BIRZEIT UNIVERSITY

COMPUTER SCIENCE DEPARTMENT FACULTY OF ENGINEERING AND TECHNOLOGY

ADVANCED PROGRAMMING COMP231

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Inheritance 2

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Overriding Methods

*To **override** a method,*

*the method must be **defined in the subclass***

*using the **same signature** and the **same return type** as in its **superclass.***

```
class Cat{

public void Sound(){
System.out.println("meow");
  }
}
class Lion extends Cat{
public  void sniff(){
   System.out.println("sniff");
  }
public void Sound(){
     System.out.println("roar");
  }
}
```



```
// Method Overriding Example

//Base class
class Parent {
   public void display() {
      System.out.println("parent method is executed");
   }
}

//Derived or Inherited class
class Child extends Parent {

   //Below method overrides the Parent display() method
   @Override
   public void display() {
      System.out.println("child method is executed");
   }
}



//Driver class
public class Main {
   public static void main(String args[])
   {
      // If a Parent type reference refers
      // to a Parent object, then Parent's
      // display() is called
      Parent parentObject = new Parent();
      parentObject.display();

      // If a Parent type reference refers
      // to a Child object Child's display()
      // is called. This is called RUN TIME
      // POLYMORPHISM.
      Parent childObject = new Child();
      childObject.display();
   }
}
```

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■ An **instance** method **can be** overridden only if it is **accessible**.

Thus a **private method cannot** be overridden, because it is not accessible outside its own class. If a method defined in a subclass is private in its superclass, the two methods are completely unrelated.

■ Like an instance method, a **static method can be inherited**. However, a static method **cannot be overridden**. If a static method defined in the superclass is redefined in a subclass, the method defined in the superclass is hidden. The hidden static methods can be invoked using the syntax **SuperClassName.staticMethodName**.

11.7 True or false? You can override a private method defined in a superclass. **11.8** True or false? You can override a static method defined in a superclass. **11.9** How do you explicitly invoke a superclass's constructor from a subclass? **11.10** How do you invoke an overridden superclass method from a subclass?	

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11.5 Overriding vs. Overloading

*Overloading means to define **multiple methods with the same name** but different signatures.*

*Overriding means to provide a **new implementation** for a method in the subclass.*

```
public class Test {
  public static void main(String[] args) {
    A a = new A();
    a.p(10);
    a.p(10.0);
  }
}

class B {
  public void p(double i) {
    System.out.println(i * 2);
  }
}

class A extends B {
  // This method overrides the method in B
  public void p(double i) {
    System.out.println(i);
  }
}
```

(a)

```
public class Test {
  public static void main(String[] args) {
    A a = new A();
    a.p(10);
    a.p(10.0);
  }
}

class B {
  public void p(double i) {
    System.out.println(i * 2);
  }
}

class A extends B {
  // This method overloads the method in B
  public void p(int i) {
    System.out.println(i);
  }
}
```

(b)

To avoid mistakes, you can use a special Java syntax, called *override annotation*, to place

@Override before the method in the subclass. For example:

```
public class CircleFromSimpleGeometricObject extends
SimpleGeometricObject {
// Other methods are omitted

@Override
public String toString() {
return super.toString() + "\nradius is " + radius;
}
}
```

This annotation denotes that the annotated method is required to override a method in the superclass. **If a method with this annotation does not override its superclass's method**, the

compiler will report an error. For example, if **toString** is mistyped as **tostring**, a compile error is reported. If the override annotation isn't used, the compile won't report an error. Using annotation avoids mistakes.	

