

C05-A First Look at Classes

Programming in Java



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Chapter Topics

- Objects and Classes
- Writing a Simple Class, Step by Step
- Instance Fields and Methods
- Constructors
- Passing Objects as Arguments
- Overloading Methods and Constructors
- Scope of Instance Fields
- Packages and `import` Statements

Objects and Classes (1 of 8)

- An object exists in memory, and performs a specific task.
- Objects have two general capabilities:
 - Objects can store data. The pieces of data stored in an object are known as *fields*.
 - Objects can perform operations. The operations that an object can perform are known as *methods*.

Objects and Classes (2 of 8)

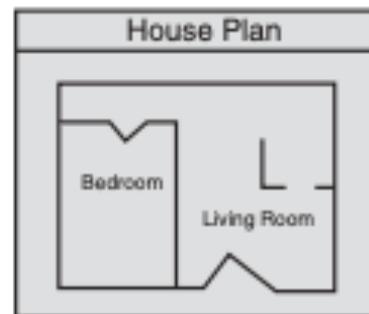
- You have already used the following objects:
 - Scanner objects, for reading input
 - Random objects, for generating random numbers
 - PrintWriter objects, for writing data to files
- When a program needs the services of a particular type of object, it creates that object in memory, and then calls that object's methods as necessary.

Objects and Classes (3 of 8)

- Classes: Where Objects Come From
 - A **class** is code that describes a particular type of object. It specifies the data that an object can hold (the object's fields), and the actions that an object can perform (the object's methods).
 - You can think of a class as a code "blueprint" that can be used to create a particular type of object.

A blueprint and houses built from the blueprint

Blueprint that describes a house



Instances of the house described by the blueprint



Objects and Classes (4 of 8)

- When a program is running, it can use the class to create, in memory, as many objects of a specific type as needed.
- Each object that is created from a class is called an *instance* of the class.

Objects and Classes (5 of 8)

Example:

This expression creates a
Scanner object in memory.

```
Scanner keyboard = new Scanner(System.in);
```

The object's memory address is
assigned to the keyboard variable.

keyboard
variable

Scanner
object

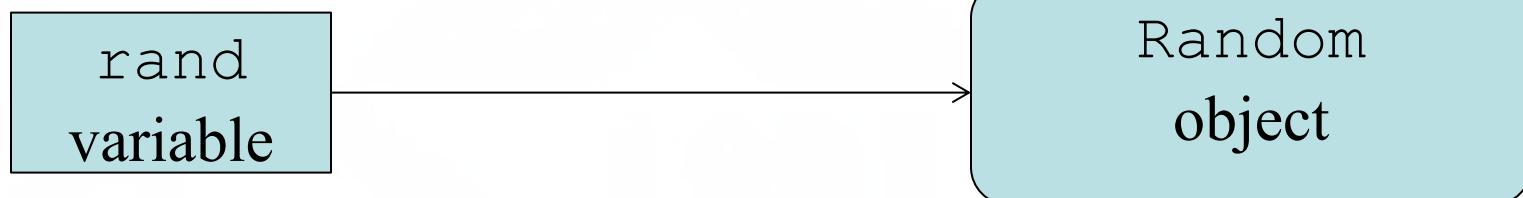
Objects and Classes (6 of 8)

Example:

This expression creates a Random object in memory.

```
Random rand = new Random();
```

The object's memory address is assigned to the `rand` variable.



Objects and Classes (7 of 8)

Example:

This expression creates a
PrintWriter object in memory.

```
PrintWriter outputFile = new PrintWriter("numbers.txt");
```

The object's memory address is assigned to
the outputFile variable.

outputFile
variable

PrintWriter
object

Objects and Classes (8 of 8)

- The Java API provides many classes
 - So far, the classes that you have created objects from are provided by the Java API.
 - Examples:
 - Scanner
 - Random
 - PrintWriter
- See [ObjectDemo.java](#)

Code Listing 6-1 (ObjectDemo.java)

```
1 import java.util.Scanner; // Needed for the Scanner class
2 import java.util.Random; // Needed for the Random class
3 import java.io.*; // Needed for file I/O classes
4
5 /**
6     This program writes random numbers to a file.
7 */
8
9 public class ObjectDemo
10 {
11     public static void main(String[] args) throws IOException
12     {
13         int maxNumbers; // Max number of random numbers
14         int number; // To hold a random number
15
16         // Create a Scanner object for keyboard input.
17         Scanner keyboard = new Scanner(System.in);
18
19         // Create a Random object to generate random numbers.
20         Random rand = new Random();
21
22         // Create a PrintWriter object to open the file.
23         PrintWriter outputFile = new PrintWriter("numbers.txt");
24
25         // Get the number of random numbers to write.
26         System.out.print("How many random numbers should I write? ");
27         maxNumbers = keyboard.nextInt();
28     }
}
```

```
29         // Write the random numbers to the file.
30         for (int count = 0; count < maxNumbers; count++)
31         {
32             // Generate a random integer.
33             number = rand.nextInt();
34
35             // Write the random integer to the file.
36             outputFile.println(number);
37         }
38
39         // Close the file.
40         outputFile.close();
41         System.out.println("Done");
42     }
43 }
```

Program Output with Example Input Shown in Bold

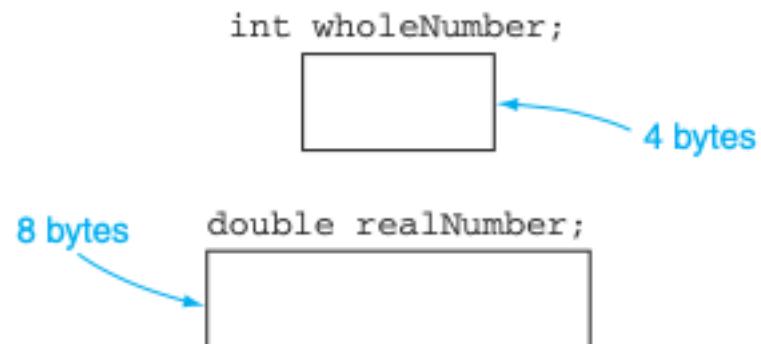
```
How many random numbers should I write? 10 [Enter]
Done
```

Primitive Variables vs. objects (1)

- Java primitive data types: byte, short, int, long, char, float, double, and boolean.

```
int wholeNumber;  
double realNumber;
```

Memory allocation



Primitive Variables vs. objects (2)

- The memory that is allocated for a primitive variable is the actual location that will hold any value that is assigned to that variable.

```
wholeNumber = 99;  
realNumber = 123.45;
```

Values assigned to the variables

```
int wholeNumber;
```

99

```
double realNumber;
```

123.45

Primitive Variables vs. objects (3)

- When you are working with an object, you are typically using two things:
 - The object itself, which must be created in memory
 - A reference variable that refers to the object

Example:

This expression creates a Random object in memory.

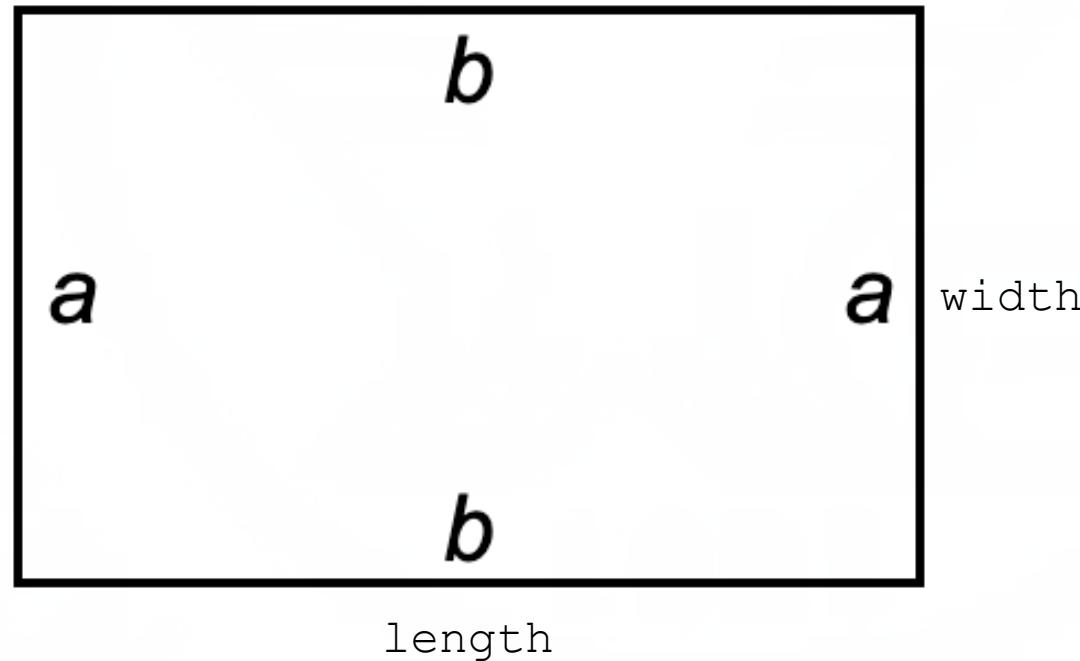
```
Random rand = new Random();
```

The object's memory address is assigned to the rand variable.



