BBM 102 – Introduction to Programming II

Spring 2018

Classes & Objects, Encapsulation in Java

Today

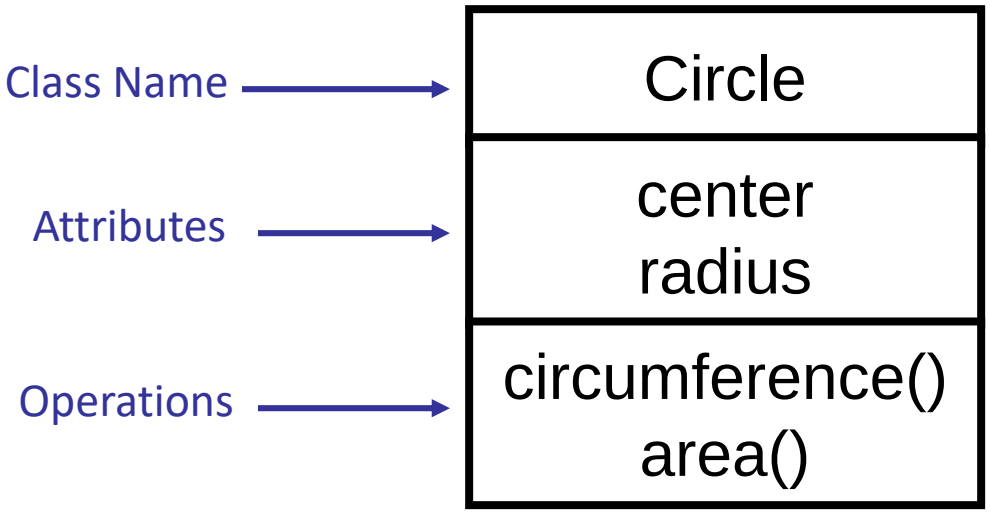
- **Classes & Objects**
  - Defining Classes, Objects and Methods
  - Accessor and Mutator Methods
  - Constructors
  - Static Members
  - Wrapper Classes
  - Parameter Passing
  - Delegation
- **Encapsulation**
  - Information Hiding
  - Encapsulation
  - The public and private Modifiers
  - UML Class Diagrams
  - Overloading
  - Packages

Class and Method Definitions

- Java program consists of objects
  - Objects of class types
  - Objects that interact with one another
- Program objects can represent
  - Objects in real world
  - Abstractions
  - Software components

Java Classes

- A class is a collection of fields (data) and methods (procedure or function) that operate on that data.



Defining a Java Class

- Syntax:

```
class  ClassName{
       [fields declaration]
       [methods declaration]
}
```

- Bare bone class definition:

```
/* This is my first java class.
It is not complete yet. */
class Circle {
    // fields will come here
    // methods will come here
}
```

Adding Fields to Class Circle

- Add fields

```
class Circle {
    public double x, y; // center coordinates
    public double r;    // radius of the circle
}
```

- The fields are also called the ***instance variables***.
  - Each object, or instance of the class has its own copy of these instance variables

- Do not worry about what *public* means at the moment.
  - Access modifiers (public, private and protected will be covered later)

Adding Methods to a Class

- A class with only data fields has no life.
  - Objects created by such a class cannot respond to any message.
- Methods are declared inside the body of the class.
- The general form of a method declaration is:

```
type MethodName (parameter-list)
{
      Method-body;
}
```

- methodName(parameter-list) part of the declaration is also known as the method signature.
  - Method signatures in a class must be unique!

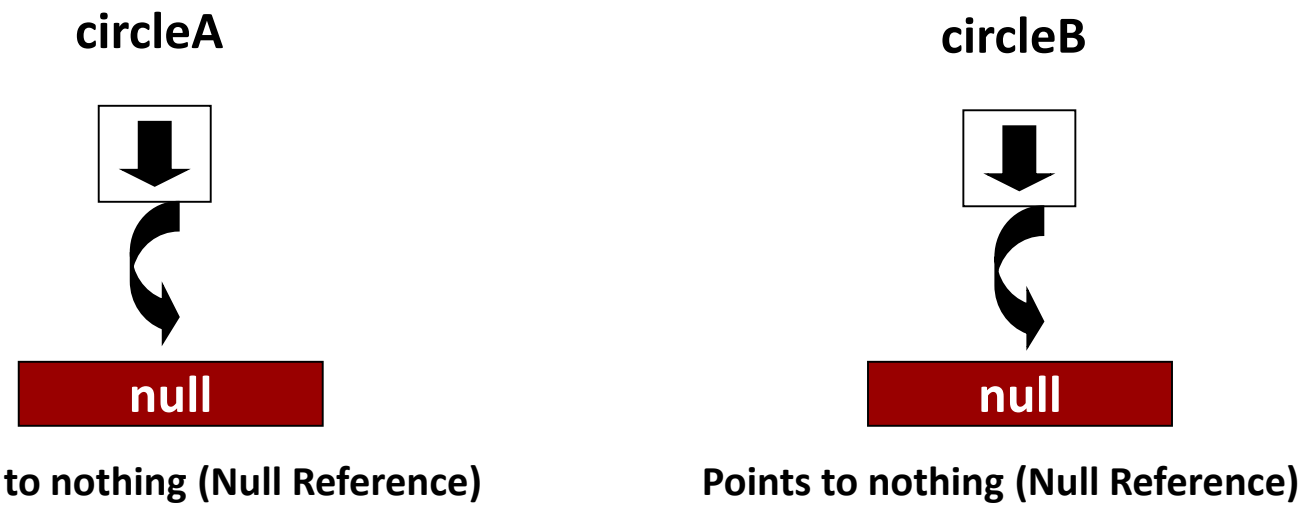
Adding Methods to Class Circle

```
public class Circle {
	public double x, y; // center of the circle
	public double r;    // radius of the circle

	// Method to return circumference
	public double circumference() {
		return 2 * 3.14 * r;
	}

	// Method to return area
	public double area() {
		return 3.14 * r * r;
	}
}
```

Defining Reference Variables of a Class

- A class can be thought as a type
- A variable (reference) can be defined as of that type (class)

