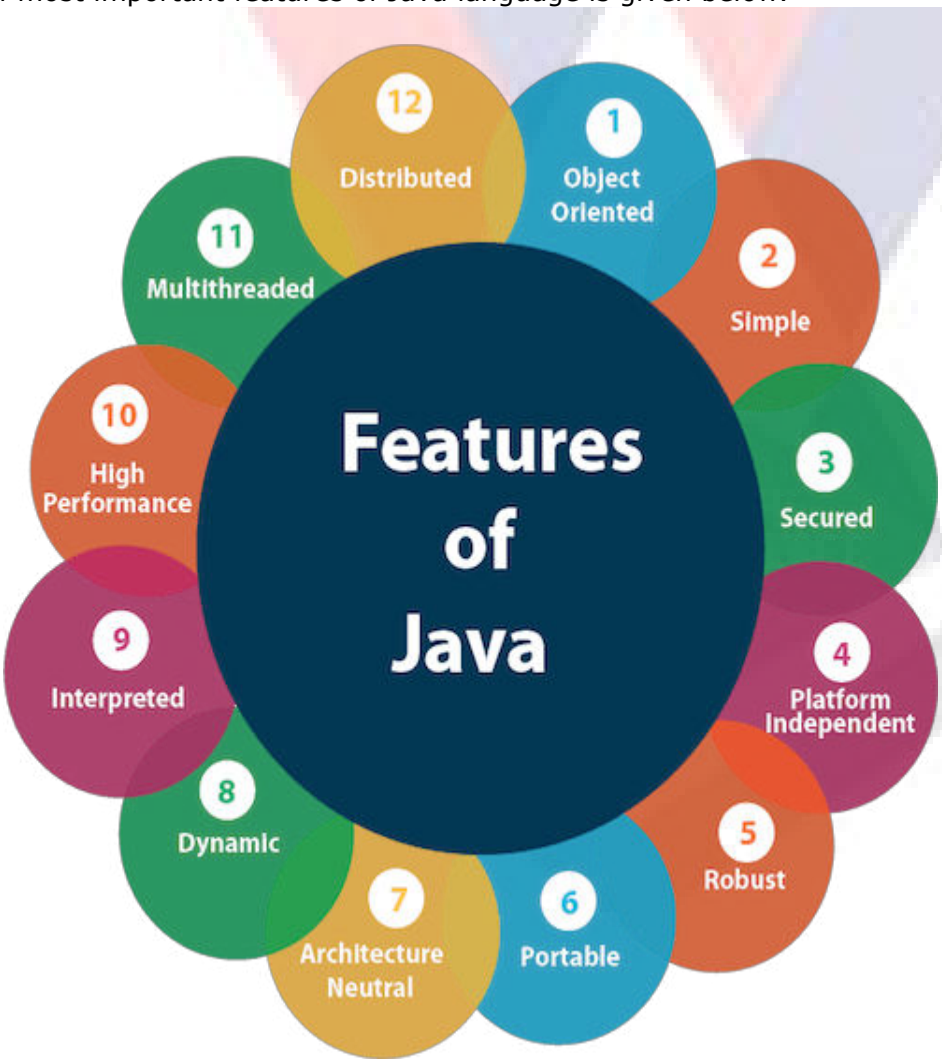
SUBJECT CODE: 501 **SUBJECT NAME: JAVA PROGRAMMING**

UNIT 1: INTRODUCTION TO JAVA

❖ Features of Java

The primary objective of Java programming language creation was to make it portable, simple and secure programming language. Apart from this, there are also some excellent features which play an important role in the popularity of this language. The features of Java are also known as java *buzzwords*.

A list of most important features of Java language is given below.



1. Simple
2. Object-Oriented
3. Portable
4. Platform independent
5. Secured
6. Robust
7. Architecture neutral
8. Interpreted
9. High Performance
10. Multithreaded
11. Distributed
12. Dynamic

Simple

Java is very easy to learn, and its syntax is simple, clean and easy to understand. According to Sun, Java language is a simple programming language because:

- Java syntax is based on C++ (so easier for programmers to learn it after C++).
- Java has removed many complicated and rarely-used features, for example, explicit pointers, operator overloading, etc.
- There is no need to remove unreferenced objects because there is an Automatic Garbage Collection in Java.

Object-oriented

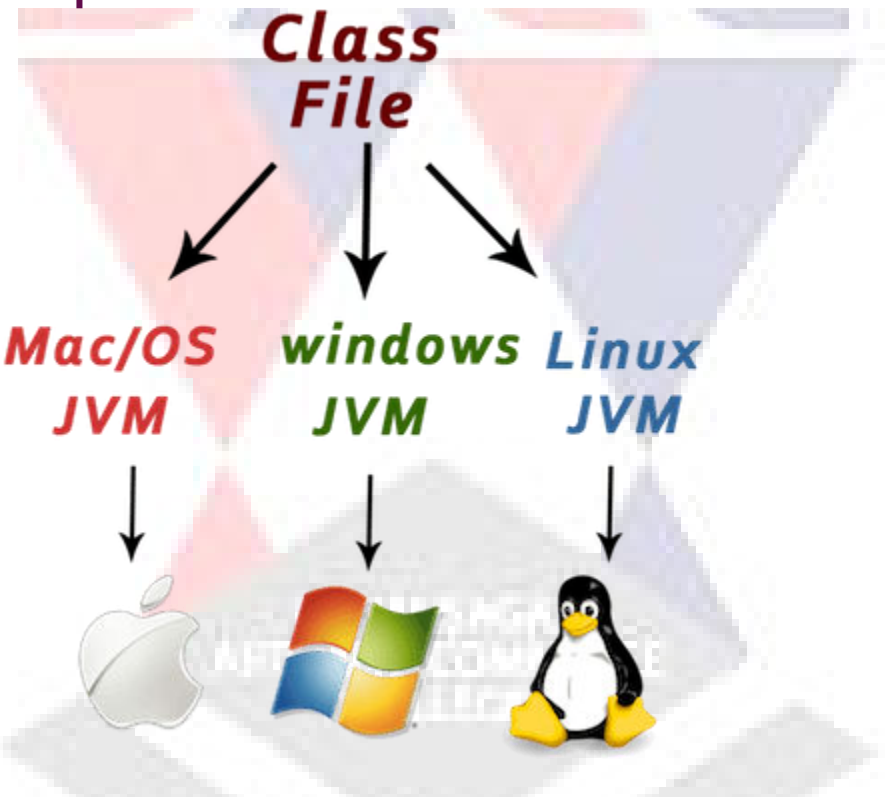
Java is an object-oriented programming language. Everything in Java is an object. Object-oriented we organize our software as a combination of different types of objects that incorporates both data and behavior.

