Chapter 7

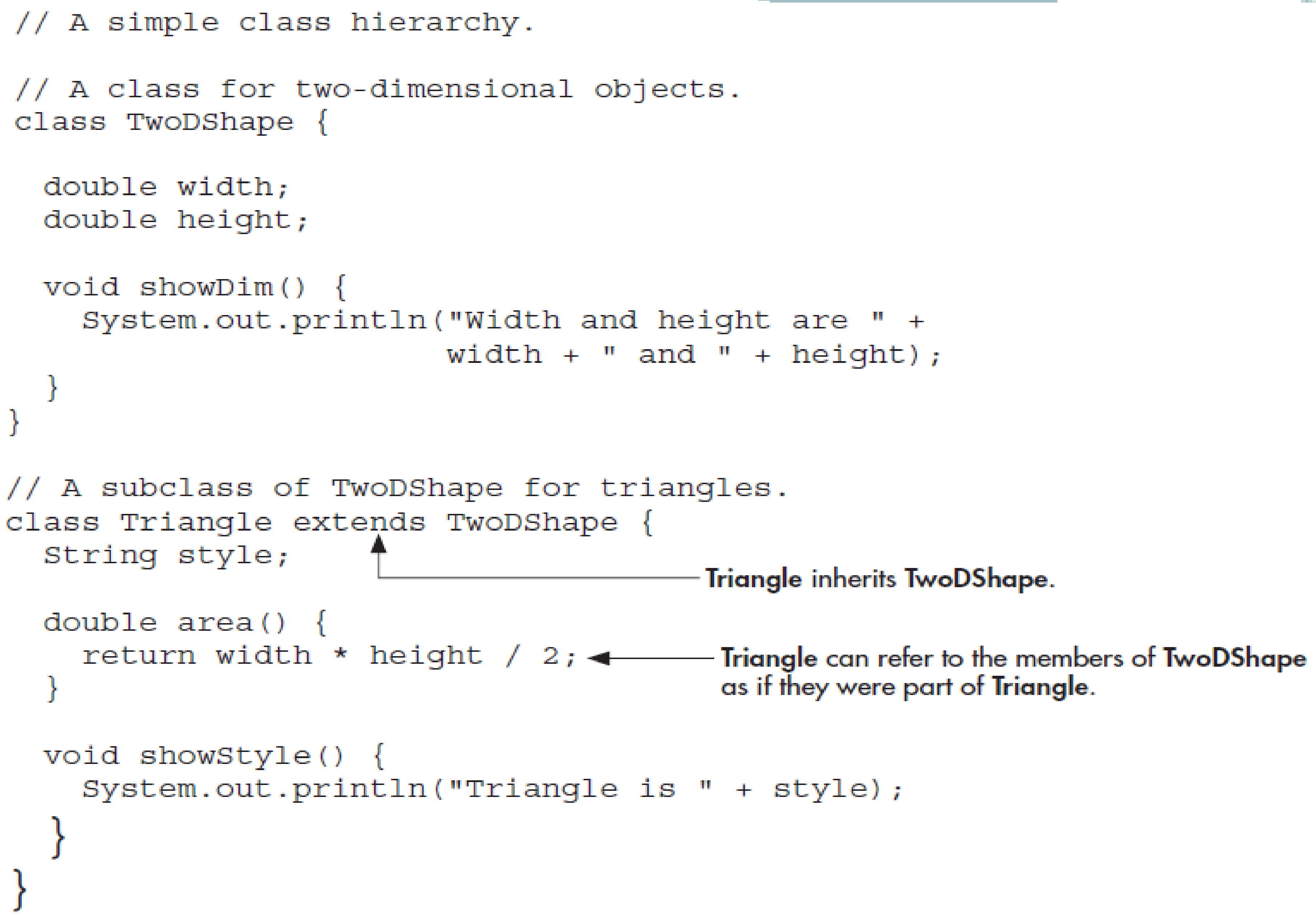
Inheritance

Inheritance

- **Inheritance** allows the creation of hierarchical classifications.
- Using inheritance, you can create a **general class** that defines traits common to a set of related items. This class can then be inherited by other, **more specific classes**, each adding those things that are unique to it.
- In the language of Java, a class that is inherited is called a ***superclass***. The class that does the inheriting is called a ***subclass***.

- A subclass is a specialized version of a superclass. It inherits all the variables and methods defined by the superclass and adds its own, unique elements.
- A class (a "subclass") can inherit all the methods and variables of another class (a "superclass").
- Use the keyword **extends**.
- General form:

