# Polymorphism in Java

**Polymorphism in Java** is a concept by which we can perform a single action in different ways. Polymorphism is derived from 2 Greek words: poly and morphs. The word "poly" means many and "morphs" means forms. So polymorphism means many forms.

There are two types of polymorphism in Java: compile-time polymorphism and runtime polymorphism. We can perform polymorphism in java by method overloading and method overriding.

Method Overloading in Java

If a class has multiple methods having same name but different in parameters, it is known as **Method Overloading**.

If we have to perform only one operation, having same name of the methods increases the readability of the program.

Suppose you have to perform addition of the given numbers but there can be any number of arguments, if you write the method such as a(int,int) for two parameters, and b(int,int,int) for three parameters then it may be difficult for you as well as other programmers to understand the behavior of the method because its name differs.

So, we perform method overloading to figure out the program quickly.

Advantage of method overloading

Method overloading *increases the readability of the program*.

Different ways to overload the method

There are two ways to overload the method in java

1. By changing number of arguments
2. By changing the data type

In java, Method Overloading is not possible by changing the return type of the method only.

1) Method Overloading: changing no. of arguments

In this example, we have created two methods, first add() method performs addition of two numbers and second add method performs addition of three numbers.

In this example, we are creating static methods so that we don't need to create instance for calling methods.

1. **class** Adder{
2. **static** **int** add(**int** a,**int** b){**return** a+b;}
3. **static** **int** add(**int** a,**int** b,**int** c){**return** a+b+c;}
4. }
5. **class** TestOverloading1{
6. **public** **static** **void** main(String[] args){
7. System.out.println(Adder.add(11,11));
8. System.out.println(Adder.add(11,11,11));
9. }}

Output:

22

33

2) Method Overloading: changing data type of arguments

In this example, we have created two methods that differs in data type. The first add method receives two integer arguments and second add method receives two double arguments.

1. **class** Adder{
2. **static** **int** add(**int** a, **int** b){**return** a+b;}
3. **static** **double** add(**double** a, **double** b){**return** a+b;}
4. }
5. **class** TestOverloading2{
6. **public** **static** **void** main(String[] args){
7. System.out.println(Adder.add(11,11));
8. System.out.println(Adder.add(12.3,12.6));
9. }}

Output:

22

24.9

Q) Why Method Overloading is not possible by changing the return type of method only?

In java, method overloading is not possible by changing the return type of the method only because of ambiguity. Let's see how ambiguity may occur:

1. **class** Adder{
2. **static** **int** add(**int** a,**int** b){**return** a+b;}
3. **static** **double** add(**int** a,**int** b){**return** a+b;}
4. }
5. **class** TestOverloading3{
6. **public** **static** **void** main(String[] args){
7. System.out.println(Adder.add(11,11));//ambiguity
8. }}

Output:

Compile Time Error: method add(int,int) is already defined in class Adder

System.out.println(Adder.add(11,11)); //Here, how can java determine which sum() method should be called?

Note: Compile Time Error is better than Run Time Error. So, java compiler renders compiler time error if you declare the same method having same parameters.

Can we overload java main() method?

Yes, by method overloading. You can have any number of main methods in a class by method overloading. But JVM calls main() method which receives string array as arguments only. Let's see the simple example:

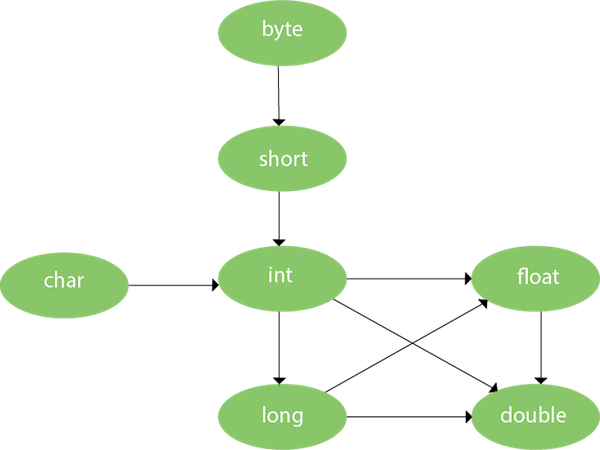
1. **class** TestOverloading4{
2. **public** **static** **void** main(String[] args){System.out.println("main with String[]");}
3. **public** **static** **void** main(String args){System.out.println("main with String");}
4. **public** **static** **void** main(){System.out.println("main without args");}
5. }

