

# Method Design & Method Overloading

November 9, 2007

ComS 207: Programming I (in Java)  
Iowa State University, FALL 2007  
Instructor: Alexander Stoytchev

© 2004 Pearson Addison-Wesley. All rights reserved.

## Quick Review of Last Lecture

© 2004 Pearson Addison-Wesley. All rights reserved.

### The this Reference

- The `this` reference allows an object to refer to itself
- That is, the `this` reference, used inside a method, refers to the object through which the method is being executed
- Suppose the `this` reference is used in a method called `tryMe`, which is invoked as follows:

```
obj1.tryMe();  
obj2.tryMe();
```

- In the first invocation, the `this` reference refers to `obj1`; in the second it refers to `obj2`

© 2004 Pearson Addison-Wesley. All rights reserved.

### The this reference

- The `this` reference can be used to distinguish the instance variables of a class from corresponding method parameters with the same names
- The constructor of the `Account` class (from Chapter 4) could have been written as follows:

```
public Account (String name, long acctNumber,  
                double balance)  
{  
    this.name = name;  
    this.acctNumber = acctNumber;  
    this.balance = balance;  
}
```

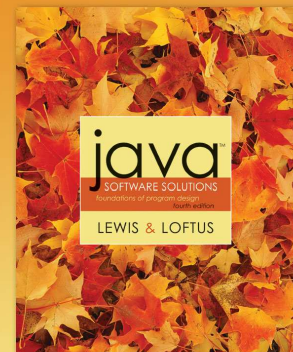
© 2004 Pearson Addison-Wesley. All rights reserved.

### The this reference

```
public Account (String owner, long account,  
                double initial)  
{  
    name = owner;  
    acctNumber = account;  
    balance = initial;  
}  
  
public Account (String name, long acctNumber,  
                double balance)  
{  
    this.name = name;  
    this.acctNumber = acctNumber;  
    this.balance = balance;  
}
```

© 2004 Pearson Addison-Wesley. All rights reserved.

## Chapter 6 Section 6.5 – 6.6



PEARSON  
Addison  
Wesley

© 2005 Pearson Addison-Wesley. All rights reserved.

## Interfaces

- A Java *interface* is a collection of abstract methods and constants
- An *abstract method* is a method header without a method body
- An abstract method can be declared using the modifier `abstract`, but because all methods in an interface are abstract, usually it is left off
- An interface is used to establish a set of methods that a class will implement

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

interface is a reserved word

```
public interface Doable
{
    public void doThis();
    public void doThat();
    public void doThis2 (float value, char ch);
    public boolean doTheOther (int num);
}
```

None of the methods in an interface are given a definition (body)

A semicolon immediately follows each method header

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

- An interface cannot be instantiated
- Methods in an interface have public visibility by default
- A class formally implements an interface by:
  - stating so in the class header
  - providing implementations for each abstract method in the interface
- If a class asserts that it implements an interface, it must define all methods in the interface

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

```
public class CanDo implements Doable
{
    public void doThis ()
    {
        // whatever
    }

    public void doThat ()
    {
        // whatever
    }

    // etc.
}
```

implements is a reserved word

Each method listed in Doable is given a definition

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

- A class that implements an interface can implement other methods as well
- See [Complexity.java](#) (page 310)
- See [Question.java](#) (page 311)
- See [MiniQuiz.java](#) (page 313)
- In addition to (or instead of) abstract methods, an interface can contain constants
- When a class implements an interface, it gains access to all its constants

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

- A class can implement multiple interfaces
- The interfaces are listed in the `implements` clause
- The class must implement all methods in all interfaces listed in the header

```
class ManyThings implements interface1, interface2
{
    // all methods of both interfaces
}
```

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

- The Java standard class library contains many helpful interfaces
- The `Comparable` interface contains one abstract method called `compareTo`, which is used to compare two objects
- We discussed the `compareTo` method of the `String` class in Chapter 5
- The `String` class implements `Comparable`, giving us the ability to put strings in lexicographic order

© 2004 Pearson Addison-Wesley. All rights reserved

## Where can you find the standard Java interfaces

- `C:\Program Files\Java\jdk1.5.0\src.zip`

© 2004 Pearson Addison-Wesley. All rights reserved

## The Comparable Interface

- Any class can implement `Comparable` to provide a mechanism for comparing objects of that type

```
if (obj1.compareTo(obj2) < 0)
    System.out.println ("obj1 is less than obj2");
```

- The value returned from `compareTo` should be negative if `obj1` is less than `obj2`, 0 if they are equal, and positive if `obj1` is greater than `obj2`
- When a programmer designs a class that implements the `Comparable` interface, it should follow this intent

© 2004 Pearson Addison-Wesley. All rights reserved

## The Comparable Interface

- It's up to the programmer to determine what makes one object less than another
- For example, you may define the `compareTo` method of an `Employee` class to order employees by name (alphabetically) or by employee number
- The implementation of the method can be as straightforward or as complex as needed for the situation

