**Java**

**Introduction 0**

- Java was developed by James Goslin in 1995 at Sun-Microsystems

- It’s an Object Oriented Programming Langauge

- It is a compiled and interpreted language

- It is a platform independent programming language that follows the logic of **“Write once , Run anywhere”**

**Features**

- **Easy** to learn and its syntax is quite simple

- Java can be used to develop virus-free systems .

- Java is **secure** because , its programs run inside virtual machine sandbox to prevent any activity from untrusted sources

- No use of explicit **pointers** , hence address access is restricted

- It is **Robust** :

- Java checks the code during the compile-time and run-time

- Java takes care of memory allocation and releasing(erasing) by its own or Java does Garbage- collection by itself only.

- **Garbage collection** means freeing up of the redundant memory loactions

- **Portable** : Application written on one platform of Java can be easily ported to another platform as it is platform independent

- **Dynamic** : Many objects are evaluated at run time and execution is carried out . ex: Run-time Polymorphism

- **Distributed**:

-It allows a Java program running in one machine can interact or call something from the program running on another machine in the network .

- RMI(Remote Method Invocation),EJB(Enterprise Java Beans) etc. are used for creating distributed applications using Java

- **Multi-threaded** :

- Thread is a task in a process/program

- Multi-threading means multiple tasks running/executing at the same time

- This facility is provided by Java so that multiple tasks can be executed at the same time

- **Object Oriented** :

- OOP Is an approach to problem-solving where all computations are carried out using objects

- Objects are the basic units of OOP

**Application domains**

- Android Apps

- Web-based Apps(Server-side programming)

- Desktop GUI Apps

- Distributed Apps

- IoT Apps

**Introduction 1**

- A function is a block of code that perfomes a task

- Every java program must have atleast one function and that function is **main()**

- Class is a container for related functions

- Every java program must have atleast one class , which contains main() function , i.e

public class **M**ain(){

public static void main(String[] args){

}

}

- In java we use different coventions for naming classes and methods . Like ,**P**ascal**N**aming**C**onvention for classes and **c**amel**N**aming**C**onvention/**camelCaseNotation** for naming the methods

- A method is a function that belongs to a class

- In a java prpgram , each classes and methods should have access modifiers .

- Access modifier is a special keyword that determines if other classes and methods are accessible in a particular class or program . Ex:- public , private etc

- We use a package to group related classes , interfaces and enums into a single module :

- By convention the base package for a java project is the domain name of your company in reverse . ex:- **package com.company;**

- **System.out.print("Hello World")**; 🡨In this statement , **System** is a **class** belongs to **java.lang** package , **.** is an operator , **out** is a **field** and **println()** is **method** of the class .

Autopsy of **public static void main(String[] args)**

**public(Access Modifier)** - It specifies that main() method can be accessed globally or from outside of the current class.

**static(Keyword)** - It means we can access the main() method without instaciating it or without creating the object of Main() class in which exists . Hence JVM directly use this method without making any object , as the entry point of the program .

**String[]** args -It’s an Array of strings and it acts as a signature for main() function , as main() is the entry point of a Java program . As it is an array , it can store command line string-arguments passed while executing the program .

**JDK , JRE and JVM**

**JDK**

- JDK is a cross-platformed software development environment that offers a collection of tools and libraries

necessary for Java-based software applications and applets . JDK = JRE + Dev-tools

- It includes JRE , an interpreter/loader(**java)** , a compiler**(javac**) , an archiver(jar) , documentation generator(Javadoc) and other tools needed in Java development

- JDK is what we need to compile the Java source-code and It is the core package used in Java which contains JRE(Java Runtime Environment) and JVM(Java Virtual Machine)

- Applet is Java program that can be embedded into a web-page . It runs inside the web-browser and works at client-side

**JRE**

- JRE(Java Runtime Environment) is what we need to run a java program and contains a set of libraries and other files that JVM uses at the run time . JRE = JVM + Library Classes

- It is an installation package that provides an environment to only run(not develop) the java program(or application) onto your machine .