Object-oriented programming (OOPs) is a methodology that simplifies software development and maintenance by providing some rules.

Basic concepts of OOPs are:

1. Object
2. Class
3. Inheritance
4. Polymorphism
5. Abstraction
6. Encapsulation

Platform Independent



Java is platform independent because it is different from other languages like C, C++, etc. which are compiled into platform specific machines while Java is a write once, run anywhere language.
A platform is the hardware or software environment in which a program runs.

There are two types of platforms software-based and hardware-based. Java provides a software-based platform.

The Java platform differs from most other platforms in the sense that it is a software-based platform that runs on the top of other hardware-based platforms. It has two components:

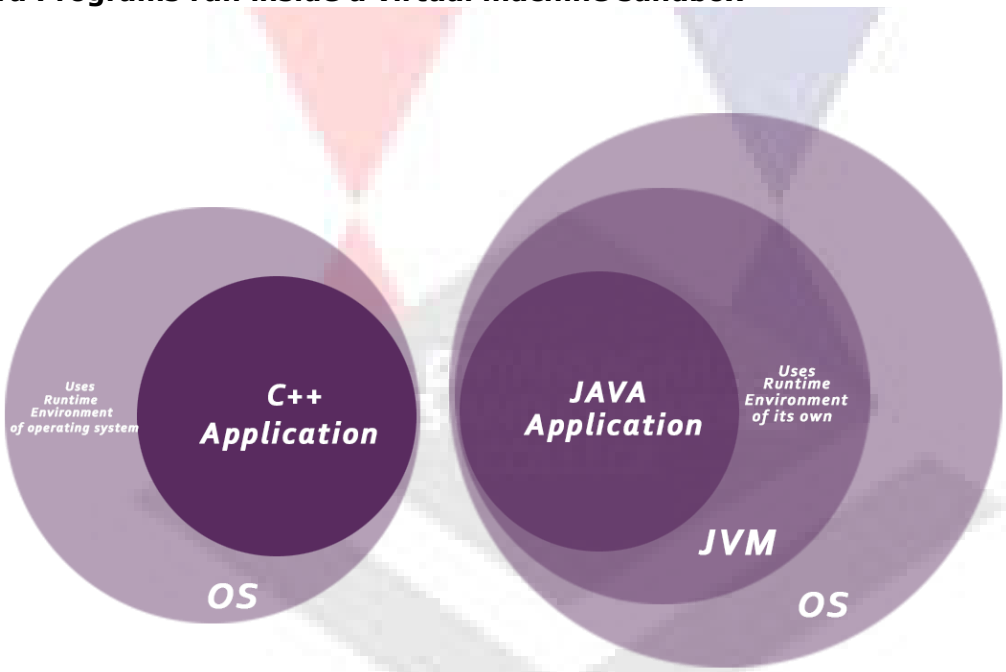
1. Runtime Environment
2. API(Application Programming Interface)

Java code can be run on multiple platforms, for example, Windows, Linux, Sun Solaris, Mac/OS, etc. Java code is compiled by the compiler and converted into bytecode. This bytecode is a platform-independent code because it can be run on multiple platforms, i.e., Write Once and Run Anywhere(WORA).

Secured

Java is best known for its security. With Java, we can develop virus-free systems. Java is secured because:

- **No explicit pointer**
- **Java Programs run inside a virtual machine sandbox**



- **Classloader:** Classloader in Java is a part of the Java Runtime Environment(JRE) which is used to load Java classes into the Java Virtual Machine dynamically. It adds security by separating the package for the classes of the local file system from those that are imported from network sources.
- **Bytecode Verifier:** It checks the code fragments for illegal code that can violate access right to objects.
- **Security Manager:** It determines what resources a class can access such as reading and writing to the local disk.

Java language provides these securities by default. Some security can also be provided by an application developer explicitly through SSL, JAAS, Cryptography, etc.

Robust

Robust simply means strong. Java is robust because:

- It uses strong memory management.
- There is a lack of pointers that avoids security problems.
- There is automatic garbage collection in java which runs on the Java Virtual Machine to get rid of objects which are not being used by a Java application anymore.
- There are exception handling and the type checking mechanism in Java. All these points make Java robust.

Architecture-neutral

Java is architecture neutral because there are no implementation dependent features, for example, the size of primitive types is fixed.

In C programming, int data type occupies 2 bytes of memory for 32-bit architecture and 4 bytes of memory for 64-bit architecture. However, it occupies 4 bytes of memory for both 32 and 64-bit architectures in Java.

Portable

Java is portable because it facilitates you to carry the Java bytecode to any platform. It doesn't require any implementation.

High-performance

Java is faster than other traditional interpreted programming languages because Java bytecode is "close" to native code. It is still a little bit slower than a compiled language (e.g., C++). Java is an interpreted language that is why it is slower than compiled languages, e.g., C, C++, etc.

Distributed

Java is distributed because it facilitates users to create distributed applications in Java. RMI and EJB are used for creating distributed applications. This feature of Java makes us able to access files by calling the methods from any machine on the internet.

Multi-threaded

A thread is like a separate program, executing concurrently. We can write Java programs that deal with many tasks at once by defining multiple threads. The main advantage of multi-threading is that it doesn't occupy memory for each thread. It shares a common memory area. Threads are important for multi-media, Web applications, etc.

