

★ YouTube → Faisal Memon

Type of Programming Languages

① Low-Level Languages :: →

These are closest to the computer hardware and are directly understood by the machine

Example

① Machine Language :: → Written in binary code (0s and 1s)

② Assembly Language :: Uses symbolic codes (like - MOV, ADD, SUB etc).

* Used for :- System programming device drivers and embedded systems.

② High-level Language :: These are easy

for humans to understand and write. They require a compiler or interpreter to translate into machine code.

Example C, C++, Java, Python etc.

③

Procedural Languages:

These are based on a step-by-step Procedure or instructions.

Example: C, Pascal, Fortran.

Used: Scientific, Mathematical and general Purpose programming.

④ Functional Languages:

These focus on functions and avoid changing state or data.

Example: Lisp, Haskell, Scala.

Used: Artificial intelligence, mathematical computation, and data analysis.

⑤ Scripting Languages:

These are mainly used for automation and web scripting.

Example: JavaScript, Python, PHP, Perl, etc

Used: Web development, automation scripts, and server management.

⑥ Markup and Query Languages

These are used to structure, format, or manage data.

- Example
- HTML (Hyper Text Markup Language) - for creating web pages
 - SQL (Structured Query Language) for managing databases.
 - XML/JSON - for data exchange between systems.

⑦: → Object Oriented Programming (OOPs)

- ⊙ Everything is represented in the form of objects.
- ⊙ Objects are instance of classes
- ⊙ Class is like a blueprint, Object is a real thing built from that blueprint.

In Simple words:

OOPs helps us design software by thinking in terms of real-world entities - like a car, Student, bank account etc.



OOPs Principles

- ⊙ Encapsulation
- ⊙ Abstraction
- ⊙ Inheritance
- ⊙ Polymorphism

★ Class in Java: A class is a blueprint or template for creating objects. It defines what data (variables) and functions (method) an object will have.

Example

```
Class car {
```

```
    String brand;
```

```
    int speed;
```

```
    void drive() {
```

```
        System.out.println(brand + " is  
        driving at " + speed + " km/h");
```

```
    }
```

```
}
```

* Object:

An Object is an instance of a class - a real example created using that blueprint.

Example: Car myCar = new Car();
myCar.brand = "Tesla";
myCar.speed = 120;
myCar.drive();

Example :- Class and Objects:

```
Class Car {  
    // Attributes  
    String brand;  
    int speed;  
    // Method (behavior)  
    void drive () {  
        System.out.println(brand + " is  
        driving at " + speed + "km/h");  
    }  
}
```



```
Public class Main {
```

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

```
        Car Toyota = new Car ();
```

```
        Toyota.brand = "Toyota";
```

```
        Toyota.speed = 100;
```

```
        Car Kia = new Car ();
```

```
        Kia.brand = "Kia";
```

```
        Kia.speed = 120;
```

```
// Call the drive () method for  
both Objects.
```

```
        Toyota.drive ();
```

```
        Kia.drive ();
```

```
    }
```

```
}
```

Output:- Toyota is driving at 100 km/h
Kia is driving at 120 km/h.

★ What is a Constructor in Java?

A constructor is a special method in Java that is automatically called when an object of a class is created.

Syntax of a Constructor:

Class ClassName {
 ClassName (---) {
 // ---
 }
}

Important Rule:

- ⊙ The Constructor's name must be the same as the class name.
- ⊙ It has no return type - not even void.

★ Types of Constructors :-

Java में तीन तरह के Constructors होते हैं :-

① Default Constructor:

A Constructor with no Parameters.

If you do not define any Constructor, Java automatically provides a default Constructor.

Example. ^{small} Class Car {
 String brand;
 int speed;
 // Default Constructor
 Car() {
 brand = "Unknown";
 Speed = 0;
 }
 void show() {
 System.out.println(brand + " is
 driving at " + speed + " km/h");
 }
}

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


```
Car c = new Car(); // Default  
Constructor called  
c.show();
```

}
}
Output: Unknown is driving at 0km/h

② Parameterized Constructor:

A Constructor that takes parameters to initialize specific values:

* → Home-Work: "This is what we
Used in your Car example"

③: Copy Constructor (User-Defined);

* Java does not have a built-in copy constructor like C++, but we can make one manually to copy data from an other object.

