Java I/O Tutorial

Java I/O (Input and Output) is used *to process the input* and *produce the output*.

Java uses the concept of a stream to make I/O operation fast. The java.io package contains all the classes required for input and output operations.

We can perform **file handling in Java** by Java I/O API.

Stream

A stream is a sequence of data. In Java, a stream is composed of bytes. It's called a stream because it is like a stream of water that continues to flow.

In Java, 3 streams are created for us automatically. All these streams are attached with the console.

1) System.out: standard output stream

2) System.in: standard input stream

3) System.err: standard error stream

Let's see the code to print **output and an error** message to the console.

```
1. System.out.println("simple message");
2. System.err.println("error message");
```

Let's see the code to get **input** from console.

```
1. int i=System.in.read();//returns ASCII code of 1st character
2. System.out.println((char)i);//will print the character
```

OutputStream vs InputStream

The explanation of OutputStream and InputStream classes are given below:

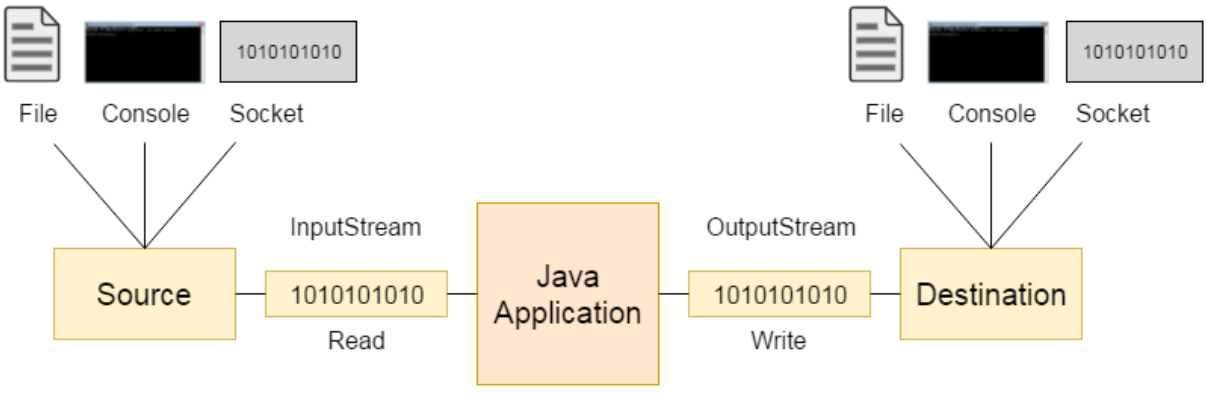
OutputStream

Java application uses an output stream to write data to a destination; it may be a file, an array, peripheral device or socket.

InputStream

Java application uses an input stream to read data from a source; it may be a file, an array, peripheral device or socket.

Let's understand the working of Java OutputStream and InputStream by the figure given below.



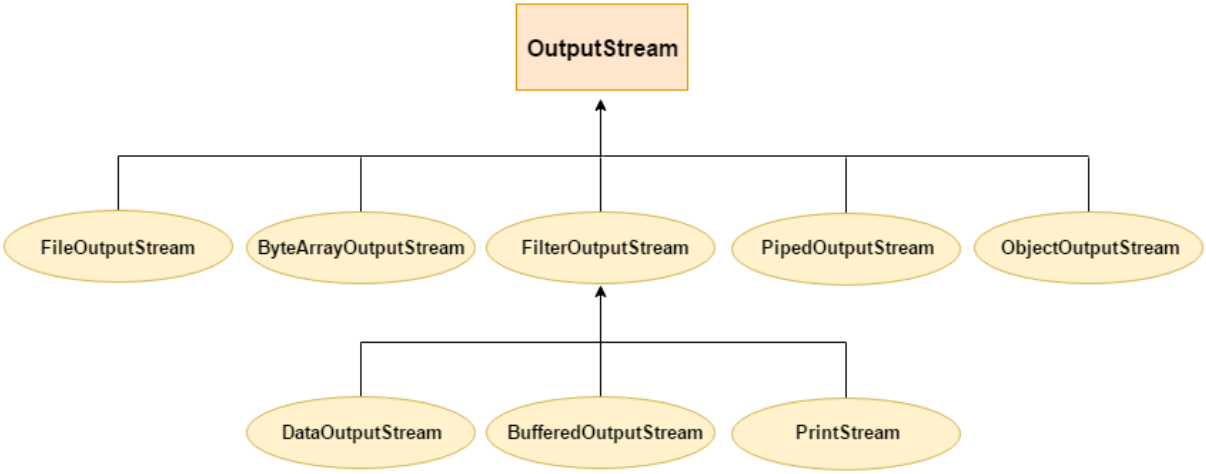
OutputStream class

OutputStream class is an abstract class. It is the superclass of all classes representing an output stream of bytes. An output stream accepts output bytes and sends them to some sink.

Useful methods of OutputStream

Method	Description
1) public void write(int)throws IOException	is used to write a byte to the current output stream.
2) public void write(byte[])throws IOException	is used to write an array of byte to the current output stream.
3) public void flush()throws IOException	flushes the current output stream.
4) public void close()throws IOException	is used to close the current output stream.