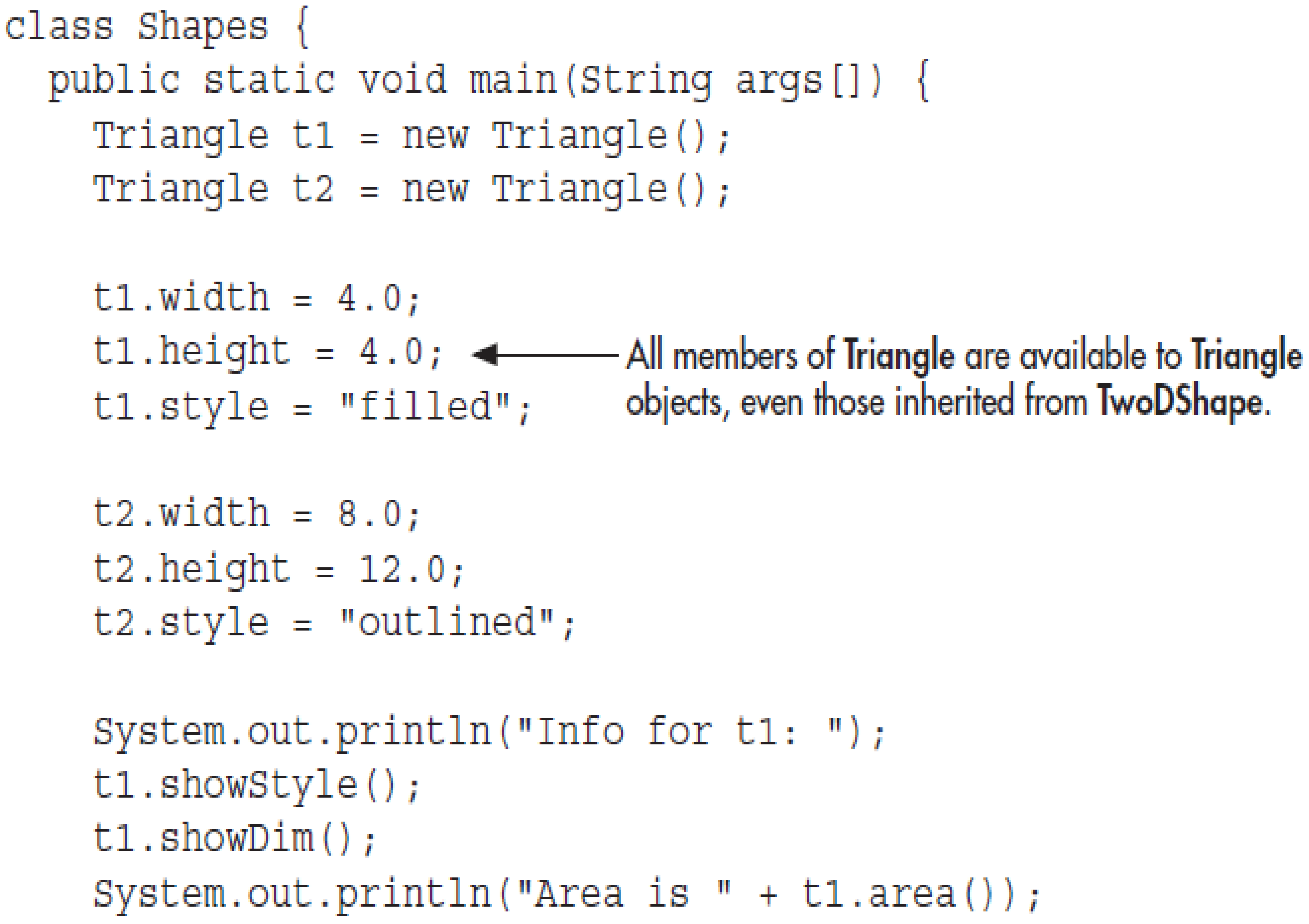
  class *subclass* extends *superclass* { … }
- The subclass extends the superclass by adding behavior and data to the behavior and data provided by the superclass.



```
// A simple class hierarchy.

// A class for two-dimensional objects.
class TwoDShape {

  double width;
  double height;

  void showDim() {
    System.out.println("Width and height are " +
                       width + " and " + height);
  }
}

// A subclass of TwoDShape for triangles.
class Triangle extends TwoDShape {
  String style;

  double area() {
    return width * height / 2;
  }

  void showStyle() {
    System.out.println("Triangle is " + style);
  }
}
```