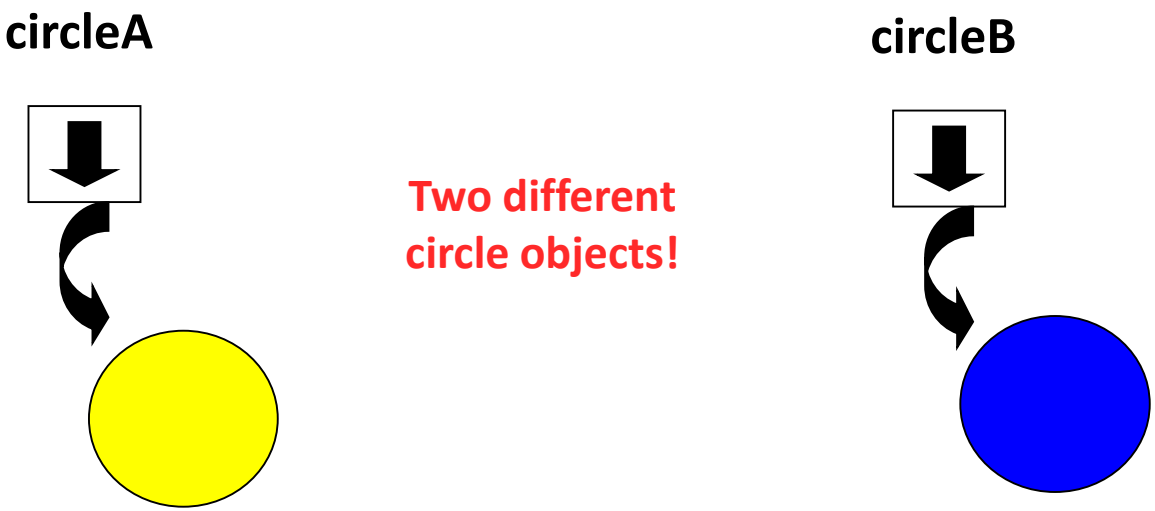
```
Circle circleA, circleB;
```



Creating Objects of a Class

- Objects are created by using the **new** keyword

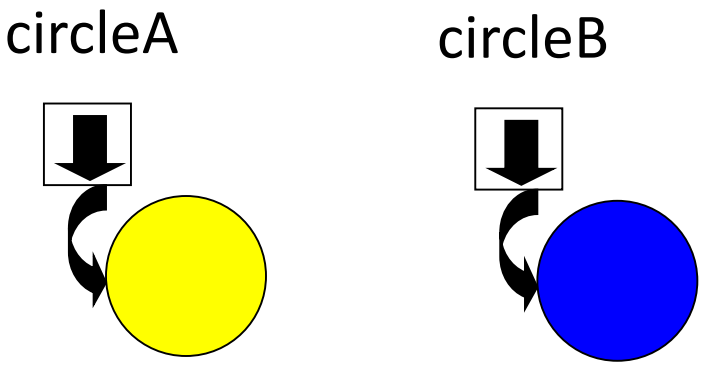
```
Circle circleA;
circleA = new Circle();

Circle circleB = new Circle();
```



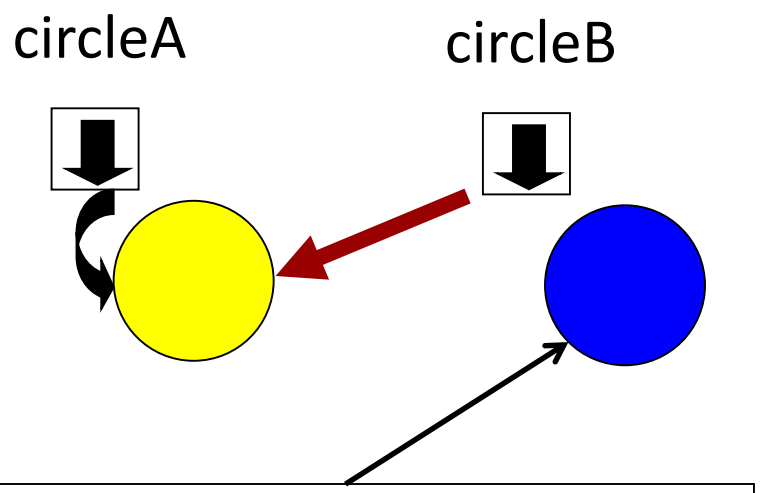
Creating Objects of a Class

```
circleA = new Circle();
circleB = new Circle() ;
circleB = circleA;
```

Before Assignment



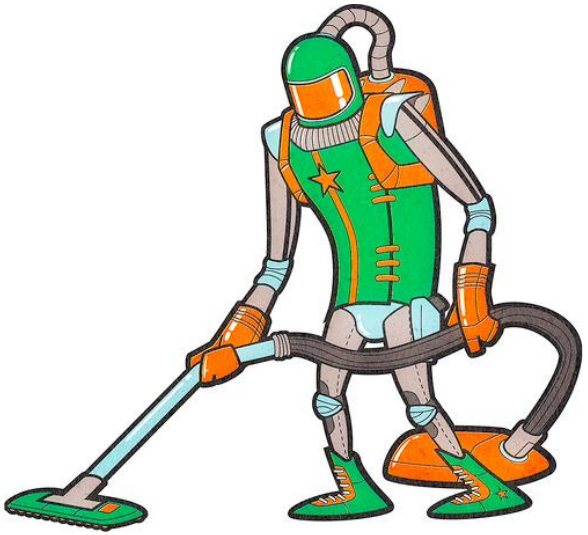
After Assignment



This object does not have a reference anymore: inaccessable!

Garbage Collection

- The object which does not have a reference cannot be used anymore.
- Such objects become a candidate for automatic garbage collection.
- Java collects garbage periodically and releases the memory occupied by such objects to be used in the future.



