Lecture Notes on JUnit (COMP 303)

- These slides extracted from material at http://junit.sourceforge.net/doc/testinfected/testing.htm .
- Slides compiled by Laurie Hendren, McGill University.

JUnit is a simple framework for testing Java programs

- Encourages you to develop tests as you develop code.
- Makes it easy to run test suites.
- You may even want to write the test first.
- You can download JUnit from http://junit.org

Example Problem: Representing a currency

```
class Money {
    private int fAmount;
    private String fCurrency;

    public Money(int amount, String currency) {
        fAmount= amount;
        fCurrency= currency;
    }

    public int amount() {
        return fAmount;
    }

    public String currency() {
        return fCurrency;
    }

    public Money add(Money m) {
      return new Money(amount()+m.amount(), currency());
    }
}
```


Want to test the add method - code a little - test a little

- Define a `MoneyTest` class that extends `TestCase` .
- Define a method `testSimpleAdd()` that:
  1. creates objects to use in the test case *fixtures*
  2. code which exercises the objects in the fixture
  3. code which verifies the result

Let's see what it looks like:

```
public class MoneyTest extends TestCase {

    public void testSimpleAdd() {
        Money m12CHF= new Money(12, "CHF");  // (1)
        Money m14CHF= new Money(14, "CHF");
        Money expected= new Money(26, "CHF");
        Money result= m12CHF.add(m14CHF);    // (2)
        Assert.assertTrue(expected.equals(result));     // (3)
    }
}
```


But wait, how do we check if two Money objects are equal?

- must override the method *equals* defined in `Object`
- let's write a test for it, before we actually code the method

```
public void testEquals() {
    Money m12CHF= new Money(12, "CHF");
    Money m14CHF= new Money(14, "CHF");

    Assert.assertTrue(!m12CHF.equals(null));
    Assert.assertEquals(m12CHF, m12CHF);
    Assert.assertEquals(m12CHF, new Money(12, "CHF")); // (1)
    Assert.assertTrue(!m12CHF.equals(m14CHF));
}
```


Now we have the test, let's implement the code

```
public class Money {
  // ... all the previous code
  public boolean equals(Object anObject) {
    if (anObject instanceof Money) {
        Money aMoney= (Money)anObject;
        return aMoney.currency().equals(currency())
            & & amount() == aMoney.amount();
    }
    return false;
}
```

- `Money` is a value object, must first check it is of the correct type, and then check the inside values.
- go back and check we have handled all cases in the test.

Maybe add another case?

```
public void testEquals() {
    Money m12CHF= new Money(12, "CHF");
    Money m14CHF= new Money(14, "CHF");
    Object o = new Object();  // new fixture here

    Assert.assertTrue(!m12CHF.equals(null));
    Assert.assertEquals(m12CHF, m12CHF);
    Assert.assertEquals(m12CHF, new Money(12, "CHF"));
    Assert.assertTrue(!m12CHF.equals(m14CHF));
    Assert.assertTrue(!m12CHF.equals(o)); // new test case here
}
```

- Note special `assertEquals` method. If not equal, tester will print `toString` of each expression.
- As an aside, **always** define a good `toString` method for every class.
- Other assertXXXX variants, check out http://junit.sourceforge.net/javadoc/junit/framework/Assert.html

Avoiding code duplication between different tests

- Note that there is some code duplication in creating the fixtures in the two methods `testSimpleAdd` and `testEquals` .
- Can put common code into methods `setUp()` and `tearDown` .

```
public class MoneyTest extends TestCase {
    private Money f12CHF;
    private Money f14CHF;

    protected void setUp() {
        f12CHF= new Money(12, "CHF");
        f14CHF= new Money(14, "CHF");
    }

    public void testEquals() {
      Assert.assertTrue(!f12CHF.equals(null));
      Assert.assertEquals(f12CHF, f12CHF);
      Assert.assertEquals(f12CHF, new Money(12, "CHF"));
      Assert.assertTrue(!f12CHF.equals(f14CHF));
    }

    public void testSimpleAdd() {
      Money expected= new Money(26, "CHF");
      Money result= f12CHF.add(f14CHF);
      Assert.assertTrue(expected.equals(result));
    }
}
```


Putting test cases into a suite of tests

Define a static method called `suite()` as follows:

- If you want to explicitly list the tests to include the following in `MoneyTest` :

```
public static Test suite() {
  TestSuite suite= new TestSuite();
  suite.addTest(new MoneyTest("testEquals"));
  suite.addTest(new MoneyTest("testSimpleAdd"));
  return suite;
}
```

- If you want all methods starting with "`test`".

```
public static Test suite() {
  return new TestSuite(MoneyTest.class);
}
```

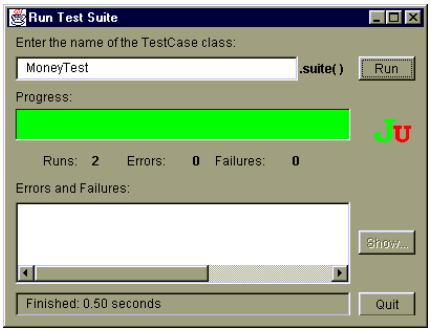

Ok, now let's run the test suite.

- Make sure `junit.jar` is on your CLASSPATH, or explicitly give the classpath on your call to `java` .
- use the command-line version:

```
java junit.textui.TestRunner MoneyTest
```

- or use the Swing version:

```
java junit.swingui.TestRunner MoneyTest
```



Some general testing practices

- Martin Fowler says *"Whenever you are tempted to type something into a print statement or a debugger expression, write it as a test case instead."*
- At first you will have to create a lot of fixtures, but then you will find you have created all the infrastructure and new tests become easier to add.
- Try to write tests that you imagine to be useful. Look for the boundary cases.
- When to add tests:
  - During development: while you are designing your class (but before implementing).
  - During debugging: when someone discovers a defect, first write a test that should succeed if your program is working, then debug until it succeeds.
- When to run the tests:
  - All the time.
  - If you find newly introduced errors right away, then you have a good idea where the error might be.
  - Fix errors right away, keep your test suite running.