

Java - Inheritance

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The class which inherits the properties of other is known as subclass (derived class, child class) and the class whose properties are inherited is known as superclass (base class, parent class).

extends Keyword

extends is the keyword used to inherit the properties of a class. Below given is the syntax of extends keyword.

```
class Super{  
    ....  
    ....  
}  
  
class Sub extends Super{  
    ....  
    ....  
}
```

Sample Code

Below given is an example demonstrating Java inheritance. In this example you can observe two classes namely Calculation and My_Calculation.

Using extends keyword the My_Calculation inherits the methods addition() and Subtraction() of Calculation class.

Copy and paste the program given below in a file with name My_Calculation.java

```
class Calculation{
    int z;
    public void addition(int x, int y){
        z=x+y;
        System.out.println("The sum of the given numbers:"+z);
    }
    public void Substraction(int x,int y){
        z=x-y;
        System.out.println("The difference between the given numbers:"+z);
    }
}

public class My_Calculation extends Calculation{

    public void multiplication(int x, int y){
        z=x*y;
        System.out.println("The product of the given numbers:"+z);
    }
    public static void main(String args[]){
        int a=20, b=10;
        My_Calculation demo = new My_Calculation();
        demo.addition(a, b);
        demo.Substraction(a, b);
        demo.multiplication(a, b);

    }
}
```

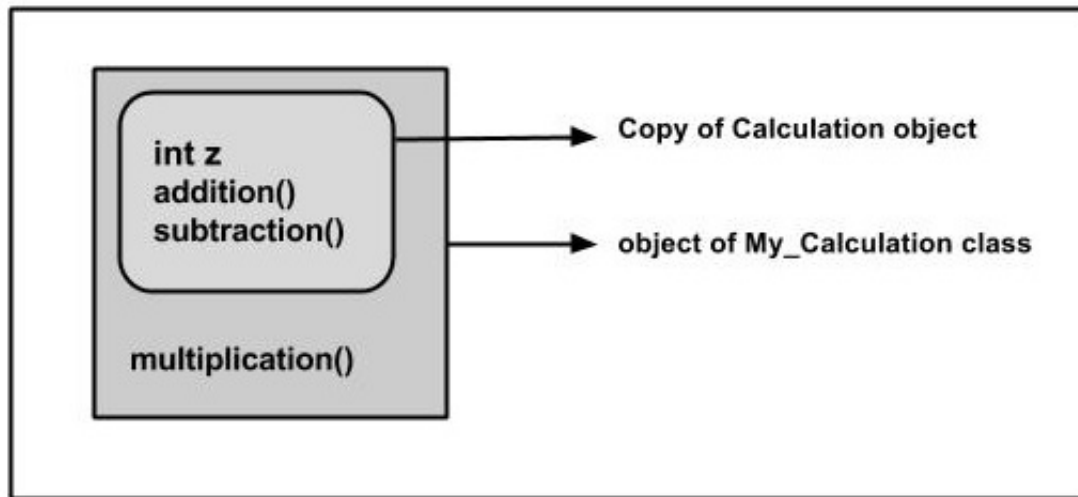
Compile and execute the above code as shown below

```
javac My_Calculation.java
java My_Calculation
```

After executing the program it will produce the following result.

```
The sum of the given numbers:30
The difference between the given numbers:10
The product of the given numbers:200
```

In the given program when an object to **My_Calculation** class is created, a copy of the contents of the super class is made with in it. That is why, using the object of the subclass you can access the members of a super class.



The Superclass reference variable can hold the subclass object, but using that variable you can access only the members of the superclass, so to access the members of both classes it is recommended to always create reference variable to the subclass.

If you consider the above program you can instantiate the class as given below as well. But using the superclass reference variable (**cal** in this case) you cannot call the method **multiplication()**, which belongs to the subclass **My_Calculation**.

```
Calculation cal=new My_Calculation();
demo.addition(a, b);
demo.Subtraction(a, b);
```

Note: A subclass inherits all the members (fields, methods, and nested classes) from its superclass. Constructors are not members, so they are not inherited by subclasses, but the constructor of the superclass can be invoked from the subclass.