**JVM**

- JVM(Java Virtual Machine) - It is an abstract machine offers the runtime environment for codes to be executed .Basically , whatever java program we run using JDK or JRE goes into JVM and JVM is responsible for executing java prpgram line by line . hence it is also known as **interpreter**

\* full description on GFG : https://www.geeksforgeeks.org/differences-jdk-jre-jvm/

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| --- | --- | --- |
| JDK | JRE | JVM |
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**How Java codes executed under the hood**

- **Source-code is first compiled into the Bytecode and then it is interpreted to Machine code**

- Basically there are two steps involved here : Compilation and Execution

- In Compilation step , IDE uses java compiler to compile the souce-code(Main.java) into a different format called Java Byte-Code(Main.class)

- Main.class is the Bytecode-representation of the java file and Bytecode is a machine independent-encoding.

-In our java-project , **src** directory holds our source-code and , **out** directory holds the results of the compilation . Hence , Java Bytecode(**Main.class)** is also stored in **out** folder

- The Java Byte-code(Main.class) is platform-independent and That means , it can run over any OS that has JRE

- In Execution step , JRE has JVM that takes the Java Bytecode and translate it into the native code for the underlying OS . Due to this architecture is the reason why Java applications are portable or platform independent .

**Fore more info : https://www.geeksforgeeks.org/compilation-execution-java-program/**

**Data-Types**

**Primitive-types :** for storing simple values . In it , we don’t need to allocate and release memory for the variable as it is done by JRE .

int a = 5 ; 🡨 Here , 5 is stored in the location of variable **a** .

int b = a ; 🡨Here , actual value of a is assigned to **b** and stored at its location in memory.

**a = 7 ;**

System.out.println(b);

**output: 5** (b not updated alongwith a)

- Above a and b are having different memory locations . Hence , a and b are completely independent

of each other . Or , if we change the value of a to 7 , the value at b is not gonna change at all .

|  |  |  |
| --- | --- | --- |
| Type | Bytes | Range |
| **byte** | 1 | [-128,127] |
| **short** | 2 | [-32k,32k] |
| **int** | 4 | [-2B,2B] |
| **long** | 8 |  |
| **float** | 4 |  |
| **double** | 8 |  |
| **char** | 2 | A,B,c,d |
| **boolean** | 1 | true/false |

int viewCount = 123456789 or 123\_456\_789(**<2B**)

**long** viewCount = 3\_123\_456\_789 (**>2B**) , Even though we have specified long data-type , it will still act like an integer by default and hence will give error. Hence , we need to add ‘**L/l**’ suffix after the value , to make it work

**long** viewCount = 3\_123\_456\_789**L**

**float** price = 10.99 , Here , Java sees this number-value as a **double** by default and hence will throw error . Hence ,here we need to add suffix **‘F/f’**

**float** price =10.99**F**

**Reference-types:** for storing complex objects . We need to allocate memory for this variable but release is handled by JRE .

Ex:- Date **now** = **new** Date(); Here , **now** is an instance/object of Date class and it has the access to all the members of Date() class . like , **now.getTime();**

Point point1 = new Point(1,1);

Point point2 = point1;

**point1.x = 2;**

System.out.println(point2);

**Output : java.awt.Point[x=2,y=1]** (point2.x updated alongwith point1.x)

- JRE will allocate some memory for **Point(1,1)** object and point1 label is attached to a separate memory location and in that memory location the address of the Point(1,1) object will be stored instead storing the Point(1,1) object .

- When we declare a primitive variable , the value that we assigned in that variable will be stored in that memory location of the variable but , in Reference-type the variable is going to store/hold the address of that Point(1 , 1) object in memory not the actual Point() object .

- Hence , point1 and point2 are storing the address of Point() object or these are the references to the Point() object in the memory .

