CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2013
Doc 3 Review, Refactoring
Jan 24, 2013

Review

- Object-Oriented Programming is good as it promotes
  - Code reuse
  - More readable code
  - More maintainable code
  - Better designs

Basic OO Heuristics

Keep related data and behavior in one place

A class should capture one and only one key abstraction

Beware of classes that have many accessor methods defined in their public interface

OO History

Objects as a formal concept in programming - Simula 67

Smalltalk introduced the term object-oriented programming - 1970s

Became dominant programming methodology
    Early and mid 1990s

So Why is Software Still so Bad?

Title Case

First letter in each word in a sentence is capitalized

This Is In Title Case.

This is not in title case.

NOR IS THIS IN TITLE CASE

Where do you put it in Java

In what class would you put a method that converts a string to title case?

Utility Method (Utility Function)

A method in a class that only uses data passed in as parameters

Code Smell

Hint that something has gone wrong somewhere in your code

http://c2.com/cgi/wiki?CodeSmell

Lists of Code Smells

A Taxonomy for "Bad Code Smells"

http://www.soberit.hut.fi/mmantyla/BadCodeSmellsTaxonomy.htm

Coding Horror: Code Smells

http://www.codinghorror.com/blog/2006/05/code-smells.html

Cunningham wiki c2

http://c2.com/cgi/wiki?CodeSmell

Code Smell - Utility Method

Helper functions are a sign that related data and operations are not together

Java & OO

In many situations we can not OO in Java

Can not keep data and operations together in many of Java's existing classes

Ruby, Objective-C & Smalltalk allow you to add to existing classes

Result

Can't practice OO in small cases

Develop poor habits

Lose benefits of OO but don't noticce

Code Smell - Vague Identifier

meetsCriteria
flag

This generally happens when the One Responsibility Rule has been violated

One Responsibility Rule

"A class has a single responsibility: it does it all, does it well, and does it only"

Bertrand Meyer

Try to describe a class in 25 words or less, and not to use "and" or "or"

