CS206 Data Structures

Brief Intro. to JAVA

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Class Objectives

- ☐ Understand basic concepts of JAVA
- ☐ Walk through the programming procedure
- ☐ Use Junit for testing your homework
- ☐ Be ready for Programming Assignment 0

- ☐ These are from Chap. 1 and 2

The Java Programming Language

Position Jul 2010	Position Jul 2009	Programming Language	Ratings Jul 2010	Delta Jul 2009	Status
1	1	Java	18.673%	-1.78%	A
2	2	C	18.480%	+1.16%	A
3	3	C++	10.469%	+0.05%	A
4	4	PHP	8.566%	-0.70%	A
5	6	C#	5.730%	+1.19%	A
6	5	(Visual) Basic	5.516%	-2.27%	A
7	7	Python	4.217%	-0.22%	A
8	8	Perl	3.099%	-1.10%	A
9	21	Objective-C	2.498%	+1.99%	A
10	9	JavaScript	2.432%	-1.08%	A
11	11	Delphi	2.323%	+0.33%	A
12	10	Ruby	1.982%	-0.59%	A
13	12	PL/SQL	0.772%	-0.12%	A
14	13	SAS	0.701%	-0.09%	A
15	15	Pascal	0.639%	-0.07%	A--
16	17	Lisp/Scheme/Clojure	0.622%	+0.01%	B
17	20	MATLAB	0.581%	+0.07%	B
18	16	ABAP	0.548%	-0.15%	B
19	19	Lua	0.535%	+0.00%	B
20	28	PowerShell	0.493%	+0.17%	B

Data from www.tiobe.com

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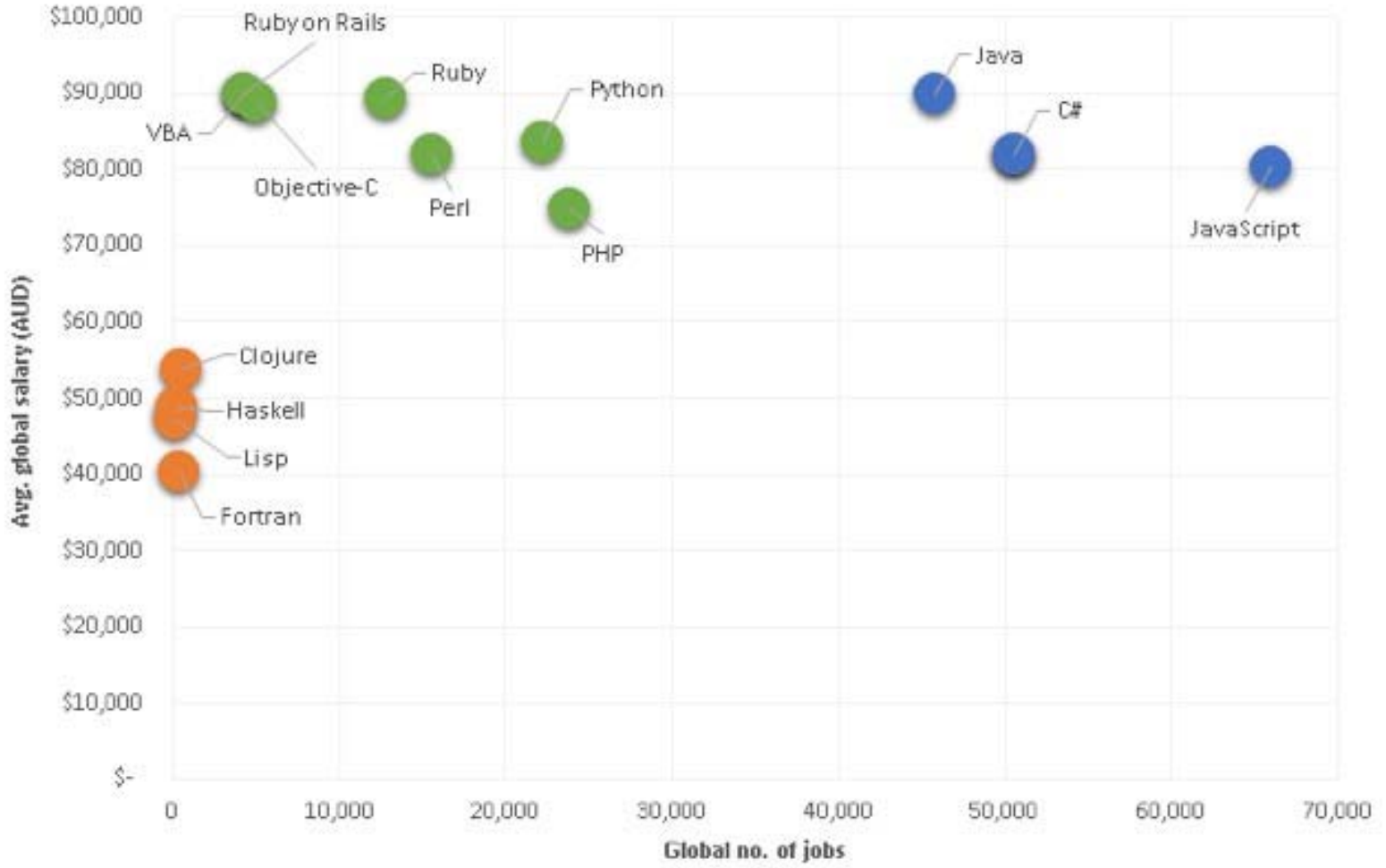
Language in terms of Salary and Demand