Using Objects

- Object's data is accessed by using the dot notation

```
Circle circleA = new Circle();

circleA.x = 25.0;
circleA.y = 25.0;
circleA.r = 3.0;
```

- Object's methods are invoked by same (dot) notation.

```
double area = circleA.area();
```

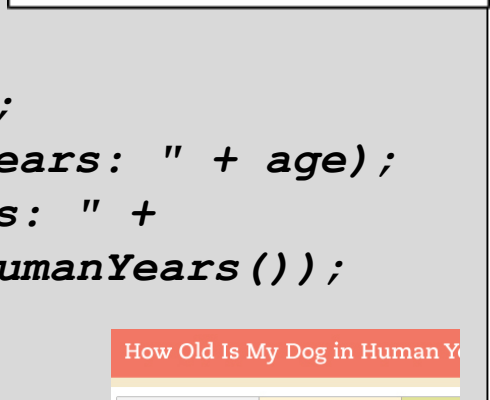
A Complete Circle Class

```
public class Circle {
	public double x, y; // center of the circle
	public double r;    // radius of the circle

	// Methods to return circumference and area
	public double circumference() {
		return 2 * 3.14 * r;
	}
	public double area() {
		return 3.14 * r * r;
	}
	public static void main(String[] args) {
		Circle circleA = new Circle();
		circleA.x = 25.0;
		circleA.y = 25.0;
		circleA.r = 3.0;

		double area = circleA.area();
		System.out.println("Area of the circle is " + area);
	}
}
```

Class Files and Separate Compilation

- Each Java class definition is usually written in a file by itself
  - File begins with the name of the class
  - Ends with .java
- Class can be compiled separately

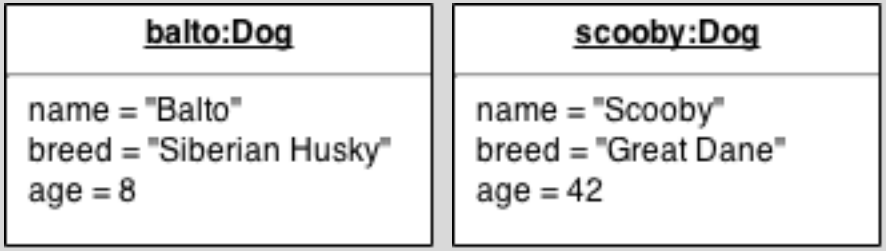
```
public class Dog {
        public String name;  // Instance variables
        public String breed;
        public int age;

        // Method that returns nothing: void method
        public void writeOutput() {
                System.out.println("Name: " + name);
                System.out.println("Breed: " + breed);
                System.out.println("Age in calendar years: " + age);
                System.out.println("Age in human years: " +
                                        getAgeInHumanYears());
        }

        // Method that returns a value
        public int getAgeInHumanYears() {
                int humanAge = 0;
                if (age <= 2) {
                        humanAge = age * 11;
                } else {
                        humanAge = 22 + ((age - 2) * 5);
                }
                return humanAge;
        }
}
```



Example Dog Class

```
public class DogDemo {
   public static void main(String[] args) {
        Dog balto = new Dog();
        balto.name = "Balto";
        balto.age = 8;
        balto.breed = "Siberian Husky";
        balto.writeOutput();

        Dog scooby = new Dog();
        scooby.name = "Scooby";
        scooby.age = 42;
        scooby.breed = "Great Dane";
        System.out.println(scooby.name + " is a " + scooby.breed + ".");
        System.out.print("He is " + scooby.age + " years old, or ");

        int humanYears = scooby.getAgeInHumanYears();
        System.out.println(humanYears + " in human years.");
   }
}
```

DogDemo class contains only a main method.



Program's output

```
Name: Balto
Breed: Siberian Husky
Age in calendar years: 8
Age in human years: 52

Scooby is a Great Dane.
He is 42 years old, or 222 in human years.
```

Accessor and Mutator Methods

- A public method that returns data from a private instance variable is called an accessor method, a get method, or a getter.
  - The names of accessor methods typically begin with **get**.

- A public method that changes the data stored in one or more private instance variables is called a mutator method, a set method, or a setter.
  - The names of mutator methods typically begin with **set**.

Circle Class with Getters/Setters

```
public class Circle {
       public double x, y; // center of the circle
       public double r;    // radius of the circle

       public double getX() { return x; }
       public void setX(double centerX) { x = centerX; }
       public double getY() { return y; }
       public void setY(double centerY) { y = centerY; }
       public double getR() { return r; }
       public void setR(double radius) { r = radius; }

       // Methods to return circumference and area
       …
}
```

Constructors

- A constructor is a special method that gets invoked "automatically" at the time of object creation.
- Constructors are normally used for initializing objects with default values unless different values are supplied.
- Constructors have the same name as the class name.
- Constructors cannot return values.
- A class can have more than one constructor as long as they have different signatures (i.e., different input arguments syntax).

Circle Class with Constructor

```
public class Circle {
        public double x, y; // center of the circle
        public double r;    // radius of the circle

        // Constructor
        public Circle(double centerX, double centerY, double radius) {
                x = centerX;
                y = centerY;
                r = radius;
        }

        // Methods to return circumference and area
        ...
}
```

```
Circle aCircle = new Circle(10.0, 20.0, 5.0);
```

Multiple Constructors

- Sometimes we may want to initialize in a number of different ways, depending on the circumstance.

- This can be supported by having multiple constructors having different input arguments (signatures).

Circle Class with Multiple Constructors

```
public class Circle {
        public double x, y; // center of the circle
        public double r;    // radius of the circle

        // Constructor
        public Circle(double centerX, double centerY, double radius) {
                x = centerX;
                y = centerY;
                r = radius;
        }

        public Circle(double radius) {
                x = 0; y = 0; r = radius;
        }

        public Circle() {
                x = 0; y = 0; r = 1.0;
        }

        // Methods to return circumference and area
        ...
}
```

```
Circle aCircle = new Circle(10.0, 20.0, 5.0);
Circle bCircle = new Circle(5.0);
Circle cCircle = new Circle();
```

Default and No-Argument Constructors

- Every class must have at least one constructor
  - If no constructors are declared, the compiler will create a default constructor
    - Takes no arguments and initializes instance variables to their initial values specified in their declaration or to their default values
      - Default values are `zero` for primitive numeric types, `false` for `boolean` values and `null` for references

Common Programming Error

- If a class has constructors, but none of the `public` constructors are no-argument constructors, and a program attempts to call a no-argument constructor to initialize an object of the class, a compilation error occurs.

- A constructor can be called with no arguments only if the class does not have any constructors (in which case the default constructor is called) or if the class has a `public` no-argument constructor.