Dynamic

Java is a dynamic language. It supports dynamic loading of classes. It means classes are loaded on demand. It also supports functions from its native languages, i.e., C and C++.

Java supports dynamic compilation and automatic memory management (garbage collection).

❖ JDK: Java Development Kit

- JDK is an acronym for Java Development Kit. The Java Development Kit (JDK) is a software development environment which is used to develop java applications and applets. It physically exists. It contains JRE + development tools.
- JDK is an implementation of any one of the below given Java Platforms released by Oracle corporation:
  - Standard Edition Java Platform
  - Enterprise Edition Java Platform
  - Micro Edition Java Platform

The JDK contains a private Java Virtual Machine (JVM) and a few other resources such as an interpreter/ loader (Java), a compiler (javac), an archiver (jar), a documentation generator (Javadoc) etc. to complete the development of a Java Application.

Components of JDK

Following is a list of primary components of JDK:

appletviewer:	This tool is used to run and debug Java applets without a web browser.
apt:	It is an annotation-processing tool.
extcheck:	it is a utility that detects JAR file conflicts.
idlj:	An IDL-to-Java compiler. This utility generates Java bindings from a given Java IDL file.
jabswitch:	It is a Java Access Bridge. Exposes assistive technologies on Microsoft Windows systems.
java:	The loader for Java applications. This tool is an interpreter and can interpret the class files generated by the javac compiler. Now a single launcher is used for both

	development and deployment. The old deployment launcher, jre, no longer comes with Sun JDK, and instead it has been replaced by this new java loader.
javac:	It specifies the Java compiler, which converts source code into Java bytecode.
javadoc:	The documentation generator, which automatically generates documentation from source code comments
jar:	The specifies the archiver, which packages related class libraries into a single JAR file. This tool also helps manage JAR files.
javafxpackager:	It is a tool to package and sign JavaFX applications.
jarsigner:	the jar signing and verification tool.
javah:	the C header and stub generator, used to write native methods.
javap:	the class file disassembler.
javaws:	the Java Web Start launcher for JNLP applications.
JConsole:	Java Monitoring and Management Console.
jdb:	the debugger.
jhat:	Java Heap Analysis Tool (experimental).
jinfo:	This utility gets configuration information from a running Java process or crash dump.
jmap:	Oracle jmap - Memory Map- This utility outputs the memory map for Java and can print shared object memory maps or heap memory details of a given process or core dump.
jmc:	Java Mission Control
jps:	Java Virtual Machine Process Status Tool lists the instrumented HotSpot Java Virtual Machines (JVMs) on the target system.
jrunscript:	Java command-line script shell.

jstack:	It is a utility that prints Java stack traces of Java threads (experimental).
jstat:	Java Virtual Machine statistics monitoring tool (experimental).
jstatd:	jstat daemon (experimental).
keytool:	It is a tool for manipulating the keystore.
pack200:	JAR compression tool.
Policytool:	It specifies the policy creation and management tool, which can determine policy for a Java runtime, specifying which permissions are available for code from various sources.
VisualVM:	It is a visual tool integrating several command-line JDK tools and lightweight [clarification needed] performance and memory profiling capabilities
wsimport:	It generates portable JAX-WS artifacts for invoking a web service.
xjc:	It is the part of the Java API for XML Binding (JAXB) API. It accepts an XML schema and generates Java classes.

❖ C++ vs Java

Comparison Index	C++	Java
Platform-independent	C++ is platform-dependent.	Java is platform-independent.
Mainly used for	C++ is mainly used for system programming.	Java is mainly used for application programming. It is widely used in window, web-based, enterprise and mobile applications.
Design Goal	C++ was designed for systems and applications programming. It was an extension of C programming language.	Java was designed and created as an interpreter for printing systems but later extended as a support network computing. It was designed with a goal of being easy to use and accessible to a broader audience.
Goto	C++ supports the goto statement.	Java doesn't support the goto statement.
Multiple inheritance	C++ supports multiple inheritance.	Java doesn't support multiple inheritance through class. It can be achieved by interfaces in java.
Operator Overloading	C++ supports operator overloading.	Java doesn't support operator overloading.
Pointers	C++ supports pointers. You can write pointer program in C++.	Java supports pointer internally. However, you can't write the pointer program in java. It means java has restricted pointer support in java.

Compiler and Interpreter	C++ uses compiler only. C++ is compiled and run using the compiler which converts source code into machine code so, C++ is platform dependent.	Java uses compiler and interpreter both. Java source code is converted into bytecode at compilation time. The interpreter executes this bytecode at runtime and produces output. Java is interpreted that is why it is platform independent.
Call by Value and Call by reference	C++ supports both call by value and call by reference.	Java supports call by value only. There is no call by reference in java.
Structure and Union	C++ supports structures and unions.	Java doesn't support structures and unions.
Thread Support	C++ doesn't have built-in support for threads. It relies on third-party libraries for thread support.	Java has built-in thread support.
Documentation comment	C++ doesn't support documentation comment.	Java supports documentation comment (/** ... */) to create documentation for java source code.
Virtual Keyword	C++ supports virtual keyword so that we can decide whether or not override a function.	Java has no virtual keyword. We can override all non-static methods by default. In other words, non-static methods are virtual by default.
unsigned right shift >>>	C++ doesn't support >>> operator.	Java supports unsigned right shift >>> operator that fills zero at the top for the negative numbers. For positive numbers, it works same like >> operator.
Inheritance Tree	C++ creates a new inheritance tree always.	Java uses a single inheritance tree always because all classes are the child of Object class in java. The object class is the root of the inheritance tree in java.

Hardware	C++ is nearer to hardware.	Java is not so interactive with hardware.
Object-oriented	C++ is an object-oriented language. However, in C language, single root hierarchy is not possible.	Java is also an object-oriented language. However, everything (except fundamental types) is an object in Java. It is a single root hierarchy as everything gets derived from java.lang.Object.