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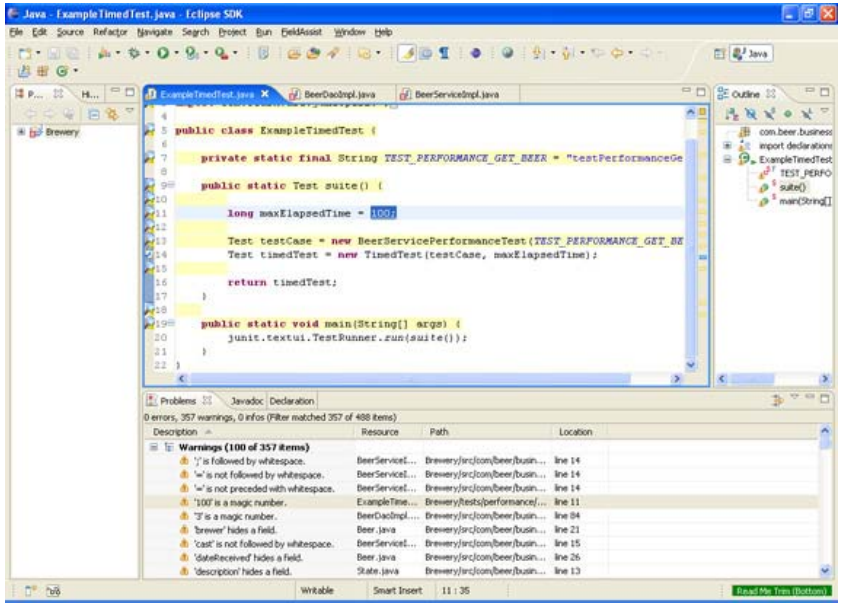
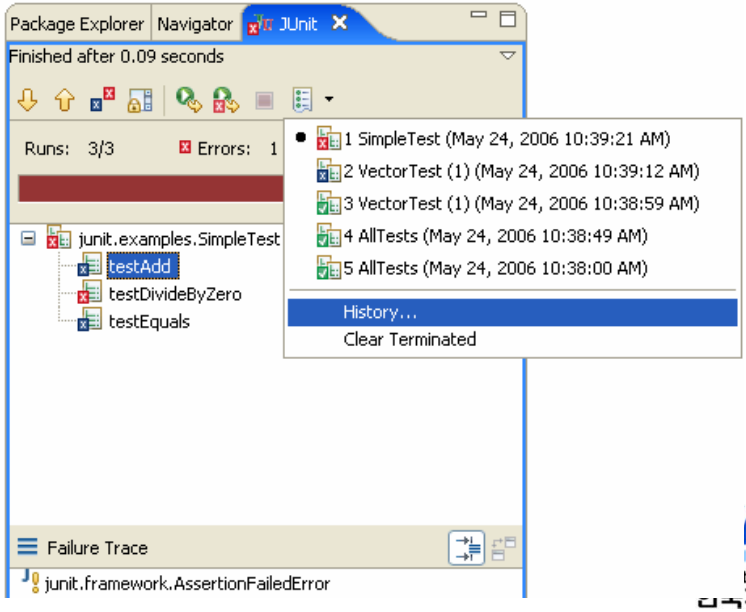
Essential Java Programming Tools