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11.11 Identify the problems in the following code:

```
public class Circle {
private double radius;

public Circle(double radius) {
radius = radius;
}

public double getRadius() {
return radius;
 }

 public double getArea() {
 return radius * radius * Math.PI;
 }
 }

 class B extends Circle {
 private double length;

 B(double radius, double length) {
 Circle(radius);
 length = length;
 }

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

11.12 Explain the difference between method overloading and method overriding.

11.13 If a method in a subclass has the **same signature** as a method in its superclass with the same **return type**, is the method overridden or overloaded?

11.14 If a method in a subclass has the **same signature** as a method in its superclass with a **different return type**, will this be a problem?

11.15 If a method in a subclass has the **same name** as a method in its superclass with **different parameter types**, is the method overridden or overloaded?

11.16 What is the benefit of using the @Override annotation?

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The `Object` Class and Its `toString()` Method

Every class in Java is descended from the **java.lang.Object** *class.*

If **no inheritance is specified** when a class is defined,

the superclass of the class is Object by default.

For example, the following two class definitions are the same:

```
public class ClassName {
  ...
}
```

Equivalent

```
public class ClassName extends Object {
  ...
}
```

There are some methods provided by the **Object**

This section introduces the **toString** method in the **Object** class.

The signature of the **toString()** method is:
public String toString()

Invoking **toString()** on an object **returns a string that describes the object**.

By default, it returns a string consisting of a **class name** of which the object is an instance, an at sign **(@),**
and the **object's memory address in hexadecimal**.

For example, consider the following code

```
Loan loan = new Loan();
System.out.println(loan.toString());
```

The output for this code displays something like **Loan@15037e5**.

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This message is not very helpful or informative. **Usually you should override** the **toString** method so that it returns a descriptive string representation of the object.

For example, the **toString** method in the **Object** class was overridden in the **GeometricObject** class in lines 46–49 in Listing 11.1 as follows:

```
public String toString() {
return "created on " + dateCreated + "\ncolor: "
+ color +
" and filled: " + filled;
}
```

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Polymorphism

*Polymorphism means that a variable of a supertype can **refer** to a subtype object.*

The three pillars of object-oriented programming are **encapsulation**, **inheritance**, and **polymorphism**.

You have already learned the first two. This section introduces polymorphism.

The definition of "Polymorphism" is hidden in its name itself. **"Poly" means "many" and "morphs" means "forms".**

Thus "Polymorphism" may be considered as a concept in Java in which an entity(object), variable or function may present in one or many forms.

You can say that **Circle** is a subtype of **GeometricObject** and **GeometricObject** is a supertype for **Circle**.

The inheritance relationship **enables** a subclass to inherit features from its superclass with additional new features.

A subclass is a specialization of its superclass; every instance of a subclass is also an instance of its superclass, but not vice versa.

For example, every circle is a geometric object, but not every geometric object is a circle.

Therefore, you can always **pass** an instance of a subclass to a parameter of its **superclass type**. Consider the code in

LISTING 11.5 PolymorphismDemo.java

```
1  public class PolymorphismDemo {
2    /** Main method */
3    public static void main(String[] args) {
4      // Display circle and rectangle properties
5      displayObject(new CircleFromSimpleGeometricObject
6              (1, "red", false));
7      displayObject(new RectangleFromSimpleGeometricObject
8              (1, 1, "black", true));
9    }
10
11   /** Display geometric object properties */
12   public static void displayObject(SimpleGeometricObject object) {
13     System.out.println("Created on " + object.getDateCreated() +
14       ". Color is " + object.getColor());
15   }
16 }
```

polymorphic call

polymorphic call

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The method **displayObject** (line 12) takes a parameter of the **GeometricObject** type. You can invoke **displayObject** by **passing any instance of GeometricObject** (e.g., **new CircleFromSimpleGeometricObject(1, "red", false)** and **new Rectangle-FromSimpleGeometricObject(1, 1, "black", false)** in lines 5–8). An object of a **subclass** can be used **wherever** its **superclass** object is used. This is commonly known as *polymorphism*	

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11.8 Dynamic Binding

A method can be implemented in several classes along the inheritance chain.

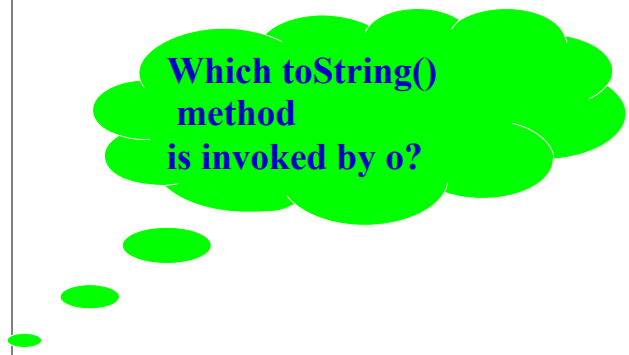
The JVM decides which method is invoked at runtime.

A method can be defined in a superclass and **overridden** in its subclass.

For example, the **toString()** method is defined in the **Object** class and overridden in **GeometricObject**.

Consider the following code:

