Software Development Tools

COMP220/COMP285
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Eclipse and JUnit:

Creating and running
a **JUnit** test case

These slides are mainly based on "*Java Development with Eclipse*" – D.Gallardo et al., Manning Publications., 2003

Eclipse and **JUnit**

- **Eclipse**'s **JDT** provides a powerful, flexible environment for
  - *writing*, *running*, and *debugging* **Java** code.
- But developing quality software requires more than that.
- Here we examine **JUnit** as **Eclipse**'s *integral testing framework* (plug-in).
- Later, we will consider **Ant** plug-in in **Eclipse**.

Persistence project

- Here we begin (but not finish!) developing a *sample application* :
  - a ***lightweight persistence component*** that allows one *to save data in files*.
- *Persisting* data means *saving* it, using some form of storage, so one can *retrieve* it later.
- Our goal is to illustrate by a simple example how **JUnit** testing framework may be used in **Eclipse** during developing this application.

Junit concepts

- Fixture
  - Loading a database with a specific, known set of data
  - Copying a specific known set of files
  - Preparation of input data and setup/creation of fake or mock objects
- Test case
  - Test with given set of test data (e.g. fixture)

Persistence project

- The first step is to **create** a new **Java *project***, called **Persistence**

  with choosing the option:

  "`Create separate folders for sources and class files`".

  (You already know how to do this.)

- **Create** under `src` directory in this project:
  - the *stub* class `FilePersistenceServices.java`
  - with some *stub* methods (see below),
  - but ***without*** the `main()` method
  - under the ***new package***

    `org.eclipseguide.persistence`

    or, **in the labs,** it should be **your personalised package:**

    `surname.name.ID123456.persistence`
  - **check Generate Comments**
  - click **Finish**

FilePersistenceServices.java

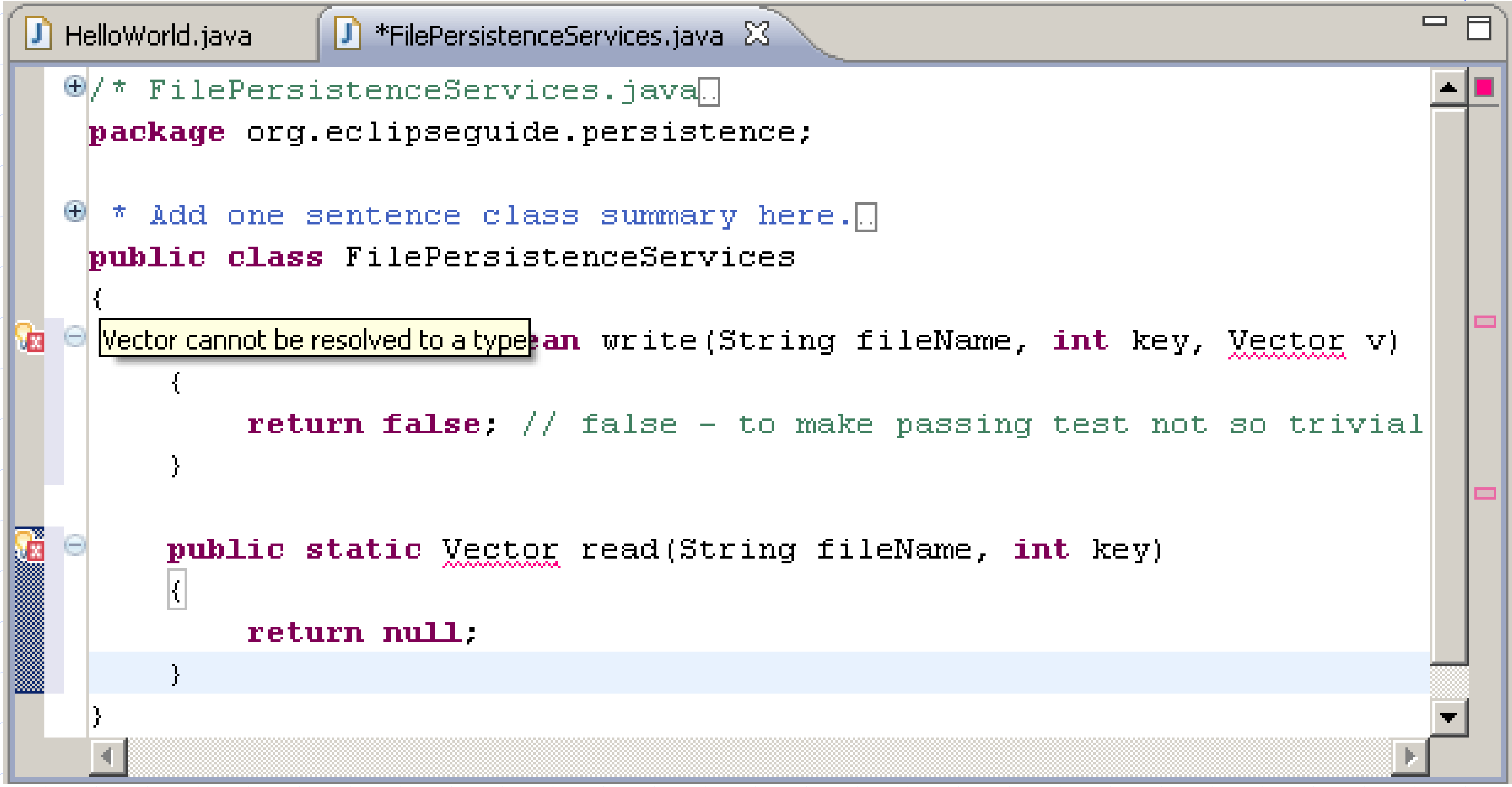
Extend the resulting Java class in the editor as follows:

```
package org.eclipseguide.persistence;

public class FilePersistenceServices
{
    public static boolean write(String fileName, int key, Vector v)
    {
        return false; // false - because the method is not yet implemented
    }

    public static Vector read(String fileName, int key)
    {
        return null; // null - just to return anything
    }
}
```

- `write()` and `read()` (stub) methods are intended to

1. *insert* a *key*-numbered vector record *v* into a *file* with returning `true`, if successful,
2. *retrieve* a vector record from a *file* by its *key* number.

