Modulo II
Técnicas para desenvolvimento de Software Ágil - JUNIT

Prof. Ismael H F Santos

Bibliografia

- *Vinicius Manhaes Teles, Extreme Programming, Novatec Editora*
- *Agile Software Development*
- *Scrum and XP from the Trenches*
- *Martin Fowler, Analysis Patterns - Reusable Object Models, Addison-Wesley,1997*
- *Martin Fowler, Refatoração - Aperfeiçoando o projeto de código existente, Ed Bookman*

Ementa

- Modulo I – Xtreme Programming
  - Valores e Princípios do XP
  - Desenvolvimento centrado em Testes
    - Continuous Integration
      - JUnit, Maven, Code-cruiser

Agenda:

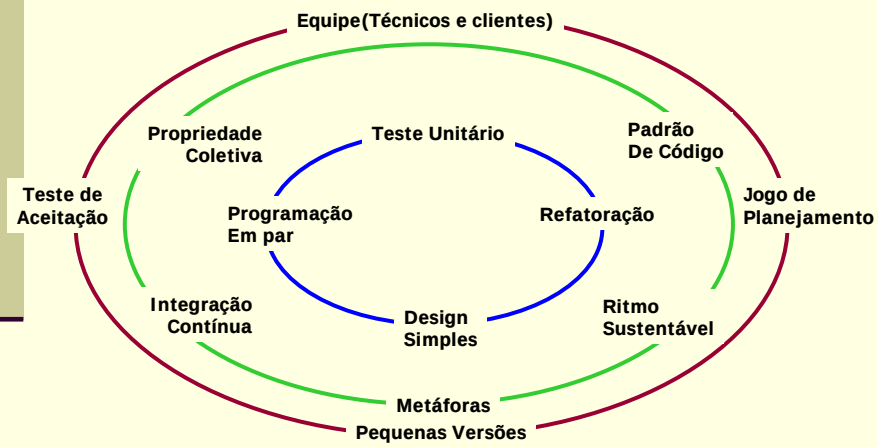
- Um pouco de XP.
- Como programar guiado a testes?
- Teste Unitário (O que?, por que?, quando?, quem?, como?).
- JUnit(O que?, por que?, quando?, quem?, como?).
- JUnit(Planejamento e arquitetura das classes).
- JUnit(Funcionamento e Análise do resultado).
- Implementado testes em JUnit usando o Eclipse.
- Outros métodos e técnicas complementares.
- Conclusão.

MA-JUNIT

Introdução

Práticas XP

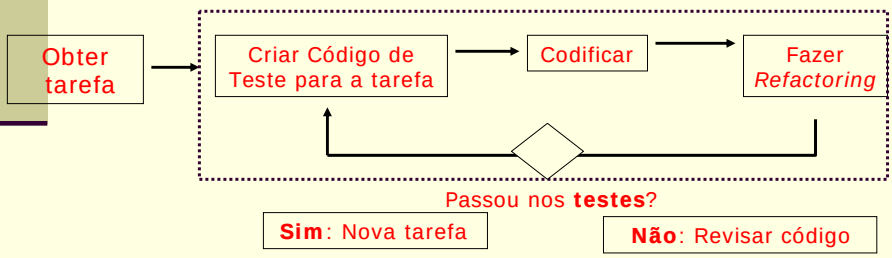
Práticas organizacionais
Práticas de equipe
Práticas de pares



TDD

Test Driven Development

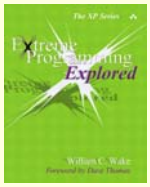
- **Desenvolvimento Guiado por Testes**, define que antes de criarmos um código novo, devemos escrever um teste para ele.
- E testes serão usados como métrica em todo o tempo de vida do projeto.



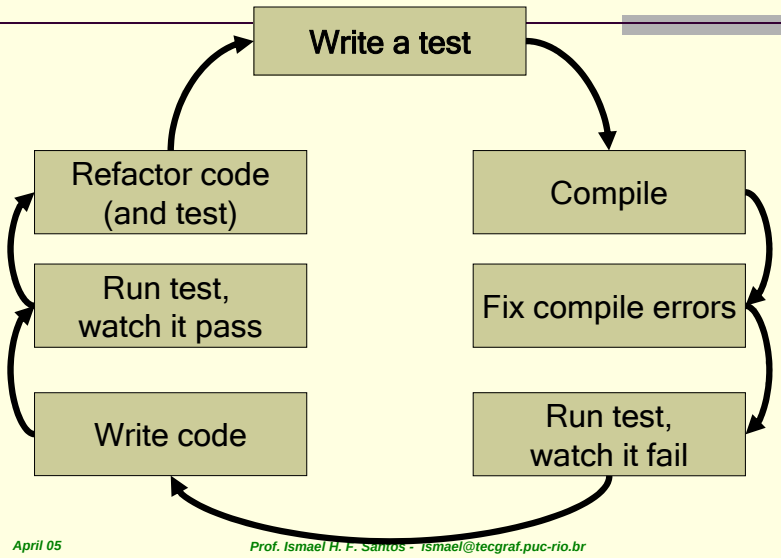
TDD Stages

- In Extreme Programming Explored (The Green Book), Bill Wake describes the test / code cycle:

1. Write a single test
2. Compile it. It shouldn't compile because you've not written the implementation code
3. Implement just enough code to get the test to compile
4. Run the test and see it **fail**
5. Implement just enough code to get the test to pass
6. Run the test and see it **pass**
7. **Refactor** for clarity and "once and only once"
8. Repeat



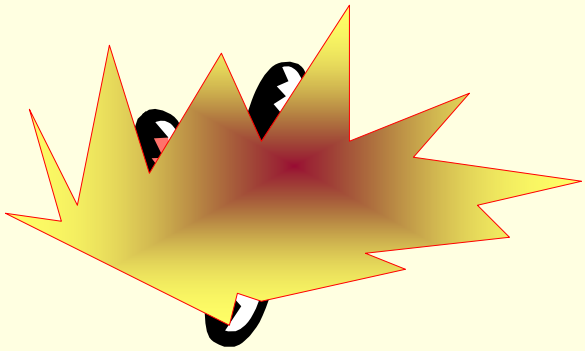
TDD Stages



Teste Unitário

Imagine se um avião só fosse testado após a conclusão de sua construção....

Seria um desastre....



Teste Unitário

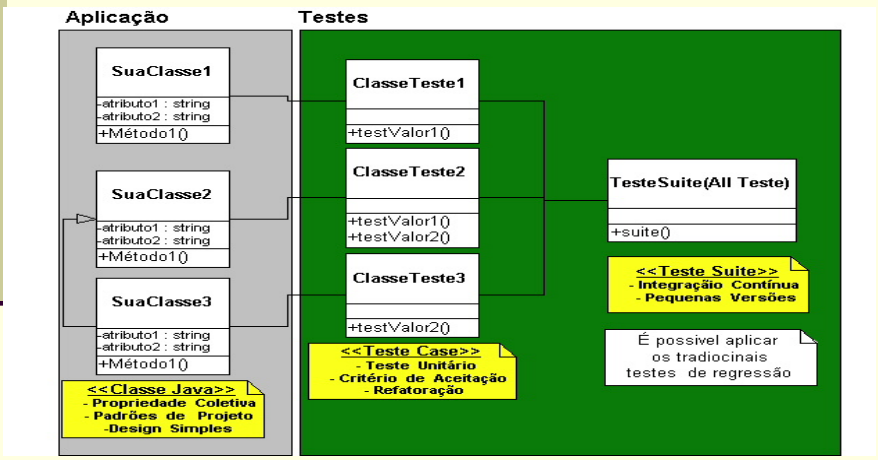
- O que é ?
  - O **teste unitário** é uma modalidade de testes que se concentra na verificação da menor unidade do projeto de software. É realizado o teste de uma **unidade lógica**, com uso de dados suficientes para se testar apenas a lógica da unidade em questão.
  - Em sistemas construídos com uso de linguagens orientadas a objetos, essa unidade pode ser identificada como um **método**, uma **classe** ou mesmo um **objeto**.