OutputStream Hierarchy



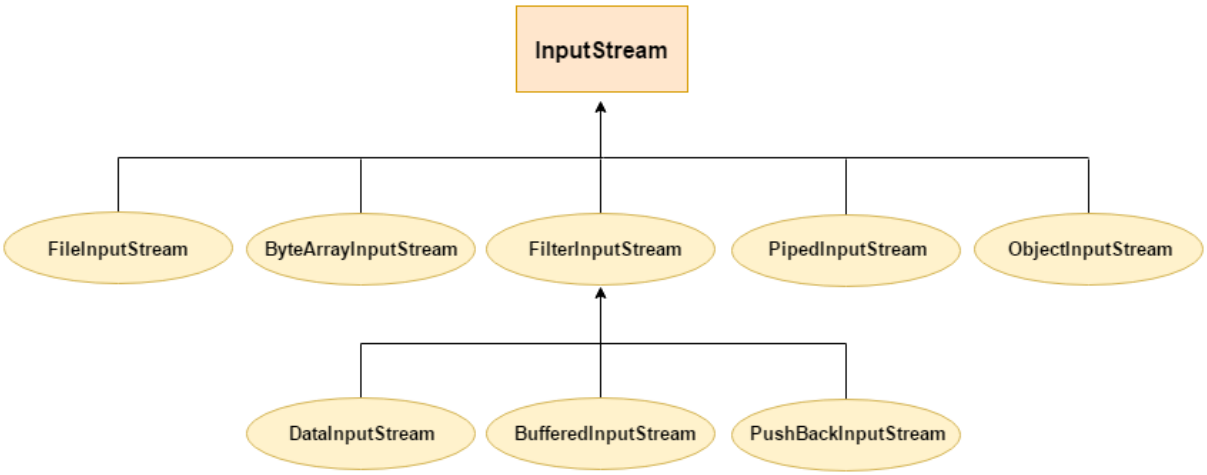
InputStream class

InputStream class is an abstract class. It is the superclass of all classes representing an input stream of bytes.

Useful methods of InputStream

Method	Description
1) public abstract int read()throws IOException	reads the next byte of data from the input stream. It returns -1 at the end of the file.
2) public int available()throws IOException	returns an estimate of the number of bytes that can be read from the current input stream.
3) public void close()throws IOException	is used to close the current input stream.

InputStream Hierarchy



Java FileOutputStream Class

Java FileOutputStream is an output stream used for writing data to a file.

If you have to write primitive values into a file, use FileOutputStream class. You can write byte-oriented as well as character-oriented data through FileOutputStream class. But, for character-oriented data, it is preferred to use FileWriter than FileOutputStream.

FileOutputStream class declaration

Let's see the declaration for Java.io.FileOutputStream class:

1. public class FileOutputStream extends OutputStream

FileOutputStream class methods

Method	Description
protected void finalize()	It is used to clean up the connection with the file output stream.
void write(byte[] ary)	It is used to write **ary.length** bytes from the byte array to the file output stream.
void write(byte[] ary, int off, int len)	It is used to write **len** bytes from the byte array starting at offset **off** to the file output stream.
void write(int b)	It is used to write the specified byte to the file output stream.
FileChannel getChannel()	It is used to return the file channel object associated with the file output stream.
FileDescriptor getFD()	It is used to return the file descriptor associated with the stream.
void close()	It is used to closes the file output stream.

Java FileOutputStream Example 1: write byte

```
import java.io.FileOutputStream;

public class FileOutputStreamExample {

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

```
        try{
         FileOutputStream fout=new FileOutputStream("D:\\testout.txt");
         fout.write(65);
         fout.close();
         System.out.println("success...");
        }catch(Exception e){System.out.println(e);}
    }
}
```

Output:

```
Success...
```

The content of a text file **testout.txt** is set with the data **A**.

testout.txt

```
A
```

Java FileOutputStream example 2: write string

```
import java.io.FileOutputStream;
public class FileOutputStreamExample {
    public static void main(String args[]){
        try{
         FileOutputStream fout=new FileOutputStream("D:\\testout.txt");
         String s="Welcome to VIT.";
         byte b[]=s.getBytes();//converting string into byte array
         fout.write(b);
         fout.close();
         System.out.println("success...");
        }catch(Exception e){System.out.println(e);}
    }
}
```

Output:

```
Success...
```

The content of a text file **testout.txt** is set with the data **Welcome to VIT.**

testout.txt

```
Welcome to VIT.
```

Java FileInputStream Class

Java FileInputStream class obtains input bytes from a file. It is used for reading byte-oriented data (streams of raw bytes) such as image data, audio, video etc. You can also read character-stream data. But, for reading streams of characters, it is recommended to use FileReader class.

Java FileInputStream class declaration

Let's see the declaration for java.io.FileInputStream class:

1. public class FileInputStream extends InputStream

Java FileInputStream class methods

Method	Description
int available()	It is used to return the estimated number of bytes that can be read from the input stream.
int read()	It is used to read the byte of data from the input stream.
int read(byte[] b)	It is used to read up to **b.length** bytes of data from the input stream.
int read(byte[] b, int off, int len)	It is used to read up to **len** bytes of data from the input stream.
long skip(long x)	It is used to skip over and discards x bytes of data from the input stream.
FileChannel getChannel()	It is used to return the unique FileChannel object associated with the file input stream.
FileDescriptor getFD()	It is used to return the FileDescriptor object.
protected void finalize()	It is used to ensure that the close method is call when there is no more reference to the file input stream.
void close()	It is used to closes the stream.

Java FileInputStream example 1: read single character

