Høyskolen Kristiania

ITP2200
Introduction to Software Testing

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Lecture 3
Graph Coverage
Logic Coverage

So, more programming this week?

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What do we remember from last time?

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We mentioned “Coverage”

```java
public class TriangleClassifier {
    public static String classify(int a, int b, int c) {

        System.out.println("This program takes as input three integers and returns " +
                "the type of triangle that can be built with them.");
        System.out.println("-------");

        if (a <= 0 || b <= 0 || c <= 0) {
            return "NOT_A_TRIANGLE";
        }

        if (a == b && b == c) {
            return "EQUILATERAL";
        }

        int max = Math.max(a, Math.max(b, c));

        if ((max == a && max - b - c >= 0) ||
                (max == b && max - a - c >= 0) ||
                (max == c && max - a - b >= 0)) {
            return "NOT_A_TRIANGLE";
        }

        if (a == b || b == c || a == c) {
            return "ISOSCELES";
        } else {
            return "SCALENE";
        }
    }
```

```java
@Test
public void testScalene() throws Exception {
    int a = 5;
    int b = 7;
    int c = 9;

    String result = TriangleClassifier.classify(a, b, c);
    assertTrue(result.equalsIgnoreCase( anotherString: "SCALENE"));

}

@Test
public void testIsosceles() throws Exception{
    int a = 5;
    int b = 5;
    int c = 7;

    String result = TriangleClassifier.classify(a, b, c);
    assertTrue(result.equalsIgnoreCase( anotherString: "ISOSCELES"));
    assertFalse(result.equalsIgnoreCase( anotherString: "SCALENE"));
}
```

Code is at
https://github.com/bogdanmarculescu/itp2200

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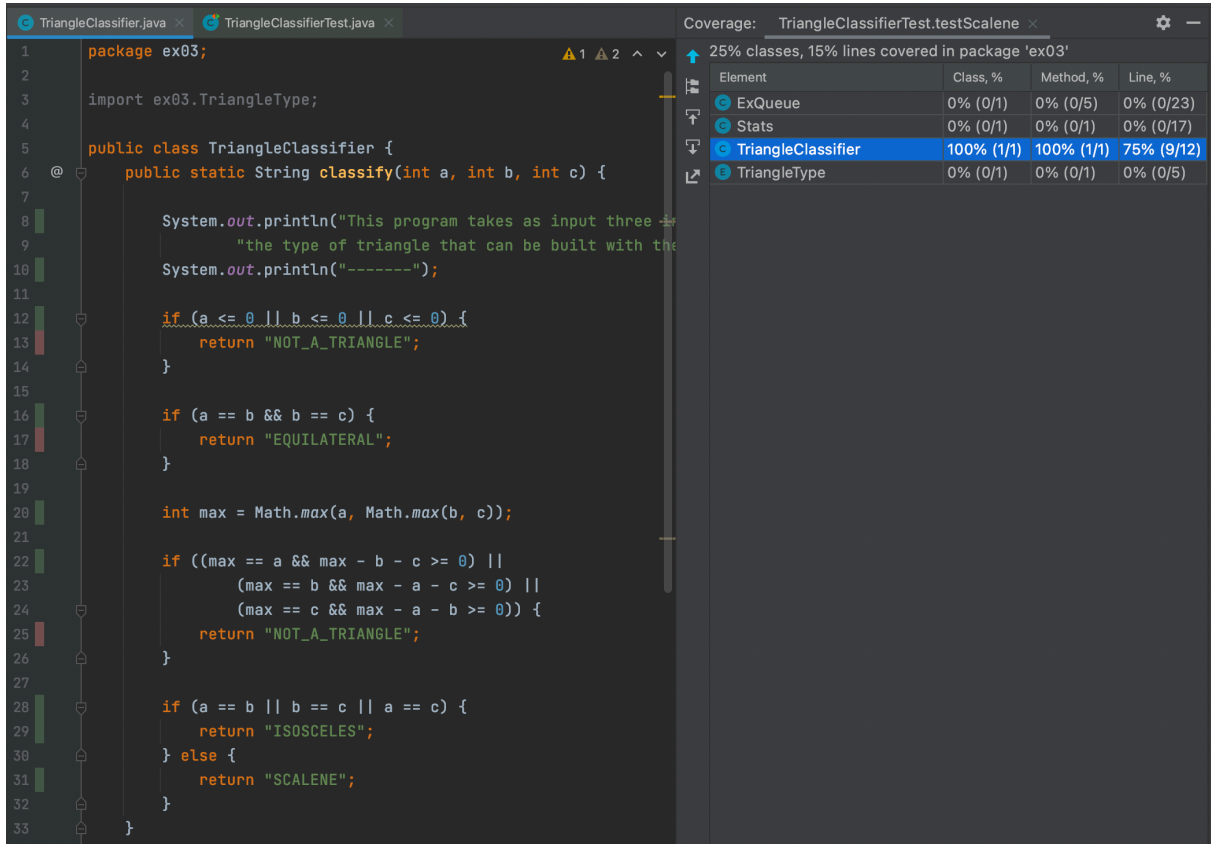
We mentioned “Coverage”



