1.00 Lecture 9

Methods and Objects
Access

Reading for next time: Big Java: sections 8.6, 8.7

Passing arguments

```
// Recall this example from Lecture 6

public class TripleTest {
  public static void main(String[] args) {
     double z=5.0;
     System.out.println("z main 1: "+z);
     triple(z);
     System.out.println("z main 2: "+z);
  }
  public static void triple(double z) {
     System.out.println("z 1: "+z);
     z *= 3;
     System.out.println("z 2: "+z);
  }
}
// What is the output, and why?
```

Passing object arguments

```
public class Number {
   private double base;
   public Number(double n) {
       base= n;
   }

   public double getBase() {
       return base;
   }

   public void setBase(double b) {
       base= b;
   }

   public String toString() {
       return (" "+ base);
   }
}
```

Passing objects, p. 2

```
// This is almost the same as TripleTest
// but with an object

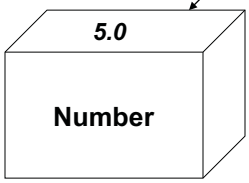
public class NumberTest {

   public static void main(String[] args) {
       Number n= new Number(5.0);
       System.out.println("n main 1: "+n);
       triple(n);
       System.out.println("n main 2: "+n);
   }

   public static void triple(Number n) {
       System.out.println("n 1: "+n);
       n.setBase(n.getBase()*3);
       System.out.println("n 2: "+n);
   }
}
// What is the output?
```

What happened?

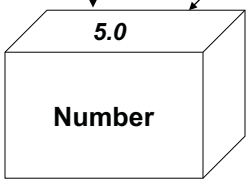
```
public static void main(String[] args) {
    Number n= new Number(5.0);      n=
```



What happened?

```
public static void main(String[] args) {
    Number n= new Number(5.0);      n=
    System.out.println("n main 1: "+n);
    triple(n);
```

Makes copy of n



What happened?

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Makes copy of n
Triples n.base

~~5.0~~ 15.0

Number

What happened?

```
public static void main(String[] args) {
    Number n= new Number(5.0);      n=
    System.out.println("n main 1: "+n);
    triple(n);
```

Makes copy of n
Triples n.base

```
    System.out.println("n main 2: "+n);
}
```

~~5.0~~ 15.0

Number

Method Calls With Objects

- When passing object references as arguments to a method:
  - The method makes its own copy of the references
  - It makes changes to the objects through its local copies of the references
  - No changes can be made to the references (arguments)
    - The method can change the reference to point to another object or set it to null locally, but it won't change the values in the calling program.
  - Results are returned through the return value, which may be an object
- When passing built-in data types as arguments to a method:
  - The method makes its own copy of the built-in variables
  - It makes changes to its local copies only
  - No changes can be made to the arguments
  - Results are returned through the return value

Exercise: Weather class

```
public class Weather {
   private double avgTemperature;
   private double precipAmt;
   public Weather(double a, double p) {
        avgTemperature= a;
        precipAmt= p;
   }
   public void setAvgTemp(double t) {
        avgTemperature= t;
   }
   public void setPrecipAmt(double pr) {
        precipAmt= pr;
   }
   public String toString() {
        return ("Temperature: " + avgTemperature +
               " ; Precipitation: " + precipAmt);
   }
}
```

Exercise: City class

```
public class City {
   private String name;
   private Weather cityWeather;

   public City(String n, Weather c) {
        name= n;
        cityWeather= c;
   }
   public String getName() {
        return name;
   }
   public Weather getWeather() {
        return cityWeather;
   }
}
```

Exercise: WeatherTest

```
public class WeatherTest {
   public static void main(String[] args) {
        Weather today= new Weather(40.0, 0.0);
        City boston= new City("Boston", today);
        City cambridge= new City("Cambridge", today);

        // Now revise the Boston weather, which was corrected
        Weather bostonToday= boston.getWeather();
        bostonToday.setAvgTemp(41.0);

        System.out.println("Boston: " + boston.getWeather());
        System.out.println("Cambridge: "+ cambridge.getWeather());
   }
}
```

Exercise

- Compile and run WeatherTest
- What is the output?

- Assume you wanted to change (correct) only the Boston weather. Change class WeatherTest to do this

