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## 1. Java Basics

### 1. What is Java? Explain its features.

Java is a high-level, object-oriented, and platform-independent programming language used to build applications that can run on any device with a JVM.

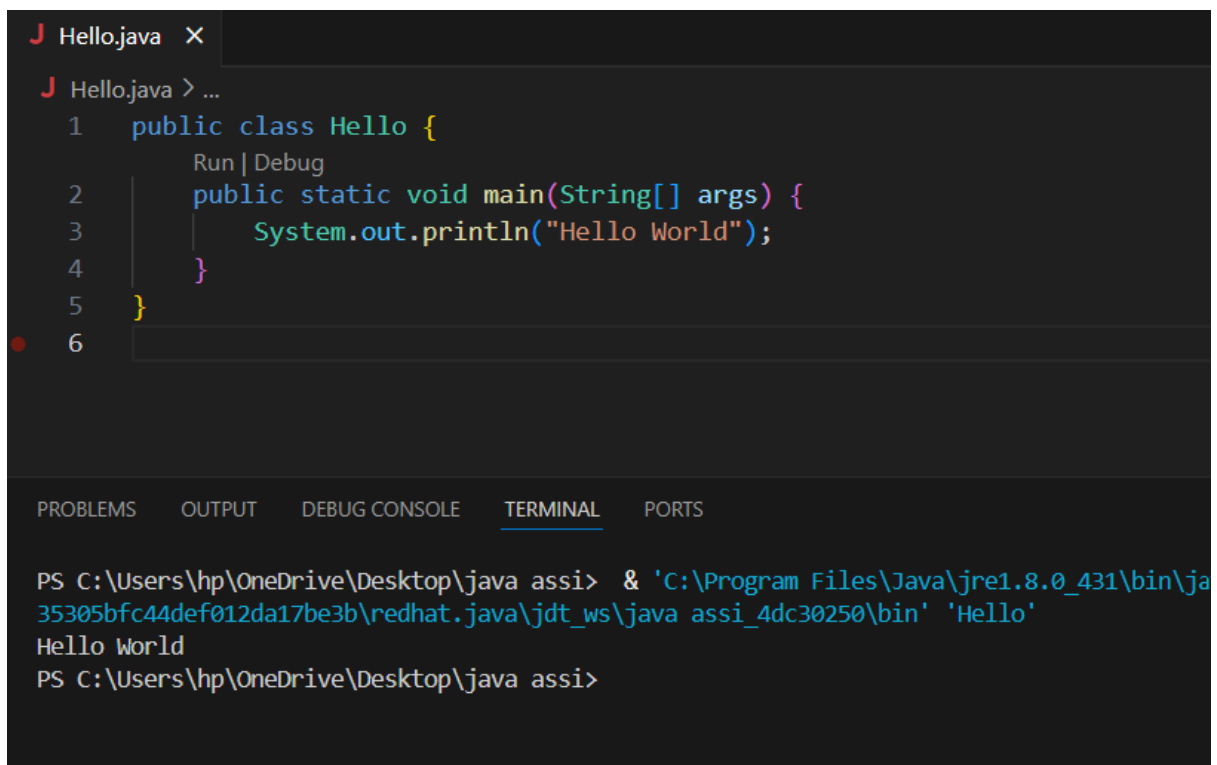
#### Features:

- **Platform Independent:** Compile once, run anywhere (WORA).
- **Object-Oriented:** Everything is treated as an object.
- **Secure:** Runs in a virtual machine sandbox.
- **Robust:** Strong memory management.
- **Multithreaded:** Supports multithreaded programming.
- **High Performance:** Just-In-Time (JIT) compiler improves performance.

### 2. Explain the Java program execution process,

1. Code is written in .java file.
2. Compiled using javac → generates .class (bytecode).
3. Bytecode is run by the JVM.

### 3. Write a simple Java program to display 'Hello World'.



The screenshot shows an IDE with a file named 'Hello.java'. The code is as follows:

```
1 public class Hello {  
2     public static void main(String[] args) {  
3         System.out.println("Hello World");  
4     }  
5 }  
6
```

Below the code editor, the 'TERMINAL' tab is active, showing the command to run the program and its output:

```
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0_431\bin\java -Xmx256m -Xms64m -jar C:\Program Files\Java\jre1.8.0_431\bin\java_assi_4dc30250\bin' 'Hello'  
Hello World  
PS C:\Users\hp\OneDrive\Desktop\java assi>
```

### 4. What are data types in Java? List and explain them.

#### 1. Primitive Data Types :

1. int – Integer (e.g., 10)
2. float – Decimal (e.g., 10.5f)
3. char – Single character (e.g., 'A')
4. Boolean – true or false
5. byte, short, long, double – Other numeric types

