Final Keywords

The **final keyword** in java is used to restrict the user. The java final keyword can be used in many context. Final can be:

1. variable
2. method
3. class

The final keyword can be applied with the variables, a final variable that have no value it is called blank final variable or uninitialized final variable. It can be initialized in the constructor only. The blank final variable can be static also which will be initialized in the static block only. We will have detailed learning of these. Let's first learn the basics of final keyword.

1) Java final variable

If we make any variable as final, we cannot change the value of final variable (It will be constant).

Example of final variable

```
class Bike9{
 final int speedlimit=90;
 void run(){
  speedlimit=400;
 }
 public static void main(String args[]){
 Bike9 obj=new  Bike9();
 obj.run();
 }
}
```

2) Java final method

If we make any method as final, we cannot override it.

Example of final method

```
class Bike{
  final void run(){System.out.println("running");}
}
class Honda extends Bike{
   void run(){System.out.println("running safely with 100kmph");}

   public static void main(String args[]){
   Honda honda= new Honda();
   honda.run();
   }
}
```

3) Java final class

If we make any class as final, we cannot extend it.

Example of final class

```
final class Bike{}

class Honda1 extends Bike{
  void run(){System.out.println("running safely with 100kmph");}

  public static void main(String args[]){
  Honda1 honda= new Honda1();
  honda.run();
  }
}
```

Polymorphism in Java

Polymorphism in Java is a concept by which we can perform a *single action in different ways*. Polymorphism is derived from 2 Greek words: poly and morphs. The word "poly" means many and "morphs" means forms. So polymorphism means many forms.

There are two types of polymorphism in Java: **compile-time polymorphism** and **runtime polymorphism**. We can perform polymorphism in java by method overloading and method overriding.

If we overload a static method in Java, it is the example of compile time polymorphism. Here, we will focus on runtime polymorphism in java.

Compile-Time Polymorphism in Java

It is also known as static polymorphism. This type of polymorphism is achieved by function overloading or operator overloading.***Note:*** *But Java doesn't support the Operator Overloading.*

Runtime Polymorphism in Java

It is also known as Dynamic Method Dispatch. It is a process in which a function call to the overridden method is resolved at Runtime. This type of polymorphism is achieved by Method Overriding. **Method overriding**, on the other hand, occurs when a derived class has a definition for one of the member functions of the base class. That base function is said to be **overridden**.

Static Binding and Dynamic Binding

Connecting a method call to the method body is known as binding.

There are two types of binding

1. Static Binding (also known as Early Binding).
2. Dynamic Binding (also known as Late Binding).

Static binding

When type of the object is determined at compiled time (by the compiler), it is known as static binding. If there is any private, final or static method in a class, there is static binding.

Example of static binding

```
class Dog{
 private void eat(){System.out.println("dog is eating...");}

 public static void main(String args[]){
  Dog d1=new Dog();
  d1.eat();
 }
}
```

Dynamic binding

When type of the object is determined at run-time, it is known as dynamic binding.

Example of dynamic binding

```
class Animal{
 void eat(){System.out.println("animal is eating...");}
}
class Dog extends Animal{
 void eat(){System.out.println("dog is eating...");}
 public static void main(String args[]){
  Animal a=new Dog();
  a.eat();
 } }
```

Abstract class in Java

A class which is declared with the abstract keyword is known as an abstract class It can have abstract and non-abstract methods (method with the body).

Abstraction in Java

Abstraction is a process of hiding the implementation details and showing only functionality to the user.

Another way, it shows only essential things to the user and hides the internal details, for example, sending SMS where we type the text and send the message. we don't know the internal processing about the message delivery.

Abstraction lets us focus on what the object does instead of how it does it.

Ways to achieve Abstraction

There are two ways to achieve abstraction in java

1. Abstract class (0 to 100%)
2. Interface (100%)

Abstract class in Java

A class which is declared as abstract is known as an **abstract class**. It can have abstract and non-abstract methods. It needs to be extended and its method implemented. It cannot be instantiated.

Points to Remember

- An abstract class must be declared with an abstract keyword.
- It can have abstract and non-abstract methods.
- It cannot be instantiated.
- It can have constructors and static methods also.
- It can have final methods which will force the subclass not to change the body of the method.