- ☐ Eclipse (IDE; Integrated Development Environment)
  - Download from www.eclipse.org
- ☐ Java Programming Tutorial - 3 - Downloading Eclipse
  - http://www.youtube.com/playlist?list=PLFE2CE09D83EE3E28
  - Local copies are at http://sglab.kaist.ac.kr/~sungeui/DS/video_tutorial/
- ☐ JUnit (included in eclipse)





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Basic JAVA Syntax

- Similar in some extent to Python and C++
- Learning JAVA language itself is not the goal of this course
  - Need to know basic JAVA that are needed for finishing homeworks
  - Focus on data structures and operations with them

Inheritance

☐ Want: compute progression

- Numeric progression: $x_{t+1} = x_t + 1$
- Arithmetic progression: $x_{t+1} = x_t + f$
- Geometric progression: $x_{t+1} = x_t * f$
- Fibonacci progression: $x_{t+1} = x_t + x_{t-1}$

☐ Would you write separate program for each progression?

☐ Let's try object-oriented design using inheritance

- Need first value (x_0) and current value (x_t) to compute next value (x_{t+1})
- Progression classes will have long-integer fields
  - `first`
  - `cur`

Numeric Progression

```
/**
 * A class for numeric progressions.
 */
public class Progression
{

    /** First value of the progression. */
    protected long first;

    /** Current value of the progression */
    protected long cur;

    /** Default constructor. */
    public Progression()
    {
        cur = first = 0;
    }

    /**
     * Resets the progression to the first
value.
     *
     * @return first value
     */
    public long firstValue()
    {
        cur = first;
        return cur;
    }
```

```
    /**
     * Advances the progression to the
next value.
     *
     * @return next value of the
progression
     */
    public long nextValue()
    {
        return ++cur; // default next
value
    }

    /**
     * Prints the first n values of the
progression.
     *
     * @param n
     *             number of values to
print
     */
    public void printProgression(int n)
    {
        System.out.print(firstValue());
        for (int i = 2; i <= n; i++)
            System.out.print(" " +
nextValue());
        System.out.println(); // ends the
line
    }
}
```

Commonly used JAVA keywords

☐ **Base types**

- **int**: 4 bytes integer
- **long**: 8 bytes integer; we can represent a big integer that can be represented within 8 bytes

☐ **Modifiers**

- **public**: Anyone can access it
- **protected**: Only methods of the same package or of its subclass can access
- **private**: Only methods within the same class can access. The default modifier is friendly, which means that any class in the same package can access.
- **static**: The variable is associated with the class, not the instance of the class. This serves as a kind of global variables
- **final**: A final variable plays as a constant value

☐ **this**: this refers to the current instance of that class

Creating and Using Objects

```
/** Test program for the progression classes */
class TestProgression
{
    public static void main(String[] args)
    {
        Progression prog;

        // test ArithProgression
        System.out.println("Arithmetic progression with default increment:");
        prog = new ArithProgression();
        prog.printProgression(10);
    }
}
```

- We declare objects first and create objects (or instances) by calling **new**
  - During creating objects, we call a constructor
  - We access methods and instance variables by using the dot operator

Arithmetic Progression

```
/**
 * Arithmetic progression.
 */
public class ArithProgression extends Progression
{

    /** Increment. */
    protected long inc;

    // Inherits variables first and cur.

    /** Default constructor setting a unit increment. */
    public ArithProgression()
    {
        this(1);
    }

    /** Parametric constructor providing the increment. */
    public ArithProgression(long increment)
    {
        inc = increment;
    }
    /** Advances the progression by adding the increment to the current value.
     *
     * @return next value of the progression
     */
    public long nextValue()
    {
        cur += inc;
        return cur;
    }

    //  Inherits methods firstValue() and printProgression(int).
}
```