If can not do this you may have more than one class

Refactoring

Refactoring

Changing the internal structure of software that changes its observable behavior

Done to make the software easier to understand and easier to modify

When to Refactor

Rule of three

- Three strikes and you refactor

When to Refactor

When you add a new function

When you need to fix a bug

When you do a code review

When Refactoring is Hard

Databases

Changing published interfaces

Major design issues

When you add a feature to a program

If needed Refactor the program to make it easy to add the feature

Then add the feature

Before you start refactoring

Make sure that you have a solid suite of tests

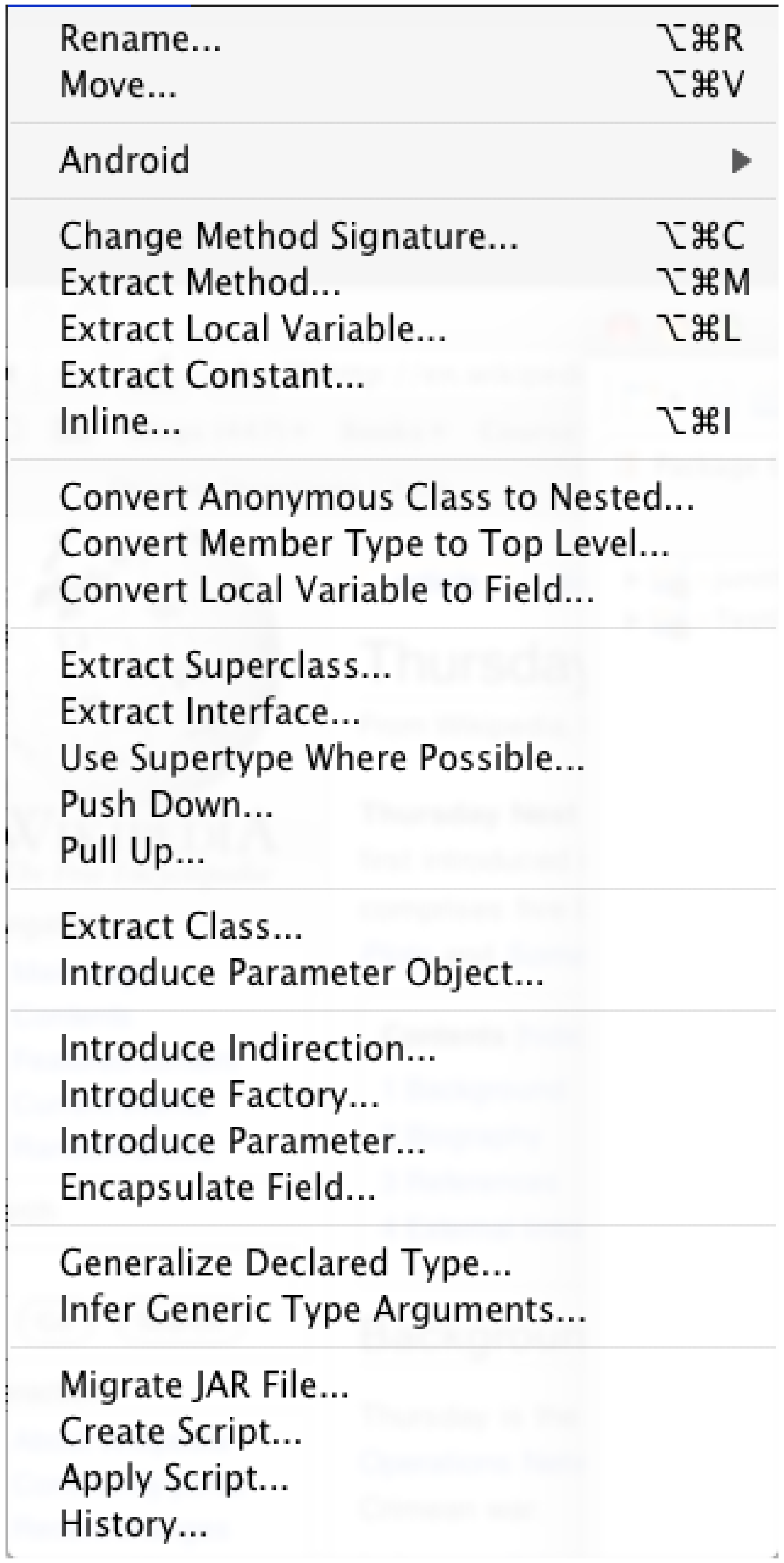
Test should be self-checking

Do I need tests when I use my IDEs refactoring tools?

Are your IDE refactoring tools bug free?

Eclipse Refactoring

Eclipse Refactoring Menu



Rename Class

```
public class Foo {
            public int foo() {
                  return 10;
      }
}
```

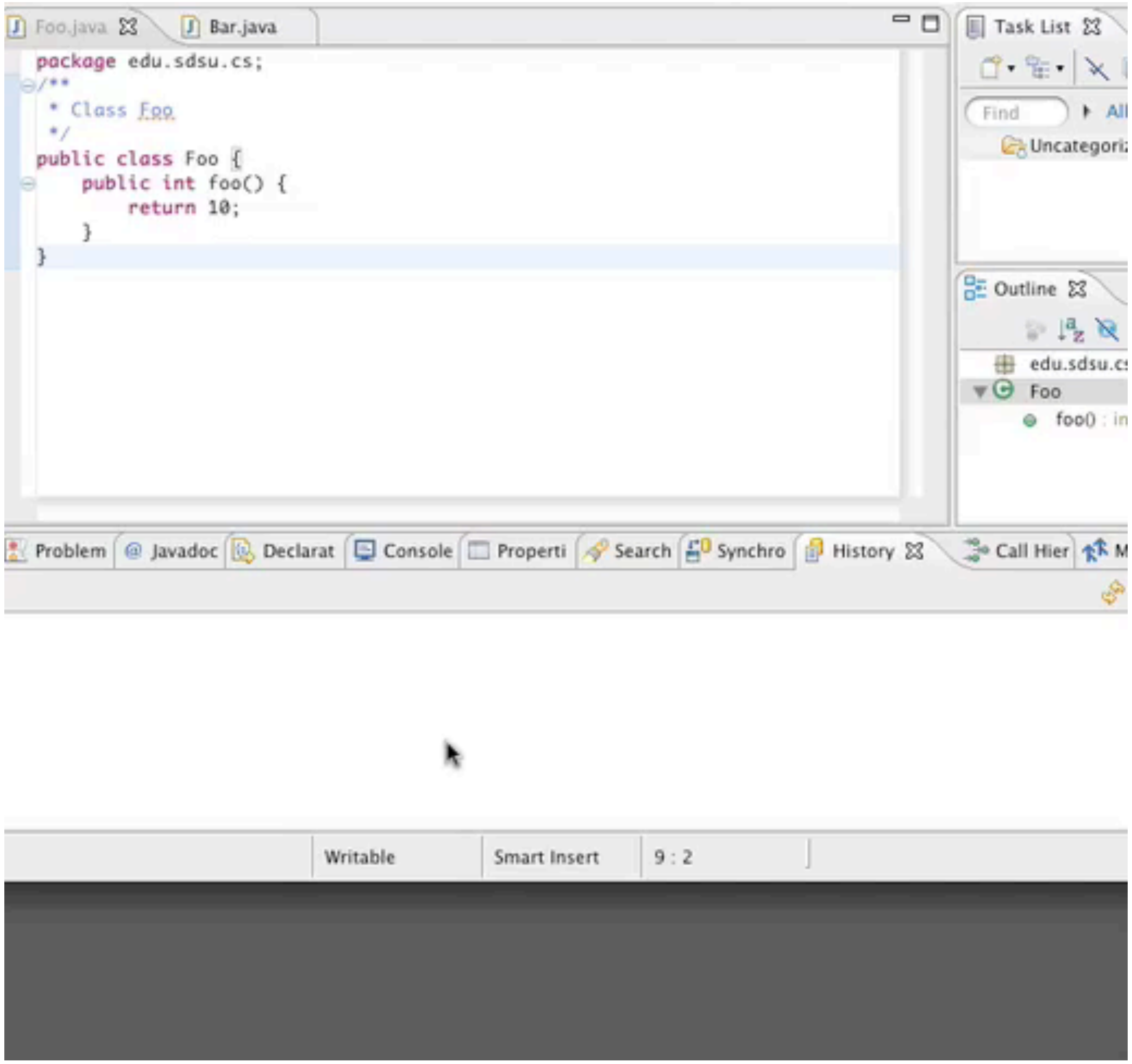
$\longrightarrow$

```
public class NewFoo {
            public int foo() {
                  return 10;
      }
}
```

```
public class Bar {
      public int bar() {
            Foo test = new Foo();
            return test.foo() + 99;
      }
}
```

```
public class Bar {
      public int bar() {
            NewFoo test = new NewFoo();
            return test.foo() + 99;
      }
}
```