- Hence , point1 and point2 are not independent of each-other as they are referencing the same object in the memory .

- Changes made to point1 will be reflected in point2 , as can be seen in the output

**- Hence Reference-Types are copied by the references and Primitive-types are copied by values**

**Strings**

- In Java Strings are Reference type-always and we use **String class** to declare a string object .

like , **String new = var String(“Hello”);**

- **String var = “Hello” ;** is just a shorthand to write **String new = var String(“Hello”);**

**-** Since String is a class then the object which we declare of it can access its members(methods, classes) too . like ,

var.endsWith(“!!”) - gives a Boolean

var.startsWith(“!!”) - Boolean

var.length() - returns length od string .

var.indexOf(‘e’) - returns the index of first occurrence of character/string in the string otherwise it returns -1

var.replace(target , replacement) - replaces the target part with the replacement part and will return a new string as it doesn’t modify the actual string

var.toLowerCase() - It turns the string to Lower Case and return a new string

var.trim() - It removes the extra spaces from the beginning and the end of the string and returns a new string

- In java strings are immutable or unchangeable

**Escape Sequences**

- A character preceded by a backslash(\) is an escape sequence and has special meaning to the compiler

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| Escape Sequences | Description |
| \n | insert a new line in the text at this point |
| \t | insert a tab in the text at this point |
| \’ | single-quote |
| \” | double-quote |
| \\ | backslash |

ex:- sout(“ **\”**Hello**\”** ”) output : “Hello” sout(“\\Hello\\”) output: \Hello\

**Arrays**

- Used to store a list of items like , list fo numbers , people etc .

- Arrays are also Reference-types in Java

Declaration : **int[] number = new int[size];** OR **int[] number = {2,3,8,1,6};**

- To print the array we go like , **sout(Arrays.toString(number)) ;** Output : **[2,3,8,1,6]**

**-** sout**(number.length)** prints the length of array i.e , 5 ; length is a field here

- sout(**Arrays.sort(number)**) wil print sorted array

**2-D Arrays**

**- int[][] number= new[2][3]** OR **int[][] = {{3,5,8},{4,7,3}};**

**-**To print the MD-array we go like , **sout(Arrays.deepToString(number)) ;** Output : **[[3,5,8],[4,7,3]]**

- To make a variable constant or unchangeable we use final keyword , like , **final float PI = 3.14F**

**Casting and Type-conversion**

**Implicit-casting/Automatic-casting/Auto-conversion :** In this conversion a shorter-type is converted/casted to higher-type automatically like , **short to int , int to long** etc .

**byte>short > int>long>float>double**

ex:- **short a = 5;** **int b = a + 6 ;** In this , variable ‘a’ would be converted to int first and then the operation will get executed

ex:- **double a = 3.1 ; double b = a + 6 ;** Since 6 is an integer and int is less precise than double , 6 will be typecasted first to double and then the sum will executed

**Explicit casting : We explicitly cast the variables form higher-type to shorter-type .**

**ex:- double x = 1.1 ; int y = (int)x + 2 ;** here , x is higher-type hence , to caste it to int we do so..

**- Intger.parseInt(“string”) - It takes a string and returns an integer . Here , Integer is wrapper-class for int-types**

- In Java wrapper classes provides the mechanism to convert primitive types into object and object into primitives .

like , Integer is a wrapper class for int-types , Short for short-types , Float for floats and Double for double-types.