Interpreting Coverage:

What happens to code that is not executed?

How should we change our test to cover those lines as well?

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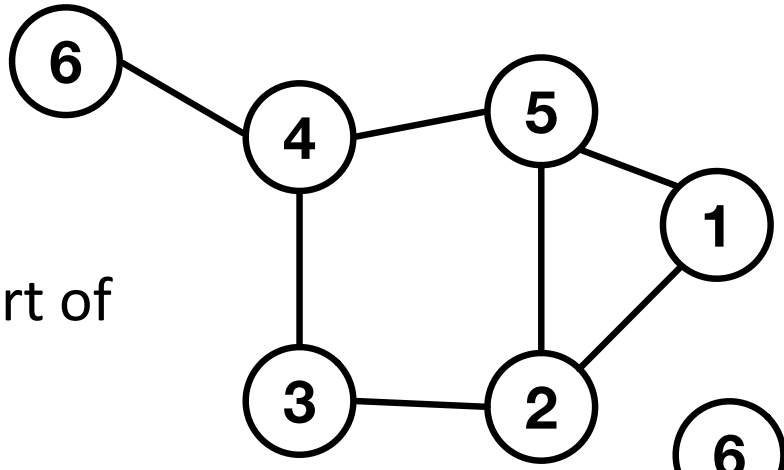
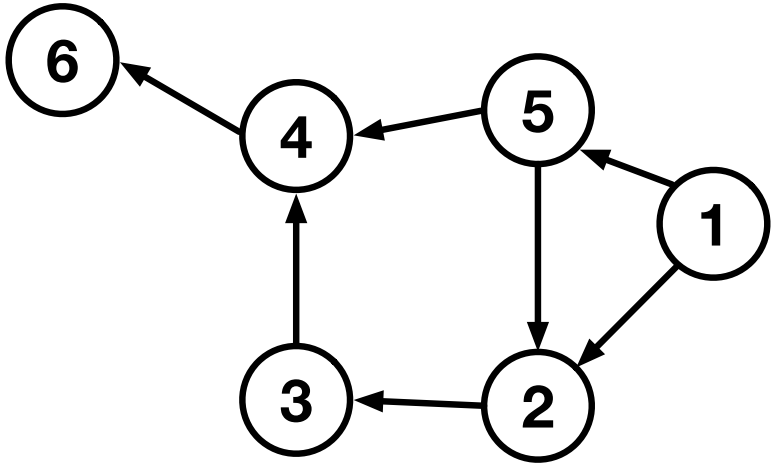
A (very brief) overview of graphs

A graph:
Structure
Nodes (Vertices, points)
- Objects that have some sort of connection



Edges
- Connection between them (can be directional or not)



Path
- A way of “moving” through the graph

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Code as a Graph

Abstraction of code:

