CS 635 Advanced Object-Oriented Design & Programming
Spring Semester, 2009
Doc 3 Refactoring Intro
Jan 28, 2009

References

JUnit Web site: http://www.junit.org/

JUnit JavaDoc, http://kentbeck.github.com/junit/javadoc/latest/

Brian Marick's Testing Web Site: http://www.exampler.com/testing-com/

Testing for Programmers, Brian Marick, Available at: http://www.exampler.com/testing-com/writings.html

Refactoring: Improving the Design of Existing Code, Fowler, Addison-Wesley, 1999, chapters 1 & 3

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

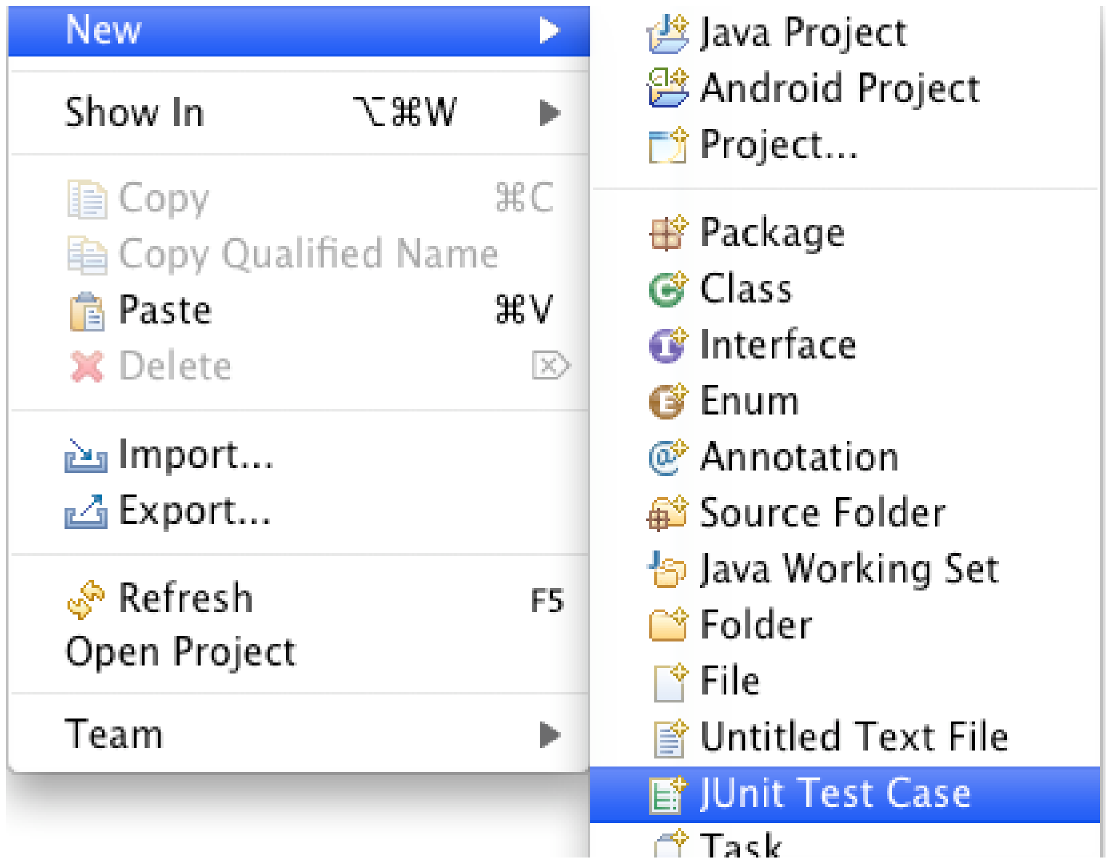
XUnit Versions

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

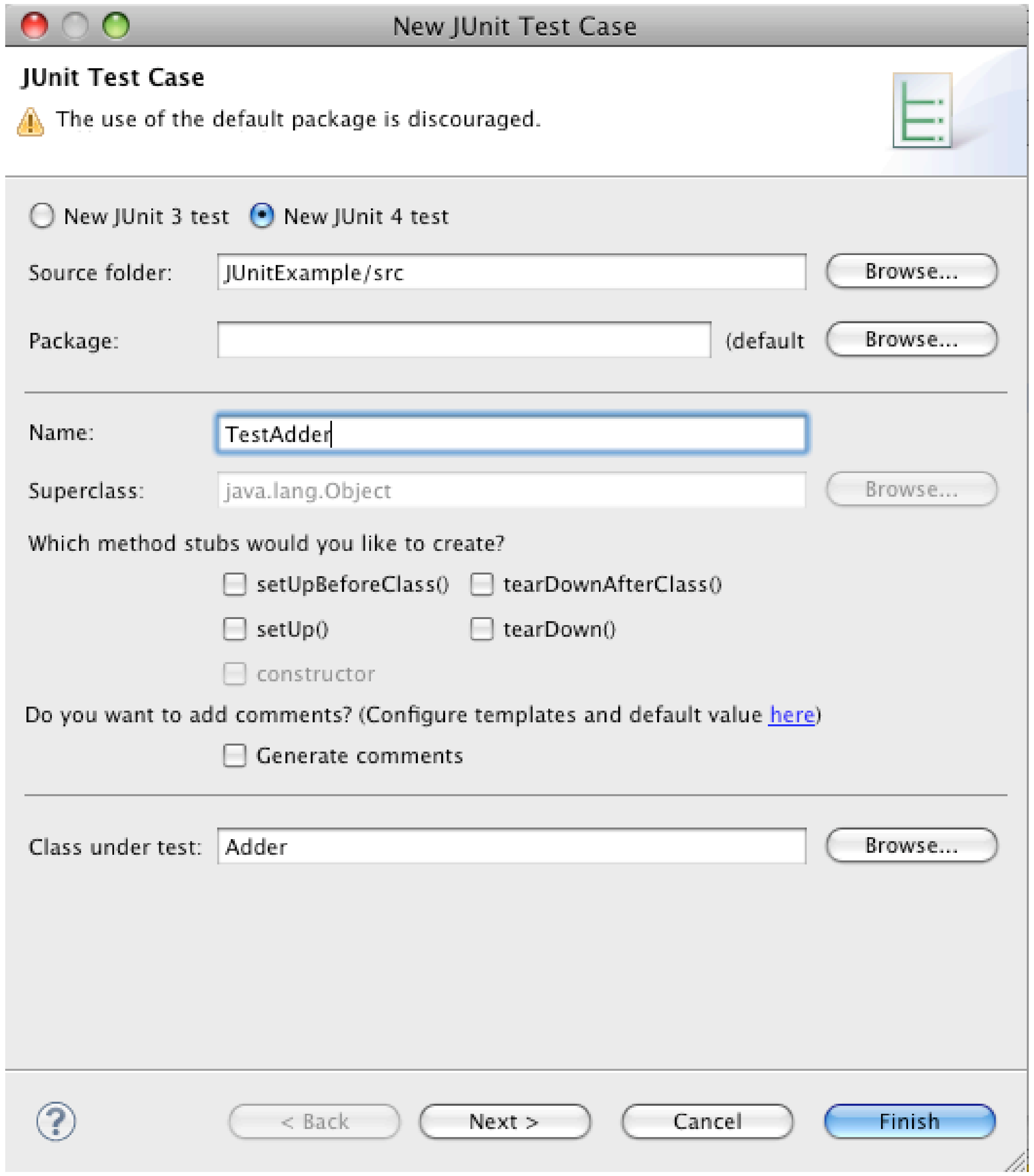
Simple Class to Test

```
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

Package: (default

Name: TestAdder

Superclass: java.lang.Object

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

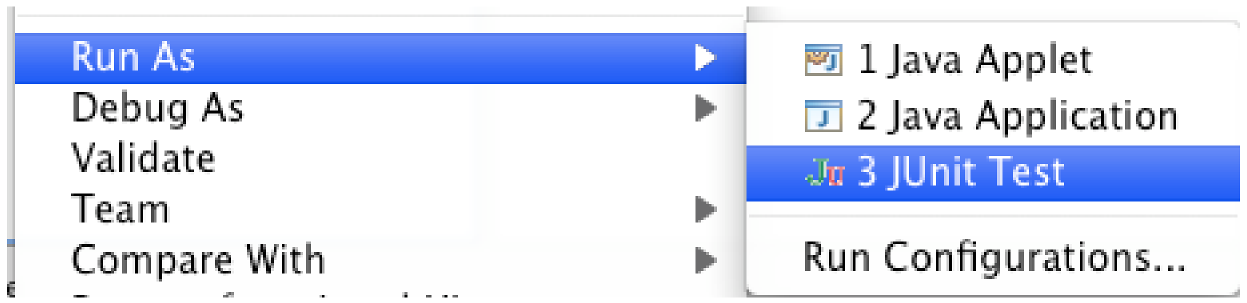
Class under test: Adder

Fill in dialog window & create the test cases

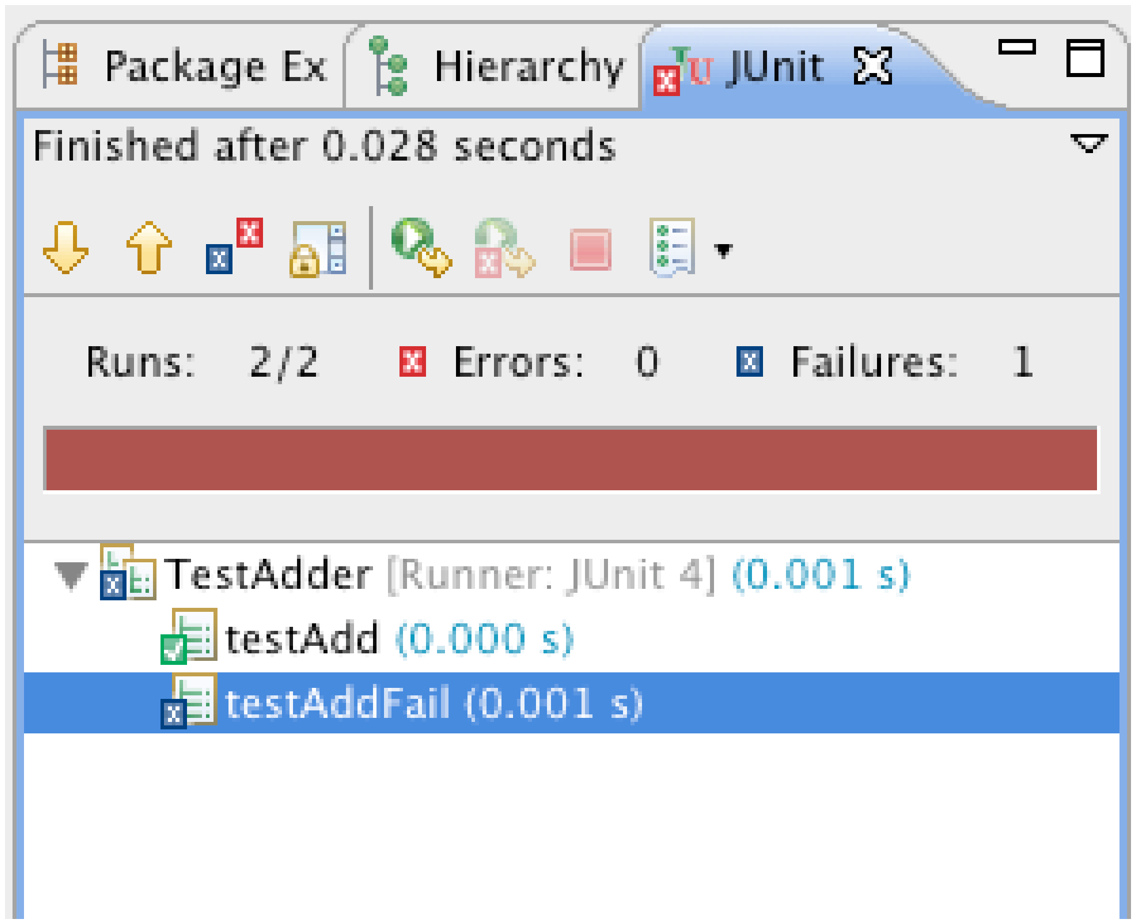
Test Class