Teste Unitário

- **Por que ?**
  - **Previne** contra o aparecimento de “BUG’S” oriundos de códigos mal escritos.
  - Código testado é mais confiável.
  - Permite alterações sem medo(**coragem**)
  - Testa situações de sucesso e de falha.
  - Resulta em outras práticas XP como : **Código coletivo**, **refatoração**, **integração contínua.**
  - Serve como métrica do projeto (*teste* **==***requisitos*)
  - Gera e preserva um “conhecimento” sobre o projeto.

Teste Unitário

- **Organização dos testes e práticas XP**



Teste Unitário

- **Quando fazer?**
  - **No início**

    Primeiro projetar e escrever as classes de testes, **depois** as classes com regra de negócios
  - **Diariamente**

    È SUGERIDO que seja rodado os testes várias vezes ao dia (é fácil corrigir **pequenos** problemas do que corrigir um "**problemão**" somente no final do projeto.

Teste Unitário

- **Quem faz?**
  - **Test Case**(para cada classe)
    Desenvolvedor(Projeta, escreve e roda)
  - **Test Suite**(Rodas vários test cases)
    Coordenador e Desenvolvedor
    (Projeta, escreve e roda)

** Teste de aceitação(homologação) é feito junto ao cliente.*

Teste Unitário

- **Que Testar?**
  - A principal regra para saber o que testar é: “Tenha **criatividade** para imaginar as **possibilidades** de testes”.
  - Comece pelas mais simples e deixe os testes “complexos“ para o final.
  - Use apenas dados suficientes (não teste 10 condições se três forem suficientes)
  - Não teste métodos triviais, tipo get e set.
  - No caso de um método set, só faça o teste caso haja validação de dados.
  - Achou um bug? Não conserte sem antes escrever um teste que o pegue (se você não o fizer, ele volta)

Exercício de Imaginação

- Ache as possibilidades de testes neste diagrama de classe

MA-JUNIT

Introdução

JUnit

- A unit test framework for Java
  - Authors: Erich Gamma, Kent Beck
- Objective:
  - “If tests are simple to create and execute, then programmers will be more inclined to create and execute tests.”

JUnit – O que é?

- Um **framework** que facilita o desenvolvimento e execução de **testes de unidade** em código **Java**
- Fornece Uma API para construir os testes e Aplicações para executar testes

Introduction

- What do we need to do automated testing?
  - Test script
    - Actions to send to system under test (SUT).
    - Responses expected from SUT.
    - How to determine whether a test was successful or not?
  - Test execution system
    - Mechanism to read test scripts, and connect test case to SUT.
    - Keeps track of test results.

Test case verdicts

- A verdict is the declared result of executing a single test.
- Pass: the test case achieved its intended purpose, and the software under test performed as expected.
- Fail: the test case achieved its intended purpose, but the software under test did not perform as expected.
- Error: the test case did not achieve its intended purpose.
  - Potential reasons:
    - An unexpected event occurred during the test case.
    - The test case could not be set up properly

A note on JUnit versions...

- The current version is 4.3.1, available from Mar. 2007
  - To use JUnit 4.x, you must use Java version 5 or 6
- JUnit 4, introduced April 2006, is a significant (i.e. not compatible) change from prior versions.
- JUnit 4 is used in this presentation.
- Much of the JUnit documentation and examples currently available are for JUnit 3, which is slightly different.
  - JUnit 3 can be used with earlier versions of Java (such as 1.4.2).
  - The junit.org web site shows JUnit version 4 unless you ask for the old version.
  - Eclipse (3.2) gives the option of using JUnit 3.8 or JUnit 4.1, which are both packaged within Eclipse.

JUnit – Por que?

- JUnit pode verificar se cada unidade de código funciona da forma esperada.
- Facilita a **criação**, **execução** automática de testes e a **apresentação** dos resultados.
- É Orientado a Objeto
- É Free e pode ser baixado em: www.junit.org

JUnit – Como instalar?

- Incluir o arquivo **junit.jar** no **classpath** para compilar e rodar os programas de teste
- Já vem configurado nas versões recentes de IDE's como Eclipse, JBuilder, BlueJ e outros.

A note on JUnit versions...

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What is a JUnit Test?

- A test "script" is just a collection of Java methods.
  - General idea is to create a few Java objects, do something interesting with them, and then determine if the objects have the correct properties.
- What is added? Assertions.
  - A package of methods that checks for various properties:
    - "equality" of objects
    - identical object references
    - null / non-null object references
  - The assertions are used to determine the test case verdict.

When is JUnit appropriate?

- As the name implies…
  - for unit testing of small amounts of code
- On its own, it is not intended for complex testing, system testing, etc.
- In the test-driven development methodology, a JUnit test should be written first (before any code), and executed.
  - Then, implementation code should be written that would be the minimum code required to get the test to pass – and no extra functionality.
  - Once the code is written, re-execute the test and it should pass.
  - Every time new code is added, re-execute all tests again to be sure nothing gets broken.

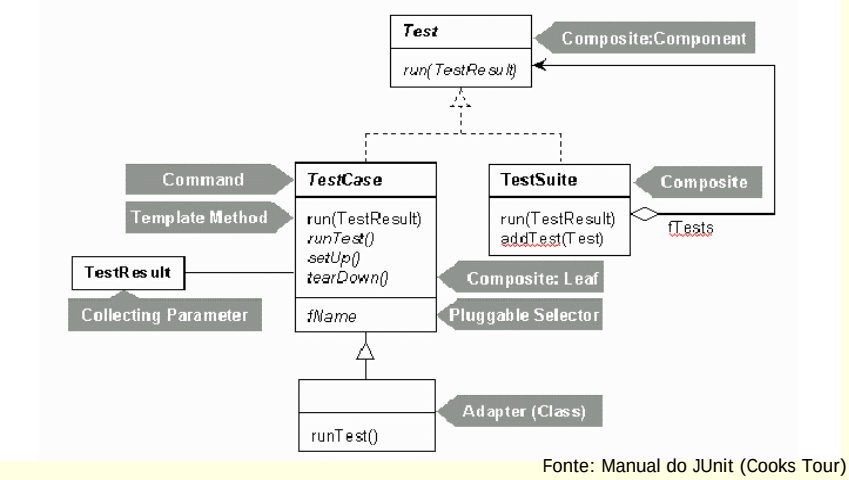
JUnit – Planejando os testes

- 1. Defina uma **lista** de tarefas a implementar(o que testar)
- 2. Escreva uma classe (**test case**) e implemente um método de teste para uma tarefa da lista.
- 3. Rode o **JUnit** e certifique-se que o teste falha
- 4. Implemente o código mais **simples** que rode o teste

JUnit – Planejando os testes

- 5. **Refatore** o código para remover a duplicação de dados
- 6. Caso necessário, escreva mais um teste ou **refine** o existente
- 7. Faça esses passos para toda a lista de tarefas.