Nodes – lines of code

Edges - transitions between lines (i.e. what gets executed)

```java
public class TriangleClassifier {
    public static String classify(int a, int b, int c) {

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        }

        if (a == b && b == c) {
            return "EQUILATERAL";
        }

        int max = Math.max(a, Math.max(b, c));

        if ((max == a && max - b - c >= 0) ||
                (max == b && max - a - c >= 0) ||
                (max == c && max - a - b >= 0)) {
            return "NOT_A_TRIANGLE";
        }

        if (a == b || b == c || a == c) {
            return "ISOSCELES";
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            return "SCALENE";
        }
    }
```

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Code as a Graph

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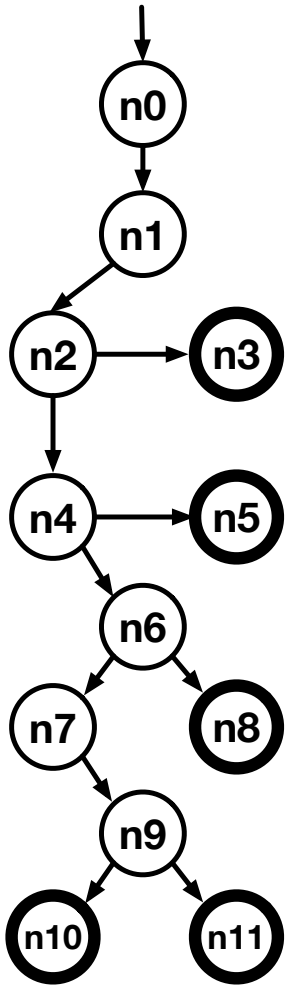


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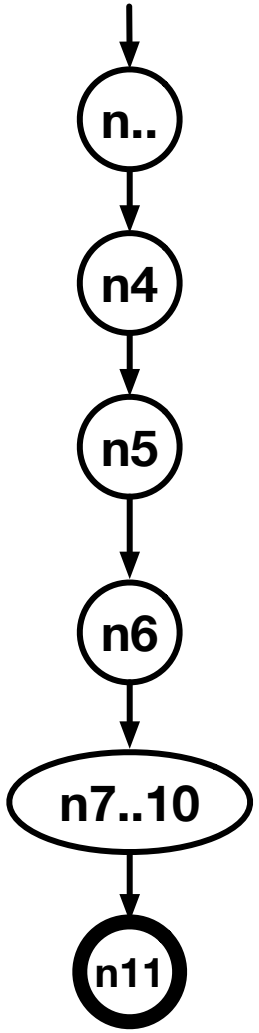


```java
public class SortingHelper {

    public static int[] sortArray(int[] array){
        int n = array.length;
        int[] result = array.clone();
        int temp = 0;
        for(int i=0; i < n; i++) // Looping through the array length
        {
            for(int j=1; j < (n-i); j++)
            {
                if(result[j-1] > result[j])
                {
                    //swap elements
                    temp = result[j-1];
                    result[j-1] = result[j];
                    result[j] = temp;
                }

            }
        }

        return result;
    }
```

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Code as a Graph

Abstraction of code:

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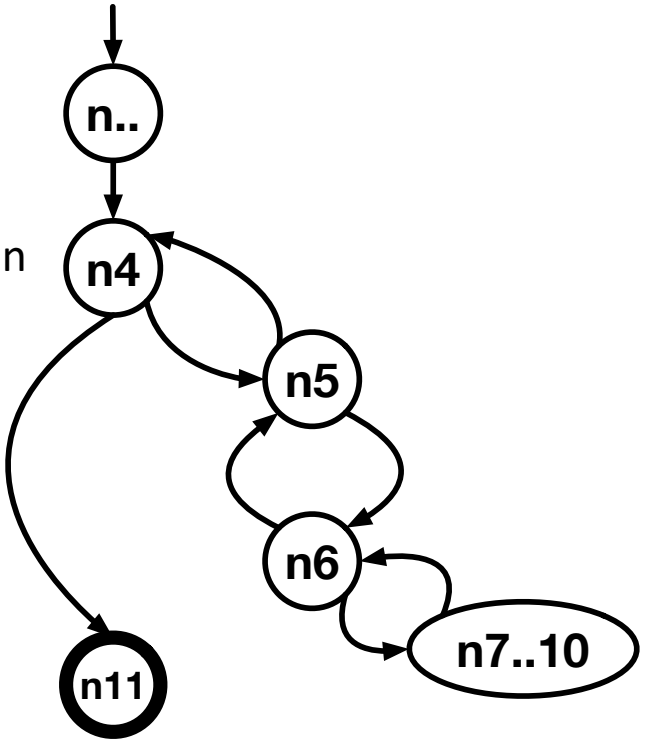


