MODULE-1
PART-1
JAVA EVOLUTION & ENVIRONMENT

WHAT IS JAVA?

- Java is an object-oriented programming language originally developed by Sun Microsystems and released in 1995.
- Java was originally developed by James Gosling at Sun Microsystems (which has since merge into Oracle Corporation).
- Java programs are platform independent which means they can be run on any operating system with any type of processor as long as the Java interpreter is available on that system.
- Java code that runs on one platform does not need to be recompiled to run on another platform, it's called "write once, run anywhere" (WORA).
- Java Virtual Machine (JVM) executes Java code, but is written in platform specific languages such as C/C++/ASM etc. JVM is not written in Java and hence cannot be platform independent and Java interpreter is actually a part of JVM.

TYPES OF JAVA APPLICATIONS

1. **Web Application**: Java is used to create server-side web applications. Currently, servlet, jsp, struts, jsf etc. technologies are used.
2. **Standalone Application**: It is also known as desktop application or window-based application. An application that we need to install on every machine or server such as media player, antivirus etc. AWT and Swing are used in java for creating standalone applications.
3. **Enterprise Application**: An application that is distributed in nature, such as banking applications etc. It has the advantage of high level security, load balancing and clustering. In java, EJB is used for creating enterprise applications.
4. **Mobile Application**: Java is used to create application softwares for mobile devices. Currently Java ME is used for creating applications for small devices, and also Java is programming language for Google Android application development.

JAVA HISTORY(MILESTONES)

1990→ Sun Microsystems decided to develop special software that could be used to manipulate consumer electronic devices. A team of Sun Microsystems programmers headed by James Gosling was formed to undertake this task.

1991→ After exploring the possibility of most Object Oriented Programming Language C++, the team announced a new language named "Oak".

1992→ The team, known as a Green Project team by Sun, demonstrated the application of their new language to control a list of home appliances using a hand-held device with a tiny touch sensitive screen.

1993→ The World Wide Web (WWW) appeared on the internet and transformed the text-based Internet into a Graphical-rich environment. The green Project team came up with the idea of developing Web Applets (tiny Programs) using the new language that could run on all types of computers connected to Internet.

1994→ The team developed a web browser called "Hot Java" to locate and run applet programs on Internet. Hot Java demonstrated the power of the new language, thus making it instantly popular among the Internet users.

1995→ Oak was named "Java", due to some legal snags. Java is just a name and is not an acronym. Many popular companies including Netscape and Microsoft announce to their support to Java.

1996→ Java established itself not only a leader for Internet Programming but also as a general-purpose, object oriented programming language. Java found its home.

The most striking feature of the language is that it is a platform-neutral language. Java is a first programming language that is not tied to any particular hardware or operating system.

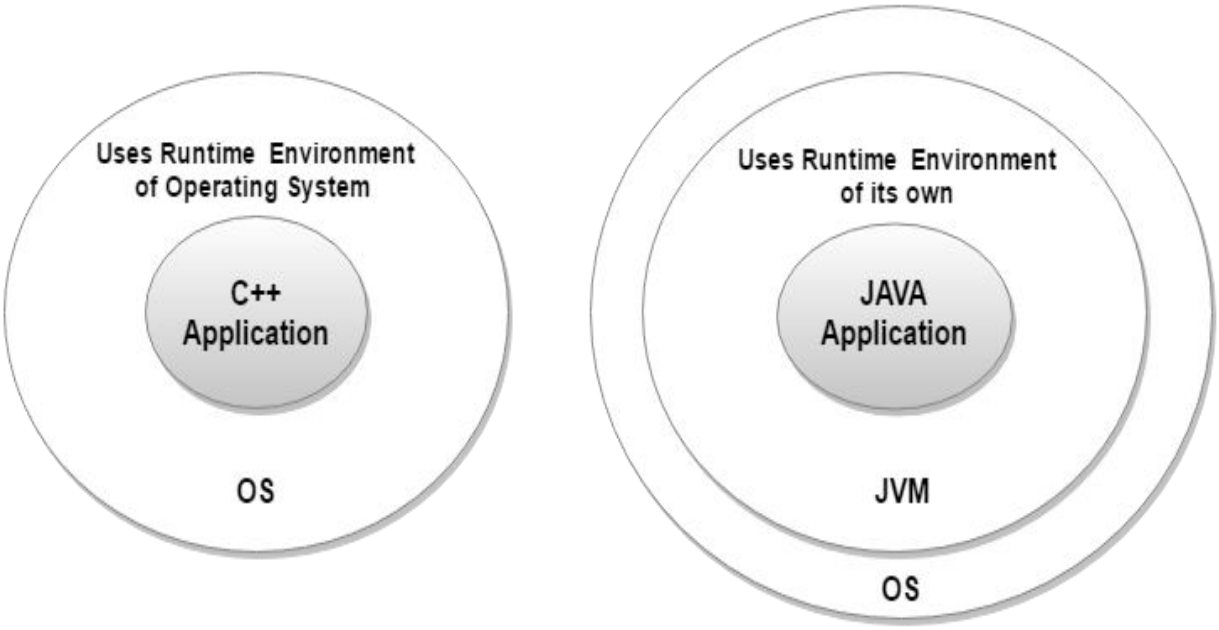
FEATURES OF JAVA

- **Simple** − Java is designed to be easy to learn. If you understand the basic concept of OOP Java, it would be easy to master.
- **Object Oriented**- Almost everything in Java is a class, method or an object. Java provides Abstraction, Encapsulation, Inheritance, and Polymorphism.
- **Secure** − With Java's secure feature it enables to develop virus-free, tamper-free systems. Java contains built in security. Java never allows the programmer to memory manipulation (pointer) of the system.
- **Architecture-neutral** – Write once, run anywhere (WORA). With a JVM, you can write one program that will run on any platform.
- **Portable** − Being architecture-neutral and having no implementation dependent aspects of the specification makes Java portable. Java programs can run on any platform without being recompiled.
- **Robust** − Java is a reliable language. It does not have permission to access all of your computer memory, so java program can't cause a crash. Java programs are less prone to error. It also provides exception and error handling.
- **Multithreaded** − With Java's multithreaded feature it is possible to write programs that can perform many tasks simultaneously. This design feature allows the developers to construct interactive applications that can run smoothly.

- **Interpreted** – You need an interpreter to run JAVA programs. The programs are compiled into the Java Virtual Machine code called byte code. The byte code is machine independent and can run on any machine that has a Java interpreter, which is a part of JVM.
- **High Performance** − With the use of Just-In-Time compilers, Java enables high performance.
- **Platform Independent** − Unlike many other programming languages including C and C++, when Java is compiled, it is not compiled into platform specific machine, rather into platform independent byte code. This byte code is distributed over the web and interpreted by the Virtual Machine (JVM) on whichever platform it is being run on.
- **Distributed** − Distributed computing involves several computers working together on a network. Java applications and applets can open and access objects across the web through URL's as easily as they can access local file system.
- **Dynamic** − Java is considered to be more dynamic than C or C++ since it is designed to adapt to an evolving environment. Maintaining different versions of application is easy in Java. Java supports dynamic memory allocation with automatic garbage collection.

WHY IS JAVA SECURED?

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



- **Classloader:** adds security by separating the package for the classes of the local file system from those that are imported from network sources.
- **Bytecode Verifier:** checks the code fragments for illegal code that can violate access right to objects.

- **Security Manager:** determines what resources a class can access such as reading and writing to the local disk.

These securities are provided by java language. Some security can also be provided by application developer through SSL, JAAS, Cryptography etc.

DIFFERENCE BETWEEN C AND JAVA

- Major difference is that C is a structure oriented language and Java is an object oriented language and has mechanism to define classes and objects.
- Java does not support an explicit pointer type
- Java does not have preprocessor, so we cant use #define, #include and #ifdef statements.
- Java does not include structures, unions and enum data types.
- Java does not include keywords like goto, sizeof and typedef.
- Java adds labeled break and continue statements.
- Java adds many features required for object oriented programming.

DIFFERENCE BETWEEN C++ & JAVA

Features removed in java:

- Java doesn't support pointers to avoid unauthorized access of memory locations.
- Java does not include structures, unions and enum data types.
- Java does not support operator over loading.
- Preprocessor plays less important role in C++ and so eliminated entirely in java.
- Java does not perform automatic type conversions that result in loss of precision.
- Java does not support global variables. Every method and variable is declared within a class and forms part of that class.
- Java does not allow default arguments.
- Java does not support inheritance of multiple super classes by a sub class (i.e., multiple inheritance). This is accomplished by using 'interface' concept.
- It is not possible to declare unsigned integers in java.
- In java objects are passed by reference only. In C++ objects may be passed by value or reference.

New features added in Java:

- Multithreading that allows two or more pieces of the same program to execute concurrently.
- C++ has a set of library functions that use a common header file. But java replaces it with its own set of API classes.
- It adds packages and interfaces.
- Java supports automatic garbage collection.
- break and continue statements have been enhanced in java to accept labels as targets.
- The use of unicode characters ensures portability.