FilePersistenceServices.java



```
/* FilePersistenceServices.java
package org.eclipseguide.persistence;

 * Add one sentence class summary here.
public class FilePersistenceServices
{
Vector cannot be resolved to a typeean write(String fileName, int key, Vector v)
    {
        return false; // false - to make passing test not so trivial
    }

    public static Vector read(String fileName, int key)
    {
        return null;
    }
}
```

Note **Red** ***syntax error marks*** on the right and left hand side of the editor

`FilePersistenceServices.java`

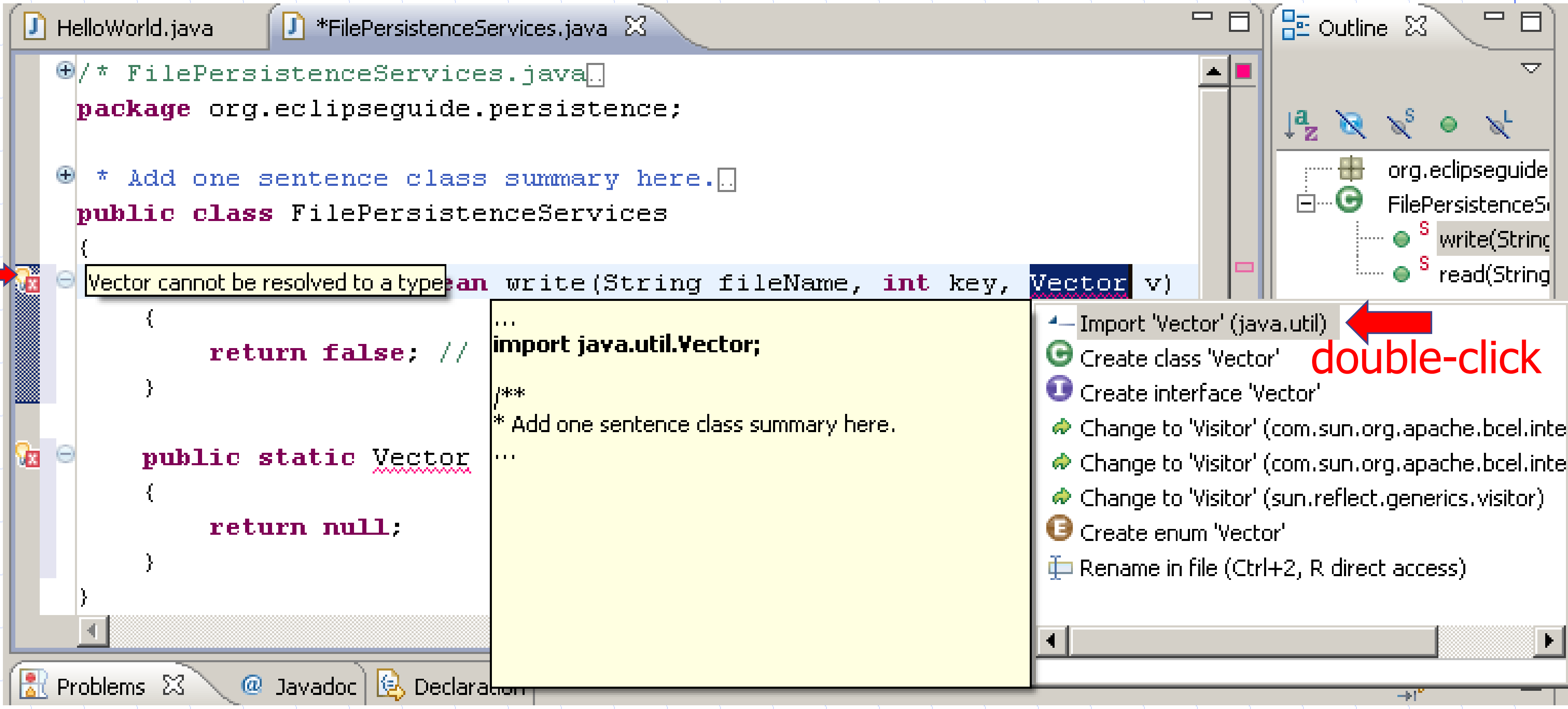
- **Red** marks on the right and left hand side of the editor "say":

  `"Vector cannot be resolved to a type".`

- In fact, this is because
  - there is **no** *import statement* for the **`Vector`** class.
- The easiest way to add it consists in using **Eclipse's Quick Fix** feature:
  - Click on one of the *light bulbs* (on left margin of the Editor)
  - Double click on suggested fix:

    `Import 'Vector' (java.util)`

FilePersistenceServices.java



```
/* FilePersistenceServices.java
package org.eclipseguide.persistence;

 * Add one sentence class summary here.
public class FilePersistenceServices
{
                                             ean write(String fileName, int key, Vector v)
    {
        return false; //
    }

    public static Vector
    {
        return null;
    }
}
```

Vector cannot be resolved to a type

```
...
import java.util.Vector;

/**
* Add one sentence class summary here.
...
```

- Import 'Vector' (java.util)
- Create class 'Vector'
- Create interface 'Vector'
- Change to 'Visitor' (com.sun.org.apache.bcel.inte
- Change to 'Visitor' (com.sun.org.apache.bcel.inte
- Change to 'Visitor' (sun.reflect.generics.visitor)
- Create enum 'Vector'
- Rename in file (Ctrl+2, R direct access)

Click on a *light bulb* (left to the Editor)

FilePersistenceServices.java

- This class should now be **error-free** because the above actions **automatically generated** new ***import declaration:***

```
import java.util.Vector;
```

- *Tidy up* and *save* the file:
  1. Right-click on the editor area and select

     Source->Format

     or **do the same from the menu**

     or use **Ctrl+Shift+F**
  2. **Save** the file.
- ***Formatting*** and ***saving*** aren't necessary, but they make some of **Eclipse's** *automated features* work better.
- Some ***yellow coloured warnings*** (***not*** **errors**) remain which mean that in corresponding places `Vector` should be replaced with `Vector<String>` `(Generic)`

The **JUnit** testing framework in **Eclipse**

- **We are ready to create a *test case* :**
  - a **special Java** class **called JUnit Test Case** class.
- It is normal to have

  one test class for each class in the program

  and to name them by adding the ***suffix*** **`Test`** to the class name:
  - **`FilePersistenceServices.java`** – given ***source (stub) class***;
  - **`FilePersistenceServicesTest.java`** – corresponding ***test case***;
- The easiest way to create **JUnit test case** classes is using
  - **JUnit *wizard*** in **Eclipse**.

