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ANSWERS FOR TUTORIAL QUESTION BANK

MODULE -III

OBJSPECIAL MEMBER FUNCTIONS AND OVERLOADING

PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS

1. Can we call sub class constructor from super class constructor?

No, it is not possible to directly call a subclass constructor from a superclass constructor in most object-oriented programming languages. The constructor of a subclass is called after the constructor of its superclass, and this process is automatically managed by the language's object creation mechanism. When you create an instance of a subclass, the superclass constructor is called first, followed by the subclass constructor. The initialization of the superclass part is completed before the subclass part begins.

Here's a simple example in Java to illustrate the point:

```
class Superclass {
 public Superclass() {
      System.out.println("Superclass constructor");
   }
}

class Subclass extends Superclass {
   public Subclass() {
      // Implicit call to Superclass constructor happens here
      System.out.println("Subclass constructor");
   }
}

public class Main {
   public static void main(String[] args) {
```

```
        Subclass obj = new Subclass();
    }
}
```

In this example, when you create an instance of **Subclass**, the output will be

Superclass constructor

Subclass constructor

The superclass constructor is automatically called as part of the subclass constructor, and you cannot explicitly invoke the subclass constructor from within the superclass constructor. This sequence ensures that the superclass is properly initialized before the subclass construction begins.

2. What happens if you keep a return type for a constructor?

If you specify a **return type for a constructor, it will essentially turn it into a regular method, and it will no longer be treated as a constructor**. This means that when you create an object using this "constructor," **it won't initialize the object's state** as a constructor should.

```
public class MyClass {
    public int MyClass () {                    // This is not a constructor
        return 42;
    }
    public void displayValue () {
        System.out.println("Value: " + MyClass ());     // Method calling
    }
    public static void main (String[] args) {
        MyClass obj = new MyClass ();
        obj.displayValue();
    }
}
```

In this example, the **MyClass** method is incorrectly specified with an int return type. When you create an object of the **MyClass** class using the constructor, it's no longer a constructor, and it returns an int value. This is evident in the displayValue method, which calls **MyClass()** and then prints the returned value.

When you run the main method, you'll get the following **output:**

Value: 42

The output shows that the **MyClass()** method, which was intended to be a constructor, is behaving like a regular method returning the integer value **42.**

3. When do we need constructor overloading?

Constructor overloading in object-oriented programming (OOP) is the practice of defining multiple constructors within a class, each with a different set of parameters. Constructor overloading provides flexibility and convenience in creating objects of a class. Here are some situations where constructor overloading is useful:

Initialization with Different Data:

- When an object needs to be initialized with different sets of data, constructor overloading allows you to provide multiple constructors to accommodate these variations.

```
class MyClass {
    private int data;

    // Default constructor
    public MyClass() {
        data = 0;
    }

    // Constructor with a parameter
    public MyClass(int initialValue) {
        data = initialValue;
    }
}
```

Support for Default Values:

- Constructor overloading enables the use of default values for parameters. This is useful when you want to provide default values for some parameters but still allow customization.

```
class Point {
```

```
    private int x;
    private int y;

    // Default constructor
    public Point() {
        x = 0;
        y = 0;
    }

    // Constructor with parameters (overloaded)
    public Point(int x, int y) {
        this.x = x;
        this.y = y;
    }
}
```

Facilitating Object Creation with Varied Inputs:

- Constructor overloading allows clients of a class to create objects using the constructor that best fits their needs, providing a more convenient and intuitive way to instantiate objects.

```
// Example of constructor overloading in usage

public class Main {

    public static void main(String[] args) {

        // Creating objects using different constructors

        MyClass obj1 = new MyClass();          // Default constructor

        MyClass obj2 = new MyClass(10);       // Constructor with a parameter

        Point point1 = new Point();           // Default constructor

        Point point2 = new Point(5, 8);       // Constructor with parameters

        Employee emp1 = new Employee("John", 101, "IT");  // Full constructor

        Employee emp2 = new Employee("Alice", 202); // Constructor with essential
                                                                parameters

    }

}
```

Constructor overloading allows you to create more flexible and user-friendly classes by providing different ways to initialize objects based on varying requirements.

4. How a no – argument constructor is different from default Constructor

No-Argument Construct**or:**

A no-argument constructor is a constructor that takes no arguments or parameters.

It's also known as a "zero-argument constructor" or "parameterless constructor."

Programmers define and create no-argument constructors in their classes when they want to provide a way to create objects without passing any specific parameters during instantiation.

You can create a custom no-argument constructor in your class, and it can contain code to initialize the object's state or perform any other tasks.

Here's an example of a no-argument constructors in Java:

```
public class MyClass {
    public MyClass() {
        // This is a no-argument constructor
        // You can add initialization code here
    }
}
```

Default Constructor:

The default constructor, on the other hand, is provided by the programming language or compiler when you don't explicitly define any constructors in your class. It's automatically generated for you if no constructors are defined in your class. The default constructor typically takes no arguments and provides a simple way to create objects without any customization.

Here's an example of a default constructor in Java:

```
public class MyClass {
    // This class does not define any constructors
    // Therefore, a default constructor is automatically provided
}
```

So, the key difference is that a "**no-argument constructor**" is explicitly defined by the programmer to provide specific behavior during object initialization, whereas a **"default constructor"** is automatically generated when no constructors are defined in the class.

5. "An overloaded function appears to perform different activities depending the kind of data send to it" Justify the statement with appropriate example.

Certainly! The concept of function overloading allows a single function name to be used for different operations depending on the types or number of parameters provided. Here's an example in Java to illustrate this.

```
public class OverloadedExample {

    // Overloaded function for adding two integers
    public static int add(int a, int b) {
        System.out.println("Adding two integers:");
        return a + b;
    }

    // Overloaded function for adding three integers
    public static int add(int a, int b, int c) {
        System.out.println("Adding three integers:");
        return a + b + c;
    }

    // Overloaded function for concatenating two strings
    public static String add(String a, String b) {
        System.out.println("Concatenating two strings:");
        return a + b;
    }

    public static void main(String[] args) {
    // Different versions of the 'add' function are called based on the provided
     arguments
        int resultTwoIntegers = add(5, 7);
        int resultThreeIntegers = add(2, 4, 6);
        String resultString = add("Hello", " World");
```

```
        // Displaying results
        System.out.println("Result (two integers): " + resultTwoIntegers);
        System.out.println("Result (three integers): " + resultThreeIntegers);
        System.out.println("Result (string): " + resultString);
    }
}
```

In this example:

- There are three overloaded versions of the `add` function.
- The first version takes two integers and adds them.
- The second version takes three integers and adds them.
- The third version takes two strings and concatenates them.

