Polymorphism in java with example program pdf

Polymorphism in Java is one of the critical concepts you need to learn, to understand the Object-Oriented Programming Paradigm. Polymorphism in Java is the phenomenon by which an object can acquire an ability to operate from different perspectives. What is Polymorphism? According to chemistry, the term polymorphism means that an object can exist in different crystalline forms. For example, carbon can exist in three common types. Coal, graphite, and diamond are the three different crystalline forms of carbon. Similarly, in Java, Polymorphism is a phenomenon of an object that can exhibit a property of performing mathematical and logical operations from different perspectives. Example: package polymorphism; class AnimalSounds { public void Sound() { System.out.println("The animals make different sounds when asked to speak. For example:"); } } class Cow extends AnimalSounds { public void Sound() { System.out.println("The cow says: moh moh"); } } class cat extends AnimalSounds { public void Sound() { System.out.println("The cat says: mew mew"); } } class Dog extends AnimalSounds { public void Sound() { System.out.println("The dog says: bow wow"); } } public class AnimalMain { public static void main(String[] args) { AnimalSounds Animal = new AnimalSounds(); AnimalSounds cow = new Cow(); AnimalSounds cat = new cat(); AnimalSounds Dog = new Dog(); Animal.Sound(); cow.Sound(); cow.Sound(); Dog.Sound(); } } //Output: The animals make different sounds when asked to speak. For example: The cow says: moh moh The cow says: moh moh The dog says: bow wow Now that we have a better understanding of Polymorphism in Java, let us move ahead into the characteristics of Polymorphism in Java. Characteristics/Features of Polymorphism Following are the significant characteristics of Polymorphism in Java: The functionality of a method behaves differently in different scenarios. The behavior of a method depends on the data provided. It allows the same name for a member or method in a class with different types. Polymorphism supports implicit type conversion. Next, we will learn about the different types of Polymorphism in Java. Types of Polymorphism There are two different types of Polymorphism in Java. They are: Compile-Time Polymorphism Run-Time Polymorphism Compile-Time Polymorphism A typical Java program encounters Compile-Time Polymorphism during the compilation stage. Here, the overloading method resolution takes place in the compilation stage. There are two occurrences of Compile-Time Polymorphism, which are: Method Overloading Method Overloading is the process in which the class has two or more methods with the same name. Nevertheless, the implementation of a specific method occurs according to the number of parameters in the method call. Example: //Method Overloading. package polymorphism; public class Addition { public int add(int x, int y) { return (x + y); } public double add(double d, double e, double f, double g) { return (d + e + f + g); } public double add(double a, double b) { return (a + b); } public static void main(String args[]) { Addition a = new Addition(); System.out.println(a.add(25, 30)); System.out.println(a.add(10.0, 15.0, 20.0, 25.0)); System.out.println(a.add(127.5, 123.5)); } } //Output: 5555 70.070.0 251.0251.0 Operator Overloading Method Overloading is a process where a class has two or more methods with the same name. Still, the implementation of the specific method takes place according to the number of parameters in the method definition. Java does not support Operator Overloading to avoid ambiguities. Run-Time Polymorphism Run-Time Polymorphism is a procedure where the program execution takes place during Run-Time. Here, the resolution of an overriding happens in the execution stage. There are two occurrences of Run-Time Polymorphism. Method Overriding Method Overriding is a procedure in which the compiler can allow a child class to implement a specific method already provided in the parent class. Example: //Method Overriding. package polymorphism; class CargoPilot { public void FlyPlane() { System.out.println("This is the Cargo Pilot, Ready to Take off"); } } class CivilianPilot extends CargoPilot { public void FlyPlane() { System.out.println("This is the Civilian Pilot, Ready to Takeoff"); } } public class Takeoff { public static void main(String args[]) { CargoPilot CPObj = new CargoPilot(); CPObj.FlyPlane(); //CivilianPilot CivilianObj = new CivilianPilot(); //CivilianObj.FlyPlane(); } } //Output: This is the Cargo Pilot, Ready to Takeoff Operator Overriding Operator Overriding a procedure where you can define an operator in both parent and child classes with the same signature, but with different operational capability. Java does not allow Operator Overriding to avoid ambiguities. Let’s draw up the differences between Compile-Time and Run-Time Polymorphism to get a better understanding. Compile-Time Polymorphism vs. Run-Time Polymorphism Compile-Time Polymorphism Run-Time Polymorphism The method call is handled by the compiler The compiler cannot control the method call in run-time Compile-Time Polymorphism is less flexible, as it needs to handle all method