❖ Java OOPs Concepts

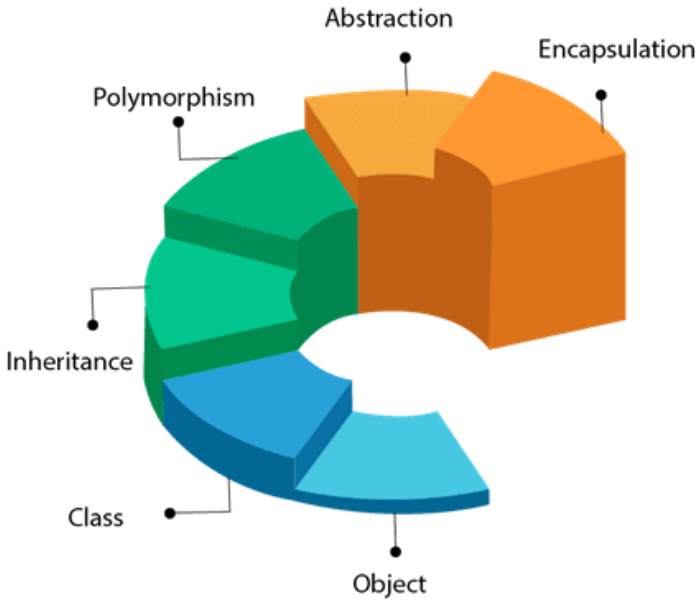
OOPs (Object-Oriented Programming System)

Object means a real-world entity such as a pen, chair, table, computer, watch, etc.

Object-Oriented Programming is a methodology or paradigm to design a program using classes and objects. It simplifies software development and maintenance by providing some concepts:

- Object
- Class
- Inheritance
- Polymorphism
- Abstraction
- Encapsulation

OOPs (Object-Oriented Programming System)



Object

Any entity that has state and behavior is known as an object. For example, a chair, pen, table, keyboard, bike, etc. It can be physical or logical.

An Object can be defined as an instance of a class. An object contains an address and takes up some space in memory. Objects can communicate without knowing the details of each other's data or code. The only necessary thing is the type of message accepted and the type of response returned by the objects.

Example: A dog is an object because it has states like color, name, breed, etc. as well as behaviors like wagging the tail, barking, eating, etc.

Class

Collection of objects is called class. It is a logical entity.

A class can also be defined as a blueprint from which you can create an individual object.

Class doesn't consume any space.

Inheritance

When one object acquires all the properties and behaviors of a parent object, it is known as inheritance.

It provides code reusability. It is used to achieve runtime polymorphism.

Polymorphism

If *one task is performed in different ways*, it is known as polymorphism. For example: to convince the customer differently, to draw something, for example, shape, triangle, rectangle, etc.

In Java, we use method overloading and method overriding to achieve polymorphism.

Another example can be to speak something; for example, a cat speaks meow, dog barks woof, etc.

Abstraction

Hiding internal details and showing functionality is known as abstraction. For example phone call, we don't know the internal processing.

In Java, we use abstract class and interface to achieve abstraction.

Encapsulation

Binding (or wrapping) code and data together into a single unit are known as encapsulation.

For example, a capsule, it is wrapped with different medicines.

A java class is the example of encapsulation. Java bean is the fully encapsulated class because all the data members are private here.

❖ Stucture of Java Program

First Java Program | Hello World Example

In this page, we will learn how to write the simple program of java. We can write a simple hello java program easily after installing the JDK.

To create a simple java program, you need to create a class that contains the main method. Let's understand the requirement first.

The requirement for Java Hello World Example

For executing any java program, you need to

- Install the JDK if you don't have installed it, download the JDK and install it.
- Set path of the jdk/bin directory. http://www.javatpoint.com/how-to-set-path-in-java
- Create the java program
- Compile and run the java program

Creating Hello World Example

Let's create the hello java program:

```
class Simple
 {
       public static void main(String args[])
      {
       System.out.println("Hello Java");
       }
}
```

save this file as Simple.java

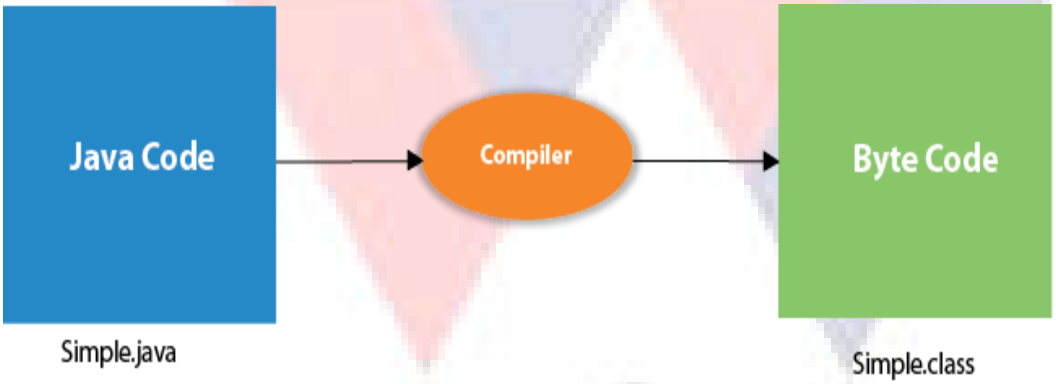
To compile: javac Simple.java

To execute: java Simple

```
Output:Hello Java
```

Compilation Flow:

When we compile Java program using javac tool, java compiler converts the source code into byte code.



Parameters used in First Java Program

Let's see what is the meaning of class, public, static, void, main, String[], System.out.println().