© 2004 Pearson Addison-Wesley. All rights reserved

## The Iterator Interface

- As we discussed in Chapter 5, an iterator is an object that provides a means of processing a collection of objects one at a time
- An iterator is created formally by implementing the `Iterator` interface, which contains three methods
- The `hasNext` method returns a boolean result – true if there are items left to process
- The `next` method returns the next object in the iteration
- The `remove` method removes the object most recently returned by the `next` method

© 2004 Pearson Addison-Wesley. All rights reserved

## The Iterator Interface

- By implementing the `Iterator` interface, a class formally establishes that objects of that type are iterators
- The programmer must decide how best to implement the iterator functions
- Once established, the for-each version of the `for` loop can be used to process the items in the iterator

© 2004 Pearson Addison-Wesley. All rights reserved

## Interfaces

- You could write a class that implements certain methods (such as `compareTo`) without formally implementing the interface (`Comparable`)
- However, formally establishing the relationship between a class and an interface allows Java to deal with an object in certain ways
- Interfaces are a key aspect of object-oriented design in Java
- We discuss this idea further in Chapter 9

© 2004 Pearson Addison-Wesley. All rights reserved

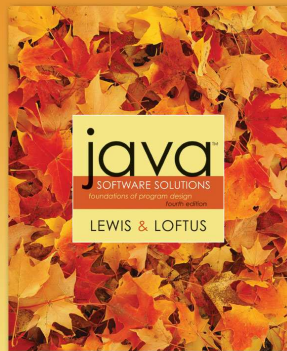
## Interface Example:

**Sortable.java**  
**SortableIntArray.java**  
**SortableStrigArray.java**  
**SortingTest.java**

© 2004 Pearson Addison-Wesley. All rights reserved

## Chapter 6

### Section 6.6



PEARSON  
Addison  
Wesley

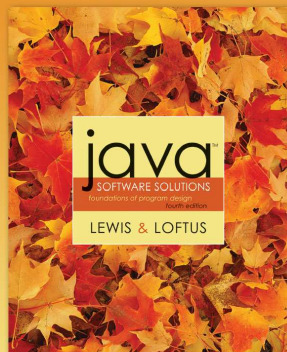
© 2005 Pearson Addison-Wesley. All rights reserved.

## Enumerated Types (read Section 6.6 on your own)

© 2004 Pearson Addison-Wesley. All rights reserved

## Chapter 6

### Section 6.7



PEARSON  
Addison  
Wesley

© 2005 Pearson Addison-Wesley. All rights reserved.

## Method Design

- As we've discussed, high-level design issues include:
  - identifying primary classes and objects
  - assigning primary responsibilities
- After establishing high-level design issues, its important to address low-level issues such as the design of key methods
- For some methods, careful planning is needed to make sure they contribute to an efficient and elegant system design

© 2004 Pearson Addison-Wesley. All rights reserved

## Method Design

- An *algorithm* is a step-by-step process for solving a problem
- Examples: a recipe, travel directions
- Every method implements an algorithm that determines how the method accomplishes its goals
- An algorithm may be expressed in *pseudocode*, a mixture of code statements and English that communicate the steps to take

© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Decomposition

- A method should be relatively small, so that it can be understood as a single entity
- A potentially large method should be decomposed into several smaller methods as needed for clarity
- A public service method of an object may call one or more private support methods to help it accomplish its goal
- Support methods might call other support methods if appropriate

© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Decomposition

- Let's look at an example that requires method decomposition – translating English into Pig Latin
- Pig Latin is a language in which each word is modified by moving the initial sound of the word to the end and adding "ay"
- Words that begin with vowels have the "yay" sound added on the end

book → ookbay      table → abletay  
item → itemyay      chair → airchay

© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Decomposition

- The primary objective (translating a sentence) is too complicated for one method to accomplish
- Therefore we look for natural ways to decompose the solution into pieces
- Translating a sentence can be decomposed into the process of translating each word
- The process of translating a word can be separated into translating words that:
  - begin with vowels
  - begin with consonant blends (sh, cr, th, etc.)
  - begin with single consonants

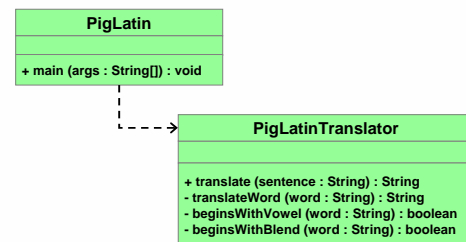
© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Decomposition

- See [PigLatin.java](#) (page 320)
- See [PigLatinTranslator.java](#) (page 323)
- In a UML class diagram, the visibility of a variable or method can be shown using special characters
- Public members are preceded by a plus sign
- Private members are preceded by a minus sign

© 2004 Pearson Addison-Wesley. All rights reserved.