Create **test case stub** by using the **JUnit wizard** in **Eclipse**

- **Right-click** on the file

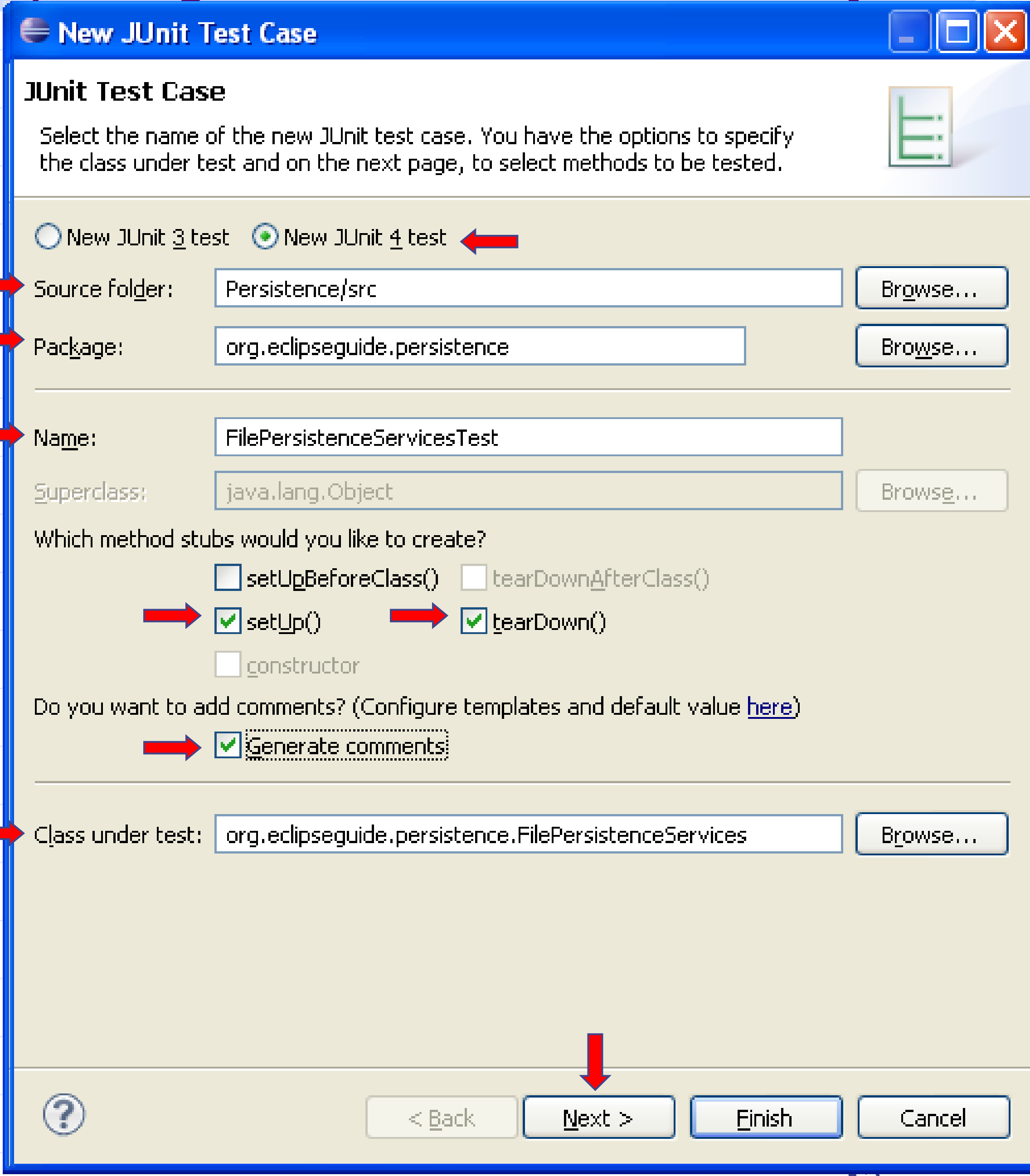
  `FilePersistenceServices.java`

  in the **Package Explorer** and
- Select

  New ->JUnit Test Case
- See next slide

Create **test case stub** by using the **JUnit wizard** in **Eclipse**

- Accept the *default values* for
  - ***Source folder***,
  - ***Package***,
  - ***Name*** of test case, and
  - ***Class under test.***
- *Check* options for **Junit 4** and for creating stubs for **`setUp()`, `tearDown()`**, (and optionally **`Generate Comments`**).
- Click **Next.**


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.

○ New JUnit 3 test [✓ ● New JUnit 4 test]

Source folder: Persistence/src [Browse...]

Package: org.eclipseguide.persistence [Browse...]

Name: FilePersistenceServicesTest

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

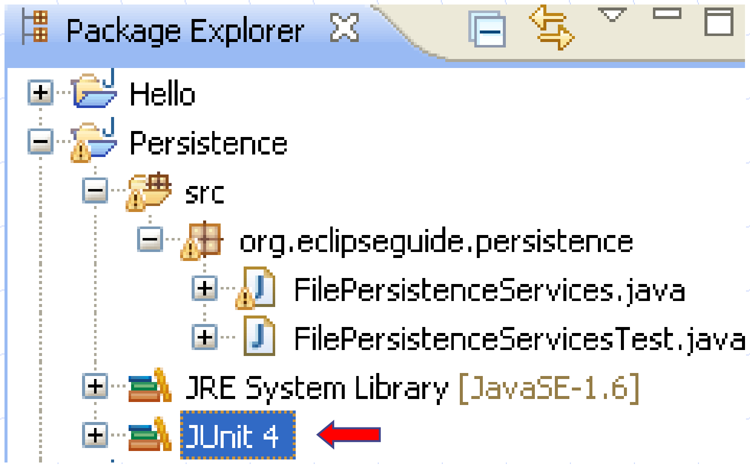
Class under test: org.eclipseguide.persistence.FilePersistenceServices [Browse...]

Create **test case stub** by using the **JUnit wizard** in **Eclipse**

In the next dialog box **check boxes** for the **FilePersistenceServices read()** and **write()** methods *to create **stub test methods*** for each of them.

Click **Finish.**

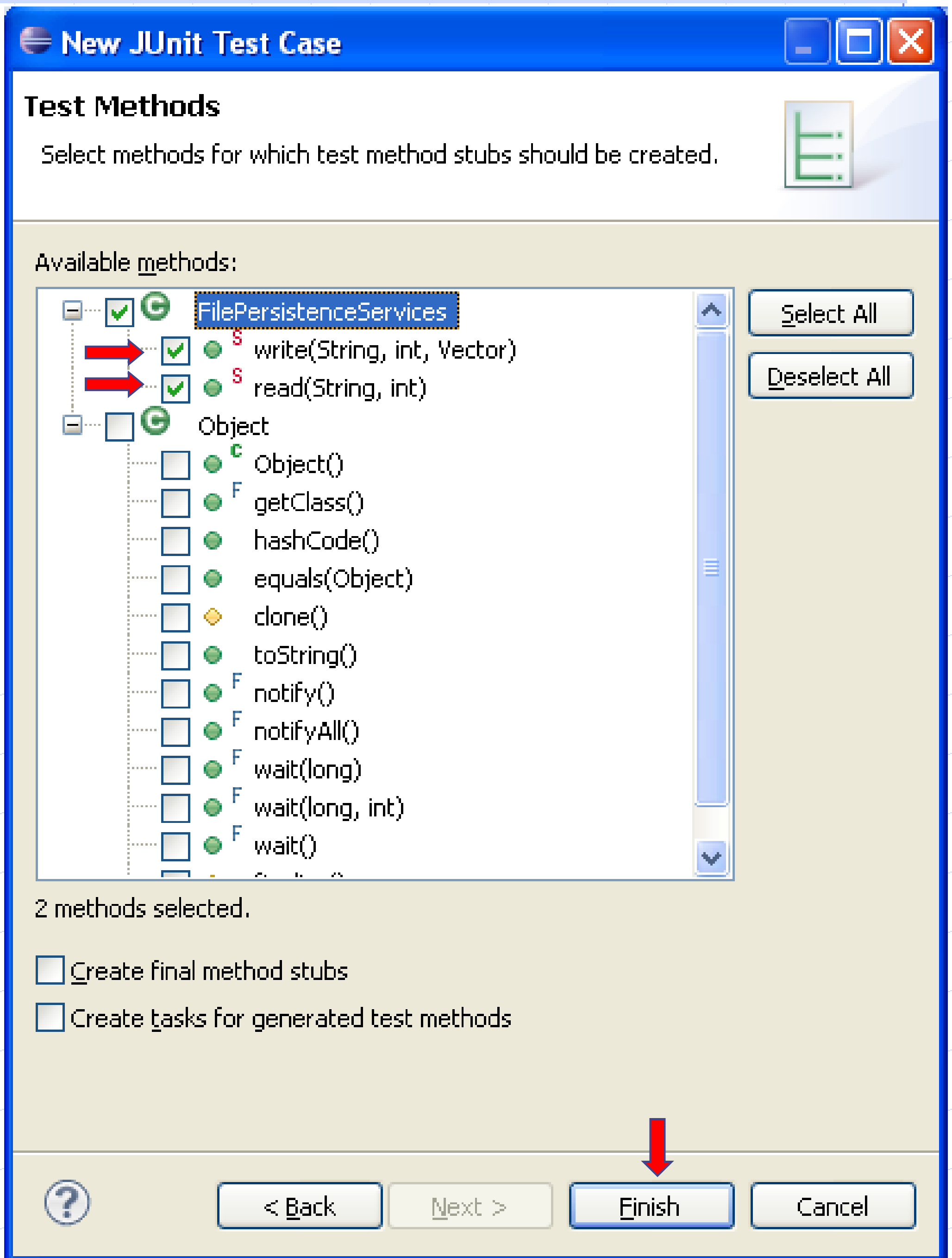
Confirm adding **Junit 4 library** to the build path.
IF Junit 4 will not appear in **Package Explorer** under **Persistence** as here,