JUnit- Arquitetura das Classes



Fonte: Manual do JUnit (Cooks Tour)

JUnit – Como implementar

- 1. Crie uma classe que estenda **junit.framework.TestCase** para cada classe a ser testada

```
import junit.framework.*;
class SuaClasseTest extends TestCase
{...
 }
```

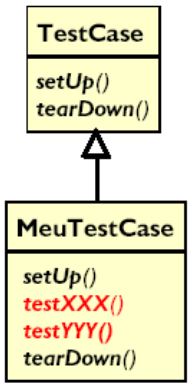
- 2. Para cada método a ser testado defina um método **public void test???()** no test case
- SuaClasse:

```
public int Soma(Object o ...)
{ ...
 }
```

- SuaClasseTest:

```
public void testSoma()
```

JUnit – Funcionamento

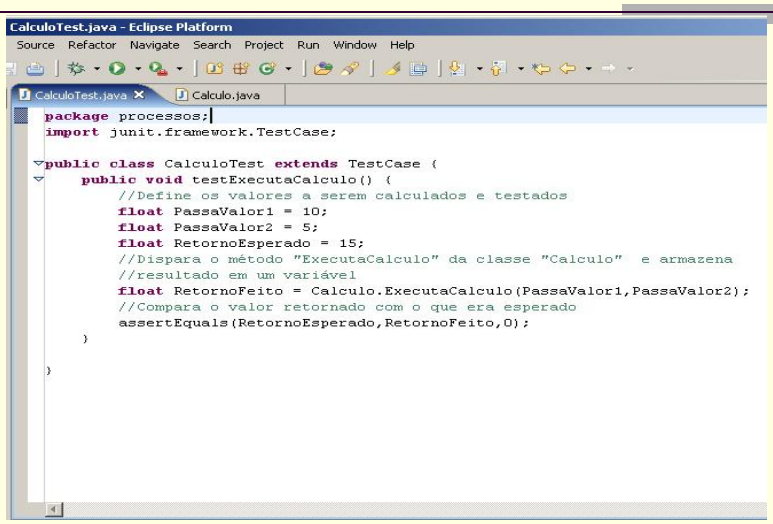


- O TestRunner recebe uma subclasse de junit.framework.TestCase
- Cada método testXXX(), executa:
  - *1. o método setUp()* */* Opcional */*
  - *2. o próprio método testXXX()*
  - *3. o método tearDown()* */* Opcional */*

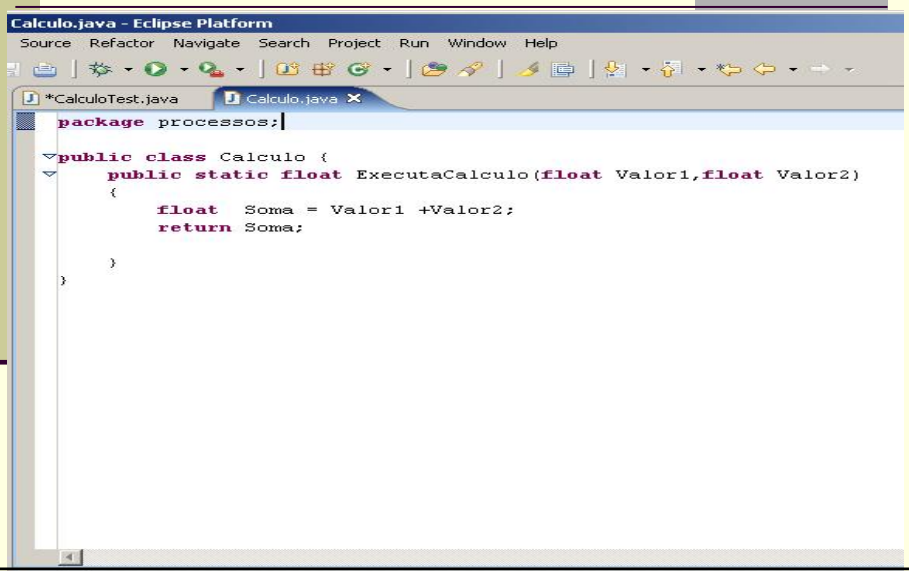
JUnit – Analisando o Resultado

- **Em modo gráfico, os métodos testados podem apresentar o seguintes resultados:**
- ***Sucesso***
- ***Falha***
- ***exceção***

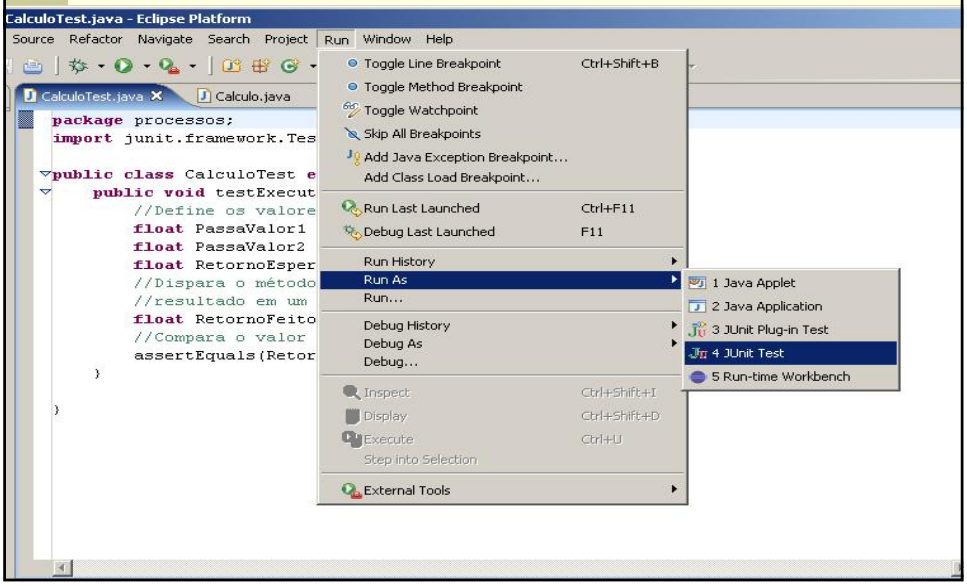
Criando a **classe** de **teste** no Eclipse