Abstract Method in Java

A method which is declared as abstract and does not have implementation is known as an abstract method.

Example of abstract method

1. `abstract void printStatus();//no method body and abstract`

Example of Abstract class that has an abstract method

```
abstract class Bike{
  abstract void run();
}
class Honda4 extends Bike{
void run(){System.out.println("running safely");}
public static void main(String args[]){
 Bike obj = new Honda4();
 obj.run();
}
}
```

Interface in Java

An **interface in Java** is a blueprint of a class. It has static constants and abstract methods.

The interface in Java is *a mechanism to achieve abstraction*. There can be only abstract methods in the Java interface, not method body. It is used to achieve abstraction and multiple inheritance in Java.

In other words, we can say that interfaces can have abstract methods and variables. It cannot have a method body.

Java Interface also **represents the IS-A relationship**. It cannot be instantiated just like the abstract class.

Why use Java interface?

There are mainly three reasons to use interface. They are given below.

- It is used to achieve abstraction.
- By interface, we can support the functionality of multiple inheritance.
- It can be used to achieve loose coupling.

How to declare an interface?

An interface is declared by using the interface keyword. It provides total abstraction; means all the methods in an interface are declared with the empty body, and all the fields are public, static and final by default. A class that implements an interface must implement all the methods declared in the interface.

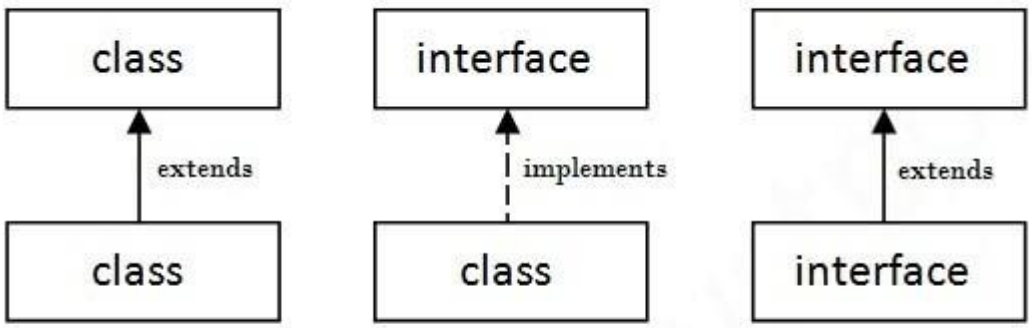
Syntax:

```
interface <interface_name>{

// declare constant fields
// declare methods that abstract
// by default.
}
```

Note: Interface fields are public, static and final by default, and the methods are public and abstract.

The relationship between classes and interfaces

As shown in the figure given below, a class extends another class, an interface extends another interface, but a **class implements an interface**.



Interface Example 1

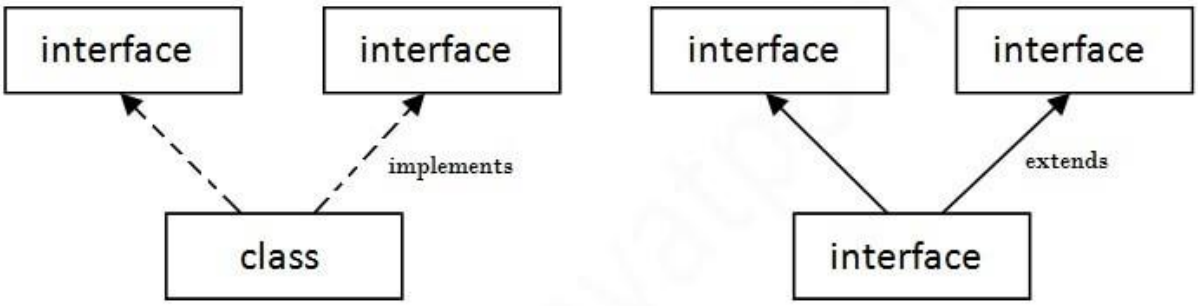
```
interface printable{
void print();
}
class A6 implements printable{
public void print(){System.out.println("Hello");}

public static void main(String args[]){
A6 obj = new A6();
obj.print();
 }
}
```

Example 2

```
interface Drawable{
void draw();
}
//Implementation: by second user
class Rectangle implements Drawable{
public void draw(){System.out.println("drawing rectangle");}
}
class Circle implements Drawable{
public void draw(){System.out.println("drawing circle");}
}
//Using interface: by third user
class TestInterface1{
public static void main(String args[]){
Drawable d=new Circle();//In real scenario, object is provided by method e.g. get
Drawable()
d.draw();
}}
```

Multiple inheritance in Java by interface

If a class implements multiple interfaces, or an interface extends multiple interfaces, it is known as multiple inheritance.