Output:

main with String[]

Method Overloading and Type Promotion

One type is promoted to another implicitly if no matching datatype is found. Let's understand the concept by the figure given below:



As displayed in the above diagram, byte can be promoted to short, int, long, float or double. The short datatype can be promoted to int,long,float or double. The char datatype can be promoted to int,long,float or double and so on.

Example of Method Overloading with TypePromotion

1. **class** OverloadingCalculation1{
2. **void** sum(**int** a,**long** b){System.out.println(a+b);}
3. **void** sum(**int** a,**int** b,**int** c){System.out.println(a+b+c);}
5. **public** **static** **void** main(String args[]){
6. OverloadingCalculation1 obj=**new** OverloadingCalculation1();
7. obj.sum(20,20);//now second int literal will be promoted to long
8. obj.sum(20,20,20);
10. }
11. }

Output:40

60

Example of Method Overloading with Type Promotion if matching found

If there are matching type arguments in the method, type promotion is not performed.

1. **class** OverloadingCalculation2{
2. **void** sum(**int** a,**int** b){System.out.println("int arg method invoked");}
3. **void** sum(**long** a,**long** b){System.out.println("long arg method invoked");}
5. **public** **static** **void** main(String args[]){
6. OverloadingCalculation2 obj=**new** OverloadingCalculation2();
7. obj.sum(20,20);//now int arg sum() method gets invoked
8. }
9. }

Output:int arg method invoked

Example of Method Overloading with Type Promotion in case of ambiguity

If there are no matching type arguments in the method, and each method promotes similar number of arguments, there will be ambiguity.

1. **class** OverloadingCalculation3{
2. **void** sum(**int** a,**long** b){System.out.println("a method invoked");}
3. **void** sum(**long** a,**int** b){System.out.println("b method invoked");}
5. **public** **static** **void** main(String args[]){
6. OverloadingCalculation3 obj=**new** OverloadingCalculation3();
7. obj.sum(20,20);//now ambiguity
8. }
9. }

Output:Compile Time Error

One type is not de-promoted implicitly for example double cannot be depromoted to any type implicitly.

Method Overriding in Java

If subclass (child class) has the same method as declared in the parent class, it is known as **method overriding in Java**.

In other words, If a subclass provides the specific implementation of the method that has been declared by one of its parent class, it is known as method overriding.

Usage of Java Method Overriding

* Method overriding is used to provide the specific implementation of a method which is already provided by its superclass.
* Method overriding is used for runtime polymorphism

Rules for Java Method Overriding

1. The method must have the same name as in the parent class
2. The method must have the same parameter as in the parent class.
3. There must be an IS-A relationship (inheritance).

Understanding the problem without method overriding

Let's understand the problem that we may face in the program if we don't use method overriding.

1. //Java Program to demonstrate why we need method overriding
2. //Here, we are calling the method of parent class with child
3. //class object.
4. //Creating a parent class
5. **class** Vehicle{
6. **void** run(){System.out.println("Vehicle is running");}
7. }
8. //Creating a child class
9. **class** Bike **extends** Vehicle{
10. **public** **static** **void** main(String args[]){
11. //creating an instance of child class
12. Bike obj = **new** Bike();
13. //calling the method with child class instance
14. obj.run();
15. }
16. }

Output:

Vehicle is running

Problem is that I have to provide a specific implementation of run() method in subclass that is why we use method overriding.

