Lecture Set #6: Encapsulation, “this”, junit testing and Libraries

1. Review of Parameter passing
2. this
3. public vs. private Choices
4. junit testing
5. Libraries

Tracing Methods and their Parameters

Issues to discuss

- Primitive type parameters
- Parameters passed to the constructor
- Parameters where a value (not variable) is the argument
- Non-primitive type parameters

Parameters and Constructors

- Recall that methods / constructors can have parameters
  
  ```java
  public Student(String newName, int IDDesired) {
      name = newName;
      id = IDDesired;
      tokenLevel = 3;
  }
  ```

- What is printed by the following?
  
  ```java
  String newName = "Joe";
  Student s = new Student(newName + " Schmoe", 123456789);
  System.out.println(s.name);
  System.out.println(s.name);
  ```
Public Declarations

- public variables/methods and classes
  - Keyword public used in declaration
  - Every user of an object can access any public element
- Sometimes access should be restricted!
  - To avoid giving object users unnecessary info (keep API small)
  - To enforce consistency on instance variables

Reference type Parameters

- Recall that methods / constructors can have parameters
  
  ```java
  public int Student giveMore(Student s) {
    if (numOfTokens > s.numOfTokens) {
      s.numOfTokens += 3;
    } else {
      numOfTokens += 3;
    }
  }
  ```

- Trace Calling assume there are Student objects stu1 and stu2
  - Where stu1 has 5 tokens and stu2 has 12 tokens
  - Called with
    - stu1.giveMore(stu2);
    - stu2.giveMore(stu1);

How Does Java Evaluate Method / Constructor Calls?

```java
int newName = "Joe";
 Student s = new Student
(newName + " Schmoe", 123456789);
```

1. Arguments are evaluated using stack in effect at call site (place where method called)
   - newName + " Schmoe", evaluates to Joe Schmoe
   - 123456789 evaluates to 123456789
2. Stack frame (temporary addition to stack) created to associate method parameters with values
3. Stack frame put into stack
4. Body of method executed in modified stack
5. Stack frame removed from stack
this

- a reference to the current object. (Only makes sense in a non-static method.)
- In an instance method, this is the object that is assumed
  - easy to refer to members (data or methods) using the assumed object
  - difficult to refer to the whole object without having a name to call it
- Only use when needed – using it all the time makes the code more difficult to read

Private Declarations

- **private** variables, methods and classes
  ```java
  private int tokenLevel = 3;
  ```
- Private variables / members cannot be accessed outside the class definition
- Declaring instance variables private means they can only be modified using public methods
- Now getters (accessors) and setters (mutators) are required

What Should Be Public / Private?

- **Class interface** = API = public variables / methods
- Only make something public if there is a reason to
- Why? **Encapsulation**
  - As long as interface is preserved, class can change without breaking other code
  - The more limited the interface, the less there is to maintain
- Rule of thumb
  - Make instance variables private
  - Implement `set`/`get` methods
  - Make auxiliary methods private
Separate:
API and the workings of the class

- Design so that
  - you can change how the class works without having to change the API
  - the only things in the API are things the user will absolutely need (make the interface as simple as possible)
- Demonstrations in Class
  - Significantly Modifying the Student class – without changing the API (or the driver)
  - The Cat class and its drivers
    - with adding a copy constructor
  - Project 3
    - API described – you are using those classes
    - documentation / comments needed

Floating Point Calculations

What will this print?

```java
public class SimpleMath {
    public static void main(String[] args) {
        if (3.9 - 3.8 == 0.1) {
            System.out.println("I am a very smart computer.");
        } else {
            System.out.println("I can't do simple arithmetic.");
        }
    }
}
```

→ I can't do simple arithmetic.

- Why?
  - Conversion of floating point to binary leads to precision errors!
- What can we do?

Floating Point Calculations (cont.)

Two important rules:
- You can never use == to compare floating point values. Instead, check if two numbers are within a certain tolerance of each other.
- Never use floating point values to represent money, e.g., 3.52 to represent $3.52. Instead, use integer 352 to represent 352 pennies.
Documentation Types

- Three Styles
  - /** ... */
  - /* ... */
  - // ...

- Two Purposes
  - Internal – those reading code
  - External – those using the class

Javadoc Documentation Standard

- When documenting a method, list exceptions that method can throw
  - Use @exception tag
  - Be sure to include unhandled exceptions that operations in method may throw
- Example:
  ```java
  /**
   * Returns the year part of a date string
   * @param d date string in mm/dd/yyyy format
   * @return an integer representing the date
   *
   * @exception IndexOutOfBoundsException
   * @exception NumberFormatException
  */
  public static int getYear(String d) {
  ...
  }
  ```

Libraries in Java

- Library: implementation of useful routines that are shared by different programs
- Java mechanism for creating libraries: packages
- Package: group of related classes
  - Example: java.util (contains Scanner class)
  - To use a class from a package, you can use a fully qualified name (package name + class name):
    ```java
    java.util.Scanner s = new java.util.Scanner(System.in);
    ```
- You can also import the class in the beginning of the file
  ```java
  import java.util.Scanner;
  ```
- To import class in a package:
  ```java
  import java.util.*;
  ```
  (Imports Scanner as well as other classes in package)
Package java.lang

- A special package containing widely used classes:
  - String
  - Math
  - etc.
- `java.lang.*` is automatically imported by every Java program

Package Management

- A class can be added to a package by including:
  ```java
  package <name of package>;
  ```
  (usually very first line)
- The variables / methods provided by a class / package are often called its API (= Application Programmers Interface)
- APIs should be documented
- `java.lang` documentation:
  ```
  http://java.sun.com/j2se/1.3/docs/api/java/lang/package-summary.html
  ```
- On the resources page of the class web site – javadoc generated descriptions.

String API & Math API

- String implements lots of string functions
  ```java
  StringExample.java
  ```
- Math implements lots of mathematical functions
  ```java
  MathExample.java
  ```