```
Object o = new GeometricObject();
System.out.println(o.toString());
```



To answer this question, we first introduce two terms: **declared type** and **actual type**.

A variable must be declared a type.

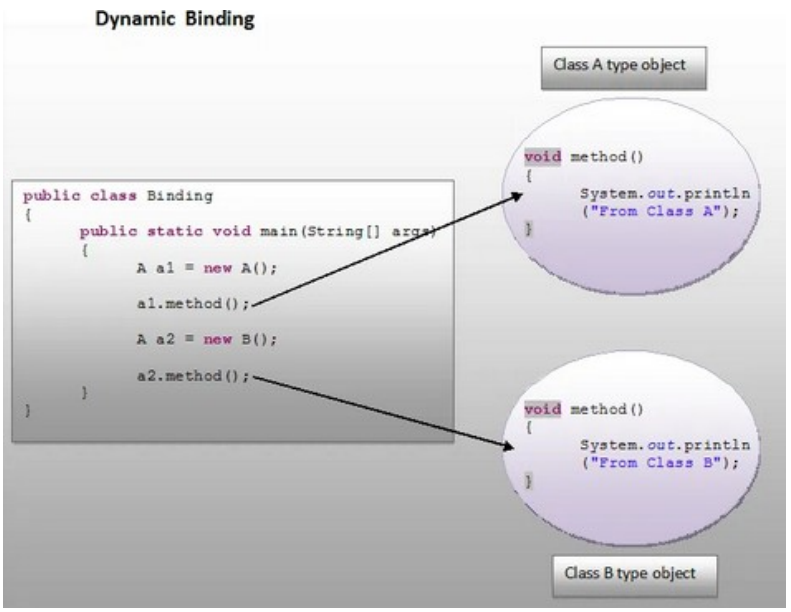
Here **o**'s **declared** type is **Object**.

Here **o**'s **actual type** is **GeometricObject**,

because **o** references an object created using **new GeometricObject()**.

Which **toString()** method is invoked by **o** is determined by **o**'s actual type.

This is known as dynamic binding.



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11.19 Can you assign **new int[50]**, **new Integer[50]**, **new String[50]**, or **new Object[50]**, into a variable of **Object[]** type?

11.20 What is wrong in the following code**?**

```
public class Test {
public static void main(String[] args) {
Integer[] list1 = {12, 24, 55, 1};
Double[] list2 = {12.4, 24.0, 55.2, 1.0};
int[] list3 = {1, 2, 3};
printArray(list1);
printArray(list2);
printArray(list3);
}

public static void printArray(Object[] list) {
for (Object o: list)
    System.out.print(o + " ");
System.out.println();
}
}
```

11.21 Show the output of the following code:

```
public class Test {
  public static void main(String[] args) {
    new Person().printPerson();
    new Student().printPerson();
  }
}

class Student extends Person {
  @Override
  public String getInfo() {
    return "Student";
  }
}

class Person {
  public String getInfo() {
    return "Person";
  }

  public void printPerson() {
    System.out.println(getInfo());
  }
}
```

(a)

```
public class Test {
  public static void main(String[] args) {
    new Person().printPerson();
    new Student().printPerson();
  }
}

class Student extends Person {
  private String getInfo() {
    return "Student";
  }
}

class Person {
  private String getInfo() {
    return "Person";
  }

  public void printPerson() {
    System.out.println(getInfo());
  }
}
```

(b)

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