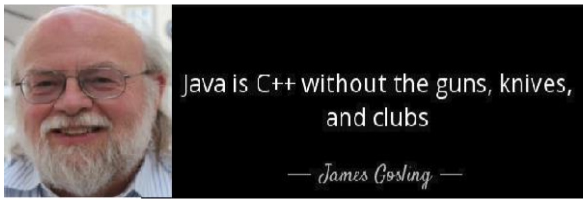
JAVA Handout for YOU.....

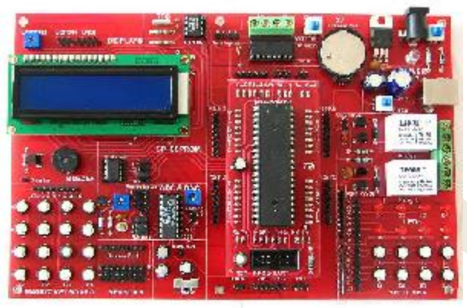
A SMOOTH SEA NEVER MADE A SKILLFUL SAILOR



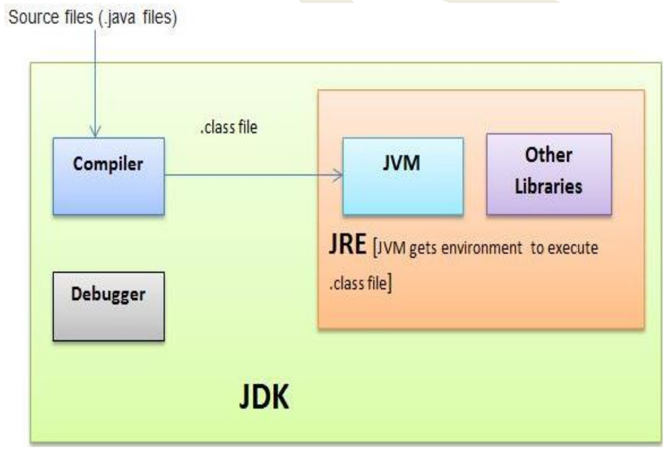
JAVA – I am everywhere............

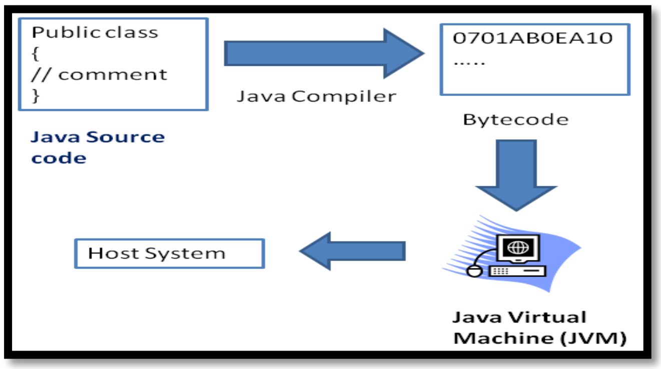
Java platform runs similarly on any combination of hardware and operating system with adequate runtime support. This is achieved by compiling the Java language code to an intermediate representation called Java bytecode, instead of directly to architecture-specific machine code. They are executed by a virtual machine (VM) written specifically for the host hardware.

JDK- Java Development Kit



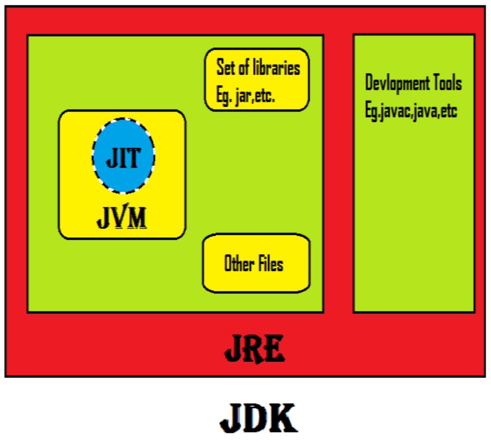
The JDK includes a private JVM and a few other resources to finish the development of a Java Application. Since the introduction of the Java platform, it has been by far the most widely used Software Development Kit (SDK).