When the `add` function is called in the `main` method, the appropriate version is selected based on the number and types of arguments provided. This showcases how function overloading allows a single function name (`add` in this case) to perform different activities depending on the kind of data sent to it.

6. If class B inherits class A privately. And class B has a friend function. Will the friend function be able to access the private member of class A?

In oops (C++), a friend function declared inside a class can only access the private members of that class, not the private members of any class it may inherit from.

If class B inherits class A privately and class B has a friend function, the friend function can access the private members of class B, but it cannot access the private members of class A directly.

In Java, there is no concept of friend classes as seen in C++. In Java, access control is primarily managed through access modifiers (`public`, `private`, `protected`, and package-private/default).

When a class B inherits class A privately (using the `private` access modifier), it means that the members of class A are not directly accessible from class B.

7. What happens if you do not provide any constructor to a class?

If you do not provide any constructor to a class, the compiler automatically generates a default constructor for you. This default constructor is a parameter less constructor that does not take any arguments. Its purpose is to initialize the object with default values or perform any necessary setup.

Here's an example

```
public class MyClass {
    // Compiler-generated default constructor
    public MyClass() {
        System.out.println("Default constructor called");
    }
    public void display() {
        System.out.println("Hello from MyClass");
    }
    public static void main(String[] args) {
        MyClass obj = new MyClass(); // Creating an object of MyClass
        obj.display(); // Calling a member function
    }
}
```

In this example, the class **MyClass** does not explicitly define any constructor. When you create an object of **MyClass** using **MyClass obj = new MyClass();,** the default constructor is called. The output will be

Default constructor called

Hello from MyClass

If you do not provide any constructor and do not define any explicitly, Java will add a default constructor for you. This default constructor is especially useful when you want to create objects without providing any specific initialization logic. However, if you need custom initialization or have specific requirements, you can define your own constructors in the class.

8. If a class has all the private members, which specifier will be used for its implicit constructor?

In Java, if a class has all private members and you do not explicitly provide any constructor, the implicit (compiler-generated) default constructor will have the access specifier **package-private** or **default access**.

In Java, when no access specifier (such as public, private, or protected) is explicitly specified for a class, constructor, or method, it defaults to **package-private access**. Package-private means that the class or member is accessible only within the same package.

Here's an example:

```
// MyClass.java
class MyClass {
    private int privateMember;
    public void display() {
        System.out.println("Private Member: " + privateMember);
    }
}
```

In this example, since the class **MyClass** does not have any explicit access specifier, it has package-private access. The default constructor generated by the compiler will also have package-private access. This means that the default constructor can be invoked from within the same package but cannot be accessed from classes outside the package.

If you want to make the class or its constructor accessible outside the package, you would need to add the **public** access specifier explicitly:

```
// MyClass.java
public class MyClass {
    private int privateMember;
    public void display() {
        System.out.println("Private Member: " + privateMember);
```

```
    }
}
```

Now, both the class **MyClass** and its default constructor are explicitly marked as **public** and can be accessed from any other class, regardless of the package.

9. How many friend functions can a class have?

In Java, there is no direct equivalent to the concept of friend functions as found in some other languages like C++. In Java, access control is primarily managed through access modifiers (public, private, protected, and default package-private).

Java's approach to encapsulation typically involves using accessors (getter and setter methods) to control access to private members of a class. Here's an example:

```
public class MyClass {
    private int privateData;

    public MyClass() {
        this.privateData = 0;
    }

    // Getter method to access privateData
    public int getPrivateData() {
        return privateData;
    }

    // Setter method to modify privateData
    public void setPrivateData(int newValue) {
        this.privateData = newValue;
    }
}
```

In this example, other classes can't directly access or modify the **privateData** field. Instead, they can use the public methods **getPrivateData** and **setPrivateData** to interact with it.

If you need to share some functionality between classes, you might use inheritance, interfaces, or other object-oriented principles to achieve the desired behavior without exposing the internal details of a class.

To sum up, Java doesn't have a direct equivalent to friend functions, and access control is typically achieved through the use of access modifiers and well-defined methods.

10. Does friend function violate encapsulation?

Encapsulation is one of the fundamental principles of object-oriented programming (OOP) that involves bundling the data (attributes) and methods (functions) that operate on the data into a single unit called a class. The idea is to hide the internal details of the object and only expose a well-defined interface to the outside world.

Friend functions, when used, allow external functions or classes to access the private and protected members of a class. While they provide a mechanism for granting special access, they can undermine encapsulation because they break the intended boundaries of a class.

(Write the above program with explanation)

PART-B LONG ANSWER QUESTIONS

1. What is constructor? Explain the concept of default and default copy with suitable example.

In Java, a constructor is a special type of method within a class that is used for initializing objects. Constructors are invoked when an object of a class is created using the new keyword. They initialize the object's state, set up any necessary resources, and perform any other setup tasks. Constructors have the same name as the class and do not have a return type.

Now, let's explain the concept of a "default constructor" and a "default copy constructor" in the context of Java:

Default Constructor in Java:

In Java, if you don't provide any constructors for a class, the compiler automatically generates a default constructor for that class.

The default constructor is a no-argument constructor that takes no parameters.

It initializes the object with default values, which typically means setting numeric types to **0**, object references to **null,** and other default values as appropriate for the data types.

Example of a default constructor in Java:

```
public class MyClass {
   // Default constructor (automatically provided)
   public MyClass () {
      // Initialization code, e.g., setting fields to default values
   }
}
```

In this example, the default constructor is automatically provided for the **MyClass** class.