The Keyword this

- this keyword can be used to refer to the object itself.
- It is generally used for accessing class members (from its own methods) when they have the same name as those passed as arguments.

```
public class Circle {
        public double x, y; // center of the circle
        public double r;    // radius of the circle

        public double getX() { return x; }
        public void setX(double x) { this.x = x; }
        public double getY() { return y; }
        public void setY(double y) { this.y = y; }
        public double getR() { return r; }
        public void setR(double r) { this.r = r; }

        // Methods to return circumference and area
        …
}
```

Static Variables

- Java supports definition of variables that can be accessed without creating objects of a class.
  - Such members are called Static members.
- This feature is useful when we want to create a variable common to all instances of a class.
- One of the most common example is to have a variable that could keep a count of how many objects of a class have been created.
- Java creates only one copy for a static variable which can be used even if the class is never instantiated.

Using Static Variables

- Define the variable by using the static keyword

```
public class Circle {
    // Class variable, one for the Circle class.
    // To keep number of objects created.
    public static int numCircles = 0;

    // Instance variables, one for each instance
    // of the Circle class.
    public double x,y,r;

    // Constructor
    Circle (double x, double y, double r){
        this.x = x;
        this.y = y;
        this.r = r;
        numCircles++;
    }
}
```

```
Circle circleA = new Circle(10, 12, 20);
// numCircles = 1
Circle circleB = new Circle(5, 3, 10);
// numCircles = 2
```

Instance vs. Static Variables

- *Instance variables*: One copy per object. Every object has its own instance variables.
  - e.g. **`x,y,r`** (center and radius of the circle)

- *Static variables*: One copy per class.
  - e.g. **`numCircles`** (total number of circle objects created)

Static Methods

- A class can have methods that are defined as **static**.
- Static methods can be accessed without using objects. So, there is **NO** need to create objects.
- Static methods are generally used to group related library functions that don't depend on data members of its class.
  - e.g., Math library functions.

Using Static Methods

```
class Comparator {
        public static int max(int a, int b) {
                if (a > b)
                        return a;
                else
                        return b;
        }

        public static String max(String a, String b) {
                if (a.compareTo(b) > 0)
                        return a;
                else
                        return b;
        }
}
```

```
// Max methods are directly accessed using ClassName.
// NO Objects created.
System.out.println(Comparator.max(5, 10));
System.out.println(Comparator.max("ANKARA", "SAMSUN"));
```

More Static Methods: The Math Class

- It is like including libraries in C language
- It contains standard mathematical methods
  - They are all static
  - Java.lang.Math

```
Math.pow(2.0, 3.0)      // 8
Math.max(5, 6)          // 6
Math.round(6.2)         // 6
Math.sqrt(4.0)          // 2.0
```

Object Cleanup

- Recall: Memory deallocation is automatic in Java
  - No dangling pointers and no memory leak problem.
- Java allows to define **finalize** method, which is invoked (if defined) just before the object destruction.
- This presents an opportunity to perform record maintenance operation or clean up any special allocations made by the user.
- The finalize method will be called by the Garbage Collector, but when this will happen is not deterministic. Try to avoid finalize.

```
protected void finalize() throws IOException {
   Circle.numCircles = Circle.numCircles--;
   System.out.println("Number of circles:"+ Circle.num_circles);
}
```

Wrapper Classes

- Each of Java's primitive data types has a class dedicated to it.
  - **B**oolean, **B**yte, **C**haracter, **I**nteger, **F**loat, **D**ouble, **L**ong, **S**hort
  - These are known as wrapper classes, because they "wrap" the primitive data type into an object of that class.
  - They contain useful predefined constants and methods
  - The wrapper classes are part of the java.lang package, which is imported by default into all Java programs.
  - Since Java 5.0 we have autoboxing and unboxing.

```
// Defining objects of wrapper class
Integer x = new Integer(33);
Integer y = 33; // Autoboxing
int yInt = y; // Unboxing

// Convert string to an integer
String s = "123”;
int i = Integer.parseInt(s);

//Converting from hexadecimal to decimal
Integer hex2Int = Integer.valueOf("D", 16);
```

Parameter Passing

- Java works as «Call by Value» for parameter-passing.
  - Copy of the primitive types
  - Copy of the reference of the Class types.
- Copy of the reference to the object is passed into the method, original value unchanged, but you may change the attributes of the objects.

```
public class ReferenceTest {

   public static void main (String[] args){
      Circle c1 = new  Circle(5, 5, 20);
      Circle c2 = new Circle(1, 1, 10);
      System.out.println ( "c1 Radius = " + c1.getRadius());
      System.out.println ( "c2 Radius = " + c2.getRadius());

      parameterTester(c1, c2);

      System.out.println ( "c1 Radius = " + c1.getRadius());
      System.out.println ( "c2 Radius = " + c2.getRadius());
   }

   public static void parameterTester(Circle circleA, Circle circleB){
      circleA.setRadius(15);
      circleB = new Circle(0, 0, 100);

      System.out.println ( "circleA Radius = " + circleA.getRadius());
      System.out.println ( "circleB Radius = " + circleB.getRadius());
   }

}
```

```
c1 Radius =  20.0
c2 Radius = 10.0
circleA Radius = 15.0
circleB Radius = 100.0
c1 Radius =  15.0
c2 Radius = 10.0
```

Delegation

- Ability for a class to delegate its responsibilities to another class.
- A way of making an object invoking services of other objects through containership.

Using Delegation

```
public class Point {
        private double xCoord;
        private double yCoord;

        public double getXCoord(){
                return xCoord;
        }
        public double getYCoord(){
                return yCoord;
        }
}
```

```
public class Circle {
        private Point center;
        public double getCenterX(){
                return center.getXCoord();              // Delegation
        }
        public double getCenterY(){
                return center.getYCoord();              // Delegation
        }
}
```

Information Hiding

- Programmer using a class method need not know details of implementation
  - Only needs to know *what* the method does

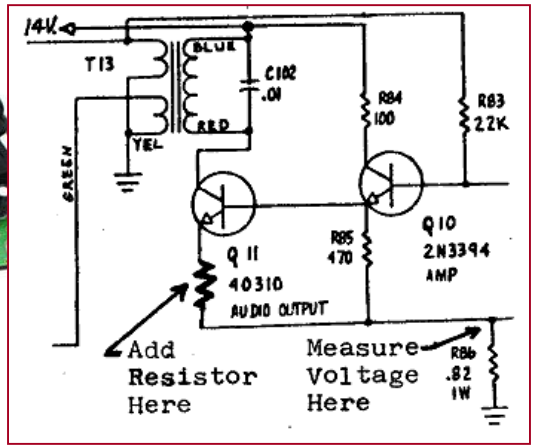
- **Information hiding:**
  - Designing a method so it can be used without knowing details

- Also referred to as ***encapsulation***

- Method design should separate *what* from *how*

Encapsulation

- **Encapsulation**: Hiding implementation details of an object from its clients.
  - Encapsulation provides *abstraction*.
    - separates external view (behavior) from internal view (state)
  - Encapsulation protects the integrity of an object's data.