Package Explorer

- Hello
- Persistence
  - src
    - org.eclipseguide.persistence
      - FilePersistenceServices.java
      - FilePersistenceServicesTest.java
  - JRE System Library [JavaSE-1.6]
  - JUnit 4

THEN see the **second half** of **Slide 47** from **EclipseJava.ppt.**



New JUnit Test Case

Test Methods

Select methods for which test method stubs should be created.

Available methods:

- [✓] FilePersistenceServices
  - [✓] write(String, int, Vector)
  - [✓] read(String, int)
- [ ] Object
  - [ ] Object()
  - [ ] getClass()
  - [ ] hashCode()
  - [ ] equals(Object)
  - [ ] clone()
  - [ ] toString()
  - [ ] notify()
  - [ ] notifyAll()
  - [ ] wait(long)
  - [ ] wait(long, int)
  - [ ] wait()

2 methods selected.

- [ ] Create final method stubs
- [ ] Create tasks for generated test methods

```java
package org.eclipseguide.persistence;
import static org.junit.Assert.*;
import org.junit.After;
import org.junit.Before;
import org.junit.Test;

public class FilePersistenceServicesTest
{
    @Before     //Runs before each @Test method
    public void setUp() throws Exception
    {}

    @After     //Runs after each @Test method
    public void tearDown() throws Exception
    {}

    @Test
    public void testWrite()
    {
        fail("Not yet implemented");
    }

    @Test
    public void testRead()
    {
        fail("Not yet implemented");
    }
}
```

Importing the necessary **Junit4** classes

stub methods for **`setUp()`** and **`tearDown()`**

stub test methods for testing **`write()`** and **`read()`**

The resulting ***test case*** **stub** created by the wizard

Further work on the test case stub `FilePersistenceServicesTest.java`

- Now we need to create a ***fixture:***
  - ***data and objects*** for which **`@Test`** annotated methods **`testWrite()`** and **`testRead()`** in a test case will be applied:
    - The annotated by **`@Before`** and **`@After`** methods **`setUP()`** and **`tearDown()`** are provided to *set up* and *clean* fixtures,
    - they are run by **JUnit**, respectively, ***before*** and ***after*** each **`@Test`** method (**`testXXX()`**).

Further work on the test case stub `FilePersistenceServicesTest.java`

- Declare ***Vector variable*** *at the beginning of the test case class declaration*

```
public class FilePersistenceServicesTest
{
    Vector v1;
```

- You will need to use **Quick Fix** light bulb to add **`Vector`** ***import statement***.
- Set up the *fixture* , **`Vector v1`**, as follows:

```
    public void setUp() throws Exception
        {
            v1 = new Vector();
            v1.addElement("One");
            v1.addElement("Two");
            v1.addElement("Three");
        }
```

fixing some **Vector `v1`** consisting of three strings

Further work on the test case stub `FilePersistenceServicesTest.java`

- In the most cases **`tearDown()`** method is unnecessary.
- But we can implement it to ***release*** **`v1`** as

```
    protected void tearDown() throws Exception
        {
            v1 = null;  // release v1
        }
```

- In general, **`tearDown()`** is used to ***release system resources*** (probably expensive!) that might not otherwise be released.

◆ Now, we are ready to ***run this test case*** in **Eclipse.**

Running the **JUnit** tests in **Eclips**

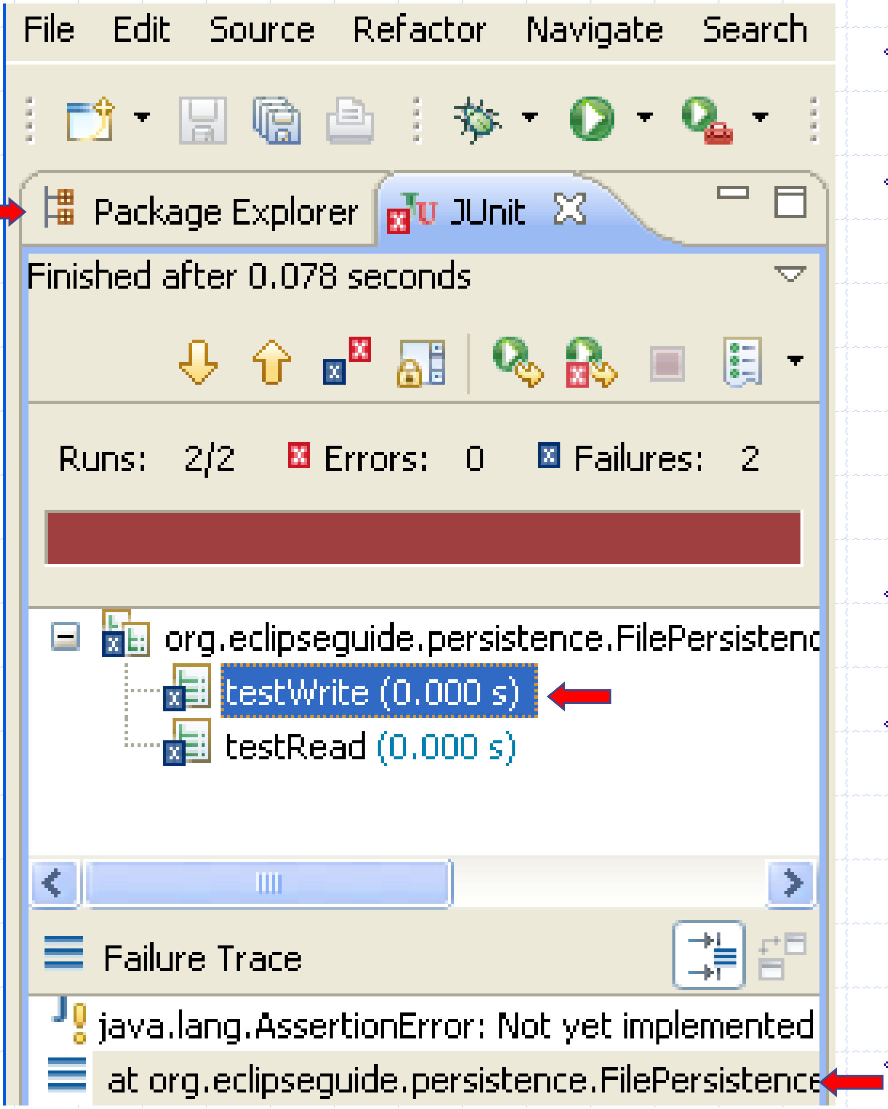
- ***Running*** the **JUnit** tests in **Eclipse** is similar to running a **Java** application:
  1. First **make sure** that the ***test case*** you want to run