Default Copy Constructor (Not Applicable in Java):

Unlike some other programming languages like C++, Java does not have a "default copy constructor" concept.

In Java, object copying is typically done using methods or custom constructors. When you want to create a new object by copying the attributes of an existing object, you would define a custom constructor or method to do that, rather than relying on a default copy constructor.

Example of copying an object in Java using a custom constructor:

```
class Person {
   private String name;
   private int age;

   // Custom constructor for copying
   public Person(Person obj) {          // object is used as a parameter
      this.name = obj.name;            // this represents the current running object
      this.age = obj.age;
   }
}
```

In this example, the **Person** class has a custom constructor that accepts another **Person** object as a parameter and copies its attributes to create a **new Person** object.

In summary, Java provides a default constructor when you don't define any constructors explicitly in your class, but there is no concept of a **"default copy constructor"** in Java.

2. How are constructors different from member functions? Explain with an example.

Constructors and member functions (also known as methods) are both essential components of object-oriented programming, but they serve different purposes and have distinct characteristics. Here's how they differ, along with an example in Java:

Purpose:

Constructors: Constructors are used for initializing objects when they are created. They set the initial state of an object and perform any necessary setup tasks. Constructors are called automatically when an object is instantiated.

Member Functions: Member functions, also known as methods, are used to define the behaviour and operations that objects of a class can perform. They are called explicitly by the programmer to perform specific tasks on objects.

Invocation:

Constructors: Constructors are automatically called when an object is created using the new keyword. They are not called explicitly by the programmer.

Member Functions: Member functions are explicitly called by the programmer to perform operations on objects. They are not automatically invoked during object creation.

Return Type:

Constructors: Constructors do not have a return type. They are responsible for initializing the object and do not return values.

Member Functions: Member functions have a return type that specifies the type of value they return (or **void** if they don't return anything).

Here's an example in Java to illustrate the differences between constructors and member functions

```
public class Car {
    private String make;
    private String model;
    private int year;

    // Constructor for initializing a Car object
    public Car(String make, String model, int year) {
        this.make = make;
```

```
        this.model = model;
        this.year = year;
    }

    // Member function to display information about the car
    public void displayInfo() {
        System.out.println("Make: " + make);
        System.out.println("Model: " + model);
        System.out.println("Year: " + year);
    }

    public static void main(String[] args) {
        // Create a Car object using the constructor
        Car myCar = new Car("Toyota", "Camry", 2020);

        // Call the displayInfo method to print the car's information
        myCar.displayInfo();
    }
}
```

In this example, we have a **Car** class with a constructor and a member function. The constructor **(Car)** is responsible for initializing the object's state by setting the make, model, and year attributes. The **displayInfo** method is a member function that prints the car's information to the console.

In the main method, we create a **Car** object using the constructor and then call the displayInfo method to display the car's details.

3. Depict the difference between private and public derivation. Explain derived class constructor with suitable example.

In Java, there is no direct concept of private or public derivation, as seen in languages like C++. Java supports only single inheritance for classes, and the access modifiers **(public, protected, private, and package-private)** control the visibility of members within the class and its subclasses.

Public Inheritance (Equivalent in Java):

In Java, when a class extends another class, it is similar to public inheritance in other languages. The members with default (package-private), protected, and public access modifiers of the superclass become visible to the subclass. Here's an example:

```
class Base {
    public int publicMember;
    public Base() {
        this.publicMember = 42;
        System.out.println("Base class constructor");
    }
}

class DerivedPublic extends Base {
    public void display() {
        System.out.println("DerivedPublic class: " + publicMember);  // Accessing publicMember
    }
}

public class Main {
    public static void main(String[] args) {
        DerivedPublic derivedObj = new DerivedPublic();
        System.out.println("Accessing publicMember: " + derivedObj.publicMember);
```

```
        derivedObj.display();
    }
}
```

In this example**, DerivedPublic** extends **Base**, and the **publicMember** remains accessible outside the class.

Private Inheritance (Not Directly Applicable in Java):

In Java, there is no direct equivalent to private inheritance, as Java supports only single inheritance. The concept of private inheritance in C++ (where public and protected members become private in the derived class) does not apply in Java.

Derived Class Constructor:

In Java, when a derived class is instantiated, the constructor of the superclass is implicitly called. You can use the **super ()** keyword to call the superclass constructor explicitly. For example:

```
class Base {
    public Base() {
        System.out.println("Base class constructor");
    }
}
class Derived extends Base {
    public Derived() {
        super();  // Implicit call to the constructor of the superclass
        System.out.println("Derived class constructor");
    }
}
public class Main {
    public static void main(String[] args) {
```

```
        Derived derivedObj = new Derived();
    }
}
```

In this example, creating an object of Derived calls both the constructor of **Derived** and the constructor of **Base** due to the **super()** call.

4. Explain the default action of the copy constructor. Give a suitable example that demonstrates the technique of overloading the copy constructor.

In Java, there is no explicit copy constructor like in some other languages (e.g., C++). However, you can achieve the equivalent functionality through methods or static factory methods. The default behavior when creating a new object in Java is to use the default constructor.

Here's an example that demonstrates creating a copy method for copying objects in Java:

```
public class MyClass {
    private int data;
    // Default constructor
    public MyClass() {
        this.data = 0;
        System.out.println("Default constructor called");
    }
    // Parameterized constructor
    public MyClass(int data) {
        this.data = data;
        System.out.println("Parameterized constructor called");
    }
    // Copy method for copying objects
```

```
    public MyClass copy() {
        MyClass copyObj = new MyClass();
        copyObj.data = this.data;
        System.out.println("Copy method called");
        return copyObj;
    }
    // Display method
    public void display() {
        System.out.println("Data: " + data);
    }
    public static void main(String[] args) {
        // Creating an object
        MyClass obj1 = new MyClass(10);
        // Copying objects using the copy method
        MyClass obj2 = obj1.copy();
        obj2.display(); // Output: Data: 10
    }
}
```

In this example, the **MyClass** has a copy method **(copy())** that creates a new object and copies the data from the existing object. This approach is commonly used in Java to mimic the behaviour of a copy constructor.