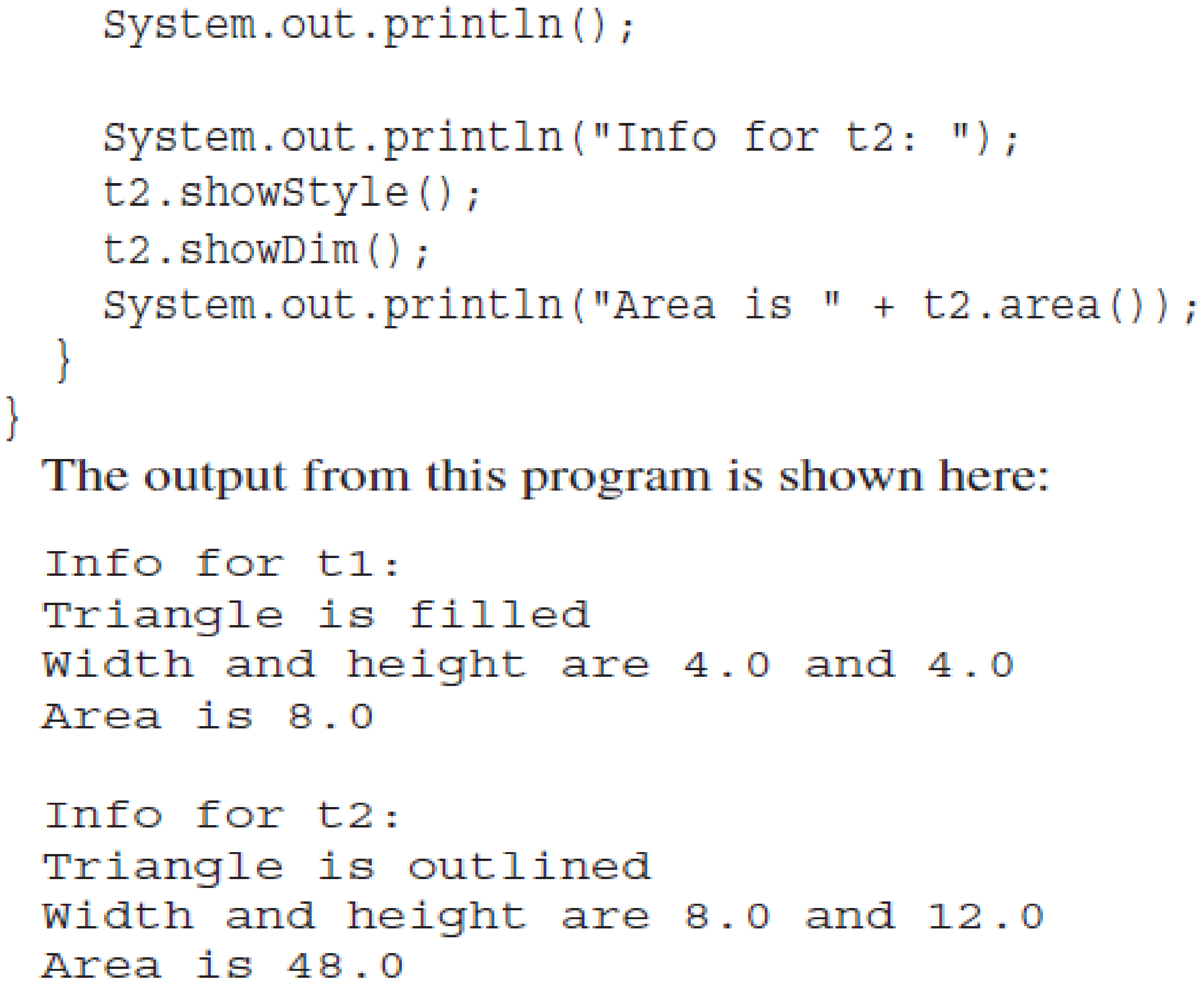
Triangle inherits **TwoDShape**.

Triangle can refer to the members of **TwoDShape** as if they were part of **Triangle**.



```
class Shapes {
  public static void main(String args[]) {
    Triangle t1 = new Triangle();
    Triangle t2 = new Triangle();

    t1.width = 4.0;
    t1.height = 4.0;
    t1.style = "filled";

    t2.width = 8.0;
    t2.height = 12.0;
    t2.style = "outlined";

    System.out.println("Info for t1: ");
    t1.showStyle();
    t1.showDim();
    System.out.println("Area is " + t1.area());
```

All members of **Triangle** are available to **Triangle** objects, even those inherited from **TwoDShape**.



```
    System.out.println();

    System.out.println("Info for t2: ");
    t2.showStyle();
    t2.showDim();
    System.out.println("Area is " + t2.area());
  }
}
```

The output from this program is shown here:

```
Info for t1:
Triangle is filled
Width and height are 4.0 and 4.0
Area is 8.0

Info for t2:
Triangle is outlined
Width and height are 8.0 and 12.0
Area is 48.0
```

Even though **TwoDShape** is a superclass for **Triangle**, it is also a completely independent, stand-alone class. Being a superclass for a subclass does not mean that the superclass cannot be used by itself. For example, the following is perfectly valid:

```
TwoDShape shape = new TwoDShape();

shape.width = 10;
shape.height = 20;

shape.showDim();
```

Of course, an object of **TwoDShape** has no knowledge of or access to any subclasses of **TwoDShape**.