Multiple Inheritance in Java

```
interface Printable{
void print();
}
interface Showable{
void show();
}
class A7 implements Printable,Showable{
public void print(){System.out.println("Hello");}
public void show(){System.out.println("Welcome");}

public static void main(String args[]){
A7 obj = new A7();
obj.print();
obj.show();
 }
}
```

Interface inheritance

A class implements an interface, but one interface extends another interface.

```
interface Printable{
void print();
}
interface Showable extends Printable{
void show();
}
class TestInterface4 implements Showable{
public void print(){System.out.println("Hello");}
public void show(){System.out.println("Welcome");}

public static void main(String args[]){
TestInterface4 obj = new TestInterface4();
obj.print();
obj.show();
 }
}
```

Static Method in Interface

We can have static method in interface. Let's see an example:

```
interface Drawable{
void draw();
static int cube(int x){return x*x*x;}
}
class Rectangle implements Drawable{
public void draw(){System.out.println("drawing rectangle");}
}

class TestInterfaceStatic{
public static void main(String args[]){
Drawable d=new Rectangle();
d.draw();
System.out.println(Drawable.cube(3));
}}
```

Difference between abstract class and interface

Abstract class and interface both are used to achieve abstraction where we can declare the abstract methods. Abstract class and interface both can't be instantiated.

But there are many differences between abstract class and interface that are given below.

Abstract class	Interface
1) Abstract class can **have abstract and non-abstract** methods.	Interface can have **only abstract** methods. Since Java 8, it can have **default and static methods** also.
2) Abstract class **doesn't support multiple inheritance**.	Interface **supports multiple inheritance**.
3) Abstract class **can have final, non-final, static and non-static variables**.	Interface has **only static and final variables**.
4) Abstract class **can provide the implementation of interface**.	Interface **can't provide the implementation of abstract class**.
5) The **abstract keyword** is used to declare abstract class.	The **interface keyword** is used to declare interface.
6) An **abstract class** can extend another Java class and implement multiple Java interfaces.	An **interface** can extend another Java interface only.
7) An **abstract class** can be extended using keyword "extends".	An **interface** can be implemented using keyword "implements".
8) A Java **abstract class** can have class members like private, protected, etc.	Members of a Java interface are public by default.

Example of abstract class and interface in Java

Let's see a simple example where we are using interface and abstract class both.

```
//Creating interface that has 4 methods
interface A{
void a();//bydefault, public and abstract
void b();
void c();
void d();
}

//Creating abstract class that provides the implementation of one method of A interface
abstract class B implements A{
public void c(){System.out.println("I am C");}
}

//Creating subclass of abstract class, now we need to provide the implementation of rest of the m
ethods
class M extends B{
public void a(){System.out.println("I am a");}
public void b(){System.out.println("I am b");}
public void d(){System.out.println("I am d");}
}

//Creating a test class that calls the methods of A interface
class Test5{
public static void main(String args[]){
A a=new M();
a.a();
a.b();
a.c();
a.d();
}}
```

Package

A **java package** is a group of similar types of classes, interfaces and sub-packages.

Package in java can be categorized in two form, built-in package and user-defined package.

There are many built-in packages such as java, lang, awt, javax, swing, net, io, util, sql etc.

