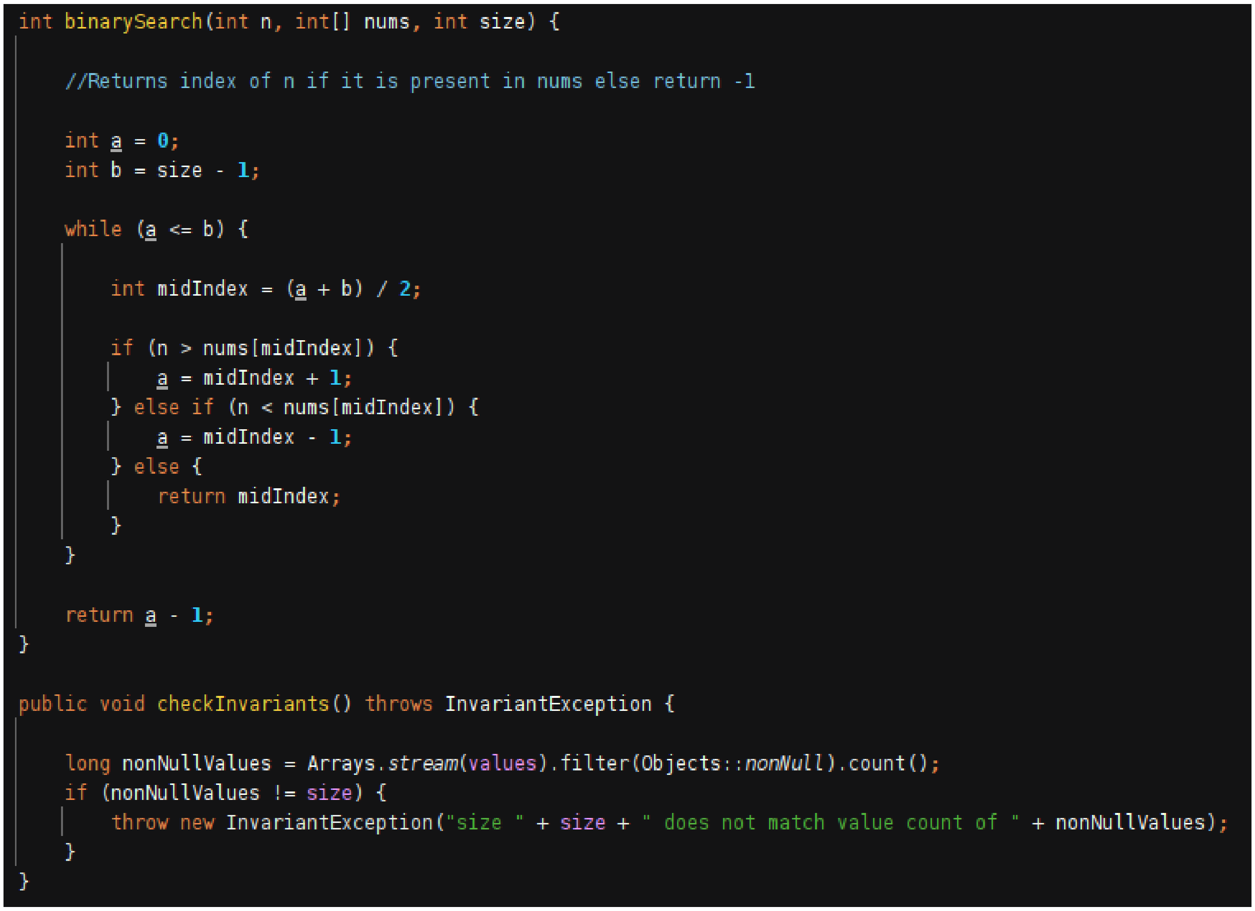
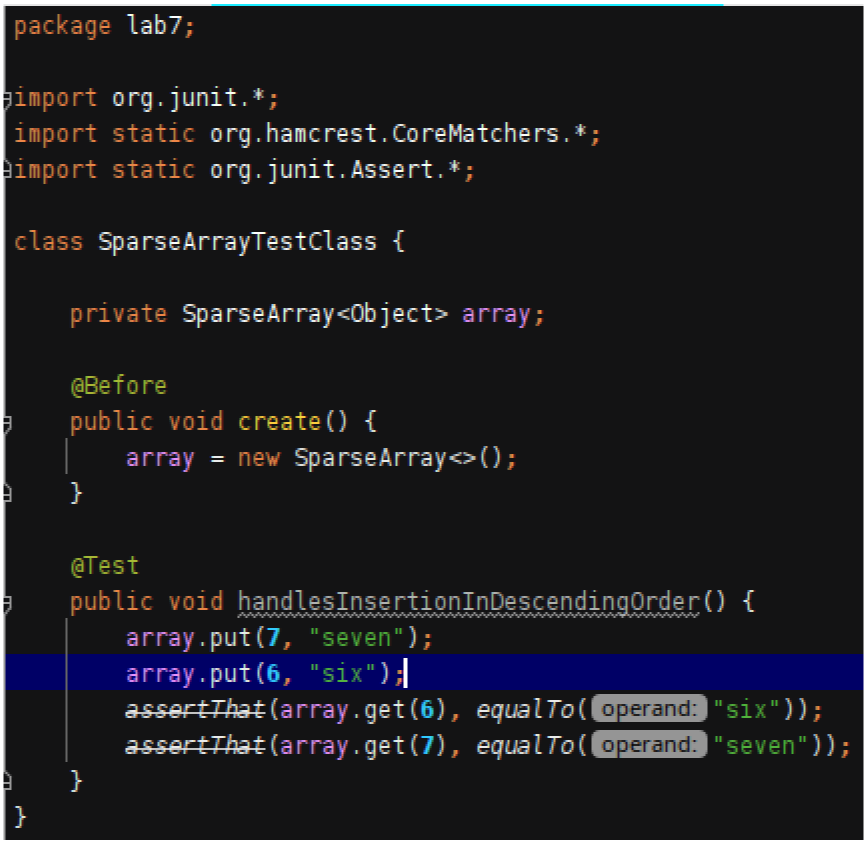
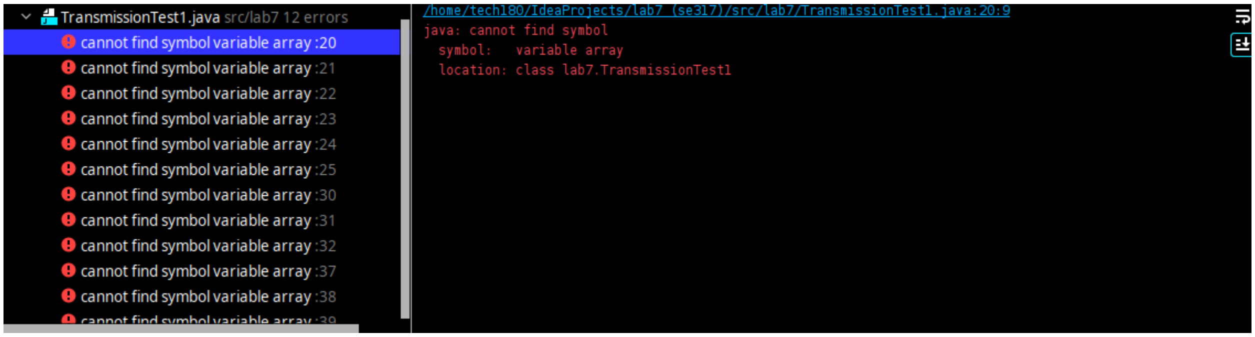
1. 

```java
int binarySearch(int n, int[] nums, int size) {

    //Returns index of n if it is present in nums else return -1

    int a = 0;
    int b = size - 1;

    while (a <= b) {

        int midIndex = (a + b) / 2;

        if (n > nums[midIndex]) {
            a = midIndex + 1;
        } else if (n < nums[midIndex]) {
            a = midIndex - 1;
        } else {
            return midIndex;
        }
    }

    return a - 1;
}

public void checkInvariants() throws InvariantException {

    long nonNullValues = Arrays.stream(values).filter(Objects::nonNull).count();
    if (nonNullValues != size) {
        throw new InvariantException("size " + size + " does not match value count of " + nonNullValues);
    }
}
```