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```

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Back to our code

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        int max = Math.max(a, Math.max(b, c));

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        if (a == b || b == c || a == c) {
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```java
@Test
public void testScalene() throws Exception {
    int a = 5;
    int b = 7;
    int c = 9;

    String result = TriangleClassifier.classify(a, b, c);
    assertTrue(result.equalsIgnoreCase( anotherString: "SCALENE"));

}

@Test
public void testIsosceles() throws Exception{
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Code as a Graph

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```

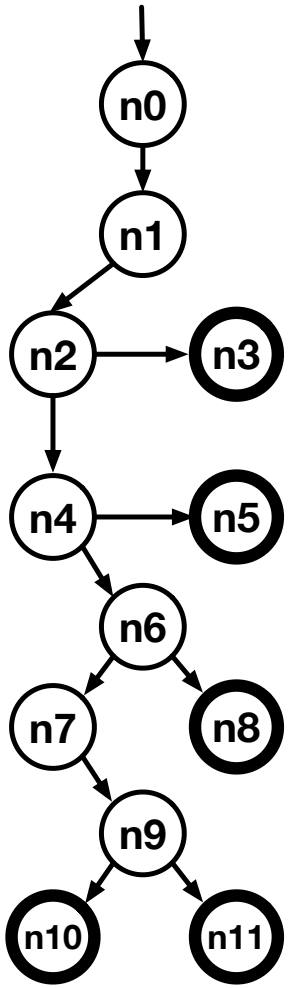


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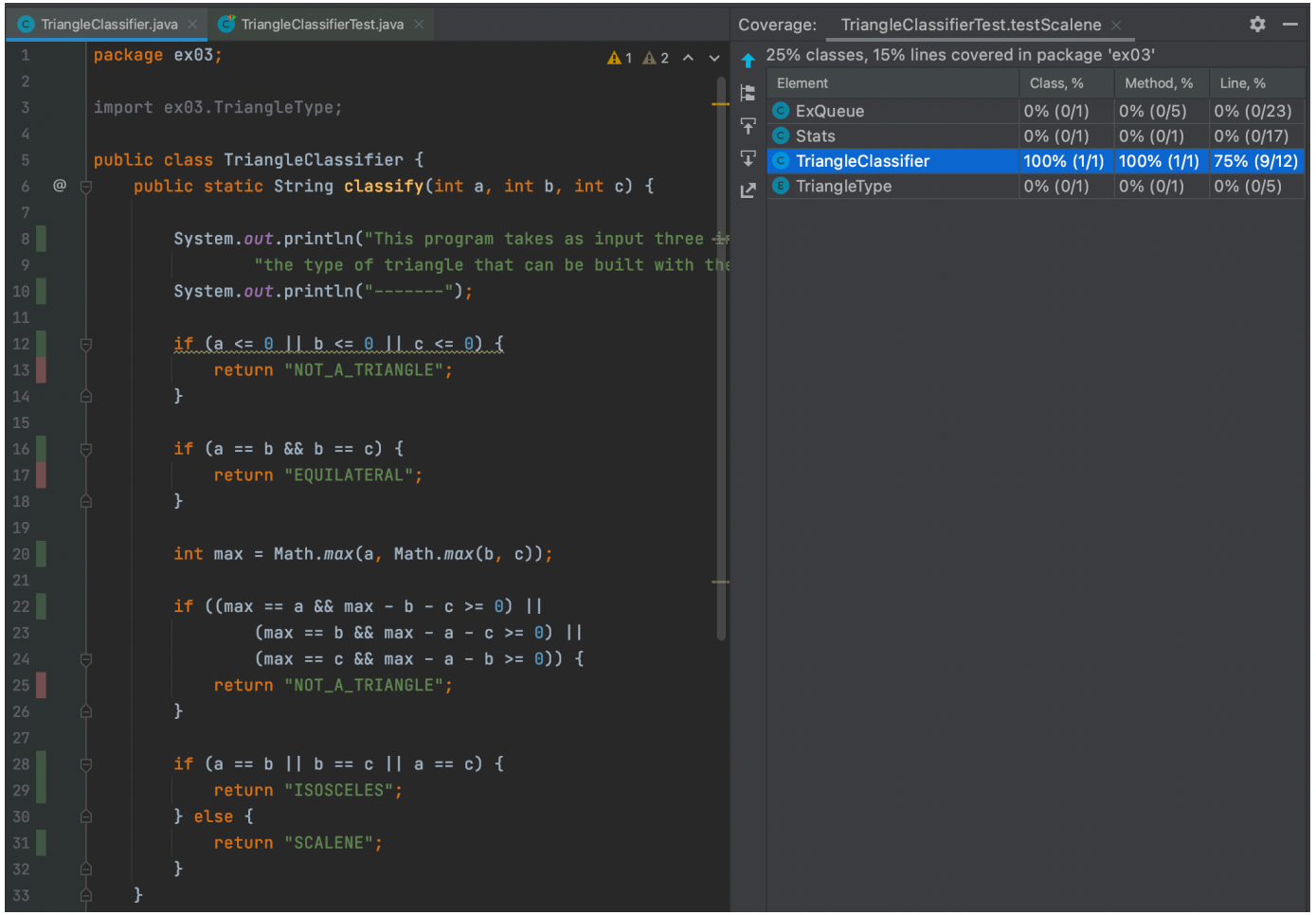
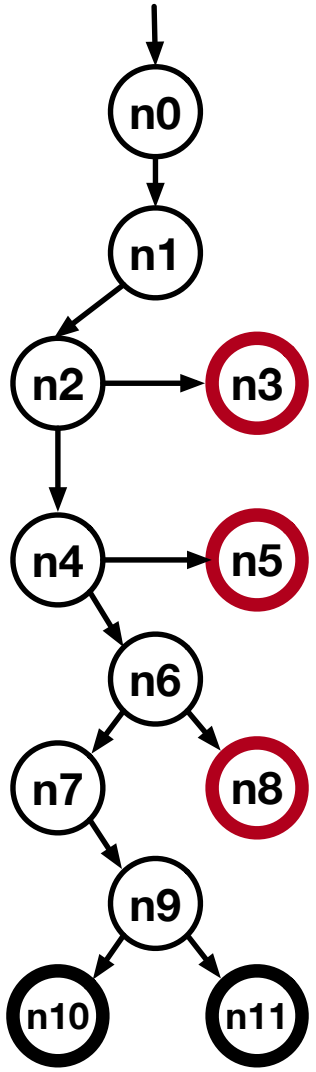
We mentioned “Coverage”