Geometric Progression

```
/**
 * Geometric Progression
 */
class GeomProgression extends Progression
{
    /** Base. */
    protected long base;

    // Inherits variables first and cur.

    /** Default constructor setting base 2. */
    public GeomProgression()
    {
        this(2);
    }

    /** Parametric constructor providing the base.
     *
     * @param b base of the progression.
     */
    public GeomProgression(long b)
    {
        base = b;
        first = 1;
        cur = first;
    }

    /** Advances the progression by multiplying the base with the current value.
     *
     * @return next value of the progression
     */
    public long nextValue()
    {
        cur *= base;
        return cur;
    }

    //  Inherits methods firstValue() and printProgression(int).
}
```

Fibonacci Progression

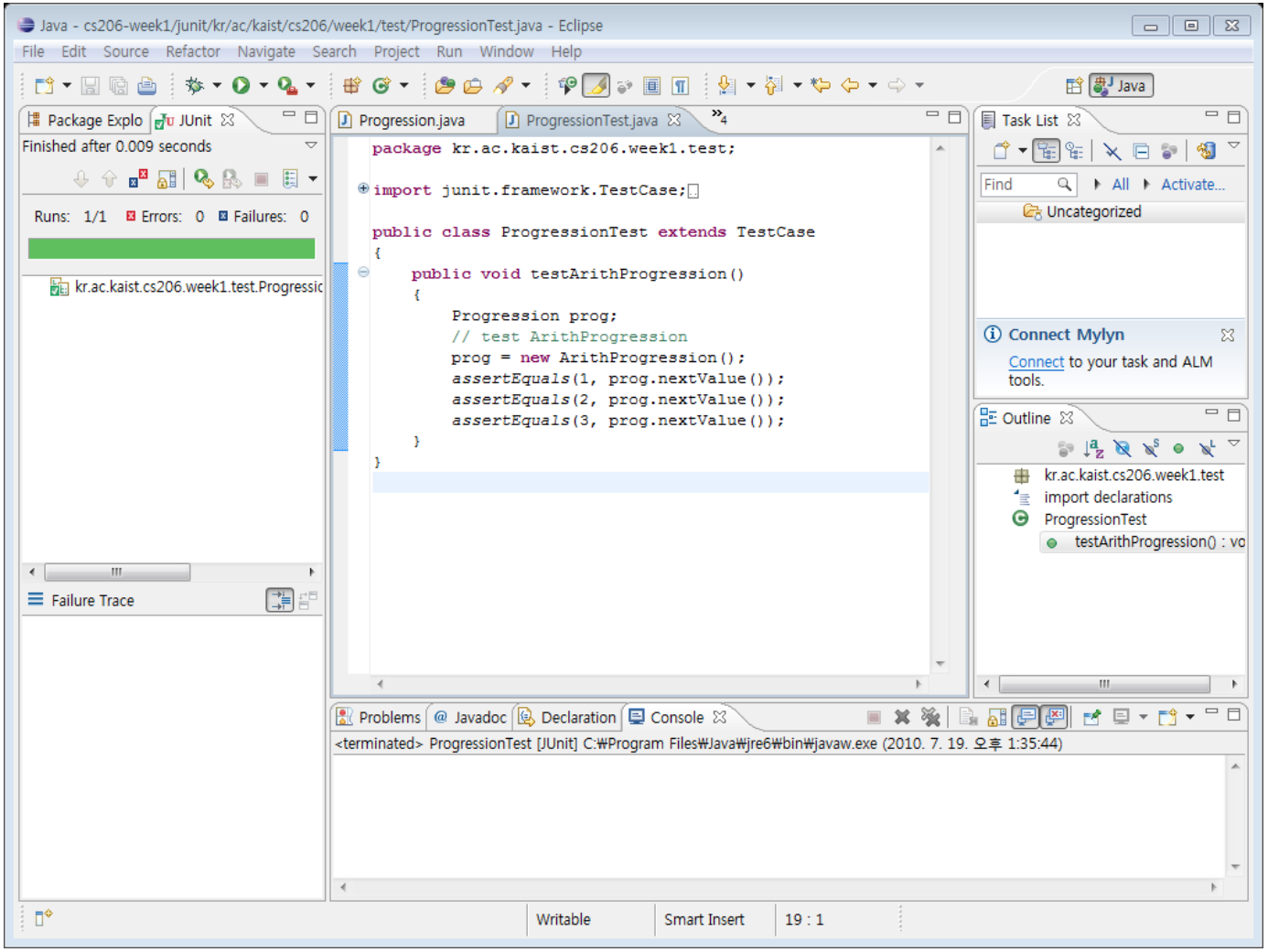
```
/**
 * Fibonacci progression.
 */
class FibonacciProgression extends Progression
{
    /** Previous value. */
    long prev;

    // Inherits variables first and cur.

    /** Default constructor setting 0 and 1 as the first two values. */
    FibonacciProgression()
    {
        this(0, 1);
    }

    /** Parametric constructor providing the first and second values.
     *
     * @param value1 first value.
     * @param value2 second value.
     */
    FibonacciProgression(long value1, long value2)
    {
        first = value1;
        prev = value2 - value1; // fictitious value preceding the first
    }

    /** Advances the progression by adding the previous value to the current value.
     *
     * @return next value of the progression
     */
    public long nextValue()
    {
        long temp = prev;
        prev = cur;
        cur += temp;
        return cur;
    }
    // Inherits methods firstValue() and printProgression(int).
}
```