Example of method overriding

In this example, we have defined the run method in the subclass as defined in the parent class but it has some specific implementation. The name and parameter of the method are the same, and there is IS-A relationship between the classes, so there is method overriding.

1. //Java Program to illustrate the use of Java Method Overriding
2. //Creating a parent class.
3. **class** Vehicle{
4. //defining a method
5. **void** run(){System.out.println("Vehicle is running");}
6. }
7. //Creating a child class
8. **class** Bike2 **extends** Vehicle{
9. //defining the same method as in the parent class
10. **void** run(){System.out.println("Bike is running safely");}
12. **public** **static** **void** main(String args[]){
13. Bike2 obj = **new** Bike2();//creating object
14. obj.run();//calling method
15. }
16. }

Output:

Bike is running safely

A real example of Java Method Overriding

Consider a scenario where Bank is a class that provides functionality to get the rate of interest. However, the rate of interest varies according to banks. For example, SBI, ICICI and AXIS banks could provide 8%, 7%, and 9% rate of interest.



Java method overriding is mostly used in Runtime Polymorphism which we will learn in next pages.

1. //Java Program to demonstrate the real scenario of Java Method Overriding
2. //where three classes are overriding the method of a parent class.
3. //Creating a parent class.
4. **class** Bank{
5. **int** getRateOfInterest(){**return** 0;}
6. }
7. //Creating child classes.
8. **class** SBI **extends** Bank{
9. **int** getRateOfInterest(){**return** 8;}
10. }
12. **class** ICICI **extends** Bank{
13. **int** getRateOfInterest(){**return** 7;}
14. }
15. **class** AXIS **extends** Bank{
16. **int** getRateOfInterest(){**return** 9;}
17. }
18. //Test class to create objects and call the methods
19. **class** Test2{
20. **public** **static** **void** main(String args[]){
21. SBI s=**new** SBI();
22. ICICI i=**new** ICICI();
23. AXIS a=**new** AXIS();
24. System.out.println("SBI Rate of Interest: "+s.getRateOfInterest());
25. System.out.println("ICICI Rate of Interest: "+i.getRateOfInterest());
26. System.out.println("AXIS Rate of Interest: "+a.getRateOfInterest());
27. }
28. }

Output:

SBI Rate of Interest: 8

ICICI Rate of Interest: 7

AXIS Rate of Interest: 9

Can we override static method?

No, a static method cannot be overridden. It can be proved by runtime polymorphism, so we will learn it later.

Why can we not override static method?

It is because the static method is bound with class whereas instance method is bound with an object. Static belongs to the class area, and an instance belongs to the heap area.

Can we override java main method?

No, because the main is a static method.

Understanding all java access modifiers

Let's understand the access modifiers by a simple table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Access Modifier** | **within class** | **within package** | **outside package by subclass only** | **outside package** | |
| **Private** | Y | N | N | N |
| **Default** | Y | Y | N | N |
| **Protected** | Y | Y | Y | N |
| **Public** | Y | Y | Y | Y |

Java access modifiers with method overriding

If you are overriding any method, overridden method (i.e. declared in subclass) must not be more restrictive.

1. **class** A{
2. **protected** **void** msg(){System.out.println("Hello java");}
3. }
5. **public** **class** Simple **extends** A{
6. **void** msg(){System.out.println("Hello java");}//C.T.Error
7. **public** **static** **void** main(String args[]){
8. Simple obj=**new** Simple();
9. obj.msg();
10. }
11. }

|  |
| --- |
| The default modifier is more restrictive than protected. That is why there is compile time error. |
| Difference between method overloading and method overriding in java  There are many differences between method overloading and method overriding in java. A list of differences between method overloading and method overriding are given below:   |  |  |  |  | | --- | --- | --- | --- | | **No.** | | **Method Overloading** | **Method Overriding** | | 1) | Method overloading is used to increase  the readability of the program. | | Method overriding is used to provide the specific  implementation of the method that is already  provided by its super class. | | 2) | Method overloading is performed within class. | | Method overriding occurs in two classes that  have IS-A (inheritance) relationship. | | 3) | In case of method overloading, parameter  must be different. | | In case of method overriding, parameter must be  same. | | 4) | Method overloading is the example of compile  time polymorphism. | | Method overriding is the example of run time  polymorphism. | | 5) | In java, method overloading can't be performed by  changing return type of the method only. Return type  can be same or different in method overloading.  But you must have to change the parameter. | | Return type must be same or covariant in method  overriding. | |