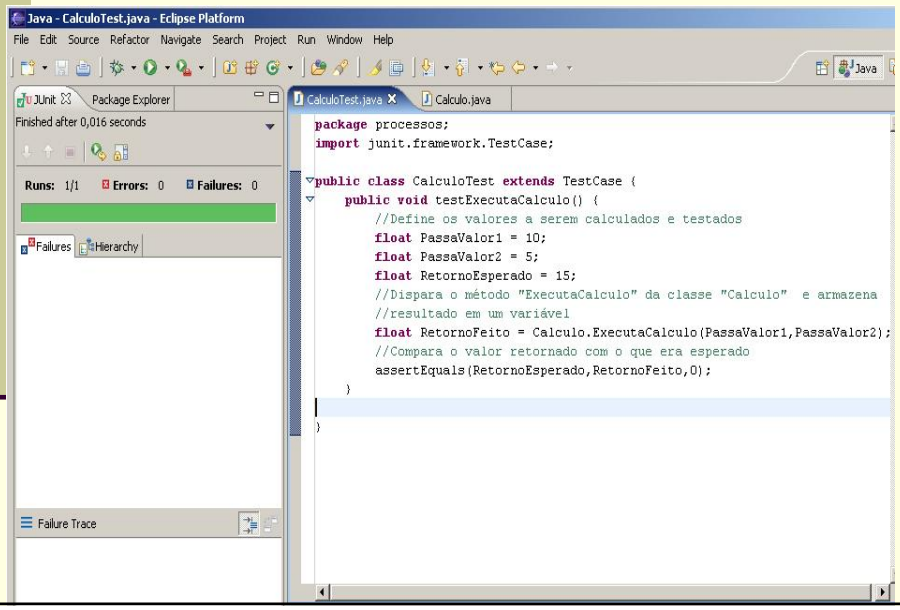
Sua Classe a ser testada



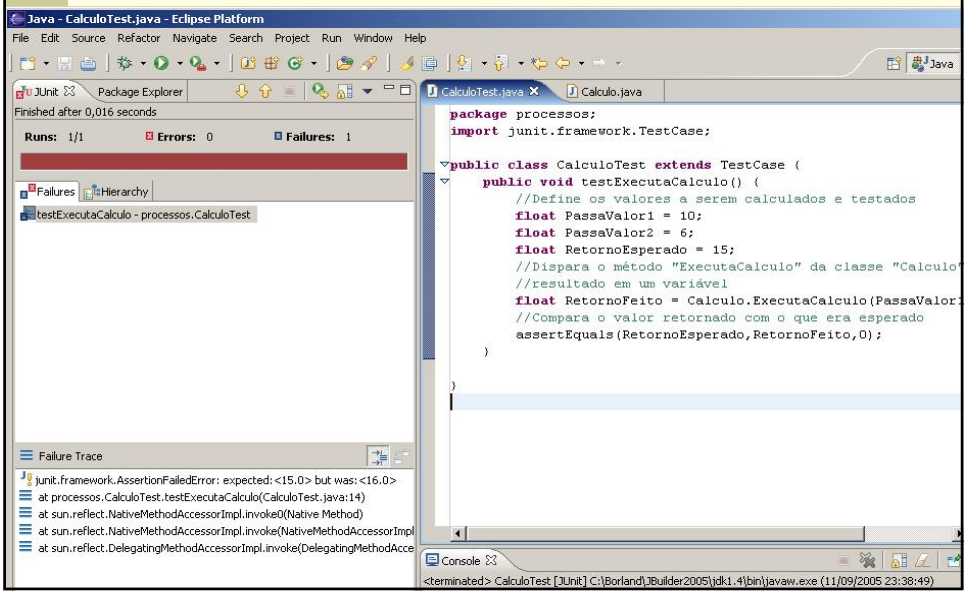
Rodando o teste em modo **gráfico**



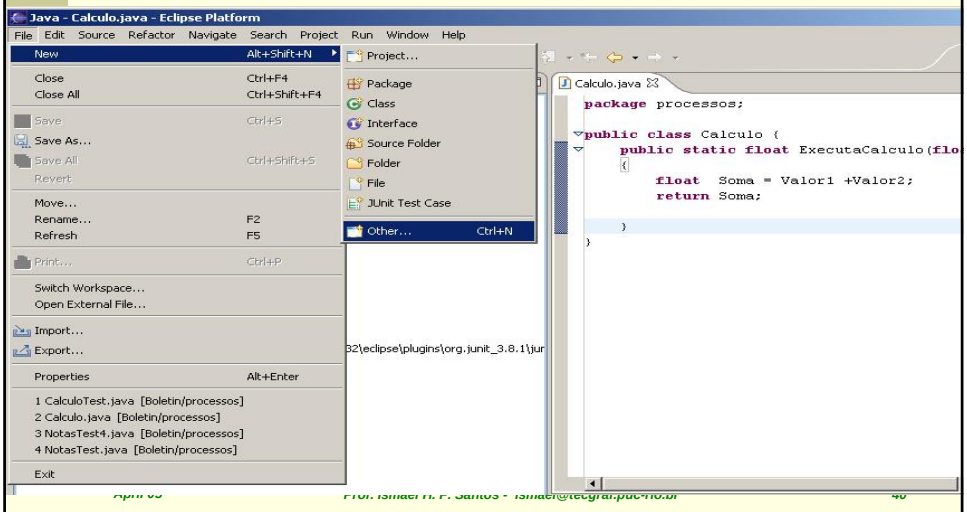
- Resultado em caso de **SUCESSO**