Writing a Class, Step by Step (1 of 2)

- A Rectangle object will have the following fields:
 - length. The length field will hold the rectangle's length.
 - width. The width field will hold the rectangle's width.

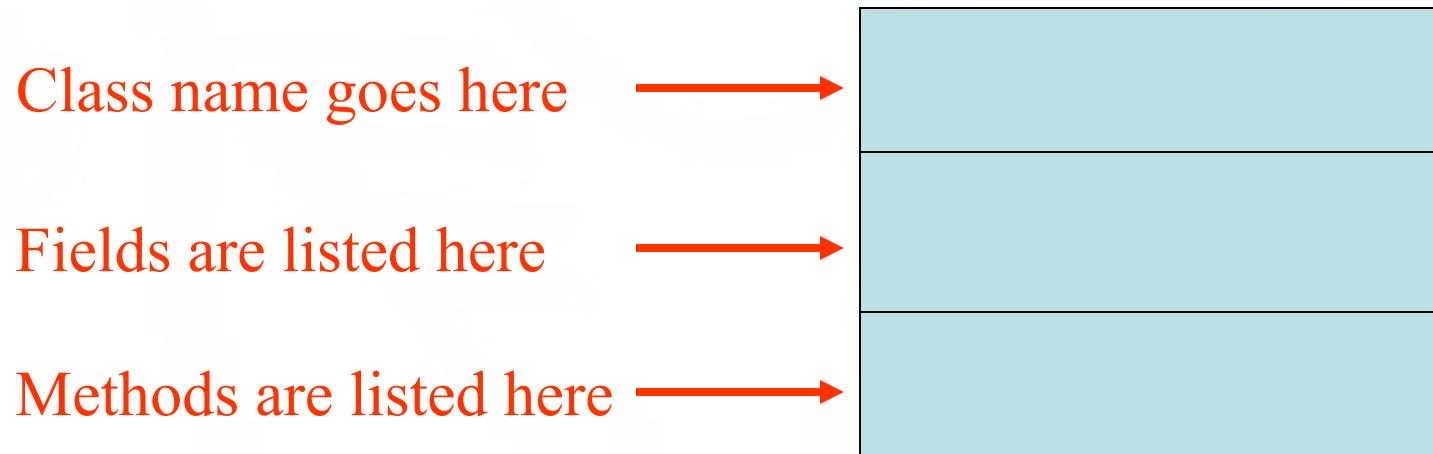


Writing a Class, Step by Step (2 of 2)

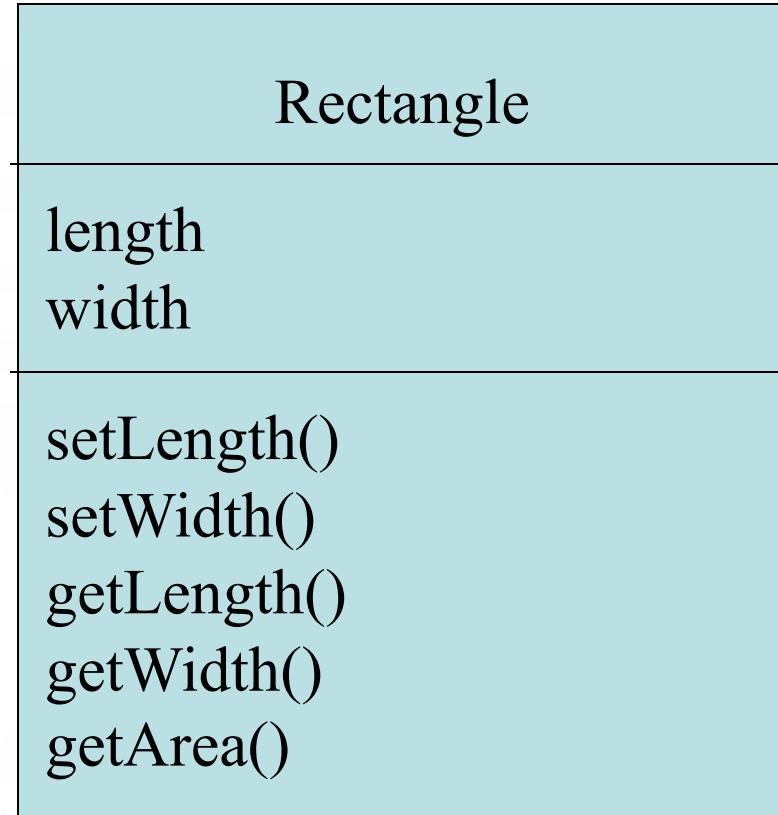
- The Rectangle class will also have the following methods:
 - **setLength**. The setLength method will store a value in an object's length field.
 - **setWidth**. The setWidth method will store a value in an object's width field.
 - **getLength**. The getLength method will return the value in an object's length field.
 - **getWidth**. The getWidth method will return the value in an object's width field.
 - **getArea**. The getArea method will return the area of the rectangle, which is the result of the object's length multiplied by its width.

UML Diagram

- Unified Modeling Language (UML) provides a set of standard diagrams for graphically depicting object-oriented systems.



UML Diagram for Rectangle class



Writing the Code for the Class Fields

```
public class Rectangle  
{  
    private double length;  
    private double width;  
}
```

Access Specifiers

- An access specifier is a Java keyword that indicates how a field or method can be accessed.
- `public`
 - When the `public` access specifier is applied to a class member, the member can be accessed by code inside the class or outside.
- `private`
 - When the `private` access specifier is applied to a class member, the member cannot be accessed by code outside the class. The member can be accessed only by methods that are members of the same class.

Header for the `setLength` Method

Access specifier Return Type Method Name

↓ ↓ ↓

public void setLength (double len)

Parameter variable declaration

Notice the word
static does not
appear in the method
header designed to work
on an instance of a class
(*instance method*).

Writing and Demonstrating the `setLength` Method

```
/**  
 * The setLength method stores a value in the  
 * length field.  
 * @param len The value to store in length.  
public void setLength(double len)  
{  
    length = len;  
}
```

Examples: [Rectangle.java](#), [LengthDemo.java](#)

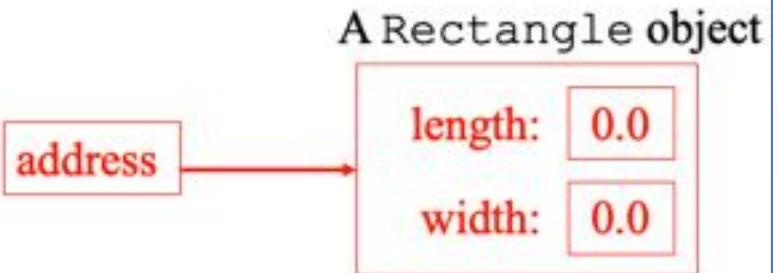
Code Listing 6-2 (Rectangle.java)

```
1  /**
2   * Rectangle class, phase 1
3   * Under construction!
4  */
5
6  public class Rectangle
7  {
8      private double length;
9      private double width;
10
11     /**
12      The setLength method stores a value in the
13      length field.
14      @param len The value to store in length.
15     */
16
17     public void setLength(double len)
18     {
19         length = len;
20     }
21 }
```

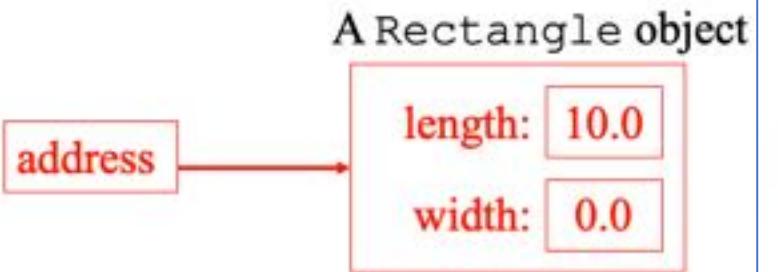
Code Listing 6-3 (LengthDemo.java)

```
1  /**
2   * This program demonstrates the Rectangle class's
3   * setLength method.
4  */
5
6 public class LengthDemo
7 {
8     public static void main(String[] args)
9     {
10         // Create a Rectangle object and assign its
11         // address to the box variable.
12         Rectangle box = new Rectangle(); →
13
14         // Indicate what we are doing.
15         System.out.println("Sending the value 10.0 " +
16                         "to the setLength method.");
17
18         // Call the box object's setLength method.
19         box.setLength(10.0); →
20
21         // Indicate we are done.
22         System.out.println("Done.");
23     }
24 }
```

The box variable holds the address of the Rectangle object.