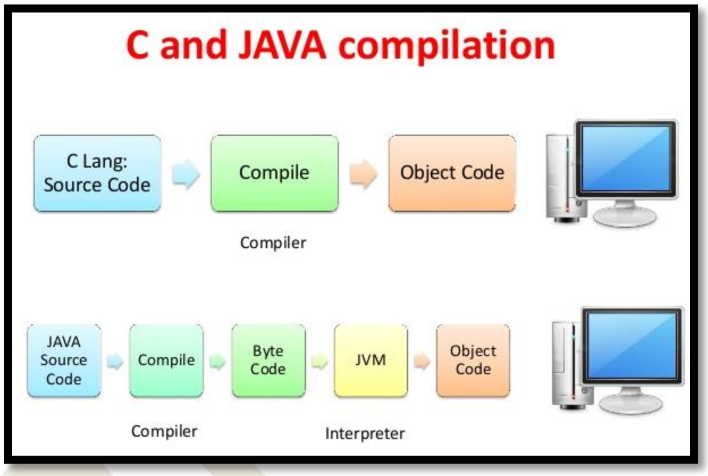

Source files (.java files)
.class file
Compiler
Debugger
JVM
Other Libraries
JRE [JVM gets environment to execute .class file]
JDK



JVM

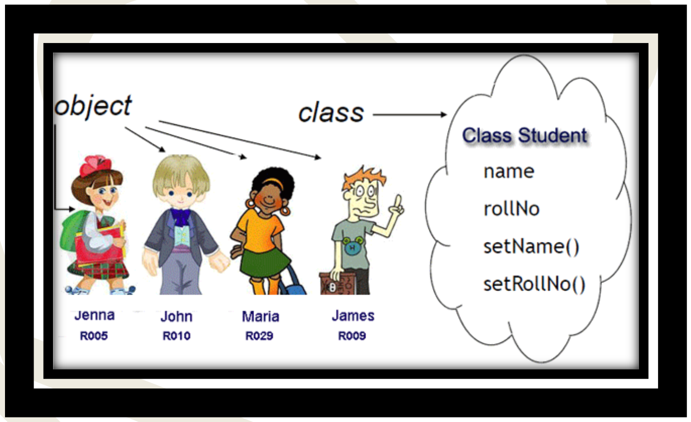
JRE

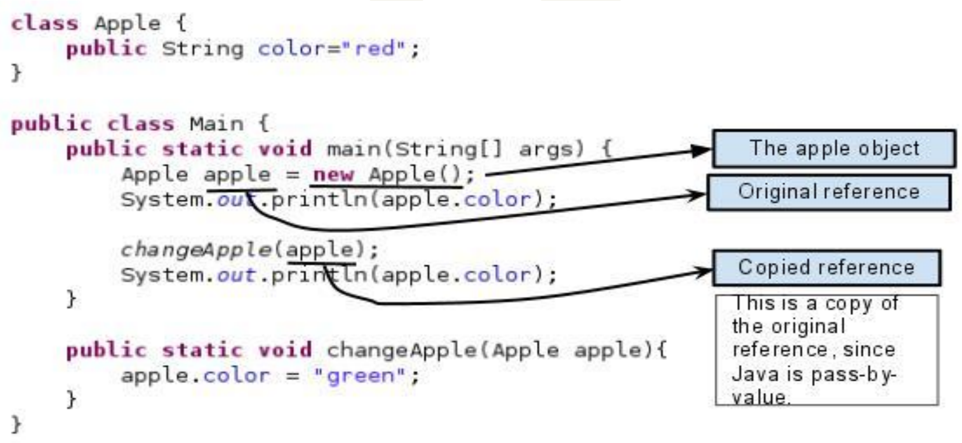




What is JIT ?

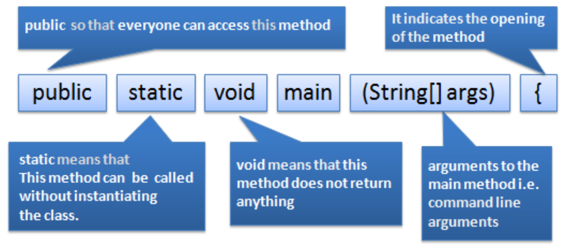
Classes, Objects, Methods

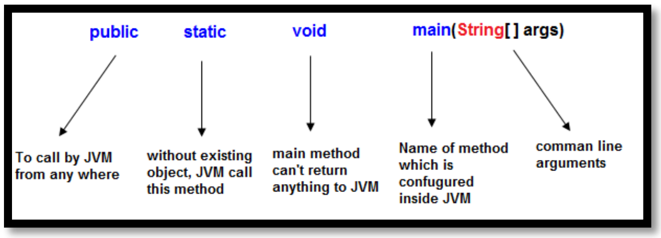


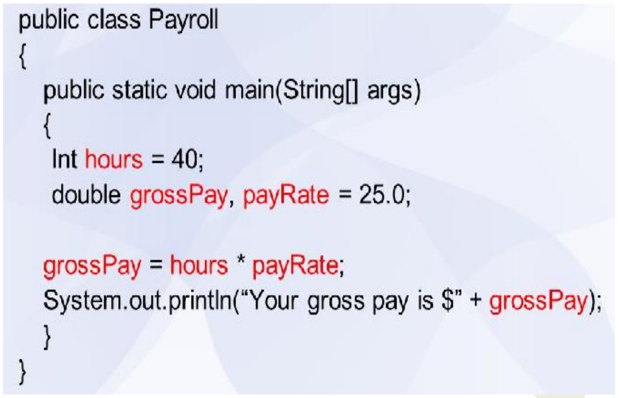


```
class Apple {
        public String color="red";
}

public class Main {
        public static void main(String[] args) {
                Apple apple = new Apple();
                System.out.println(apple.color);

                changeApple(apple);
                System.out.println(apple.color);
        }

        public static void changeApple(Apple apple){
                apple.color = "green";
        }
}
```