Example

```
class Car {  
    String brand;  
    String color;  
    int speed;
```

// Parameterized constructor

```
Car (String b, String c, int s) {  
    brand = b;  
    color = c;  
    speed = s;  
}
```

// Copy Constructor

```
Car (Car obj) {  
    brand = obj.brand;  
    color = obj.color;  
    speed = obj.speed;  
}
```

```
void show () {  
    System.out.println("brand + "  
        (" + color + ") speed: " + speed);  
}
```

```

public class Main {
    public static void main (String [] args) {
        Car Toyota = new Car("Toyota",
                               "Red", 100);

        Car CopyCar = new Car(Toyota);
        // Copy constructor called.
        Toyota.show();
        CopyCar.show();
    }
}

```

Output: Toyota (Red) speed : 100 → Toyota
 Toyota (Red) speed : 100 → CopyCar

Note: → "this" keyword in Java is a reference variable that refers to the current object (the object which is calling the method or constructor)

Home-work: " Create a class Car with instance variables using (this keyword)

- brand (String)
- color (String)
- Speed (int)

★ Getter and Setter in Java.

Getters and Setters are special methods used to access and modify private variables of a class.

They help in encapsulation - hiding data and controlling access to it.

⑥ Why Use Them?

- ① To make class fields private (data hiding)
- ② To provide controlled access to variables
- ③ To validate or modify data before setting or returning it.

Example

```
Class Student {  
    Private String name;  
    Private int age;  
    // Getter to read value  
    Public String getName() {  
        return name;  
    }  
}
```

// Setter to Set Value.

```
Public void setName (String name) {  
    this.name = name;  
}
```

```
Public int getAge () {  
    return age;  
}
```

```
Public void setAge (int Age) {  
    if (age > 0) {
```

```
// Validation --
```

```
    this.age = age;
```

```
    } else {
```

```
        System.out.println ("Age must be  
        Positive!");
```

```
    }  
}  
}
```

```
Public class Main {
```

```
    Public static void main (String [] args) {
```

```
        Student s1 = new Student ();
```

```
        s1.setName ("Sandy");
```

```
        s1.setAge (24);
```

```
System.out.println("Name : " + S1.getName());
```

```
System.out.println("Age : " + S1.getAge());
```

```
}  
}
```

Output: Name : Sandy
 Age : 24

Key Points:

Concept

Description

Getter - - - - - Used to read private data (getVariableName())

Setter - - - - - Used to write/update private data (setVariableName())

Encapsulation

Achieved by making variables private and using getters/setters.

Validation - - - - - Can be added inside setter to control input.

Naming Rule: - - - Always starts with get or set followed by variable name. (capitalized.)

★ What is a Record in Java:

A Record in Java is a special types of class introduced in Java 14 (Preview) and made stable in Java 16. Used to store immutable data in a compact way.

Example

```
public record Student (String name,  
    int age) { }  
  
public class Main {  
    public static void main (String [] args) {  
        Student s1 = new Student ("Sandy", 24);  
        System.out.println (s1.name());  
        // Getter  
        System.out.println (s1.age());  
        System.out.println (s1);  
        // Auto toString()  
    }  
}
```

Output:

Sandy
24

Student [name = Sandy, age 24].

* Key Features:

- ① Immutable
- ② Auto-generated methods
- ③ Compact syntax
- ④ Can implement interfaces ! "yes"
- ⑤ Cannot extend classes
- ⑥ No setters.

⊗ What is Encapsulation in Java:

Encapsulation means binding data (variables) and methods (function) that operate on that data into a single unit (class) and restricting direct access to the data.

★ Key Concept:

- Make variables private not accessible directly.
- Use getter and setter methods to access or modify data safely.

Example

```
class Car {
```

```
    private String brand; // data hidden
```

```
    private int speed;
```

```
    // Getter
```

```
    public String getBrand() {
```

```
        return brand;
```

```
    }
```

```
    // Setter
```

```
    public void setBrand(String brand) {
```

```
        this.brand = brand;
```

```
    }
```

```
    public int getSpeed() {
```

```
        return speed;
```

```
    }
```

```
    // setter with validation.
```

```
    public void setSpeed(int speed) {
```

```
        if (speed > 0)
```

```
            this.speed = speed;
```

```
        else
```

```
            System.out.println("Speed must be  
positive!");
```

```
        }  
    }
```



```
Public class Main {  
    Public Static void main(String[] args) {  
        Car car = new Car();  
        car.setBrand("Toyota");  
        car.setSpeed(120);  
        System.out.println("Brand:" + car.getBrand());  
        System.out.println("Speed: " + car.getSpeed());  
    }  
}
```

Output: Brand : Toyota
 Speed : 120

• Advantages:

- ① Data Security
- ② Data Control
- ③ Code Flexibility
- ④ Improved Maintenance

* Inheritance in Java

Inheritance is a mechanism in Java by which one class (child/subclass) can acquire Properties and behaviors (fields and methods) of another class (Parent/ Superclass).

