# CS 635 Advanced Object-Oriented Design & Programming

Spring Semester, 2006
Doc 2 Terms & Testing
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## References


Object-Oriented Design Heuristics, Riel, 1996

JUnit Cookbook http://junit.sourceforge.net/doc/cookbook/cookbook.htm

JUnit Test Infected: Programmers Love Writing Tests http://junit.sourceforge.net/doc/testinfected/testing.htm

JUnit Javadoc: http://www.junit.org/junit/javadoc/3.8/index.htm

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

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

# Terms

Abstraction

Encapsulation

Information Hiding

Polymorphism

## Heuristics

All data should be hidden within its class

```
public class A {
        public int x;
        public int y;
        public int z;
}
```

```
public class B {
        private int x;
        private int y;
        private int z;

        public int getX() { return x;}
        public int getY() { return y;}
        public int getZ() { return z;}
        public void setX(int value) {x = value;}
        public void setY(int value) {y = value;}
        public void setZ(int value) {z = value;}
}
```

## Heuristics

Keep related data and behavior in one place

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

Do not create god classes/objects in your system

A class should capture one and only one key abstraction

Beware of classes that have too much noncommunicating behavoir

## 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

Automotated 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

## JUnit Example

Goal: Implement a Stack containing integers.

Tests:

Subclass junit.framework.TestCase

Methods starting with 'test" are run by TestRunner

First tests for the constructors:

```
import junit.framework.*;
public class  TestStack extends TestCase {
        public void testDefaultConstructor() {
                Stack test = new Stack();
                assertTrue("Default constructor", test.isEmpty() );
        }

        public void testSizeConstructor() {
                Stack test = new Stack(5);
                assertTrue( test.isEmpty() );
        }
}
```

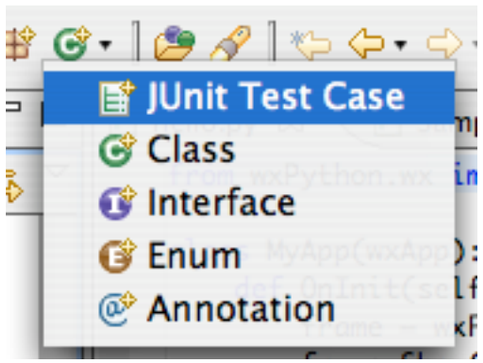
## Start of Stack Class

```
public class Stack  {
        int[] elements;
        int topElement = -1;

        public Stack() {
         this(10);
        }

        public Stack(int size) {
                elements = new int[size];
        }

        public boolean isEmpty() {
                return topElement == -1;
        }
}
```