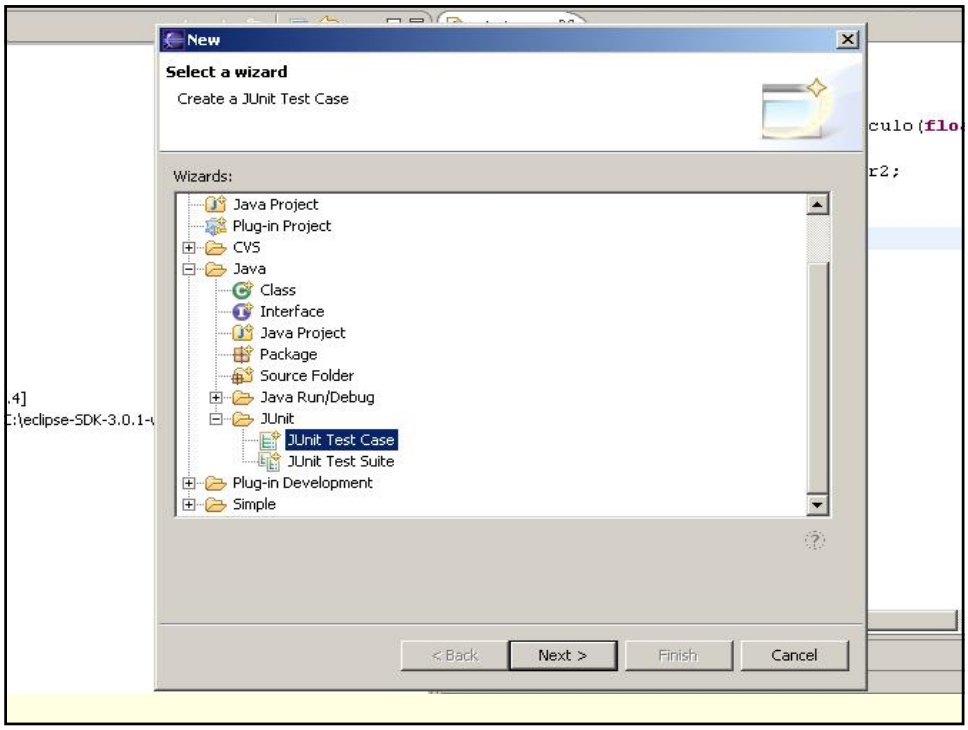


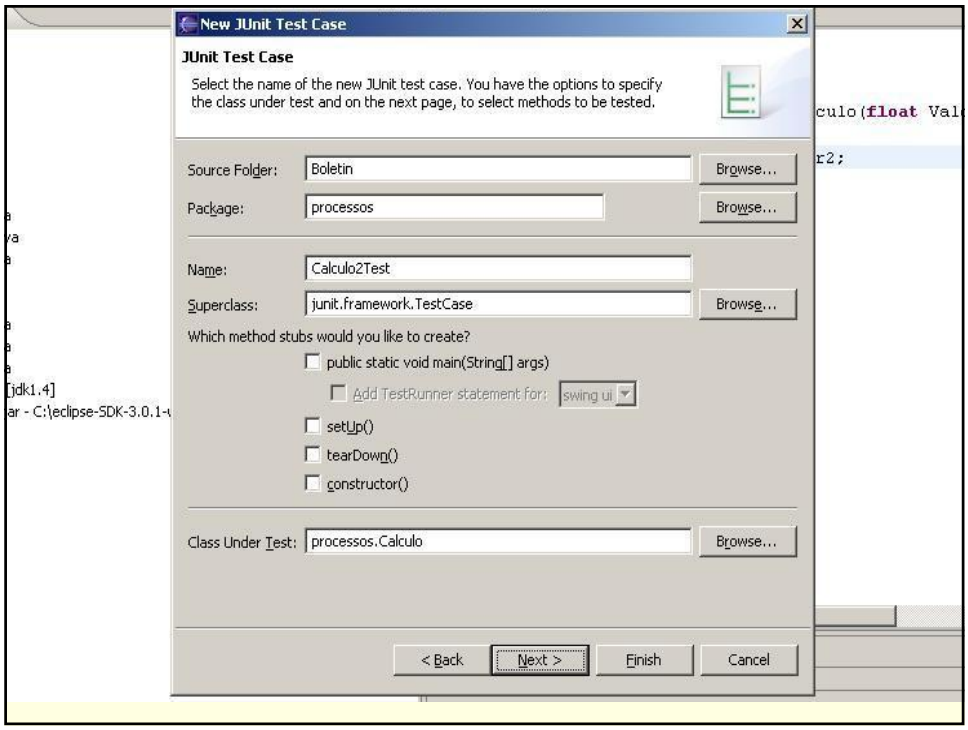
Resultado em caso de **FALHA**

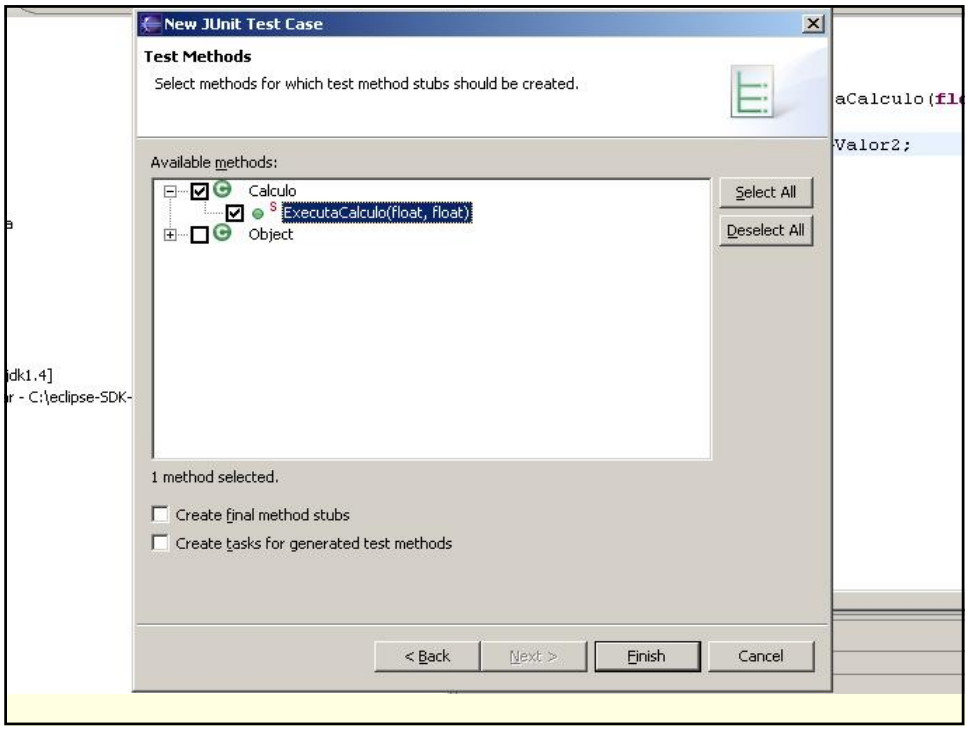


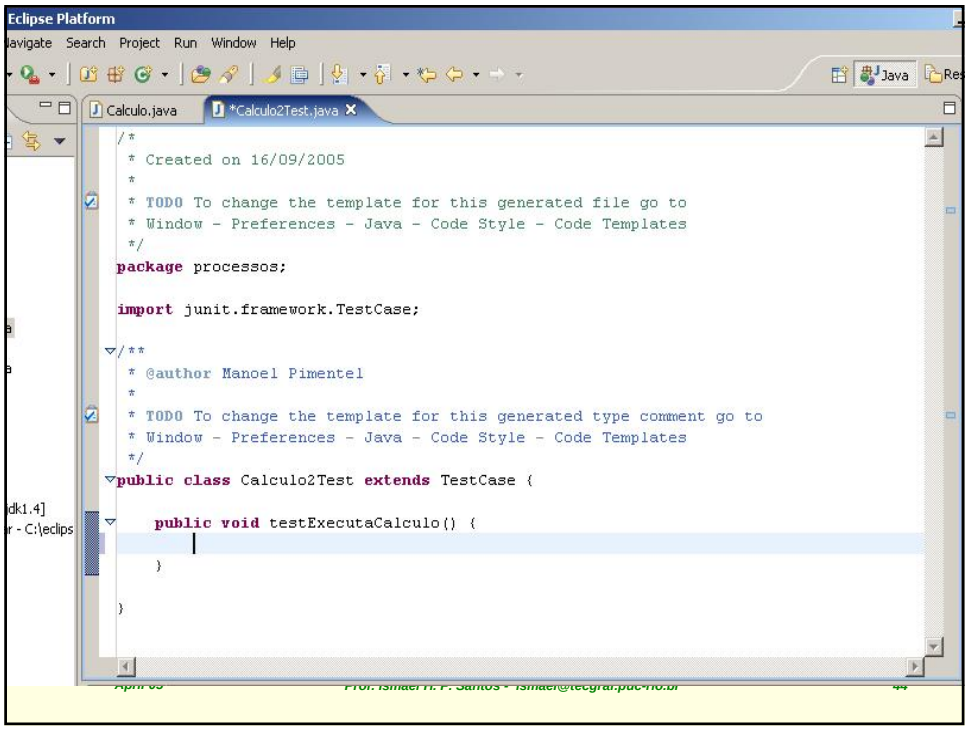
Automatizando a criação dos **Test Cases**