⊙ Purpose:

- ⊙ To reuse code
- ⊙ To avoid duplication
- ⊙ To establish relationship between classes.
- ⊙ To support polymorphism.

Example → // Parent Class

```
class Vehicle {  
    String brand = "Generic Vehicle";  
    void start() {  
        System.out.println(brand + " is  
            starting....");  
    }  
}
```

// Child class

```
class Car extends Vehicle {  
    int speed = 120;  
    void showDetails() {  
        System.out.println(brand + " running at" +  
            speed + " KM/h");  
    }  
}
```

// Main class

```
Public class Main {  
    Public Static void main (String[] args) {  
        Car Car Small Car = new Car();  
        Car.start();  
        Car.showDetails();  
    }  
}
```

Output: Generic Vehicle is starting....
Generic Vehicle running at 120 km/h.

⇒ Types of Inheritance in Java.

Type	Description
① - Single Inheritance	One class inherits another
② Multilevel Inheritance	Class inherits from another class which is already a subclass.
③ Hierarchical In -	Multiple subclasses inherit from one parent
④ Multiple Inheritance (through interface.)	- One class implements multiple interfaces.

* Advantages of Inheritance:-

- ① Code Reusability
- ② Easy Maintenance
- ③ Method Overriding
- ④ Clean Structure

* Rules of Inheritance:

- ① Private members of parent are not inherited
- ② Constructors are not inherited but can be called using `super()`
- ③ Java does not support multiple inheritance with classes (only via interfaces)
- ④ Order of constructor call, : Parent, child.

★ Polymorphism in Java.

Polymorphism means "One name, many forms".

In Java. It allows a single method or object to behave differently based on context or object type.

* Types of Polymorphism in Java.

Type	Also called
Compile-Time	Static Polymorphism / Method Overloading
Runtime	Dynamic Polymorphism Method Overriding

① - Method Overloading.

```
class Calculator {
```

```
    int add (int a, int b) {  
        return a+b;
```

```
    }
```

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

```
public class Main {  
    public static void main(String [] args) {  
        Calculator calc = new Calculator();  
        System.out.println (calc.add (5, 10));  
        System.out.println (calc.add (5.5, 10.5));  
    }  
}
```

Output: 15
 16.0

u Same method name, different Parameters "

② Runtime Or - Method Overriding

```
class Vehicle {  
    void start () {  
        System.out.println ("Vehicle is  
            starting---");  
    }  
}
```



```
Class Car extends Vehicle {  
    @Override  
    void start() {  
        System.out.println("Car is starting---");  
    }  
}
```

```
public class Main {  
    public static void main(String[]  
        args) {  
        Vehicle = new Car(); // Parent  
        reference, child Object.  
        V.start(); // Calls Car's  
        start() - runtime poly -  
    }  
}
```

Output: - Car is starting---

★ Abstraction in Java.

Abstraction is the OOP concept of hiding internal implementation details and showing only essential features to the user.

① Abstract Class

A class declared with 'abstract' keyword. Can have abstract methods (no body) and concrete method (with body)

Cannot create objects of an abstract class directly

Syntax:

```
abstract class BankAccount {  
    String accountHolder;  
    double balance;  
    abstract void deposit(double amount);  
    abstract void withdraw(double amount);  
    void displayBalance()  
    {  
        // concrete method  
        System.out.println("Balance:" + balance);  
    }  
}
```

Key Points:

- Abstract class — Blueprint for subclasses
- Subclass must implement all abstract method
- Can have constructors, fields, and normal methods.
- Can achieve partial abstraction.

(2) Interface:

Pure abstraction! Only method signatures
(Java 8 + allows default/static methods)

Declared using interface keyword
Classes implement the interface using
implements keyword.

Example →

~~Class Robot~~

```
Interface ControlSystem {  
    void start ();  
    void stop ();  
}
```


class car implements ControlSystem {
 @Override -

 public void start() {
 System.out.println("Car Started");
 }

 @Override

 public void stop() {
 System.out.println("Car Stopped");
 }

public class Main {
 public static void main(String[]
 args) {
 ControlSystem c = new Car();
 c.start();
 c.stop();
 }
}

Output:

Car Started
Car Stopped.

* Difference between Abstract Class and Interface:

Feature	Abstract class	Interface
① Inheritance	extends	Implements
② Methods	Abstract + Concrete	Only abstract (before Java 8)
③ Variables	Can have instance Variables	Only constants (Public, Static, Final)
④ Constructor	Yes	No
⑤ Multiple Inheritance	Not allowed	Allowed (using Interfaces)
⑥ Object Creation	No	No