The box variable holds the address of the Rectangle object.



Program Output

```
Sending the value 10.0 to the setLength method.
Done.
```

Writing the `getLength` Method

```
/**  
 * The getLength method returns a Rectangle  
 * object's length.  
 * @return The value in the length field.  
 */  
  
public double getLength()  
{  
    return length;  
}
```

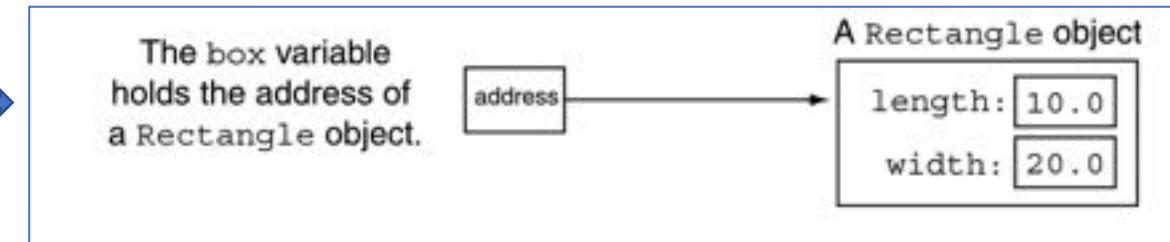
Similarly, the `setWidth` and `getWidth` methods can be created.

Examples: [Rectangle.java](#), [LengthWidthDemo.java](#)

Code Listing 6-5 (Rectangle.java)

```
1 /**
2  Rectangle class, phase 3
3  Under construction!
4 */
5
6 public class Rectangle
7 {
8     private double length;
9     private double width;
10
11    /**
12     The setLength method stores a value in the
13     length field.
14     @param len The value to store in length.
15    */
16
17    public void setLength(double len)
18    {
19        length = len;
20    }
21
22    /**
23     The setWidth method stores a value in the
24     width field.
25     @param w The value to store in width.
26    */
27
28    public void setWidth(double w)
29    {
30        width = w;
31    }
32
33    /**
34     The getLength method returns a Rectangle
35     object's length.
36     @return The value in the length field.
37    */
38
39    public double getLength()
40    {
41        return length;
42    }
43
44    /**
45     The getWidth method returns a Rectangle
46     object's width.
47     @return The value in the width field.
48    */
49
50    public double getWidth()
51    {
52        return width;
53    }
54 }
```

Code Listing 6-6 (LengthWidthDemo.java)



Program Output

The box's length is 10.0
The box's width is 20.0

Writing and Demonstrating the `getArea` Method

```
/**  
 * The getArea method returns a Rectangle  
 * object's area.  
 * @return The product of length times width.  
 */  
public double getArea()  
{  
    return length * width;  
}
```

Examples: [Rectangle.java](#), [RectangleDemo.java](#)

Code Listing 6-7 (Rectangle.java)

```
1  /**
2   * Rectangle class, phase 4
3   * Under construction!
4  */
5
6 public class Rectangle
7 {
8     private double length;
9     private double width;
10
11    /**
12     * The setLength method stores a value in the
13     * length field.
14     * @param len The value to store in length.
15    */
16
17    public void setLength(double len)
18    {
19        length = len;
20    }
21
22    /**
23     * The setWidth method stores a value in the
24     * width field.
25     * @param w The value to store in width.
26    */
27
28    public void setWidth(double w)
29    {
30        width = w;
31    }
32
33    /**
34     * The getLength method returns a Rectangle
35     * object's length.
36     * @return The value in the length field.
37    */
38
39    public double getLength()
40    {
41        return length;
42    }
43
44    /**
45     * The getWidth method returns a Rectangle
46     * object's width.
47     * @return The value in the width field.
48    */
49
50    public double getWidth()
51    {
52        return width;
53    }
54
55    /**
56     * The getArea method returns a Rectangle
57     * object's area.
58     * @return The product of length times width.
59    */
60
61    public double getArea()
62    {
63        return length * width;
64    }
65 }
```

Code Listing 6-8 (RectangleDemo.java)

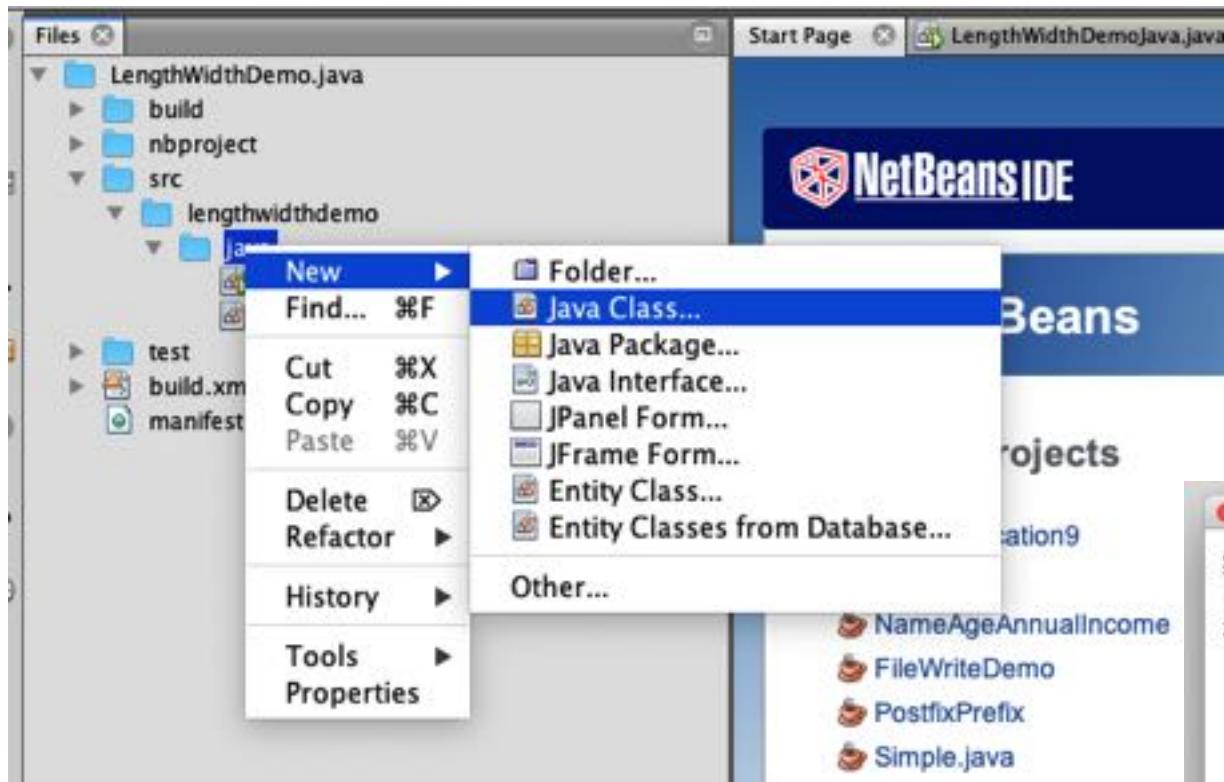
```
1  /**
2   * This program demonstrates the Rectangle class's
3   * setLength, setWidth, getLength, getWidth, and
4   * getArea methods.
5  */
6
7 public class RectangleDemo
8 {
9     public static void main(String[] args)
10    {
11        // Create a Rectangle object.
12        Rectangle box = new Rectangle();
13    }
```

```
14     // Set length to 10.0 and width to 20.0.
15     box.setLength(10.0);
16     box.setWidth(20.0);
17
18     // Display the length.
19     System.out.println("The box's length is " +
20                         box.getLength());
21
22     // Display the width.
23     System.out.println("The box's width is " +
24                         box.getWidth());
25
26     // Display the area.
27     System.out.println("The box's area is " +
28                         box.getArea());
29    }
30 }
```