Eclipse Rename



```
package edu.sdsu.cs;
/**
 * Class Foo
 */
public class Foo {
    public int foo() {
        return 10;
    }
}
```

Move

```
public class Bar {
	public int helperMethod(Foo test) {
		return test.foo() + test.fooTwo();
	}

	public int callHelper() {
		Foo data = new Foo();
		return helperMethod(data);
	}
}
```

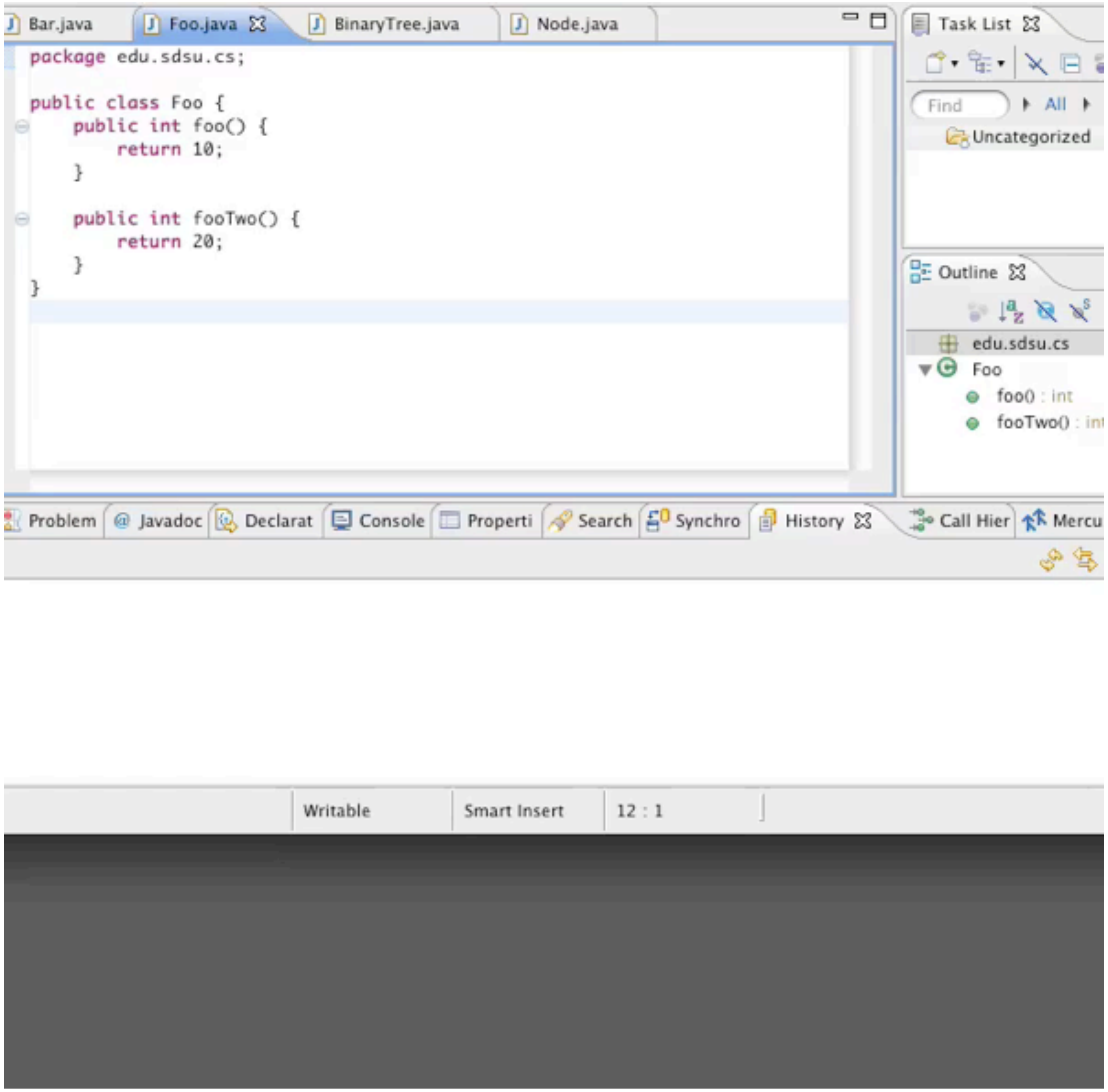
```
public class Foo {
	public int foo() { return 10;}

	public int fooTwo() { return 20; }
}
```