Testing Progression

```
/** Test program for the progression classes */
class TestProgression
{
    public static void main(String[] args)
    {
        Progression prog;
        // test ArithProgression
        System.out.println("Arithmetic progression with default increment:");
        prog = new ArithProgression();
        prog.printProgression(10);
        System.out.println("Arithmetic progression with increment 5:");
        prog = new ArithProgression(5);
        prog.printProgression(10);
        // test GeomProgression
        System.out.println("Geometric progression with default base:");
        prog = new GeomProgression();
        prog.printProgression(10);
        System.out.println("Geometric progression with base 3:");
        prog = new GeomProgression(3);
        prog.printProgression(10);
        // test FibonacciProgression
        System.out.println("Fibonacci progression with default start values:");
        prog = new FibonacciProgression();
        prog.printProgression(10);
        System.out.println("Fibonacci progression with start values 4 and 6:");
        prog = new FibonacciProgression(4, 6);
        prog.printProgression(10);
    }
}
```

Trying Out in Eclipse

- I will show you how to use JUnit instead of the `TestProgression` class



Testing Progression using Junit

```
package testprog;

import static org.junit.Assert.*;    // import Junit packages
import org.junit.Test;

public class ProgressionTest {

        @Test              // Junit test functions with @Test
        public void test() {
                Progression prog;

                prog = new ArithProgression ();
                assertEquals (1, prog.nextValue ()); // raise error if it is not same
                assertEquals (2, prog.nextValue ());
                assertEquals (3, prog.nextValue ());
        }

}
```

Exceptions

☐ Objects thrown by code when unexpected condition happens

- Extends `Exception` class

☐ Throwing an exception

```
if (insertIndex >= A.length) {
    throw new
    BoundaryViolationException("No element at index " + insertIndex);
}
```

```
    public void goShopping() throws ShoppingListTooSmallException,
                                    OutOfMoneyException
    {    // method body . . .
    }

    public void getReadyForClass() throws ShoppingListTooSmallException,
                                          OutOfMoneyException
    {
        goShopping(); // I don't have to try or catch the exceptions
                      // which goShopping() might throw because
                      // getReadyForClass() will just pass these along.
        makeCookiesForTA();
    }
```

Catching Exceptions

☐ Uncaught exceptions…

```
java.lang.NullPointerException: Returned a null locator
   at java.awt.Component.handleEvent(Component.java:900)
   at java.awt.Component.postEvent(Component.java:838)
   at java.awt.Component.postEvent(Component.java:845)
   at sun.awt.motif.MButtonPeer.action(MButtonPeer.java:39)
   at java.lang.Thread.run(Thread.java)
```

☐ Catching exceptions

```
int index = Integer.MAX_VALUE; // 2.14 Billion
try
// This code might have a problem...
{
    String toBuy = shoppingList[index];
} catch (ArrayIndexOutOfBoundsException aioobx)
{
    System.out.println("The index "
            + index
            + " is outside the array.");
}
```

Interfaces

- Users just need to know methods that each object can support
  - E.g., turn the wheel left, if you want to move the car left
  - Users don't need to know how it works

- They are represented in:
  - Application Programming Interface (API) or
  - Interface