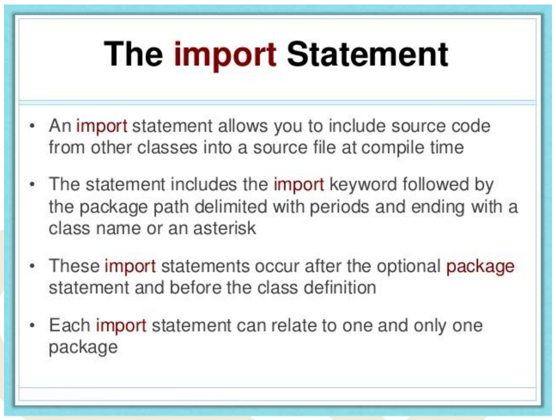
The apple object
Original reference
Copied reference
This is a copy of the original reference, since Java is pass-by-value.


public so that everyone can access this method
It indicates the opening of the method
public
static
void
main
(String[] args)
{
static means that This method can be called without instantiating the class.
void means that this method does not return anything
arguments to the main method i.e. command line arguments


public
static
void
main(String[] args)
To call by JVM from any where
without existing object, JVM call this method
main method can't return anything to JVM
Name of method which is confugured inside JVM
comman line arguments



```
public class Payroll
{
   public static void main(String[] args)
   {
    Int hours = 40;
    double grossPay, payRate = 25.0;

   grossPay = hours * payRate;
   System.out.println("Your gross pay is $" + grossPay);
   }
}
```



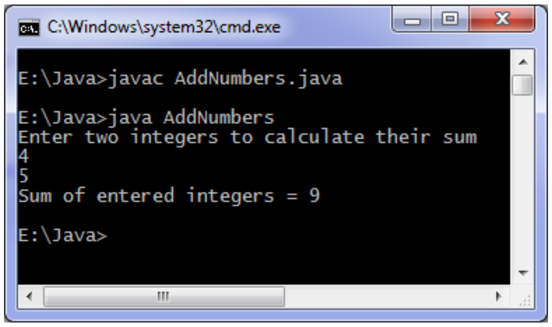
The import Statement

- An import statement allows you to include source code from other classes into a source file at compile time
- The statement includes the import keyword followed by the package path delimited with periods and ending with a class name or an asterisk
- These import statements occur after the optional package statement and before the class definition
- Each import statement can relate to one and only one package

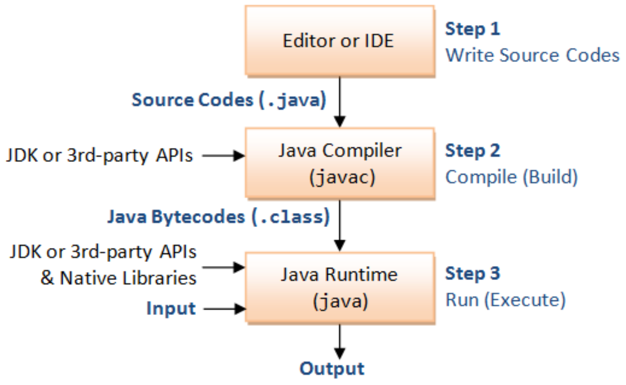
Example:

```
import java.util.Scanner;

class AddNumbers
{
  public static void main(String args[])
  {
    int x, y, z;
    System.out.println("Enter two integers to calculate their sum ");
    Scanner in = new Scanner(System.in);
    x = in.nextInt();
    y = in.nextInt();
    z = x + y;
    System.out.println("Sum of entered integers = "+z);
  }
}
```

Output of program:



```
E:\Java>javac AddNumbers.java

E:\Java>java AddNumbers
Enter two integers to calculate their sum
4
5
Sum of entered integers = 9

E:\Java>
```



Above code can add only numbers in range of integers(4 bytes), if you wish to add very large numbers then you can use BigInteger class.