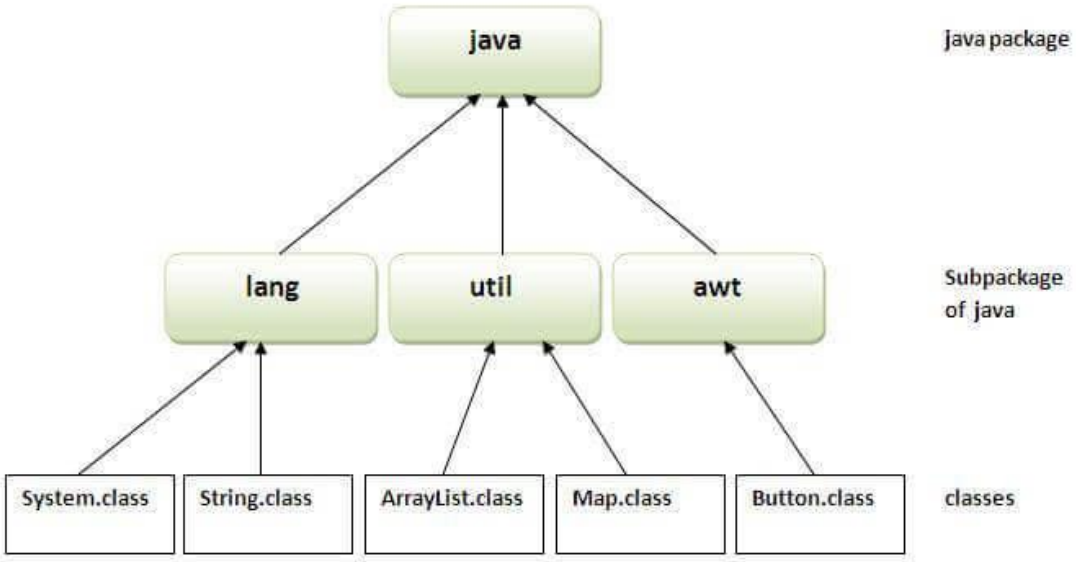
Here, we will have the detailed learning of creating and using user-defined packages.

Advantage of Java Package

1) Java package is used to categorize the classes and interfaces so that they can be easily maintained.

2) Java package provides access protection.

3) Java package removes naming collision.



Simple example of java package

The **package keyword** is used to create a package in java.

```
//save as Simple.java
package mypack;
public class Simple{
 public static void main(String args[]){
    System.out.println("Welcome to package");
   }
}
```

How to compile java package

If we are not using any IDE, you need to follow the **syntax** given below:

javac -d directory java filename

For **Example**

javac -d . Simple.java

How to run java package program

we need to use fully qualified name e.g. mypack.Simple etc to run the class.

To Compile: javac -d . Simple.java

To Run: java mypack.Simple

```
Output:Welcome to package
```

The -d is a switch that tells the compiler where to put the class file i.e. it represents destination. The . represents the current folder.

How to access package from another package?

There are three ways to access the package from outside the package.

1. import package.*;
2. import package.classname;
3. fully qualified name.

1) Using packagename.*

If we use package.* then all the classes and interfaces of this package will be accessible but not subpackages.

The **import** keyword is used to make the classes and interface of another package accessible to the current package.

Example of package that import the packagename.*

```
1. package pack;
2. public class A{
3. public void msg(){System.out.println("Hello");}
4. }
5. //save by B.java
6. package mypack;
7. import pack.*;
8.
9. class B{
10.  public static void main(String args[]){
11.   A obj = new A();
12.   obj.msg();
13.  }
14. }
```

```
Output:Hello
```

---

2) Using packagename.classname

If we import package.classname then only declared class of this package will be accessible.

Example of package by import package.classname

```
1. package pack;
2. public class A{
3.   public void msg(){System.out.println("Hello");
4. }
```

```
}
```

Example 2

```
package mypack;
import pack.A;

class B{
  public static void main(String args[]){
   A obj = new A();
   obj.msg();
  }
}

```

```
Output:Hello
```

---

3) Using fully qualified name

If we use fully qualified name then only declared class of this package will be accessible. Now there is no need to import. But we need to use fully qualified name every time when we are accessing the class or interface.

It is generally used when two packages have same class name e.g. java.util and java.sql packages contain Date class.

Example of package by import fully qualified name

```
//save by A.java
package pack;
public class A{
  public void msg(){System.out.println("Hello");}
}
```

```
//save by B.java
package mypack;
class B{
  public static void main(String args[]){
   pack.A obj = new pack.A();//using fully qualified name
```

```
6.     obj.msg();
7.   }
8. }
```

```
Output:Hello
```

Note: If we import a package, subpackages will not be imported.

If you import a package, all the classes and interface of that package will be imported excluding the classes and interfaces of the subpackages. Hence, you need to import the subpackage as well.