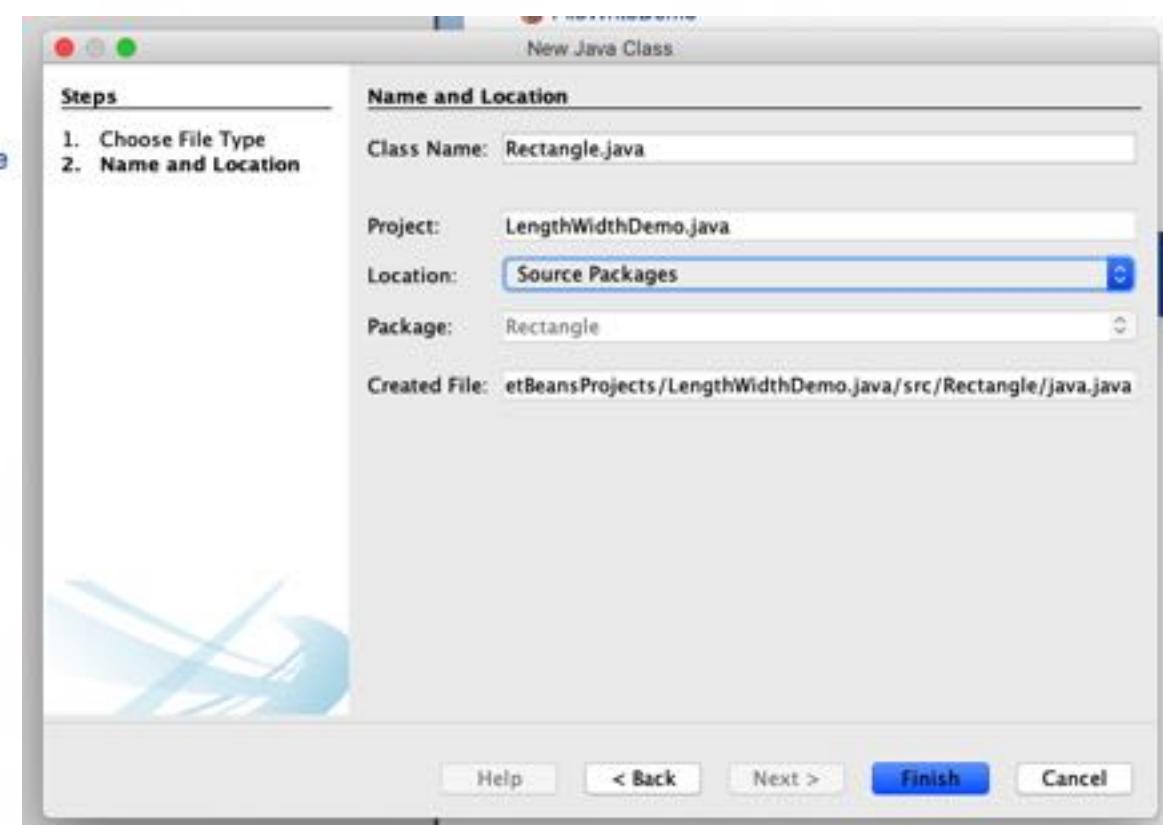
Program Output

```
The box's length is 10.0
The box's width is 20.0
The box's area is 200.0
```

1



2



LengthWidthDemo.java

```
1 package lengthwidthdemo.java;
2
3 /**
4 * @author sunil
5 */
6 public class Rectangle {
7     private double length;
8     private double width;
9
10    public void setLength(double len)
11    {
12        length = len;
13    }
14
15    public void setWidth(double w)
16    {
17        width = w;
18    }
19
20    public double getLength()
21    {
22        return length;
23    }
24
25    public double getWidth()
26    {
27        return width;
28    }
29
30    public double getArea()
31    {
32        return length * width;
33    }
34
35}
36
37
38
39
40
41
42}
```

LengthWidthDemoJava.java

```
1 package lengthwidthdemo.java;
2
3 /**
4 * @author sunil
5 */
6 public class LengthWidthDemoJava {
7
8    /**
9     * @param args the command line arguments
10    */
11    public static void main(String[] args) {
12
13        // Create a Rectangle object.
14        Rectangle box = new Rectangle();
15
16        // Set length to 10.0 and width to 20.0.
17        box.setLength(10.0);
18        box.setWidth(20.0);
19
20        // Display the length.
21        System.out.println("The box's length is " + box.getLength());
22
23        // Display the width.
24        System.out.println("The box's width is " + box.getWidth());
25
26        // Display the area.
27        System.out.println("The box's area is " + box.getArea());
28
29    }
30
31
32
33
34
35}
```

run:
The box's length is 10.0
The box's width is 20.0
The box's area is 200.0
BUILD SUCCESSFUL (total time: 0 seconds)

Accessor and Mutator Methods

- Because of the concept of data hiding, fields in a class are private.
- The methods that retrieve the data of fields are called *accessors*.
- The methods that modify the data of fields are called *mutators*.
- Each field that the programmer wishes to be viewed by other classes needs an accessor.
- Each field that the programmer wishes to be modified by other classes needs a mutator.

Rectangle
- length : double
- width : double
+ setLength(len : double) : void
+ setWidth(w : double) : void
+ getLength() : double
+ getWidth() : double
+ getArea() : double

Accessors and Mutators

- For the Rectangle example, the accessors and mutators are:
 - **setLength** : Sets the value of the length field.
`public void setLength(double len) ...`
 - **setWidth** : Sets the value of the width field.
`public void setWidth(double w) ...`
 - **getLength** : Returns the value of the length field.
`public double getLength() ...`
 - **getWidth** : Returns the value of the width field.
`public double getWidth() ...`
- Other names for these methods are *getters* and *setters*.

Rectangle
– length : double
– width : double
+ setLength(len : double) : void
+ setWidth(w : double) : void
+ getLength() : double
+ getWidth() : double
+ getArea() : double

Data Hiding

- An object hides its internal, private fields from code that is outside the class that the object is an instance of.
- Only the class's methods may directly access and make changes to the object's internal data.
- Code outside the class must use the class's public methods to operate on an object's private fields.
- Data hiding is important because classes are typically used as components in large software systems, involving a team of programmers.
- Data hiding helps enforce the integrity of an object's internal data.

Rectangle
- length : double
- width : double
+ setLength(len : double) : void
+ setWidth(w : double) : void
+ getLength() : double
+ getWidth() : double
+ getArea() : double

Stale Data (1 of 2)

- Some data is the result of a calculation.
- Consider the area of a rectangle.
 - $length \times width$
- It would be impractical to use an *area* variable here.
- Data that requires the calculation of various factors has the potential to become *stale*.
- To avoid stale data, it is best to calculate the value of that data within a method rather than store it in a variable.

Stale Data (2 of 2)

- Rather than use an area variable in a Rectangle class:

```
public double getArea()  
{  
    return length * width;  
}
```

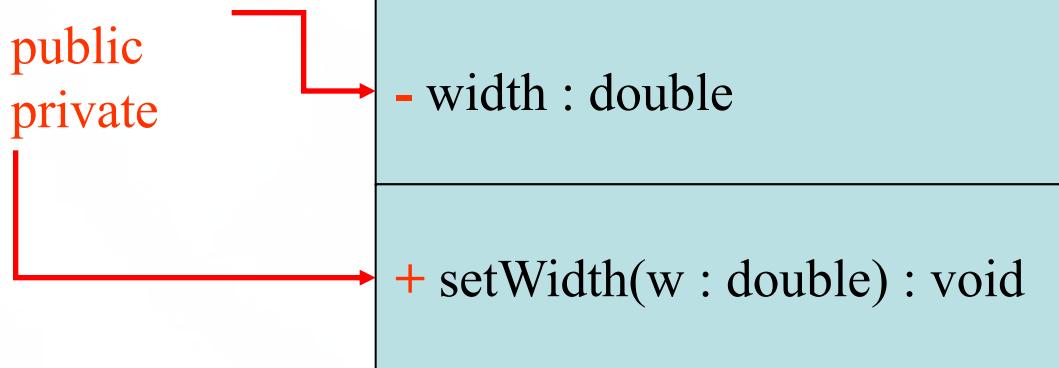
- This dynamically calculates the value of the rectangle's area when the method is called.
- Now, any change to the length or width variables will not leave the area of the rectangle stale.