The super keyword

The **super** keyword is similar to **this** keyword following are the scenarios where the super keyword is used.

It is used to **differentiate the members** of superclass from the members of subclass, if they have same names.

It is used to **invoke the superclass** constructor from subclass.

Differentiating the members

If a class is inheriting the properties of another class. And if the members of the superclass have the names same as the sub class, to differentiate these variables we use super keyword as shown below.

```
super.variable  
super.method();
```

Sample Code

This section provides you a program that demonstrates the usage of the **super** keyword.

In the given program you have two classes namely *Sub_class* and *Super_class*, both have a method named `display()` with different implementations, and a variable named `num` with different values. We are invoking `display()` method of both classes and printing the value of the variable `num` of both classes, here you can observe that we have used `super` key word to differentiate the members of super class from sub class.

Copy and paste the program in a file with name `Sub_class.java`.

```
class Super_class{  
  
    int num=20;  
  
    //display method of superclass  
    public void display(){  
        System.out.println("This is the display method of superclass");  
    }  
}  
  
public class Sub_class extends Super_class {  
  
    int num=10;  
  
    //display method of sub class  
    public void display(){  
        System.out.println("This is the display method of subclass");  
    }  
  
    public void my_method(){  
  
        //Instantiating subclass  
        Sub_class sub=new Sub_class();  
  
        //Invoking the display() method of sub class  
        sub.display();  
  
        //Invoking the display() method of superclass  
        super.display();  
  
        //printing the value of variable num of subclass  
        System.out.println("value of the variable named num in sub class:"+ sub.num);  
  
        //printing the value of variable num of superclass  
        System.out.println("value of the variable named num in super class:"+ super.num);  
    }  
}
```

```
public static void main(String args[]){  
    Sub_class obj = new Sub_class();  
    obj.my_method();  
}  
}
```

Compile and execute the above code using the following syntax.

```
javac Super_Demo  
java Super
```

On executing the program you will get the following result:

```
This is the display method of subclass  
This is the display method of superclass  
value of the variable named num in sub class:10  
value of the variable named num in super class:20
```

Invoking Superclass constructor

If a class is inheriting the properties of another class, the subclass automatically acquires the default constructor of the super class. But if you want to call a parametrized constructor of the super class, you need to use the super keyword as shown below.

```
super(values);
```

Sample Code

The program given in this section demonstrates how to use the super keyword to invoke the parametrized constructor of the superclass. This program contains a super class and a sub class, where the super class contains a parametrized constructor which accepts a string value, and we used the super keyword to invoke the parametrized constructor of the super class.

Copy and paste the below given program in a file with name Subclass.java

```
class Superclass{  
  
    int age;  
  
    Superclass(int age){  
        this.age=age;  
    }  
  
    public void getAge(){  
        System.out.println("The value of the variable named age in super class is: " +age);  
    }  
}
```

```
}

public class Subclass extends Superclass {

    Subclass(int age){
        super(age);
    }

    public static void main(String argd[]){
        Subclass s= new Subclass(24);
        s.getAge();
    }

}
```

Compile and execute the above code using the following syntax.

```
javac Subclass
java Subclass
```

On executing the program you will get the following result:

```
The value of the variable named age in super class is: 24
```

IS-A Relationship:

IS-A is a way of saying : This object is a type of that object. Let us see how the **extends** keyword is used to achieve inheritance.

```
public class Animal{
}

public class Mammal extends Animal{
}

public class Reptile extends Animal{
}

public class Dog extends Mammal{
}
```

Now, based on the above example, In Object Oriented terms, the following are true:

Animal is the superclass of Mammal class.

Animal is the superclass of Reptile class.

Mammal and Reptile are subclasses of Animal class.

Dog is the subclass of both Mammal and Animal classes.

Now, if we consider the IS-A relationship, we can say:

Mammal IS-A Animal

Reptile IS-A Animal

Dog IS-A Mammal

Hence : Dog IS-A Animal as well

With use of the extends keyword the subclasses will be able to inherit all the properties of the superclass except for the private properties of the superclass.

We can assure that Mammal is actually an Animal with the use of the instance operator.