```
import java.io.FileInputStream;

public class DataStreamExample {



    public static void main(String args[]){

        try{

          FileInputStream fin=new FileInputStream("D:\\testout.txt");
```

```
    int i=fin.read();

    System.out.print((char)i);



    fin.close();

   }catch(Exception e){System.out.println(e);}

  }

 }
```

Note: Before running the code, a text file named as **"testout.txt"** is required to be created. In this file, we are having following content:

```
Welcome to VIT.
```

After executing the above program, you will get a single character from the file which is 87 (in byte form). To see the text, you need to convert it into character.

Output:

```
W
```

Java FileInputStream example 2: read all characters

```
import java.io.FileInputStream;

public class DataStreamExample {

    public static void main(String args[]){

      try{

        FileInputStream fin=new FileInputStream("D:\\testout.txt");

        int i=0;

        while((i=fin.read())!=-1){

         System.out.print((char)i);

        }

        fin.close();

       }catch(Exception e){System.out.println(e);}

      }

     }
```

Output:

```
Welcome to VIT
```

Java File Class

The File class is an abstract representation of file and directory pathname. A pathname can be either absolute or relative.

The File class have several methods for working with directories and files such as creating new directories or files, deleting and renaming directories or files, listing the contents of a directory etc.

Fields

Modifier	Type	Field	Description
static	String	pathSeparator	It is system-dependent path-separator character, represented as a string for convenience.
static	char	pathSeparatorChar	It is system-dependent path-separator character.
static	String	separator	It is system-dependent default name-separator character, represented as a string for convenience.
static	char	separatorChar	It is system-dependent default name-separator character.

Constructors

Constructor	Description
File(File parent, String child)	It creates a new File instance from a parent abstract pathname and a child pathname string.
File(String pathname)	It creates a new File instance by converting the given pathname string into an abstract pathname.
File(String parent, String child)	It creates a new File instance from a parent pathname string and a child pathname string.
File(URI uri)	It creates a new File instance by converting the given file: URI into an abstract pathname.

Useful Methods

Modifier and Type	Method	Description
static File	createTempFile(String prefix, String suffix)	It creates an empty file in the default temporary-file directory, using the given prefix and suffix to generate its name.
Boolean	createNewFile()	It atomically creates a new, empty file named by this abstract pathname if and only if a file with this name does not yet exist.
Boolean	canWrite()	It tests whether the application can modify the file denoted by this abstract pathname.String[]
Boolean	canExecute()	It tests whether the application can execute the file denoted by this abstract pathname.
Boolean	canRead()	It tests whether the application can read the file denoted by this abstract pathname.
Boolean	isAbsolute()	It tests whether this abstract pathname is absolute.
Boolean	isDirectory()	It tests whether the file denoted by this abstract pathname is a directory.
Boolean	isFile()	It tests whether the file denoted by this abstract pathname is a normal file.
String	getName()	It returns the name of the file or directory denoted by this abstract

		pathname.
String	getParent()	It returns the pathname string of this abstract pathname's parent, or null if this pathname does not name a parent directory.
Path	toPath()	It returns a java.nio.file.Path object constructed from the this abstract path.
URI	toURI()	It constructs a file: URI that represents this abstract pathname.
File[]	listFiles()	It returns an array of abstract pathnames denoting the files in the directory denoted by this abstract pathname
Long	getFreeSpace()	It returns the number of unallocated bytes in the partition named by this abstract path name.
String[]	list(FilenameFilter filter)	It returns an array of strings naming the files and directories in the directory denoted by this abstract pathname that satisfy the specified filter.
Boolean	mkdir()	It creates the directory named by this abstract pathname.

Java File Example 1

```
import java.io.*;

public class FileDemo {

   public static void main(String[] args) {



      try {

         File file = new File("javaFile123.txt");

         if (file.createNewFile()) {

            System.out.println("New File is created!");

         } else {

            System.out.println("File already exists.");

         }

      } catch (IOException e) {

         e.printStackTrace();

      }



   }

}
```

Output:

```
New File is created!
```

Java File Example 2

```
1.  import java.io.*;
```

```
2.  public class FileDemo2 {
3.      public static void main(String[] args) {
4.
5.          String path = "";
6.          boolean bool = false;
7.          try {
8.              // createing  new files
9.              File file  = new File("testFile1.txt");
10.             file.createNewFile();
11.             System.out.println(file);
12.             // createing new canonical from file object
13.             File file2 = file.getCanonicalFile();
14.             // returns true if the file exists
15.             System.out.println(file2);
16.             bool = file2.exists();
17.             // returns absolute pathname
18.             path = file2.getAbsolutePath();
19.             System.out.println(bool);
20.             // if file exists
21.             if (bool) {
22.                 // prints
23.                 System.out.print(path + " Exists? " + bool);
24.             }
25.         } catch (Exception e) {
26.             // if any error occurs
27.             e.printStackTrace();
28.         }
29.     }
30. }
```

Output:

```
testFile1.txt
/home/Work/Project/File/testFile1.txt
true
/home/Work/Project/File/testFile1.txt Exists? true
```

Java File Example 3

```
import java.io.*;

public class FileExample {

public static void main(String[] args) {

   File f=new File("/Users/sonoojaiswal/Documents");