Objects As Arguments

```
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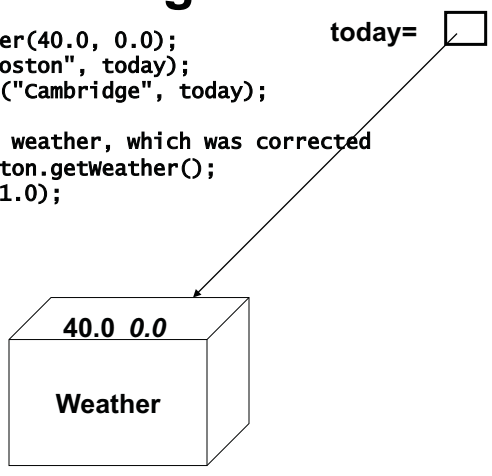

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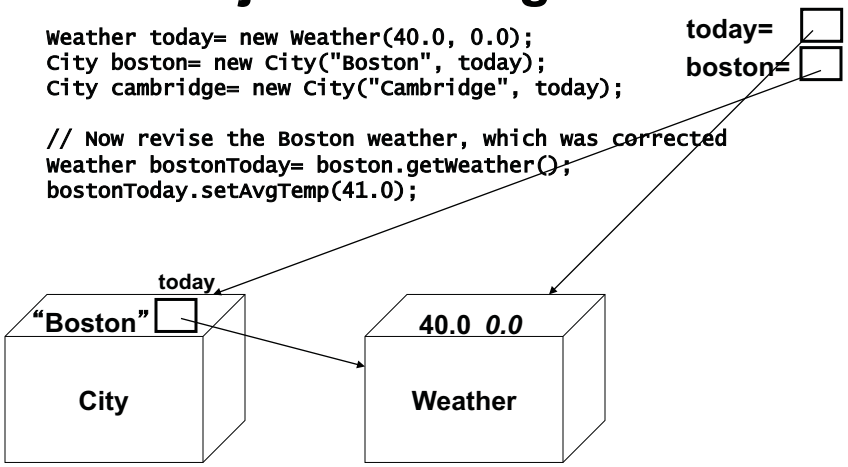

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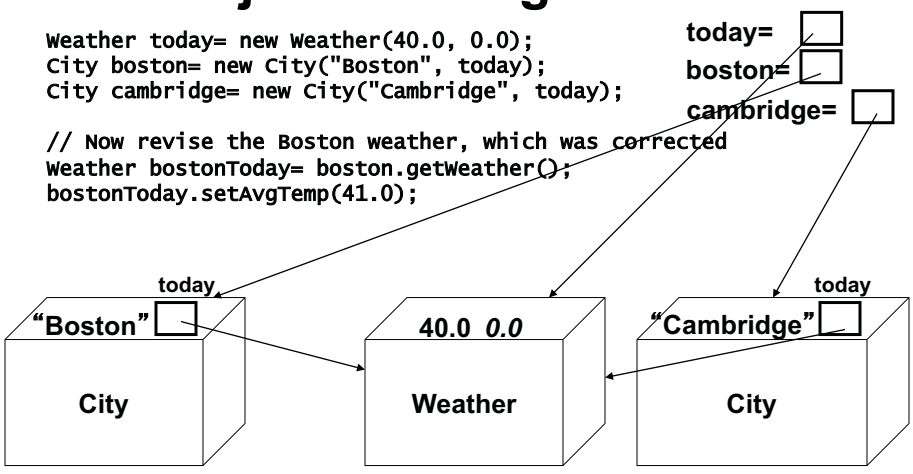

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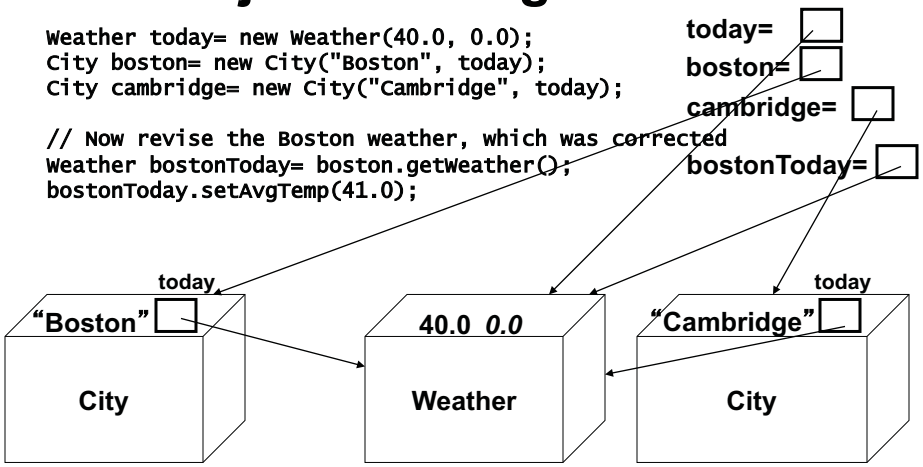

Objects As Arguments

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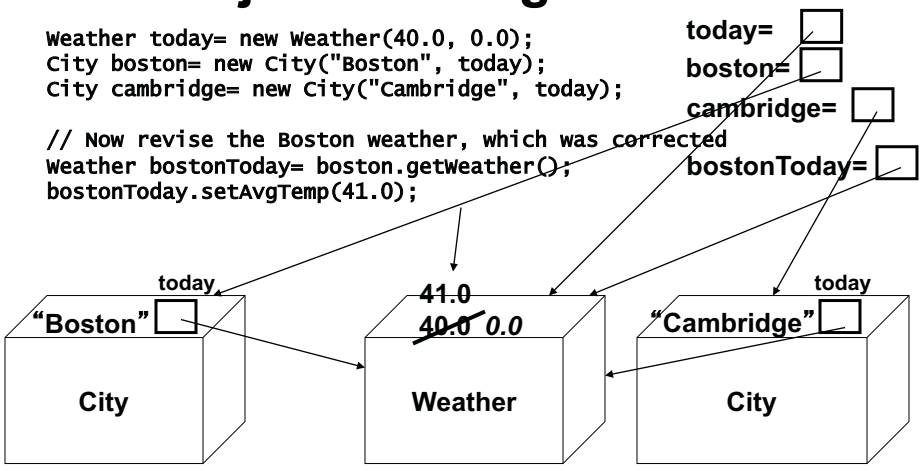
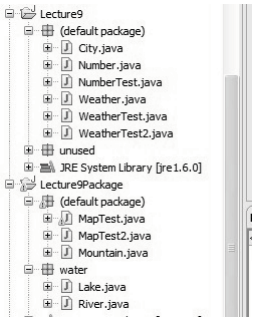


When objects are passed as arguments to methods, the method makes a copy of the reference to the object, not a copy of the object! Why?

Access: Variables, Methods

- **Data members and methods have 4 access modifiers:**
  - **Private: Access only to own class methods**
    - **Data fields should be private**
      - **Users of an object should use its methods, not its data members**
    - **Objects of same class can access each others' private variables**
  - **Public: Access to all methods in all classes**
    - **Methods should be public**
      - **They are the primary way that objects are used in Java programs**
  - **Package: Access to methods of classes in same package**
    - **A package is a group of classes with same first line, e.g.:**
      `package water;`
    - **Objects in same package can access each others' package variables**
    - **No 'package' keyword; it's the default with no keyword**
  - **Protected: Used with inheritance (covered later)**

Packages in Eclipse



In Eclipse:

1. File -> New -> Project. Type 'Lecture9Package'

2. File -> New -> Package. Type 'water'

Use lower case names by convention

3. Drag MapTest.java, Mountain.java into default pkg

4. Drag Lake.java, River.java into water package

Class Mountain