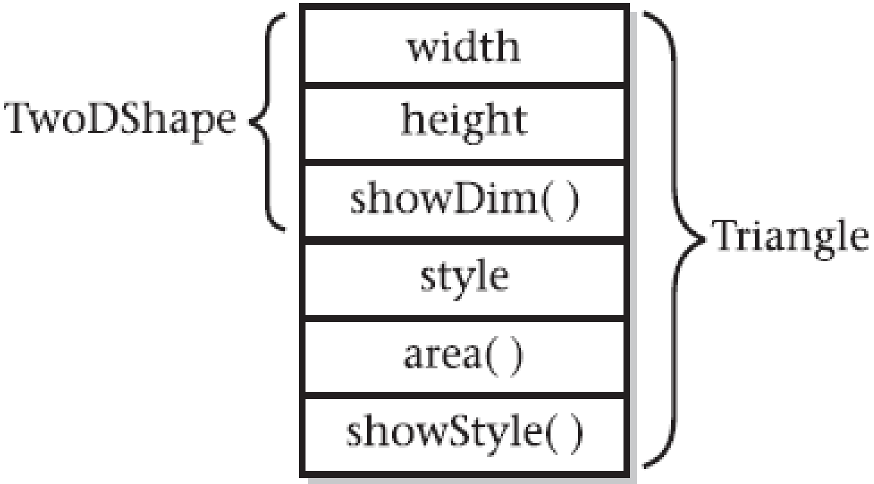


Figure 7-1 A conceptual depiction of the **Triangle** class

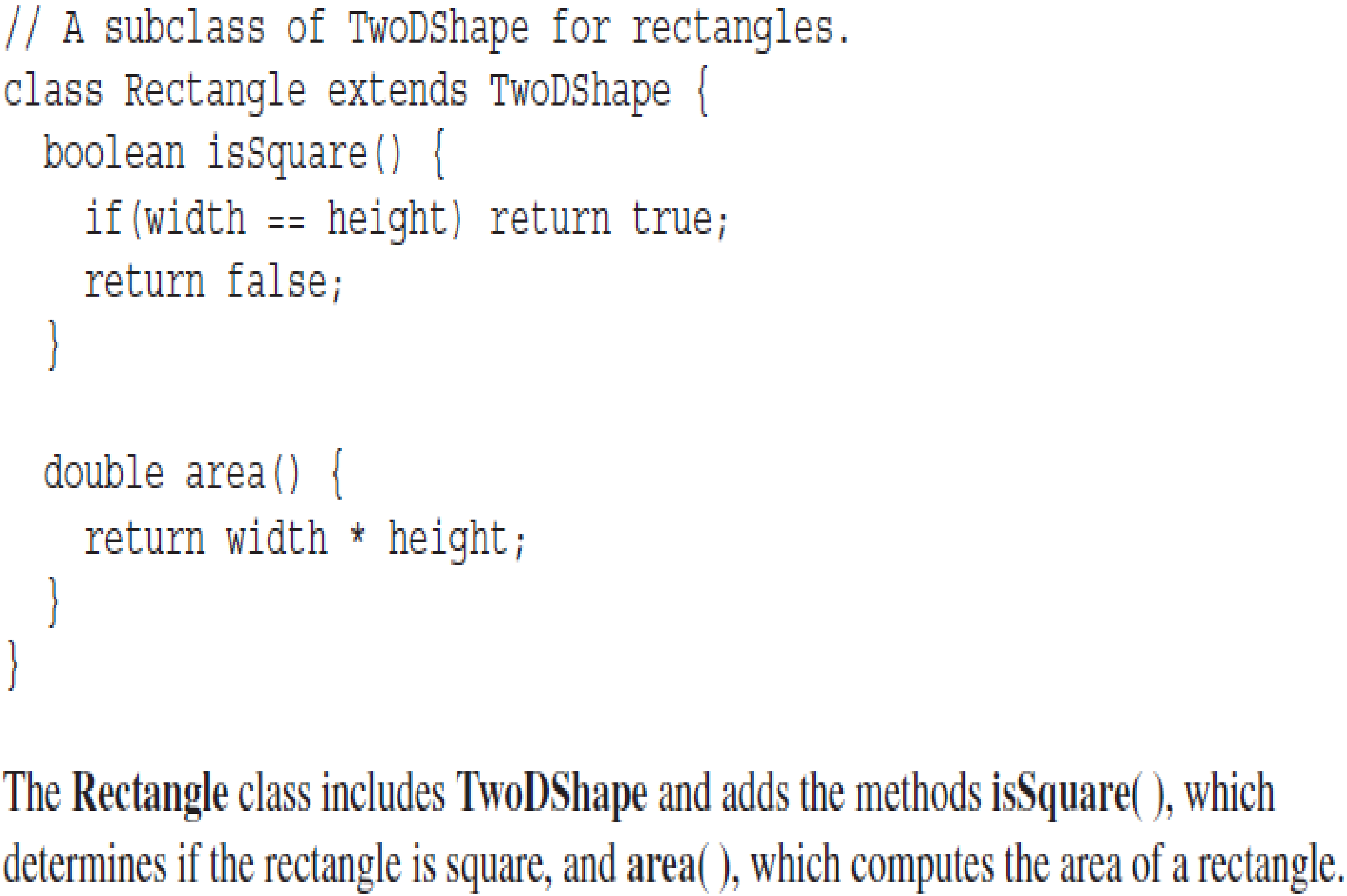
Another Example

```
class OneDimPoint {
  int x = 3;
  int getX() { return x; }
}
class TwoDimPoint extends OneDimPoint {
  int y = 4;
  int getY() { return y; }
}
class TestInherit {
  public static void main(String[] args) {
    TwoDimPoint pt = new twoDimPoint();
    System.out.println(pt.getX() + "," + pt.getY());
  }
}
```

Properties of Inheritance

- A subclass cannot access the private members of its superclass.
- Each class can have at most one superclass, but each superclass can have many subclasses.
- A subclass constructor can call a superclass constructor by use of **super( )**, before doing anything else.
- If you do not call a superclass constructor, the no-argument constructor is automatically called.

- Java does not support the inheritance of multiple superclasses into a single subclass
- You can create a hierarchy of inheritance in which a subclass becomes a superclass of another subclass
- A major advantage of inheritance is that once you have created a superclass that defines the attributes common to a set of objects, it can be used to create any number of more specific subclasses
- Each subclass can precisely tailor its own classification



```
// A subclass of TwoDShape for rectangles.
class Rectangle extends TwoDShape {
  boolean isSquare() {
    if(width == height) return true;
    return false;
  }

  double area() {
    return width * height;
  }
}
```

The **Rectangle** class includes **TwoDShape** and adds the methods **isSquare( )**, which determines if the rectangle is square, and **area( )**, which computes the area of a rectangle.