   String filenames[]=f.list();

   for(String filename:filenames){

      System.out.println(filename);

   }

}

}
```

Output:

```
"info.properties"
```

```
"info.properties".rtf
.DS_Store
.localized
Alok news
apache-tomcat-9.0.0.M19
apache-tomcat-9.0.0.M19.tar
bestreturn_org.rtf
BIODATA.pages
BIODATA.pdf
BIODATA.png
struts2jars.zip
workspace
```

Java File Example 4

```
import java.io.*;

public class FileExample {

public static void main(String[] args) {

   File dir=new File("/Users/sonoojaiswal/Documents");

   File files[]=dir.listFiles();

   for(File file:files){

      System.out.println(file.getName()+" Can Write: "+file.canWrite()+"

      Is Hidden: "+file.isHidden()+" Length: "+file.length()+" bytes");

   }

}

}
```

Output:

```
"info.properties" Can Write: true Is Hidden: false Length: 15 bytes
"info.properties".rtf Can Write: true Is Hidden: false Length: 385 bytes
.DS_Store Can Write: true Is Hidden: true Length: 36868 bytes
.localized Can Write: true Is Hidden: true Length: 0 bytes
Alok news Can Write: true Is Hidden: false Length: 850 bytes
apache-tomcat-9.0.0.M19 Can Write: true Is Hidden: false Length: 476 bytes
apache-tomcat-9.0.0.M19.tar Can Write: true Is Hidden: false Length: 13711360 bytes
bestreturn_org.rtf Can Write: true Is Hidden: false Length: 389 bytes
BIODATA.pages Can Write: true Is Hidden: false Length: 707985 bytes
BIODATA.pdf Can Write: true Is Hidden: false Length: 69681 bytes
BIODATA.png Can Write: true Is Hidden: false Length: 282125 bytes
workspace Can Write: true Is Hidden: false Length: 1972 bytes
```

Serialization and Deserialization in Java

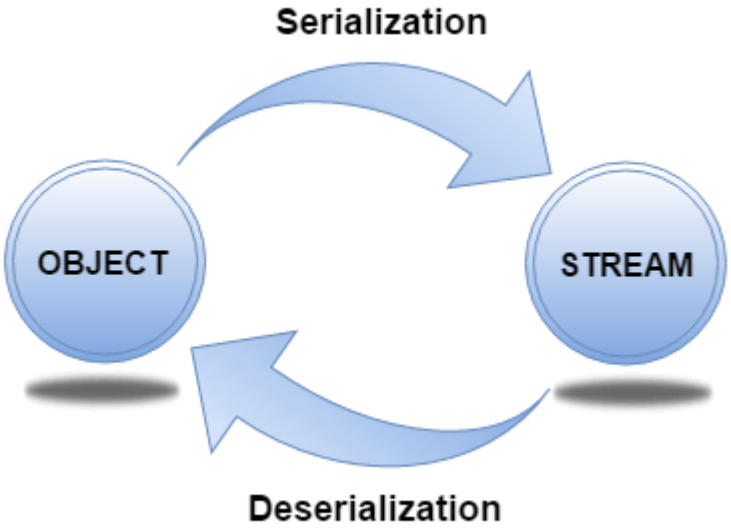
Serialization in Java is a mechanism of *writing the state of an object into a byte stream*.

It is mainly used in Hibernate, RMI, JPA, EJB and JMS technologies.

The reverse operation of serialization is called *deserialization*.

Advantages of Java Serialization

It is mainly used to travel object's state on the network (which is known as marshaling).



java.io.Serializable interface

Serializable is a marker interface (has no data member and method). It is used to "mark" Java classes so that objects of these classes may get the certain capability. The Cloneable and Remote are also marker interfaces.

It must be implemented by the class whose object you want to persist.

The String class and all the wrapper classes implement the *java.io.Serializable* interface by default.

Let's see the example given below:

```
import java.io.Serializable;
public class Student implements Serializable{
 int id;
 String name;
 public Student(int id, String name) {
  this.id = id;
  this.name = name;
 }
}
```

In the above example, Student class implements Serializable interface. Now its objects can be converted into stream.

ObjectOutputStream class

The ObjectOutputStream class is used to write primitive data types, and Java objects to an OutputStream. Only objects that support the java.io.Serializable interface can be written to streams.

Constructor

1) public ObjectOutputStream(OutputStream out) throws IOException {}	creates an ObjectOutputStream that writes to the specified OutputStream.

Important Methods

Method	Description
1) public final void writeObject(Object obj) throws IOException {}	writes the specified object to the ObjectOutputStream.
2) public void flush() throws IOException {}	flushes the current output stream.
3) public void close() throws IOException {}	closes the current output stream.

Example of Java Serialization

In this example, we are going to serialize the object of Student class. The writeObject() method of ObjectOutputStream class provides the functionality to serialize the object. We are saving the state of the object in the file named f.txt.