Features that differ:

- Though C++ and java supports Boolean data type, C++ takes any nonzero value as true and zero as false. True and false in java are predefined literals that are values for a boolean expression.
- Java has replaced the destructor function with a finalize() function.
- C++ supports exception handling that is similar to java's. However, in C++ there is no requirement that a thrown exception be caught.

PRINCIPLES OF OOPs

In Object Oriented Programming, classes have attributes, represented by data member. The attributes distinguish an object of the class. Classes have behaviors, which are represented by methods. The methods define how an object acts or reacts.

Feature of Object Oriented Programming :

Information Encapsulation (Hiding):-

Object oriented programming allows you to encapsulate data that you do not want users of the object to access. Typically, attributes of a class are encapsulated.

Abstraction:-

Providing users with only what they need to know is known as abstraction. i.e. Abstraction lets us ignore the irrelevant details and concentrate on the essentials.

Inheritance: - Inheritance is the process by which objects of one class acquire the properties of objects of another class. Inheritance supports the concept of hierarchical classification. In OOP, the concept of inheritance provides the idea of reusability. This means that we can add additional features to an existing class without modifying it. This is possible by deriving a new class from the existing one. The new class will have the combined features of both the classes.

Polymorphism: - Polymorphism means “One Interface, multiple implementations.”

SETTING UP THE PATH FOR WINDOWS

Assuming you have installed Java in c:\Program Files\java\jdk directory −

- Right-click on 'My Computer' and select 'Properties'.
- Click the 'Environment variables' button under the 'Advanced' tab.
- Now, alter the 'Path' variable so that it also contains the path to the Java executable. Example, if the path is currently set to 'C:\WINDOWS\SYSTEM32', then change your path to read 'C:\WINDOWS\SYSTEM32;c:\Program Files\java\jdk\bin;

POPULAR JAVA EDITORS

To write your Java programs, you will need a text editor. There are even more sophisticated IDEs available in the market. But for now, you can consider one of the following −

- **Notepad** − On Windows machine, you can use any simple text editor like Notepad (Recommended for this tutorial), TextPad.

- **Netbeans** − A Java IDE that is open-source and free which can be downloaded from https://www.netbeans.org/index.html.

- **Eclipse** − A Java IDE developed by the eclipse open-source community and can be downloaded from https://www.eclipse.org/

JAVA AND WWW

World Wide Web (WWW) is an open-ended information retrieval system designed to be used in the Internet's distributed environment. This system contains Web pages that provide both information and controls. Web system is open-ended and we can navigate to a new document in any direction. This is made possible with the help of a language called Hypertext Markup Language (HTML). Web pages contain HTML tags that enable us to find, retrieve, manipulate and display documents worldwide.

Java was meant to be used in distributed environments such as Internet. Since, both the Web and Java share the same philosophy, Java could be easily incorporated into the Web system. Before Java, the World Wide Web was limited to the display of still images and texts. However, the incorporation of Java into Web pages has made it capable of supporting animation, graphics, games, and a wide range of special effects.

WEB BROWSERS

Web Browser is application software that allows us to view and explore information on the web. User can request for any web page by just entering a URL into address bar.

Web browser can show text, audio, video, animation and more. It is the responsibility of a web browser to interpret text and commands contained in the web page.

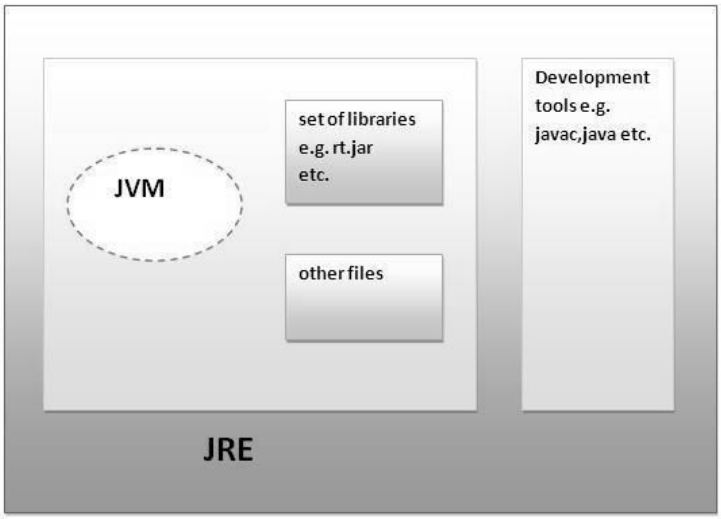
Earlier the web browsers were text-based. Nowadays graphical-based or voice-based web browsers are also available. Following are the most common web browser available today:

Browser	Vendor
Internet Explorer	Microsoft
Google Chrome	Google
Mozilla Firefox	Mozilla
Netscape Navigator	Netscape Communications Corp.
Opera	Opera Software
Safari	Apple
Sea Monkey	Mozilla Foundation
K-meleon	K-meleon

PART-2
JAVA ENVIRONMENT

JAVA DEVELOPMENT KIT(JDK)

JDK (Java SE Development Kit) includes a complete JRE (Java Runtime Environment) plus tools for developing, debugging, and monitoring Java applications. JDK is needed to develop Java applications and applets as well as run them.



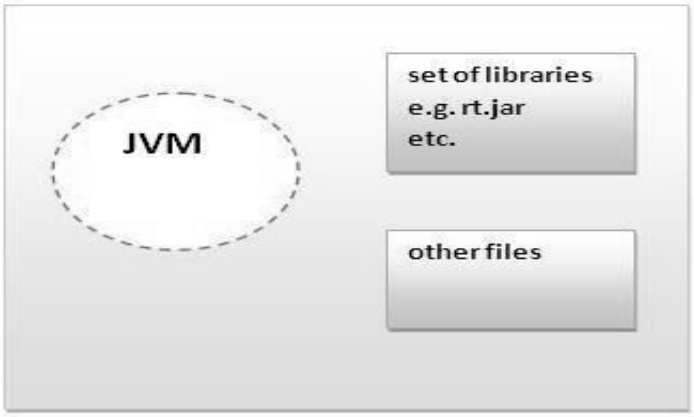
JDK

Java Development kit contains with the following tools

- **Appletviewer:** Enables us to run java applets(without actually using a java-compatible browser).
- **java:** java interpreter, which runs applets and applications by reading and interpreting bytecode files.
- java: The java compiler, which translates java source code to bytecode files that the interpreter can understand.
- **javadoc :** Creates HTML format documentation from java source code files.
- **javah :** Produces header files for use with native methods
- **javap** : Java disassembler, which enables us to convert bytecode files into a program description.
- **jdb :** Java debugger, which helps us to find errors in our programs.

JAVA RUNTIME ENVIRONMENT(JRE)

JRE is an acronym for Java Runtime Environment. It is used to provide runtime environment. It is the implementation of JVM. It physically exists. It contains set of libraries + other files that JVM uses at runtime.



JRE

APPLICATION PROGRAMMING INTERFACE (API):

Java supports several packages which contains hundreds of classes & methods.
java.lang.* - language support package
A collection of classes and methods require for implementing basic features of java.

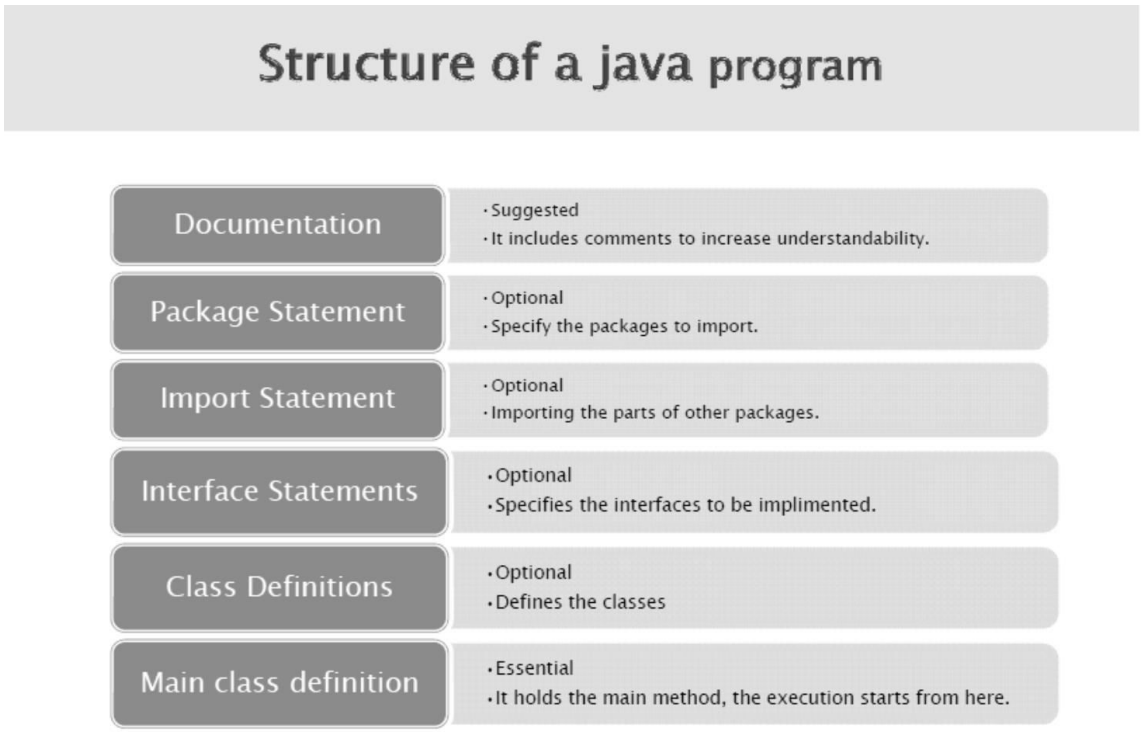
java.util.* - utilities packages
A collection of classes to provide utility functions such as date & time functions.