- A collection of method declarations with no data and no bodies

Interfaces

```
/** Interface for objects that can be sold. */
public interface Sellable
{
    /** description of the object */
    public String description();
    /** list price in cents */
    public int listPrice();
    /** lowest price in cents we will accept */
    public int lowestPrice();
}

/** Class for photographs that can be sold */
public class Photograph implements Sellable
{
    private String descript; // description of this photo
    private int price; // the price we are setting
    private boolean color; // true if photo is in color

    public Photograph(String desc, int p,
            boolean c) // constructor
    { descript = desc; price = p; color = c; }
    public String description()
    {       return descript;    }
    public int listPrice()
    {       return price;    }
    public int lowestPrice()
    {       return price / 2;    }
    public boolean isColor()
    {       return color;    }
}
```

Multiple Interfaces

```
/** Interface for objects that can be
transported. */
public interface Transportable
{
    /** weight in grams */
    public int weight();

    /** whether the object is hazardous */
    public boolean isHazardous();
}

/** Class for objects that can be sold,
packed, and shipped. */
public class BoxedItem implements Sellable,
        Transportable
{

    private String descript; //
description of this item
    private int price; // list price in
cents
    private int weight; // weight in grams
    private boolean haz; // true if object
is hazardous
    private int height = 0; // box height
in centimeters
    private int width = 0; // box width in
centimeters
    private int depth = 0; // box depth in
centimeters
```

```
    /** Constructor */
    public BoxedItem(String desc, int p,
int w,
            boolean h)
    {
        descript = desc; price = p; weight
= w; haz = h;
    }
    public String description()
    {       return descript;    }
    public int listPrice()
    {       return price;    }
    public int lowestPrice()
    {       return price / 2;    }
    public int weight()
    {       return weight;    }
    public boolean isHazardous()
    {       return haz;    }
    public int insuredValue()
    {       return price * 2;    }
    public void setBox(int h, int w, int d)
    {
        height = h; width = w;
        depth = d;
    }
}
```

Multiple Inheritance in Interfaces

☐ An interface can extend more than one interfaces

```
public interface InsurableItem extends
        Transportable, Sellable
{
    /** Returns insured Value in cents */
    public int insuredValue();
}

public class BoxedItem2 implements InsurableItem {

  // ... same code as class BoxedItem
}
```

- What about classes?

Class Objectives were:

- ☐ Understand basic concepts of JAVA
- ☐ Walk through the programming procedure
- ☐ Use JUnit for testing your homework

- ☐ These are from Chap. 1 and 2

Any Questions? (Question HW)

☐ Come up with one question on what we have discussed in the class and submit at the end of the class

- 1 for typical questions (that have been already answered in the class)
- 2 for questions with thoughts or or that surprised me

☐ Write questions at least 4 times

- Write a question about one per month
- Anything related to class materials is okay
- Unrelated questions are not counted (e.g., faculty club에 학부생도 출입이 가능한가요?)

☐ You can type online (KLMS)

My Responses to Those Questions

- ☐ Identify common questions and address them at the Q&A file
- ☐ Some of questions will be discussed in the class

- ☐ If you want to know the answer of your question, ask me or TA on person
  - Feel free to ask questions in the class

- ☐ We are focusing on having good questions!
  - All of us are already well trained for answering questions

Programming Assignment 0

☐ Create a program of “Hello World”

- Do it by yourself
- Submit it (codes and binary) by 11:59pm, Sep.-11 (Thur.)

☐ Todo:

- Download the eclipse
- Just print “Hello JAVA”
- Compile and run it, and play with the eclipse

☐ JAVA online lecture materials

- Java Programming Tutorial - 4 - Hello YouTube
- http://www.youtube.com/playlist?list=PLFE2CE09D83EE3E28

☐ JAVA materials

- Tutorial: http://docs.oracle.com/javase/tutorial/
- Reference: http://docs.oracle.com/javase/7/docs/api/

Lab.

☐ 9/15 (Mon.)

- Starts at 7:00pm, N1-201
- 3 TAs will be there
- 50 computers are there; first come first served

☐ If you can follow online video well, you don't need to attend the lab.

☐ Otherwise, please attend it and get supports from TAs

Homework

- ☐ Go over the next lecture slides before the class
  - Just 10 min ~ 20 min should be okay

Next Time

☐ Array and linked list