2.



```
package lab7;

import org.junit.*;
import static org.hamcrest.CoreMatchers.*;
import static org.junit.Assert.*;

class SparseArrayTestClass {

    private SparseArray<Object> array;

    @Before
    public void create() {
        array = new SparseArray<>();
    }

    @Test
    public void handlesInsertionInDescendingOrder() {
        array.put(7, "seven");
        array.put(6, "six");
        assertThat(array.get(6), equalTo( operand: "six"));
        assertThat(array.get(7), equalTo( operand: "seven"));
    }
}
```

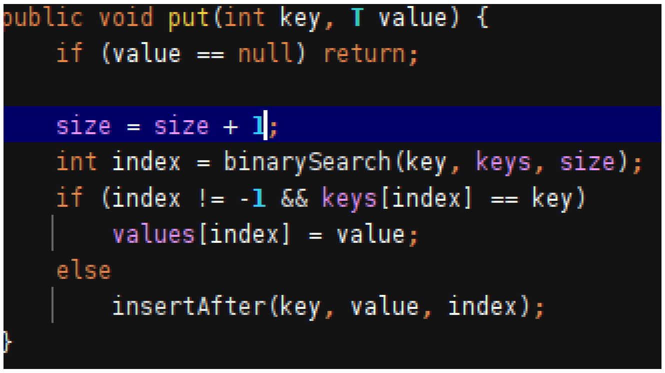


```
TransmissionTest1.java src/lab7 12 errors
    cannot find symbol variable array :20
    cannot find symbol variable array :21
    cannot find symbol variable array :22
    cannot find symbol variable array :23
    cannot find symbol variable array :24
    cannot find symbol variable array :25
    cannot find symbol variable array :30
    cannot find symbol variable array :31
    cannot find symbol variable array :32
    cannot find symbol variable array :37
    cannot find symbol variable array :38
    cannot find symbol variable array :39
```

```
/home/tech180/IdeaProjects/lab7 (se317)/src/lab7/TransmissionTest1.java:20:9
java: cannot find symbol
  symbol:   variable array
  location: class lab7.TransmissionTest1
```

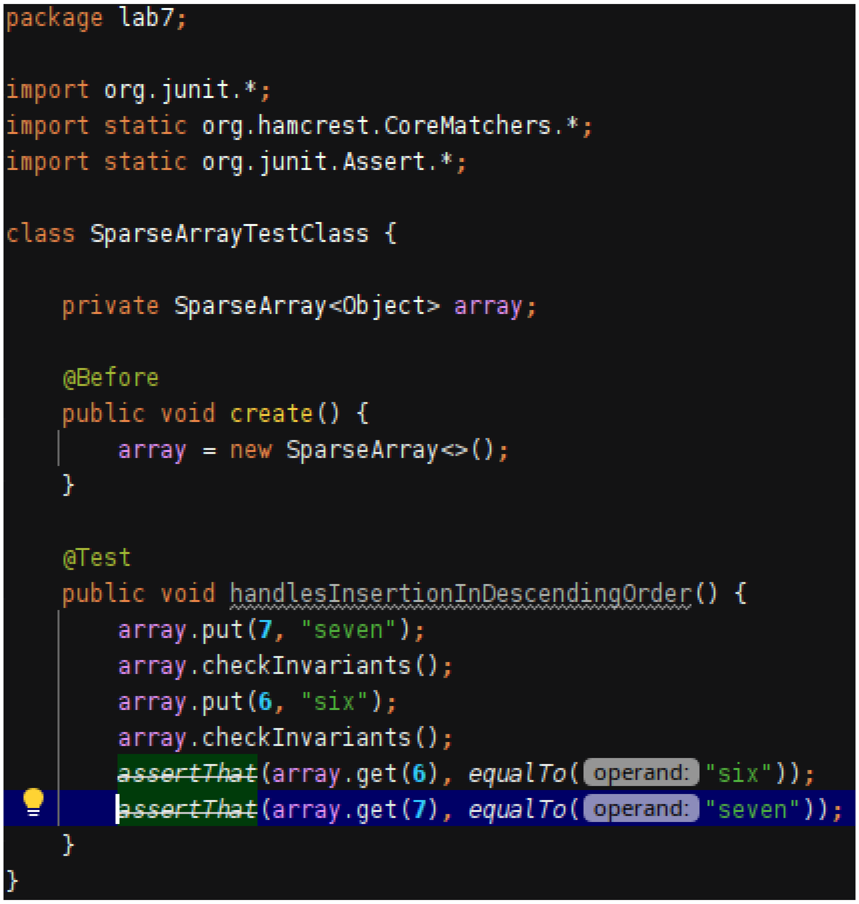
a. The problem ends up being in the test case it doesn’t check for invariants at all between 7 and 6 along with between 6 and equal to 6. To fix and remedy this problem all i did was adding size = size + 1 to allow it to not hit its limit and stay above 0.