     `FilePersistenceServicesTest.java`

     is ***selected*** – either in the *editor* or on the *Package Explorer view.*
  2. Select **Run->Run As->*JUnit Test***
- **JUnit view** is automatically added, covering **Package Explorer view**.

(See next slide)

Running the **JUnit** tests in **Eclips**



Finished after 0.078 seconds

Runs: 2/2 Errors: 0 Failures: 2

org.eclipseguide.persistence.FilePersistenc
testWrite (0.000 s)
testRead (0.000 s)

java.lang.AssertionError: Not yet implemented
at org.eclipseguide.persistence.FilePersistence

The **JUnit test view.**
Notice the **red coloured** bar!

- **Red** bar turns **green** once your class passes **all** tests successfully.
- Our tests **do not pass.**
  - nothing strange!
  - the tests ***fail*** by trivial reason: being *"Not yet implemented"*
  - more precisely: they are ***deliberately implemented to be failed***
- ***Further work*** *both on the source file and on the test case* ***is required.***
- Try to **double-click**
  - on ***failed tests*** in **JUnit view,**
  - on the ***second line*** of the **Failure Trace,**
  - and also on various elements in **Outline view.**
- This will ***lead you to corresponding places in the editor***. (Very helpful!)
- After viewing the test results, you can click on the **Package Explorer** tab to return this view on the top.

Further work on the **Test Case** stub

- Let us **test** whether **`read()`** and **`write()`** methods return reasonable values by using more general **JUnit** **`assert*`** methods (instead of **`fail()`**).
- **`assert*`** methods will be further discussed in our lectures.
  - The boolean **`write()`** method should return **true** if it succeeds in writing the values stored in the **`Vector`** into a file:

```
    public void testWrite()
    {
//      fail("Not yet implemented");
        assertTrue("NOT WRITTEN???",
                FilePersistenceServices.write
                    ("TestTable", 1, v1));
    }
```

Comment or omit this line

file name

key

vector

Writing data to file should be successful

Further work on the test case stub

- Analogously, for **`read()`** method we expect it to pass the following test:

```
    public void testRead()
    {
            fail("Not yet implemented");
```

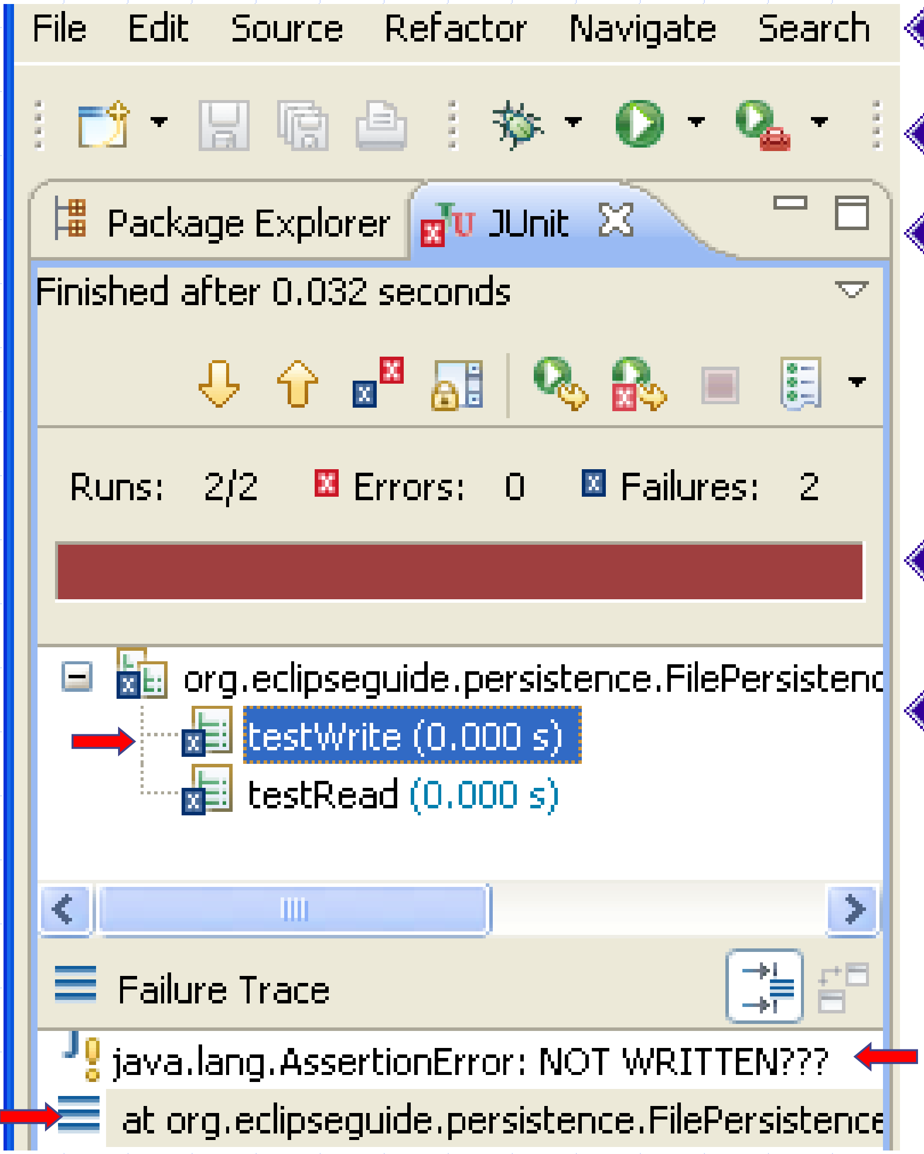
replaced with the following:

```
        FilePersistenceServices.write("TestTable", 1, v1);
        Vector w =
           FilePersistenceServices.read("TestTable", 1);
        assertEquals(v1,w);
    }
```

expected actual

reading from a file should produce the same value which has been written into the file beforehand

Running the JUnit tests in Eclips again



Finished after 0.032 seconds

Runs: 2/2 Errors: 0 Failures: 2

org.eclipseguide.persistence.FilePersistenc
testWrite (0.000 s)
testRead (0.000 s)

java.lang.AssertionError: NOT WRITTEN???
at org.eclipseguide.persistence.FilePersistence

The **JUnit test view** appears.
Again **red coloured** bar!