Code to add very large numbers:

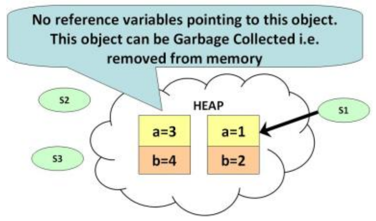
```
import java.util.Scanner;
import java.math.BigInteger;

class AddingLargeNumbers {
  public static void main(String[] args) {
    String number1, number2;
    Scanner in = new Scanner(System.in);

    System.out.println("Enter first large number");
    number1 = in.nextLine();

    System.out.println("Enter second large number");
    number2 = in.nextLine();

    BigInteger first  = new BigInteger(number1);
    BigInteger second = new BigInteger(number2);
    BigInteger sum;

    sum = first.add(second);

    System.out.println("Result of addition = " + sum);
  }}
```

In our code we create two objects of BigInteger class in java.math package. Input should be digit strings otherwise an exception will be raised, also you cannot simply use '+' operator to add objects of bigInteger class, you have to use add method for addition of two objects.

Output of program:

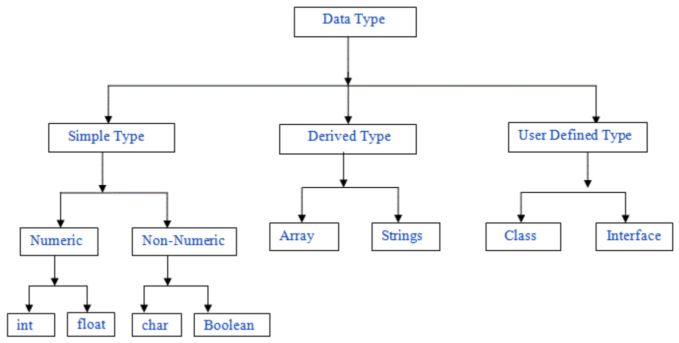
```
Enter first large number
11111111111111
Enter second large number
99999999999999
Result of addition = 111111111111110
```

Garbage Collector


No reference variables pointing to this object. This object can be Garbage Collected i.e. removed from memory
HEAP
S2
S3
S1
a=3
b=4
a=1
b=2

- Garbage means unreferenced objects. Garbage Collection is process of reclaiming the runtime unused memory automatically. It is a way to destroy the unused objects. We were using free () function in C language and delete() in C++. But, in java it is performed automatically. So, java provides better memory management.
- It makes java memory efficient because garbage collector removes the unreferenced objects from heap memory. It is automatically done by the garbage collector (a part of JVM). All primitive data types in Java are signed. Java does not support unsigned types.
- Local variables – **Stack** Memory Dynamic Objects – **Heap** Memory
- Now, an object can also be declared on the heap. For the sake of this discussion, think of the heap as an amorphous blob of memory. Unlike the stack, which automatically allocates and de-allocates the necessary memory as you enter and exit stack frames, you must manually reserve and free heap memory.
- An object declared on the heap does, after a fashion, "survive" between stack frames. One could say that an object declared on the heap never goes out of scope, but that's really because the object is never really associated with any scope. Such an object must be created via the new keyword, and must be referred to by a pointer. It is your responsibility to free the heap object once you are done with it. You free heap objects with the delete keyword. The destructor on a heap object is not called until you free the object.
- The pointers that refer to heap objects are themselves usually local variables associated with scopes. Once you are done using the heap object, you allow the pointer(s) referring to it to go out of scope. If you haven't explicitly freed the object the pointer is pointing to, then the block of heap memory will never be freed until the process exits (this is called a memory leak).
- Think of it all this way: an object created on the stack is like a balloon taped to a chair in a room. When you exit the room, the balloon automatically pops. An object created on the heap is like a balloon on a ribbon, tied to a chair in a room. The ribbon is the pointer. When you exit the room, the ribbon automatically vanishes, but the balloon just floats to the ceiling and takes up space. The proper procedure is to pop the balloon with a pin, and then exit the room, whereupon the ribbon will disappear. But, the good thing about the balloon on the string is you can also untie the ribbon, hold it in your hand, and exit the room and take the balloon with you.
- So to go to your linked list example: typically, nodes of such a list are declared on the heap, with each node holding a pointer to the next node. All of this is sitting on the heap and never goes out of scope. The only thing that could go out of scope is the pointer that points to the root of the list - the pointer you use to reference into the list in the first place. That can go out of scope.