UML Data Type and Parameter Notation (1 of 4)

- UML diagrams are language independent.
- UML diagrams use an independent notation to show return types, access modifiers, etc.

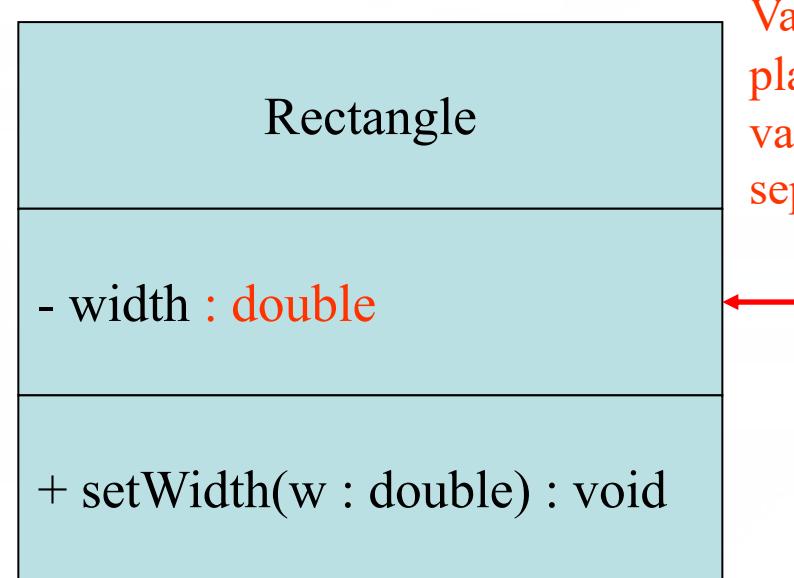
Access modifiers
are denoted as:

+ public
- private



UML Data Type and Parameter Notation (2 of 4)

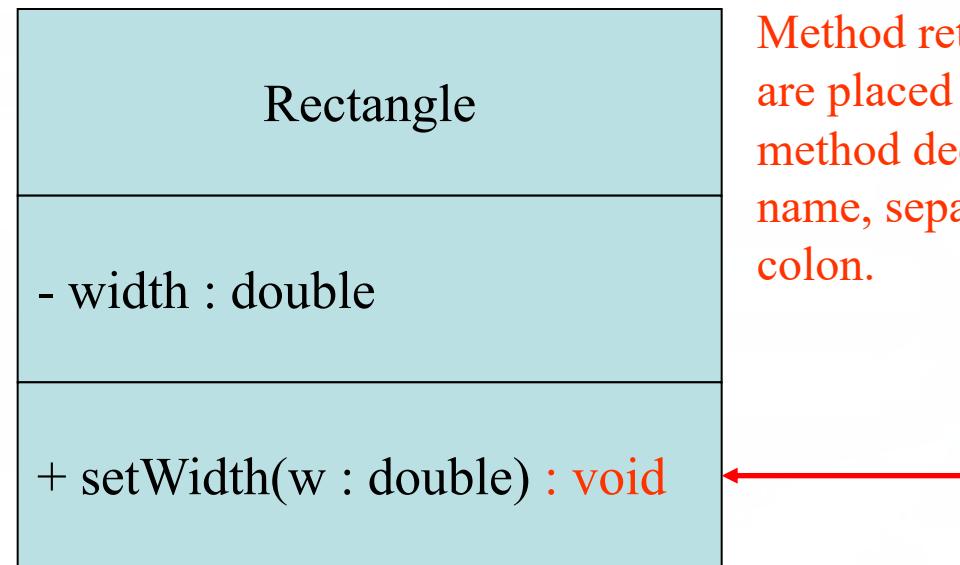
- UML diagrams are language independent.
- UML diagrams use an independent notation to show return types, access modifiers, etc.



Variable types are placed after the variable name, separated by a colon.

UML Data Type and Parameter Notation (3 of 4)

- UML diagrams are language independent.
- UML diagrams use an independent notation to show return types, access modifiers, etc.

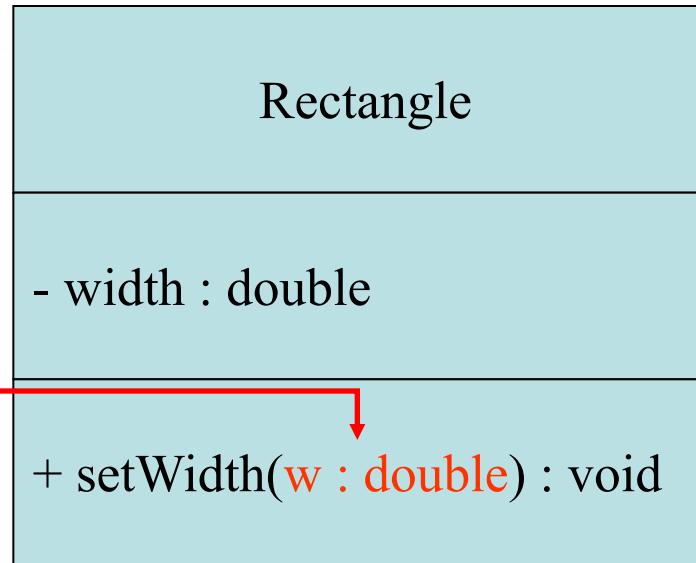


Method return types
are placed after the
method declaration
name, separated by a
colon.

UML Data Type and Parameter Notation (4 of 4)

- UML diagrams are language independent.
- UML diagrams use an independent notation to show return types, access modifiers, etc.

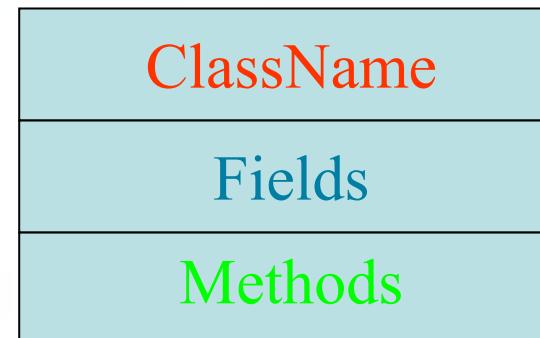
Method parameters
are shown inside the
parentheses using the
same notation as
variables.



Converting the UML Diagram to Code (1 of 3)

- Putting all of this information together, a Java class file can be built easily using the UML diagram.
- The UML diagram parts match the Java class file structure.

```
class header  
{  
    Fields  
    Methods  
}
```



Converting the UML Diagram to Code (2 of 3)

The structure of the class can be compiled and tested without having bodies for the methods. Just be sure to put in dummy return values for methods that have a return type other than void.

Rectangle
- width : double - length : double
+ setWidth(w : double) : void + setLength(len : double) : void + getWidth() : double + getLength() : double + getArea() : double

```
public class Rectangle
{
    private double width;
    private double length;

    public void setWidth(double w)
    {
    }

    public void setLength(double len)
    {
    }

    public double getWidth()
    {
        return 0.0;
    }

    public double getLength()
    {
        return 0.0;
    }

    public double getArea()
    {
        return 0.0;
    }
}
```

Converting the UML Diagram to Code (3 of 3)

Once the class structure has been tested, the method bodies can be written and tested.

Rectangle	
- width : double	
- length : double	

+ setWidth(w : double) : void
+ setLength(len : double) : void
+ getWidth() : double
+ getLength() : double
+ getArea() : double

```
public class Rectangle
{
    private double width;
    private double length;

    public void setWidth(double w)
    {
        width = w;
    }

    public void setLength(double len)
    {
        length = len;
    }

    public double getWidth()
    {
        return width;
    }

    public double getLength()
    {
        return length;
    }

    public double getArea()
    {
        return length * width;
    }
}
```

Class Layout Conventions

- The layout of a source code file can vary by employer or instructor.
- A common layout is:
 - Fields listed first
 - Methods listed second
 - Accessors and mutators are typically grouped.
- There are tools that can help in formatting layout to specific standards.