#### 2. Non-Primitive Data Types:

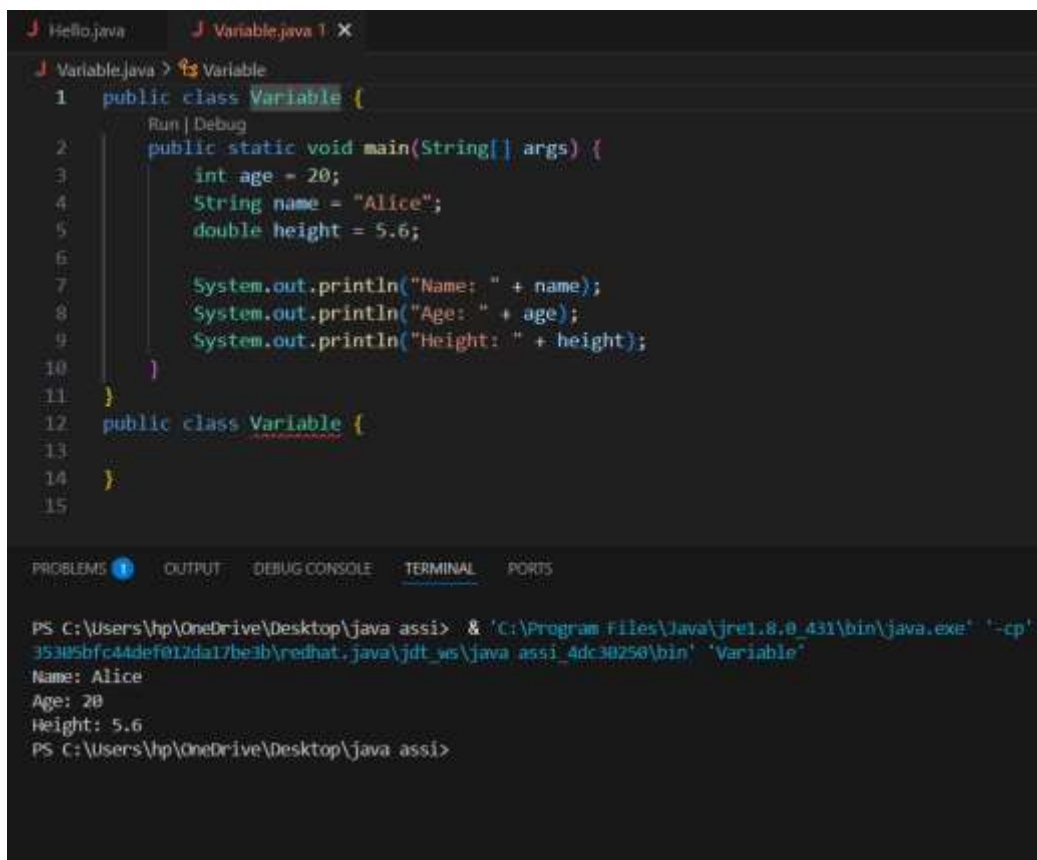
String, Arrays, Classes, Interfaces – User-defined or built-in objects.

### 5. What is the difference between JDK, JRE, and JVM?

- **JDK (Java Development Kit):**
  - Contains tools to write, compile, and run Java programs (includes JRE + compiler).
- **JRE (Java Runtime Environment):**
  - Provides environment to run Java programs (includes JVM + libraries).
- **JVM (Java Virtual Machine):**
  - Executes Java bytecode and makes Java platform-independent.

## 6. What are variables in Java? Explain with examples.

Variables in Java are containers used to store data values. Each variable has a type, a name, and can hold a value.



The screenshot shows an IDE with two tabs: 'Hello.java' and 'Variable.java'. The 'Variable.java' tab is active, displaying the following code:

```
1 public class Variable {  
    Run | Debug  
2     public static void main(String[] args) {  
3         int age = 20;  
4         String name = "Alice";  
5         double height = 5.6;  
6  
7         System.out.println("Name: " + name);  
8         System.out.println("Age: " + age);  
9         System.out.println("Height: " + height);  
10    }  
11 }  
12 public class Variable {  
13  
14 }  
15
```

Below the code editor, the 'TERMINAL' tab is active, showing the command used to compile and run the program:

```
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0_431\bin\java.exe' '-cp' '35305bfc44def012da17be3b\redhat.java\jdt_ws\java assi_4dc30250\bin' 'Variable'
```

The output of the program is displayed in the terminal:

```
Name: Alice  
Age: 20  
Height: 5.6  
PS C:\Users\hp\OneDrive\Desktop\java assi>
```

## 7. What are the different types of operators in Java?

### Types of Operators in Java:

1. **Arithmetic Operators:** +, -, \*, /, %
2. **Relational Operators:** ==, !=, >, <, >=, <=
3. **Logical Operators:** &&, ||, !
4. **Assignment Operators:** =, +=, -=, \*=, /=, %=
5. **Unary Operators:** +, -, ++, --, !
6. **Bitwise Operators:** &, |, ^, ~, <<, >>
7. **Ternary Operator:** condition ? expr1 : expr2
8. **Instanceof Operator:** Checks object type – obj instanceof Class

## 8. Explain control statements in Java (if, if-else, switch).

### 1. if Statement

Executes a block of code only if a specified condition is true.

