Homework Assignments

- APP B
- Reference on Junit Testing

Classes

- Class Definition

  class ClassName**:**

  attributes and methods

- Public Attribute

  name (optional = value)

- Private Attribute

  __name (optional = value)

  Note: A programmer convention only

  Access IS NOT prevented by interpreter

- Conventional Word “self”

  Used to refer to your own object in Python

  You may use another word, but “self” is the commonly accepted convention.

- Class Definition

  public class Classname

  {

  attributes and methods

  } // end of class definition

- Public Attribute

  public *(static) type* name (optional = value)**;**

- Private Attribute

  private *(static) type* name (optional = value)**;**

  Note: Access IS prevented by compiler

- Reserved Word “this”

  Used similarly to “self” in Python

  You **must** use the reserved word “this”.

  Not required in as many places in the code, e.g. not needed in method parameter lists.

Classes

- Constructor Method

```
def __init__ (self, parameter):
        self.parameter = parameter
```

- Public Method

```
def name (self, parameters):
        statements
```

- Private Method

```
def __name (self, parameters):
        statements
```

Note: A programmer convention only

Access IS NOT prevented by interpreter

- Constructor Method

```
public ClassName (parameter)
{
        this.parameter = parameter;
}  // end of method
```

- Public Method

```
public type name (parameters)
{
        statements;
}  // end of method
```

- Private Method

```
private type name (parameters)
{
        statements;
}  // end of method
```

Note: Access IS prevented by compiler

Classes

- Method Return Value

```
def name (self, parameters):
        return expression
```

- Method Overloading

```
def name (self, param = None):
        if param is None:
                1st version of statements
        else:
                2nd version of statements
```

- Method Return value

```
public type name (parameters)
{
        return expression of type;
}  // end of method
```

- Method Overloading

```
public type name ( )    // no parameter
{
        1st version of statements;
}  // end of first “name” method

public type name (type param)
{
        2nd version of statements;
}  // end of second “name” method
```

Python “Magic” Methods

- Magic Methods

__str__(self) # representation

__cmp__(self, other) # compare objects
(Supports operator overloading for >, <, etc.)

__add__(self, other) # and sub, mul, div, etc
(Supports operator overloading for +, -, *, /, etc)

__eq__(self, other) # check equality

__iter__(self) # returns an iterator
(Supports “for item in items” type of loop)

__del__(self) # clean up

- Java Equivalents

public String toString() // representation

public int compareTo(that) // compare objects
(Supports implementing Comparable interface)

Note: Operator overloading is NOT supported

public boolean equals(that) // check equality

public Iterator<T> iterator() // returns an interator
(Supports “for (*type* item **:** items)” for-each loop
and implementing Iterable<T> interface)

protected void finalize() // clean up

Creating / Deleting Objects

- Instantiating an Object

```
myObject = ClassName(. . .)
# … are values for constructor's parameters
```

- Creating an Alias

```
yourObject = myObject
# … both variables refer to the same object
```

- Deleting an Object

```
myObject = None      # deletes object
                     # (if there is no alias)
```

- Instantiating an Object

```
Classname myObject = new ClassName(. . . );
// … are values for constructor's parameters
```

- Creating an Alias

```
ClassName yourObject = myObject;
# … both variables refer to the same object
```

- Deleting an Object

```
myObject = null;  // deletes object
                  // (if there is no alias)
```

Inheritance / Interfaces

- Inheritance

```
# OO Concept:  A Cat is an Animal
class Cat(Animal):
    attributes and methods
```

- Multiple Inheritance

```
class ClassName(Class1, Class2, …):
    attributes and methods
```

- Inheritance

```
// OO Concept:  A Cat is an Animal
public class Cat extends Animal
{
    attributes and methods
} // end of class
```

- No Multiple Inheritance

Java doesn't support more than one parent class

- Interfaces

Java supports implementing multiple interfaces

```
public class ClassName implements Int1, Int2, …
{
} // end of class
```