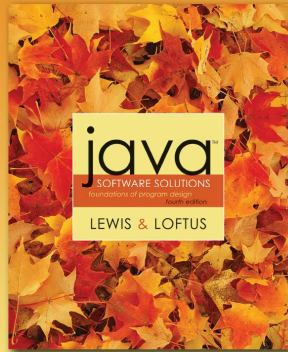
## Class Diagram for Pig Latin



© 2004 Pearson Addison-Wesley. All rights reserved.



Chapter 6  
Section 6.8



© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Overloading

- **Method overloading** is the process of giving a single method name multiple definitions
- If a method is overloaded, the method name is not sufficient to determine which method is being called
- The **signature** of each overloaded method must be unique
- The signature includes the number, type, and order of the parameters

© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Overloading

- The compiler determines which method is being invoked by analyzing the parameters

```
float tryMe(int x)
{
    return x + .375;
}

float tryMe(int x, float y)
{
    return x*y;
}
```

**Invocation**

`result = tryMe(25, 4.32)`

© 2004 Pearson Addison-Wesley. All rights reserved.

## Method Overloading

- The `println` method is overloaded:

```
println (String s)
println (int i)
println (double d)
```

and so on...

- The following lines invoke different versions of the `println` method:

```
System.out.println ("The total is:");
System.out.println (total);
```

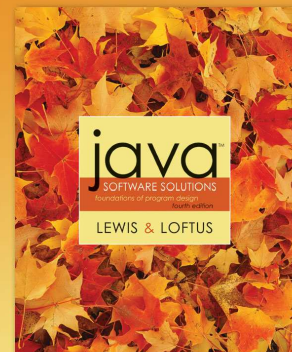
© 2004 Pearson Addison-Wesley. All rights reserved.

## Overloading Methods

- The return type of the method is not part of the signature
- That is, overloaded methods cannot differ only by their return type
- Constructors can be overloaded
- Overloaded constructors provide multiple ways to initialize a new object

© 2004 Pearson Addison-Wesley. All rights reserved.

Chapter 6  
Section 6.9



© 2004 Pearson Addison-Wesley. All rights reserved.

## Testing (read Section 6.9 on your own)

© 2004 Pearson Addison-Wesley. All rights reserved

## Testing

- Testing can mean many different things
- It certainly includes running a completed program with various inputs
- It also includes any evaluation performed by human or computer to assess quality
- Some evaluations should occur before coding even begins
- The earlier we find a problem, the easier and cheaper it is to fix

© 2004 Pearson Addison-Wesley. All rights reserved

## Testing

- The goal of testing is to find errors
- As we find and fix errors, we raise our confidence that a program will perform as intended
- We can never really be sure that all errors have been eliminated
- So when do we stop testing?
  - Conceptual answer: Never
  - Snide answer: When we run out of time
  - Better answer: When we are willing to risk that an undiscovered error still exists

© 2004 Pearson Addison-Wesley. All rights reserved

## Reviews

- A *review* is a meeting in which several people examine a design document or section of code
- It is a common and effective form of human-based testing
- Presenting a design or code to others:
  - makes us think more carefully about it
  - provides an outside perspective
- Reviews are sometimes called *inspections* or *walkthroughs*

© 2004 Pearson Addison-Wesley. All rights reserved

## Test Cases

- A *test case* is a set of input and user actions, coupled with the expected results
- Often test cases are organized formally into *test suites* which are stored and reused as needed
- For medium and large systems, testing must be a carefully managed process
- Many organizations have a separate Quality Assurance (QA) department to lead testing efforts

© 2004 Pearson Addison-Wesley. All rights reserved

## Defect and Regression Testing

- *Defect testing* is the execution of test cases to uncover errors
- The act of fixing an error may introduce new errors
- After fixing a set of errors we should perform *regression testing* – running previous test suites to ensure new errors haven't been introduced
- It is not possible to create test cases for all possible input and user actions
- Therefore we should design tests to maximize their ability to find problems

© 2004 Pearson Addison-Wesley. All rights reserved

## Black-Box Testing

- In *black-box testing*, test cases are developed without considering the internal logic
- They are based on the input and expected output
- Input can be organized into *equivalence categories*
- Two input values in the same equivalence category would produce similar results
- Therefore a good test suite will cover all equivalence categories and focus on the boundaries between categories

© 2004 Pearson Addison-Wesley. All rights reserved

## White-Box Testing

- *White-box testing* focuses on the internal structure of the code
- The goal is to ensure that every path through the code is tested
- Paths through the code are governed by any conditional or looping statements in a program
- A good testing effort will include both black-box and white-box tests

© 2004 Pearson Addison-Wesley. All rights reserved

THE END

© 2004 Pearson Addison-Wesley. All rights reserved