Covariant Return Type

The covariant return type specifies that the return type may vary in the same direction as the subclass.

Before Java5, it was not possible to override any method by changing the return type. But now, since Java5, it is possible to override method by changing the return type if subclass overrides any method whose return type is Non-Primitive but it changes its return type to subclass type. Let's take a simple example:

Note: If you are beginner to java, skip this topic and return to it after OOPs concepts.

Simple example of Covariant Return Type

1. **class** A{
2. A get(){**return** **this**;}
3. }
5. **class** B1 **extends** A{
6. B1 get(){**return** **this**;}
7. **void** message(){System.out.println("welcome to covariant return type");}
9. **public** **static** **void** main(String args[]){
10. **new** B1().get().message();
11. }
12. }

Output:welcome to covariant return type

As you can see in the above example, the return type of the get() method of A class is A but the return type of the get() method of B class is B. Both methods have different return type but it is method overriding. This is known as covariant return type.

How is Covariant return types implemented?

Java doesn't allow the return type based overloading but JVM always allows return type based overloading. JVM uses full signature of a method for lookup/resolution. Full signature means it includes return type in addition to argument types. i.e., a class can have two or more methods differing only by return type. javac uses this fact to implement covariant return types.

Runtime Polymorphism in Java

**Runtime polymorphism** or **Dynamic Method Dispatch** is a process in which a call to an overridden method is resolved at runtime rather than compile-time.

In this process, an overridden method is called through the reference variable of a superclass. The determination of the method to be called is based on the object being referred to by the reference variable.

Let's first understand the upcasting before Runtime Polymorphism.

Upcasting

If the reference variable of Parent class refers to the object of Child class, it is known as upcasting. For example:



1. **class** A{}
2. **class** B **extends** A{}
3. A a=**new** B();//upcasting

For upcasting, we can use the reference variable of class type or an interface type. For Example:

1. **interface** I{}
2. **class** A{}
3. **class** B **extends** A **implements** I{}

Here, the relationship of B class would be:

B IS-A A

B IS-A I

B IS-A Object

Since Object is the root class of all classes in Java, so we can write B IS-A Object.

Example of Java Runtime Polymorphism

In this example, we are creating two classes Bike and Splendor. Splendor class extends Bike class and overrides its run() method. We are calling the run method by the reference variable of Parent class. Since it refers to the subclass object and subclass method overrides the Parent class method, the subclass method is invoked at runtime.

Since method invocation is determined by the JVM not compiler, it is known as runtime polymorphism.

1. **class** Bike{
2. **void** run(){System.out.println("running");}
3. }
4. **class** Splendor **extends** Bike{
5. **void** run(){System.out.println("running safely with 60km");}
7. **public** **static** **void** main(String args[]){
8. Bike b = **new** Splendor();//upcasting
9. b.run();
10. }
11. }

Output:

running safely with 60km.

Java Runtime Polymorphism Example: Bank

Consider a scenario where Bank is a class that provides a method to get the rate of interest. However, the rate of interest may differ according to banks. For example, SBI, ICICI, and AXIS banks are providing 8.4%, 7.3%, and 9.7% rate of interest.



Note: This example is also given in method overriding but there was no upcasting.