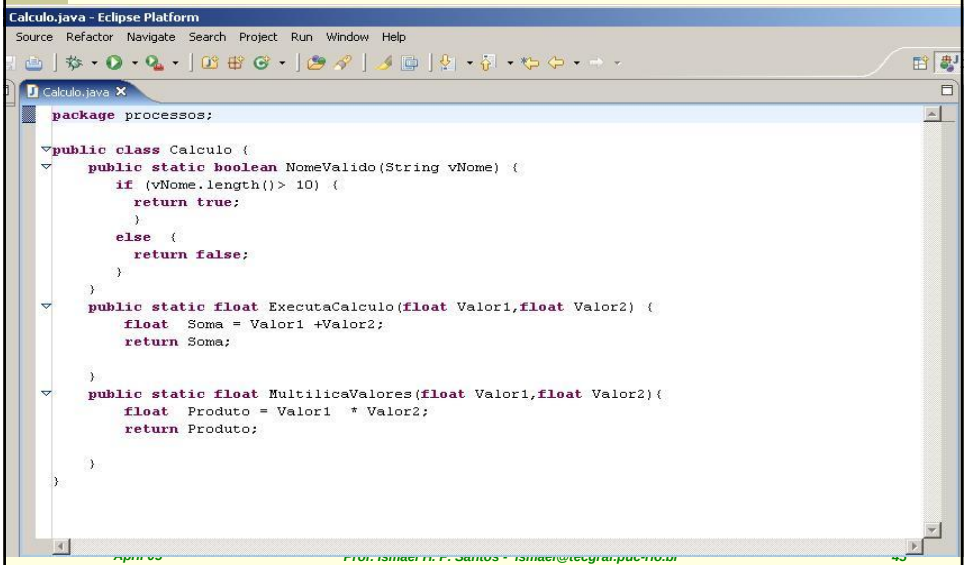

New
Select a wizard
Create a JUnit Test Case
Wizards:
Java Project
Plug-in Project
CVS
Java
Class
Interface
Java Project
Package
Source Folder
Java Run/Debug
JUnit
JUnit Test Case
JUnit Test Suite
Plug-in Development
Simple
< Back
Next >
Finish
Cancel

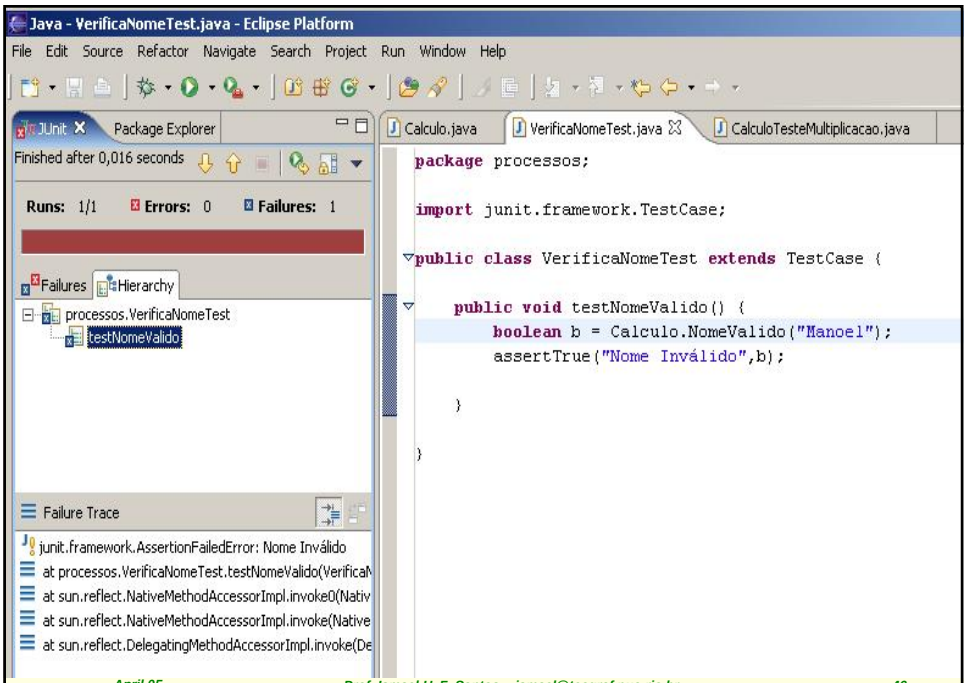

New JUnit Test Case
JUnit Test Case
Select the name of the new JUnit test case. You have the options to specify the class under test and on the next page, to select methods to be tested.
Source Folder:
Boletin
Browse...
Package:
processos
Browse...
Name:
Calculo2Test
Superclass:
junit.framework.TestCase
Browse...
Which method stubs would you like to create?
public static void main(String[] args)
Add TestRunner statement for:
swing ui
setUp()
tearDown()
constructor()
Class Under Test:
processos.Calculo
Browse...
< Back
Next >
Finish
Cancel


New JUnit Test Case
Test Methods
Select methods for which test method stubs should be created.
Available methods:
Calculo
ExecutaCalculo(float, float)
Object
Select All
Deselect All
1 method selected.
Create final method stubs
Create tasks for generated test methods
< Back
Next >
Finish
Cancel

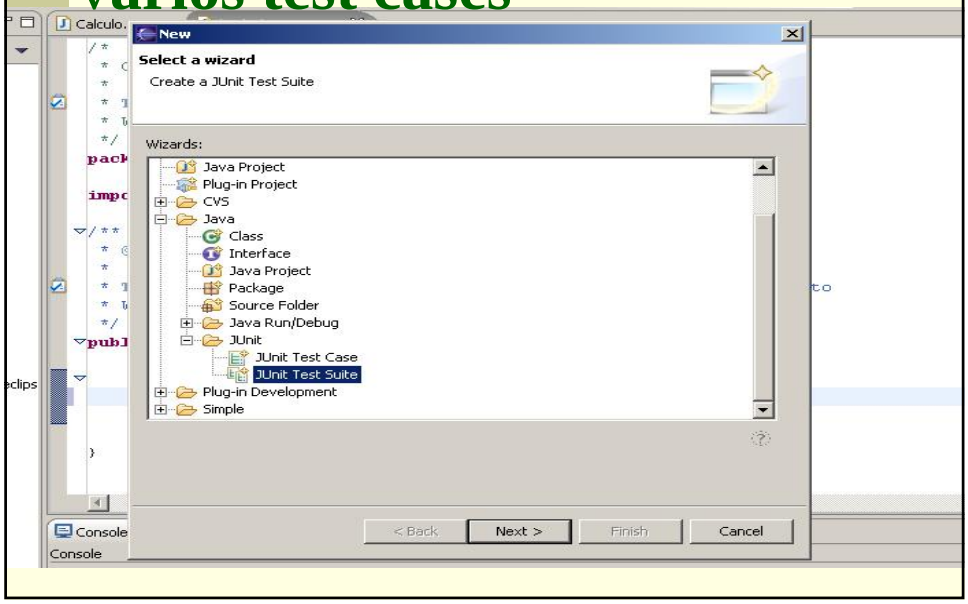

Eclipse Platform
Navigate Search Project Run Window Help
Java
Calculo.java
*Calculo2Test.java
/*
* Created on 16/09/2005
*
* TODO To change the template for this generated file go to
* Window - Preferences - Java - Code Style - Code Templates
*/
package processos;
import junit.framework.TestCase;
/**
* @author Manoel Pimentel
*
* TODO To change the template for this generated type comment go to
* Window - Preferences - Java - Code Style - Code Templates
*/
public class Calculo2Test extends TestCase {
public void testExecutaCalculo() {
}
}