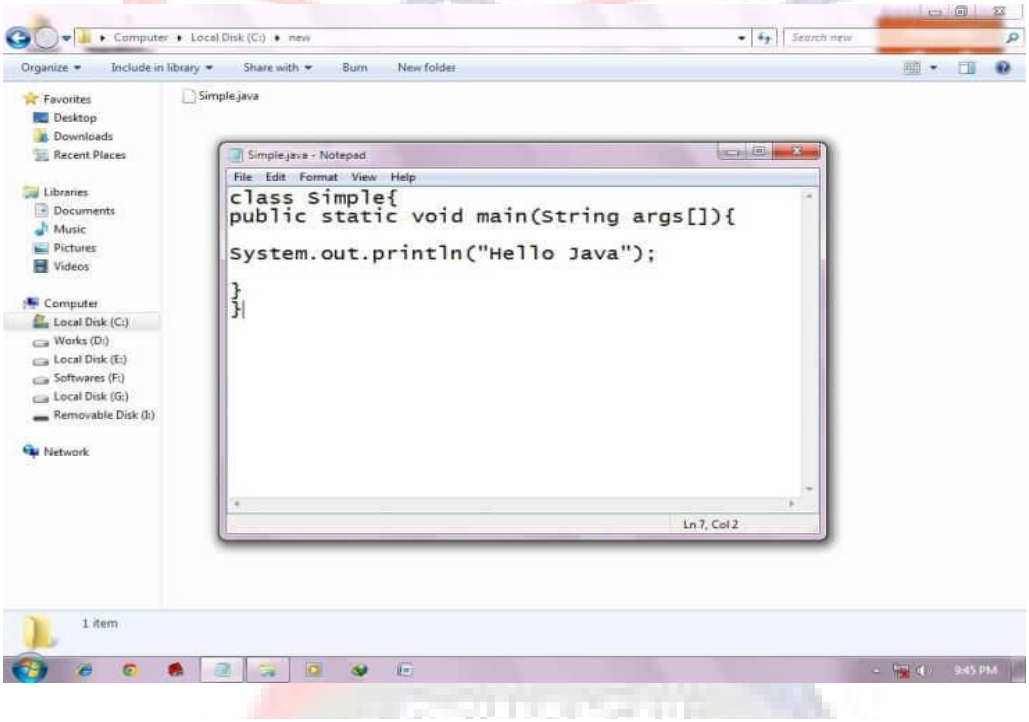
- **class** keyword is used to declare a class in java.
- **public** keyword is an access modifier which represents visibility. It means it is visible to all.
- **static** is a keyword. If we declare any method as static, it is known as the static method.

  The core advantage of the static method is that there is no need to create an object to invoke the static method. The main method is executed by the JVM, so it doesn't require to create an object to invoke the main method. So it saves memory.

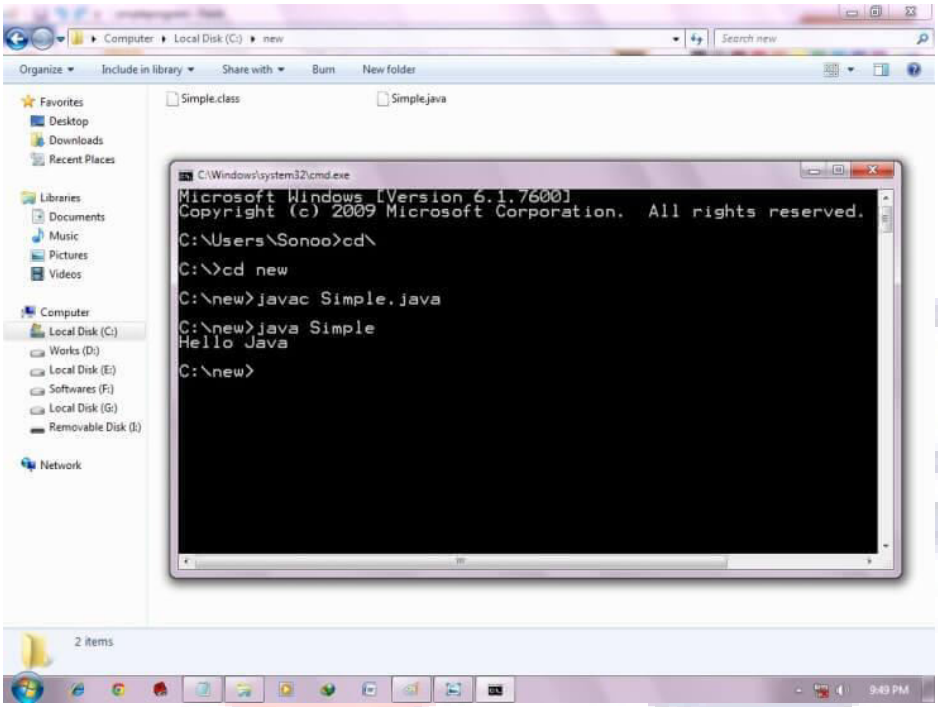
- **void** is the return type of the method. It means it doesn't return any value.
- **main** represents the starting point of the program.
- **String[] args** is used for command line argument. We will learn it later.

- **System.out.println()** is used to print statement. Here, System is a class, out is the object of PrintStream class, println() is the method of PrintStream class. We will learn about the internal working of System.out.println statement later.

To write the simple program, you need to open notepad by **start menu -> All Programs -> Accessories -> notepad** and write a simple program as displayed below:



As displayed in the above diagram, write the simple program of java in notepad and saved it as Simple.java. To compile and run this program, you need to open the command prompt by **start menu -> All Programs -> Accessories -> command prompt**.



To compile and run the above program, go to your current directory first; my current directory is c:\new. Write here:

To compile: javac Simple.java

To execute: java Simple

How many ways can we write a Java program

There are many ways to write a Java program. The modifications that can be done in a Java program are given below:

1) By changing the sequence of the modifiers, method prototype is not changed in Java.

Let's see the simple code of the main method.

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

2) The subscript notation in Java array can be used after type, before the variable or after the variable.

Let's see the different codes to write the main method.

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

3) You can provide var-args support to the main method by passing 3 ellipses (dots)

Let's see the simple code of using var-args in the main method. We will learn about var-args later in Java New Features chapter.

```
public static void main(String... args)
```

4) Having a semicolon at the end of class is optional in Java.