java.io.* - Input/Output package
A collection of classes required for input and output manipulations.

java.net.* - networking package
A collection of classes for communicating with other computers via internet.

java.awt.* - AWT(Abstract Window Toolkit) package
This package contains classes that implements platform independent GUI (Graphical User Interface)

java.applet.*- Applet package
This includes a set of classes that allow us to create JAVA applets.



BYTECODE & JVM(Java Virtual Machine)

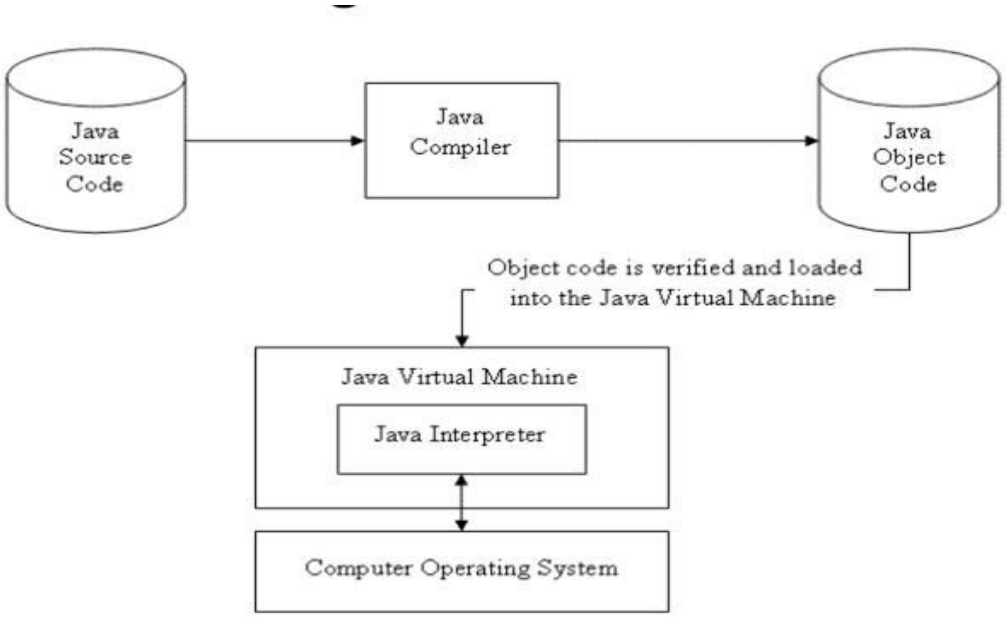
- Since platform-independence is a defining characteristic of Java, it is important to understand how it is achieved.
- Programs exist in two forms; source code and object code.
- **Source Code** is the textual version of the program that you write using a text editor.
- Executable form of a program is **object code**. The computer can execute object code. typically, object code is specific to a particular CPU. Therefore, it cannot be executed on a different platform.
- Like all computer languages, a java program begins with its source code.
- The difference is what happens when a Java program is compiled. Instead of producing executable code, the Java Compiler produces an object file that contains bytecode.
- **Bytecodes** are instructions that are not for any specific CPU. Instead, they are designed to be interpreted by a Java Virtual Machine (JVM).
- The key to Java's platform-independence comes from the fact that the same bytecodes can be executed by any JVM on any platform.
- As long as there is a JVM implemented for a given environment, it can run any Java program. For example, Java programs can execute under Windows 98,Solaris,IRIX, or any other platform for which a JVM can be implemented for that platform. This would then allow any Java program to execute in that new environment.

JVM (Java Virtual Machine) is an abstract machine. It is a specification that provides runtime environment in which java bytecode can be executed.

JVMs are available for many hardware and software platforms. JVM, JRE and JDK are platform dependent because configuration of each OS differs. But, Java is platform independent.

The JVM performs following main tasks:

- Loads code
- Verifies code
- Executes code
- Provides runtime environment



Just-in-time Compiler (JIT)

JIT is the part of the Java Virtual Machine (JVM) that is used to speed up the execution time. JIT interprets parts of the bytecode that have similar functionality at the same time, and hence reduces the amount of time needed for full interpretation.

FIRST JAVA APPLICATION

Create a file with name HelloWorld.java, because the compiler expects the file name to match the class identifier.

The HelloWorld application.

```
public class HelloWorld

 {

 public static void main(String args[])

{

System.out.println("Hello World!!");

}

}
```

Explanation:

Class Declaration
The first line public class HelloWorld declares a class, which is an Object-Oriented construct. As stated earlier Java is true Object-Oriented language and therefore, everything must be placed inside a class. Class is a keyword and declares that a new class definition follows.

Opening Brace
Every class definition in Java begins with an opening brace "{" and ends with a matching closing brace "}", appearing in the last line in the example.

public static void main

- The word public means that it is accessible by any other classes.
- The word static means that it is unique.
- The word void means this main method has no return value.
- main is a method where the program starts.

String args[] declares a parameter named args, which contains an array of objects of the class type String.

The Output Line

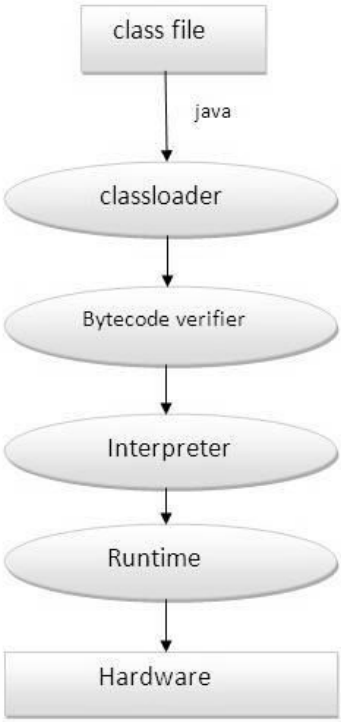
The only executable Statement in the program is

System.out.println("Hello World!!");

The println method is a member of the out Object, which is static data Member of the System class. This line prints **Hello World!!** to the screen. The method println always appends a newline character to the end of the string.

What happens at runtime?

At runtime, following steps are performed:



Classloader: is the subsystem of JVM that is used to load class files.

Bytecode Verifier: checks the code fragments for illegal code that can violate access right to objects.

Interpreter: read bytecode stream then execute the instructions.

DATA TYPES IN JAVA

1. Primary Data Type (Java supports 8 primitive data types): byte, short, int, long, float, double, char and boolean.

2. Non-Primitive Data Types: string, array etc.

Integer Types

Type	Contains	Default	Size	Range
byte	Signed integer	0	8 bit or 1 byte	-27 to 27-1 or -128 to 127
short	Signed integer	0	16 bit or 2 bytes	-215 to 215-1 or -32768 to 32767
int	Signed integer	0	32 bit or 4 bytes	-231 to 231-1 or -2147483648 to 2147483647
long	Signed integer	0	64 bit or 8 bytes	-263 to 263-1 or -9223372036854775808 to 9223372036854775807

Rational Numbers

Type	Contains	Default	Size	Range
float	IEEE 754 floating point single-precision	0.0f	32 bit or 4 bytes	±1.4E-45 to ±3.40282347E+38F
double	IEEE 754 floating point double-precision	0.0	64 bit or 8 bytes	±439E-324 to ±1.7976931348623157E+308

Characters

Type	Contains	Default	Size	Range
char	Unicode character unsigned	\u0000	16 bits or 2 bytes	0 to 216-1 or \u0000 to \uFFFF

Conditional

Type	Contains	Default	Size	Range
boolean	true or false	false	1 bit	true or false

JAVA Tokens

- The smallest individual unit in a program is known as Token.
- Java language includes five types of tokens

1. Reserved Keywords
2. Identifiers
3. Literals
4. Operators
5. Separators

KEYWORDS

Keywords are essential to define language. Specific features of language are implemented using them. There are 50 Keywords in java language. They are,

abstract	continue	for	new	switch
assert	default	goto*	package	synchronized
boolean	do	if	private	this
break	double	implements	protected	throw
byte	else	import	public	throws
case	enum	instanceof	return	transient
catch	extends	int	short	try
char	final	interface	static	void
class	finally	long	strictfp	volatile
const*	float	native	super	while

IDENTIFIERS

All Java components require names. Names used for classes, variables, and methods are called **identifiers**.