5. Write short notes on: a) Early binding, b) late binding.

Early Binding: The binding which can be resolved at compile time by the compiler is known as static or early binding. Binding of all the static, private and final methods is done at compile-time.

Example:

```
public class NewClass {
        public static class superclass {
                static void print()
                {
                        System.out.println("print in superclass.");
                }
        }
        public static class subclass extends superclass {
                static void print()
                {
                        System.out.println("print in subclass.");
                }
        }

        public static void main(String[] args)
        {
                superclass A = new superclass();
                superclass B = new subclass();
                A.print();
                B.print();
        }
}
```

Output

```
print in superclass.
print in superclass.
```

Late binding: In the late binding or dynamic binding, the compiler doesn't decide the method to be called. Overriding is a perfect example of dynamic binding. In overriding both parent and child classes have the same method.

Example:

```
public class NewClass {
    public static class superclass {
        void print()
        {
            System.out.println("print in superclass.");
        }
    }

    public static class subclass extends superclass {
        @Override
        void print()
        {
            System.out.println("print in subclass.");
        }
    }

    public static void main(String[] args)
    {
        superclass A = new superclass();
        superclass B = new subclass();
        A.print();
        B.print();
    }
}
```

Output

print in superclass.

print in superclass.

6. Explain types of constructors with examples.

Types of Constructor

In Java, constructors can be divided into 3 types:

1. No-Arg Constructor
2. Parameterized Constructor
3. Default Constructor

No-Arg Constructors:

Similar to methods, a Java constructor may or may not have any parameters (arguments). If a constructor does not accept any parameters, it is known as a no-argument constructor. For example,

```
class Main {
  int i;
  // constructor with no parameter
  private Main() {
    i = 5;
    System.out.println("Constructor is called");
  }
  public static void main(String[] args) {
    // calling the constructor without any parameter
    Main obj = new Main();
    System.out.println("Value of i: " + obj.i);
  }
}
```

Output

Constructor is called

Value of i: 5

In the above example, we have created a constructor **Main()**. Here, the constructor does not accept any parameters. Hence, it is known as a **no-arg constructor**.

Parameterized Constructor

A Java constructor can also accept one or more parameters. Such constructors are known as parameterized constructors (constructor with parameters).

```
class Main {

  String languages;

  // constructor accepting single value

  Main(String lang) {

    languages = lang;

    System.out.println(languages + " Programming Language");

  }

  public static void main(String[] args) {

    // call constructor by passing a single value

    Main obj1 = new Main("Java");

    Main obj2 = new Main("Python");

    Main obj3 = new Main("C");

  }

}
```

Output

```
Java Programming Language
Python Programming Language
```

In the above example, we have created a constructor named **Main().** Here, the constructor takes a single parameter. Notice the expression,

```
Main obj1 = new Main("Java");
```

Here, we are passing the single value to the constructor. Based on the argument passed, the language variable is initialized inside the constructor.

Java Default Constructor

If we do not create any constructor, the Java compiler automatically create a no-arg constructor during the execution of the program. This constructor is called default constructor.

```
class Main {
  int a;
  boolean b;
  public static void main(String[] args) {
    // A default constructor is called
    Main obj = new Main();
    System.out.println("Default Value:");
    System.out.println("a = " + obj.a);
    System.out.println("b = " + obj.b);
  }
}
```

Output

```
Default Value:
a = 0
b = false
```

Here, we haven't created any constructors. Hence, the Java compiler automatically creates the default constructor.

7. What is copy constructor? When it is used implicitly for what purpose?

In Java, there is no explicit copy constructor like in some other programming languages (e.g., C++). However, the concept of copying objects can be achieved through other means, such as methods or static factory methods. Java provides the **clone()** method for creating a copy of an object, but it must be used cautiously, and the class must implement the **Cloneable** interface.

clone() Method in Java:

1. **Object Cloning:**
   - The **clone()** method is provided by the Cloneable interface in Java.
   - It creates and returns a copy of the object on which it is called.
   - The class must implement the Cloneable interface for the **clone()** method to work.

Example:

```
class MyClass implements Cloneable {
   private int data;

   // Parameterized constructor
   public MyClass(int data) {
      this.data = data;
   }

   // Getter and Setter methods

   @Override
   protected Object clone() throws CloneNotSupportedException {
      return super.clone();
   }
}

public class Main {
   public static void main(String[] args) {
      MyClass obj1 = new MyClass(42);

      try {
         // Implicitly calling the clone method
```

```
        MyClass obj2 = (MyClass) obj1.clone();
        System.out.println("Data in obj2: " + obj2.getData());
      } catch (CloneNotSupportedException e) {
        e.printStackTrace();
      }
    }
}
```

1. In this example, the **clone()** method is called implicitly when creating a copy of an object. Note that explicit handling of **"CloneNotSupportedException"** is required.
2. **Purpose of clone() in Java:**
    - The **clone()** method provides a mechanism for creating a copy of an object.
    - It is used for scenarios where a new object with the same state as an existing object is needed.
    - The purpose is to allow developers to create independent copies of objects without affecting the original objects.

While the **clone()** method can be used for object copying in Java, it should be used carefully, and the class's implementation of **clone()** needs to ensure a proper and deep copy, especially for objects containing mutable fields. Additionally, the **Cloneable** interface serves as a marker interface to indicate that a class supports cloning.

8. What is the difference between copy constructor and default constructor?
Copy Constructor:

- **Definition:** A copy constructor is a special constructor that creates a new object by copying the values from an existing object of the same class.
- **Usage:** It is used explicitly or implicitly to create a new object that is a copy of an existing object.
- **Implementation:** In Java, there is no direct support for copy constructors. Instead, developers use methods or static factory methods to achieve object copying.

Example:

```
class MyClass {

   private int data;

   // Copy method for copying objects

   public MyClass copy() {
```

```
        MyClass copyObj = new MyClass();

        copyObj.data = this.data;

        return copyObj;

    }

}
```

Default Constructor:

- **Definition:** A default constructor is a constructor provided by Java if no constructor is explicitly defined in a class.
- **Usage:** It is used when an object is created without providing explicit initialization values.
- **Implementation:** If no constructor is defined in the class, Java automatically adds a default constructor.