1. **class** Bank{
2. **float** getRateOfInterest(){**return** 0;}
3. }
4. **class** SBI **extends** Bank{
5. **float** getRateOfInterest(){**return** 8.4f;}
6. }
7. **class** ICICI **extends** Bank{
8. **float** getRateOfInterest(){**return** 7.3f;}
9. }
10. **class** AXIS **extends** Bank{
11. **float** getRateOfInterest(){**return** 9.7f;}
12. }
13. **class** TestPolymorphism{
14. **public** **static** **void** main(String args[]){
15. Bank b;
16. b=**new** SBI();
17. System.out.println("SBI Rate of Interest: "+b.getRateOfInterest());
18. b=**new** ICICI();
19. System.out.println("ICICI Rate of Interest: "+b.getRateOfInterest());
20. b=**new** AXIS();
21. System.out.println("AXIS Rate of Interest: "+b.getRateOfInterest());
22. }
23. }

Output:

SBI Rate of Interest: 8.4

ICICI Rate of Interest: 7.3

AXIS Rate of Interest: 9.7

Java Runtime Polymorphism Example: Shape

1. **class** Shape{
2. **void** draw(){System.out.println("drawing...");}
3. }
4. **class** Rectangle **extends** Shape{
5. **void** draw(){System.out.println("drawing rectangle...");}
6. }
7. **class** Circle **extends** Shape{
8. **void** draw(){System.out.println("drawing circle...");}
9. }
10. **class** Triangle **extends** Shape{
11. **void** draw(){System.out.println("drawing triangle...");}
12. }
13. **class** TestPolymorphism2{
14. **public** **static** **void** main(String args[]){
15. Shape s;
16. s=**new** Rectangle();
17. s.draw();
18. s=**new** Circle();
19. s.draw();
20. s=**new** Triangle();
21. s.draw();
22. }
23. }

Output:

drawing rectangle...

drawing circle...

drawing triangle...

Java Runtime Polymorphism Example: Animal

1. **class** Animal{
2. **void** eat(){System.out.println("eating...");}
3. }
4. **class** Dog **extends** Animal{
5. **void** eat(){System.out.println("eating bread...");}
6. }
7. **class** Cat **extends** Animal{
8. **void** eat(){System.out.println("eating rat...");}
9. }
10. **class** Lion **extends** Animal{
11. **void** eat(){System.out.println("eating meat...");}
12. }
13. **class** TestPolymorphism3{
14. **public** **static** **void** main(String[] args){
15. Animal a;
16. a=**new** Dog();
17. a.eat();
18. a=**new** Cat();
19. a.eat();
20. a=**new** Lion();
21. a.eat();
22. }}

Output:

eating bread...

eating rat...

eating meat...

Java Runtime Polymorphism with Data Member

A method is overridden, not the data members, so runtime polymorphism can't be achieved by data members.

In the example given below, both the classes have a data member speedlimit. We are accessing the data member by the reference variable of Parent class which refers to the subclass object. Since we are accessing the data member which is not overridden, hence it will access the data member of the Parent class always.

Rule: Runtime polymorphism can't be achieved by data members.

1. **class** Bike{
2. **int** speedlimit=90;
3. }
4. **class** Honda3 **extends** Bike{
5. **int** speedlimit=150;
7. **public** **static** **void** main(String args[]){
8. Bike obj=**new** Honda3();
9. System.out.println(obj.speedlimit);//90
10. }

Output:

90

Java Runtime Polymorphism with Multilevel Inheritance

Let's see the simple example of Runtime Polymorphism with multilevel inheritance.