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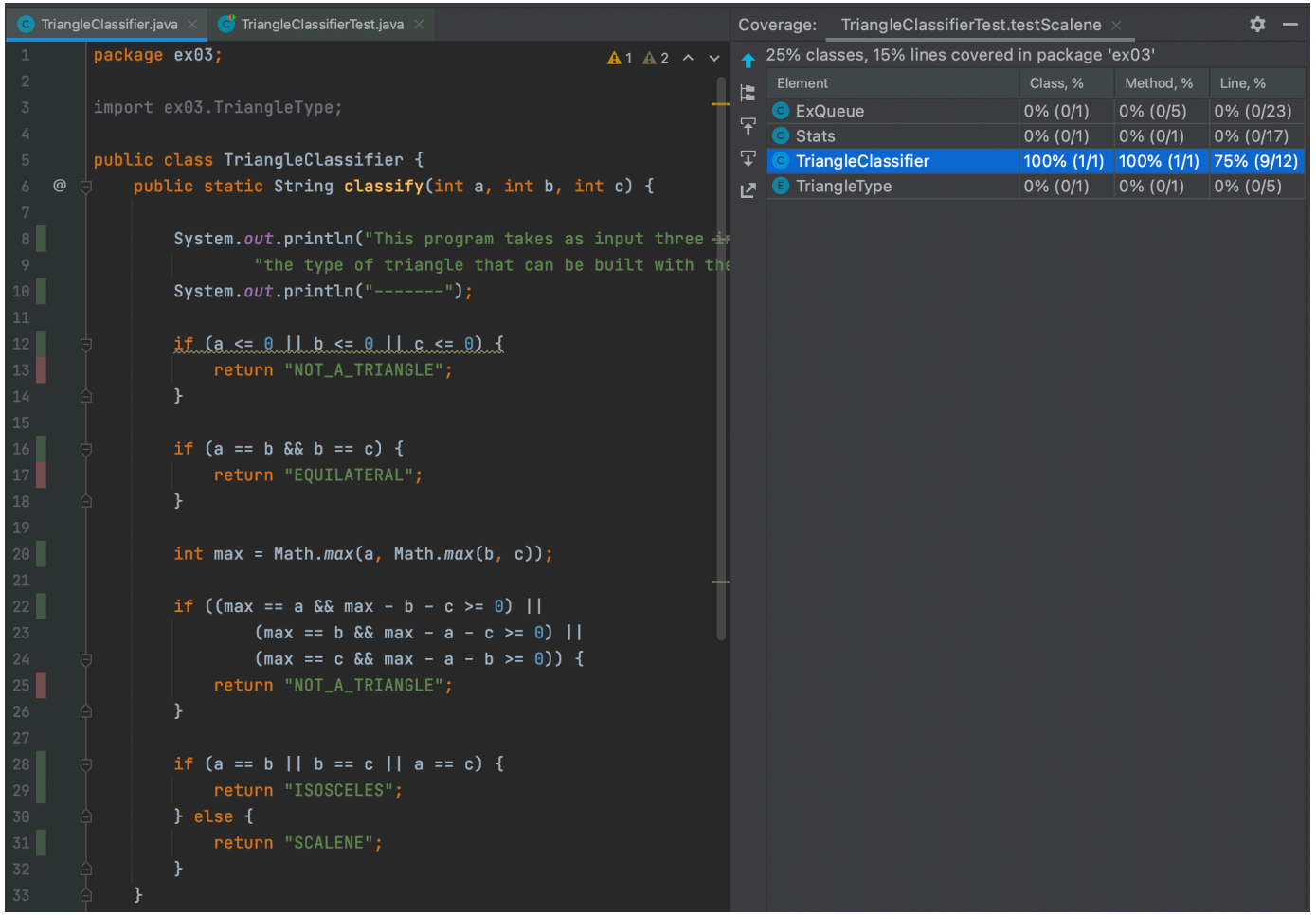

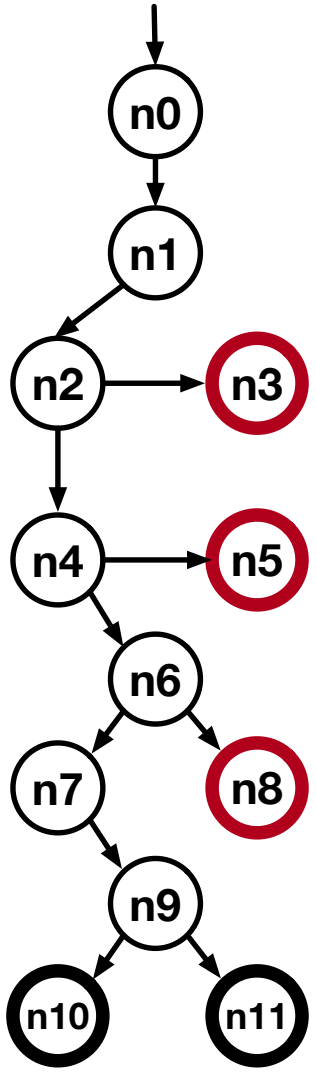

How can we cover the remaining nodes?