**Math-class** and its **Methods**

**-** This class is defined in **java.lang** package

**int val = Math.round(1.1F) , val=1** : takes float/double and returns whole(int)/long

**int val = (int)Math.ceil(1.1) , val = 2** : it returns smallest integer greater than or equal to the number . It returns double , hence to store it returned value in int variable we first need to cast the returned value to integer otherwise it gives a compilation error

**int val = (int)Math.floor(1.1F) , val = 1** : It returns the largest integer that is smaller or equal to this number .

**Math.max/min(int , int) :** it returns max/min of the given integers

**double val = Math.random()**

- It generates a random double-value b/w 0 and 1

- to get a double value b/w 0 and 100 we simply do **, Math.random()\*100**

- to get a number without decimal values we go like , **double val = Math.round(Math.random()\*100);**

- to get random integer values b/w 0 and 100 we do , **int val = (int)Math.round(Math.random()\*100); ,** since Math.round returns a long value , hence we can’t store it in an int variable , hence we need casting the returned value to int.

- we can also go like , **int val = (int)(Math.random()\*100);** , to meet the above outcome

**Formatting Numbers(Format class)**

**- In formatting any numbers we make the simple numbers in(1235.54) different formats like , currency ($1,235.54), percentage(1235.54%)**

**NumberFormat class**

- It is the direct child class of format-class

- defined in **java.text** package and in this package we have lots of classes to handling numbers , dates ,texts etc.

- It is an abstract class , means it can’t be instanciated

- Since we can’t use **‘new’** operator to make an instance of this class , hence we use the bunch of methods defined in it and when we call these methods , it will create an instance of NumberFormat class and will return it . ex:- getCurrencyInstance() , getPercentageInstance() etc

- Hence , these methods are called Factory Methods , because it creates instances and return them

- These factory methods will return a NumberFormat object and can be stored in a variable of type NumberFormat , like

**NumberFormat currency = NumberFormat. getCurrencyInstance();**

- The returned object currency has a method **format()** , to format the values , and it will return a string value

**String result = currency.format(123456.54);**

sout(result); output : **$123,456.54**

also , **NumberFormat percent = NumberFormat. getPercentInstance();**

**String result = percent.format(0.5);**

**System.out.println(result);**

**ouput : 50%**

we can also use **method-chaining** to achieve the same result

**String result = NumberFormat. getCurrencyInstance().format(0.5);**

**Reading Input**

**Scanner scanner = new Scanner(System.in); ,** System.in specifies that we are gonna read the data from terminal window

- Scanner class is defined in **java.util** package

- here ‘**in’** is a field defined in System class

- scanner have multiple methods to read inputs like , integer , strings , floats , doubles , etc as , we use ,

int n = scanner.**nextInt()** for integer

String s = **scanner.next()** and.**nextLine()** for strings

- Two space-separated strings are called two distinct tokens .

|  |  |
| --- | --- |
| next() | nextLine() |
| It reads input from the input device till the space character | I reads the input till the line change |
| It ends reading the input after getting space | It ends reading the input after getting ‘\n’ or press enter |
| next() will read only one token at a time | nextLine() read multiple tokens at a time or it reads the entire line  we type no matter how many number of spaces are there |
| we can’t use trim() method with it to remove the  spaces in the string | We can use trim() method to remove the extra spaces present in the  beginning and at the end of the string typed . like,  String s = scanner.**nextLine().trim()**  **input: spaces**  **sout(s);**  **output:spaces** |

- Expression is a piece of code that produces values , like **a==b** is a Boolean expression and it produces true or false

Comparison Operators : **==** , **!=** , **<=** and **>=**

Logical Operators : &&(Logical AND) , ||(OR) , !(NOT)

Ternary Operator : condition **?** output **:** another output

String input = “” ; 🡨It is a string of a reference-type , Hence we can’t use comparison operators with it, OR , we can’t write like , **while(input!=”quit”)** , b/c input is holding an address , and we can’t use comparison operators b/w reference types b/c it will compare the addresses of input and “quit” and not their values , instead we can go like , **while(!input.equals(“quit”))**

**- String str = “SCHOOL” ,** we can use **.toLowerCase** method of string class-objects to convert it to lower case like , str.toLowerCase

**for-each loop**

- It is mainly used to traverse the array or collection elements

syntax : **for(array-datatype loop-variable : array/collection name){**

**sout(loop-var);**

**}**

ex:- String[] fruits = {"A","B","C"};

for(String **fruit**:fruits)