1. **class** Animal{
2. **void** eat(){System.out.println("eating");}
3. }
4. **class** Dog **extends** Animal{
5. **void** eat(){System.out.println("eating fruits");}
6. }
7. **class** BabyDog **extends** Dog{
8. **void** eat(){System.out.println("drinking milk");}
9. **public** **static** **void** main(String args[]){
10. Animal a1,a2,a3;
11. a1=**new** Animal();
12. a2=**new** Dog();
13. a3=**new** BabyDog();
14. a1.eat();
15. a2.eat();
16. a3.eat();
17. }
18. }

Output:

eating

eating fruits

drinking Milk

Try for Output

1. **class** Animal{
2. **void** eat(){System.out.println("animal is eating...");}
3. }
4. **class** Dog **extends** Animal{
5. **void** eat(){System.out.println("dog is eating...");}
6. }
7. **class** BabyDog1 **extends** Dog{
8. **public** **static** **void** main(String args[]){
9. Animal a=**new** BabyDog1();
10. a.eat();
11. }}

Output:

Dog is eating

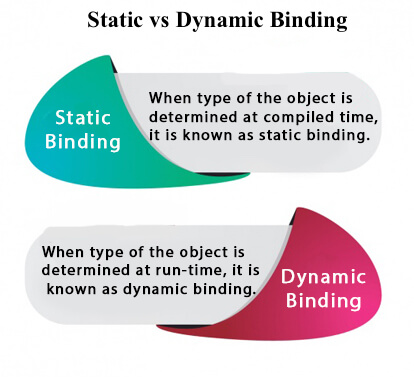
Since, BabyDog is not overriding the eat() method, so eat() method of Dog class is invoked.

Static Binding and Dynamic Binding

Connecting a method call to the method body is known as binding.

There are two types of binding

1. Static Binding (also known as Early Binding).
2. Dynamic Binding (also known as Late Binding).



Understanding Type

Let's understand the type of instance.

1) variables have a type

Each variable has a type, it may be primitive and non-primitive.

1. **int** data=30;

Here data variable is a type of int.

2) References have a type

1. **class** Dog{
2. **public** **static** **void** main(String args[]){
3. Dog d1;//Here d1 is a type of Dog
4. }
5. }

3) Objects have a type

|  |
| --- |
| An object is an instance of particular java class,but it is also an instance of its superclass. |

1. **class** Animal{}
3. **class** Dog **extends** Animal{
4. **public** **static** **void** main(String args[]){
5. Dog d1=**new** Dog();
6. }
7. }

|  |
| --- |
| Here d1 is an instance of Dog class, but it is also an instance of Animal. |

static binding

When type of the object is determined at compiled time(by the compiler), it is known as static binding.

If there is any private, final or static method in a class, there is static binding.

Example of static binding

1. **class** Dog{
2. **private** **void** eat(){System.out.println("dog is eating...");}
4. **public** **static** **void** main(String args[]){
5. Dog d1=**new** Dog();
6. d1.eat();
7. }
8. }

Dynamic binding

When type of the object is determined at run-time, it is known as dynamic binding.

Example of dynamic binding

1. **class** Animal{
2. **void** eat(){System.out.println("animal is eating...");}
3. }
5. **class** Dog **extends** Animal{
6. **void** eat(){System.out.println("dog is eating...");}
8. **public** **static** **void** main(String args[]){
9. Animal a=**new** Dog();
10. a.eat();
11. }
12. }

Output:dog is eating...

|  |
| --- |
| In the above example object type cannot be determined by the compiler, because the instance of Dog is also an instance of Animal.So compiler doesn't know its type, only its base type. |

Java instanceof

1. [java instanceof](https://www.javatpoint.com/downcasting-with-instanceof-operator#instanceof)
2. [Example of instanceof operator](https://www.javatpoint.com/downcasting-with-instanceof-operator#instanceofex)
3. [Applying the instanceof operator with a variable the have null value](https://www.javatpoint.com/downcasting-with-instanceof-operator#instanceofnull)
4. [Downcasting with instanceof operator](https://www.javatpoint.com/downcasting-with-instanceof-operator#instanceofdowncasting)
5. [Downcasting without instanceof operator](https://www.javatpoint.com/downcasting-with-instanceof-operator#instanceofdowncastingwithout)

The **java instanceof operator** is used to test whether the object is an instance of the specified type (class or subclass or interface).