In Java, there are several points to remember about identifiers. They are as follows −

- All identifiers should begin with a letter (A to Z or a to z), currency character ($) or an underscore (_).
- After the first character, identifiers can have any combination of characters.
- A key word cannot be used as an identifier.
- Most importantly, identifiers are case sensitive.
- Examples of legal identifiers: age, $salary, _value, __1_value.
- Examples of illegal identifiers: 123abc, -salary.

LITERALS

Sequence of characters representing a constant value, to be stored in a variable.
Eg- int a=10; // 10 is an integer literal
boolean b=true; // true is a Boolean literal

OPERATORS

An operator is a symbol that takes one or more arguments and operates on them to produce a result.
Eg- 2+3, 5*6 etc..

Java provides a rich set of operators to manipulate variables. We can divide all the Java operators into the following groups −

- Arithmetic Operators
- Relational Operators
- Bitwise Operators

- Logical Operators
- Assignment Operators
- Misc Operators

Operator Precedence	
Operators	**Precedence**
postfix	*expr*++ *expr*--
unary	++*expr* --*expr* +*expr* -*expr* ~ !
multiplicative	* / %
additive	+ -
shift	<< >> >>>
relational	< > <= >= instanceof
equality	== !=
bitwise AND	&
bitwise exclusive OR	^
bitwise inclusive OR	|
logical AND	&&
logical OR	||
ternary	? :
assignment	= += -= *= /= %= &= ^= |= <<= >>= >>>=

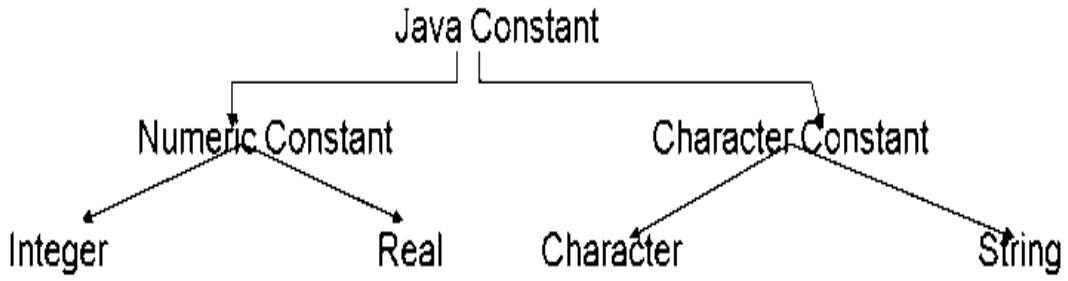
SEPERATORS

Symbols used to indicate where groups of code are divided and arranged.

Symbol	Name	Description
()	Parentheses	Used in: 1. method signatures to contain lists of arguments. 2. expressions to raise operator precedence. 3. narrowing conversions. 4. loops to contain expressions to be evaluated
{}	Braces	Used in: 1. declaration of types. 2. blocks of statements 3. array initialization.
[]	Brackets	Used in: 1. array declaration. 2. array value dereferencing
< >	Angle brackets	Used to pass parameter to parameterized types.
;	Semicolon	Used to terminate statements and in the for statement to separate the initialization code, the expression, and the update code.
:	Colon	Used in the for statement that iterates over an array or a collection.
,	Comma	Used to separate arguments in method declarations.
.	Period	Used to separate package names from subpackages and type names, and to separate a field or method from a reference variable.

CONSTANTS

Constants in Java refer to fixed values that do not change during the execution of a program. Java supports several types of constants given in figure below:



Integer Constants : Refers to a sequence of digits. There are three types of Integers, namely, decimal,octal and hexadecimal integer.

Decimal Integer consist of of a set of digits, 0 through 9, preceded by an optional minus sign.

An octal integer constant consists of any combination of digits from the set 0 through 7, with a leading 0.

A sequence of digits preceded by ox or OX is considered as hexadecimal integer. They may also include alphabets A through F.

Real Constants : Integer constant are inadequate to represent quantities that vary continuously, such as distance, heights, temperature, prices and so on. These quantities are represented by numbers containing fractional parts like 17.546. Such numbers are called real.

Single Character Constants : A single character constant (or simply character constant) contains a single character enclosed within a pair of single quote marks. Examples of character constants are : '5' 'X' ';'

String Constant : A string constant is a sequence of characters enclosed between double quotes. The characters may be alphabets,digits,special characters and blank spaces. Example are : "Hello Java" "1997"

VARIABLE

A variable is an Identifier that denotes a storage location used to store a data value. Unlike constants that remain unchanged during the execution of program.
Examples of variables : average, height, total_height.
Variable name may consist of alphabets, digits, the underscore(_) and dollor characters.

Rules to write Variable/Identifier in Java :

- They must not begin with digit
- Upper and lowercase are distinct. This means that the variable Total is not the same as total or TOTAL.
- It should not be a keyword.
- White space is not allowed.
- Variable names can be of any length.

There are three kinds of variables in Java −

1. **Local variables**

- Local variables are declared in methods, constructors, or blocks.
- Local variables are created when the method, constructor or block is entered and the variable will be destroyed once it exits the method, constructor, or block.

2. **Instance variables**

- Instance variables are declared in a class, but outside a method, constructor or any block.
- Instance variables are created when an object is created with the use of the keyword 'new' and destroyed when the object is destroyed.

3. **Class/Static variables**

- Class variables also known as static variables are declared with the static keyword in a class, but outside a method, constructor or a block.
- There would only be one copy of each class variable per class, regardless of how many objects are created from it.

EXPRESSION

An expression is a operators and operands. An expression may appear on the right side of an assignment statement. For example,
Int answer;
Answer=100*31;
Java expression may contain Variables, constants or both. For example assuming that answer and count are variables, this expression is perfectly valid.
Answer=count-100;

DECISION MAKING STATEMENTS

Java supports following decision-making statements:

- if statement
- if-else statement
- else-if statement
- switch statement

1. If Statement

Java if statement is used to execute some code, if a condition is true otherwise if condition is false, execute nothing.

Syntax:

```
if(condition)
{
   statement 1;
   statement 2;
   ...
}
```

Example:

```
public class Sample{
public static void main(String args[]){
     int a=20, b=30;
     if(b>a)
       System.out.println("b is greater");
     }
}
```

Output:
b is greater

2. If-else Statement

Java if else statements is used to execute some code, if a condition is true otherwise if condition is false, execute nothing, or execute some other code.

Syntax:

```
if(condition)
{
  //execute your code
}
else
{
  //execute your code
}
```

Example:

```
public class Sample {
public static void main(String args[]) {
      int a = 80, b = 30;
      if (b > a) {
         System.out.println("b is greater");
      }
      else {
         System.out.println("a is greater");
      }
   }
}
```

Output:
a is greater

3. Else if Statement

Java elseif is a like doing another if condition for a true or false value.

Syntax:

```
if(condition)
{
  //execute your code
```

```
}
else if(condition n)
{
  //execute your code
}
else
{
  //execute your code
}
```

Example:

```
public class Sample {

public static void main(String args[]) {
      int a = 30, b = 30;
      if (b > a) {
         System.out.println("b is greater");
      }
      else if(a > b){
         System.out.println("a is greater");
      }
      else {
         System.out.println("Both are equal");
      }
   }
}
```

Output:

Both are equal

4. Switch Statement

Java switch statement is used when you have multiple possibilities for the if statement.

Syntax:

```
switch(variable)
{
case 1:
  //execute your code
break;

case n:
  //execute your code
```

```
break;

default:
  //execute your code
break;
}
```

Example:

```
public class Sample {

public static void main(String args[]) {
      int a = 5;
      switch (a) {
         case 1:
            System.out.println("You chose One");
            break;

         case 2:
            System.out.println("You chose Two");
            break;

         case 3:
            System.out.println("You chose Three");
            break;

         case 4:
            System.out.println("You chose Four");
            break;

         case 5:
            System.out.println("You chose Five");
            break;

         default:
            System.out.println("Invalid Choice. Enter a no between 1 and 5");
            break;
      }
   }
}
```

Output:

```
You chose five
```

LOOPS IN JAVA

Sometimes we want a Java program to repeat something over and over again, loops are used to make a program do something more than one time.

Java loops execute a block of commands a specified number of times, until a condition is met.

Java supports following types of loops:

- while loops
- do while loops
- for loops

1. While loop

Java while loops statement allows to repeatedly run the same block of code, until a condition is met.