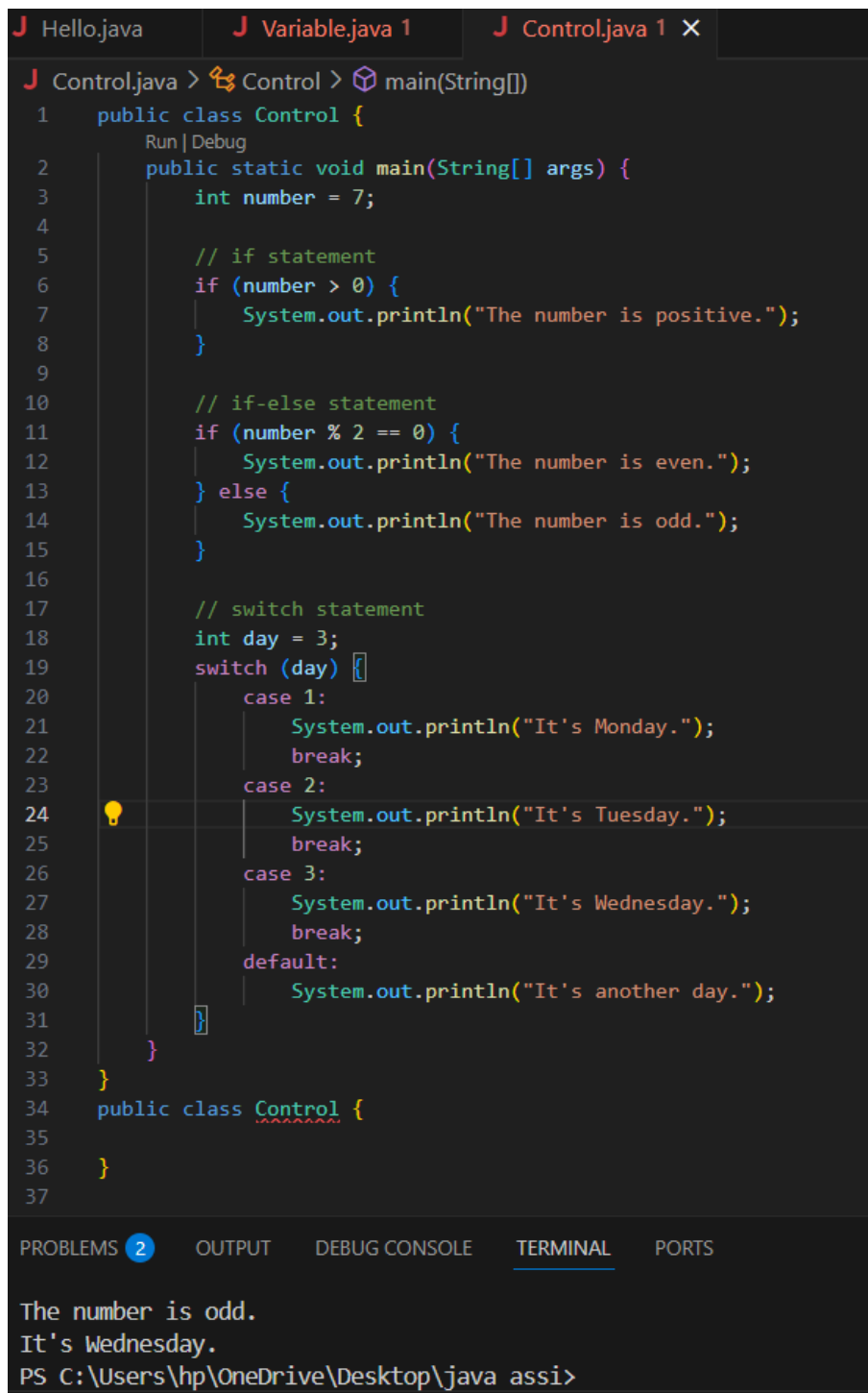
### 2. if-else Statement

Executes one block of code if the condition is true, otherwise executes another block.

### 4. switch Statement

Used to select one option from multiple choices based on the value of a variable. Each

option is called a "case"



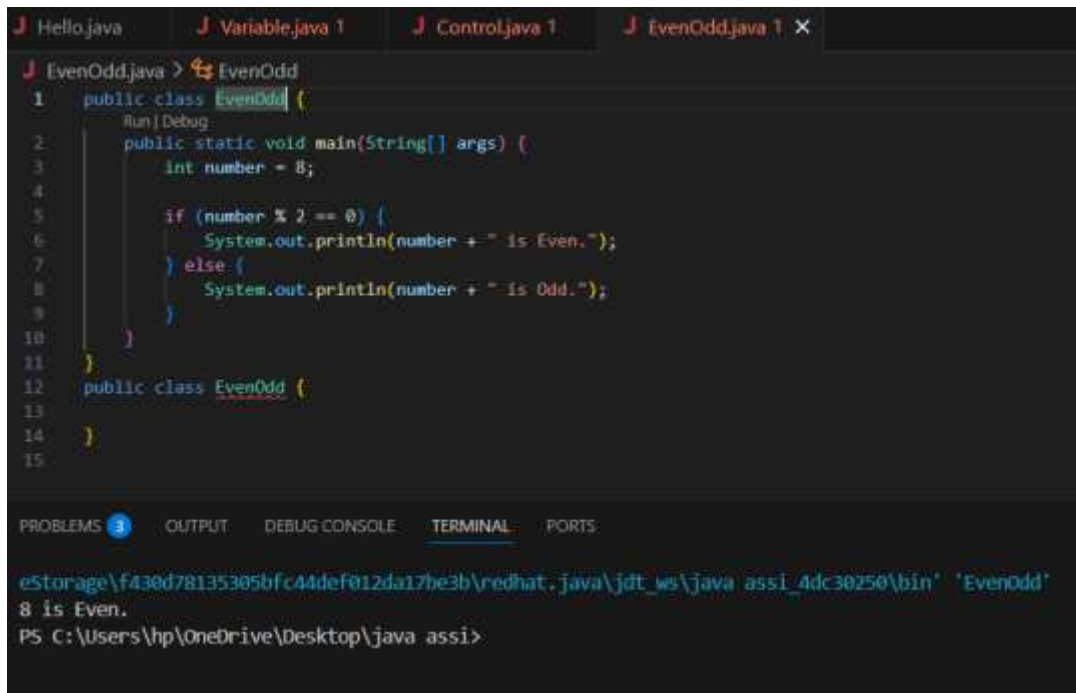
The screenshot shows an IDE with three tabs: 'Hello.java', 'Variable.java 1', and 'Control.java 1 X'. The 'Control.java' tab is active, displaying a Java program. The code defines a 'Control' class with a 'main' method. Inside 'main', it initializes 'number' to 7. It then uses an 'if' statement to check if 'number' is greater than 0, printing 'The number is positive.' if true. Next, it uses an 'if-else' statement to check if 'number' is even (number % 2 == 0), printing 'The number is even.' if true, or 'The number is odd.' if false. Finally, it uses a 'switch' statement to check the value of 'day' (initialized to 3), printing the corresponding day of the week. The IDE's output window at the bottom shows the execution results: 'The number is odd.' and 'It's Wednesday.' The terminal prompt is 'PS C:\Users\hp\OneDrive\Desktop\java assi>'.

```
Control.java > Run | Debug main(String[])
1 public class Control {
2     public static void main(String[] args) {
3         int number = 7;
4
5         // if statement
6         if (number > 0) {
7             System.out.println("The number is positive.");
8         }
9
10        // if-else statement
11        if (number % 2 == 0) {
12            System.out.println("The number is even.");
13        } else {
14            System.out.println("The number is odd.");
15        }
16
17        // switch statement
18        int day = 3;
19        switch (day) {
20            case 1:
21                System.out.println("It's Monday.");
22                break;
23            case 2:
24                System.out.println("It's Tuesday.");
25                break;
26            case 3:
27                System.out.println("It's Wednesday.");
28                break;
29            default:
30                System.out.println("It's another day.");
31        }
32    }
33 }
34 public class Control {
35
36 }
37
```