```
import java.io.*;
class Persist{
 public static void main(String args[])throws Exception{
  Student s1 =new Student(111,"Ruhan");
  FileOutputStream fout=new FileOutputStream("f.txt");
  ObjectOutputStream out=new ObjectOutputStream(fout);
  out.writeObject(s1);
  out.flush();
  System.out.println("success");
```

```
 }
}
```

Output

```
success
```

DeSerialization in java

Deserialization is the process of reconstructing the object from the serialized state.It is the reverse operation of serialization.

ObjectInputStream class

An ObjectInputStream deserializes objects and primitive data written using an ObjectOutputStream.

Constructor

1) public ObjectInputStream(InputStream in) throws IOException {}	creates an ObjectInputStream that reads from the specified InputStream.

Important Methods

Method	Description
1) public final Object readObject() throws IOException, ClassNotFoundException{}	reads an object from the input stream.
2) public void close() throws IOException {}	closes ObjectInputStream.

Example of Java Deserialization

```
import java.io.*;
class Depersist{
 public static void main(String args[])throws Exception{

  ObjectInputStream in=new ObjectInputStream(new FileInputStream("f.txt"));
  Student s=(Student)in.readObject();
  System.out.println(s.id+" "+s.name);

  in.close();
 }
}
```

Java Serialization with Inheritance (IS-A Relationship)

If a class implements serializable then all its sub classes will also be serializable. Let's see the example given below:

```
import java.io.Serializable;
class Person implements Serializable{
 int id;
 String name;
 Person(int id, String name) {
  this.id = id;
  this.name = name;
 }
}
class Student extends Person{
 String course;
 int fee;
 public Student(int id, String name, String course, int fee) {
  super(id,name);
  this.course=course;
  this.fee=fee;
 }
}
```

Now you can serialize the Student class object that extends the Person class which is Serializable. Parent class properties are inherited to subclasses so if parent class is Serializable, subclass would also be.

Java Serialization with Aggregation (HAS-A Relationship)

If a class has a reference to another class, all the references must be Serializable otherwise serialization process will not be performed. In such case, *NotSerializableException* is thrown at runtime.

```
class Address{
 String addressLine,city,state;
 public Address(String addressLine, String city, String state) {
  this.addressLine=addressLine;
  this.city=city;
  this.state=state;
```

```
 }
}
import java.io.Serializable;
public class Student implements Serializable{
 int id;
 String name;
 Address address;//HAS-A
 public Student(int id, String name) {
  this.id = id;
  this.name = name;
 }
}
```

Since Address is not Serializable, you can not serialize the instance of Student class.
Note: All the objects within an object must be Serializable.

Java Serialization with the static data member
If there is any static data member in a class, it will not be serialized because static is the part of class not object.

```
1.  class Employee implements Serializable{
2.   int id;
3.   String name;
4.   static String company="SSS IT Pvt Ltd";//it won't be serialized
5.   public Student(int id, String name) {
6.    this.id = id;
7.    this.name = name;
8.   }
9.  }
```

Java Serialization with array or collection
Rule: In case of array or collection, all the objects of array or collection must be serializable. If any object is not serialiizable, serialization will be failed.

Externalizable in java
The Externalizable interface provides the facility of writing the state of an object into a byte stream in compress format. It is not a marker interface.
The Externalizable interface provides two methods:

- **public void writeExternal(ObjectOutput out) throws IOException**
- **public void readExternal(ObjectInput in) throws IOException**

Lambda Expressions in Java 8

Lambda expressions basically express instances of functional interfaces (An interface with single abstract method is called functional interface. An example is java.lang.Runnable. lambda expressions implement the only abstract function and therefore implement functional interfaces

- lambda expressions are added in Java 8 and provide below functionalities.
- Enable to treat functionality as a method argument, or code as data.
- A function that can be created without belonging to any class.
- A lambda expression can be passed around as if it was an object and executed on demand.

lambda expression
Syntax:
lambda operator -> body
where lambda operator can be:
Zero parameter:
() -> System.out.println("Zero parameter lambda");
One parameter:–
(p) -> System.out.println("One parameter: " + p);
It is not mandatory to use parentheses, if the type of that variable can be inferred from the context
// Java program to demonstrate lambda expressions to implement a user defined functional interface.

```
// A sample functional interface (An interface with single abstract method
interface FuncInterface
{
   // An abstract function
   void abstractFun(int x);

   // A non-abstract (or default) function
```

```
   default void normalFun()
   {
     System.out.println("Hello");
   }
}

class Test
{
   public static void main(String args[])
   {
      // lambda expression to implement above
      // functional interface. This interface
      // by default implements abstractFun()
      FuncInterface fobj = (int x)->System.out.println(2*x);

      // This calls above lambda expression and prints 10.
      fobj.abstractFun(5);
   }
}
```
Output:

10

Multiple parameters :
(p1, p2) -> System.out.println("Multiple parameters: " + p1 + ", " + p2);
Please note: Lambda expressions are just like functions and they accept parameters just like functions.

```
// A Java program to demonstrate simple lambda expressions
import java.util.ArrayList;
class Test
{
   public static void main(String args[])
   {
      // Creating an ArrayList with elements
      // {1, 2, 3, 4}
      ArrayList<Integer> arrL = new ArrayList<Integer>();
      arrL.add(1);
      arrL.add(2);
      arrL.add(3);
      arrL.add(4);

      // Using lambda expression to print all elements
      // of arrL
      arrL.forEach(n -> System.out.println(n));

      // Using lambda expression to print even elements
      // of arrL
      arrL.forEach(n -> { if (n%2 == 0) System.out.println(n); });
   }
}
```
Output :

1
2
3
4
2
4

Note that lambda expressions can only be used to implement functional interfaces. In the above example also, the lambda expression implements Consumer Functional Interface.

A Java program to demonstrate working of lambda expression with two arguments.