Syntax:

```
While (condition)
{
  statement(s);
  Incrementation;
}
```

Example:

```
public class Sample {
public static void main(String args[]) {
      /* local variable Initialization */
      int n = 1, times = 5;
      /* while loops execution */
      while (n <= times) {
        System.out.println("Java while loops:" + n);
        n++;
      }
   }
}
```

Output:

```
Java while loops:1
Java while loops:2
Java while loops:3
Java while loops:4
Java while loops:5
```

2. do while loop

Java do while loops is very similar to the java while loops, but it always executes the code block at least once and further more as long as the condition remains true.

Syntax:

```
do
{
  statement(s);

} while( condition );
```

Example:

```
public class Sample {
public static void main(String args[]) {
      /* local variable Initialization */
      int n = 1, times = 0;

      /* do-while loops execution */
      do {
         System.out.println("Java do while loops:" + n);
         n++;
      } while (n <= times);
   }
}
```

Output:

```
Java do while loops:1
```

3. For loop

Java for loops is very similar to Java while loops in that it continues to process a block of code until a statement becomes false, and everything is defined in a single line.

Syntax:

```
for ( init; condition; increment )
```

```
{
  statement(s);
}
```

Example:

```
public class Sample {
public static void main(String args[]) {
      /* local variable Initialization */
int n = 1, times = 5;
      /* for loops execution */
for (n = 1; n <= times; n = n + 1) {
 System.out.println("Java for loops:" + n);
      }
   }
}
```

Output:

```
Java for loops:1
Java for loops:2
Java for loops:3
Java for loops:4
Java for loops:5
```

BRANCHING STATEMENTS IN JAVA

Loop control statements change execution from its normal sequence. When execution leaves a scope, all automatic objects that were created in that scope are destroyed.

1. break Statement

When a break statement is encountered inside a loop, the loop is terminated and program control resumes at the next statement following the loop.

```
public class BreakDemo
{
  public static void main(String[] args)
  {
    for (int i = 1; i <= 10; i++)
    {
      if (i == 5)
      {
        break;    // terminate loop if i is 5
      }
```

```
        System.out.print(i + " ");
      }

      System.out.println("Loop is over.");
    }
}
```

Output :

1 2 3 4 Loop is over.

The break statement has two forms: labeled and unlabeled. You can also use an unlabeled break to terminate a for, while, or do-while loop

2. continue Statement

The continue statement skips the current iteration of a for, while, or do-while loop. When a continue statement is encountered inside the body of a loop, remaining statements are skipped and loop proceeds with the next iteration.

```
public class ContinueDemo
{
  public static void main(String[] args)
  {
    for (int i = 1; i <= 10; i++)
    {
      if (i % 2 == 0)
      {
        continue;    // skip next statement if i is even
      }

      System.out.println(i + " ");
    }
  }
}
```

Output :

1 3 5 7 9

The unlabeled form skips to the end of the innermost loop's body and evaluates the boolean expression that controls the loop.

3. return Statement

The last of the branching statements is the return statement. The return statement exits from the current method, and control flow returns to where the method was invoked. The return statement has two forms: one that returns a value, and one that doesn't.

To return a value simply put the value (or an expression that calculates the value) after the return keyword.

```
return ++count;
```

The data type of the returned value must match the type of the method's declared return value. When a method is declared void, use the form of return that doesn't return a value.

```
return;
```

STATEMENTS IN JAVA

A statement specifies an action in a Java program, such as assigning the sum of x and y to z, printing a message to the standard output, writing data to a file, etc.

Statements in Java can be broadly classified into three categories:

- Declaration statement
- Expression statement
- Control flow statement

1. Declaration Statement

A declaration statement is used **to declare a variable**. For example,

```
int num;

int num2 = 100;

String str;
```

2. Expression Statement

An **expression with a semicolon at the end** is called an expression statement. For example,

```
//Increment and decrement expressions

num++;

++num;

num--;

--num;
```

//Assignment expressions

```
num = 100;

num *= 10;
```

//Method invocation expressions

```
System.out.println("This is a statement");

someMethod(param1, param2);
```

3. Control Flow Statement

By default, all statements in a Java program are executed in the order they appear in the program. Sometimes you may want to execute a set of statements repeatedly for a number of times or as long as a particular condition is true.

All of these are possible in Java using control flow statements. If block, while loop and for loop statements are examples of control flow statements.

MACHINE NEUTRAL

Machine Neutral Platform Independent means that while writing the program in java, we don't need to care about on which Machine or platform the program will going to be executed. Like in C language if we want to run the program in Windows XP the we need to write the program in windows compatible C compiler and in windows platform to c program in UNIX or Linux we need to edit and compile the same program in Linux and UNIX compatible compiler and environment . Same in visual basic program can only run in Windows platform.

Java breaks all these restriction, Java gives the freedom to write and compile the program in any platform or machine and the same program can run on different platform and machine. Example Java program written for Linux system can also run on windows and UNIX etc.

How Java do this?

The secret behind platform independent of java is JAVA VIRTUAL MACHINE. All language compilers translate source code into machine code for a specific computer. Java compiler also does the same thing. Then, how does java achieve architecture neutrality? The answer is that the Java compiler produces an itermedia code known as **bytecode** for a machine that does not exits. This

machine is called the Java Virtual Machine and it exits only inside the computer memory. It is a simulated computer within the computer and does all major functions of a real computer.

COMMAND LINE ARGUMENTS IN JAVA

The parameters which are provided to the program at the command line are called command line arguments.
Eg: d:\> java a 10 20 30

Here, "java" is an interpreter, "a" is file name, 10, 20, 30 are arguments passed to the program while executing the program.
And the notation of String args[ ] in main method will be cleared with the command line arguments.
public static void main(String[ ] args)
The "String args[ ]" declares args as an array of strings. args by default holds the strings given to the program while executing it.

EXAMPLE-1

```
class Command
{
public static void main(String args[])
{
System.out.println(args[0]);//holds the first string
System.out.println(args[1]);//holds the second string
System.out.println(args[2]);//holds the third string
}
}
```

EXAMPLE-2

```
class applyCommand
{
public static void main(String[] args)
{
String name;
name=args[0];//first value given in command line
int Roll;
Roll=Integer.parseInt(args[1]);//converting string to integer
float marks;
marks=Float.parseFloat(args[2]);//converting string to float
System.out.println("Name is:"+name);
System.out.println("Roll no:"+Roll);
System.out.println("Marks are:"+marks);
}
}
```

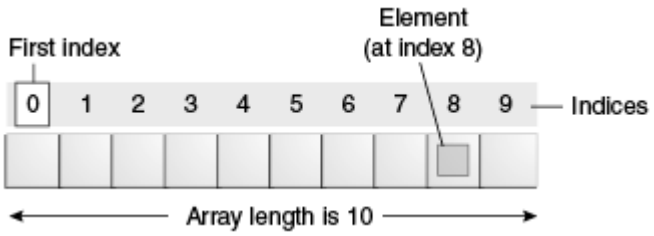
PART-3
ARRAYS AND STRINGS

ARRAY

Normally, array is a collection of similar type of elements that have contiguous memory location.

Java array is an object that contains elements of similar data type. It is a data structure where we store similar elements. We can store only fixed set of elements in a java array.

Array in java is index based. First element of the array is stored at 0 index.



Advantage of Java Array

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

Disadvantage of Java Array

- **Size Limit:** We can store only 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.

SINGLE DIMENSIONAL ARRAY IN JAVA

Declaration of Array in java

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

Creating and Initializing Arrays

One way to create an array is with the new operator.

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

The above statement does two things −

- It creates an array using new dataType[arraySize].
- It assigns the reference of the newly created array to the variable arrayRefVar.

```
// create an array of 10 integers
anArray = new int[10];
```

We can assign values to each element of the array:

```
anArray[0] = 100; // initialize first element
anArray[1] = 200; // initialize second element
anArray[2] = 300; // and so forth
```

Each array element is accessed by its numerical index:

```
System.out.println("Element 1 at index 0: " + anArray[0]);
System.out.println("Element 2 at index 1: " + anArray[1]);
System.out.println("Element 3 at index 2: " + anArray[2]);
```

Alternatively, you can use the shortcut syntax to create and initialize an array:

```
int[] anArray = {
    100, 200, 300,
    400, 500, 600,
    700, 800, 900, 1000
};
```

Here the length of the array is determined by the number of values provided between braces and separated by commas.

Example of single dimensional java array

```
class Testarray{
public static void main(String args[]){
int a[]=new int[5];//declaration and instantiation
a[0]=10;//initialization
a[1]=20;
a[2]=70;
a[3]=40;
a[4]=50;
  //printing array
for(int i=0;i<a.length;i++)//length is the property of array
System.out.println(a[i]);
```

```
 }}
```
Output: 10
20
70
40
50

Processing Arrays

When processing array elements, we often use either **for** loop or **foreach** loop because all of the elements in an array are of the same type and the size of the array is known.