$\longrightarrow$

```
public class Bar {
	public int callHelper() {
		Foo data = new Foo();
		return data.sum();
	}
}
```

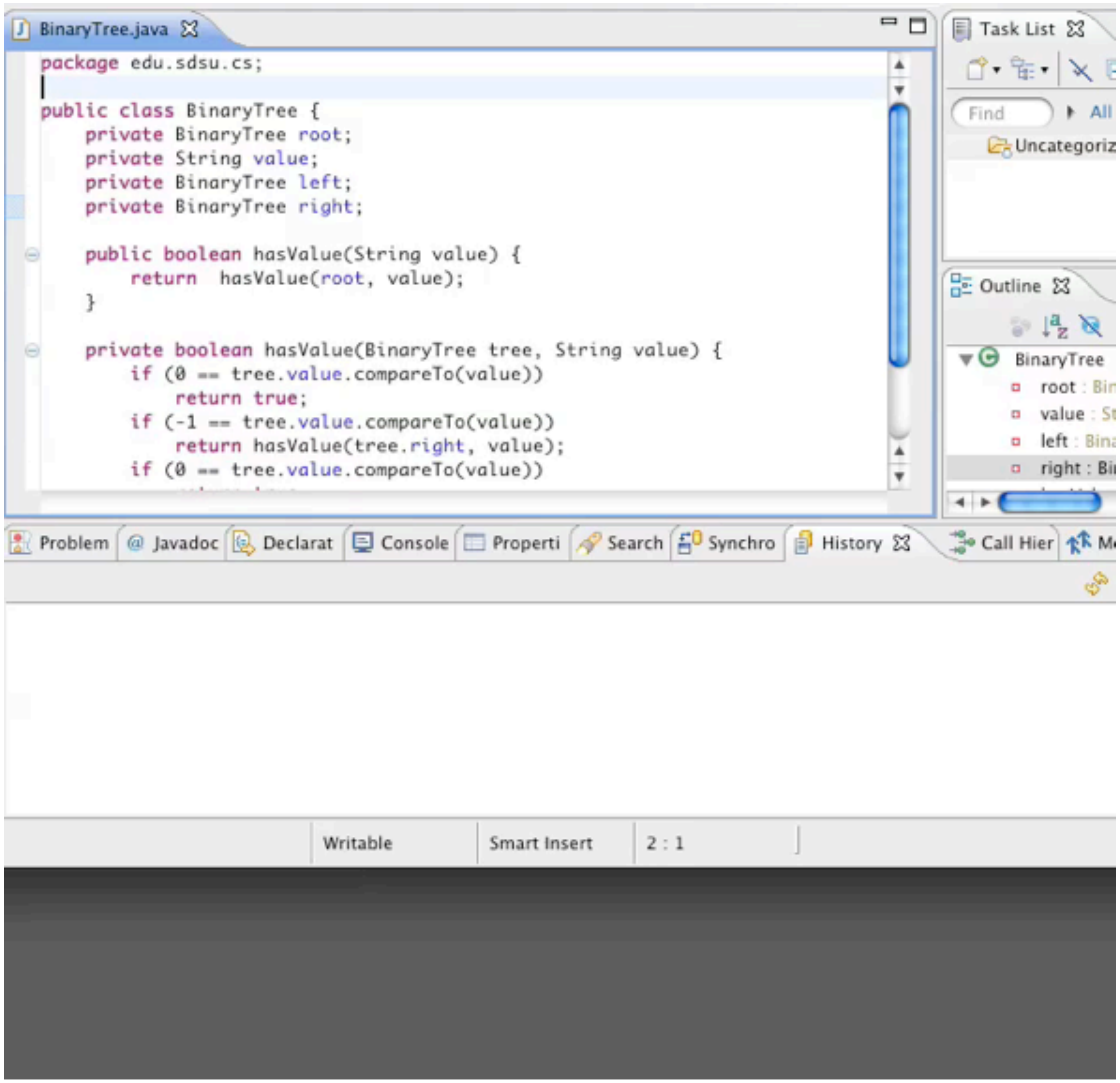
```
public class Foo {
	public int foo() { return 10;}

	public int fooTwo() {return 20; }

	public int sum() {
		return foo() + fooTwo();
	}
}
```

Eclipse Move



```
package edu.sdsu.cs;

public class Foo {
    public int foo() {
        return 10;
    }

    public int fooTwo() {
        return 20;
    }
}
```

Extract Class



```
package edu.sdsu.cs;

public class BinaryTree {
    private BinaryTree root;
    private String value;
    private BinaryTree left;
    private BinaryTree right;

    public boolean hasValue(String value) {
        return  hasValue(root, value);
    }

    private boolean hasValue(BinaryTree tree, String value) {
        if (0 == tree.value.compareTo(value))
            return true;
        if (-1 == tree.value.compareTo(value))
            return hasValue(tree.right, value);
        if (0 == tree.value.compareTo(value))
```