PROBLEMS 2 OUTPUT DEBUG CONSOLE TERMINAL PORTS

The number is odd.  
It's Wednesday.  
PS C:\Users\hp\OneDrive\Desktop\java assi>

**9. Write a Java program to find whether a number is even or odd.**



```
1 public class EvenOdd {
2     public static void main(String[] args) {
3         int number = 8;
4
5         if (number % 2 == 0) {
6             System.out.println(number + " is Even.");
7         } else {
8             System.out.println(number + " is Odd.");
9         }
10    }
11 }
12 public class EvenOdd {
13 }
14 }
15 }
```

PROBLEMS 3 OUTPUT DEBUG CONSOLE TERMINAL PORTS

eStorage\430d78135305bfc44def012da17be3b\redhat.java\jdk\_ws\java\_assi\_4dc30250\bin' 'EvenOdd'  
8 is Even.  
PS C:\Users\hp\OneDrive\Desktop\java\_assi>

## 10.What is the difference between while and do-while loop?

- In a while loop, the condition is checked before the loop body is executed.
- In a do-while loop, the condition is checked after the loop body is executed.
- The while loop may not run at all if the condition is false initially.
- The do-while loop will always run at least once, even if the condition is false.
- while loop is used when you want to run the loop only if the condition is true.
- do-while loop is used when you want the loop to run once before checking the condition.

## 2.Object-OrientedProgramming

**1. What are the main principles of OOPs in Java? Explain each.**

**Main Principles of OOPs in Java:**

**1. Encapsulation**

- Wrapping data and methods into a single unit (class).
- Achieved using private variables and public getters/setters.

**2. Abstraction**

- Hiding internal details and showing only essential features.
- Done using abstract classes and interfaces.

**3. Inheritance**

- One class inherits properties of another class.
- Promotes code reuse using the extends keyword.

**4. Polymorphism**

- One task, many forms.
- Compile-time polymorphism: method overloading.
- Runtime polymorphism: method overriding.

**2. What is a class and an object in Java? Give examples.**

**Class:** A class in Java is a blueprint for creating objects. It defines properties (variables) and behaviors (methods).

**Object:** An object is an instance of a class. It holds real values and can use class methods.

```

Hello.java  Variable.java  Control.java  EvenOdd.java  Main.java X
Main.java > ...
1 // Class
2 class Student {
3     String name;
4     int age;
5
6     void display() {
7         System.out.println(name + " is " + age + " years old.");
8     }
9 }
10
11 // Object
12 public class Main {
13     Run | Debug
14     public static void main(String[] args) {
15         Student s1 = new Student(); // Creating object
16         s1.name = "John";
17         s1.age = 20;
18         s1.display();
19     }
20 }
21
22 public class Main {
23 }
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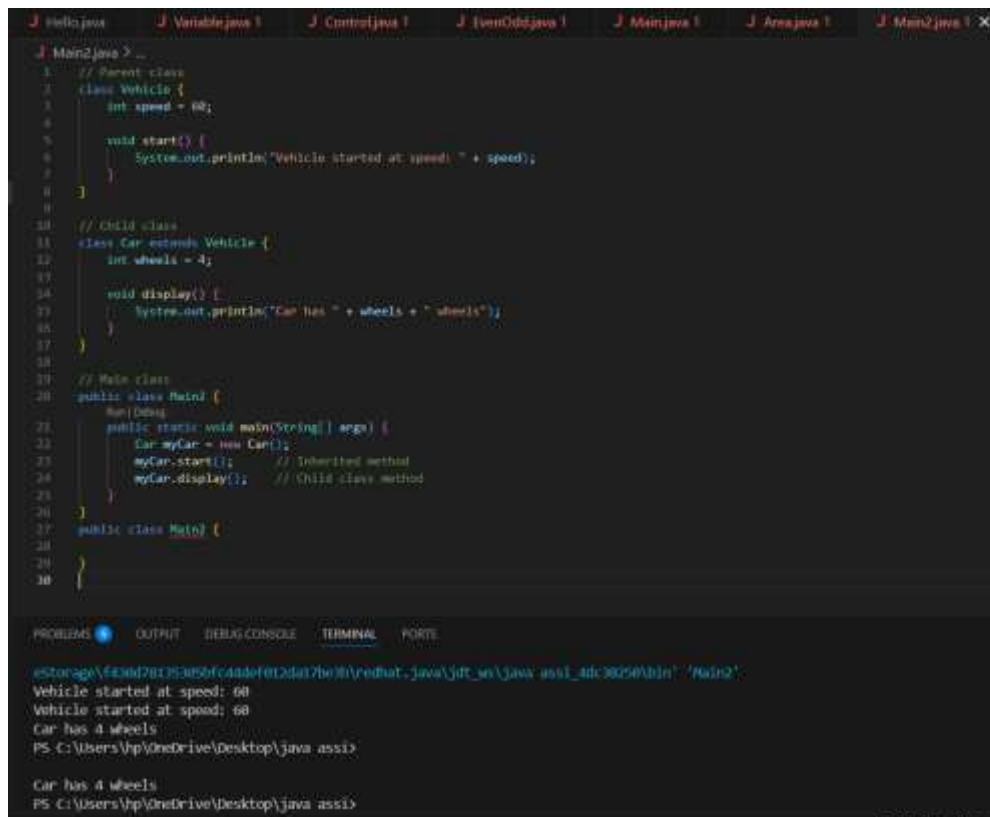


## 4.Explain inheritance with real-life example and Java code.

Inheritance is an OOP principle where one class (child) inherits the properties and behaviors of another class (parent). It promotes code reusability and supports method overriding.

Real-life Example:

- Parent Class: Vehicle – has general features like speed and start().
- Child Class: Car – inherits from Vehicle and adds wheels.