Let's see the simple code.

```
class A{
    static public void main(String... args){
      System.out.println("hello java4");
    }
    };
```

Valid java main method signature

```
public static void main(String[] args)
public static void main(String []args)
public static void main(String args[])
public static void main(String... args)
static public void main(String[] args)
public static final void main(String[] args)
final public static void main(String[] args)
final strictfp public static void main(String[] args)
```

Invalid java main method signature

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

❖ Java Variables

A variable is a container which holds the value while the Java program is executed.

A variable is assigned with a data type.

Variable is a name of memory location. There are three types of variables in java: local, instance and static.

There are two types of data types in Java: primitive and non-primitive.

Variable

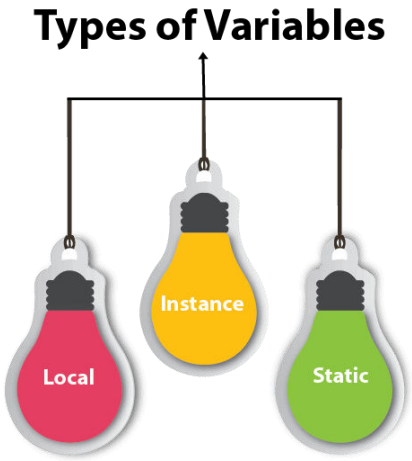
Variable is name of *reserved area allocated in memory*. In other words, it is a *name of memory location*. It is a combination of "vary + able" that means its value can be changed.


```
int data=50;//Here data is variable
```

Types of Variables

There are three types of variables in Java:

- local variable
- instance variable
- static variable



1) Local Variable

A variable declared inside the body of the method is called local variable.

You can use this variable only within that method and the other methods in the class aren't even aware that the variable exists.

A local variable cannot be defined with "static" keyword.

2) Instance Variable

A variable declared inside the class but outside the body of the method, is called instance variable.

It is not declared as static.

It is called instance variable because its value is instance specific and is not shared among instances.

3) Static variable

A variable which is declared as static is called static variable. It cannot be local.

You can create a single copy of static variable and share among all the instances of the class.

Memory allocation for static variable happens only once when the class is loaded in the memory.

Example to understand the types of variables in java

```
class A{
int data=50;//instance variable
static int m=100;//static variable
void method(){
 int n=90;//local variable
 }
  }//end of class
```

Java Variable Example: Add Two Numbers

```
class Simple{
 public static void main(String[] args){
 int a=10;
 int b=10;
int c=a+b;
     System.out.println(c);
     }}
```

Output:

```
20
```

❖ Data Types in Java

Data types specify the different sizes and values that can be stored in the variable.

There are two types of data types in Java:

1. **Primitive data types:** The primitive data types include boolean, char, byte, short, int, long, float and double.
2. **Non-primitive data types:** The non-primitive data types include Classes, Interfaces, and Arrays.

Java Primitive Data Types

In Java language, primitive data types are the building blocks of data manipulation.

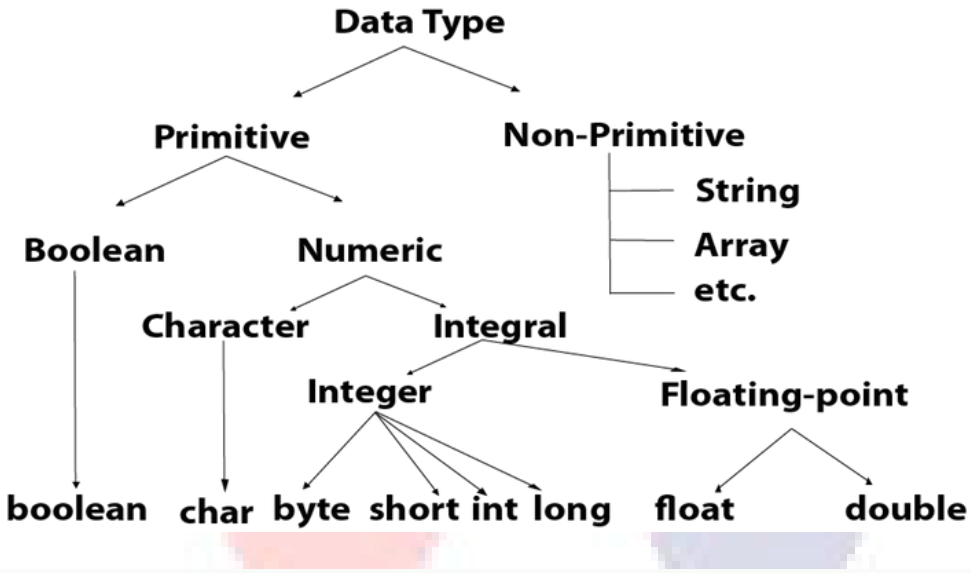
These are the most basic data types available in Java language.

Java is a statically-typed programming language. It means, all variables must be declared before its use.

That is why we need to declare variable's type and name.

There are 8 types of primitive data types:

- boolean data type
- byte data type
- char data type
- short data type
- int data type
- long data type
- float data type
- double data type



Data Type	Default Value	Default size
boolean	false	1 bit
char	'\u0000'	2 byte
byte	0	1 byte
short	0	2 byte
int	0	4 byte
long	0L	8 byte
float	0.0f	4 byte
double	0.0d	8 byte

❖ Operators in Java

Operator in Java is a symbol which is used to perform operations. For example: +, -, *, / etc.

There are many types of operators in Java which are given below:

- Unary Operator,
- Arithmetic Operator,
- Shift Operator,
- Relational Operator,
- Bitwise Operator,
- Logical Operator,
- Ternary Operator and
- Assignment Operator.

❖ Java Keywords

Java keywords are also known as **reserved words**. Keywords are particular words which acts as a key to a code. These are predefined words by Java so it cannot be used as a variable or object name.