- To ***re-run***, click **Run** button
- Our tests again **do not pass!**
- Again try to **double-click**
  - on ***failed tests*** in **JUnit view,**
  - on the ***second line*** of the **Failure Trace,**
- This will lead you to corresponding places in the editor.
- For example, we can see that
  - `testWrite` failed because of `assertTrue` which expects `true`. Our message `"NOT WRITTEN???"` helps to understand the reason.
  - Now, select `testRead`. We see that it failed because of `java.lang.AssertionError: expected:<[One, Two, Three]> but was: <null>`.

All of this can help to understand the reason of test failures.

Running the **JUnit** tests in **Eclips**

- You can get a little **instant gratification** by
  - **changing** the ***return value*** of the `write()` method in the `FilePersistenceServices` class **from** `false` **to** `true` and
  - **commenting** out the whole `testRead()` method in `FilePersistenceServices`*`Test`* class.
- *Selected* code may be *commented out* or *uncommented* by **Ctrl-/**.

Running the **JUnit** tests in **Eclipse**

- To ***re-run*** a selected **Junit** test case, click **Run** button
- Now we see **green bar**:
  - the only remaining **`testWrite()`** method succeeded (of course, by trivial reason).
- **Recover** the original versions of our files by using **Undo (Ctrl-Z)**.

Further testing-coding

- Thus, two minimal tests and zero functionality!
- But we *should not expect anything else* because the source code is just a *stub*.
- Anyway, we have already seen how **JUnit** works in **Eclipse**.
- To develop functionality of our source code, let us
  - ***test* and *code at a finer level of detail*.**

Further testing-coding

- To implement our methods
  - `boolean write(String fileName, int key, Vector v)`
  - `Vector read(String fileName, int key)`

  we will need intermediate – ***helper methods***
  - `vector2String()`
  - `string2Vector()`
- This is an *intermediate step* to **write/read** vectors *via* their *string representation* into/from a file.

Further testing-coding

- We intend to store data in a text file line-by-line for each record:

```
"1","One","Two","Three"
"2","Antbook","Hatcher","Manning","2003"
"3","Eclipse","Gallardo","Manning","2003"
```

Our string **s1** considered below

using *comma-separated values* (CSV)

- Here `"1","2",…` serve as *keys* to locate a specific record.

- E.g. `[Antbook,Hatcher,Manning,2003]` is ***vector*** or ***record*** saved into the file as a ***string*** under the key `2`.

- Each line in the file is a ***string*** to be created first by the method `vector2String(Vector v, int key)` which is ***not yet implemented***.

Further testing-coding

- According to ***test-first*** *philosophy*, let's start with **extending** `FilePersistenceServicesTest` class:

1. **Add** the following `String s1` attribute under the `Vector v1` attribute

```
String s1 = "\"1\",\"One\",\"Two\",\"Three\"";
```

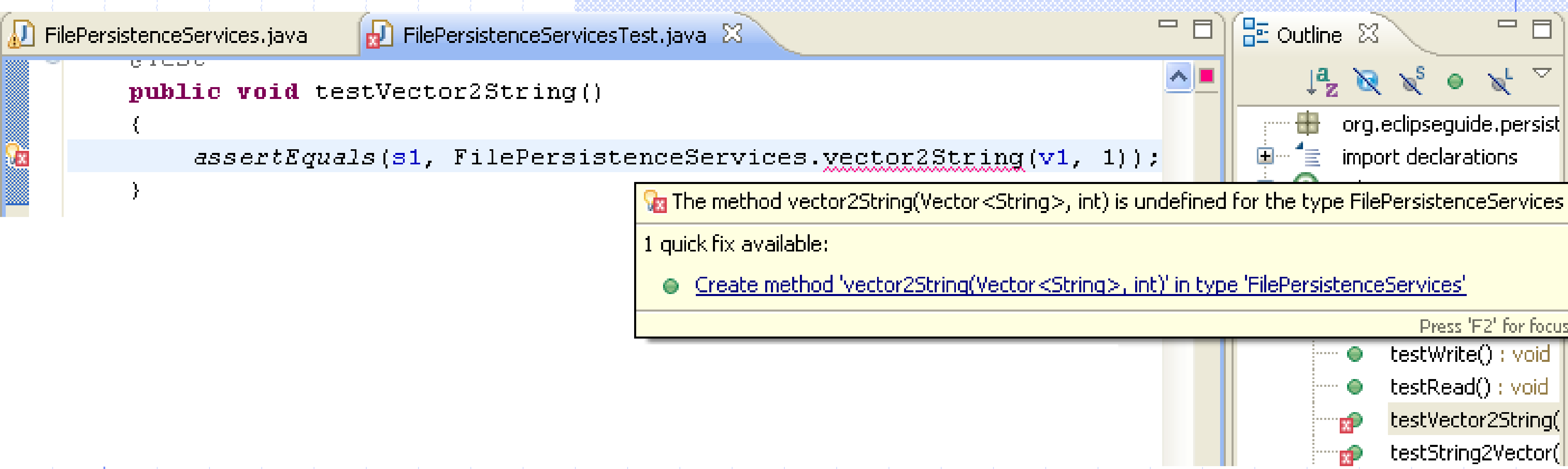
   Recall that actually `v1 = [One, Two, Three]`

2. **Add** new `@Test` ***method*** in `FilePersistenceServicesTest` class which we expect *to pass:*

```
   @Test
   public void testVector2String()
   {
      assertEquals(s1,

   FilePersistenceServices.vector2String(v1,1));
   }
```

expected

actual



FilePersistenceServices.java FilePersistenceServicesTest.java

```
public void testVector2String()
{
    assertEquals(s1, FilePersistenceServices.vector2String(v1, 1));
}
```

The method vector2String(Vector<String>, int) is undefined for the type FilePersistenceServices

1 quick fix available:

Create method 'vector2String(Vector<String>, int)' in type 'FilePersistenceServices'