i.



```
public void put(int key, T value) {
    if (value == null) return;

    size = size + 1;
    int index = binarySearch(key, keys, size);
    if (index != -1 && keys[index] == key)
        values[index] = value;
    else
        insertAfter(key, value, index);
}
```

ii.

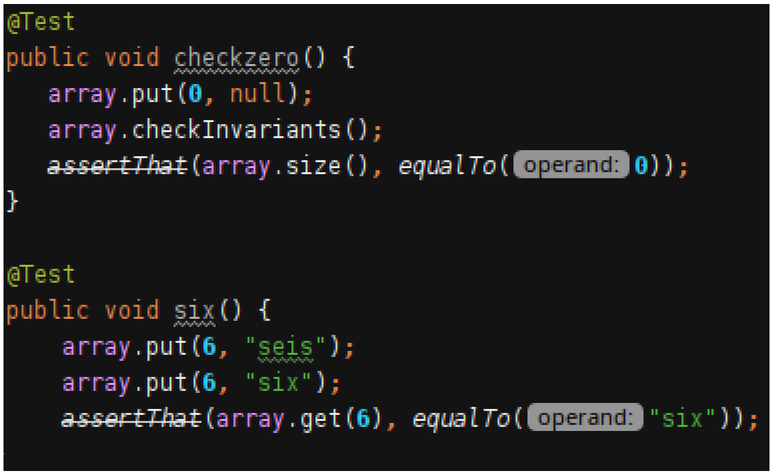


```
package lab7;

import org.junit.*;
import static org.hamcrest.CoreMatchers.*;
import static org.junit.Assert.*;

class SparseArrayTestClass {

    private SparseArray<Object> array;

    @Before
    public void create() {
        array = new SparseArray<>();
    }

    @Test
    public void handlesInsertionInDescendingOrder() {
        array.put(7, "seven");
        array.checkInvariants();
        array.put(6, "six");
        array.checkInvariants();
        ~~assertThat~~(array.get(6), equalTo(operand: "six"));
        ~~assertThat~~(array.get(7), equalTo(operand: "seven"));
    }
}
```