List of Java Keywords

A list of Java keywords or reserved words are given below:

1. **abstract:** Java abstract keyword is used to declare abstract class. Abstract class can provide the implementation of interface. It can have abstract and non-abstract methods.
2. **boolean:** Java boolean keyword is used to declare a variable as a boolean type. It can hold True and False values only.
3. **break:** Java break keyword is used to break loop or switch statement. It breaks the current flow of the program at specified condition.
4. **byte:** Java byte keyword is used to declare a variable that can hold an 8-bit data values.
5. **case:** Java case keyword is used to with the switch statements to mark blocks of text.
6. **catch:** Java catch keyword is used to catch the exceptions generated by try statements.

   It must be used after the try block only.
7. **char:** Java char keyword is used to declare a variable that can hold unsigned 16-bit Unicode characters
8. **class:** Java class keyword is used to declare a class.
9. **continue:** Java continue keyword is used to continue the loop. It continues the current flow of the program and skips the remaining code at the specified condition.
10. **default:** Java default keyword is used to specify the default block of code in a switch statement.
11. **do:** Java do keyword is used in control statement to declare a loop. It can iterate a part of the program several times.
12. **double:** Java double keyword is used to declare a variable that can hold a 64-bit floating-point numbers.
13. **else:** Java else keyword is used to indicate the alternative branches in an if statement.

14. **enum:** Java enum keyword is used to define a fixed set of constants. Enum constructors are always private or default.
15. **extends:** Java extends keyword is used to indicate that a class is derived from another class or interface.
16. **final:** Java final keyword is used to indicate that a variable holds a constant value. It is applied with a variable. It is used to restrict the user.
17. **finally:** Java finally keyword indicates a block of code in a try-catch structure. This block is always executed whether exception is handled or not.
18. **float:** Java float keyword is used to declare a variable that can hold a 32-bit floating-point number.
19. **for:** Java for keyword is used to start a for loop. It is used to execute a set of instructions/functions repeatedly when some conditions become true. If the number of iteration is fixed, It is recommended to use for loop.
20. **if:** Java if keyword tests the condition. It executes the if block if condition is true.
21. **implements:** Java implements keyword is used to implement an interface.
22. **import:** Java import keyword makes classes and interfaces available and accessible to the current source code.
23. **instanceof:** Java instanceof keyword is used to test whether the object is an instance of the specified class or implements an interface.
24. **int:** Java int keyword is used to declare a variable that can hold a 32-bit signed integer.
25. **interface:** Java interface keyword is used to declare an interface. It can have only abstract methods.
26. **long:** Java long keyword is used to declare a variable that can hold a 64-bit integer.
27. **native:** Java native keyword is used to specify that a method is implemented in native code using JNI (Java Native Interface).
28. **new:** Java new keyword is used to create new objects.
29. **null:** Java null keyword is used to indicate that a reference does not refer to anything. It removes the garbage value.
30. **package:** Java package keyword is used to declare a Java package that includes the classes.
31. **private:** Java private keyword is an access modifier. It is used to indicate that a method or variable may be accessed only in the class in which it is declared.
32. **protected:** Java protected keyword is an access modifier. It can be accessible within package and outside the package but through inheritance only. It can't be applied on the class.
33. **public:** Java public keyword is an access modifier. It is used to indicate that an item is accessible anywhere. It has the widest scope among all other modifiers.
34. **return:** Java return keyword is used to return from a method when its execution is complete.

35. **short:** Java short keyword is used to declare a variable that can hold a 16-bit integer.
36. **static:** Java static keyword is used to indicate that a variable or method is a class method. The static keyword in Java is used for memory management mainly.
37. **strictfp:** Java strictfp is used to restrict the floating-point calculations to ensure portability.
38. **super:** Java super keyword is a reference variable that is used to refer parent class object. It can be used to invoke immediate parent class method.
39. **switch:** The Java switch keyword contains a switch statement that executes code based on test value. The switch statement tests the equality of a variable against multiple values.
40. **synchronized:** Java synchronized keyword is used to specify the critical sections or methods in multithreaded code.
41. **this:** Java this keyword can be used to refer the current object in a method or constructor.
42. **throw:** The Java throw keyword is used to explicitly throw an exception. The throw keyword is mainly used to throw custom exception. It is followed by an instance.
43. **throws:** The Java throws keyword is used to declare an exception. Checked exception can be propagated with throws.
44. **transient:** Java transient keyword is used in serialization. If you define any data member as transient, it will not be serialized.
45. **try:** Java try keyword is used to start a block of code that will be tested for exceptions. The try block must be followed by either catch or finally block.
46. **void:** Java void keyword is used to specify that a method does not have a return value.
47. **volatile:** Java volatile keyword is used to indicate that a variable may change asynchronously.
48. **while:** Java while keyword is used to start a while loop. This loop iterates a part of the program several times. If the number of iteration is not fixed, it is recommended to use while loop.

❖ Java If-else Statement

The Java *if statement* is used to test the condition.

It checks boolean condition: *true* or *false*. There are various types of if statement in Java.

- if statement
- if-else statement
- if-else-if ladder
- nested if statement

❖ Java Switch Statement

The Java *switch statement* executes one statement from multiple conditions.

It is like if-else-if ladder statement. The switch statement works with byte, short, int, long, enum types, String and some wrapper types like Byte, Short, Int, and Long. Since Java 7, you can use strings in the switch statement.

In other words, the switch statement tests the equality of a variable against multiple values.

Points to Remember

- There can be *one or N number of case values* for a switch expression.
- The case value must be of switch expression type only. The case value must be *literal or constant*. It doesn't allow variables.
- The case values must be *unique*. In case of duplicate value, it renders compile-time error.
- The Java switch expression must be of *byte, short, int, long (with its Wrapper type), enums and string*.
- Each case statement can have a *break statement* which is optional. When control reaches to break statement, it jumps the control after the switch expression. If a break statement is not found, it executes the next case.
- The case value can have a *default label* which is optional.

Syntax:

```
switch(expression){
case value1:
     //code to be executed;
    break;  //optional
            case value2:
    //code to be executed;
    break;  //optional
            ......

            default:
    code to be executed if all cases are not matched;
    }
```

❖ Loops in Java

In programming languages, loops are used to execute a set of instructions/functions repeatedly when some conditions become true. There are three types of loops in Java.