Example

Here is a complete example showing how to create, initialize, and process arrays −

```
public class TestArray {

  public static void main(String[] args) {
    double[] myList = {1.9, 2.9, 3.4, 3.5};

    // Print all the array elements
    for (int i = 0; i < myList.length; i++) {
      System.out.println(myList[i] + " ");
    }

    // Summing all elements
    double total = 0;
    for (int i = 0; i < myList.length; i++) {
      total += myList[i];
    }
    System.out.println("Total is " + total);

    // Finding the largest element
    double max = myList[0];
    for (int i = 1; i < myList.length; i++) {
      if (myList[i] > max) max = myList[i];
    }
    System.out.println("Max is " + max);
  }
}
```

This will produce the following result −

Output

1.9
2.9
3.4
3.5
Total is 11.7
Max is 3.5

The foreach Loops

JDK 1.5 introduced a new for loop known as foreach loop or enhanced for loop, which enables you to traverse the complete array sequentially without using an index variable.

Example

The following code displays all the elements in the array myList −

```
public class TestArray {
public static void main(String[] args) {
   double[] myList = {1.9, 2.9, 3.4, 3.5};

   // Print all the array elements
   for (double element: myList) {
      System.out.println(element);
   }
}
}
```

This will produce the following result −

Output

1.9
2.9
3.4
3.5

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 to initialize Multidimensional Array in java

```
arr[0][0]=1;
arr[0][1]=2;
arr[0][2]=3;
arr[1][0]=4;
arr[1][1]=5;
arr[1][2]=6;
arr[2][0]=7;
arr[2][1]=8;
arr[2][2]=9;
```

Example of Multidimensional java array

Let's see the simple example to declare, instantiate, initialize and print the 2Dimensional 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

STRINGS IN JAVA:

- Generally, string is a sequence of characters.
- In java, string is an object that represents a sequence of characters.
- The java.lang.String class is used to create string object.
- String can be created in number of ways, here are a few ways of creating string object.

1) **Using a String literal**

String literal is a simple string enclosed in double quotes " ". A string literal is treated as a String object.

String str1=”Hello”;

2) **Using another String object**

String str2=new String(str1);

3) **Using new Keyword**

String str3=new String(“Java”);

4) **Using + operator (Concatenation)**

String str4=str1+str2;

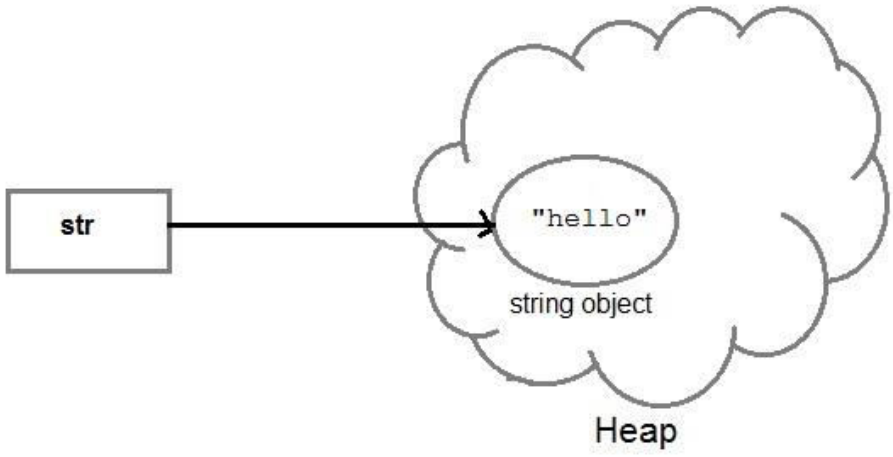
Or

String str4=”Hello”+”Java”;

How String object are stored?

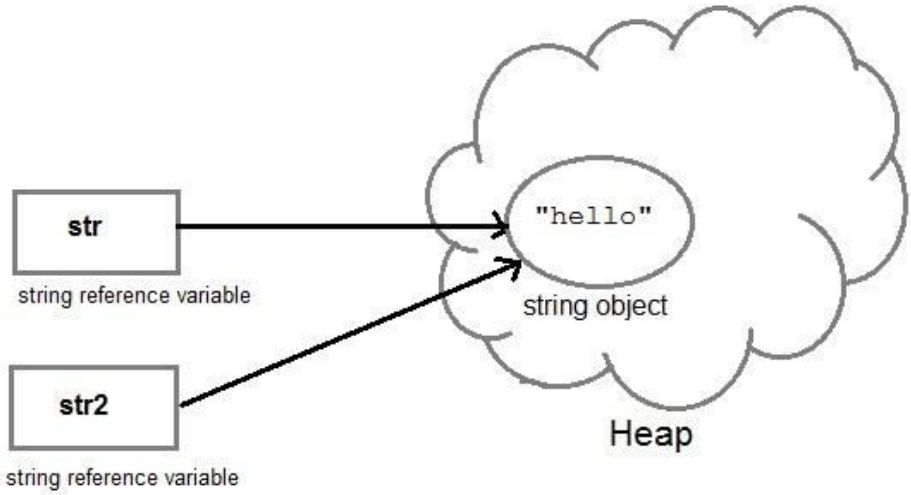
Each time you create a String literal, the JVM checks the string pool first. If the string literal already exists in the pool, a reference to the pool instance is returned. If string does not exist in the pool, a new string object is created, and is placed in the pool. String objects are stored in a special memory area known as string constant pool inside the heap memory.

String str1=”Hello”;



And, when we create another object with same string, then a reference of the string literal already present in string pool is returned.

String str2=str;



Java String class methods

The java.lang.String class provides many useful methods to perform operations on sequence of char values.The following methods are some of the most commonly used methods of String class.

1. charAt()

charAt() function returns the character located at the specified index.

String str = "studytonight";

System.out.println(str.charAt(2));

Output : u

2. equalsIgnoreCase()

equalsIgnoreCase() determines the equality of two Strings, ignoring thier case (upper or lower case doesn't matters with this fuction).

String str = "java";

System.out.println(str.equalsIgnoreCase("JAVA"));

Output : true

3. length()

length() function returns the number of characters in a String.

String str = "Count me";

System.out.println(str.length());

Output : 8

4. replace()

replace() method replaces occurances of character with a specified new character.

String str = "Change me";

System.out.println(str.replace('m','M'));

Output : Change Me

5. substring()

substring() method returns a part of the string. substring() method has two forms,

public String substring(int begin);

public String substring(int begin, int end);

The first argument represents the starting point of the subtring. If the substring() method is called with only one argument, the subtring returned, will contain characters from specified starting point to the end of original string.

But, if the call to substring() method has two arguments, the second argument specify the end point of substring.

String str = "0123456789";

System.out.println(str.substring(4));

Output : 456789

System.out.println(str.substring(4,7));

Output : 456

6. toLowerCase()

toLowerCase() method returns string with all uppercase characters converted to lowercase.

String str = "ABCDEF";

System.out.println(str.toLowerCase());

Output : abcdef

7. valueOf()

Overloaded version of valueOf() method is present in String class for all primitive data types and for type Object.

NOTE : valueOf() function is used to convert primitive data types into Strings.

But for objects, valueOf() method calls toString() function.

8. toString()

toString() method returns the string representation of the object used to invoke this method. toString() is used to represent any Java Object into a meaningful string representation. It is declared in the Object class, hence can be overrided by any java class. (Object class is super class of all java classes.)

```
public class Car {
 public static void main(String args[])
 {
  Car c=new Car();
  System.out.println(c);
 }
 public String toString()
```

```
 {
  return "This is my car object";
 }
}
```

Output : This is my car object

Whenever we will try to print any object of class Car, its toString() function will be called. toString() can also be used with normal string objects.

```
String str = "Hello World";
System.out.println(str.toString());
```

Output : Hello World

9. toUpperCase()

This method returns string with all lowercase character changed to uppercase.

```
String str = "abcdef";
System.out.println(str.toUpperCase());
```

Output : ABCDEF

10. trim()

This method returns a string from which any leading and trailing whitespaces has been removed.

```
String str = "    hello  ";
System.out.println(str.trim());
```

Output : hello

11. equals() method

equals() method compares two strings for equality. Its general syntax is,

boolean equals (Object str)

It compares the content of the strings. It will return true if string matches, else returns false.

```
String s = "Hell";
```

String s1 = "Hello";

String s2 = "Hello";

s1.equals(s2); //true

s.equals(s1) ; //false

Difference between == & equals()

== operator compares two object references to check whether they refer to same instance. This also, will return true on successful match.

String s1 = "Java";

String s2 = "Java";

String s3 = new string ("Java");

test(Sl == s2) //true

test(s1 == s3) //false

where as equals() compares the content of the strings.

12. compareTo() method

compareTo() method compares values and returns an int which tells if the string compared is less than, equal to or greater than th other string. Its general syntax is,

int compareTo(String str)

To use this function you must implement the Comparable Interface. compareTo() is the only function in Comparable Interface.