Example:

```
class MyClass {

    private int data;

    // Default constructor (implicitly provided)

    public MyClass() {

        // Initialization logic, if any

    }

}
```

- The default constructor initializes the object with default values (e.g., 0 for numeric types, **null** for references).

Key Differences:

- A copy constructor is used for creating a new object as a copy of an existing object, while a default constructor is used for creating an object with default values.

- Copy constructors are not directly supported in Java, and developers often use methods or static factory methods for object copying.
- Default constructors are implicitly provided by Java if no constructor is defined in the class.

9. Describe unary operator overloading along with syntax and example

In Java, unary operator overloading refers to the ability to provide custom behaviour for unary operators (e.g., '++', '--', '-', '+', '!') in user-defined classes. However, it's important to note that Java has some limitations in terms of operator overloading compared to languages like C++. In Java, overloading is limited to methods, and it doesn't support custom operator definitions.

For example, you can't directly overload the ++ or -- operators in Java. However, you can provide methods that mimic the behavior of these operators. Let's look at an example for the unary ++ operator:

```
class MyNumber {
  private int value;

  // Constructor
  public MyNumber(int value) {
    this.value = value;
  }

  // Method to mimic unary ++ operator
  public MyNumber increment() {
    return new MyNumber(this.value + 1);
  }

  // Getter method
  public int getValue() {
    return this.value;
  }
}

public class Main {
  public static void main(String[] args) {
    MyNumber num1 = new MyNumber(5);

    // Using the increment method to mimic ++
    MyNumber num2 = num1.increment();

    System.out.println("Original value: " + num1.getValue());
    System.out.println("After increment: " + num2.getValue());
```

```
    }
}
```

In this example, the **MyNumber** class provides a method **increment()** that mimics the behavior of the unary ++ operator. The **increment()** method returns a new **MyNumber** object with the incremented value.

It's important to understand that Java doesn't allow direct operator overloading as seen in some other languages. Instead, developers use methods to achieve similar functionality.

10.Describe binary operator overloading along with syntax and example.

In Java, operator overloading, especially for binary operators like '+', '-', '*', etc., is not directly supported as it is in some other languages like C++. However, you can achieve similar functionality through method overloading by defining methods with appropriate names.

Let's consider an example where we want to simulate binary operator overloading for addition ('**+**') in a **Vector** class:

```
class Vector {
    private double x;
    private double y;

    // Constructor
    public Vector(double x, double y) {
        this.x = x;
        this.y = y;
    }

    // Method to simulate binary + operator for vector addition
    public Vector add(Vector other) {
        double newX = this.x + other.x;
        double newY = this.y + other.y;
        return new Vector(newX, newY);
    }

    // Method to display the vector
    public void display() {
        System.out.println("(" + x + ", " + y + ")");
    }
}

public class Main {
```

```
    public static void main(String[] args) {
        // Creating two vectors
        Vector vector1 = new Vector(2, 3);
        Vector vector2 = new Vector(1, 4);

       // Adding two vectors using the add method
        Vector result = vector1.add(vector2);

        // Displaying the result
        System.out.print("Result of vector addition: ");
        result.display();
    }
}
```

In this example, the **Vector** class provides an add method that simulates the behaviour of the binary '**+**' operator for vector addition. The method takes another **Vector** as a parameter and returns a new **Vector** representing the sum.

While Java doesn't directly support traditional operator overloading, this approach allows you to achieve similar functionality through method overloading by providing meaningful methods in your classes.

11. What is overloading of an operator? When it is necessary to overload an operator?

In Java, operator overloading refers to providing multiple implementations of a specific operator for different data types or user-defined classes. Unlike some languages such as C++, Java does not support traditional operator overloading, where you can define custom behaviour for operators like '+','-', etc. on user-defined types.

In Java, the operators have fixed behaviours based on the types of operands they operate on. For example, the + operator is used for addition with numeric types and string concatenation with strings. You cannot define custom behaviour for the + operator for your own classes.

However, you can achieve similar functionality by providing methods with meaningful names in your classes. For example, if you have a **Vector** class and want to add two vectors, you can provide a method like **add**:

```
public class Vector {
    private double x;
    private double y;

    // Constructor
```

```
    public Vector(double x, double y) {
        this.x = x;
        this.y = y;
    }

    // Method to add two vectors
    public Vector add(Vector other) {
        return new Vector(this.x + other.x, this.y + other.y);
    }

    // Other methods and members...
}
```

In this way, you achieve similar functionality to operator overloading, although the syntax is different.

In general, it is necessary to simulate operator-like behavior through method overloading in Java when you want to provide meaningful and expressive operations on objects of your classes. It helps improve code readability and maintainability.

12. Differentiate between the concepts of overloading and overriding with an example.

Method Overloading:

1. **Definition:**
   - Overloading refers to defining multiple methods in the same class with the same name but different parameters (either a different number of parameters or different types of parameters).
2. **Signature:**
   - The signature of the overloaded methods must differ either in the number or types of parameters.

Example:

```
public class Calculator {
    // Overloaded methods
    public int add(int a, int b) {
        return a + b;
    }

    public double add(double a, double b) {
        return a + b;
    }
```

}

In this example, the **add** method is overloaded with two versions - one for integers and one for doubles.

Method Overriding:

1. **Definition:**
   - Overriding occurs when a subclass provides a specific implementation for a method that is already defined in its superclass.
2. **Signature:**
   - The overridden method in the subclass must have the same signature (name, return type, and parameters) as the method in the superclass.

Example:

```
public class Animal {
   public void makeSound() {
      System.out.println("Generic animal sound");
   }
}

public class Cat extends Animal {
   @Override
   public void makeSound() {
      System.out.println("Meow");
   }
}
```

Key Differences:

- **Inheritance:**
  - Overloading can occur in the same class or subclasses.
  - Overriding happens in a subclass that inherits from a superclass.
- **Method Signature:**
  - Overloading changes the method signature by varying parameters.
  - Overriding maintains the same method signature.