Instance Fields and Methods (1 of 2)

- Fields and methods that are declared as previously shown are called *instance fields* and *instance methods*.
- Objects created from a class each have their own copy of instance fields.
- Instance methods are methods that are not declared with a special keyword, static.

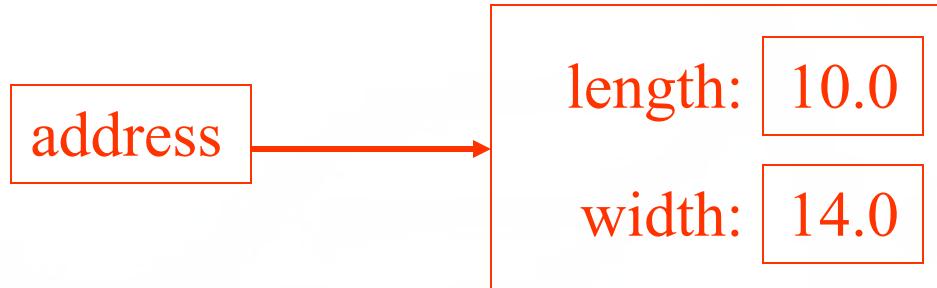
Instance Fields and Methods (2 of 2)

- Instance fields and instance methods require an object to be created in order to be used.
- See example: [RoomAreas.java](#)
- Note that each room represented in this example can have different dimensions.

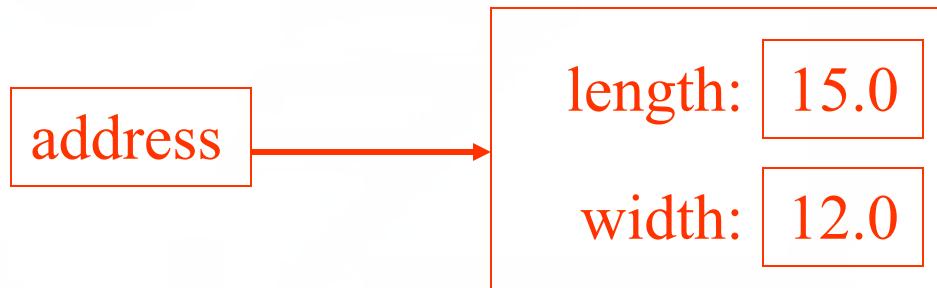
```
Rectangle kitchen = new Rectangle();  
Rectangle bedroom = new Rectangle();  
Rectangle den = new Rectangle();
```

States of Three Different Rectangle Objects

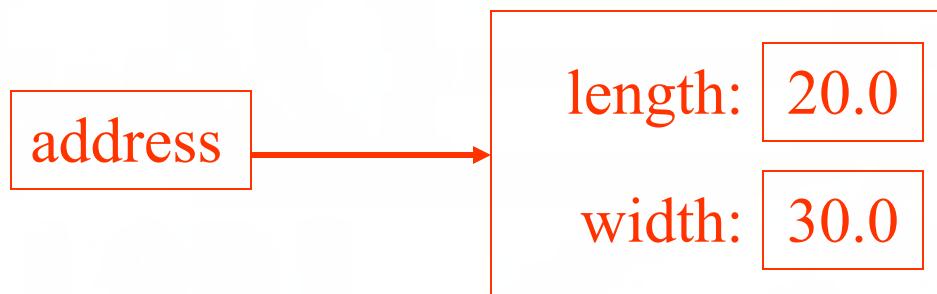
The kitchen variable holds the address of a Rectangle Object.



The bedroom variable holds the address of a Rectangle Object.



The den variable holds the address of a Rectangle Object.



Code Listing 6-9 (RoomAreas.java)

```
1 import javax.swing.JOptionPane;
2
3 /**
4     This program creates three instances of the
5     Rectangle class.
6 */
7
8 public class RoomAreas
9 {
10     public static void main(String[] args)
11     {
12         double number;          // To hold a number
13         double totalArea;       // The total area
14         String input;           // To hold user input
15
16         // Create three Rectangle objects.
17         Rectangle kitchen = new Rectangle();
18         Rectangle bedroom = new Rectangle();
19         Rectangle den = new Rectangle();
20
21         // Get and store the dimensions of the kitchen.
22         input = JOptionPane.showInputDialog("What is the " +
23                                         "kitchen's length?");
24         number = Double.parseDouble(input);
25         kitchen.setLength(number);
26         input = JOptionPane.showInputDialog("What is the " +
27                                         "kitchen's width?");
28         number = Double.parseDouble(input);
29         kitchen.setWidth(number);
30 }
```

```
31         // Get and store the dimensions of the bedroom.
32         input = JOptionPane.showInputDialog("What is the " +
33                                         "bedroom's length?");
34         number = Double.parseDouble(input);
35         bedroom.setLength(number);
36         input = JOptionPane.showInputDialog("What is the " +
37                                         "bedroom's width?");
38         number = Double.parseDouble(input);
39         bedroom.setWidth(number);
40
41         // Get and store the dimensions of the den.
42         input = JOptionPane.showInputDialog("What is the " +
43                                         "den's length?");
44         number = Double.parseDouble(input);
45         den.setLength(number);
46         input = JOptionPane.showInputDialog("What is the " +
47                                         "den's width?");
48         number = Double.parseDouble(input);
49         den.setWidth(number);
50
51         // Calculate the total area of the rooms.
52         totalArea = kitchen.getArea() + bedroom.getArea()
53             + den.getArea();
54
55         // Display the total area of the rooms.
56         JOptionPane.showMessageDialog(null, "The total area " +
57                                         "of the rooms is " + totalArea);
58
59         System.exit(0);
60     }
61 }
```

Figure 6-18 Interaction with the RoomAreas.java program

- 1  An input dialog box titled "Input". It contains a question mark icon, the text "What is the kitchen's length?", and an input field containing the value "10". At the bottom are "OK" and "Cancel" buttons.

What is the kitchen's length?
10

OK Cancel
- 2  An input dialog box titled "Input". It contains a question mark icon, the text "What is the kitchen's width?", and an input field containing the value "14". At the bottom are "OK" and "Cancel" buttons.

What is the kitchen's width?
14

OK Cancel
- 3  An input dialog box titled "Input". It contains a question mark icon, the text "What is the bedroom's length?", and an input field containing the value "15". At the bottom are "OK" and "Cancel" buttons.

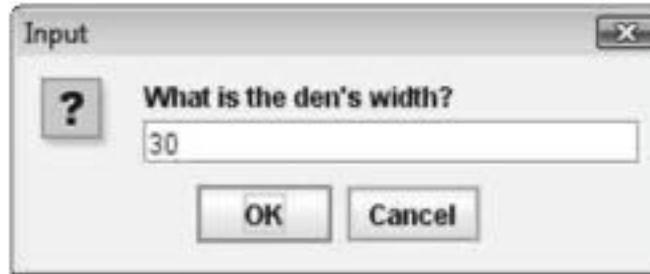
What is the bedroom's length?
15

OK Cancel
- 4  An input dialog box titled "Input". It contains a question mark icon, the text "What is the bedroom's width?", and an input field containing the value "12". At the bottom are "OK" and "Cancel" buttons.

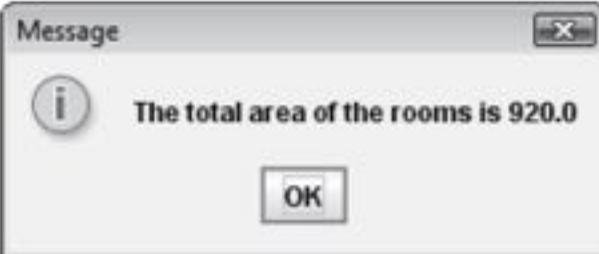
What is the bedroom's width?
12

OK Cancel
- 5  An input dialog box titled "Input". It contains a question mark icon, the text "What is the den's length?", and an input field containing the value "20". At the bottom are "OK" and "Cancel" buttons.

What is the den's length?
20

OK Cancel
- 6  An input dialog box titled "Input". It contains a question mark icon, the text "What is the den's width?", and an input field containing the value "30". At the bottom are "OK" and "Cancel" buttons.

What is the den's width?
30

OK Cancel
- 7  A message dialog box titled "Message". It contains an information icon, the text "The total area of the rooms is 920.0", and an "OK" button.