```
1 // Parent class
2 class Vehicle {
3     int speed = 60;
4
5     void start() {
6         System.out.println("Vehicle started at speed: " + speed);
7     }
8 }
9
10 // Child class
11 class Car extends Vehicle {
12     int wheels = 4;
13
14     void display() {
15         System.out.println("Car has " + wheels + " wheels");
16     }
17 }
18
19 // Main class
20 public class Main {
21     public static void main(String[] args) {
22         Car myCar = new Car();
23         myCar.start(); // Inherited method
24         myCar.display(); // Child class method
25     }
26 }
27
28 public class Main2 {
29 }
30 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

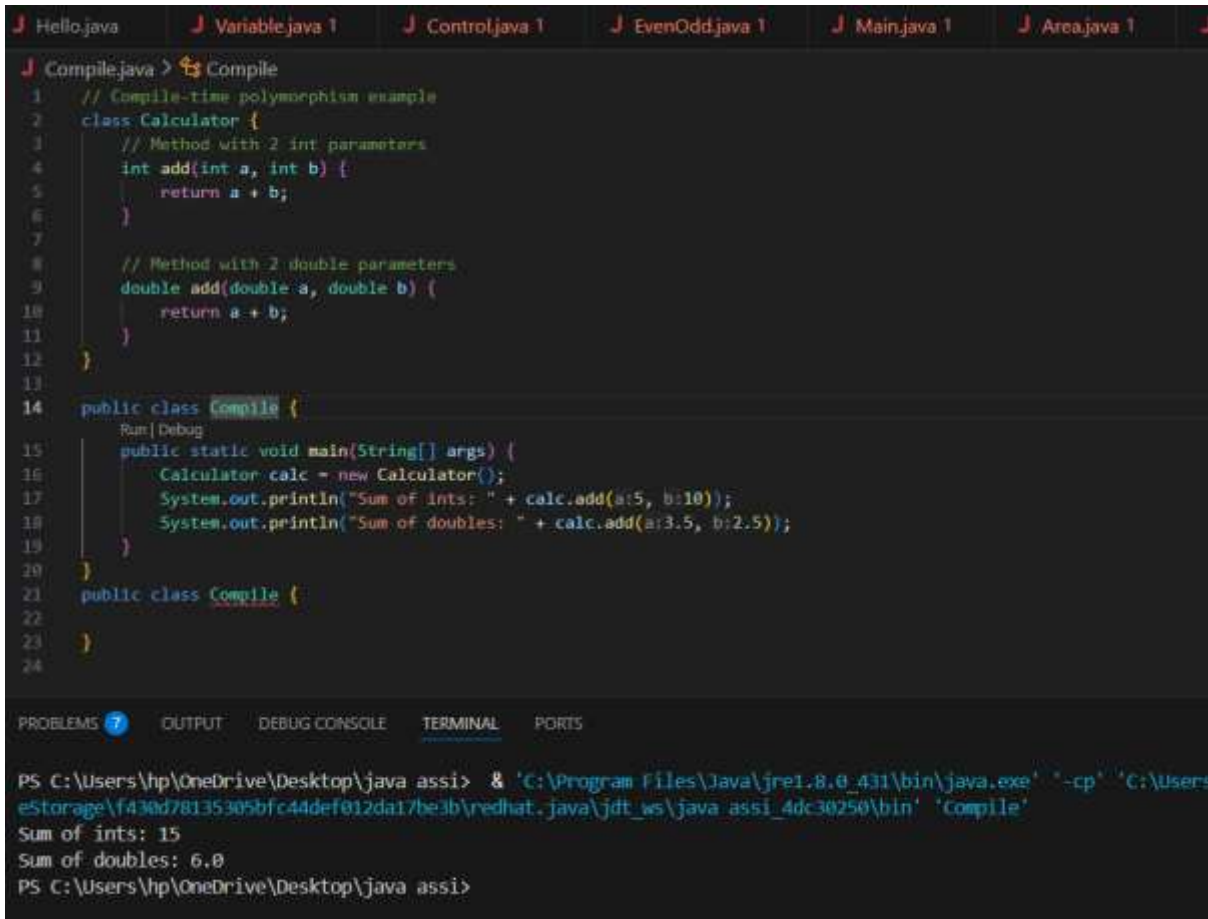
```
@Storage\F430d701PS3050fca4d0f012da7b00\redhat_java\jdk_8x\java_ansi_40c3050\bin> "Main2"
Vehicle started at speed: 60
Vehicle started at speed: 60
Car has 4 wheels
PS C:\Users\hp\OneDrive\Desktop\java ass1>
Car has 4 wheels
PS C:\Users\hp\OneDrive\Desktop\java ass1>
```

## 5.What is polymorphism? Explain with compile-time and runtime examples.

Polymorphism in Java means one name, many forms. It allows the same method name to perform different tasks.