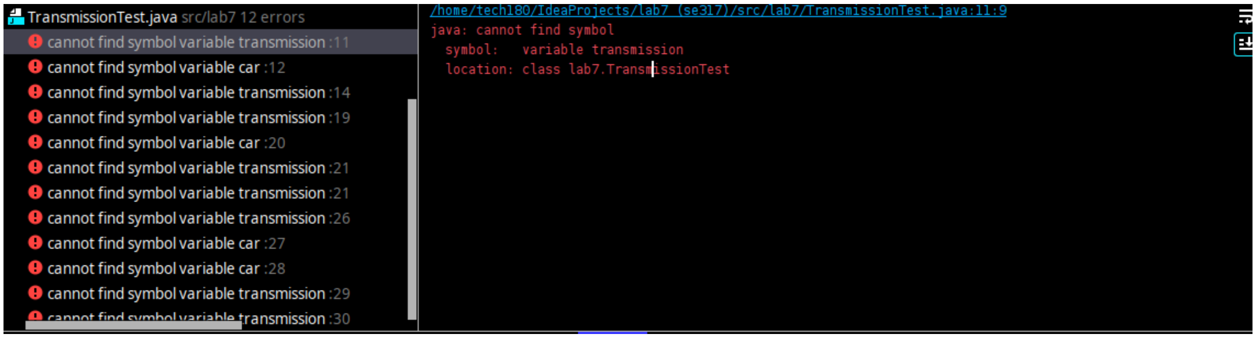
\

iii.

3.

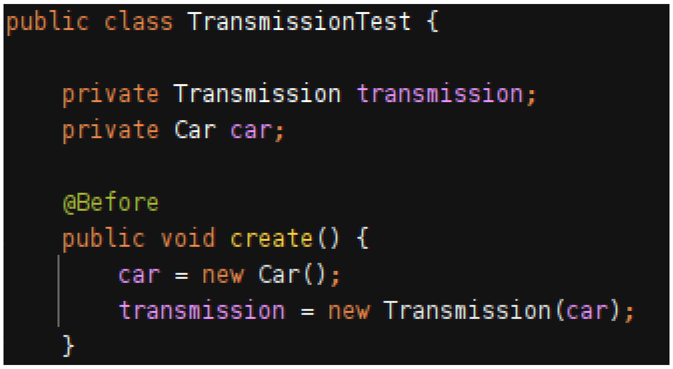


```
@Test
public void checkzero() {
   array.put(0, null);
   array.checkInvariants();
   ~~assertThat~~(array.size(), equalTo(operand: 0));
}

@Test
public void six() {
    array.put(6, "seis");
    array.put(6, "six");
    ~~assertThat~~(array.get(6), equalTo(operand: "six"));
```

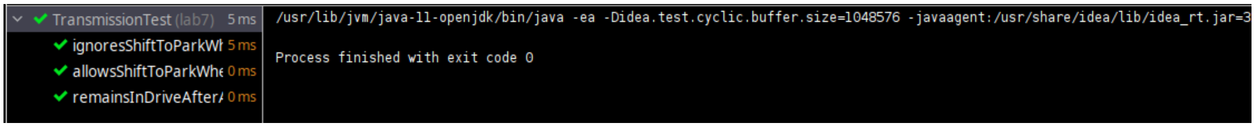
4. 

```
TransmissionTest.java src/lab7 12 errors
  cannot find symbol variable transmission :11
  cannot find symbol variable car :12
  cannot find symbol variable transmission :14
  cannot find symbol variable transmission :19
  cannot find symbol variable car :20
  cannot find symbol variable transmission :21
  cannot find symbol variable transmission :21
  cannot find symbol variable transmission :26
  cannot find symbol variable car :27
  cannot find symbol variable car :28
  cannot find symbol variable transmission :29
  cannot find symbol variable transmission :30
```

```
/home/tech180/IdeaProjects/lab7 (se317)/src/lab7/TransmissionTest.java:11:9
java: cannot find symbol
  symbol:   variable transmission
  location: class lab7.TransmissionTest
```

5. 

```java
public class TransmissionTest {

    private Transmission transmission;
    private Car car;

    @Before
    public void create() {
        car = new Car();
        transmission = new Transmission(car);
    }
```



```
✓ TransmissionTest (lab7)   5 ms
    ✓ ignoresShiftToParkWh  5 ms
    ✓ allowsShiftToParkWhe  0 ms
    ✓ remainsInDriveAfter/  0 ms
```

```
/usr/lib/jvm/java-11-openjdk/bin/java -ea -Didea.test.cyclic.buffer.size=1048576 -javaagent:/usr/share/idea/lib/idea_rt.jar=3

Process finished with exit code 0
```

Part 3

1. Done
2. The checkVariants() method checks if the array is a non null value and then if the size doesn't match that value it throws an invariant exception.
3. The Transmission class checks if a it is moveable and has gears, then afterwards check the current speed and if it is in park within the shift function.