The total area of the rooms is 920.0

OK

Constructors (1 of 2)

- Classes can have special methods called *constructors*.
- A constructor is a method that is automatically called when an object is created.
- Constructors are used to perform operations at the time an object is created.
- Constructors typically initialize instance fields and perform other object initialization tasks.

Constructors (2 of 2)

- Constructors have a few special properties that set them apart from normal methods.
 - Constructors have the same name as the class.
 - Constructors have no return type (not even `void`).
 - Constructors may not return any values.
 - Constructors are typically public.

Constructor for Rectangle Class

```
/**  
 * Constructor  
 * @param len The length of the rectangle.  
 * @param w The width of the rectangle.  
 */  
public Rectangle(double len, double w)  
{  
    length = len;  
    width = w;  
}
```

Examples: [Rectangle.java](#), [ConstructorDemo.java](#)

Code Listing 6-10 (Rectangle.java)

```
1  /**
2   * Rectangle class, phase 5
3  */
4
5 public class Rectangle
6 {
7     private double length;
8     private double width;
9
10    /**
11     * Constructor
12     * @param len The length of the rectangle.
13     * @param w The width of the rectangle.
14    */
15
16    public Rectangle(double len, double w)
17    {
18        length = len;
19        width = w;
20    }

```

... The remainder of the class has not changed, and is not shown.

Code Listing 6-11 (ConstructorDemo.java)

```
1  /**
2   * This program demonstrates the Rectangle class's
3   * constructor.
4  */
5
6 public class ConstructorDemo
7 {
8     public static void main(String[] args)
9     {
10         // Create a Rectangle object, passing 5.0 and
11         // 15.0 as arguments to the constructor.
12         Rectangle box = new Rectangle(5.0, 15.0);
13
14         // Display the length.
15         System.out.println("The box's length is " +
16                           box.getLength());
17
18         // Display the width.
19         System.out.println("The box's width is " +
20                           box.getWidth());
21
22         // Display the area.
23         System.out.println("The box's area is " +
24                           box.getArea());
25     }
26 }
```

Program Output

```
The box's length is 5.0
The box's width is 15.0
The box's area is 75.0
```

Constructors in UML

- In UML, the most common way constructors are defined is:

Rectangle
- width : double
- length : double
+Rectangle(len:double, w:double)
+ setWidth(w : double) : void
+ setLength(len : double) : void
+ getWidth() : double
+ getLength() : double
+ getArea() : double

Notice there is no return type listed for constructors.



Uninitialized Local Reference Variables

- Reference variables can be declared without being initialized.

```
Rectangle box;
```

- This statement does not create a Rectangle object, so it is an uninitialized local reference variable.
- A local reference variable must reference an object before it can be used, otherwise a compiler error will occur.

```
box = new Rectangle(7.0, 14.0);
```

- box will now reference a Rectangle object of length 7.0 and width 14.0.

The Default Constructor (1 of 2)

- When an object is created, its constructor is always called.
- If you do not write a constructor, Java provides one when the class is compiled. The constructor that Java provides is known as the *default constructor*.
 - It sets all of the object's numeric fields to 0.
 - It sets all of the object's boolean fields to false.
 - It sets all of the object's reference variables to the special value *null*.

The Default Constructor (2 of 2)

- The default constructor is a constructor with no parameters, used to initialize an object in a default configuration.
- The only time that Java provides a default constructor is when you do not write any constructor for a class.
 - See example: First version of [Rectangle.java](#)
- A default constructor is not provided by Java if a constructor is already written.
 - See example: [Rectangle.java](#) with Constructor

Writing Your Own No-Arg Constructor

- A constructor that does not accept arguments is known as a *no-arg constructor*.
- The default constructor (provided by Java) is a no-arg constructor.
- We can write our own no-arg constructor

```
public Rectangle()  
{  
    length = 1.0;  
    width = 1.0;  
}
```

The String Class Constructor (1 of 2)

- One of the String class constructors accepts a string literal as an argument.
- This string literal is used to initialize a String object.
- For instance:

```
String name = new String("Michael Long");
```

The String Class Constructor (2 of 2)

- This creates a new reference variable *name* that points to a String object that represents the name “Michael Long”
- Because they are used so often, String objects can be created with a shorthand:

```
String name = "Michael Long";
```

Passing Objects as Arguments

- When you pass an object as an argument, the thing that is passed into the parameter variable is the object's memory address.
- As a result, parameter variable references the object, and the receiving method has access to the object.
- See [DieArgument.java](#)

Overloading Methods and Constructors

- Two or more methods in a class may have the same name as long as their parameter lists are different.
- When this occurs, it is called *method overloading*. This also applies to constructors.
- Method overloading is important because sometimes you need several different ways to perform the same operation.

Overloaded Method add

```
public int add(int num1, int num2)
{
    int sum = num1 + num2;
    return sum;
}

public String add (String str1, String str2)
{
    String combined = str1 + str2;
    return combined;
}
```

Method Signature and Binding

- A method signature consists of the method's name and the data types of the method's parameters, in the order that they appear. The return type is not part of the signature.

add(int, int)
add(String, String)

*Signatures of the
add methods of
previous slide*

- The process of matching a method call with the correct method is known as *binding*. The compiler uses the method signature to determine which version of the overloaded method to bind the call to.

Rectangle Class Constructor Overload (1 of 2)

If we were to add the no-arg constructor we wrote previously to our Rectangle class in addition to the original constructor we wrote, what would happen when we execute the following calls?

```
Rectangle box1 = new Rectangle();  
Rectangle box2 = new Rectangle(5.0, 10.0);
```

Rectangle Class Constructor Overload (2 of 2)

If we were to add the no-arg constructor we wrote previously to our Rectangle class in addition to the original constructor we wrote, what would happen when we execute the following calls?

```
Rectangle box1 = new Rectangle();  
Rectangle box2 = new Rectangle(5.0, 10.0);
```

The first call would use the no-arg constructor and box1 would have a length of 1.0 and width of 1.0.

The second call would use the original constructor and box2 would have a length of 5.0 and a width of 10.0.

Scope of Instance Fields

- Variables declared as instance fields in a class can be accessed by any instance method in the same class as the field.
- If an instance field is declared with the `public` access specifier, it can also be accessed by code outside the class, as long as an instance of the class exists.

Rectangle
<code>- length : double</code> <code>- width : double</code>
<code>+ setLength(len : double) : void</code> <code>+ setWidth(w : double) : void</code> <code>+ getLength() : double</code> <code>+ getWidth() : double</code> <code>+ getArea() : double</code>