Inheritance / Interfaces

- Polymorphism

```
class Pet:              # abstract parent class
    def makeSound(self):
        raise NameOfError("text")

class Dog(Pet):         # concrete child class
    def makeSound(self):
        print "Woof Woof"

class Cat(Pet):         # concrete child class
    def makeSound(self):
        print "Meow"

spot = Dog()
spot.makeSound()        # Woof Woof
fluffy = Cat()
fluffy.makeSound()      # Meow

# Attempt to create/use an abstract class
fubar = Pet()
fubar.makeSound()       # raises an Error
                        # at run time
```

- Polymorphism

In Java, a reference to any object may be saved as a reference to the type of a parent class or of any implemented interface:

If Cat class and Dog class extend Pet class, we can do these "widening" conversions:

```
Dog d = new Dog();
Pet p = d;          // our Pet is a Dog
p = New Cat();      // and is now a Cat
```

And call any Pet method on variable p:

```
p.anyPetMethod(. . .);  // on Dog/Cat
```

If a method parameter needs to be a Pet,

```
public void methodName(Pet p) {…}
```

we can pass a Dog or a Cat object to it:

```
methodName(d);      // pass it a Dog
methodName(new Cat());   // or Cat
```

If Pet is an abstract class, we can't create a Pet object (causes a compilation error)

```
Pet p = new Pet();     // compile error
```

Inheritance / Interfaces

- Polymorphism

  If a method definition requires returning a reference to a class or interface, it may return a reference to an object of the class, a child class, or an implementing class.

  If Pet class implements Comparable<T>,
  Dog and Cat class also implement it.
  If we invoke a method with a return value
  of type Comparable<T>:

```
Comparable<T> c = methodName( . . . );
```

  It can return a Dog or a Cat object:

```
public Comparable<T> methodName(. . .)
{
    if (some boolean expression)
        return new Dog();
    else
        return new Cat();
}
```