Thursday, January 24, 13

Refactoring Tool Issue

People tend to only use the features they know

Refactoring Tool Issue

Is a tool hard to use because I am unfamiliar with it or is it just hard to use

Refactoring by 41 Professional Programmers

	Number of Programmers used Refactoring	Total Times used
IntroduceFactory	1	1
PushDown	1	1
UseSupertype	1	6
EncapsulateField	2	5
Introduce Parameter	3	25
Convert Local to Field	5	37
Extract Interface	10	26
Inline	11	185
Modify Parameters	11	79
Pull up	11	37
Extract Method	20	344
Move	24	212
Rename	41	2396

From Refactoring Tools: Fitness for Purpose, Emerson Murphy-Hill and Andrew P. Black,http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.139.191&rep=rep1&type=pdf

Try In Eclipse

Rename
Move
Encapsulate Field
Extract Method
Extract Class

Unit Testing

Testing

Johnson's Law

If it is not tested it does not work

The more time between coding and testing

- More effort is needed to write tests
- More effort is needed to find bugs
- Fewer bugs are found
- Time is wasted working with buggy code
- Development time increases
- Quality decreases

Unit Testing

Tests individual code segments

Automated tests

What wrong with:

Using print statements

Writing driver program in main

Writing small sample programs to run code

Running program and testing it be using it

We have a QA Team, so why should I write tests?

When to Write Tests

First write the tests

Then write the code to be tested

Writing tests first saves time

- Makes you clear of the interface & functionality of the code
- Removes temptation to skip tests

What to Test

Everything that could possibly break

Test values
- Inside valid range
- Outside valid range
- On the boundary between valid/invalid

GUIs are very hard to test
- Keep GUI layer very thin
- Unit test program behind the GUI, not the GUI

Common Things Programs Handle Incorrectly

Adapted with permission from “A Short Catalog of Test Ideas” by Brian Marick,

http://www.testing.com/writings.html

Strings

Empty String

Collections

Empty Collection

Collection with one element

Collection with duplicate elements

Collections with maximum possible size

Numbers

Zero

The smallest number

Just below the smallest number

The largest number

Just above the largest number

XUnit

Free frameworks for Unit testing

SUnit originally written by Kent Beck 1994

JUnit written by Kent Beck & Erich Gamma

Available at: http://www.junit.org/

Ports to many languages at:
http://www.xprogramming.com/software.htm

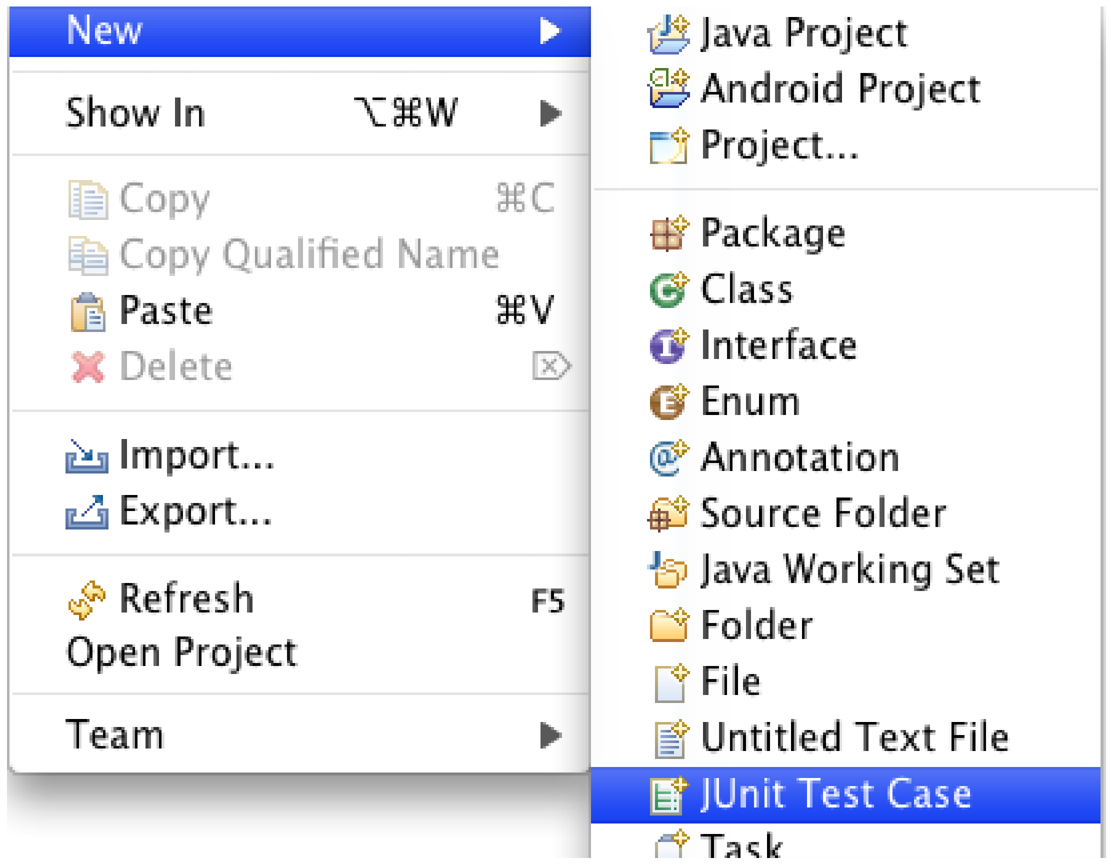
XUnit Versions

3.x	4.x
Old version	Current version 4.8.1
Works with a versions of Java	Uses Annotations
	Requires Java 5 or later