- **Static vs. Dynamic Binding:**
  - Overloading is an example of static binding (compile-time polymorphism).
  - Overriding is an example of dynamic binding (run-time polymorphism).
- **Applicability:**

- Overloading is used to provide multiple methods with similar functionality but different parameter types.
- Overriding is used to provide a specific implementation of a method in a subclass.

13. What is the difference between constructor overloading and operator overloading?

Constructor overloading and operator overloading are two different concepts in programming, each serving a distinct purpose. Let's explore the key differences between them:

Constructor Overloading:

1. **Definition:**
   - Constructor overloading involves defining multiple constructors within a class, each with a different set of parameters.
2. **Purpose:**
   - Constructors are used to initialize the object's state when an instance of a class is created.
   - Constructor overloading allows the creation of objects with different initial states based on the parameters provided during object creation.

Example

```
public class Rectangle {
private int length;
private int width;

// Default constructor
public Rectangle() {
   this.length = 0;
   this.width = 0;
}

// Parameterized constructor
public Rectangle(int length, int width) {
   this.length = length;
   this.width = width;
}
}
```

Operator Overloading:

1. **Definition:**
   - Operator overloading involves defining custom behaviours for operators when applied to objects of a user-defined class.

2. **Purpose:**
    - Operators like '+', '-', '*', etc., typically have predefined behaviours for built-in types.
    - Operator overloading allows you to define how these operators should behave when applied to objects of your class.

Example

```
public class ComplexNumber {
private double real;
private double imaginary;

// Constructor
public ComplexNumber(double real, double imaginary) {
   this.real = real;
   this.imaginary = imaginary;
}

// Operator overloading for addition
public ComplexNumber add(ComplexNumber other) {
   return new ComplexNumber(this.real+other.real,this.imaginary+ other.imaginary);
}
}
```

Key Differences:

- **Purpose:**
    - Constructor overloading is primarily for creating objects with different initial states.
    - Operator overloading is for defining custom behaviours of operators when applied to objects.
- **Usage:**
    - Constructor overloading is invoked implicitly when an object is created.
    - Operator overloading is invoked explicitly when an operator is applied to objects.
- **Syntax:**
    - Constructor overloading involves defining multiple constructors with different parameter lists.
    - Operator overloading involves defining methods that mimic the behaviour of operators.

14. Explain the constructor overloading with an example.

Constructor overloading in Java allows a class to have multiple constructors with different parameter lists. This provides flexibility in creating instances of the class with different sets of initial values. Let's go through an example:

```
public class Book {
    private String title;
    private String author;
    private int year;

    // Default constructor
    public Book() {
        this.title = "Unknown";
        this.author = "Unknown";
        this.year = 0;
    }

    // Constructor with title and author
    public Book(String title, String author) {
        this.title = title;
        this.author = author;
        this.year = 0; // Default year
    }

    // Full constructor with title, author, and year
    public Book(String title, String author, int year) {
        this.title = title;
        this.author = author;
        this.year = year;
    }

    // Other methods...

    // Getter methods for accessing private members
    public String getTitle() {
        return title;
    }

    public String getAuthor() {
        return author;
    }

    public int getYear() {
        return year;
    }
}
```

In this example, the Book class has three constructors:

1. **Default Constructor:**
   - Initializes the book with default values.
2. **Constructor with Title and Author:**
   - Initializes the book with the given title and author. The year is set to the default value.
3. **Full Constructor with Title, Author, and Year:**
   - Initializes the book with the given title, author, and year.

You can create instances of the **Book** class using these constructors:

```
// Using the default constructor
Book defaultBook = new Book();

// Using the constructor with title and author
Book partialBook = new Book("The Catcher in the Rye", "J.D. Salinger");

// Using the full constructor
Book fullBook = new Book("To Kill a Mockingbird", "Harper Lee", 1960);
```

Each constructor allows you to create a **Book** object with a different set of initial values, demonstrating the concept of constructor overloading in Java.

15. Define static data members and explain with an example.

Static data members in Java belong to the class rather than instances of the class. They are shared among all instances of the class and are initialized only once when the class is loaded. Here's an example to illustrate static data members:

```
public class Student {
// Static data member
private static int totalStudents = 0;

// Instance variables
private String name;
private int age;

// Constructors
public Student(String name, int age) {
   this.name = name;
   this.age = age;
   totalStudents++; // Increment the totalStudents count when a new student is created
}

// Other methods...
```

```
    // Getter methods for accessing private members
    public String getName() {
        return name;
    }

    public int getAge() {
        return age;
    }

    // Static method to get the total number of students
    public static int getTotalStudents() {
        return totalStudents;
    }
}
```

In this example:

- **totalStudents** is a static data member, and it belongs to the class **Student**. It is used to keep track of the total number of **Student** objects created.
- The constructor of the **Student** class increments the **totalStudents** count each time a new student is created.
- The **getTotalStudents** method is a static method that allows you to retrieve the total number of students without creating an instance of the class.

Usage of the Student class:

```
// Creating instances of the Student class
Student student1 = new Student("John", 20);
Student student2 = new Student("Alice", 22);

// Accessing instance variables
System.out.println("Student 1: " + student1.getName() + ", Age: " + student1.getAge());

// Accessing static data member using the class name
System.out.println("Total Students: " + Student.getTotalStudents()); // Output: 2
```

In this example, the **totalStudents** count is shared among all instances of the **Student** class, and you can access it using the class name without creating an object.

16. What is the use of operator overloading? How to overload post and pre-increment operators?

Operator overloading in Java allows you to define custom behaviors for operators when applied to objects of a class. This feature enhances code readability and allows you to use operators in a way that makes sense for your specific class. While Java doesn't support custom operator overloading as comprehensively as some other languages like C++, you can still achieve certain forms of operator overloading.