Visibility Modifiers

- All parts of a *class* have visibility modifiers
  - Java keywords
  - **public**, protected, **private**
  - do not use these modifiers on local (method) variables (syntax error)
- **public** means that constructor, method, or field may be accessed outside of the class.
  - part of the interface
  - constructors and methods are generally public
- **private** means that part of the class is hidden and inaccessible by code outside of the class
  - part of the implementation
  - data fields are generally private

The `public` and `private` Modifiers

- Type specified as **`public`**
  - Any other class can directly access that object by name
- Classes are generally specified as **`public`**
- Instance variables are usually not **`public`**
  - Instead specify as **`private`**

Private fields

- A field can be declared *private*.
  - No code outside the class can access or change it.

```
private type name;
```

  - Examples:

```
private int id;
private String name;
```

- Client code sees an error when accessing private fields:

```
PointMain.java:11: x has private access in Point
System.out.println("p1 is (" + p1.x + ", " + p1.y + ")");
                                  ^
```

Accessing private state

- We can provide methods to get and/or set a field's value:

```
// A "read-only" access to the x field ("accessor")
public int getX() {
    return x;
}

// Allows clients to change the x field ("mutator")
public void setX(int newX) {
    x = newX;
}
```

- Client code will look more like this:

```
System.out.println("p1: (" + p1.getX() + ", " + p1.getY() + ")");
p1.setX(14);
```

Programming Example

```
public class Rectangle
{
    private int width;
    private int height;
    private int area;

    public void setDimensions (int newWidth, int newHeight)
    {
        width = newWidth;
        height = newHeight;
        area = width * height;
    }
    public int getArea ()
    {
        return area;
    }
}
```

Note `setDimensions` method : This is the only way the `width` and `height` may be altered outside the class

- Statement such as

  `box.width = 6;`

  is illegal since width is `private`
- Keeps remaining elements of the class consistent

Point class

```
// A Point object represents an (x, y) location.
public class Point {
    private int x;
    private int y;

    public Point(int initialX, int initialY) {
        x = initialX;
        y = initialY;
    }

    public double distanceFromOrigin() {
        return Math.sqrt(x * x + y * y);
    }

    public int getX() {
        return x;
    }

    public int getY() {
        return y;
    }

    public void setLocation(int newX, int newY) {
        x = newX;
        y = newY;
    }

    public void translate(int dx, int dy) {
        x = x + dx;
        y = y + dy;
    }
}
```

Client code

```
public class PointMain4 {
    public static void main(String[] args) {
        // create two Point objects
        Point p1 = new Point(5, 2);
        Point p2 = new Point(4, 3);

        // print each point
        System.out.println("p1: (" + p1.getX() + ", " + p1.getY() + ")");
        System.out.println("p2: (" + p2.getX() + ", " + p2.getY() + ")");

        // move p2 and then print it again
        p2.translate(2, 4);
        System.out.println("p2: (" + p2.getX() + ", " + p2.getY() + ")");
  }
}
```

OUTPUT :

```
p1 is (5, 2)
p2 is (4, 3)
p2 is (6, 7)
```

Encapsulation

- Consider example of driving a car
  - We see and use break pedal, accelerator pedal, steering wheel – know what they do
  - We do not see mechanical details of how they do their jobs

- Encapsulation divides class definition into
  - *Class interface*
  - *Class implementation*