The instanceof in java is also known as type *comparison operator* because it compares the instance with type. It returns either true or false. If we apply the instanceof operator with any variable that has null value, it returns false.

Simple example of java instanceof

Let's see the simple example of instance operator where it tests the current class.

1. **class** Simple1{
2. **public** **static** **void** main(String args[]){
3. Simple1 s=**new** Simple1();
4. System.out.println(s **instanceof** Simple1);//true
5. }
6. }Output:true

An object of subclass type is also a type of parent class. For example, if Dog extends Animal then object of Dog can be referred by either Dog or Animal class.

Another example of java instanceof operator

1. **class** Animal{}
2. **class** Dog1 **extends** Animal{//Dog inherits Animal
4. **public** **static** **void** main(String args[]){
5. Dog1 d=**new** Dog1();
6. System.out.println(d **instanceof** Animal);//true
7. }
8. }

Output:true

instanceof in java with a variable that have null value

If we apply instanceof operator with a variable that have null value, it returns false. Let's see the example given below where we apply instanceof operator with the variable that have null value.

1. **class** Dog2{
2. **public** **static** **void** main(String args[]){
3. Dog2 d=**null**;
4. System.out.println(d **instanceof** Dog2);//false
5. }
6. }

Output:false

Downcasting with java instanceof operator

When Subclass type refers to the object of Parent class, it is known as downcasting. If we perform it directly, compiler gives Compilation error. If you perform it by typecasting, ClassCastException is thrown at runtime. But if we use instanceof operator, downcasting is possible.

1. Dog d=**new** Animal();//Compilation error

If we perform downcasting by typecasting, ClassCastException is thrown at runtime.

1. Dog d=(Dog)**new** Animal();
2. //Compiles successfully but ClassCastException is thrown at runtime

Possibility of downcasting with instanceof

Let's see the example, where downcasting is possible by instanceof operator.

1. **class** Animal { }
3. **class** Dog3 **extends** Animal {
4. **static** **void** method(Animal a) {
5. **if**(a **instanceof** Dog3){
6. Dog3 d=(Dog3)a;//downcasting
7. System.out.println("ok downcasting performed");
8. }
9. }
11. **public** **static** **void** main (String [] args) {
12. Animal a=**new** Dog3();
13. Dog3.method(a);
14. }
16. }

Output:ok downcasting performed

Downcasting without the use of java instanceof

Downcasting can also be performed without the use of instanceof operator as displayed in the following example:

1. **class** Animal { }
2. **class** Dog4 **extends** Animal {
3. **static** **void** method(Animal a) {
4. Dog4 d=(Dog4)a;//downcasting
5. System.out.println("ok downcasting performed");
6. }
7. **public** **static** **void** main (String [] args) {
8. Animal a=**new** Dog4();
9. Dog4.method(a);
10. }
11. }

Output:ok downcasting performed

Let's take closer look at this, actual object that is referred by a, is an object of Dog class. So if we downcast it, it is fine. But what will happen if we write:

1. Animal a=**new** Animal();
2. Dog.method(a);
3. //Now ClassCastException but not in case of instanceof operator

Understanding Real use of instanceof in java

Let's see the real use of instanceof keyword by the example given below.

1. **interface** Printable{}
2. **class** A **implements** Printable{
3. **public** **void** a(){System.out.println("a method");}
4. }
5. **class** B **implements** Printable{
6. **public** **void** b(){System.out.println("b method");}
7. }
9. **class** Call{
10. **void** invoke(Printable p){//upcasting
11. **if**(p **instanceof** A){
12. A a=(A)p;//Downcasting
13. a.a();
14. }
15. **if**(p **instanceof** B){
16. B b=(B)p;//Downcasting
17. b.b();
18. }
20. }
21. }//end of Call class
23. **class** Test4{
24. **public** **static** **void** main(String args[]){
25. Printable p=**new** B();
26. Call c=**new** Call();
27. c.invoke(p);
28. }
29. }

Output: b method