Member Access and Inheritance

- An instance variable of a class will be declared **private** to prevent its unauthorized use.
- Inheriting a class *does not* overrule the **private** access restriction.
- Thus, even though a subclass includes all of the members of its superclass, it cannot access those members of the superclass that have been declared **private**.
- For example, if, as shown here, **width** and **height** are made private in **TwoDShape**, then **Triangle** will not be able to access them:

```
// Private members are not inherited.    This example will not compile.
// A class for two-dimensional objects.
class TwoDShape {
     private double width;       // these are
     private double height;      // now private
     void showDim() {
             System.out.println("Width and height are " +
                                                   width + " and " + height);
      }
 }
// A subclass of TwoDShape for triangles.
class Triangle extends TwoDShape {
     String style;
     double area() {
             return width * height / 2;         // Error! can't access
       }                  // Can’t access a private member of a superclass.
     void showStyle() {
             System.out.println("Triangle is " + style);
      }
}
```

```
// Use accessor methods to set and get private members.
// A class for two-dimensional objects.
class TwoDShape {
     private double width;      // these are
     private double height; // now private
    // Accessor methods for width and height.
    double getWidth() { return width; }
    double getHeight() { return height; }
    void setWidth(double w) { width = w; }
    void setHeight(double h) { height = h; }
    void showDim() {
       System.out.println("Width and height are " +width + " and " + height);
     }
  }
// A subclass of TwoDShape for triangles.
class Triangle extends TwoDShape {
     String style;
     double area()   {   return getWidth() * getHeight() / 2;  }
    void showStyle() {  System.out.println("Triangle is " + style)  }
 }
```

```
class Shapes2 {
    public static void main(String args[]) {
        Triangle t1 = new Triangle();

        t1.setWidth(4.0);
        t1.setHeight(4.0);
        t1.style = "filled";

        System.out.println("Info for t1: ");
        t1.showStyle();
        t1.showDim();
        System.out.println("Area is " + t1.area());


   }
}
```

```
class Shapes2 {  //Two instances of Triangle
      public static void main(String args[]) {
            Triangle t1 = new Triangle();
            Triangle t2 = new Triangle();
            t1.setWidth(4.0);
            t1.setHeight(4.0);
            t1.style = "filled";
            t2.setWidth(8.0);
            t2.setHeight(12.0);
            t2.style = "outlined";
            System.out.println("Info for t1: ");
            t1.showStyle();
            t1.showDim();
            System.out.println("Area is " + t1.area());
            System.out.println();
            System.out.println("Info for t2: ");
            t2.showStyle();
             t2.showDim();
            System.out.println("Area is " + t2.area());
    }
}
```

Constructors and Inheritance

- It is possible for both superclasses and subclasses to have their own constructors.
- What constructor is responsible for building an object of the subclass—the one in the superclass, the one in the subclass, or both?
- The constructor for the superclass constructs the superclass portion of the object, and the constructor for the subclass constructs the subclass part.
- The superclass has no knowledge of or access to any element in a subclass. Thus, their construction must be separate.
- in practice, most classes will have explicit constructors.
- When only the subclass defines a constructor, it constructs the subclass object.
- The superclass portion of the object is constructed automatically using its default constructor.

```
// Add a constructor to Triangle.
// A class for two-dimensional objects.
class TwoDShape {
    private double width;      // these are
    private double height;     // now private
    // Accessor methods for width and  height.
    double getWidth() { return width; }
    double getHeight() { return height; }
    void setWidth(double w) { width = w; }
    void setHeight(double h) { height = h; }
    void showDim() {
        System.out.println("Width and height are " +
                                          width + " and " + height);
     }
  }
// A subclass of TwoDShape for triangles.
class Triangle extends TwoDShape {
    private String style;
```

```
 // Constructor
Triangle(String s, double w, double h) {
           setWidth(w);
           setHeight(h);
           style = s;
       }
     double area() {
           return getWidth() * getHeight() / 2;
      }
    void showStyle() {
           System.out.println("Triangle is " + style);
     }
 }
class Shapes3 {
     public static void main(String args[]) {
           Triangle t1 = new Triangle("filled", 4.0, 4.0);
           System.out.println("Info for t1: ");
           t1.showStyle();
           t1.showDim();
           System.out.println("Area is " + t1.area());
```

```
          Triangle t2 = new Triangle("outlined", 8.0, 12.0);
          System.out.println();
          System.out.println("Info for t2: ");
          t2.showStyle();
          t2.showDim();
          System.out.println("Area is " + t2.area());
      } }
```

- When both the superclass and the subclass define constructors, both the superclass and subclass constructors must be executed.
- We must use Java’s keyword, **super**, which has **two general forms**.
- **The first** calls a superclass constructor.
- **The second** is used to access a member of the superclass that has been hidden by a member of a subclass.
- A subclass can call a constructor defined by its superclass by use of the following form of super:

```
super(parameter-list);
```