Are all nodes reachable?

(Should we?
Is it worth doing?)

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Code!!!

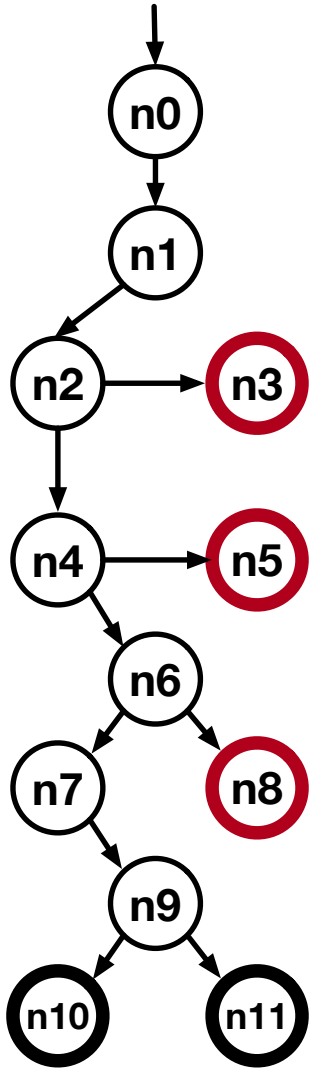
TriangleClassifier.java | TriangleClassifierTest.java

```
1   package ex03;
2
3   import ex03.TriangleType;
4
5   public class TriangleClassifier {
6   @     public static String classify(int a, int b, int c) {
7
8           System.out.println("This program takes as input three
9                   "the type of triangle that can be built with th
10          System.out.println("-------");
11
12          if (a <= 0 || b <= 0 || c <= 0) {
13              return "NOT_A_TRIANGLE";
14          }
15
16          if (a == b && b == c) {
17              return "EQUILATERAL";
18          }
19
20          int max = Math.max(a, Math.max(b, c));
21
22          if ((max == a && max - b - c >= 0) ||
23                  (max == b && max - a - c >= 0) ||
24                  (max == c && max - a - b >= 0)) {
25              return "NOT_A_TRIANGLE";
26          }
27
28          if (a == b || b == c || a == c) {
29              return "ISOSCELES";
30          } else {
31              return "SCALENE";
32          }
33      }
```

Coverage: TriangleClassifierTest.testScalene

25% classes, 15% lines covered in package 'ex03'

Element	Class, %	Method, %	Line, %
ExQueue	0% (0/1)	0% (0/5)	0% (0/23)
Stats	0% (0/1)	0% (0/1)	0% (0/17)
TriangleClassifier	100% (1/1)	100% (1/1)	75% (9/12)
TriangleType	0% (0/1)	0% (0/1)	0% (0/5)



Let’s add tests to cover the remaining nodes!

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Questions so far?

Exercise for the Seminar

Rooms:

A3-01

A4-03

A5-10

A5-18

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Exercise for the Seminar

Self-organized.
In repo:
Stats.java - Contains code for some basic stats on a group of numbers.

tests/StatsTest.java - Contains scaffolding for tests.

SO:
Draw up the graph for Stats.java
Write up what paths you want to cover (ideally all nodes will be covered)
Write up the tests for those paths.
Run (with coverage)!

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Exercise for the Seminar

When done
PatternMatcher.java - Contains code for some string pattern matching.

tests/PatTest.java - Contains scaffolding for tests.

SO:
Draw up the graph for PatternMatcher.java
Write up what paths you want to cover (ideally all nodes will be covered)
Write up the tests for those paths.
Run (with coverage)!

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