Press 'F2' for focus

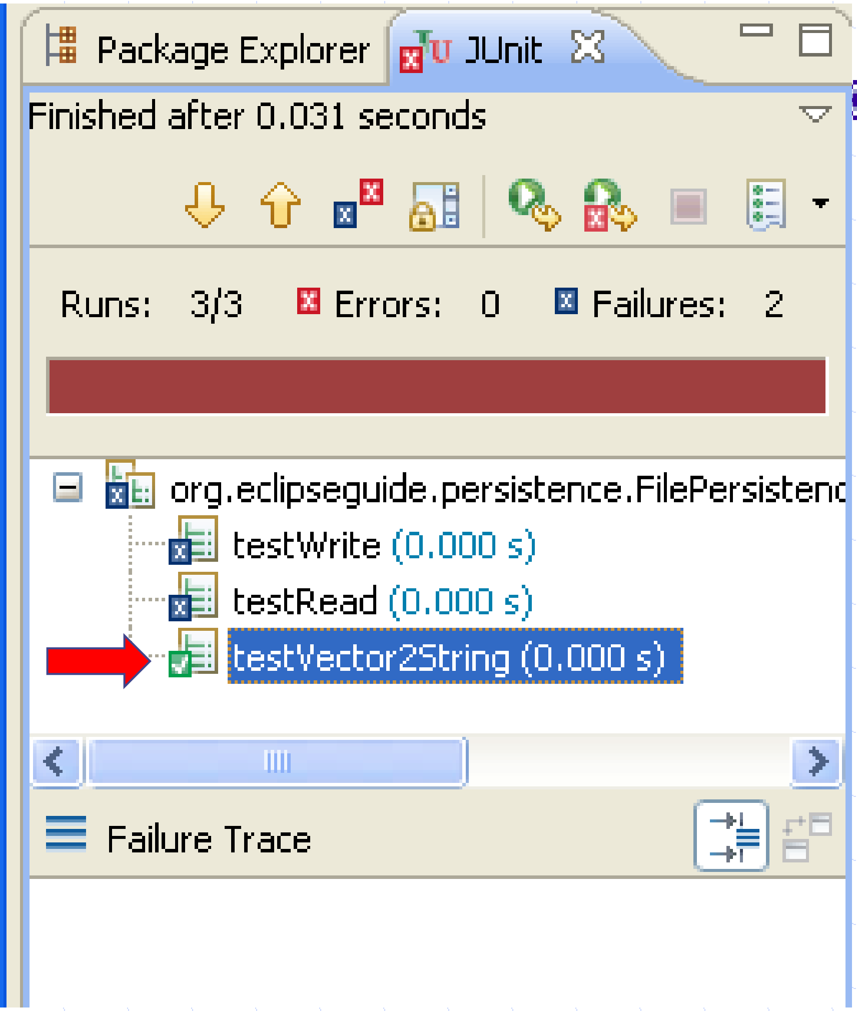
- But now **red sign** and **light bulb** appear on the right and left boarders of the **Editor view** witnessing on a syntax error in the test class which **uses non-existing yet method** **`vector2String`**.
    - **Click** on the *light bulb* which ***suggests*** to
        - **create automatically(!)** the stub method **`vector2String(Vector v, int key)`** in the ***source file*** **`FilePersistenceServices.`**
    - **Agree** with this suggesstion by *double clicking*, and
    - **Continue editing** the resulting method ***as it is shown in the next slide*** with the goal for it
        - to ***pass the above test***.

vector2String() added to FilePersistenceServices

```
public static String vector2String(Vector v, int key)
{
    String s = null;
    StringBuffer buffer = new StringBuffer();
    // start with key in quotation marks and comma
    buffer.append("\"" + Integer.toString(key) + "\",");
    // add quote delimited entry
    // for each element in Vector v:
    for (int i = 0; i < v.size(); i++)
    {
        buffer.append("\"");
        buffer.append(v.elementAt(i));
        buffer.append("\"");
        if (i != (v.size() - 1)) // if i is not last
        {
            buffer.append(","); // Add comma in case
        }                       // of not last element
    }
    s = buffer.toString();
    return s;
}
```

Do not forget to regularly **format,** `Ctrl+Shift+F`, and **save** your files.

Further testing-coding



Package Explorer | JUnit

Finished after 0.031 seconds

Runs: 3/3 Errors: 0 Failures: 2

```
org.eclipseguide.persistence.FilePersistenc
    testWrite (0.000 s)
    testRead (0.000 s)
    testVector2String (0.000 s)
```

Failure Trace

- **Run**

  FilePersistenceServicesTest

  again using :

  - the first two tests still ***fail***,
  - but the new *third test* ***passes!!!***
  - Indeed, we see the **green tick** and the ***empty*** **Failure Trace**

Not a complete success, but the new ***test*** `testVector2String()` ***successfully passes!***

Further testing-coding

- To implement **`string2Vector(String s)`**, let's first
- **add** the following new **`@Test`** method to **`FilePersistenceServicesTest`**

```
@Test
public void testString2Vector()
{
   assertEquals(v1,                expected
     FilePersistenceServices.string2Vector(s1));
}                                  actual
```

- suggests again to implement **`string2Vector()`** in the source file (as we are ***testing a non-existing method***).
- We also need to use **Java's `StringTokenizer`** class to
  - **parse** any **`String s`** into **tokens,** and
  - **add** each **token** to a **`Vector v`** as shown in the next slide:

Further testing-coding

string2vector() added to **FilePersistenceServices**

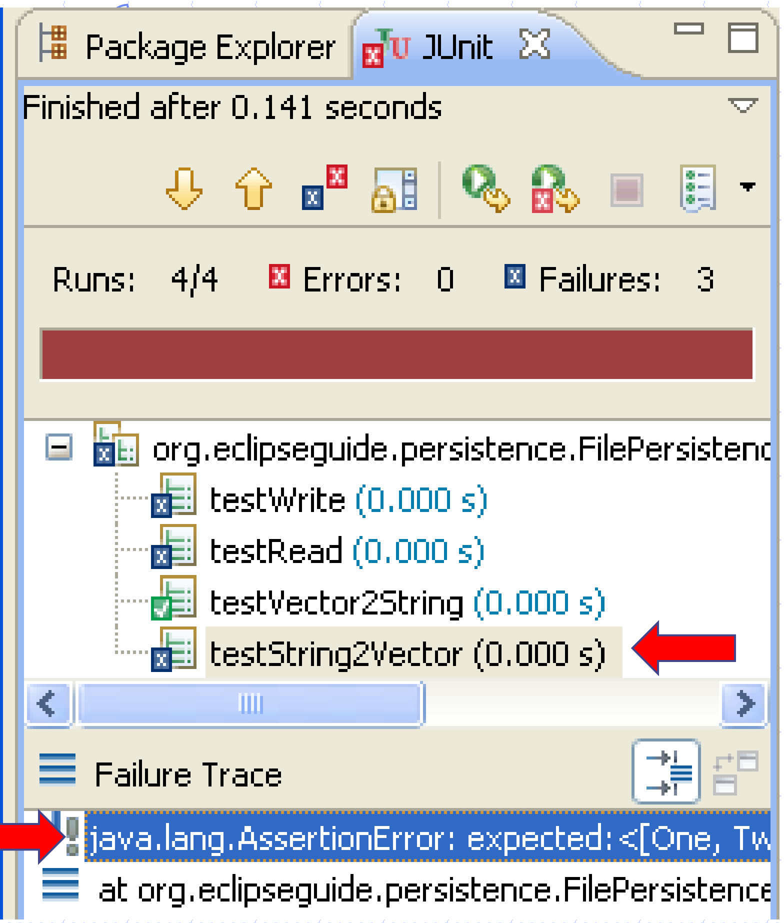
```
public static Vector string2Vector(String s)
{
    Vector v = new Vector();
    // use comma and double quotation mark as delimiters
    StringTokenizer st = new StringTokenizer(s, "\",");

    while (st.hasMoreTokens())
    {
        v.addElement(st.nextToken());
    }
    return v;
}
```

parsing string **s** into tokens and **adding** them to vector **v**

E.g. string `""One","Two","Three""` transforms to vector `[One,Two,Three]`.