calls in compile-time Run-Time Polymorphism exhibits higher flexibility as the method calls get handled at run-time The execution period for the Compile-Time Polymorphism is less The execution period for the Run-Time Polymorphism is more Integrating the right method call with the proper method is done in compile-time Combining the correct method call with the right method is done in run-time Occurs during Method Overloading and Operator Overloading Occurs during Method Overriding With this, we have understood the differences between the types of Polymorphism in Java and the working terminology of Run-Time Polymorphism and Compile-Time Polymorphism. Since the process of polymorphism deals with extending the methods and members of the parent class, we need to know how to extend the members and methods, particularly from the parent class. In the next part, we will learn about a reference keyword that is used to refer to the parent class objects. Unlike “this” keyword, the “super” keyword is what we will be exploring. Super Keyword The term "super" is a keyword in Java that refers to the program's immediate parent class object or method. In this procedure, whenever you create an instance of a subclass, automatically, the compiler will create an instance of the parent class implicitly. The super reference variable will be referring to the parent class’ instance. Example: //Super Keyword package polymorphism; public class SuperKeyWord { public static void main(String[] args) { triangle two = new triangle(); two.countsides(); } } class square { int sides = 4; } class triangle extends square { int sides = 3; public void countsides() { System.out.println("Number of sides in the square : " + sides); System.out.println("Number of sides in the triangle : " + super.sides); } } //Output: Number of sides in the square: 3 Number of sides in the triangle: 4 Advantages of Polymorphism Programmers code can be reused via Polymorphism Supports a single variable name for multiple data types Reduces coupling between different functionalities Do you wish to become a Java Developer? Check out the Java Certification Training Course and get certified today. Disadvantages of Polymorphism Polymorphism ends up raising performance issues in real-time Polymorphism reduces the readability of the code Programmers find Polymorphism a little challenging to implement So, these are a few important advantages and disadvantages of Polymorphism in Java. With this, we have arrived at the end of this "Polymorphism in Java" article. We hope you enjoyed understanding the essential concepts of Polymorphism in Java. Are you interested in Java Programming Language and getting certified as a professional Java Developer? Then, check out our Java training and certification program. It is curated by the most experienced real-time industry experts. Got a question on "Polymorphism in Java"? Please mention it in the article's comment section, and we'll have our experts answer it for you right away. Polymorphism is an important concept of object-oriented programming. It simply means more than one form. That is, the same entity (method or operator or object) can perform different operations in different scenarios. Example: Java Polymorphism class Polygon { // method to render a shape public void render() { System.out.println("Rendering Polygon..."); } } class Square extends Polygon { // renders Square public void render() { System.out.println("Rendering Square..."); } } class Circle extends Polygon { // renders circle public void render() { System.out.println("Rendering Circle..."); } } class Main { public static void main(String[] args) { // create an object of Square Square s1 = new Square(); s1.render(); // create an object of Circle Circle c1 = new Circle(); c1.render(); } } Output Rendering Square... Rendering Circle... In the above example, we have created a superclass: Polygon and two subclasses: Square and Circle. Notice the use of the render() method. The main purpose of the render() method is to render the shape. However, the process of rendering a square is different than the process of rendering a circle. Hence, the render() method behaves differently in different classes. Or, we can say render() is polymorphic. Why Polymorphism? Polymorphism allows us to create consistent code. In the previous example, we can also create different methods: renderSquare() and renderCircle() to render Square and Circle, respectively. This will work perfectly. However, for every shape, we need to create different methods. It will make our code inconsistent. To solve this, polymorphism in Java allows us to create a single method render() that will behave differently for different shapes. Note: The print() method is also an example of polymorphism. It is used to print values of different types like char, int, string, etc. We can achieve polymorphism in Java using the following ways: Method Overriding Method Overloading Operator Overloading Java Method Overriding During inheritance in Java, if the same method is present in both the superclass and the subclass. Then, the method in the subclass overrides the same method in the superclass. This is called method overriding. In this