Types of Polymorphism:

## 1. Compile-Time Polymorphism (Method Overloading) Same method name, different parameters.



```
1 // Compile-time polymorphism example
2 class Calculator {
3     // Method with 2 int parameters
4     int add(int a, int b) {
5         return a + b;
6     }
7
8     // Method with 2 double parameters
9     double add(double a, double b) {
10        return a + b;
11    }
12 }
13
14 public class Compile {
15     public static void main(String[] args) {
16         Calculator calc = new Calculator();
17         System.out.println("Sum of ints: " + calc.add(5, 10));
18         System.out.println("Sum of doubles: " + calc.add(3.5, 2.5));
19     }
20 }
21
22 public class Compile {
23 }
24
```

PROBLEMS 7 OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0_431\bin\java.exe' -cp 'C:\Users\hp\OneDrive\Desktop\java assi\Compile' 'Compile'
Sum of ints: 15
Sum of doubles: 6.0
PS C:\Users\hp\OneDrive\Desktop\java assi>
```

## 2.Runtime Polymorphism (Method Overriding)

- Subclass provides specific implementation of a method already defined in its parent.

```
J runtime.java > runtime
1 // Runtime polymorphism example
2 class Animal {
3     void sound() {
4         System.out.println("Animal makes a sound");
5     }
6 }
7
8 class Dog extends Animal {
9     @Override
10    void sound() {
11        System.out.println("Dog barks");
12    }
13 }
14
15 class Cat extends Animal {
16     @Override
17    void sound() {
18        System.out.println("Cat meows");
19    }
20 }
21
22 public class runtime {
23     Run | Debug
24     public static void main(String[] args) {
25         Animal a;
26
27         a = new Dog();
28         a.sound(); // Output: Dog barks
29
30         a = new Cat();
31         a.sound(); // Output: Cat meows
32     }
33 }
34
35 public class runtime {
36 }
37
38 PROBLEMS 0 OUTPUT DEBUG CONSOLE TERMINAL PORTS
39
40 PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0_431\bin\java.exe' '-cp' 'C:\Program Files\Java\jre1.8.0_431\bin\java.exe' 'runtime'
41 Dog barks
42 Cat meows
```

## 5.What is method overloading and method overriding? Show with examples.

- Method Overloading (Compile-Time Polymorphism)  
Same method name, but different parameters in the same class.

```
Overloading.java > Overloading
1 class MathOperations {
2     int add(int a, int b) {
3         return a + b;
4     }
5
6     double add(double a, double b) {
7         return a + b;
8     }
9 }
10
11 public class Overloading {
12     Run | Debug
13     public static void main(String[] args) {
14         MathOperations obj = new MathOperations();
15         System.out.println("Int Sum: " + obj.add(a:5, b:3));
16         System.out.println("Double Sum: " + obj.add(a:2.5, b:1.5));
17     }
18 }
19
20 public class Overloading {
21 }
22 }
```

PROBLEMS 10 OUTPUT DEBUG CONSOLE TERMINAL PORTS

eStorage\438d78135385bfc44def812da17be3b\redhat.java\jdt\_ws\java\_assi\_4dc38250\bin' 'Overloading'  
Int Sum: 8  
Double Sum: 4.0  
PS C:\Users\hp\OneDrive\Desktop\java assi>

- Method Overriding (Runtime Polymorphism)  
Same method name and parameters, but defined in child class to override parent method.

```
EvenOdd.java 1 Main.java 1 Area.java 1 Main2.java 1 Compile.java 1 runtime
overriding.java > overriding
1 class Animal {
2     void sound() {
3         System.out.println("Animal makes a sound");
4     }
5 }
6
7 class Dog extends Animal {
8     @Override
9     void sound() {
10         System.out.println("Dog barks");
11     }
12 }
13
14 public class overriding {
15     Run | Debug
16     public static void main(String[] args) {
17         Animal a = new Dog(); // Parent reference, child object
18         a.sound(); // Calls Dog's version
19     }
20 }
21
22 public class overriding {
23 }
```

PROBLEMS 10 OUTPUT DEBUG CONSOLE TERMINAL PORTS

PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0\_431\bin\java.exe' '-c  
eStorage\438d78135385bfc44def812da17be3b\redhat.java\jdt\_ws\java\_assi\_4dc38250\bin' 'overriding'  
Dog barks  
PS C:\Users\hp\OneDrive\Desktop\java assi>

## 7. What is encapsulation? Write a program demonstrating encapsulation.

Encapsulation is the concept of wrapping data (variables) and methods into a single unit (class), and restricting direct access using private access modifiers. Access is provided through getters and setters.

```
J Main.java 1 J Area.java 1 J Main2.java 1 J Compile.java 1 J r
J main3.java > main3 > main(String[])
1  class Person {
2      // Private data members
3      private String name;
4      private int age;
5
6      // Public getter method
7      public String getName() {
8          return name;
9      }
10
11     // Public setter method
12     public void setName(String newName) {
13         name = newName;
14     }
15
16     public int getAge() {
17         return age;
18     }
19
20     public void setAge(int newAge) {
21         age = newAge;
22     }
23 }
24
25 public class main3 {
26     Run | Debug
27     public static void main(String[] args) {
28         Person p = new Person();
29         p.setName(newName:"Alice");
30         p.setAge(newAge:25);
31
32         System.out.println("Name: " + p.getName());
33         System.out.println("Age: " + p.getAge());
34     }
35 }
36
37 public class main3 {
38 }
```