suggests to `import java.util.StringTokenizer;`

Further testing-coding



Package Explorer | JUnit

Finished after 0.141 seconds

Runs: 4/4 Errors: 0 Failures: 3

```
org.eclipseguide.persistence.FilePersistenc
    testWrite (0.000 s)
    testRead (0.000 s)
    testVector2String (0.000 s)
    testString2Vector (0.000 s)
```

Failure Trace

```
java.lang.AssertionError: expected:<[One, Tw
at org.eclipseguide.persistence.FilePersistence
```

- However, the **test** for `string2Vector` **fails**:
  - **Failure Trace** in the **JUnit view** indicates that the comparison of
    - the *expected* value `v1` and
    - the *returned* `string2Vector(s1)` are ***different***:

```
java.lang.AssertionError:
expected:<[One, Two, Three]>
but was:<[1, One, Two, Three]>
```

- **CORRECT** implementation of the method `string2Vector()` to make *`test`*`String2Vector` passing.
  - **Just ignore the initial token 1 (How? Think, it is easy!)**
  - **Run the test again; it should succeed!**

Further testing-coding

- **Iimplement yourself** another method

```
public static int getKey(String s){???}
```

in **FilePersistenceServices** class, **but ...**

- **Preliminary write** *test*GetKey() in **FilePersistenceServicesTest** classs:

```
@Test
public void testGetKey()
{
    assertEquals(1,                                    expected
    FilePersistenceServices.getKey(s1));               actual
}
```

suggests **further actions:**

to create and **implement!!!** ***getKey*** . . .

Run the test for GetKey() again to assure that it passes.

Further testing-coding

- Our work on **Persistence** project is **not finished yet**.
- See **yourselves** further steps and details in **Eclipse Book.**
- Our goal was to give you a *flavour* of *Test Driven approach* to programming, and how **Eclipse** helps in this approach.
- This only could *help you to start* using this approach.
- Try to use this approach in your programming practice.
- Read more on **JUnit** testing to study it *deeper* and to learn *best practices* of its using.
- Then you will get a ***better understanding*** and some ***benefits*** of this approach.
- Recall that ***testing many times a day will rather***
  - ***save your time*** , and
  - make your work much more ***comfortable*** and ***confident***.

Running tests from the command line

- The button ▶ makes running **JUnit** test classes In **Eclipse** very easy.
- However, **JUnit** in itself is a **Java** application and can be run just *from the command line*.
- E.g., from the directory **`Persistence`** corresponding to our **project** we can
  - ***compile*** both source code and the test class and then
  - ***run*** the test class as follows:

Compiling and Running tests from the **command line**

```
C:\workspace\Persistence>javac -d bin
src\org\eclipseguide\persistence\*.java
```

Where (direction) to compile
What to compile

Do not forget to **recompile** each time!!!

Test runner

```
C:\workspace\Persistence>java -cp bin;C:\JAVA\junit4.9\junit-4.9.jar
org.junit.runner.JUnitCore
org.eclipseguide.persistence.FilePersistenceServicesTest
JUnit version 4.9
.E.E...
Time: 0.015
There were 2 failures:
1) testWrite(org.eclipseguide.persistence.FilePersistenceServicesTest)
java.lang.AssertionError: NOT WRITTEN???

<many lines skipped>


2) testRead(org.eclipseguide.persistence.FilePersistenceServicesTest)
java.lang.AssertionError: expected:<[One, Two, Three]> but was:<null>

<many lines skipped>


FAILURES!!!
Tests run: 5,  Failures: 2
```

Class path

Test case to run

`E` **(error)** means that the previous **testXXX** methods – shown as one **dot** (.) – ***failed***

Your message to yourself

Description of a **test failure**

Last lines show that we should **look upwards** for the failures

Complicated commands and a lot of unimportant lines (skipped) makes this way of running tests not very comfortable. Compare how it was done in **Eclipse**!

Detailed Summary: Essential steps, advantages, and peculiarities of **creating** and **running** a **JUnit** test case in **Eclipse**.

- **JUnit** is included in **Eclipse** as a well-integrated *plug-in*.
- **Eclipse** has a *wizard* creating *test cases* from existing **Java** Classes to be tested.
  - Therefore it makes sense to create first a **Java** Class to be tested, but *initially* only with method *stubs*.

Detailed Summary: Essential steps, advantages, and peculiarities of **creating** and **running** a **JUnit** test case in **Eclipse**.

- The wizard automatically suggests the *default names* for
  - source folder (`src`),
  - folder where to compile (`bin`),
  - test case name `ClassTest`

    corresponding to the name of the tested `Class`
  - package for test case `ClassTest`, the same as that of the tested `Class`
- The wizard also suggests the options for creating ***stub*** methods
  - `setUp()` and `tearDown()`

annotated as `@Before` and `@After`, respectively.

Detailed Summary: Essential steps, advantages, and peculiarities of **creating** and **running** a **JUnit** test case in **Eclipse**.

- In the **Next step** the wizard presents the options to create `@Test` method **stubs**, `testXXX()`, to test each of the methods `xXX()` in the `Class` under testing.
- All of these considerably alleviates and even *automates* the preliminary routine editing work to create a test case.
- **Next step** is to *finish creating test case:*
  - to `setUp()` (and, optionally, `tearDown()`) a ***fixture***, and
  - to finish writing `testXXX()` methods.
- The latter is, of course, ***not*** an automated part of work.
- Nevertheless, **Eclipse** can help, as in the case of editing of any **Java** code.

Detailed Summary: Essential steps, advantages, and peculiarities of **creating** and **running** a **JUnit** test case in **Eclipse**.

- *Running* **JUnit** *test cases* in **Eclipse** is similar to running a **Java** *application* (just by mouse click) and has the same convenience in comparison with command line running.
- It automatically adds **JUnit** *view* which instantly shows by the **red/green** bar
  - whether our `Class` *passes all the unit tests successfully*,
  - the information about each *failed* `@Test` annotated method `testXXX()`,
  - whether it failed *because* of some of its *assertion method*,
  - or *due to* a compilation or runtime *error*.

Detailed Summary: Essential steps, advantages, and peculiarities of **creating** and **running** a **JUnit** test case in **Eclipse**.

- For each failed `@Test` method `testXXX()` there is a Failure Trace in **JUnit** view which can help to find out the *reason of the failure*.
- To investigate further, the powerful ***debugger*** tool of **Eclipse** can be used as well.

  (We have not considered this in detail, but you should know about existence of debugger in **Eclipse**)
- After correcting all errors and passing all tests
  - the *cycle* on further **writing tests** and **adapting the source code** to pass tests is *repeated* ...
  - *until* a satisfactory source code will be obtained.