Example

```
class Animal{  
}  
  
class Mammal extends Animal{  
}  
  
class Reptile extends Animal{  
}  
  
public class Dog extends Mammal{  
  
    public static void main(String args[]){  
  
        Animal a = new Animal();  
        Mammal m = new Mammal();  
        Dog d = new Dog();  
  
        System.out.println(m instanceof Animal);  
        System.out.println(d instanceof Mammal);  
        System.out.println(d instanceof Animal);  
    }  
}
```

This would produce the following result:

```
true  
true  
true
```

Since we have a good understanding of the **extends** keyword let us look into how the **implements** keyword is used to get the IS-A relationship.

The **implements** keyword is used by classes by inherit from interfaces. Interfaces can never be extended by the classes.

Example

```
public interface Animal {  
}  
  
public class Mammal implements Animal{  
}  
  
public class Dog extends Mammal{  
}
```

The instanceof Keyword

Let us use the **instanceof** operator to check determine whether Mammal is actually an Animal, and dog is actually an Animal

```
interface Animal{  
  
}  
  
class Mammal implements Animal{  
  
}  
  
public class Dog extends Mammal{  
    public static void main(String args[]){  
  
        Mammal m = new Mammal();  
        Dog d = new Dog();  
  
        System.out.println(m instanceof Animal);  
        System.out.println(d instanceof Mammal);  
        System.out.println(d instanceof Animal);  
    }  
}
```

This would produce the following result:

```
true  
true  
true
```

HAS-A relationship

These relationships are mainly based on the usage. This determines whether a certain class **HAS-A** certain thing. This relationship helps to reduce duplication of code as well as bugs.

Lets us look into an example:

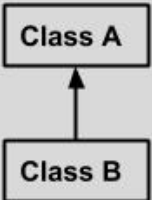
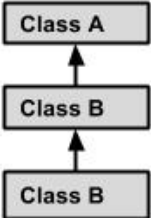
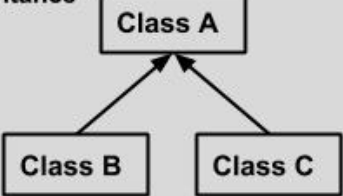
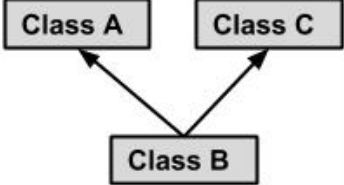

```
public class Vehicle{}
public class Speed{}
public class Van extends Vehicle{
    private Speed sp;
}
```

This shows that class Van HAS-A Speed. By having a separate class for Speed, we do not have to put the entire code that belongs to speed inside the Van class., which makes it possible to reuse the Speed class in multiple applications.

In Object-Oriented feature, the users do not need to bother about which object is doing the real work. To achieve this, the Van class hides the implementation details from the users of the Van class. So basically what happens is the users would ask the Van class to do a certain action and the Van class will either do the work by itself or ask another class to perform the action.

Types of inheritance

There are various types of inheritance as demonstrated below.

Single Inheritance  <pre> graph BT B[Class B] --> A[Class A] </pre>	<pre> public class A { } public class B extends A { } </pre>
Multi Level Inheritance  <pre> graph BT B2[Class B] --> B1[Class B] B1 --> A[Class A] </pre>	<pre> public class A {} public class B extends A {.....} public class C extends B {.....} </pre>
Hierarchical Inheritance  <pre> graph BT B[Class B] --> A[Class A] C[Class C] --> A </pre>	<pre> public class A {} public class B extends A {.....} public class C extends A {.....} </pre>
Multiple Inheritance  <pre> graph BT B[Class B] --> A[Class A] B --> C[Class C] </pre>	<pre> public class A {} public class B {.....} public class C extends A,B { } // Java does not support mutiple Inheritance </pre>

A very important fact to remember is that Java does not support multiple inheritance. This means

that a class cannot extend more than one class. Therefore following is illegal:

```
public class extends Animal, Mammal{}
```

However, a class can implement one or more interfaces. This has made Java get rid of the impossibility of multiple inheritance.

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