case, the same method will perform one operation in the superclass and another operation in the subclass. For example, Example 1: Polymorphism using method overriding class Language { public void displayInfo() { System.out.println("Common English Language"); } } class Java extends Language { @Override public void displayInfo() { System.out.println("Java Programming Language"); } } class Main { public static void main(String[] args) { // create an object of Java class Java j1 = new Java(); j1.displayInfo(); // create an object of Language class Language l1 = new Language(); l1.displayInfo(); } } Output: Java Programming Language Common English Language In the above example, we have created a superclass named Language and a subclass named Java. Here, the method displayInfo() is present in both Language and Java. The use of displayInfo() is to print the information. However, it is printing different information in Language and Java. Based on the object used to call the method, the corresponding information is printed. Working of Java PolymorphismNote: The method that is called is determined during the execution of the program. Hence, method overriding is a run-time polymorphism. 2. Java Method Overloading In a Java class, we can create methods with the same name if they differ in parameters. For example, void func() { ... } void func(int a) { ... } float func(double a) { ... } float func(int a, float b) { ... } This is known as method overloading in Java. Here, the same method will perform different operations based on the parameter. Example 3: Polymorphism using method overloading class Pattern { // method without parameter public void display() { for (int i = 0; i < 10; i++) { System.out.print("*"); } } // method with single parameter public void display(char symbol) { for (int i = 0; i < 10; i++) { System.out.print(symbol); } } } class Main { public static void main(String[] args) { Pattern d1 = new Pattern(); // call method without any argument d1.display(); System.out.println(""); // call method with a single argument d1.display('#'); } } Output: ********** ########## In the above example, we have created a class named Pattern. The class contains a method named display() that is overloaded. // method with no arguments display() {...} // method with a single char type argument display(char symbol) {...} Here, the main function of display() is to print the pattern. However, based on the arguments passed, the method is performing different operations: prints a pattern of *, if no argument is passed or prints pattern of the parameter, if a single char type argument is passed. Note: The method that is called is determined by the compiler. Hence, it is also known as compile-time polymorphism. 3. Java Operator Overloading Some operators in Java behave differently with different operands. For example, + operator is overloaded to perform numeric addition as well as string concatenation, and operators like &, |, and ! are overloaded for logical and bitwise operations. Let's see how we can achieve polymorphism using operator overloading. The + operator is used to add two entities. However, in Java, the + operator performs two operations. 1. When + is used with numbers (integers and floating-point numbers), it performs mathematical addition. For example, int a = 5; int b = 6; // + with numbers int sum = a + b; // Output = 11 2. When we use the + operator with strings, it will perform string concatenation (join two strings). For example, String first = "Java "; String second = "Programming"; // + with strings name = first + second; // Output = Java Programming Here, we can see that the + operator is overloaded in Java to perform two operations: addition and concatenation. Note: In languages like C++, we can define operators to work differently for different operands. However, Java doesn't support user-defined operator overloading. Polymorphic Variables A variable is called polymorphic if it refers to different values under different conditions. Object variables (instance variables) represent the behavior of polymorphic variables in Java. It is because object variables of a class can refer to objects of its class as well as objects of its subclasses. Example: Polymorphic Variables class ProgrammingLanguage { public void display() { System.out.println("I am Programming Language."); } } class Java extends ProgrammingLanguage { @Override public void display() { System.out.println("I am Object-Oriented Programming Language."); } } class Main { public static void main(String[] args) { // declare an object variable ProgrammingLanguage pl; // create object of ProgrammingLanguage pl = new ProgrammingLanguage(); pl.display(); // create object of Java class pl = new Java(); pl.display(); } } Output: I am Programming Language. I am Object-Oriented Programming Language. In the above example, we have created an object variable pl of the ProgrammingLanguage class. Here, pl is a polymorphic variable. This is because, In statement pl = new ProgrammingLanguage(), pl refer to the object of the ProgrammingLanguage class. And, in statement pl = new Java(), pl refer to the object of the Java class.

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