Datatypes



In-built classes (commonly used)

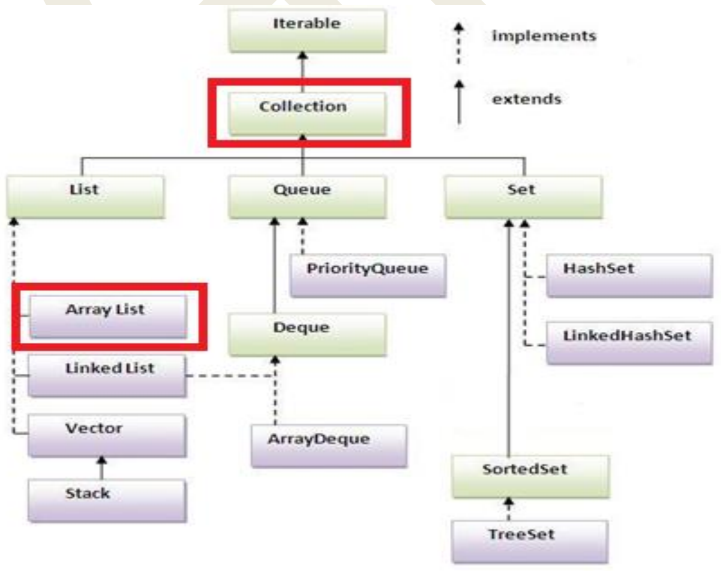
1. **java.lang.String**
   String class will be the undisputed champion on any day by popularity and none will deny that. This is a final class and used to create / operate immutable string literals. It was available from JDK 1.0
2. **java.lang.System**
   Usage of System depends on the type of project you work on. You may not be using it in your project but still it is one of the popular java classes around. This is a utility class and cannot be instantiated. Main uses of this class are access to standard input, output, environment variables, etc. Available since JDK 1.0
3. **java.lang.Exception**
   Throwable is the super class of all Errors and Exceptions. All abnormal conditions that can be handled comes under Exception. NullPointerException is the most popular among all the exceptions. Exception is at top of hierarchy of all such exceptions. Available since JDK 1.0
4. **java.util.ArrayList**
   An implementation of array data structure. This class implements List interface and is the most popular member or java collections framework. Difference between ArrayList and Vector is one popular topic among the beginners and frequently asked question in java interviews. It was introduced in JDK 1.2
5. **java.util.HashMap**
   An implementation of a key-value pair data structure. This class implements Map interface. As similar to ArrayList vs Vector, we have HashMap vs Hashtable popular comparisons. This happens to be a popular collection class that acts as a container for property-value pairs and works as a transport agent between multiple layers of an application. It was introduced in JDK 1.2.
6. **java.lang.Object**
   Great grandfather of all java classes. Every java class is a subclass of Object. It will be used often when we work on a platform/framework. It contains the important methods like equals, hashcode, clone, toString, etc. It is available from day one of java (JDK 1.0)
7. **java.lang.Thread**
   A thread is a single sequence of execution, where multiple thread can co-exist and share resources. We can extend this Thread class and create our own threads. Using Runnable is also another option. Usage of this

class depends on the domain of your application. It is not absolutely necessary to build a usual application. It was available from JDK 1.0

8. **java.lang.Class**
   Class is a direct subclass of Object. There is no constructor in this class and their objects are loaded in JVM by classloaders. Most of us may not have used it directly but I think it is an essential class. It is an important class in doing reflection. It is available from JDK 1.0
9. **java.util.Date**
   This is used to work with date. Sometimes we feel that this class should have added more utility methods and we end up creating those. Every enterprise application we create has a date utility. Introduced in JDK 1.0 and later made huge changes in JDK1.1 by deprecating a whole lot of methods.
10. **java.util.Iterator**
   This is an interface. It is very popular and came as a replacement for Enumeration. It is a simple to use convenience utility and works in sync with Iterable. It was introduced in JDK 1.2.

Collections

Collections in java are a framework that provides architecture to store and manipulate the group of objects. All the operations that you perform on a data such as searching, sorting, insertion, manipulation, deletion etc. can be performed by Java Collections. Collection represents a single unit of objects i.e. a group. Collection framework represents a unified architecture for storing and manipulating group of objects. The java.util package contains all the classes and interfaces for Collection framework.



Methods of Collection interface

There are many methods declared in the Collection interface. They are as follows:

No.	Method	Description
1	public boolean add(Object element)	is used to insert an element in this collection.
2	public boolean addAll(collection c)	is used to insert the specified collection elements in the invoking collection.
3	public boolean remove(Object element)	is used to delete an element from this collection.
4	public boolean removeAll(Collection c)	is used to delete all the elements of specified collection from the invoking collection.
5	public boolean retainAll(Collection c)	is used to delete all the elements of invoking collection except the specified collection.
6	public int size()	return the total number of elements in the collection.
7	public void clear()	removes the total no of element from the collection.
8	public boolean contains(object element)	is used to search an element.
9	public boolean containsAll(Collection c)	is used to search the specified collection in this collection.
10	public Iterator iterator()	returns an iterator.
11	public Object[] toArray()	converts collection into array.
12	public boolean isEmpty()	checks if collection is empty.
13	public boolean equals(Object element)	matches two collection.
14	public int hashCode()	returns the hashcode number for collection.