Java Arrays

Arrays are used to store multiple values in a single variable, instead of declaring separate variables for each value.

To declare an array, define the variable type with **square brackets**:

```
String[] cars;
```

We have now declared a variable that holds an array of strings. To insert values to it, you can place the values in a comma-separated list, inside curly braces:

```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
```

To create an array of integers, you could write:

```
int[] myNum = {10, 20, 30, 40};
```

Access the Elements of an Array

we can access an array element by referring to the index number.

This statement accesses the value of the first element in cars:

Example

```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
System.out.println(cars[0]);
```

Change an Array Element

To change the value of a specific element, refer to the index number:

```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
cars[0] = "Opel";
System.out.println(cars[0]);
```

Array Length

To find out how many elements an array has, use the `length` property:

Example

```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
System.out.println(cars.length);
```

Loop Through an Array

we can loop through the array elements with the `for` loop, and use the `length` property to specify how many times the loop should run.

The following example outputs all elements in the **cars** array:

```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
for (int i = 0; i < cars.length; i++) {
```

```
System.out.println(cars[i]);

}
```

Multidimensional Arrays

A multidimensional array is an array of arrays.

Multidimensional arrays are useful when you want to store data as a tabular form, like a table with rows and columns.

To create a two-dimensional array, add each array within its own set of **curly braces**:

Access Elements

To access the elements of the **myNumbers** array, specify two indexes: one for the array, and one for the element inside that array. This example accesses the third element (2) in the second array (1) of myNumbers:

Example

```
int[][] myNumbers = { {1, 2, 3, 4}, {5, 6, 7} };

System.out.println(myNumbers[1][2]); // Outputs 7
```

What is String in Java?

String is a sequence of characters. But in Java, string is an object that represents a sequence of characters. The java.lang.String class is used to create a string object.

How to create a string object?

There are two ways to create String object

1.By string literal & 2. By new keyword

String Literal

Java String literal is created by using double quotes. For Example:

```
1. String s="welcome";
```

2) By new keyword

```
1. String s=new String("Welcome");//creates two objects and one reference variable
```

In such case, JVM will create a new string object in normal (non-pool) heap memory, and the literal "Welcome" will be placed in the string constant pool. The variable s will refer to the object in a heap (non-pool).

Java String Example

StringExample.java

```
1. public class StringExample{
2. public static void main(String args[]){
3. String s1="java";//creating string by Java string literal
4. char ch[]={'s','t','r','i','n','g','s'};
5. String s2=new String(ch);//converting char array to string
6. String s3=new String("example");//creating Java string by new keyword
7. System.out.println(s1);
8. System.out.println(s2);
9. System.out.println(s3);
10. }}
```

The java.lang.String class provides many useful methods to perform operations on sequence of char values.

No.	Method	Description
1	char charAt(int index)	It returns char value for the particular index
2	int length()	It returns string length
3	static String format(String format, Object... args)	It returns a formatted string.
4	static String format(Locale l, String format, Object... args)	It returns formatted string with given locale.
5	String substring(int beginIndex)	It returns substring for given begin index.
6	String substring(int beginIndex, int endIndex)	It returns substring for given begin index and end index.
7	boolean contains(CharSequence s)	It returns true or false after matching the sequence of char value.
8	static String join(CharSequence delimiter, CharSequence... elements)	It returns a joined string.
9	static String join(CharSequence delimiter, Iterable<? extends CharSequence> elements)	It returns a joined string.
10	boolean equals(Object another)	It checks the equality of string with the given object.
11	boolean isEmpty()	It checks if string is empty.

12	String concat(String str)	It concatenates the specified string.
13	String replace(char old, char new)	It replaces all occurrences of the specified char value.
14	String replace(CharSequence old, CharSequence new)	It replaces all occurrences of the specified CharSequence.
15	static String equalsIgnoreCase(String another)	It compares another string. It doesn't check case.
16	String[] split(String regex)	It returns a split string matching regex.
17	String[] split(String regex, int limit)	It returns a split string matching regex and limit.
18	String intern()	It returns an interned string.
19	int indexOf(int ch)	It returns the specified char value index.
20	int indexOf(int ch, int fromIndex)	It returns the specified char value index starting with given index.
21	int indexOf(String substring)	It returns the specified substring index.
22	int indexOf(String substring, int fromIndex)	It returns the specified substring index starting with given index.
23	String toLowerCase()	It returns a string in lowercase.
24	String toLowerCase(Locale l)	It returns a string in lowercase using specified locale.
25	String toUpperCase()	It returns a string in uppercase.

