Polymorphism in Java

**Polymorphism in java** is a concept by which we can perform a *single action by 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:

1. compile time polymorphism and
2. runtime polymorphism.

We can perform polymorphism in java by method overloading and method overriding.

If you overload static method in java, it is the example of compile time polymorphism. Here, we will focus on runtime polymorphism in java.

Runtime Polymorphism in Java

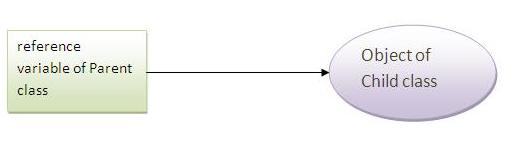
**Runtime polymorphism** or **Dynamic Method Dispatch** is a process in which a call to an overridden method is resolved at runtime rather than compile-time.

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

When 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

### Example of Java Runtime Polymorphism

In this example, we are creating two classes Bike and Splendar. Splendar 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, 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** Splender **extends** Bike{
5. **void** run(){System.out.println("running safely with 60km");}
7. **public** **static** **void** main(String args[]){
8. Bike b = **new** Splender();//upcasting
9. b.run();
10. }
11. }

Output:running safely with 60km.

## Java Runtime Polymorphism Example: Bank

Consider a scenario, Bank is a class that provides method to get the rate of interest. But, 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.

Java Runtime Polymorphism example of bank

#### 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

|  |
| --- |
| Method is overridden not the datamembers, so runtime polymorphism can't be achieved by data members. |
| In the example given below, both the classes have a datamember speedlimit, we are accessing the datamember by the reference variable of Parent class which refers to the subclass object. Since we are accessing the datamember which is not overridden, hence it will access the datamember of 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.