- Here, parameter-list specifies any parameters needed by the constructor in the superclass.
- super( ) must always be the first statement executed inside a subclass constructor.

```
// Add more constructors to TwoDShape.
class TwoDShape {
        private double width;
        private double height;
        // A default constructor.
        TwoDShape() {
                width = height = 0.0;
         }
         // Parameterized constructor.
        TwoDShape(double w, double h) {
                width = w;
                height = h;
          }
        // Construct object with equal width and height.
        TwoDShape(double x) {
                width = height = x;
          }
        // Accessor methods for width and height.
                double getWidth() { return width; }
                double getHeight() { return height; }
        void setWidth(double w) { width = w; }
        void setHeight(double h) { height = h; }
        void showDim() {
            System.out.println("Width and height are " + width + " and " + height);
        }
    }
    // A subclass of TwoDShape for triangles.
    class Triangle extends TwoDShape {
        private String style;
       // A default constructor.
       Triangle() {
               super();
               style = "none";
        }
        // Constructor
        Triangle(String s, double w, double h) {
               super(w, h); // call superclass constructor
               style = s;
         }
        // One argument constructor.
       Triangle(double x) {
               super(x); // call superclass constructor
```

```
style = "filled";
}
double area() {
return getWidth() * getHeight() / 2;
}
void showStyle() {
System.out.println("Triangle is " + style);
}
}
class Shapes5 {
public static void main(String args[]) {
Triangle t1 = new Triangle();
Triangle t2 = new Triangle("outlined", 8.0, 12.0);
Triangle t3 = new Triangle(4.0);
 t1=t2;
System.out.println("Info for t1: ");
t1.showStyle();
t1.showDim();
System.out.println("Area is " + t1.area());
System.out.println();
System.out.println("Info for t2: ");
t2.showStyle();
```

```
        t2.showDim();
        System.out.println("Area is " + t2.area());
        System.out.println();
        System.out.println("Info for t3: ");
        t3.showStyle();
        t3.showDim();
        System.out.println("Area is " + t3.area());
        }
    }
```

Here is the output from this version:

```
Info for t1:
Triangle is outlined
Width and height are 8.0 and 12.0
Area is 48.0
Info for t2:
Triangle is outlined
Width and height are 8.0 and 12.0
 Area is 48.0
 Info for t3:
 Triangle is filled
 Width and height are 4.0 and 4.0
 Area is 8.0
```

Using super to Access Superclass Members

- There is a **second form of super** that refers to the superclass of the subclass in which it is used. This usage has the following general form:

  super.member

- Here, member can be either a method or an instance variable.
- This is applicable to situations in which member names of a subclass hide members by the same name in the superclass.

```
// Using super to overcome name hiding.
class A {
        int i;
  }
// Create a subclass by extending class A.
class B extends A {
      int i; // this i hides the i in A
      B(int a, int b) {
            super.i = a; // i in A
            i = b; // i in B
         }
      void show() {
            System.out.println("i in superclass: " + super.i);
            System.out.println("i in subclass: " + i);
        }
}
```

```
class UseSuper {
    public static void main(String args[]) {
          B subOb = new B(1, 2);
          subOb.show();
     }
}
```

This program displays the following:

```
i in superclass: 1
i in subclass: 2
```

Creating a Multilevel Hierarchy

- You can build hierarchies that contain as many layers of inheritance as you like.
- It is perfectly acceptable to use a subclass as a superclass of another.
- Given three classes called A, B, and C, C can be a subclass of B, which is a subclass of A. C inherits all aspects of B and A.

- In the following, the subclass Triangle is used as a superclass to create the subclass called ColorTriangle.
- ColorTriangle inherits all of the traits of Triangle and TwoDShape and adds a field called color, which holds the color of the triangle.

```
// A multilevel hierarchy.
class TwoDShape {
        private double width;
        private double height;
        // A default constructor.
        TwoDShape() {
             width = height = 0.0;
          }
        // Parameterized constructor.
       TwoDShape(double w, double h) {
             width = w;
             height = h;
        }
        // Construct object with equal width and height.
        TwoDShape(double x) {
             width = height = x;
         }
       // Accessor methods for width and height.
       double getWidth() { return width; }
       double getHeight() { return height; }
```

```
        void setWidth(double w) { width = w; }
        void setHeight(double h) { height = h; }
        void showDim() {
             System.out.println("Width and height are " +
                                                                width + " and " + height);
         }
  }
// Extend TwoDShape.
class Triangle extends TwoDShape {
         private String style;
         // A default constructor.
        Triangle() {
             super();
             style = "none";
         }
       Triangle(String s, double w, double h) {
             super(w, h); // call superclass constructor
             style = s;
        }
       // One argument constructor.
```

```
Triangle(double x) {
super(x); // call superclass constructor
style = "filled";
}
double area() {
return getWidth() * getHeight() / 2;
}
void showStyle() {
System.out.println("Triangle is " + style);
}
}
// Extend Triangle.
class ColorTriangle extends Triangle {
private String color;
ColorTriangle(String c, String s,
double w, double h) {
super(s, w, h);
color = c;
}
```

```
    String getColor() { return color; }
    void showColor() {
        System.out.println("Color is " + color);
    }
}
class Shapes6 {
    public static void main(String args[]) {
        ColorTriangle t1 =
        new ColorTriangle("Blue", "outlined", 8.0, 12.0);
        ColorTriangle t2 =
        new ColorTriangle("Red", "filled", 2.0, 2.0);
        System.out.println("Info for t1: ");
        t1.showStyle();
        t1.showDim();
        t1.showColor();
        System.out.println("Area is " + t1.area());
        System.out.println();
        System.out.println("Info for t2: ");
        t2.showStyle();
        t2.showDim();
        t2.showColor();
        System.out.println("Area is " + t2.area());
    }
}
```

The output of this program is shown here:

```
Info for t1:
Triangle is outlined
Width and height are 8.0 and 12.0
Color is Blue
Area is 48.0
Info for t2:
Triangle is filled
Width and height are 2.0 and 2.0
Color is Red
Area is 2.0
```