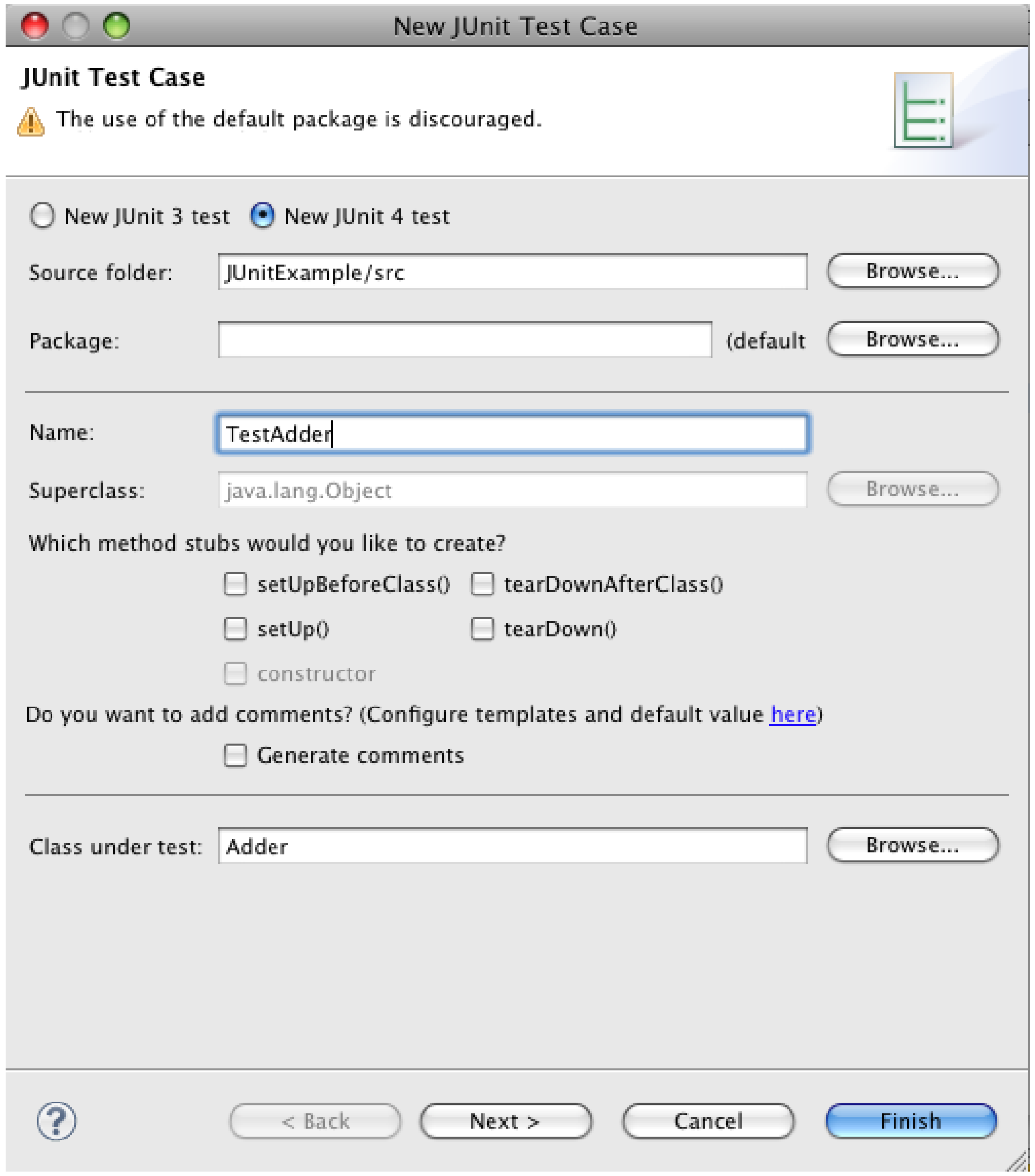
Simple Class to Test

```
public class Adder {
      private int base;
      public Adder(int value) {
            base = value;
      }

      public int add(int amount) {
            return base + amount;
      }
}
```

Creating Test Case in Eclipse



Creating Test Case in Eclipse



New JUnit Test Case

JUnit Test Case

⚠ The use of the default package is discouraged.

○ New JUnit 3 test ● New JUnit 4 test

Source folder:	JUnitExample/src	Browse...
Package:	(default	Browse...
Name:	TestAdder	
Superclass:	java.lang.Object	Browse...

Which method stubs would you like to create?