- for loop
- while loop
- do-while loop

❖ Java Arrays

Normally, an array is a collection of similar type of elements which has contiguous memory location.

Java array is an object which contains elements of a similar data type. Additionally, The elements of an array are stored in a contiguous memory location. It is a data structure where we store similar elements. We can store only a fixed set of elements in a Java array.

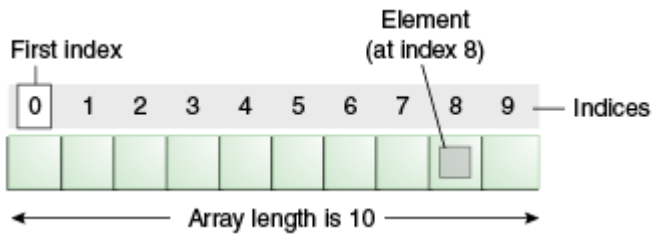
Array in Java is index-based, the first element of the array is stored at the 0th index, 2nd element is stored on 1st index and so on.

Unlike C/C++, we can get the length of the array using the length member.

In C/C++, we need to use the sizeof operator.

In Java, array is an object of a dynamically generated class. Java array inherits the Object class, and implements the Serializable as well as Cloneable interfaces. We can store primitive values or objects in an array in Java. Like C/C++, we can also create single dimentional or multidimentional arrays in Java.

Moreover, Java provides the feature of anonymous arrays which is not available in C/C++.



Advantages

- **Code Optimization:** It makes the code optimized, we can retrieve or sort the data efficiently.
- **Random access:** We can get any data located at an index position.

Disadvantages

- **Size Limit:** We can store only the fixed size of elements in the array. It doesn't grow its size at runtime. To solve this problem, collection framework is used in Java which grows automatically.

Types of Array in java

There are two types of array.

- Single Dimensional Array
- Multidimensional Array

Single Dimensional Array in Java

Syntax to Declare an Array in Java

dataType[] arr; (or)
dataType []arr; (or)
dataType arr[];

Instantiation of an Array in Java

arrayRefVar=**new** datatype[size];

Example of Java Array

```
//Java Program to illustrate how to declare, instantiate, initialize
//and traverse the Java array.
1. class Testarray{
2. public static void main(String args[]){
3. int a[]=new int[5];//declaration and instantiation
4. a[0]=10;//initialization
5. a[1]=20;
6. [2]=70;
7. a[3]=40;
8. a[4]=50;
//traversing array
9. for(int i=0;i<a.length;i++)//length is the property of array
10. System.out.println(a[i]);
11. }}
```

Output:

```
10
20
70
40
50
```

Multidimensional Array in Java

In such case, data is stored in row and column based index (also known as matrix form).

Syntax to Declare Multidimensional Array in Java

```
dataType[][] arrayRefVar; (or)
dataType [][]arrayRefVar; (or)
dataType arrayRefVar[][]; (or)
dataType []arrayRefVar[];
```

Example to instantiate Multidimensional Array in Java

```
int[][] arr=new int[3][3];//3 row and 3 column
```

Example of Multidimensional Java Array

```
//Java Program to illustrate the use of multidimensional array
	class Testarray3{
	public static void main(String args[]){
	//declaring and initializing 2D array
	int arr[][]={{1,2,3},{2,4,5},{4,4,5}};
	//printing 2D array
	for(int i=0;i<3;i++){
	for(int j=0;j<3;j++){
	System.out.print(arr[i][j]+" ");
	}
	System.out.println();
```

```
}
}}
```

Output:

```
1 2 3
2 4 5
4 4 5
```

❖ Java String

In Java, string is basically an object that represents sequence of char values.

An array of characters works same as Java string. For example:

```
char[] ch={'j','a','v','a','t','p','o','i','n','t'};
        String s=new String(ch);
```

same as:

```
String s="javatpoint";
```

Java String class provides a lot of methods to perform operations on strings such as compare(), concat(), equals(), split(), length(), replace(), compareTo(), intern(), substring() etc.

Immutable String in Java

In java, **string objects are immutable**. Immutable simply means unmodifiable or unchangeable.

Once string object is created its data or state can't be changed but a new string object is created.

Java String class methods

1. toUpperCase() and toLowerCase() method

The java string toUpperCase() method converts this string into uppercase letter and string toLowerCase() method into lowercase letter.

2. trim() method

The string trim() method eliminates white spaces before and after string.

3. charAt() method

The string charAt() method returns a character at specified index.

4. length() method

The string length() method returns length of the string.

5. valueOf() method

The string valueOf() method coverts given type such as int, long, float, double, boolean, char and char array into string.

6. replace() method

The string replace() method replaces all occurrence of first sequence of character with second sequence of character.

❖ Java StringBuffer class

Java StringBuffer class is used to create mutable (modifiable) string.

The StringBuffer class in java is same as String class except it is mutable i.e. it can be changed.

1) StringBuffer append() method

The append() method concatenates the given argument with this string.

2) StringBuffer insert() method

The insert() method inserts the given string with this string at the given position.

3) StringBuffer replace() method

The replace() method replaces the given string from the specified beginIndex and endIndex.

4) StringBuffer delete() method

The delete() method of StringBuffer class deletes the string from the specified beginIndex to endIndex.

5) StringBuffer reverse() method

The reverse() method of StringBuilder class reverses the current string.

6) StringBuffer capacity() method

The capacity() method of StringBuffer class returns the current capacity of the buffer. The default capacity of the buffer is 16. If the number of character increases from its current capacity, it increases the capacity by (oldcapacity*2)+2. For example if your current capacity is 16, it will be (16*2)+2=34.

7) StringBuffer ensureCapacity() method

The ensureCapacity() method of StringBuffer class ensures that the given capacity is the minimum to the current capacity. If it is greater than the current capacity, it increases the capacity by (oldcapacity*2)+2. For example if your current capacity is 16, it will be (16*2)+2=34.