String s1 = "Abhi";

String s2 = "Viraaj";

String s3 = "Abhi";

s1.compareTo(S2); //return -1 because s1 < s2

s1.compareTo(S3); //return 0 because s1 == s3

s2.compareTo(s1); //return 1 because s2 > s1

13. concat() method

string s = "Hello";

string str = "Java";

string str2 = s.concat(str);

String str1 = "Hello".concat("Java"); //works with string literals too.

StringBuffer class

- StringBuffer class is used to create a **mutable** string object.
- It represents growable and writable character sequence.
- As we know that String objects are immutable, so if we do a lot of changes with **String** objects, we will end up with a lot of memory leak.
- So **StringBuffer** class is used when we have to make lot of modifications to our string.
- It is also thread safe i.e multiple threads cannot access it simultaneously.

StringBuffer defines some constructors. They are,

1. **StringBuffer** ( )- creates an empty string buffer and reserves room for 16 characters.
2. **StringBuffer** (int size)- creates an empty string and takes an integer argument to set capacity of the buffer.

```
class Test {
 public static void main(String args[])
 {
  String str = "Hello";
  str.concat("Java");
  System.out.println(str);      // Output: Hello
  StringBuffer strB = new StringBuffer("Hello");
  strB.append("Java");
  System.out.println(strB);    // Output: HelloJava
 }
}
```

Important methods of StringBuffer class

The following methods are some most commonly used methods of StringBuffer class.

1. append()

This method will concatenate the string representation of any type of data to the end of the invoking **StringBuffer** object. append() method has several overloaded forms.

StringBuffer append(String str)

StringBuffer append(int n)

StringBuffer append(Object obj)

The string representation of each parameter is appended to **StringBuffer** object.

```
StringBuffer str = new StringBuffer("test");
str.append(123);
System.out.println(str);
Output : test123
```

2. insert()

This method inserts one string into another. Here are few forms of insert() method.

StringBuffer insert(int index, String str)

StringBuffer insert(int index, int num)

StringBuffer insert(int index, Object obj)

Here the first parameter gives the index at which position the string will be inserted and string representation of second parameter is inserted into StringBuffer object.

```
StringBuffer str = new StringBuffer("test");
str.insert(4, 123);
System.out.println(str);
Output : test123
```

3. reverse()

This method reverses the characters within a **StringBuffer** object.

```
StringBuffer str = new StringBuffer("Hello");
str.reverse();
System.out.println(str);
Output : olleH
```

4. replace()

This method replaces the string from specified start index to the end index.

```
StringBuffer str = new StringBuffer("Hello World");
str.replace( 6, 11, "java");
System.out.println(str);
```
Output : Hello java

5. capacity()

This method returns the current capacity of **StringBuffer** object.

```
StringBuffer str = new StringBuffer();
System.out.println( str.capacity() );
```
Output : 16

6. ensureCapacity()

This method is used to ensure minimum capacity of StringBuffer object.

```
StringBuffer str = new StringBuffer("hello");

str.ensureCapacity(10);
```

VECTORS

- Vectors (the java.util.Vector class) are commonly used instead of arrays, because they expand automatically when new data is added to them.
- The Java 2 Collections API introduced the similar ArrayList data structure.
- ArrayLists are unsynchronized and therefore faster than Vectors, but less secure in a multithreaded environment
- A vector is a dynamic array, whose size can be increased, where as an array size cannot be changed.
- Reserve space can be given for vector, where as for arrays cannot.
- A vector is a class where as an array is not.
- Vectors can store any type of objects, where as an array can store only homogeneous values.

- **Create a Vector with default initial size**
  Vector v = new Vector();
- **Create a Vector with an initial size**
  Vector v = new Vector(300);
- **Advantages of Vector:**
  - Size of the vector can be changed
  - Multiple objects can be stored
  - Elements can be deleted from a vector

- **Disadvantages of Vector:**
  - A vector is an object, memory consumption is more.

Important methods of Vector Class:

Method call	**Task performed**
list.addElement(item)	Adds the item specified to the list at the end
list.elementAt(10)	Gives the name of the 10^{th} object
list.size()	Gives the number of object present
list.removeElement(item)	Removes the specified item from the list
list.removeElementAt(n)	Remove the items stored in nth position of the list
list.removeAllElements()	Remove all the elements in the list
list.copyInto(array)	Copies all items from list to array
list.insertElementAt(item,n)	Inserts the item at nth position

Example:

```
import java.util.*;
public class VectorExample {
public static void main(String args[]) {
Vector list = new Vector ();
int length=args.length;
for(int i=0;i<length;i++)
{
list.addElement(args[i]);
}
list.insertElementAt("COBOL",2);
int size=list.size();
String listArray[]=new String[size];
```

```
list.copyInto(listArray);
System.out.println("List of Languages");
for(int i=0;i<size;i++)
{
System.out.println(listArray[i]);
}
}
}
```

OUTPUT:

```
D:\program\java VectorExample c c++ java python fortran
c
c++
cobol
java
python
fortran
```

WRAPPER CLASSES

A wrapper class wraps (encloses) around a data type and gives it an object appearance. Wherever, the data type is required as an object, this object can be used (called as boxing). Wrapper classes include methods to unwrap the object and give back the data type (called as unboxing).

Example 1: Observe the following conversion.

```
int k = 100;
Integer it1 = new Integer(k);
```

The int data type k is converted into an object, it1 using Integer class. The it1 object can be used in Java programming wherever k is required an object.

Example 2: The following code can be used to unwrap (getting back int from Integer object) the object it1.

```
int m = it1.intValue();
System.out.println(m*m); // prints 10000
```

intValue() is a method of Integer class that returns an int data type.

List of Wrapper classes:

Eight wrapper classes exist in **java.lang** package that represent 8 data types. Following list gives.

Primitive data type	Wrapper class
byte	Byte
short	Short
int	Integer
long	Long
float	Float
double	Double
char	Character
boolean	Boolean

Following is the hierarchy of the above classes.

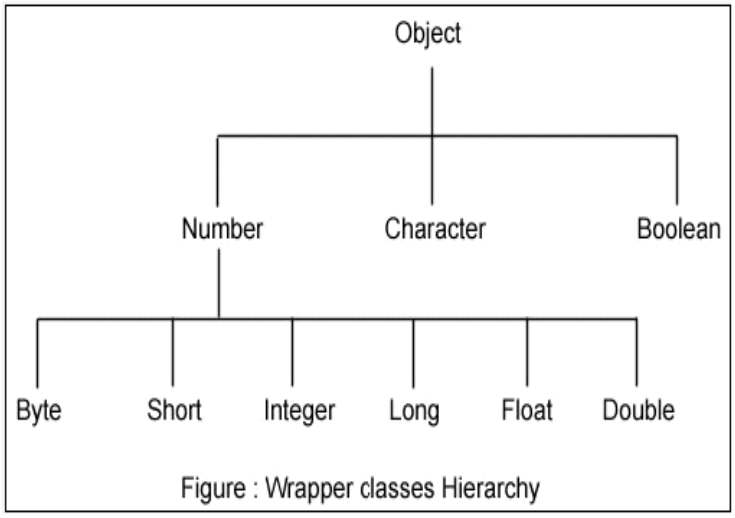


Figure : Wrapper classes Hierarchy

Importance of Wrapper classes

There are mainly two uses with wrapper classes.

- To convert simple data types into objects, that is, to give object form to a data type; here constructors are used.
- To convert strings into data types (known as parsing operations), here methods of type parseXXX() are used.

List of tables for conversions from one type to other type:

1) converting Primitive Numbers to objects numbers using constructor method

Constructor calling	Conversion action

Interger IntVal=new Integer(i);	Primitive integer to integer object
Float FloatVal=new Float(f);	Primitive float to float object
Double DoubleVal=new Double(d);	Primitive double to double object
Long LongVal=new Long(l);	Primitive long to long object

2)converting object numbers to primitive numbers using typeValue() method

Method calling	**Conversion action**
Int i=IntVal.intValue();	Object to primitive integer
Float f=FloatVal.floatValue();	Object to primitive float
Long l=LongVal.longValue();	Object to primitive long
Double d=DoubleVal.doubleValue();	Object to primitive double

3)converting numbers to strings using string() method

Method calling	**Conversion action**
str=Integer.toString(i);	Primityive intger to string
str=Float.toString(f);	Primitive float to string
str=Double.toString(d);	Primitive double to string
str=Long.toString(l);	Primitve long to string

4)conversion from string object to numeric object uising Valueof() method

Method calling	**Conversion action**
DoubleVal=Double.Valueof(str);	Converts string to double object
FloatVal=Float.Valueof(str);	Conversts string to float object
Intval=Integer.Valueof(str);	Converts string to integer object
LongVal=Long.Valueof(str);	Converts string to long object

5) converting numeric strings to primitive numbers using parsing methods

Method calling	**Conversion action**
Int i=Integer.parseInt(Str);	Converst string to primitive integer
Long i=Long.parseLong(str);	Converts string to primitive long

The following program expresses the style of converting data type into an object and at the same time retrieving the data type from the object.