# Running JUnit Using Eclipse

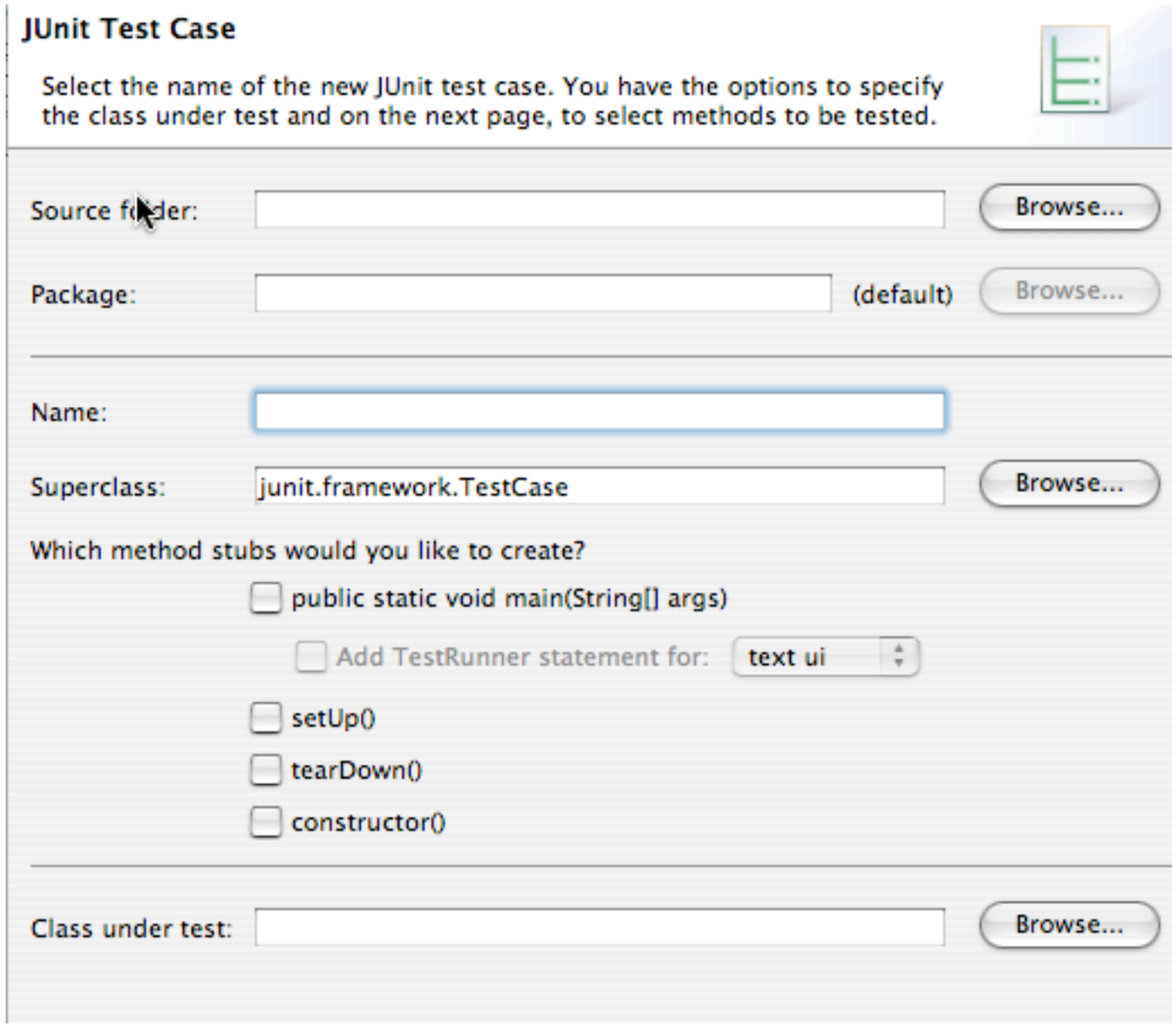
After creating your Stack Class

Select JUnit TestCase in Create Icons Menu



# Running JUnit Using Eclipse

Fill in dialog window & create the test cases




Select Junit test case from the "Run as..." menu

# Assert Methods

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

For a complete list see

http://www.junit.org/junit/javadoc/3.8/index.htm/allclasses-frame.html/junit/junit/framework/Assert.html/Assert.html

## Testing the Tests

If can be useful to modify the code to break the tests

```
package example;

public class Stack  {
	int[] elements;
	int topElement = -1;

	etc.

	public boolean isEmpty() {
		return topElement == 1;
	}
}
```

## Test Fixures

Before each test setUp() is run

After each test tearDown() is run

```
package example;
import junit.framework.TestCase;

public class  StackTest extends TestCase {
        Stack test;

        public void setUp() {
                test = new Stack(5);
                for (int k = 1; k <=5;k++)
                        test.push( k);
        }

        public void testPushPop() {
                for (int k = 5; k >= 1; k--)
                        assertEquals( "Pop fail on element " + k,  test.pop() , k);
        }
}
```

## Testing Exceptions

```
public void testIndexOutOfBoundsException() {

    ArrayList list = new ArrayList(10);
    try {
        Object o = list.get(11);
        fail("Should raise an IndexOutOfBoundsException");
    } catch (IndexOutOfBoundsException success) {}
}
```

Example is from the JUnit FAQ