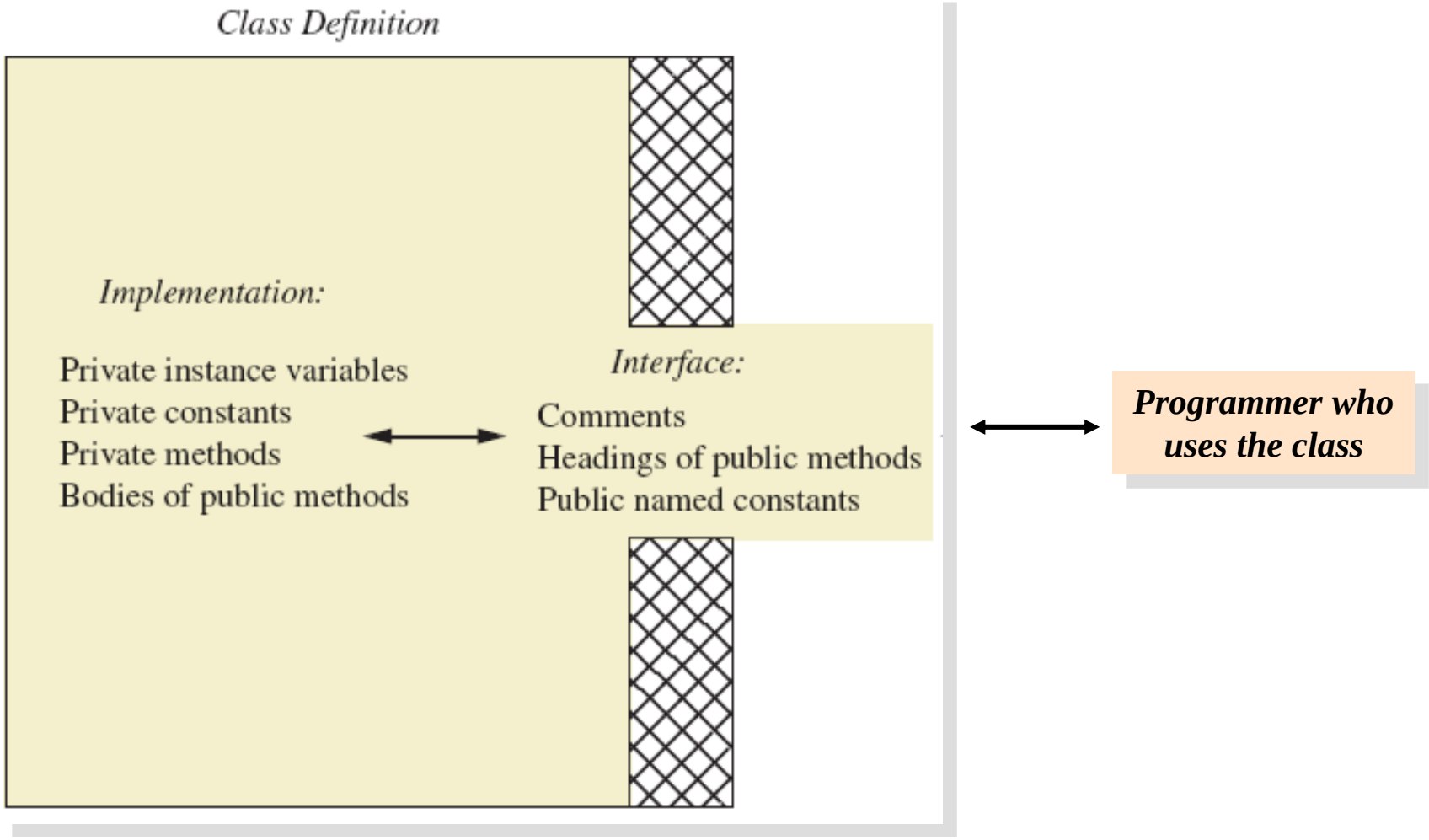
Encapsulation

- *Class interface*
  - Tells what the class does
  - Gives headings for public methods and comments about them

- *Class implementation*
  - Contains private variables
  - Includes implementations of public and private methods

Encapsulation

- A well encapsulated class definition



Encapsulation – Best Practices

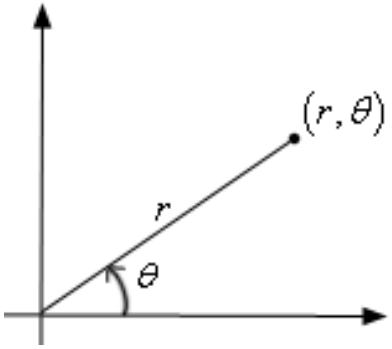
- Preface class definition with comment on how to use class
- Declare all instance variables in the class as private.
- Provide public accessor methods to retrieve data and provide public methods to manipulate data
  - Such methods could include public mutator methods.
- Place a comment before each public method heading that fully specifies how to use the method.
- Make any helping methods private.
- Write comments within class definition to describe implementation details.

Benefits of encapsulation

- Provides abstraction between an object and its clients.

- Protects an object from unwanted access by clients.
  - A bank app forbids a client to change an `Account`'s balance.

- Allows you to change the class implementation.
  - `Point` could be rewritten to use polar coordinates (radius *r*, angle ϑ), but with the same methods.



- Allows you to constrain objects' state (**invariants**).
  - Example: Only allow `Points` with non-negative coordinates.

Outline

Time1.java

(1 of 2)

```
1  // Fig. 8.1: Time1.java
2  // Time1 class declaration maintains the time in 24-hour format.
3
4  public class Time1
5  {
6     private int hour;   // 0 - 23
7     private int minute; // 0 - 59
8     private int second; // 0 - 59
9
10    // set a new time value using universal time; ensure that
11    // the data remains consistent by setting invalid values to zero
12    public void setTime( int h, int m, int s )
13
14       hour = ( ( h >= 0 && h < 24 ) ? h : 0 );   // validate hour
15       minute = ( ( m >= 0 && m < 60 ) ? m : 0 ); // validate minute
16       second = ( ( s >= 0 && s < 60 ) ? s : 0 ); // validate second
17    } // end method setTime
18
```

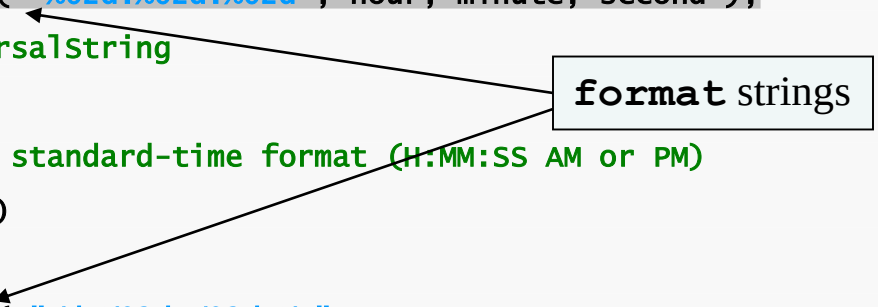
private instance variables

Declare **public** method **setTime**

Validate parameter values before setting instance variables

Outline

```
19    // convert to String in universal-time format (HH:MM:SS)
20    public String toUniversalString()
21    {
22       return String.format( "%02d:%02d:%02d", hour, minute, second );
23    } // end method toUniversalString
24
25    // convert to String in standard-time format (H:MM:SS AM or PM)
26    public String toString()
27    {
28       return String.format( "%d:%02d:%02d %s",
29          ( ( hour == 0 || hour == 12 ) ? 12 : hour % 12 ),
30          minute, second, ( hour < 12 ? "AM" : "PM" ) );
31    } // end method toString
32 } // end class Time1
```



Time1.java

(2 of 2)

Outline

Time1Test.java
(1 of 2)

```
1  // Fig. 8.2: Time1Test.java
2  // Time1 object used in an application.
3
4  public class Time1Test
5  {
6     public static void main( String args[] )
7     {
8        // create and initialize a Time1 object
9        Time1 time = new Time1(); // invokes Time1 constructor
10
11       // output string representations of the time
12       System.out.print( "The initial universal time is: " );
13       System.out.println( time.toUniversalString() );
14       System.out.print( "The initial standard time is: " );
15       System.out.println( time.toString() );
16       System.out.println(); // output a blank line
17
```

Create a **`Time1`** object

Call **`toUniversalString`** method

Call **`toString`** method

Outline

Time1Test.java

(2 of 2)

```
18       // change time and output updated time
19       time.setTime( 13, 27, 6 );
20       System.out.print( "Universal time after setTime is: " );
21       System.out.println( time.toUniversalString() );
22       System.out.print( "Standard time after setTime is: " );
23       System.out.println( time.toString() );
24       System.out.println(); // output a blank line
25
26       // set time with invalid values; output updated time
27       time.setTime( 99, 99, 99 );
28       System.out.println( "After attempting invalid settings:" );
29       System.out.print( "Universal time: " );
30       System.out.println( time.toUniversalString() );
31       System.out.print( "Standard time: " );
32       System.out.println( time.toString() );
33    } // end main
34 } // end class Time1Test
```

Call **`setTime`** method

Call **`setTime`** method with invalid values

```
The initial universal time is: 00:00:00
The initial standard time is: 12:00:00 AM

Universal time after setTime is: 13:27:06
Standard time after setTime is: 1:27:06 PM

After attempting invalid settings:
Universal time: 00:00:00
Standard time: 12:00:00 AM
```

Software Development Observations & Tips

- When one object of a class has a reference to another object of the same class, the first object can access all the second object's data and methods (including those that are `private`).