In a class hierarchy, constructors complete their execution in order of derivation, from superclass to subclass. Since super( ) must be the first statement executed in a subclass' constructor, this order is the same whether or not super( ) is used.

when constructors are executed?

```
// Create a super class.
class A {
        A() {
                System.out.println("Constructing A.");
        }
}
// Create a subclass by extending class A.
class B extends A {
         B() {
                System.out.println("Constructing B.");
         }
}
// Create another subclass by extending B.
class C extends B {
          C() {
                System.out.println("Constructing C.");
          }
}
```

```
class OrderOfConstruction {
public static void main(String args[]) {
C c = new C();
}
}
```

The output from this program is shown here:

```
Constructing A.
Constructing B.
Constructing C.
```

Superclass References and Subclass Objects

- A reference variable for one class type cannot normally refer to an object of another class type.

Superclass References and Subclass Objects

- A reference variable for one class type cannot normally refer to an object of another class type.
- A reference variable of a superclass can be assigned a reference to an object of any subclass derived from that superclass.

```
// A superclass reference can refer to a subclass object.
class X {
int a;
X(int i) { a = i; }
}
class Y extends X {
        int b;
        Y(int i, int j) {
             super(j);
             b = i;
         }
}
```

```
class SupSubRef {
    public static void main(String args[]) {
        X x = new X(10);
        X x2;
        Y y = new Y(5, 6);

        x2 = x;             // OK, both of same type
        System.out.println("x2.a: " + x2.a);

        x2 = y;            // still Ok because Y is derived from X
        System.out.println("x2.a: " + x2.a);

        // X references know only about X members
        x2.a = 19;       // OK
        // x2.b = 27;    // Error, X doesn't have a b member
    }
}
```

```
class TwoDShape {    // a superclass reference can refer to a subclass object
      private double width;
      private double height;
      // Construct an object from an object.
      TwoDShape(TwoDShape ob) {   //TwoDShape reference is pointing to
              width = ob.width;                // Triangle class object
              height = ob.height;
       }
// A subclass of TwoDShape for triangles.
class Triangle extends TwoDShape {
       private String style;
       // Construct an object from an object.
       Triangle(Triangle ob) {
              super(ob);              // pass object to TwoDShape constructor
              style = ob.style;
         }     }
class Shapes7 {
       public static void main(String args[]) {
              Triangle t1 =  new Triangle("outlined", 8.0, 12.0);
              // make a copy of t1
              Triangle t2 = new Triangle(t1);
        }   }
```

Progress Check

- Can a subclass be used as a superclass for another superclass?
- In a class hierarchy, in what order are the constructors executed?
- Given that Jet extends Airplane, can an Airplance reference refer to a Jet Object?

Method Overriding

- In a class hierarchy, when a method in a subclass has the same return type and signature as a method in its superclass, then the method in the subclass is said to override the method in the superclass.
- When an overridden method is called from within a subclass, it will always refer to the version of that method defined by the subclass.
- The version of the method defined by the superclass will be hidden.
- If the signatures of the two methods are not identical then the two methods are simply overloaded.

```
// Method overriding.
class A {
    int i, j;
    A(int a, int b) {
        i = a;
        j = b;
    }
    // display i and j
    void show() {
        System.out.println("i and j: " + i + " " + j);
    }
}
```

```
class B extends A {
       int k;
       B(int a, int b, int c) {
             super(a, b);
             k = c;
        }
      void show() {          // display k – this overrides show() in A
             System.out.println(“overridden : " + k);
        }
       void show(String msg) {        // overload show()
             System.out.println(msg + k);  //since signature is different
        }
 }
class Override {
        public static void main(String args[]) {
             B subOb = new B(1, 2, 3);
             subOb.show();      // this calls overridden show() in B
             subOb.show(“overload: ”);     // this calls  overloaded show
         }
  }     //The output produced by this program is shown here:       overridden: 3
         overloaded : 3
```

Overridden Methods Support Polymorphism

- *Dynamic method dispatch* is the mechanism by which a call to an overridden method is resolved at run time rather than compile time.
- Through Dynamic method dispatch, Java implements run-time polymorphism.
- A superclass reference variable can refer to a subclass object.
- Java uses this fact to resolve calls to overridden methods at run time.
- When an overridden method is called through a superclass reference, Java determines which version of that method to execute based upon the type of the object being referred to at the time the call occurs.
- When different types of objects are referred to, different versions of an overridden method will be called.
- It is the type of the object being referred to (not the type of the reference variable) that determines which version of an overridden method will be executed.
- If a superclass contains a method that is overridden by a subclass, then when different types of objects are referred to through a superclass reference variable, different versions of the method are executed.

```
// Demonstrate dynamic method dispatch.
class Sup {
     void who() {
        System.out.println("who() in Sup");
      }
}
class Sub1 extends Sup {
    void who() {
       System.out.println("who() in Sub1");
     }
}
class Sub2 extends Sup {
     void who() {
        System.out.println("who() in Sub2");
     }
}
class DynDispDemo {
     public static void main(String args[]) {
          Sup superOb = new Sup();
          Sub1 subOb1 = new Sub1();
          Sub2 subOb2 = new Sub2();
          Sup supRef;
          supRef = superOb;
          supRef.who();
          supRef = subOb1;
          supRef.who();
          supRef = subOb2;
          supRef.who();
     }
}
```

The output from the program is shown here:

```
who() in Sup
who() in Sub1
who() in Sub2
```

In each case, the version of **who( )** to call is determined at run time by the type of object being referred to.