Here's an example of overloading the post-increment (++) and pre-increment (++) operators in a Java class:

```
public class Counter {

private int count;


// Constructor

public Counter(int initialCount) {

   this.count = initialCount;

}

// Getter method

public int getCount() {

  return count;

}

// Overloading the post-increment operator (i++)

public Counter postIncrement() {

Counter result = new Counter(this.count); // Create a copy of the current object

   this.count++; // Increment the count in the original object

   return result; // Return the copy (the state before increment)

}

// Overloading the pre-increment operator (++i)

public void preIncrement() {
```

```
        this.count++;
    }
}
```

In this example:

- The **postIncrement** method overloads the post-increment operator **(i++).** It returns a new Counter object with the current count, and then increments the count in the original object.
- The **preIncrement** method overloads the pre-increment operator **(++i).** It increments the count in the original object directly.

17. Differentiate between method overloading and method overriding.

S.No.	Property	Overloading	Overriding
1	Argument type	Must be different (at least order).	Must be the same (including order).
2	Method signatures	Must be different.	Must be the same.
3	Return type	Same or different.	Must be the same until Java 1.4 version only. Java 1.5 onwards, Covariant return type is allowed.
4	Class	Generally performed in the same class.	Performed in two classes through Inheritance (Is-A relationship).
5	Private/Static/Final method	Can be overloaded.	Cannot be overridden.
6	Access modifiers	Anything or different.	Subclass method's access modifier must be same or higher than superclass method access modifier.
7	Throws clause	Anything	If child class method throws any checked exception compulsory parent class method should throw the same exception is its parent otherwise, we will get compile-time error but there is no restriction for an unchecked exception.
8	Method resolution	Always take care by Java compiler based on reference type.	Always take care by JVM based on runtime object.
9	Polymorphism	Also known as compile-time polymorphism, static polymorphism, or early binding.	Also known as runtime polymorphism, dynamic polymorphism, or late binding.
10	Performance	Better	Less

18. What is the concept of friend function? How it violates the data hiding principle? Justify with example.

In object-oriented programming, a friend function, that is a "friend" of a given class, is a function that is given the same access as methods to private and protected data. A friend function is declared by the class that is granting access, so friend functions are part of the class interface, like methods.

Friend functions have access to private members of a class from outside the class which violates the law of the data hiding. Friend functions cannot do any run time polymorphism in its members.

In Java, the concept of friend functions is not directly supported as it is in some other programming languages like C++. Java enforces strict encapsulation, and access to class members is controlled through access modifiers (public, private, protected). In Java, there is no direct equivalent of a friend function that can access private members of a class from outside the class.

To illustrate the importance of encapsulation and how direct access to private members can lead to a violation of the data hiding principle, let's consider a scenario using Java:

```
public class MyClass {

private int privateData;


public MyClass(int value) {

  this.privateData = value;

}


// Getter method to access privateData

public int getPrivateData() {

   return privateData;

}

}

public class FriendFunctionExample {

// Friend function (not allowed in Java)
```

```
    // Attempting to access privateData directly (violates encapsulation)

    public static void friendFunction(MyClass obj) {

        int dataValue = obj.privateData;  // This line would result in a compilation error

      System.out.println("Friend Function: Accessing private data - " + dataValue);

    }

    public static void main(String[] args) {

        MyClass myObject = new MyClass(42);

        // Accessing privateData through the public getter method

        int dataValue = myObject.getPrivateData();

        System.out.println("Main Function: Accessing private data - " + dataValue);

    }

}
```

In this example:

- The **MyClass** class has a private member **privateData.**
- The F**riendFunctionExample** class attempts to create a friend function that directly accesses the private data member, which is not allowed in Java.
- The attempt to access **obj.privateData** directly would result in a compilation error.

Java enforces encapsulation by not allowing direct access to private members from outside the class. Instead, access is controlled through public methods (getters and setters). This ensures that the internal implementation details are hidden and can only be accessed or modified through the defined public interfaces, maintaining the integrity of the encapsulation principle.

19. List out the guidelines that should be followed while using friend functions.

In Java, the concept of friend functions as it exists in C++ is not directly supported. Java enforces strict encapsulation, and access to class members is typically controlled through access modifiers (public, private, protected). However, there are alternative approaches to achieve similar functionality in Java.

1. **Access Modifiers:**
   - Utilize Java's access modifiers (public, private, protected) to control access to class members. Keep members private whenever possible to enforce encapsulation.

2. **Getter and Setter Methods:**
   - Provide getter and setter methods to access and modify private members. This allows controlled access to the internal state of a class while maintaining encapsulation.

```
public class MyClass {
    private int privateData;

    public int getPrivateData() {
        return privateData;
    }

    public void setPrivateData(int value) {
        privateData = value;
    }
}
```

3. **Immutable Classes:**
   - Consider creating immutable classes, where the state of an object cannot be modified after creation. This reduces the need for setter methods and provides a form of encapsulation.

```
public final class ImmutableClass {
    private final int data;

    public ImmutableClass(int data) {
        this.data = data;
    }

    public int getData() {
        return data;
    }
}
```

4. **Package-Private Access:**
   - Use the package-private (default) access level for classes and members when appropriate. Classes within the same package have access to each other's package-private members.

```
package com.example;

class PackagePrivateClass {
    // Package-private member
```

```
    int data;
}
```

5. **Composition:**
   - Favor composition over inheritance. Instead of using friend classes, consider creating classes that collaborate through composition.

```
public class FriendClass {
    public void collaborate(MyClass obj) {
        // Access public members of MyClass
        int data = obj.getPublicData();
    }
}
```

6. **Documentation:**
   - Clearly document the reasons for accessing certain members and the intended usage. This helps other developers understand the design decisions and the intended access patterns.
7. **Use Interfaces:**
   - Define interfaces to specify the contract that classes must adhere to. This allows different classes to interact through a common interface without exposing their internal details.

```
public interface MyInterface {
    void performAction();
}

public class MyClass implements MyInterface {
    public void performAction() {
        // Implementation
    }
}

public class FriendClass {
    public void collaborate(MyInterface obj) {
        // Access the common interface
        obj.performAction();
    }
}
```

Remember that Java's design principles emphasize strong encapsulation and controlled access to class members. While the notion of friend functions as in C++ is not directly applicable, these guidelines provide alternatives to achieve similar goals in a Java context.