- When implementing a method of a class, use the class's *set* and *get* methods to access the class's `private` data. This simplifies code maintenance and reduces the likelihood of errors.

- This architecture helps hide the implementation of a class from its clients, which improves program modifiability

`final` Instance Variables

- `final` instance variables
  - Keyword `final`
    - Specifies that a variable is not modifiable (is a constant)
  - `final` instance variables can be initialized at their declaration
    - If they are not initialized in their declarations, they must be initialized in all constructors

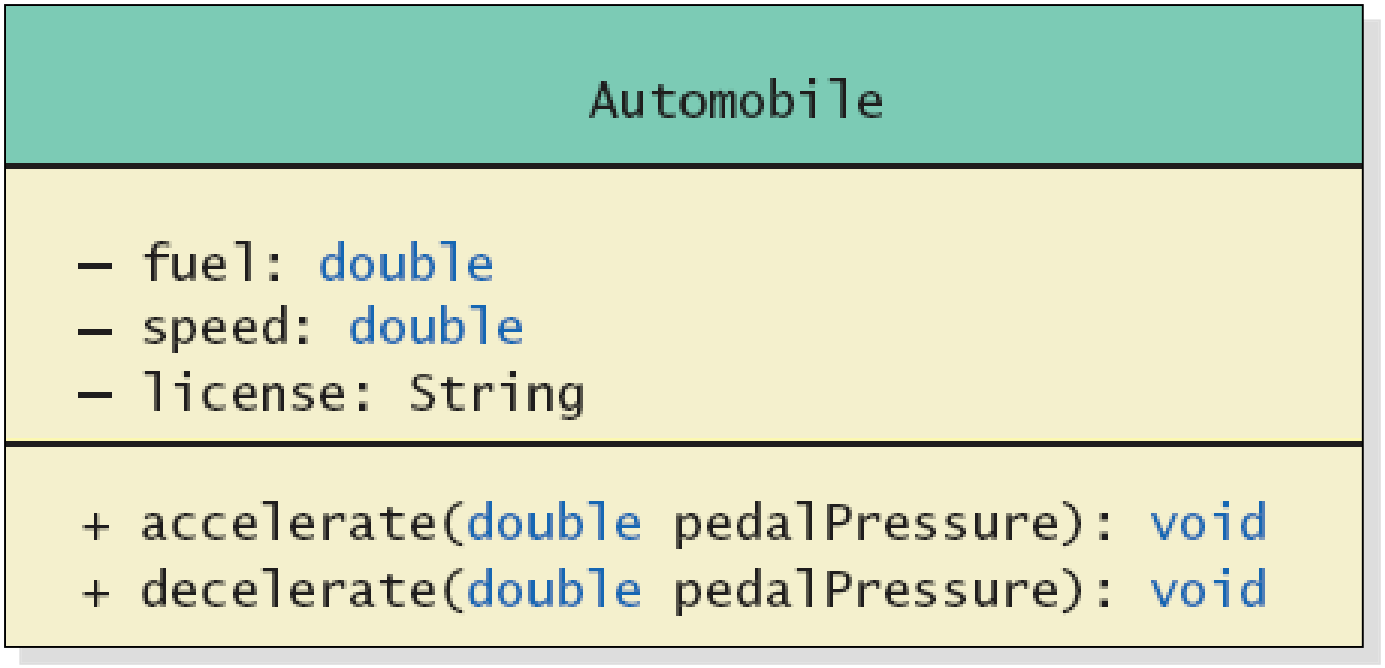
- If an instance variable should not be modified, declare it to be `final` to prevent any erroneous modification.

`static final` Instance Variables

- A `final` field should also be declared `static` if it is initialized in its declaration.
- Once a `final` field is initialized in its declaration, its value can never change.
- Therefore, it is not necessary to have a separate copy of the field for every object of the class.
- Making the field `static` enables all objects of the class to share the `final` field.
- Example: `public static final double PI = 3.141592;`