ArrayList Example:

```
import java.util.*;
public class ArrayListExample {
  public static void main(String args[]) {
    /*Creation of ArrayList: I'm going to add String
     *elements so I made it of string type */
                ArrayList<String> obj = new ArrayList<String>();
```

```
        /*This is how elements should be added to the array list*/
        obj.add("Ajeet");
        obj.add("Harry");
        obj.add("Chaitanya");
        obj.add("Steve");
        obj.add("Anuj");
        /* Displaying array list elements */
        System.out.println("Currently the array list has following elements:"+obj);
        /*Add element at the given index*/
        obj.add(0, "Rahul");
        obj.add(1, "Justin");
        /*Remove elements from array list like this*/
        obj.remove("Chaitanya");
        obj.remove("Harry");
        System.out.println("Current array list is:"+obj);
        /*Remove element from the given index*/
        obj.remove(1);
        System.out.println("Current array list is:"+obj);
  }
}
```

Output:

```
Currently the array list has following elements:[Ajeet, Harry, Chaitanya, Steve, Anuj]
Current array list is:[Rahul, Justin, Ajeet, Steve, Anuj]
Current array list is:[Rahul, Ajeet, Steve, Anuj]
```

Practice with Coding Standards

1. Write a program to ask the user to enter marks obtained in exam. Compare the input marks against minimum passing marks. Print the appropriate message on the screen based on whether user passed the exam or not.
2. Write a program to print multiplication table of a number entered by the user using a `for` loop. You can modify it for `while` or `do while` loop for practice.
3. Write a program to reverse a number entered by the user. If the input is 951 then output will be 159.
4. Write a program to display date and time.
5. Write a program to compare 2 strings entered by the user.

Interfaces

It is a collection of abstract methods. A class implements an interface, thereby inheriting the abstract methods of the interface. Writing an interface is similar to writing a class. But a class describes the attributes and behaviors of an object. And an interface contains behaviors that a class implements.

Example:

```
interface Mobile {
  public void call();
  public void browse();
}
```

A class uses the **implements** keyword to implement an interface. The implements keyword appears in the class declaration following the extends portion of the declaration.

```
/* File name : Samsung.java */
public class Samsung implements Mobile{
  public void call(){
    System.out.println("Call Activated");
  }
  public void browse(){
    System.out.println("Search - Google");
  }
  public int storeImages(){
    return 0;
  }
  public static void main(String args[]){
    Samsung s = new Samsung();
    s.call();
    s.browse();
  }
}
```

Output:

```
Call Activated

Search - Google
```

Packages

Packages are used in Java in order to prevent naming conflicts, to control access, to make searching/locating and usage of classes, interfaces, enumerations and annotations easier, etc. Some of the existing packages in Java are::

- **java.lang** - bundles the fundamental classes
- **java.io** - classes for input , output functions are bundled in this package

Programmers can define their own packages to bundle group of classes/interfaces, etc. It is a good practice to group related classes implemented by you so that a programmer can easily determine that the classes, interfaces, enumerations, annotations are related.

Example:

```
package Mobiles;
/* File name : Mobile.java */
interface Mobile {
  public void call();
  public void browse();
}
package Mobiles;
/* File name : Samsung.java */
public class Samsung implements Mobile{
  public void call(){
    System.out.println("Call Activated");
  }
  public void browse(){
    System.out.println("Search - Google");
  }
  public int storeImages(){
    return 0;
  }
  public static void main(String args[]){
    Samsung s = new Samsung();
    s.call();
    s.browse();
  }
}
```

Inheritance

Inheritance can be defined as the process where one class acquires the properties (methods and fields) of another. The keyword **extends** is used to inherit the properties of a class.

Example:

```
class Calculation{
  int z;
public void addition(int x, int y){
    z = x+y;
    System.out.println("The sum of the given numbers:"+z);
  }
public void Substraction(int x,int y){
    z = x-y;
    System.out.println("The difference between the given numbers:"+z);
  } }
public class My_Calculation extends Calculation{
   public void multiplication(int x, int y){
    z = x*y;
    System.out.println("The product of the given numbers:"+z);
  }
public static void main(String args[]){
    int a = 20, b = 10;
    My_Calculation demo = new My_Calculation();
    demo.addition(a, b);
    demo.Substraction(a, b);
    demo.multiplication(a, b);
  }}
```

Output:

```
The sum of the given numbers:30
The difference between the given numbers:10
The product of the given numbers:200
```