☐ setUpBeforeClass() ☐ tearDownAfterClass()

☐ setUp() ☐ tearDown()

☐ constructor

Do you want to add comments? (Configure templates and default value here)

☐ Generate comments

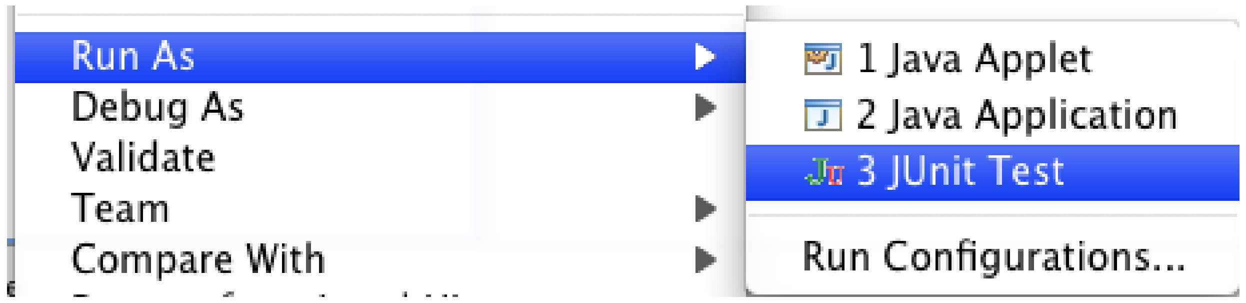
Class under test: Adder Browse...

Fill in dialog window & create the test cases

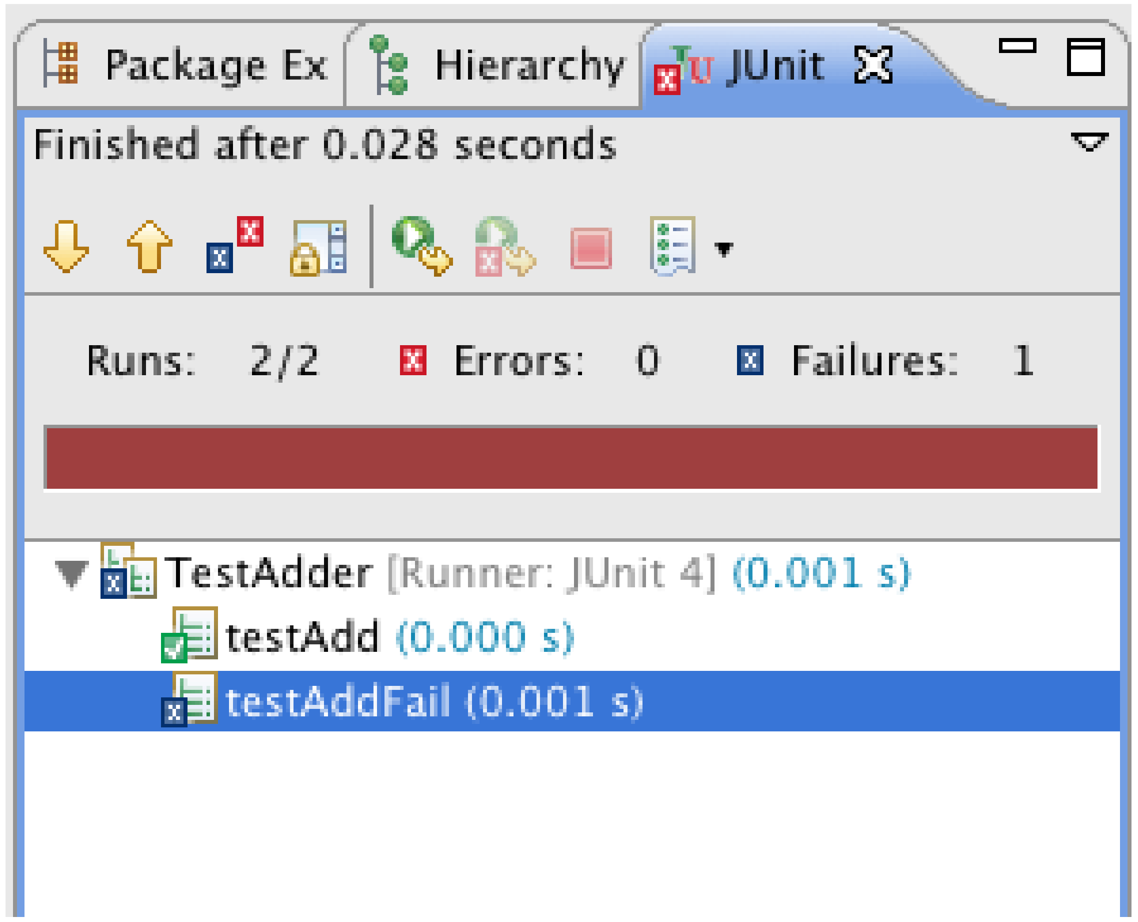
Test Class

```
import static org.junit.Assert.assertEquals;
import static org.junit.Assert.assertTrue;
import org.junit.Test;

public class TestAdder {

    @Test
    public void testAdd() {
        Adder example = new Adder(3);
        assertEquals(4, example.add(1));
    }

    @Test
    public void testAddFail() {
        Adder example = new Adder(3);
        assertTrue(3 == example.add(1));
    }
}
```