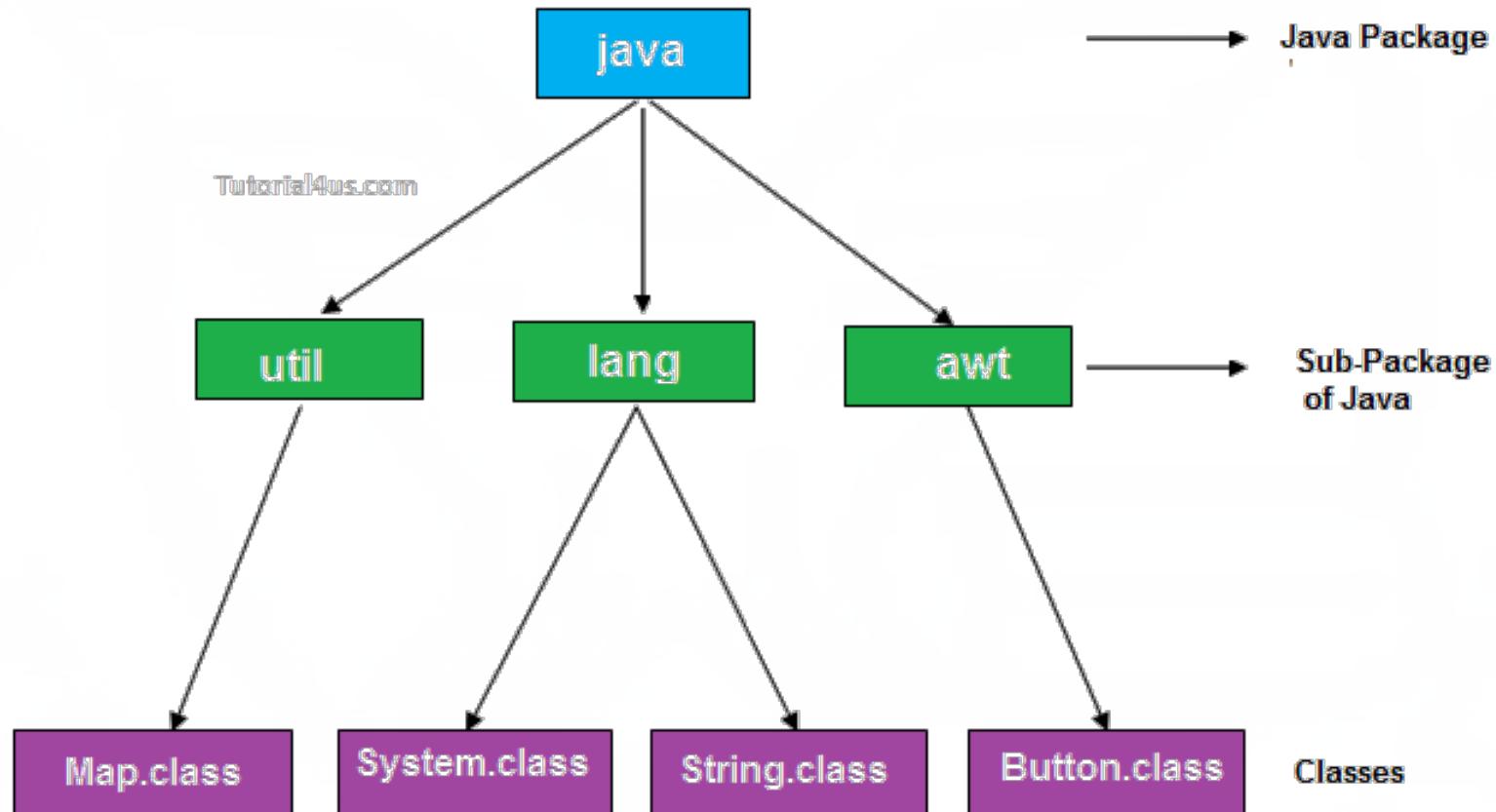
Shadowing

- A parameter variable is, in effect, a local variable.
- Within a method, variable names must be unique.
- A method may have a local variable with the same name as an instance field.
- This is called *shadowing*.
- The local variable will *hide* the value of the instance field.
- Shadowing is discouraged and local variable names should not be the same as instance field names.

```
public void setLength(double len)
{
    int length;          // Local variable
    length = len;
}
```

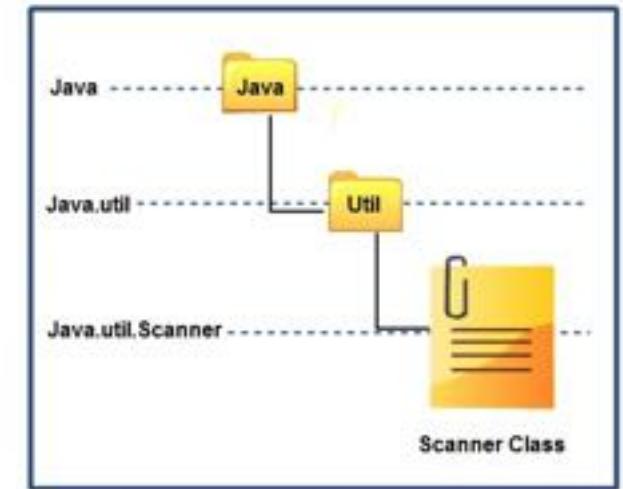
Packages and import Statements

- Classes in the Java API are organized into ***packages***.



Packages and import Statements

- Many of the classes in the Java API are not automatically available to your program. Quite often, you have to `import` an API class in order to use it. You use the `import` key word to import a class.
- Explicit and Wildcard import statements
 - Explicit imports name a specific class
 - `import java.util.Scanner;`
 - Wildcard imports name a package, followed by an `*`
 - `import java.util.*;`
- The `java.lang` package is automatically made available to any Java class.



Some Java Standard Packages

Table 6-2 A few of the standard Java packages

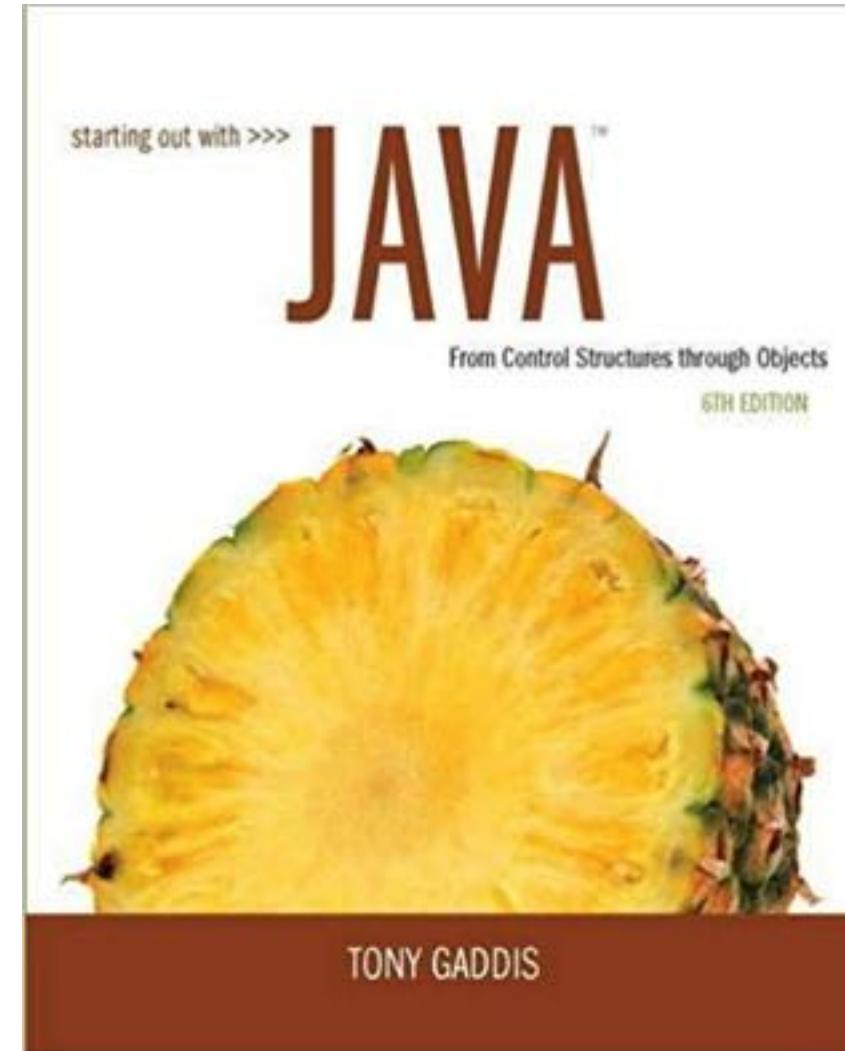
Package	Description
java.io	Provides classes that perform various types of input and output.
java.lang	Provides general classes for the Java language. This package is automatically imported.
java.net	Provides classes for network communications.
java.security	Provides classes that implement security features.
java.sql	Provides classes for accessing databases using structured query language.
java.text	Provides various classes for formatting text.
java.util	Provides various utility classes.

Object Oriented Design:Finding Classes and Their Responsibilities

- **Finding the classes**
 - Get written description of the problem domain
 - Identify all nouns, each is a potential class
 - Refine list to include only classes relevant to the problem
- **Identify the responsibilities**
 - Things a class is responsible for knowing
 - Things a class is responsible for doing
 - Refine list to include only classes relevant to the problem

Reading Task

- Chapter 6- A First Look at Classes
 - Page 384 to 390



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esi kam sah hamnida

ତୋରାକେ ଧନ୍ୟବାଦ

A collage of various languages spelling out the word "thank you". The words are arranged in a grid-like pattern, each in a different color and font style. The languages include: Баярлалаа (Mongolian), спасибо (Russian), faafetaa (Finnish), nanni (Swedish), nandii (Dutch), kiitos (Finnish), dankie (Afrikaans), dianyarad (Malay), bokosi (Croatian), bayerlala (Hungarian), gracie (Portuguese), hvala (Croatian), thank you (English), dzieku (Polish), sobodi (Slovene), dekuiji (Finnish), and obrigado (Portuguese).