Threads

Computer users take it for granted that their systems can do more than one thing at a time. They assume that they can continue to work in a word processor, while other applications download files, manage the print queue, and stream audio. Even a single application is often expected to do more than one thing at a time. For example, that streaming audio application must simultaneously read the digital audio off the network, decompress it, manage playback, and update its display. Even the word processor should always be ready to respond to keyboard and mouse events, no matter how busy it is reformatting text or updating the display. Software that can do such things is known as *concurrent* software. The Java platform is designed from the ground up to support concurrent programming, with basic concurrency support in the Java programming language and the Java class libraries. Since version 5.0, the Java platform has also included high-level concurrency APIs. There are two types of threads in an application – **user thread** and **daemon thread**. When we start an application, main is the first user thread created and we can create multiple user threads as well as daemon threads. When all the user threads are executed, JVM terminates the program. We can set different priorities to different Threads but it doesn't guarantee that higher priority thread will execute first than lower priority thread. Thread scheduler is the part of Operating System implementation and when a Thread is started, it's execution is controlled by Thread Scheduler and JVM doesn't have any control on it's execution. We can create Threads by either implementing Runnable interface or by extending Thread Class.

```
Thread thread = new Thread(){
   public void run(){
     System.out.println("Thread Running");
   }
 }
```

thread.start();

Applets

An applet is a Java program that runs in a Web browser. An applet can be a fully functional Java application because it has the entire Java API at its disposal.

There are some important differences between an applet and a standalone Java application, including the following:

- An applet is a Java class that extends the java.applet.Applet class.
- A main() method is not invoked on an applet, and an applet class will not define main().
- Applets are designed to be embedded within an HTML page.
- When a user views an HTML page that contains an applet, the code for the applet is downloaded to the user's machine.
- A JVM is required to view an applet. The JVM can be either a plug-in of the Web browser or a separate runtime environment.
- The JVM on the user's machine creates an instance of the applet class and invokes various methods during the applet's lifetime.
- Applets have strict security rules that are enforced by the Web browser. The security of an applet is often referred to as sandbox security, comparing the applet to a child playing in a sandbox with various rules that must be followed.
- Other classes that the applet needs can be downloaded in a single Java Archive (JAR) file.

Example

```
import java.applet.*;
import java.awt.*;
public class HelloWorldApplet extends Applet
{
   public void paint (Graphics g)
   {
      g.drawString ("Hello World", 25, 50);
   }
}
```

Invoking an Applet

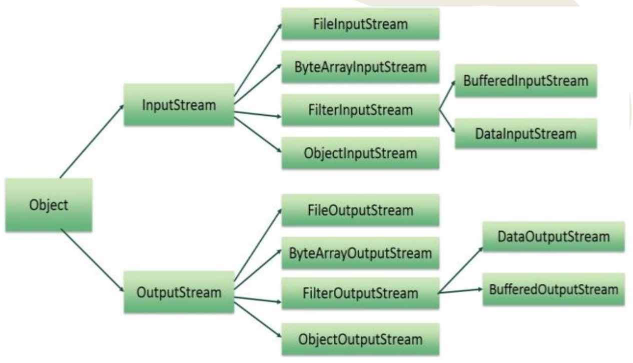
```
<html>
<title>The Hello, World Applet</title>
<hr> <applet code="HelloWorldApplet.class" width="320" height="120">
```

```
If your browser was Java-enabled, a "Hello, World"
message would appear here.
</applet>
<hr></html>
```

Practice with Coding Standards

1. Find out duplicate number between 1 to N numbers.
2. Write a program to implement your own ArrayList class. It should contain add(), get(), remove(), size() methods. Use dynamic array logic. It should increase its size when it reaches threshold.
3. Write a program to swap or exchange two numbers. You should not use any temporary or third variable to swap.
4. Draw a rectangle in the browser screen using applets.
5. Program ATM machine using interfaces.
6. Program Store management system using inheritance and packages.

Files & directories, Exception handling



File Inpu tStream:

This stream is used for reading data from the files. Objects can be created using the keyword new and there are several types of constructors available.

Following constructor takes a file name as a string to create an input stream object to read the file.:

InputStream f = new FileInputStream("C:/java/hello");

Following constructor takes a file object to create an input stream object to read the file. First we create a file object using File() method as follows:

File f = new File("C:/java/hello");

InputStream f = new FileInputStream(f);

Once you have *InputStream* object in hand, then there is a list of helper methods which can be used to read to stream or to do other operations on the stream.

SN	Methods with Description
1	**public void close() throws IOException{}** This method closes the file output stream. Releases any system resources associated with the file. Throws an IOException.
2	**protected void finalize()throws IOException {}** This method cleans up the connection to the file. Ensures that the close method of this file output stream is called when there are no more references to this stream. Throws an IOException.
3	**public int read(int r)throws IOException{}** This method reads the specified byte of data from the InputStream. Returns an int. Returns the next byte of data and -1 will be returned if it's end of file.
4	**public int read(byte[] r) throws IOException{}** This method reads r.length bytes from the input stream into an array. Returns the total number of bytes read. If end of file -1 will be returned.
5	**public int available() throws IOException{}** Gives the number of bytes that can be read from this file input stream. Returns an int.

