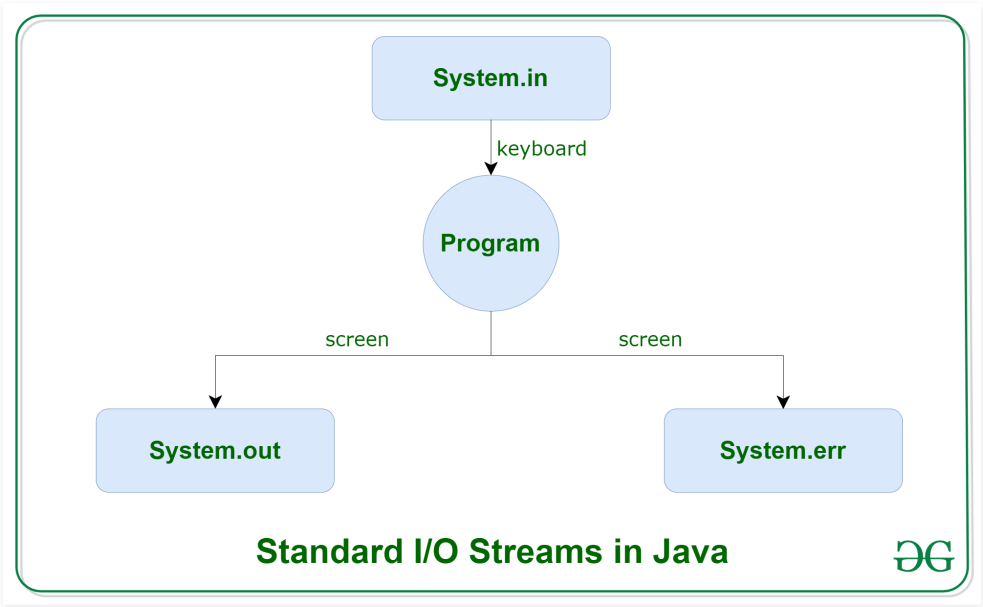
Java IO : Input-output in Java with Examples

Difficulty Level : Medium Last Updated : 01 Sep, 2021

Java brings various Streams with its I/O package that helps the user to perform all the input-output operations. These streams support all the types of objects, data-types, characters, files etc to fully execute the I/O operations.

Before exploring various input and output streams lets look at **3 standard or default streams** that Java has to provide which are also most common in use:



1. System.in**:** This is the **standard input stream** that is used to read characters from the keyboard or any other standard input device.
2. System.out**:** This is the **standard output stream** that is used to produce the result of a program on an output device like the computer screen.
   Here is a list of the various print functions that we use to output statements:
   - print()**:** This method in Java is used to display a text on the console. This text is passed as the parameter to this method in the form of String. This method prints the text on the console and the cursor remains at the end of the text at the console. The next printing takes place from just here.
     Syntax:

```
System.out.print(parameter);
```

Example:

```
// Java code to illustrate print()
import java.io.*;

class Demo_print {
    public static void main(String[] args)
    {

        // using print()
        // all are printed in the
        // same line
        System.out.print("GfG! ");
        System.out.print("GfG! ");
        System.out.print("GfG! ");
    }
}
```

Output:

```
GfG! GfG! GfG!
```

- println(): This method in Java is also used to display a text on the console. It prints the text on the console and the cursor moves to the start of the next line at the console. The next printing takes place from the next line.
  Syntax:

```
System.out.println(parameter);
```

Example:

```
// Java code to illustrate println()

import java.io.*;

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

```
    {

        // using println()
        // all are printed in the
        // different line
        System.out.println("GfG! ");
        System.out.println("GfG! ");
        System.out.println("GfG! ");
    }
}
```

Output:

```
GfG!
GfG!
GfG!
```

- printf(): This is the easiest of all methods as this is similar to printf in C. Note that System.out.print() and System.out.println() take a single argument, but printf() may take multiple arguments. This is used to format the output in Java.
  Example:

```
// A Java program to demonstrate working of printf() in Java
class JavaFormatter1 {
    public static void main(String args[])
    {
        int x = 100;
        System.out.printf(
            "Printing simple"
                + " integer: x = %d\n",
            x);