20. What are friend classes? Explain the advantages of using friend classes.

In Java, the concept of friend classes, as it exists in C++, is not directly supported. Java enforces strict encapsulation and access control through access modifiers (public, private, protected). In Java, you typically use access modifiers, interfaces, and other mechanisms to achieve controlled access to class members. However, there are alternative approaches to achieve similar functionality to friend classes:

Package-Private Access:

- In Java, classes with package-private access (default access) can be accessed by other classes in the same package. While this is not exactly the same as friend classes, it allows controlled access within a package.

```
// MyClass.java
package com.example;

class MyClass {
   // Package-private member
   int data;
}

// FriendClass.java
package com.example;

public class FriendClass {
   public void collaborate(MyClass obj) {
      // Access package-private member of MyClass
      int data = obj.data;
   }
}
```

Interfaces:

- Define interfaces to specify a contract that classes must adhere to. This allows different classes to interact through a common interface without exposing their internal details.

```
// MyInterface.java
package com.example;
public interface MyInterface {
    void collaborate();
}
// MyClass.java
package com.example;
class MyClass implements MyInterface {
    @Override
    public void collaborate() {
        // Implementation
    }
}
// AnotherClass.java
package com.example;
public class AnotherClass {
    public void interactWithMyClass(MyInterface obj) {
        obj.collaborate();
    }
}
```

While Java doesnot have a direct equivalent of friend classes, these alternative mechanisms help achieve controlled access and collaboration between classes.

PART-C SHORT ANSWER QUESTIONS

1. Define a constructor.

A constructor is a special initialization function that is automatically called whenever a class is declared. The constructor always has the same name as the class name, and no data types are defined for the argument list or the return type. Normally a constructor is used to initialize a class.

2. Define constructor chaining.

Constructor chaining is the process of calling one constructor from another constructor with respect to current object. One of the main uses of constructor chaining is to avoid duplicate codes while having multiple constructor (by means of constructor overloading) and make code more readable.

3. What is No-arg constructor?

As the name suggests, a no-argument constructor is one that does not accept any arguments or parameters. The default constructor is the only no-argument constructor of a class. In other words, you can have one – and only one – no argument constructor in a class.

4. Define a copy constructor.

copy constructor is a particular type of constructor that we use to create a duplicate (exact copy) of the existing object of a class. Copy constructors create and return a new object using the existing object of a class.

5. What are distinguishing characteristics of copy constructors?

1. The copy constructor should have at least one argument of the same class and this argument must be passed as a constant reference type.
2. If additional arguments are present in the copy constructor, then it must contain default arguments.
3. Explicit function call of copy constructor is not allowed.
4. Copy constructor is also called automatically, when an object is passed to a function using pass by value.
5. If a new object is declared and existing object is passed as a parameter to it in the declaration itself, then also the copy constructor is invoked.

6. What is a dynamic constructor?

Dynamic constructor is used to allocate the memory to the objects at the run time. Memory is allocated at run time with the help of 'new' operator. By using this constructor, we can dynamically initialize the objects.

7. What is dynamic initialization?

Dynamic initialization of object refers to initializing the objects at run time i.e. the initial value of an object is to be provided during run time. Dynamic initialization can be achieved using constructors and passing parameters values to the constructors.

8. Define destructor?

A destructor is used to delete or destroy the objects when they are no longer in use. Constructors are called when an instance of a class is created. Destructors are called when an object is destroyed or released.

9. What is the use of destructors?

Destructors are usually used to deallocate memory and do other cleanup for a class object and its class members when the object is destroyed. A destructor is called for a class object when that object passes out of scope or is explicitly deleted.

10. Define method overloading.

Method overloading is a feature that allows a class to have more than one method with the same name, but with different parameters.

11. Define method overriding.

Method overriding is a Java feature that allows a subclass or child class to provide a unique implementation for a method that has already been defined in one of its parent classes or super classes.

12. What are the different types of constructors?

In Java, constructors can be divided into 4 types: No-Argument Constructor. Parameterized Constructor. Default Constructor, and copy constructor.

13. What are distinguishing characteristics of default constructors?

- **Initialization**: It initializes every object with default values. This is crucial because, without a default constructor, uninitialized objects might contain garbage values, leading to unpredictable behavior.
- **Creation of Objects:** In many programming languages, if the programmer defines no constructor, the compiler provides a default constructor implicitly, allowing the creation of objects even when no specific initialization is required.
- **Overloading Constructors:** In classes where, multiple constructors are provided to allow for various initialization scenarios, the default constructor maintains a pathway to create an object with no customization.
- **Inheritance:** In inheritance, a default constructor ensures that a base class can be properly initialized when a derived class is instantiated, especially when the derived class does not explicitly call a parent constructor.

14. What are distinguishing characteristics of overloaded constructors?

Constructor overloading means having more than one constructor with the same name. Constructors are methods invoked when an object is created. You have to use the same name for all the constructors which is the class name. This is done by declaration the constructor with a different number of arguments.

15. What is operator overloading?

Operator overloading is a programming method where operators are implemented in user-defined types with specific logic dependent on the types of given arguments. Operator overloading makes it easier to specify a user-defined implementation for operations with one or both operands of a user-defined class or structure.

16. What is unary operator overloading?

Unary operators are those which operate on a single variable. Overloading unary operator means extending the operator's original functionality to operate upon object of the class. The declaration of an overloaded unary operator function precedes the word operator.

17. Name the binary operators that can be overloaded.

It is a polymorphic compile technique where a single operator can perform various functionalities by taking two operands from the programmer or user. There are multiple binary operators in OOPS (c++) like +, -, *, /, etc., that can directly manipulate or overload the object of a class.

18. Define friend function.

A friend function is a function that is not a member of a class but has access to the class's private and protected members. Friend functions are not considered class members; they are normal external functions that are given special access privileges.

19. What are the characteristics of friend functions?

It cannot be called using the object as it is not in the scope of that class. It can be invoked like a normal function without using the object. It cannot access the member names directly and has to use an object name and dot membership operator with the member name.

20. What is the difference between friend function and friend class in OOP?

A friend function is used for accessing the non public member of a class. A class can allow non-member function and other classes to access its own private data by making them friend A Friend class has full access of private data members of another class without being member of that class.