There are other important input streams available,

- ByteArrayInputStream
- DataInputStream

FileOutputStream:

FileOutputStream is used to create a file and write data into it. The stream would create a file, if it doesn't already exist, before opening it for output.

Here are two constructors which can be used to create a FileOutputStream object.

Following constructor takes a file name as a string to create an input stream object to write the file:

OutputStream f = new FileOutputStream("C:/java/hello")

Following constructor takes a file object to create an output stream object to write the file. First, we create a file object using File() method as follows:

File f = new File("C:/java/hello");

OutputStream f = new FileOutputStream(f);

Once you have *OutputStream* object in hand, then there is a list of helper methods, which can be used to write to stream or to do other operations on the stream.

SN	Methods with Description
1	**public void close() throws IOException{}** This method closes the file output stream. Releases any system resources associated with the file. Throws an IOException
2	**protected void finalize()throws IOException {}** This method cleans up the connection to the file. Ensures that the close method of this file output stream is called when there are no more references to this stream. Throws an IOException.
3	**public void write(int w)throws IOException{}** This methods writes the specified byte to the output stream.
4	**public void write(byte[] w)** Writes w.length bytes from the mentioned byte array to the OutputStream.

There are other important output streams available, for more detail you can refer to the following links:

- ByteArrayOutputStream
- DataOutputStream

Example:

```
import java.io.*;
public class fileStreamTest{
 public static void main(String args[]){
  try{
  byte bWrite [] = {11,21,3,40,5};
  OutputStream os = new FileOutputStream("test.txt");
  for(int x=0; x < bWrite.length ; x++){
    os.write( bWrite[x] ); // writes the bytes
  }
  os.close();
  InputStream is = new FileInputStream("test.txt");
  int size = is.available();
  for(int i=0; i< size; i++){
    System.out.print((char)is.read() + "  ");
  }
  is.close();
 }catch(IOException e){
  System.out.print("Exception");
 }  } }
```

The above code would create file test.txt and would write given numbers in binary format. Same would be output on the stdout screen.

File Navigation and I/O:

There are several other classes for File Navigation and I/O.

- File Class
- FileReader Class
- FileWriter Class

JDBC

JDBC standardizes how to connect to a database, how to execute queries against it, how to navigate the result of such a query, and how to exeucte updates in the database. JDBC does not standardize the SQL sent to the database. This may still vary from database to database.

```
//STEP 1. Import required packages
import java.sql.*;
public class FirstExample {
  // JDBC driver name and database URL
  static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";
  static final String DB_URL = "jdbc:mysql://localhost/EMP";
  //  Database credentials
  static final String USER = "username";
  static final String PASS = "password";
  public static void main(String[] args) {
  Connection conn = null;
  Statement stmt = null;
  try{
    //STEP 2: Register JDBC driver
    Class.forName("com.mysql.jdbc.Driver");
    //STEP 3: Open a connection
    System.out.println("Connecting to database...");
    conn = DriverManager.getConnection(DB_URL,USER,PASS);
    //STEP 4: Execute a query
    System.out.println("Creating statement...");
    stmt = conn.createStatement();
    String sql;
    sql = "SELECT id, first, last, age FROM Employees";
    ResultSet rs = stmt.executeQuery(sql);
    //STEP 5: Extract data from result set
    while(rs.next()){
      //Retrieve by column name
      int id  = rs.getInt("id");
      int age = rs.getInt("age");
      String first = rs.getString("first");
      String last = rs.getString("last");
```

```
         //Display values
         System.out.print("ID: " + id);
         System.out.print(", Age: " + age);
         System.out.print(", First: " + first);
         System.out.println(", Last: " + last);
      }  }
catch(Exception e){
      //Handle errors for Class.forName
      e.printStackTrace();
   }finally{
// Clean-up environment
      rs.close();
      stmt.close();
      conn.close();
      }
   System.out.println("Goodbye!");
} //end main
} //end FirstExample
```

Output:

```
Connecting to database...
Creating statement...
ID: 100, Age: 18, First: Zara, Last: Ali
ID: 101, Age: 25, First: Mahnaz, Last: Fatma
ID: 102, Age: 30, First: Zaid, Last: Khan
ID: 103, Age: 28, First: Sumit, Last: Mittal
```

Practice with Coding Standards

1. Create a bank application and store the transactions in the database. Allow the application to insert, delete, update, and view the records.

"WITHOUT YOUR INVOLVEMENT YOU CAN'T SUCCEED

WITH YOUR INVOLVEMENT YOU CAN'T FAIL"