```
// Java program to demonstrate working of lambda expressions
public class Test
{
   // operation is implemented using lambda expressions
   interface FuncInter1
   {
      int operation(int a, int b);
   }

   // sayMessage() is implemented using lambda expressions  above
   interface FuncInter2
   {
      void sayMessage(String message);
   }
    // Performs FuncInter1's operation on 'a' and 'b'
   private int operate(int a, int b, FuncInter1 fobj)
   {
      return fobj.operation(a, b);
   }

   public static void main(String args[])
   {
      // lambda expression for addition for two parameters
      // data type for x and y is optional.
      // This expression implements 'FuncInter1' interface
      FuncInter1 add = (int x, int y) -> x + y;

      // lambda expression multiplication for two parameters
      // This expression also implements 'FuncInter1' interface
      FuncInter1 multiply = (int x, int y) -> x * y;

      // Creating an object of Test to call operate using
      // different implementations using lambda Expressions
      Test tobj = new Test();

      // Add two numbers using lambda expression
      System.out.println("Addition is " +
                  tobj.operate(6, 3, add));

      // Multiply two numbers using lambda expression
      System.out.println("Multiplication is " +
                  tobj.operate(6, 3, multiply));

      // lambda expression for single parameter
      // This expression implements 'FuncInter2' interface
      FuncInter2 fobj = message ->System.out.println("Hello "
                                    + message);
      fobj.sayMessage("Geek");
   }
}
```

Output:

```
Addition is 9
Multiplication is 18
Hello Geek
```

Important points:

The body of a lambda expression can contain zero, one or more statements.
When there is a single statement curly brackets are not mandatory and the return type of the anonymous function is the same as that of the body expression.
When there are more than one statements, then these must be enclosed in curly brackets (a code block) and the return type of the anonymous function is the same as the type of the value returned within the code block, or void if nothing is returned.

Collections in Java

The **Collection in Java** is a framework that provides an architecture to store and manipulate the group of objects.

Java Collections can achieve all the operations that you perform on a data such as searching, sorting, insertion, manipulation, and deletion.

Java Collection means a single unit of objects. Java Collection framework provides many interfaces (Set, List, Queue, Deque) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, TreeSet).

What is Collection in Java

A Collection represents a single unit of objects, i.e., a group.

What is a framework in Java

- It provides readymade architecture.
- It represents a set of classes and interfaces.
- It is optional.

What is Collection framework

The Collection framework represents a unified architecture for storing and manipulating a group of objects. It has:

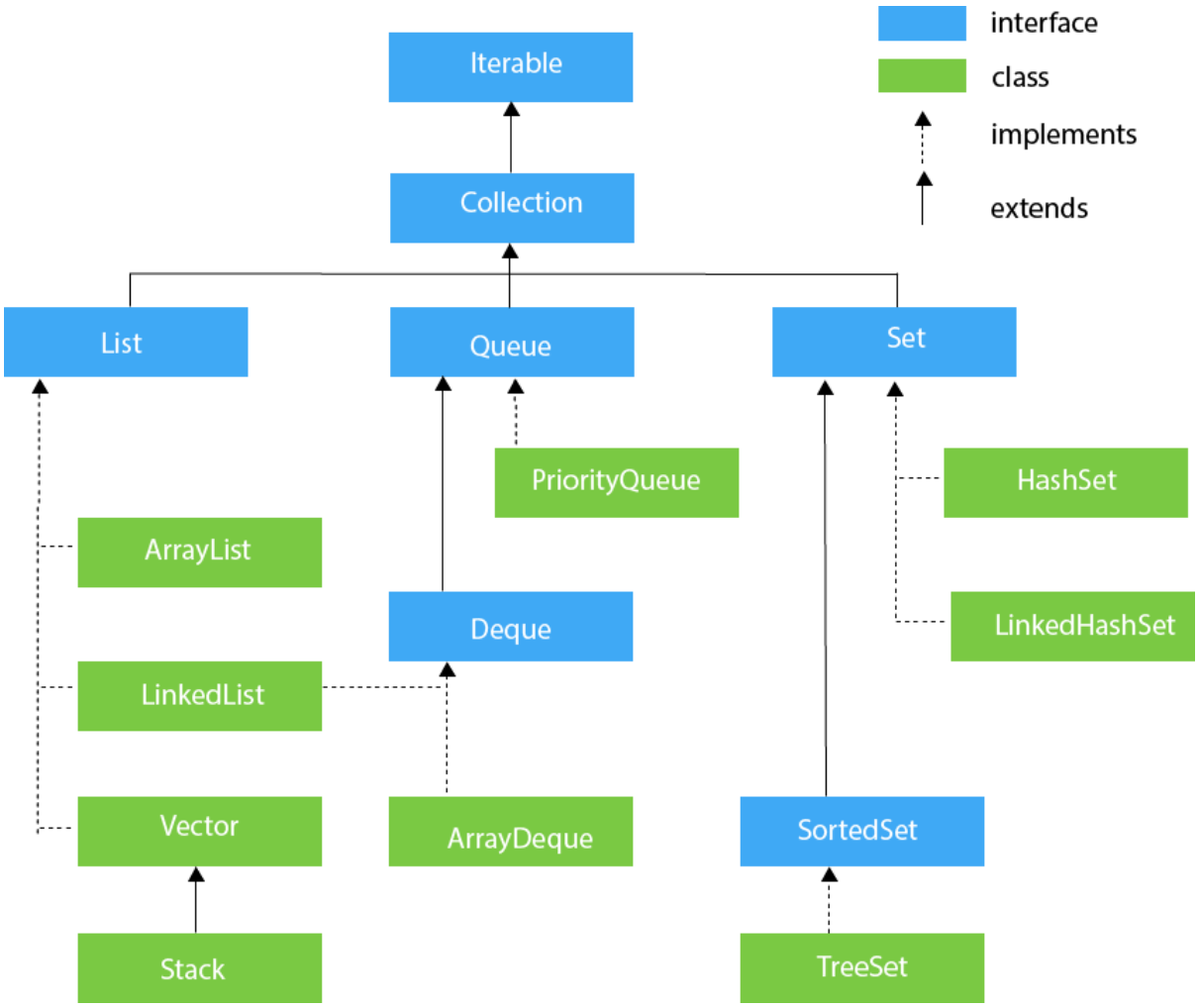
1. Interfaces and its implementations, i.e., classes
2. Algorithm

Do You Know?

- What are the two ways to iterate the elements of a collection?
- What is the difference between ArrayList and LinkedList classes in collection framework?
- What is the difference between ArrayList and Vector classes in collection framework?
- What is the difference between HashSet and HashMap classes in collection framework?
- What is the difference between HashMap and Hashtable class?
- What is the difference between Iterator and Enumeration interface in collection framework?
- How can we sort the elements of an object? What is the difference between Comparable and Comparator interfaces?
- What does the hashcode() method?
- What is the difference between Java collection and Java collections?

Hierarchy of Collection Framework

Let us see the hierarchy of Collection framework. The **java.util** package contains all the classes and interfaces for the 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(E e)	It is used to insert an element in this collection.
2	public boolean addAll(Collection<? extends E> c)	It is used to insert the specified collection elements in the invoking collection.
3	public boolean remove(Object element)	It is used to delete an element from the collection.
4	public boolean removeAll(Collection<?> c)	It is used to delete all the elements of the specified collection from the invoking collection.
5	default boolean removeIf(Predicate<? super E> filter)	It is used to delete all the elements of the collection that satisfy the specified predicate.
6	public boolean retainAll(Collection<?> c)	It is used to delete all the elements of invoking collection except the specified collection.
7	public int size()	It returns the total number of elements in the collection.
8	public void clear()	It removes the total number of elements from the collection.
9	public boolean contains(Object element)	It is used to search an element.
10	public boolean containsAll(Collection<?> c)	It is used to search the specified collection in the collection.
11	public Iterator iterator()	It returns an iterator.
12	public Object[] toArray()	It converts collection into array.
13	public <T> T[] toArray(T[] a)	It converts collection into array. Here, the runtime type of the returned array is that of the specified array.
14	public boolean isEmpty()	It checks if collection is empty.
15	default Stream<E> parallelStream()	It returns a possibly parallel Stream with the collection as its source.
16	default Stream<E> stream()	It returns a sequential Stream with the collection as its source.

17	default Spliterator<E> spliterator()	It generates a Spliterator over the specified elements in the collection.
18	public boolean equals(Object element)	It matches two collections.
19	public int hashCode()	It returns the hash code number of the collection.

Iterator interface

Iterator interface provides the facility of iterating the elements in a forward direction only.

Methods of Iterator interface

There are only three methods in the Iterator interface. They are:

No.	Method	Description
1	public boolean hasNext()	It returns true if the iterator has more elements otherwise it returns false.
2	public Object next()	It returns the element and moves the cursor pointer to the next element.
3	public void remove()	It removes the last elements returned by the iterator. It is less used.

Iterable Interface

The Iterable interface is the root interface for all the collection classes. The Collection interface extends the Iterable interface and therefore all the subclasses of Collection interface also implement the Iterable interface.

It contains only one abstract method. i.e.,

1. Iterator<T> iterator()

It returns the iterator over the elements of type T.

Collection Interface

The Collection interface is the interface which is implemented by all the classes in the collection framework. It declares the methods that every collection will have. In other words, we can say that the Collection interface builds the foundation on which the collection framework depends.

Some of the methods of Collection interface are Boolean add (Object obj), Boolean addAll (Collection c), void clear(), etc. which are implemented by all the subclasses of Collection interface.

List Interface

List interface is the child interface of Collection interface. It inhibits a list type data structure in which we can store the ordered collection of objects. It can have duplicate values.

List interface is implemented by the classes ArrayList, LinkedList, Vector, and Stack.

To instantiate the List interface, we must use :

1. List <data-type> list1= new ArrayList();
2. List <data-type> list2 = new LinkedList();
3. List <data-type> list3 = new Vector();
4. List <data-type> list4 = new Stack();

There are various methods in List interface that can be used to insert, delete, and access the elements from the list.

The classes that implement the List interface are given below.

ArrayList

The ArrayList class implements the List interface. It uses a dynamic array to store the duplicate element of different data types. The ArrayList class maintains the insertion order and is non-synchronized. The elements stored in the ArrayList class can be randomly accessed. Consider the following example.