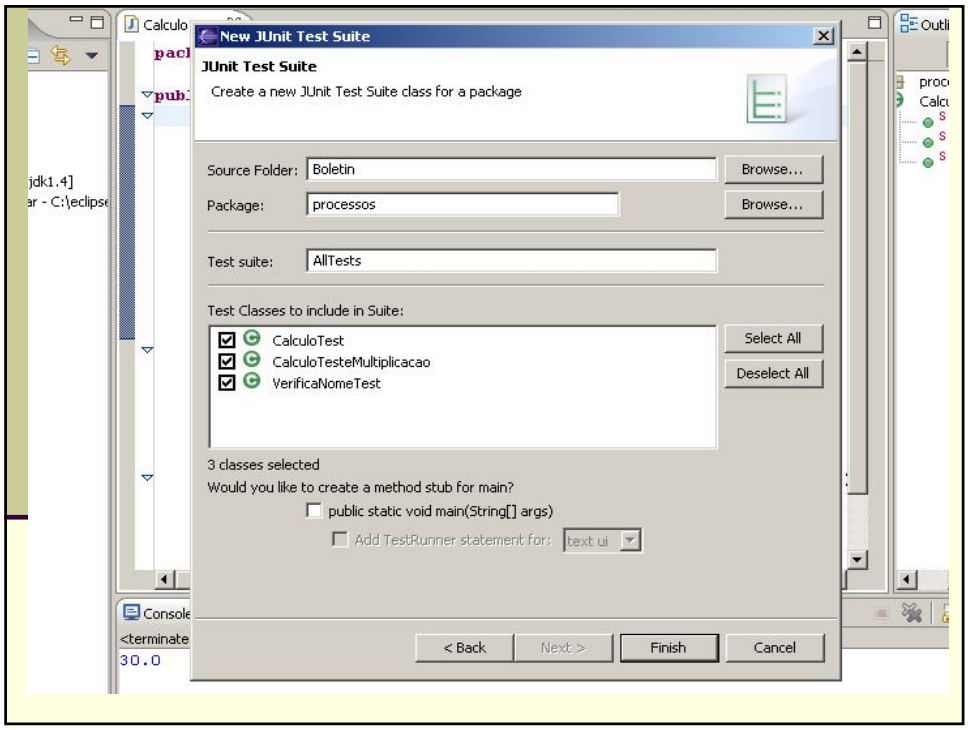
Outros **Exemplo** de **teste**

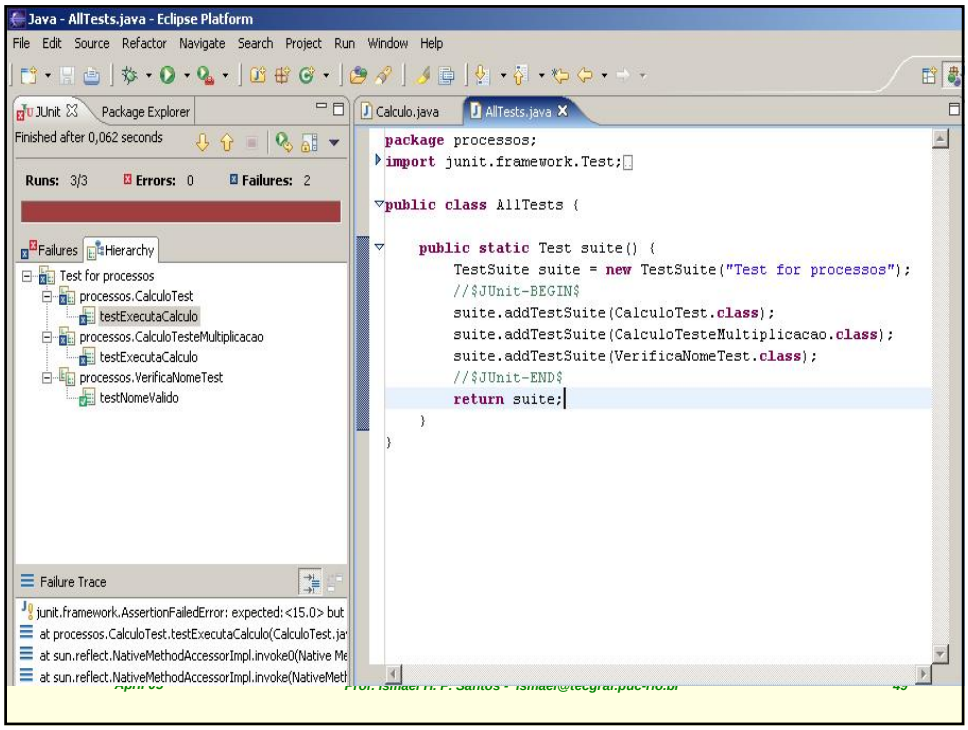




Criando **Test Suite** para rodar **vários test cases**







JUnit - Outros **Métodos** de **Testes**

- **assertEquals**
  - Testa igualdade entre dois objetos(esperado x retornado)
- **assertFalse( )**
  - Testa Retorno booleano FALSO
- **assertTrue( )**
  - Testa Retorno booleano VERDADEIRO
- **assertNotNull( )**
  - Testa se um valor de um objeto NÃO está NULO
- **assertNull( )**
  - Testa se um valor de um objeto está NULO

JUnit – métodos **setUp()** e **tearDown()**

- São os dados **reutilizados** por vários testes, **Inicializados** no setUp() e **destruídos** no tearDown() (se necessário)

```
package processos;
import junit.framework.TestCase;
public class CalculoVariosTest extends TestCase {
    float PassaValor1;
    float PassaValor2;
    protected void setUp(){
          PassaValor1 = 10;
          PassaValor2 = 5;  }
    public void testExecutaCalculo() {
        float RetornoEsperado = 15;
        float RetornoFeito = Calculo.ExecutaCalculo(PassaValor1,PassaValor2);
        assertEquals(RetornoEsperado,RetornoFeito,0);   }
    public void testMultiplicaValores() {
        float RetornoEsperado = 60;
        float RetornoFeito = Calculo.MultiplicaValores(PassaValor1,PassaValor2);
        assertEquals(RetornoEsperado,RetornoFeito,0);}
}
```


Técnicas complementares

- É importante também, ser aplicado tipos de testes como:
  - Teste de Performance,
  - Teste de Carga,
  - Teste de estresse,
  - Teste de aceitação, etc.

A JUnit 4 Test Case

```
  /** Test of setName() method, of class
Value  */

  @Test
  public void createAndSetName()
  {
      Value v1 = new Value( );

      v1.setName( "Y" );

      String expected = "Y";
      String actual = v1.getName( );

      Assert.assertEquals( expected, actual
);
```


A JUnit 4 Test Case

```
  /** Test of setName() method, of class
Value  */

  @Test
  public void createAndSetName()
  {
      Value v1 = new Value( );

      v1.setName( "Y" );

      String expected = "Y";
      String actual = v1.getName( );

      Assert.assertEquals( expected, actual
);
```

Identifies this Java method as a test case, for the test runner

A JUnit 4 Test Case

```
  /** Test of setName() method, of class
Value  */

  @Test
  public void createAndSe
  {
      Value v1 = new Valu

      v1.setName( "Y" );

      String expected = "Y";
      String actual = v1.getName( );

      Assert.assertEquals( expected, actual
);
```

Objective: confirm that `setName` saves the specified name in the `Value` object

A JUnit 4 Test Case

```
  /** Test of setName() method, of class
Value  */

  @Test
  public void createAndSetN
  {
      Value v1 = new Value(

      v1.setName( "Y" );

      String expected = "Y"
      String actual = v1.getName( );

      Assert.assertEquals( expected, actual
);
```

Check to see that the `Value` object really did store the name

A JUnit 4 Test Case

```
  /** Test of setName() method, of class
Value  */

  @Test
  public void createAndSetN
  {
      Value v1 = new Value(

      v1.setName( "Y" );

      String expected = "Y";
      String actual = v1.getName( );

      Assert.assertEquals( expected, actual
);
```

We want **`expected`** and **`actual`** to be equal.

If they aren't, then the test case should fail.