```
PROBLEMS 11 OUTPUT DEBUG CONSOLE TERMINAL PORTS
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1
eStorage\430d78135305bfc44def012da17be3b\redhat.java\jdt_ws\java assi_4d
Name: Alice
Age: 25
PS C:\Users\hp\OneDrive\Desktop\java assi>
```

## 8. What is abstraction in Java? How is it achieved?

Abstraction is the process of hiding internal details and showing only essential features to the user.

It helps reduce complexity and increase code clarity.

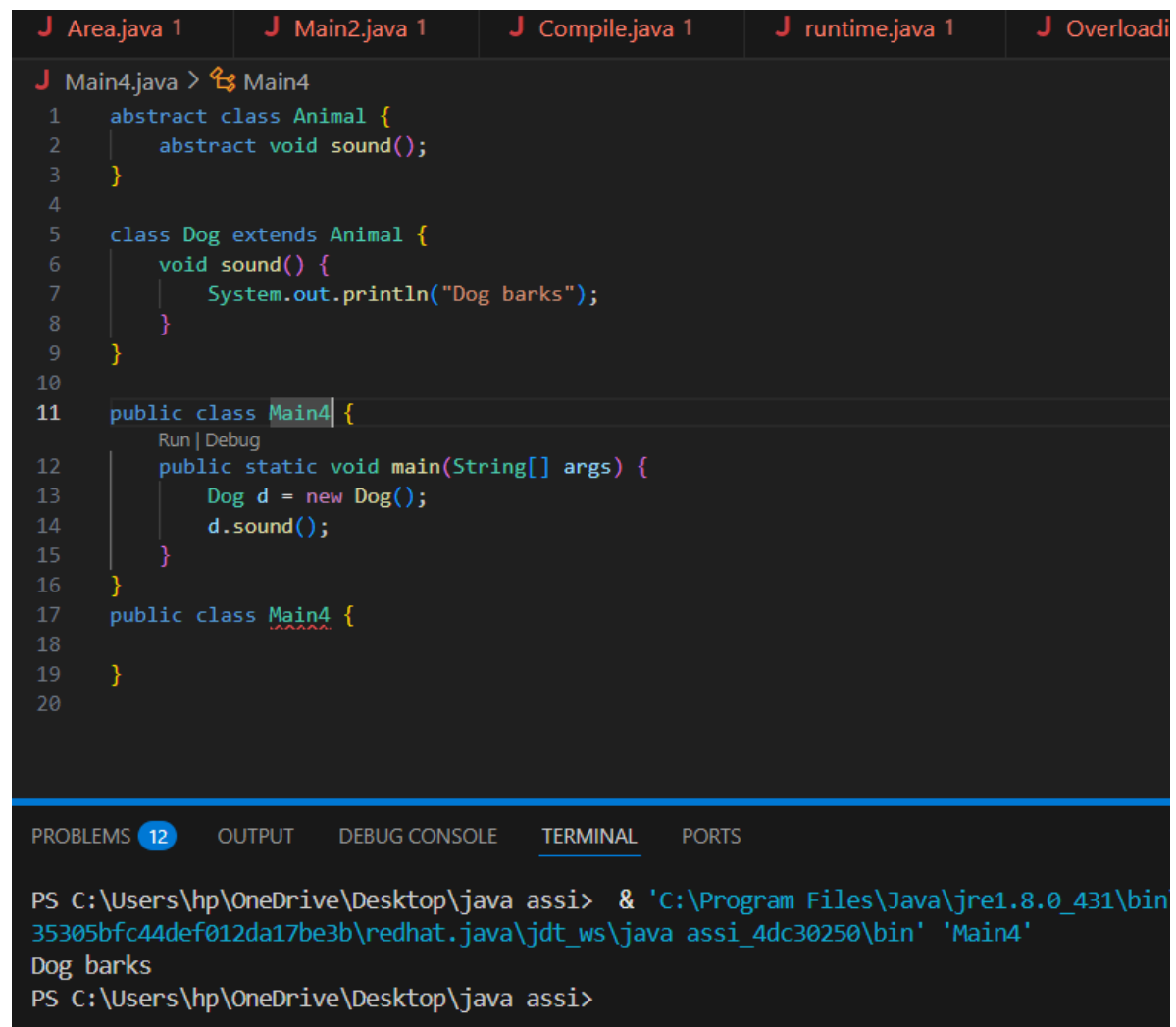
Abstraction is achieved in java :

### 1.Using Abstract Classes

- A class with abstract keyword
- Can have both abstract (no body) and concrete methods

### 2.Using Interfaces

- Contains only abstract methods (Java 8+ can have default/static too)

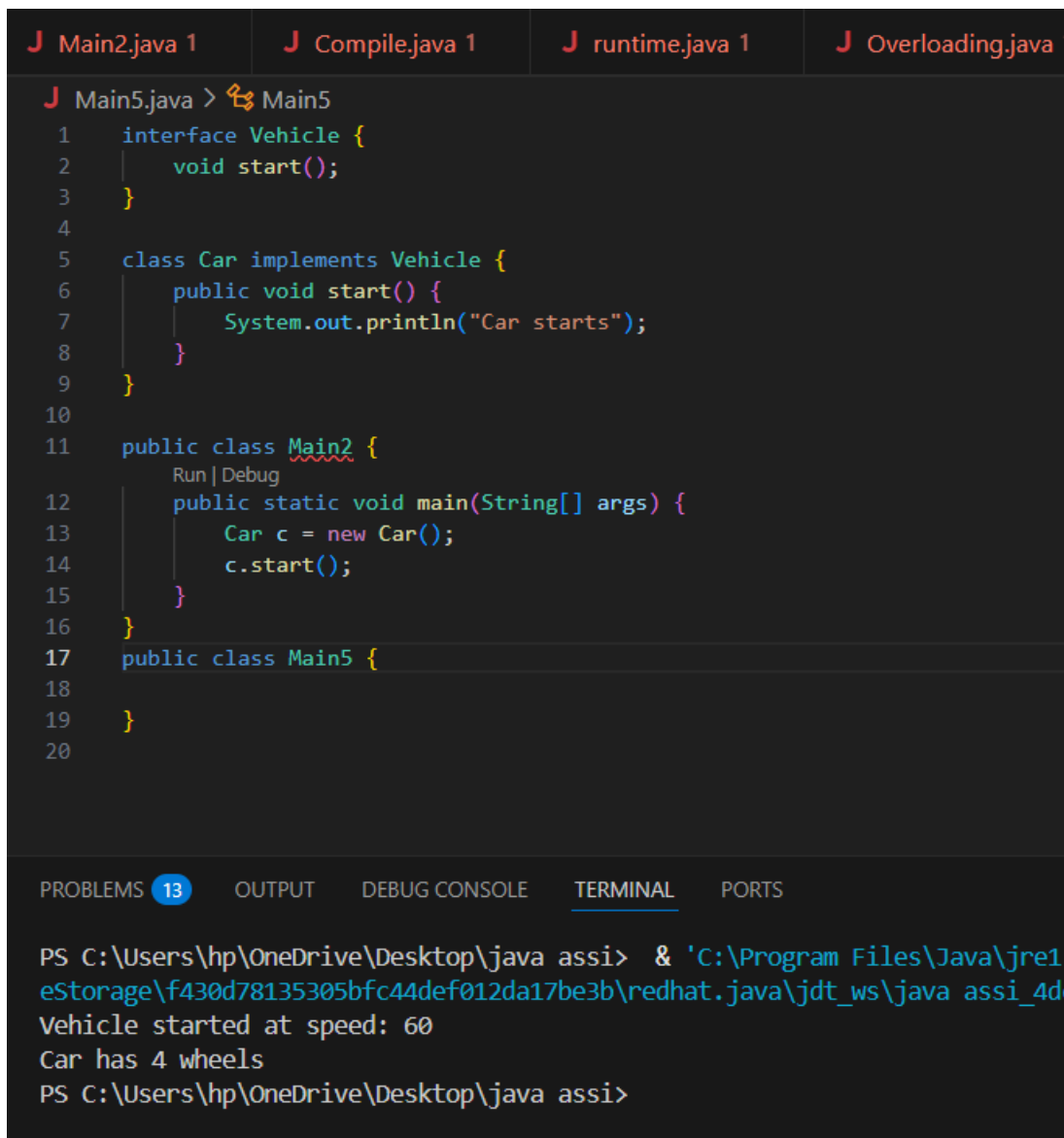


The screenshot shows an IDE with several tabs at the top: Area.java 1, Main2.java 1, Compile.java 1, runtime.java 1, and Overloadi. The active tab is Main4.java, which contains the following code:

```
1  abstract class Animal {
2      abstract void sound();
3  }
4
5  class Dog extends Animal {
6      void sound() {
7          System.out.println("Dog barks");
8      }
9  }
10
11 public class Main4 {
12     public static void main(String[] args) {
13         Dog d = new Dog();
14         d.sound();
15     }
16 }
17 public class Main4 {
18 }
19
20
```

Below the code editor, there is a terminal window. The terminal shows the command to run the program and its output:

```
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1.8.0_431\bin
35305bfc44def012da17be3b\redhat.java\jdt_ws\java_assi_4dc30250\bin' 'Main4'
Dog barks
PS C:\Users\hp\OneDrive\Desktop\java assi>
```



The screenshot shows an IDE with four tabs at the top: 'Main2.java 1', 'Compile.java 1', 'runtime.java 1', and 'Overloading.java'. The active tab is 'Main5.java > Main5'. The code in the editor is as follows:

```
1 interface Vehicle {
2     void start();
3 }
4
5 class Car implements Vehicle {
6     public void start() {
7         System.out.println("Car starts");
8     }
9 }
10
11 public class Main2 {
12     Run | Debug
13     public static void main(String[] args) {
14         Car c = new Car();
15         c.start();
16     }
17 }
18 public class Main5 {
19 }
20
```

Below the code editor, there is a tab bar with 'PROBLEMS 13', 'OUTPUT', 'DEBUG CONSOLE', 'TERMINAL', and 'PORTS'. The 'TERMINAL' tab is selected, showing the following output:

```
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jre1
eStorage\f430d78135305bfc44def012da17be3b\redhat.java\jdt_ws\java assi_4d
Vehicle started at speed: 60
Car has 4 wheels
PS C:\Users\hp\OneDrive\Desktop\java assi>
```

## 9. Explain the difference between abstract class and interface.

1. Abstract class can have both abstract and concrete methods; interface has only abstract methods (until Java 7).
2. Abstract class can have constructors and instance variables; interface cannot have constructors, only constants.
3. A class can extend only one abstract class, but can implement multiple interfaces.
4. Abstract class members can have any access modifier; interface members are always public.
5. Use abstract class for shared code; use interface to define a common behavior (contract).

6. From Java 8, interfaces can have default and static methods.
7. Interfaces can be used as functional interfaces; abstract classes cannot.

## 10. Create a Java program to demonstrate the use of interface.

```
J Overloading.java 1 X J overriding.java 1 J main3.java 1 J Main4.java
J InterfaceExample2.java > InterfaceExample2
1 // Define the interface
2 interface Shape {
3     void draw(); // abstract method
4 }
5
6 // Implementing the interface in Circle class
7 class Circle implements Shape {
8     public void draw() {
9         System.out.println("Drawing Circle");
10    }
11 }
12
13 // Implementing the interface in Square class
14 class Square implements Shape {
15     public void draw() {
16         System.out.println("Drawing Square");
17    }
18 }
19
20 // Main class to test interface implementation
21 public class InterfaceExample2 {
22     public static void main(String[] args) {
23         // Creating objects using interface reference
24         Shape shape1 = new Circle();
25         Shape shape2 = new Square();
26
27         // Calling the draw method
28         shape1.draw();
29         shape2.draw();
30     }
31 }
32 public class InterfaceExample2 {
33 }
34 }
35
```

```
PROBLEMS 14 OUTPUT DEBUG CONSOLE TERMINAL PORTS
PS C:\Users\hp\OneDrive\Desktop\java assi> & 'C:\Program Files\Java\jdk-8.0.602\bin\java.exe' -cp 'C:\Program Files\Java\jdk-8.0.602\bin\java_assi_4dc30250\bin' 'InterfaceExample2'
Drawing Circle
Drawing Square
PS C:\Users\hp\OneDrive\Desktop\java assi>
```