```
import java.util.*;
class TestJavaCollection1{
public static void main(String args[]){
ArrayList<String> list=new ArrayList<String>();//Creating arraylist
list.add("Ravi");//Adding object in arraylist
list.add("Vijay");
list.add("Ravi");
list.add("Ajay");
//Traversing list through Iterator
Iterator itr=list.iterator();
while(itr.hasNext()){
System.out.println(itr.next());
}
}
}
```

Output:

```
Ravi
Vijay
Ravi
Ajay
```

LinkedList

LinkedList implements the Collection interface. It uses a doubly linked list internally to store the elements. It can store the duplicate elements. It maintains the insertion order and is not synchronized. In LinkedList, the manipulation is fast because no shifting is required.

Consider the following example.

```
import java.util.*;
public class TestJavaCollection2{
public static void main(String args[]){
LinkedList<String> al=new LinkedList<String>();
al.add("Ravi");
al.add("Vijay");
al.add("Ravi");
al.add("Ajay");
Iterator<String> itr=al.iterator();
while(itr.hasNext()){
System.out.println(itr.next());
}
}
}
```

Output:

```
Ravi
Vijay
Ravi
Ajay
```

Vector

Vector uses a dynamic array to store the data elements. It is similar to ArrayList. However, It is synchronized and contains many methods that are not the part of Collection framework.

Consider the following example.

```
import java.util.*;
public class TestJavaCollection3{
public static void main(String args[]){
Vector<String> v=new Vector<String>();
v.add("Ayush");
v.add("Amit");
v.add("Ashish");
v.add("Garima");
Iterator<String> itr=v.iterator();
while(itr.hasNext()){
System.out.println(itr.next());
}
}
}
```

Output:

```
Ayush
Amit
Ashish
Garima
```

Stack

The stack is the subclass of Vector. It implements the last-in-first-out data structure, i.e., Stack. The stack contains all of the methods of Vector class and also provides its methods like boolean push(), boolean peek(), boolean push(object o), which defines its properties.

Consider the following example.

```
import java.util.*;
public class TestJavaCollection4{
public static void main(String args[]){
Stack<String> stack = new Stack<String>();
stack.push("Ayush");
stack.push("Garvit");
stack.push("Amit");
stack.push("Ashish");
stack.push("Garima");
stack.pop();
Iterator<String> itr=stack.iterator();
while(itr.hasNext()){
System.out.println(itr.next());
}
}
}
```

Output:

```
Ayush
Garvit
Amit
Ashish
```

Set Interface

Set Interface in Java is present in java.util package. It extends the Collection interface. It represents the unordered set of elements which doesn't allow us to store the duplicate items. We can store at most one null value in Set. Set is implemented by HashSet, LinkedHashSet, and TreeSet.

Set can be instantiated as:

1. Set<data-type> s1 = new HashSet<data-type>();
2. Set<data-type> s2 = new LinkedHashSet<data-type>();
3. Set<data-type> s3 = new TreeSet<data-type>();

HashSet

HashSet class implements Set Interface. It represents the collection that uses a hash table for storage. Hashing is used to store the elements in the HashSet. It contains unique items.

Consider the following example.

```
1. import java.util.*;
2. public class TestJavaCollection7{
3. public static void main(String args[]){
4. //Creating HashSet and adding elements
5. HashSet<String> set=new HashSet<String>();
6. set.add("Ravi");
7. set.add("Vijay");
8. set.add("Ravi");
9. set.add("Ajay");
10. //Traversing elements
11. Iterator<String> itr=set.iterator();
12. while(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }
```

Output:

```
Vijay
Ravi
Ajay
```

LinkedHashSet

LinkedHashSet class represents the LinkedList implementation of Set Interface. It extends the HashSet class and implements Set interface. Like HashSet, It also contains unique elements. It maintains the insertion order and permits null elements.

Consider the following example.

```
1. import java.util.*;
2. public class TestJavaCollection8{
3. public static void main(String args[]){
4. LinkedHashSet<String> set=new LinkedHashSet<String>();
5. set.add("Ravi");
6. set.add("Vijay");
7. set.add("Ravi");
8. set.add("Ajay");
9. Iterator<String> itr=set.iterator();
10. while(itr.hasNext()){
11. System.out.println(itr.next());
12. }
13. }
14. }
```

Output:

```
Ravi
Vijay
Ajay
```

SortedSet Interface

SortedSet is the alternate of Set interface that provides a total ordering on its elements. The elements of the SortedSet are arranged in the increasing (ascending) order. The SortedSet provides the additional methods that inhibit the natural ordering of the elements.

The SortedSet can be instantiated as:

1. SortedSet<data-type> set = new TreeSet();

TreeSet

Java TreeSet class implements the Set interface that uses a tree for storage. Like HashSet, TreeSet also contains unique elements. However, the access and retrieval time of TreeSet is quite fast. The elements in TreeSet stored in ascending order. Consider the following example:

```
1.  import java.util.*;
2.  public class TestJavaCollection9{
3.  public static void main(String args[]){
4.  //Creating and adding elements
5.  TreeSet<String> set=new TreeSet<String>();
6.  set.add("Ravi");
7.  set.add("Vijay");
8.  set.add("Ravi");
9.  set.add("Ajay");
10. //traversing elements
11. Iterator<String> itr=set.iterator();
12. while(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }
```

Output:

```
Ajay
Ravi
Vijay
```