```
// In default package

public class Mountain {
   String name;               // Package access
   private double elevation;
   public Mountain(String n, double e) {
        name= n;
        elevation= e;
   }

   public boolean isTallerThan(Mountain m) {
        if (elevation > m.elevation)
                return true;
        else
                return false;
   }    // Or return (elevation > m.elevation)
}
```

Class Lake

When you drag file Lake.java onto the package 'water' icon, Eclipse writes the 'package' statement for you.

```
package water;

public class Lake {
   String name;               // Package access
   double area;               // Package access
   public Lake(String n, double a) {
        name= n;
        area= a;
   }
}
```

Class River

When you drag file River.java onto the package 'water' icon, Eclipse writes the 'package' statement for you.

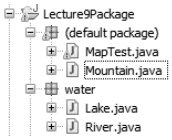
```
package water;

public class River {
   String name;        // Package access
   double length;      // Package access
   Lake source;        // Package access
   public River(String n, double l, Lake s) {
        name= n;
        length= l;
        source= s;
   }
   public double getSourceLakeSize() {
        return source.area;    // River can see Lake data
   }
}
```

Packages

- **Packages are a way to organize software:**
  - **Group related classes in a package**
  - **Allow related classes to share package-access data**
- **You import packages to use them**
  - **You place them in your namespace by importing them**
    - `import water.*;  // At the top of the file`
  - **This does not bring them into your class' package**
  - **If you don't import a package, you can still use it by, e.g.:**
    - `water.Lake winni= new water.Lake("Winni", 44586);`
- **We use the default package for convenience in 1.00**
  - **We'll continue to use it for consistency**
  - **In code you write after 1.00, don't use the default package**
    - **Place every class in a named package**
- **Use package access appropriately between related classes to improve clarity (less verbose) and convenience**

Exercise: Lake, River, Mountain



- Mountain, MapTest (which you will complete) are in default package
- Lake, River are in water package
  - Their data members have package access:
  - Lake can see River data and River can see Lake data
- Mountain and MapTest cannot see River, Lake data
  - MapTest can see Mountain name (package)
  - But not Mountain elevation (private)
- You will write MapTest to create a Mountain, Lake, River
  - And to output some of their data
- For MapTest to see River and Lake classes, it must in line 1:
  `import water.*;`
  - 'Import' does not bring River and Lake into this class' package. It just makes them visible to the class

Courtesy of The Eclipse Foundation. Used with permission.

Exercise: Write Class MapTest

```
// 1. What do you need to import to see Lake, River?

public class MapTest {
   public static void main(String[] args) {
        Mountain w= new Mountain("Washington", 6288);
        Mountain j= new Mountain("Jefferson", 5791);
//      2. Try to print out Mt Washington elevation, name directly
//       If it doesn't work, fix it. Don't change access.

//      3. Is Mt Washington or Mt Jefferson taller?

        Lake winni=new Lake("Winnipesaukee", 44586); // Acres
        River m= new River("Merrimack", 120, winni);
//      4. Try to print area of Lake Winnipesaukee
//      If it doesn't work, fix it. Don't change access.
   }
} // When done, move your MapTest solution to main Lecture9 project
  // so you zip up just one project to hand in for active learning
```

1.00 / 1.001 / 1.002 Introduction to Computers and Engineering Problem Solving
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