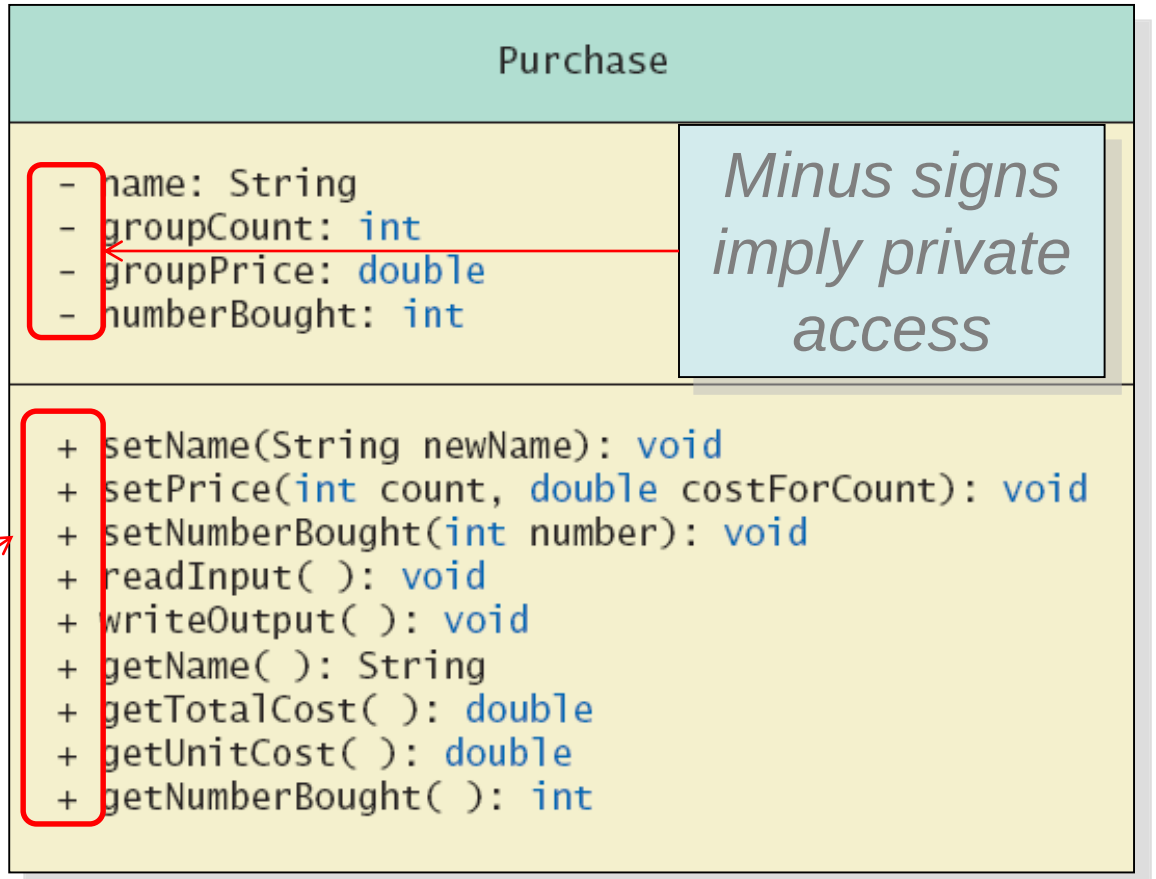
UML Class Diagrams

- An automobile class outline as a UML class diagram



UML Class Diagrams

- Example:
  `Purchase`
  class



UML Class Diagrams

- Contains more than interface, less than full implementation
- Usually written *before* class is defined
- Used by the programmer defining the class
  - Corresponds to the *interface* used by programmer who uses the class

How to Import a Library

- Import the reusable class into a program
  - Single-type-import declaration
    - Imports a single class
    - Example: `import java.util.Random;`
  - Type-import-on-demand declaration
    - Imports all classes in a package
    - Example: `import java.util.*;`

Overloading Basics

- When two or more methods have same name within the same class
- Java distinguishes the methods by number and types of parameters
  - If it cannot match a call with a definition, it attempts to do type conversions
- A method's name and number and type of parameters is called the *signature*

Programming Example

```
/** This class illustrates overloading. */
public class Overload {

public static void main (String [] args) {
   double average1 = Overload.getAverage (40.0, 50.0);
   double average2 = Overload.getAverage (1.0, 2.0, 3.0);
   char average3 = Overload.getAverage ('a', 'c');
       System.out.println ("average1 = " + average1);
       System.out.println ("average2 = " + average2);
       System.out.println ("average3 = " + average3); }

public static double getAverage (double first, double second) {
       return (first + second) / 2.0; }

public static double getAverage (double first, double second,
double third) { return (first + second + third) / 3.0; }

public static char getAverage (char first, char second) {
       return (char) (((int) first + (int) second) / 2); }
}
```

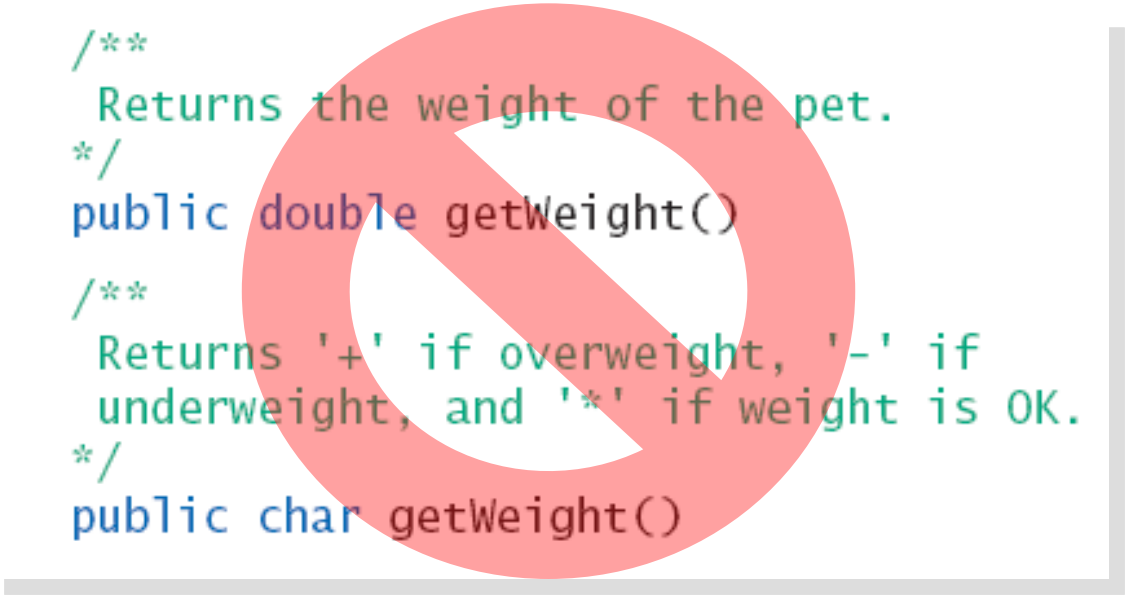
```
average1= 45.0
average2= 2.0
average3 = b
```

Overloading and Type Conversion

- Overloading and automatic type conversion can conflict
- Remember the compiler attempts to overload before it does type conversion
- Use descriptive method names, avoid overloading when possible

Overloading and Return Type

- You can not overload a method where the only difference is the type of value returned



```
/**
 Returns the weight of the pet.
*/
public double getWeight()

/**
 Returns '+' if overweight, '-' if
 underweight, and '*' if weight is OK.
*/
public char getWeight()
```

Summary

- Classes, objects, and methods are the basic components used in Java programming.
- Constructors allow seamless initialization of objects.
- Classes can have static members, which serve as global members of all objects of a class.
- Objects can be passed as parameters and they can be used for exchanging messages.

Summary

- Usage of visibility modifiers for encapsulation
- Separation of interface and implementation is important
- Class designers use UML notation to describe classes
- Use packages for software reusability
- Overloading must be done with care