Assertions

- Assertions are defined in the JUnit class **`Assert`**
  - If an assertion is true, the method continues executing.
  - If any assertion is false, the method stops executing at that point, and the result for the test case will be fail.
  - If any other exception is thrown during the method, the result for the test case will be error.
  - If no assertions were violated for the entire method, the test case will pass.
- All assertion methods are static methods

Assertion methods (1)

- Boolean conditions are true or false
  `assertTrue(condition)`
  `assertFalse(condition)`
- Objects are null or non-null
  `assertNull(object)`
  `assertNotNull(object)`
- Objects are identical (i.e. two references to the same object), or not identical.
  `assertSame(expected, actual)`
  - true if: `expected == actual`

  `assertNotSame(expected, actual)`

Assertion methods (2)

- "Equality" of objects:
  `assertEquals(expected, actual)`
  - valid if: `expected.equals( actual )`
- "Equality" of arrays:
  `assertArrayEquals(expected, actual)`
  - arrays must have same length
  - for each valid value for `i`, check as appropriate:
    `assertEquals(expected[i],actual[i])`
    or
    `assertArrayEquals(expected[i],actual[i])`
- There is also an unconditional failure assertion `fail()` that always results in a fail verdict.

Assertion method parameters

- In any assertion method with two parameters, the first parameter is the expected value, and the second parameter should be the actual value.
  - This does not affect the comparison, but this ordering is assumed for creating the failure message to the user.
- Any assertion method can have an additional `String` parameter as the first parameter. The string will be included in the failure message if the assertion fails.
  - Examples:

```
fail( message )
assertEquals( message, expected, actual)
```


Equality assertions

- `assertEquals(a,b)` relies on the `equals()` method of the class under test.
  - The effect is to evaluate `a.equals( b ).`
  - It is up to the class under test to determine a suitable equality relation. JUnit uses whatever is available.
  - Any class under test that does not override the `equals()` method from class `Object` will get the default `equals()` behaviour – that is, object identity.
- If `a` and `b` are of a primitive type such as `int`, `boolean`, etc., then the following is done for `assertEquals(a,b)` :
  - `a` and `b` are converted to their equivalent object type (`Integer`, `Boolean`, etc.), and then `a.equals( b )` is evaluated.

Floating point assertions

- When comparing floating point types (`double` or `float`), there is an additional required parameter `delta`.
- The assertion evaluates
  `Math.abs( expected – actual ) <= delta`
  to avoid problems with round-off errors with floating point comparisons.
- Example:

```
assertEquals( aDouble, anotherDouble,
  0.0001 )
```


Organization of JUnit tests

- Each method represents a single test case that can independently have a verdict (pass, error, fail).
- Normally, all the tests for one Java class are grouped together into a separate class.
  - Naming convention:
    - Class to be tested: `Value`
    - Class containing tests: `ValueTest`

Running JUnit Tests (1)

- The JUnit framework does not provide a graphical test runner. Instead, it provides an API that can be used by IDEs to run test cases and a textual runner than can be used from a command line.
- Eclipse and Netbeans each provide a graphical test runner that is integrated into their respective environments.

Running JUnit tests (2)

- With the runner provided by JUnit:
  - When a class is selected for execution, all the test case methods in the class will be run.
  - The order in which the methods in the class are called (i.e. the order of test case execution) is not predictable.
- Test runners provided by IDEs may allow the user to select particular methods, or to set the order of execution.
- It is good practice to write tests with are independent of execution order, and that are without dependencies on the state any previous test(s).

Test fixtures

- A test fixture is the context in which a test case runs.
- Typically, test fixtures include:
  - Objects or resources that are available for use by any test case.
  - Activities required to make these objects available and/or resource allocation and de-allocation: "setup" and "teardown".

Setup and Teardown

- For a collection of tests for a particular class, there are often some repeated tasks that must be done prior to each test case.
  - Examples: create some "interesting" objects to work with, open a network connection, etc.
- Likewise, at the end of each test case, there may be repeated tasks to clean up after test execution.
  - Ensures resources are released, test system is in known state for next test case, etc.
  - Since a test case failure ends execution of a test method at that point, code to clean up cannot be at the end of the method.

Setup and Teardown

- Setup:
  - Use the **@Before** annotation on a method containing code to run before each test case.
- Teardown (regardless of the verdict):
  - Use the **@After** annotation on a method containing code to run after each test case.
  - These methods will run even if exceptions are thrown in the test case or an assertion fails.
- It is allowed to have any number of these annotations.
  - All methods annotated with **@Before** will be run before each test case, but they may be run in any order.

Example: Using a file as a text fixture

```
public class OutputTest
{
    private File output;

    @Before public void createOutputFile()
    {
       output = new File(...);
    }

    @After public void deleteOutputFile()
    {
        output.delete();
    }

    @Test public void test1WithFile()
    {
       // code for test case objective
    }

    @Test public void test2WithFile()
    {
```

Method execution order

1. `createOutputFile()`
2. `test1WithFile()`
3. `deleteOutputFile()`
4. `createOutputFile()`
5. `test2WithFile()`
6. `deleteOutputFile()`

- Assumption: `test1WithFile` runs before `test2WithFile`– which is not guaranteed.

Once-only setup

- It is also possible to run a method once only for the entire test class, before any of the tests are executed, and prior to any `@Before` method(s).
- Useful for starting servers, opening communications, etc. that are time-consuming to close and re-open for each test.
- Indicate with `@BeforeClass` annotation (can only be used on one method, which must be static):

```
@BeforeClass public static void
 anyNameHere()
{
   // class setup code here
}
```

Once-only tear down

- A corresponding once-only cleanup method is also available. It is run after all test case methods in the class have been executed, and after any `@After` methods
- Useful for stopping servers, closing communication links, etc.
- Indicate with `@AfterClass` annotation (can only be used on one method, which must be static):

```
@AfterClass public static void
 anyNameHere()
{
   // class cleanup code here
}
```


Exception testing (1)

- Add parameter to `@Test` annotation, indicating that a particular class of exception is expected to occur during the test.

```
@Test(expected=ExceptedTypeOfException.class)
public void testException()
{
   exceptionCausingMethod();
}
```

- If no exception is thrown, or an unexpected exception occurs, the test will fail.
  - That is, reaching the end of the method with no exception will cause a test case failure.
- Testing contents of the exception message, or limiting the scope of where the exception is expected requires using the approach on the next slide.

Exception testing (2)

- Catch exception, and use **`fail( )`** if not thrown

```
public void testException()
{
   try
   {
      exceptionCausingMethod();

      // If this point is reached, the expected
      // exception was not thrown.

      fail("Exception should have occurred");
   }
   catch ( ExceptedTypeOfException exc )
   {
      String expected = "A suitable error message";
      String actual = exc.getMessage();
      Assert.assertEquals( expected, actual );
   }
}
```


JUnit 3

- At this point, migration is still underway from JUnit 3 to JUnit 4
  - Eclipse 3.2 has both
    - The Eclipse test and performance tools platform does not yet work with JUnit 4.
  - Netbeans 5.5 has only JUnit 3.
- Within the JUnit archive, the following packages are used so that the two versions can co-exist.
  - JUnit 3: **`junit.framework.*`**
  - JUnit 4: **`org.junit.*`**

Topics for another day...

- Differences between JUnit 3 and JUnit 4
- More on test runners
- Parameterized tests
- Tests with timeouts
- Test suites