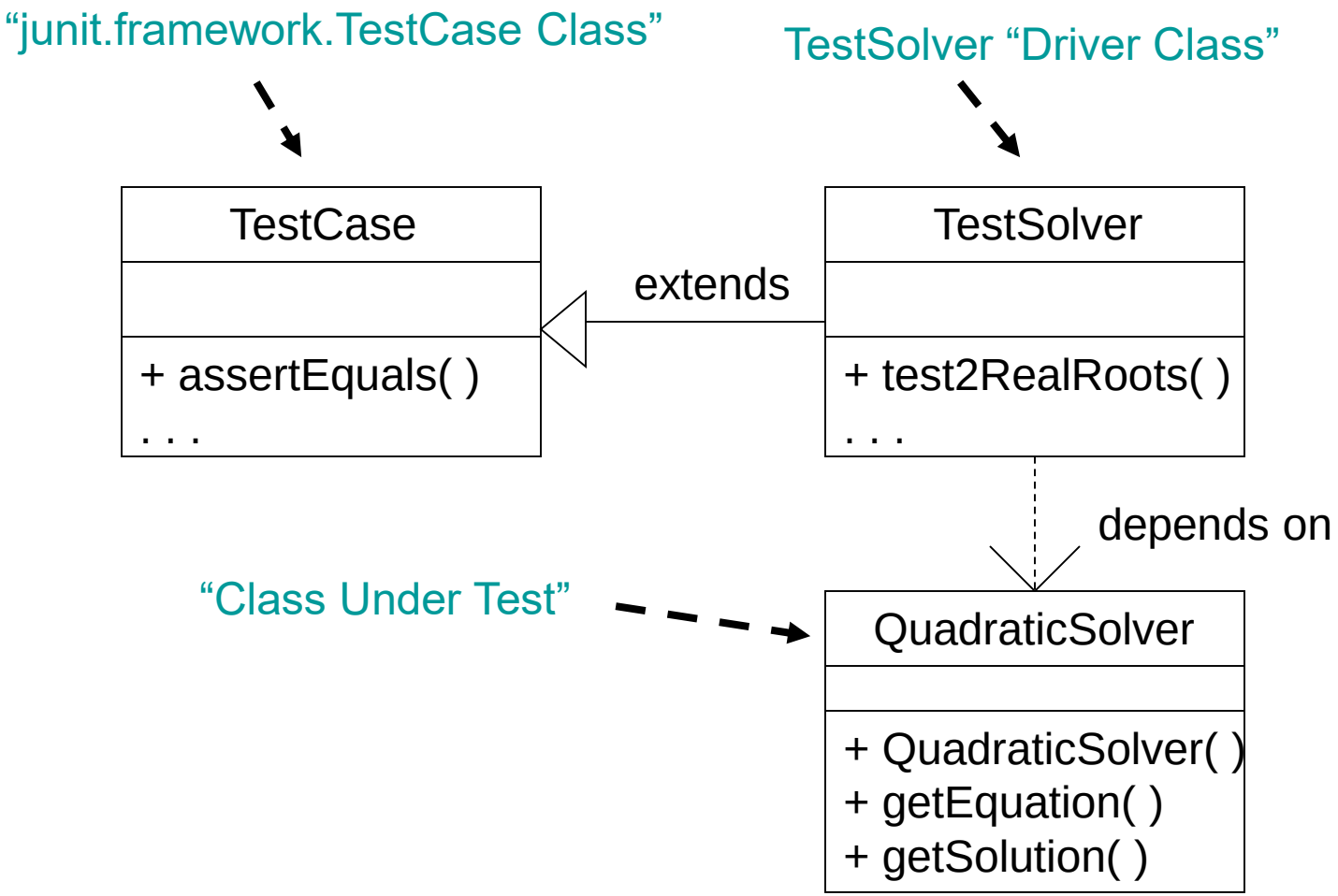
JUnit Testing

- Testing is critical to developing software quality
- Good test plans are difficult to specify but also difficult to document precisely in English
- Good testing must be repeatable
- Good testing is tedious so you will be tempted to cut corners and omit out some needed testing
- Testing is a good candidate for automation
- Some SW development methodologies such as “Extreme Programming” require daily builds and automated testing

JUnit Testing

- In Lab 2, when you develop Java code for the QuadraticSolver class, you use the CLI class itself as the “driver” to enter and execute the test cases from the table in the assignment
- You manually enter the test case values and visually verify whether the response provided is correct or not
- This is labor intensive and error prone!!
- The JUnit framework helps us build a “test case” class to automate testing of a “class under test”

JUnit Testing



JUnit Testing

- Useful method inherited from TestCase class:

```
assertEquals(Object expected, Object actual)
assertEquals("expected", cut.toString( ));
```

- The assertEquals method flags discrepancies between the “expected” value and the result returned by the “class under test” method( )
- assertEquals method automatically displays the difference between the “expected value” and the actual return value received

JUnit Testing

- Other useful assert… methods

```
assertEquals(double expected_value,
             double actual_value,
             double threshold_value)
```

- Automatically compares absolute difference between first two parameters with a threshold

```
assertEquals(4.3, cut.getDbl(), 0.1);
```

JUnit Testing

- Useful assert… methods for boolean data type
- Automatically expects returned value is true

```
assertTrue(cut.getBoolean());
```

- Automatically expects returned value is false

```
assertFalse(cut.getBoolean());
```

JUnit Test for QuadraticSolver

```
import junit.framework.TestCase;

public class TestSolver extends TestCase {
   private QuadraticSolver cut;              // a reference to an object of the “class under test”

   public TestSolver()
   {
       // nothing needed here
   }

  // First of six test case methods for the QuadraticSolver class
   public void test2RealRoots()
  {
      cut = new QuadraticSolver(1, 0, -1);
      assertEquals("Solving: 1x\u00b2 + 0x -1 = 0", uut.getEquation());
      assertEquals("Root 1 is 1.0\nRoot 2 is -1.0", uut.getSolution());
  }
}
```

JUnit Testing

- Test Case Execution
  1 test failed:
    TestSolver
      test2RealRoots
      test2ImaginaryRoots
      testOnly1Root
      testLinear
      testNoSolution
      testAnySolution
  File: C:\Documents and Settings\bobw\My Documents\bobw\public_html\CS110\Project1\JUnitSolution\TestSolver.java [line: 48]
  Failure: expected:<.....> but was:<...1...>
  (I removed part of "should be" string constant to create an error)

JUnit Testing

- The Java code in the TestCase class(es) precisely documents all the test cases
- It allows them to be run automatically
- It allows people other than the test designer to run them without knowing the details of how they work
- It prevents oversights in identification of any discrepancies in the results
- Caveat:
  - When you get errors, check both the test case code and the code of the class under test
  - The error may be caused in either or both places