```
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

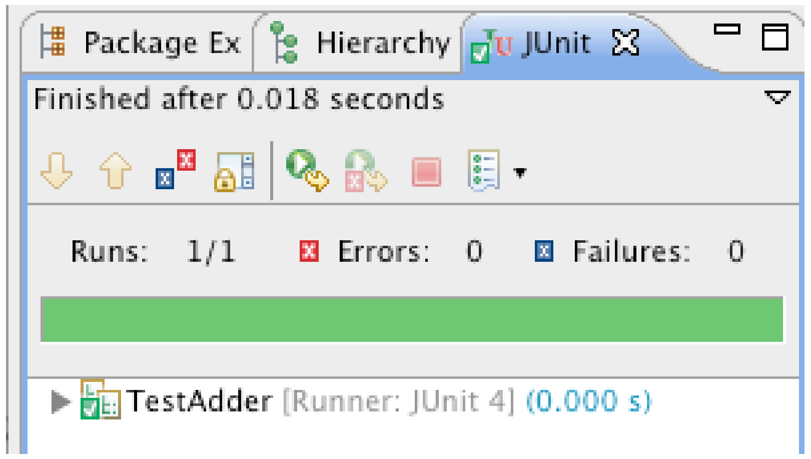
Ignore

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)

Refactoring

Refactoring

Changing the internal structure of software without changing its observable behavior

Done to make the software easier to understand and cheaper 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?

Code Smells

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