Program:

```
import java.util.*;
import java.io.*;
public class WrappingUnwrapping
```

```
{
 public static void main(String args[])
 {                  //  data types
   byte grade = 2;
   int marks = 50;
   float price = 8.6f;
   double rate = 50.5;
   Byte g1 = new Byte(grade);                    // wrapping
   Integer m1 = new Integer(marks);
   Float f1 = new Float(price);
   Double r1 = new Double(rate);
   System.out.println("Values of Wrapper objects (printing as objects)");
   System.out.println("Byte object g1:  " + g1);
   System.out.println("Integer object m1:  " + m1);
   System.out.println("Float object f1:  " + f1);
   System.out.println("Double object r1:  " + r1);
   byte bv = g1.byteValue();                  // unwrapping
   int iv = m1.intValue();
   float fv = f1.floatValue();
   double dv = r1.doubleValue();
   System.out.println("Unwrapped values (printing as data types)");
   System.out.println("byte value, bv: " + bv);
   System.out.println("int value, iv: " + iv);
   System.out.println("float value, fv: " + fv);
   System.out.println("double value, dv: " + dv);
 }
}
```

BASIC I/O STREAMS

IO Stream

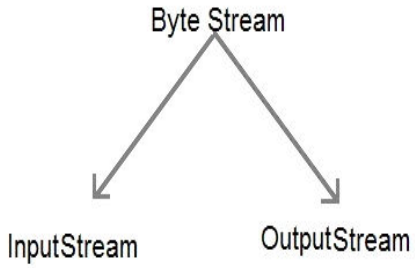
Java performs I/O through **Streams**. A Stream is linked to a physical layer by java I/O system to make input and output operation in java. In general, a stream means continuous flow of data. Streams are clean way to deal with input/output without having every part of your code understand the physical.

Java encapsulates Stream under **java.io** package. Java defines two types of streams. They are,

- **Byte Stream :** It provides a convenient means for handling input and output of byte.
- **Character Stream :** It provides a convenient means for handling input and output of characters. Character stream uses Unicode and therefore can be internationalized.

Byte Stream Classes

Byte stream is defined by using two abstract class at the top of hierarchy, they are InputStream and OutputStream.



These two abstract classes have several concrete classes that handle various devices such as disk files, network connection etc.

Some important Byte stream classes.

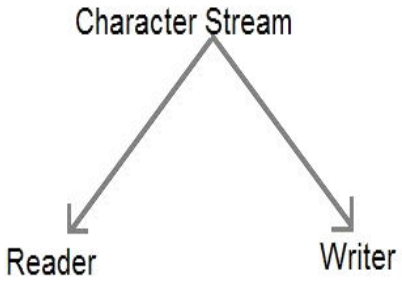
Stream class	Description
BufferedInputStream	Used for Buffered Input Stream.
BufferedOutputStream	Used for Buffered Output Stream.
DataInputStream	Contains method for reading java standard datatype
DataOutputStream	An output stream that contain method for writing java standard data type
FileInputStream	Input stream that reads from a file
FileOutputStream	Output stream that write to a file.
InputStream	Abstract class that describe stream input.
OutputStream	Abstract class that describe stream output.
PrintStream	Output Stream that contain print()and println()method

These classes define several key methods. Two most important are

- read() : reads byte of data.
- write() : Writes byte of data.

Character Stream Classes

Character stream is also defined by using two abstract class at the top of hierarchy, they are Reader and Writer.



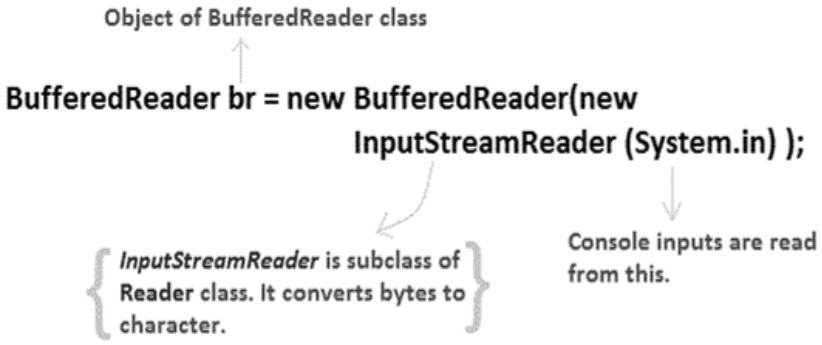
These two abstract classes have several concrete classes that handle unicode character.

Some important Character stream classes.

Stream class	Description
BufferedReader	Handles buffered input stream.
BufferedWriter	Handles buffered output stream.
FileReader	Input stream that reads from file.
FileWriter	Output stream that writes to file.
InputStreamReader	Input stream that translate byte to character
OutputStreamReader	Output stream that translate character to byte.
PrintWriter	Output Stream that contain print()and println()method.
Reader	Abstract class that define character stream input
Writer	Abstract class that define character stream output

Reading Console Input

We use the object of BufferedReader class to take inputs from the keyboard.



Reading Input Characters

To read a character from a BufferedReader we will use int read() throws IOException. Each time that read() is called, it reads a character from the input stream and returns it as an integer value. It returns -1 when the end of the stream is encountered. If there goes something wrong it can throw an IOException. The following program demonstrates read() by reading characters from the console until the user types a 'q'. Notice that any I/O exceptions that might be generated are simply thrown out of main(). Such an approach is common when reading from the console, but you can handle these types of errors yourself, if you chose.

```
// BufferedReader to read characters from the console.
import java.io.*;
class BufferedReaderCharDemo
```

```
{
  public static void main(String args[]) throws IOException
  {
    char c;
    BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
    System.out.println("Enter characters, press 'q' to quit.");
    // read characters
    do
    {
      c = (char) br.read();
      System.out.println(c);
    } while(c != 'q');
  }
}
```

OUTPUT

```
D:\JavaPrograms>javac BufferedReaderCharDemo.java

D:\JavaPrograms>java BufferedReaderCharDemo
Enter characters, press 'q' to quit.
krishanq
k
r
i
s
h
a
n
q
```

Reading Input Strings

To read a string from the keyboard we use String readLine() throws IOException that is a member of the BufferedReader class. As you can see, it returns a String object. The following program demonstrates BufferedReader and the readLine() method; the program reads and displays lines of text until you enter the word "stop":

```
// Reading string from console.
import java.io.*;
class BufferedReaderStringDemo
{
  public static void main(String args[]) throws IOException
  {
```

```
    // create a BufferedReader using System.in
    BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
    String str;
    System.out.println("Enter lines of text.");
    System.out.println("Enter 'stop' to quit.");
    do
    {
      str = br.readLine();
      System.out.println(str);
    } while(!str.equals("stop"));
  }
}
```

OUTPUT

```
D:\JavaPrograms>javac BufferedReaderStringDemo.java
D:\JavaPrograms>java BufferedReaderStringDemo
Enter lines of text.
Enter 'stop' to quit.
This is a String
This is a String
stop
stop
```

JAVA SCANNER CLASS

- There are various ways to read input from the keyboard, the **java.util.Scanner** class is one of them.
- The **Java Scanner** class breaks the input into tokens using a delimiter that is whitespace by default.
- It provides many methods to read and parse various primitive values.
- Java Scanner class is widely used to parse text for string and primitive types using regular expression.
- Java Scanner class extends Object class and implements Iterator and Closeable interfaces.

Commonly used methods of Scanner class

There is a list of commonly used Scanner class methods:

Method	Description
public String next()	it returns the next token from the scanner.
public String nextLine()	it moves the scanner position to the next line and returns the value as a string.
public byte nextByte()	it scans the next token as a byte.
public short nextShort()	it scans the next token as a short value.

public int nextInt()	it scans the next token as an int value.
public long nextLong()	it scans the next token as a long value.
public float nextFloat()	it scans the next token as a float value.
public double nextDouble()	it scans the next token as a double value.

Java Scanner Example to get input from console

Let's see the simple example of the Java Scanner class which reads the int, string and double value as an input:

```
import java.util.Scanner;
class ScannerTest
{
 public static void main(String args[])
{
   Scanner sc=new Scanner(System.in);
   System.out.println("Enter your rollno");
   int rollno=sc.nextInt();
   System.out.println("Enter your name");
   String name=sc.next();
   System.out.println("Enter your fee");
   double fee=sc.nextDouble();
   System.out.println("Rollno:"+rollno+" name:"+name+" fee:"+fee);
   sc.close();
 }
}
```

Output:

```
Enter your rollno
111
Enter your name
Ratan
Enter
450000
Rollno:111 name:Ratan fee:450000
```