Running the Tests



The result



Finished after 0.028 seconds

Runs: 2/2   Errors: 0   Failures: 1

TestAdder [Runner: JUnit 4] (0.001 s)
testAdd (0.000 s)
testAddFail (0.001 s)

Assert Methods

assertArrayEquals()
assertTrue()
assertFalse()
assertEquals()
assertNotEquals()
assertSame()
assertNotSame()
assertNull()
assertNotNull()
fail()

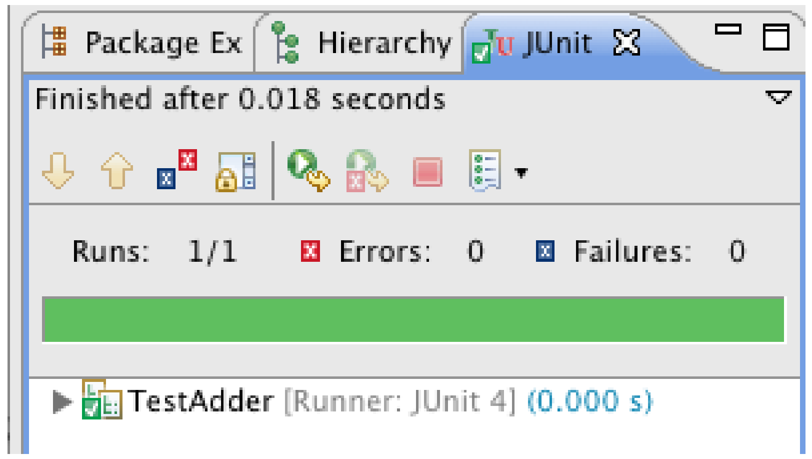
For a complete list see http://kentbeck.github.com/junit/javadoc/latest/

Annotations

After
AfterClass
Before
BeforeClass
Ignore
Rule
Test

Using Before

```
import static org.junit.Assert.assertEquals;
import static org.junit.Assert.assertTrue;

import org.junit.Before;
import org.junit.Test;

public class TestAdder {
	Adder example;
	@Before
	public void setupExample() {
		example = new Adder(3);
	}

	@Test
	public void testAdd() {
		assertEquals(4, example.add(1));
	}
}
```



```
Finished after 0.018 seconds

Runs:  1/1    Errors:  0    Failures:  0

TestAdder [Runner: JUnit 4] (0.000 s)
```

Code Smells

Classifying Fowler's Code Smells

Bloaters	Long method Large Class Primitive Obsession Long Parameter List Data Clumps
Object-Orientation Abusers	Switch Statements Temporary Field Refused Bequest Alternative Classes with Different Interfaces
Change Preventers	Divergent Change Shotgun Surgery Parallel Inheritance Hierarchies

http://www.soberit.hut.fi/mmantyla/BadCodeSmellsTaxonomy.htm

Classifying Fowler's Code Smells

Dispensables	Lazy class Data class Duplicate Code Dead Code, Speculative Generality
Couplers	Feature Envy Inappropriate Intimacy Message Chains Middle Man

http://www.soberit.hut.fi/mmantyla/BadCodeSmellsTaxonomy.htm

Duplicate Code

Duplicate Code

Duplicate Code

Duplicate Code

Duplicate Code

Duplicate Code

Duplicate Code

Duplicate Code

Long Method - Large Class

The average method size should be less than 8 lines of code (LOC) for Smalltalk and 24 LOC for C++

The average number of methods per class should be less than 20

The average number of fields per class should be less than 6.

The class hierarchy nesting level should be less than 6

The average number of comment lines per method should be greater than 1

Mark Lorenz, *Object-Oriented Software Development: A Practical Guide*, 1993, Appendix I Measures and Metrics

Long Parameter List

```
a.foo(12, 2, "cat", "<tr>", 19.6, x, y, classList, cutOffPoint)
```

Divergent Change

One class is changed in different ways for different reasons

ShotGun Surgery

When you have to make a kind of change you have to make a lot of little changes in different locations

Feature Envy

A method seems more interested in a class other than the on it is in.

Data Clumps

Same three or four data items together in lots of places

Primitive Obsession

Using primitive types instead of creating small classes

Switch Statements

How do you program without them?

Lazy Class

Class that is not doing enough to pay for itself

Data Class

Class with just fields and setter/getter methods

Data classes are like children.

They are okay as a starting point, but to participate as a grownup object, they need to take some responsibility

Inappropriate Intimacy

Classes that spend too much time delving into other classes private parts

Message Chains

```
location = rat.getRoom().getMaze().getLocation()
```

Negative Slope

```
if (foo) {
    if (bar) {
        if (cat = dog) {
            if (rat < 10) {
                ...
```

Temporary Field

Field is only used in certain circumstances

Common case

- field is only used by an algorithm
- Don't want to pass around long parameter list
- Make parameter a field

Refused Bequest

Subclass does not want to support all the methods of parent class

Subclass should support the interface of the parent class