System.out.println(**fruit**);

- In the loop body , we use the loop variable we created rather than using an indexed array element

**Drawbacks:-**

- It always iterates forward only and so we can’t iterate over the array from the end to beginning

- Or , it can’t traverse the array in reverse order

- It doesn’t work on index-basis , hence , it doesn’t keep track of indexes

- Moreover , you can’t traverse the odd or even elements only

- You can’t modify the array

**Advantages:-**

- It makes the code more readable

- It eliminates the possibility of programming errors

**\*\*head to gfg for more ...........**

**OOPS**

- Classes and objects were introduced in programming because we can solve the real world problems thorugh programing

- methods(functions) and properties(fields) are the members of a class .

for exmpale : for a class car,

properties can be : name , prize , color , mileage etc

methods can be : drift , drive , stop etc

|  |  |
| --- | --- |
| classes | objects |
| A class is a template for creating objects | objects are the instances of classes |
| class is a logical entity | object is a physical entity |
| class doesn’t allocate memory space | objects allocate memory |
| class can be declared only once | multiple objects can be created |
| Ex: car | ex: Jaguar , bolero , benz |
| class generates objects | objects provide life to the classes |
| Classes can’t be manipulated as they are not  available in memory | can be manipulated |
| it doesn’t have any values which are associated  with the fields | Each and every object has its own values , which  are associated with the fields |
| classes can be created using ‘class’ keyword | can be created using “new ” keywords |

- creating an **object(instance)** of Bro class

**Bro obj = new Bro();**

- Here , the **obj** is the reference variable of its object

- **new** keyword allocates the memory for object in heap

- **Bro()** is a special function which is called **Constructor**

- **this** is also a reference variable that referx to current object in a method or constructor

**Constructor**

package com.company;

class Student{

String name ;

int age;

**Student(){**

**System.out.println("constuctor created");**

**};**

}

public class Main {

public static void main(String[] args) {

Student s1 = new **Student();**

}

}

- A constructor in java is a special method that is used to initialize objects or to construct objects

- It is called when an object of a class is created using **new** keyword

**Properties of Constructors**

- Its name is same as the class name

- It doesn’t return anything hence return-type is not used with it , like , void , int etc

- It is called only once , i.e at the time we create an object

**Types**

1.Non-Parameterized : parameters are not passed

**Student()**

**{**

**System.out.println("constuctor created");**

**};**

Student s1 = new **Student();**

2 . Parameterized : Paramteres are passed in the constructor

**Student(String name , int age)**

**{**

**this.name = name;**

**this.age = age;**

**};**

Student s1 = new **Student(“Rahul” , 22);**

**-** here, **this.name** refers the name field/property of the current object which is assigned with passed name a rgument and It works same for this.age

3 . Copy : It is a constructor that creates an object using the fields and methods of another object of the same Java class

- This concept comes from C++ , where it is defined by default as well as by user

- But , in Java copy constructor is defined only by user instead bydefault

class Student{

String name ;

int age;

public void printInfo()

{

System.out.println(this.name);

System.out.println(this.age);

}

**Student(Student s)**

**{**

**this.name = s.name;**

**this.age = s.age;**

**}**

**Student()**{ }//This empty constructor must be defined for s1 object , if we use copy constructor for s2

}

public class Main {

public static void main(String[] args) {

Student s1 = new Student();

s1.name = "rahul";

s1.age = 21;

**Student s2 = new Student(s1);**

**s2.printInfo();**

}

}

- In this code we have assigned the properties of s1 object to s2 , by passing s1 to the constructor of s2

**- If we don’t create any constructor in any class then Java automatically creates its own non-parameterized constructor by default and runs the code**

- Fields are the variables declared inside a class .

Exceptions and Errors

- Exceptions are Java’s way to express errors