26	String toUpperCase(Locale l)	It returns a string in uppercase using specified locale.
27	String trim()	It removes beginning and ending spaces of this string.
28	static String valueOf(int value)	It converts given type into string. It is an overloaded method.

Vector in java

The `Vector` class is an implementation of the `List` interface that allows us to create resizable-arrays similar to the ArrayList class.

Creating a Vector

Here is how we can create vectors in Java.

```
Vector<Type> vector = new Vector<>();
```

Here, `Type` indicates the type of a linked list. For example,

```
// create Integer type linked list
Vector<Integer> vector= new Vector<>();

// create String type linked list
Vector<String> vector= new Vector<>();
```

Methods of Vector

The `Vector` class also provides the resizable-array implementations of the `List` interface (similar to the `ArrayList` class). Some of the `Vector` methods are:

Add Elements to Vector

- `add(element)` - adds an element to vectors
- `add(index, element)` - adds an element to the specified position
- `addAll(vector)` - adds all elements of a vector to another vector

For example,

```
import java.util.Vector;

class Main {
    public static void main(String[] args) {
        Vector<String> mammals= new Vector<>();

        // Using the add() method
        mammals.add("Dog");
        mammals.add("Horse");

        // Using index number
        mammals.add(2, "Cat");
        System.out.println("Vector: " + mammals);

        // Using addAll()
        Vector<String> animals = new Vector<>();
        animals.add("Crocodile");

        animals.addAll(mammals);
        System.out.println("New Vector: " + animals);
    }
}
```

Run Code

Output

```
Vector: [Dog, Horse, Cat]
New Vector: [Crocodile, Dog, Horse, Cat]
```

Access Vector Elements

- `get(index)` - returns an element specified by the index
- `iterator()` - returns an iterator object to sequentially access vector elements

For example,

```
import java.util.Iterator;
import java.util.Vector;

class Main {
    public static void main(String[] args) {
        Vector<String> animals= new Vector<>();
        animals.add("Dog");
        animals.add("Horse");
        animals.add("Cat");

        // Using get()
        String element = animals.get(2);
        System.out.println("Element at index 2: " + element);

        // Using iterator()
        Iterator<String> iterate = animals.iterator();
        System.out.print("Vector: ");
        while(iterate.hasNext()) {
            System.out.print(iterate.next());
            System.out.print(", ");
        }
    }
}
```

Run Code

Output

```
Element at index 2: Cat
Vector: Dog, Horse, Cat,
```

Remove Vector Elements

- `remove(index)` - removes an element from specified position
- `removeAll()` - removes all the elements
- `clear()` - removes all elements. It is more efficient than `removeAll()`

For example,

```
import java.util.Vector;

class Main {
    public static void main(String[] args) {
        Vector<String> animals= new Vector<>();
        animals.add("Dog");
        animals.add("Horse");
        animals.add("Cat");

        System.out.println("Initial Vector: " + animals);

        // Using remove()
        String element = animals.remove(1);
        System.out.println("Removed Element: " + element);
        System.out.println("New Vector: " + animals);

        // Using clear()
        animals.clear();
        System.out.println("Vector after clear(): " + animals);
    }
}
```

Run Code

Output

```
Initial Vector: [Dog, Horse, Cat]
Removed Element: Horse
New Vector: [Dog, Cat]
Vector after clear(): []
```

Others Vector Methods

Methods	Descriptions
`set()`	changes an element of the vector
`size()`	returns the size of the vector
`toArray()`	converts the vector into an array
`toString()`	converts the vector into a String
`contains()`	searches the vector for specified element and returns a boolean result

Introduction for File Handling

Java में File Handling के लिए java.io इस package का इस्तेमाल किया जाता है | java.io package पर input.output के लिए सभी classes मौजूद होते है |

Program में File Handling के लिए streams का इस्तेमाल किया जाता है |

Java के java.io package ऐसे classes है जिनको दो streams में विभाजित किया गया है |

1. Byte Streams
2. Character Streams