Why Overridden Methods?

- Overridden methods allow Java to support run-time polymorphism.
- Polymorphism allows a general class to specify methods that will be common to all of its derivatives, while allowing subclasses to define the specific implementation of some or all of those methods.
- Overridden methods allow Java implements the “one interface, multiple methods” aspect of polymorphism.
- The superclasses and subclasses form a hierarchy that moves from lesser to greater specialization.
- The superclass provides all elements that a subclass can use directly.
- It also defines those methods that the derived class must implement on its own.
- By combining inheritance with overridden methods, a superclass can define the general form of the methods that will be used by all of its subclasses.

Progress Check

- What is method overriding?
- Why is method overriding is important?
- When an overridden method is called through a superclass reference, which version of method is executed

Abstract Classes

- Sometimes you want a class that is only partially implemented and you want to leave it to the subclasses to complete the implementation.
- In that case, use an *abstract* class with *abstract* methods.
- To declare a class or method as abstract, just add the keyword **abstract** in front of the class or method declaration.
- In the case of an abstract method, you must also leave off the body of the method.

Abstract Classes

- An abstract class must be declared with an abstract keyword.
- It can have abstract and non-abstract methods.
- It cannot be instantiated.
- It can have constructors and static methods also.
- It can have final methods which will force the subclass not to change the body of the method.

Example of an Abstract Class

```
abstract class Super {
  int x;

  int getX() { return x; }

  abstract void setX(int newX); // no body
}

class Sub extends Super {

  void setX(int newX) { x = newX; }
}
```

Progress Check

- What is an abstract method? How is one created?
- When must a class be declared abstract?
- Can an object of abstract class can be instantiated?

The Keyword final

- If you do not want a class to be subclassed, precede the class declaration with the keyword **final**.
- If you do not want a method to be overridden by a subclass, precede the method declaration with the keyword **final**.
- If you want a variable to be read-only (that is, a constant), precede it with the keyword **final**.

Example Using final

```
//class final, prevents inheritancee
final class MyClass {
  //variable final, read only
  final int x = 3;
  public static final double PI = 3.14159;
  //method final, can not be overridden
  final double getPI() { return PI; }
}
```

Progress Check

- How do you prevent a method being overriding?
- If a class is declared as final, can it be inherited?

The Object Class

- Java defines a special class called **Object** that is an **implicit superclass** of all other classes.
- Therefore, all classes inherit the methods in the **Object** class.
- A variable of type **Object** can refer to an object of any other class, including an array.

Some Methods in the **Object** Class

Method	**Purpose**
Object clone( )	Creates a copy of this object
boolean equals(Object *obj*)	Tests whether two objects are equal
void finalize( )	Called before recycling the object
Class<?> getClass( )	Returns the class of the object
int hashCode( )	Returns the hash code of the object
void notify( )	Resumes execution of a thread waiting on the object
void notifyAll( )	Resumes execution of all threads waiting on the object
String toString( )	Returns a string describing the object
void wait( )	Waits on another thread of execution

Which of the following statements is correct?

a. An object of a super class can access any of the members of its subclass
b. An object of a sub class can access any of the members of its superclass
c. An object of a super class can access only data members of its subclass
d. An object of a super class can access only data members of its subclass

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Which of the following statements is correct?

a. A superclass specifies specialization and a subclass specifies generalization
b. A subclass specifies specialization and a superclass specifies generalization
c. A superclass specifies containership and a subclass specifies generalization
d. A subclass specifies containership and a superclass specifies generalization

Which of the following statements is correct?

a. A superclass specifies specialization and a subclass specifies generalization

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a. pass the parameters to super class constructor
b. Refer to the hidden member of the super class
c. Both a and b above are true
d. None of the above

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Which of the following is a superclass of every class in Java?

a) ArrayList
b) Abstract class
c) Object class
d) String

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‘final’ can be used to

a. Prevent a method from being overridden
b. Create named constants
c. Prevent a class being inherited
d. All the above

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a. Prevent a method from being overridden
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```java
class A
{
public int i;
private int j;
}
class B extends A
{
void display()
{
super.j = super.i + 1;
System.out.println(super.i + " " + super.j);
}
}
class inheritance
{
public static void main(String args[])
{
B obj = new B();
obj.i=1;
obj.j=2;
obj.display();
}
}
```

- Compilation Error

Class contains a private member variable j, this cannot be inherited by subclass B and does not have access to it.

```
class A
{
public int i;
protected int j;
}
class B extends A
{
int j;
void display()
{
super.j = 3;
System.out.println(i + " " + j);
}
}
class Output
{
public static void main(String args[])
{
B obj = new B();
obj.i=1;
obj.j=2;
obj.display();
}
}
```

- 1 2

Both class A & B have member with same name that is j, member of class B will be called by default if no specifier is used. I contains 1 & j contains 2, printing 1 2.

```java
final class A
{
int i;
}
class B extends A
{
int j;
System.out.println(j + " " + i);
}
class inheritance
{
public static void main(String args[])
{
B obj = new B();
obj.display();
}
}
```

- Compilation Error

class A has been declared final hence it cannot be inherited by any other class. Hence class B does not have member i, giving compilation error.