        // this will print it upto
        // 2 decimal places
        System.out.printf(
            "Formatted with"
                + " precision: PI = %.2f\n",
            Math.PI);

        float n = 5.2f;

        // automatically appends zero
        // to the rightmost part of decimal
        System.out.printf(
            "Formatted to "
                + "specific width: n = %.4f\n",
            n);
```

```
            n = 2324435.3f;

            // here number is formatted from
            // right margin and occupies a
            // width of 20 characters
            System.out.printf(
                "Formatted to "
                    + "right margin: n = %20.4f\n",
                n);
        }
    }
```

Output:

```
Printing simple integer: x = 100
Formatted with precision: PI = 3.14
Formatted to specific width: n = 5.2000
Formatted to right margin: n =         2324435.2500
```

3. System.err**:** This is the **standard error stream** that is used to output all the error data that a program might throw, on a computer screen or any standard output device. This stream also uses all the 3 above-mentioned functions to output the error data:
   - print()
   - println()
   - printf()

   Example:

```
// Java code to illustrate standard
// input output streams

import java.io.*;
public class SimpleIO {

    public static void main(String args[])
        throws IOException
    {

        // InputStreamReader class to read input
        InputStreamReader inp = null;
```

```
        // Storing the input in inp
        inp = new InputStreamReader(System.in);

        System.out.println("Enter characters, "
                           + " and '0' to quit.");
        char c;
        do {
            c = (char)inp.read();
            System.out.println(c);
        } while (c != '0');
    }
}
```

Input:

```
GeeksforGeeks0
```

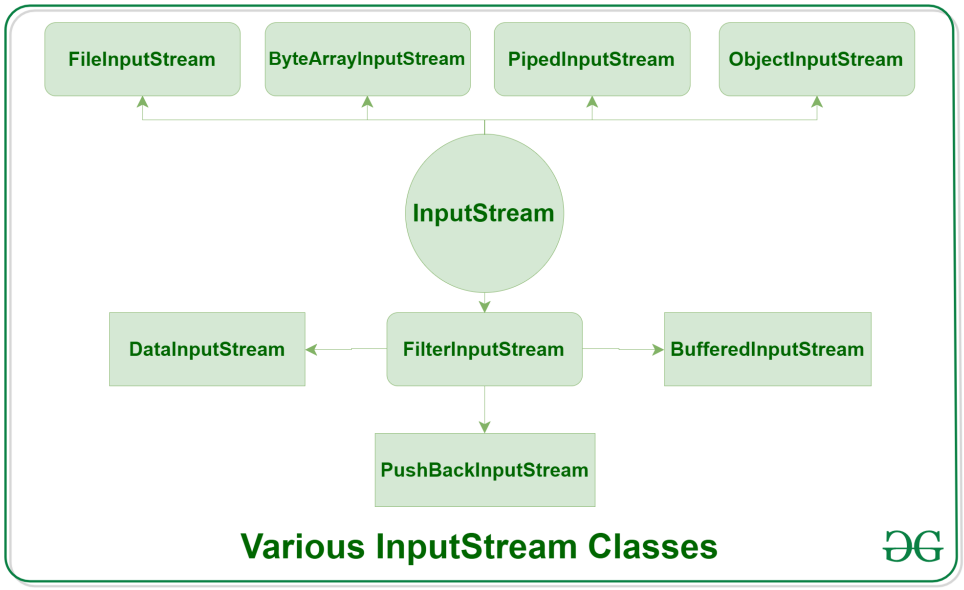
Output:

```
Enter characters, and '0' to quit.
G

e

e

k

s

f

o

r

G

e

e

k

s

0
```

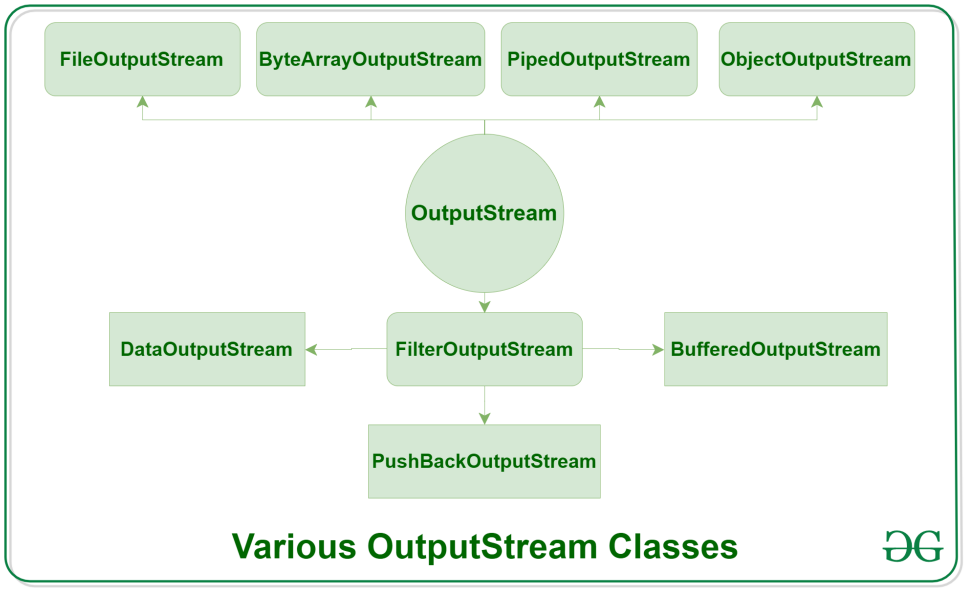
Types of Streams:

- **Depending on the type of operations**, streams can be divided into two primary classes:
  1. Input Stream: These streams are used to read data that must be taken as an input from a source array or file or any peripheral device. For eg., FileInputStream,

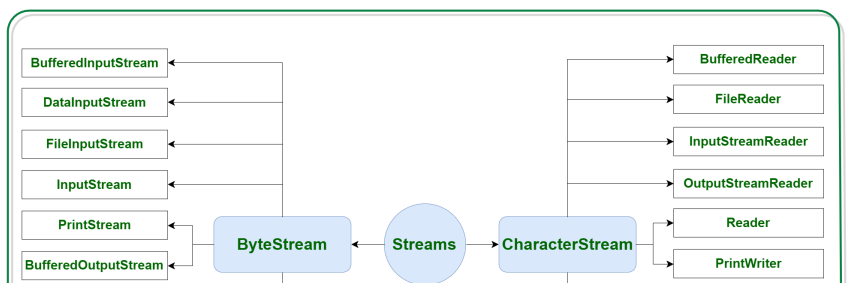
BufferedInputStream, ByteArrayInputStream etc.

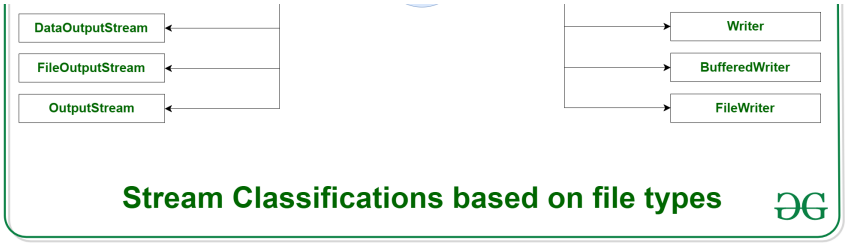


2. Output Stream: These streams are used to write data as outputs into an array or file or any output peripheral device. For eg., FileOutputStream, BufferedOutputStream, ByteArrayOutputStream etc.



- **Depending on the types of file**, Streams can be divided into two primary classes which can be further divided into other classes as can be seen through the diagram below followed by the explanations.





1. **ByteStream:** This is used to process data byte by byte (8 bits). Though it has many classes, the FileInputStream and the FileOutputStream are the most popular ones. The FileInputStream is used to read from the source and FileOutputStream is used to write to the destination. Here is the list of various ByteStream Classes:

Stream class	Description
BufferedInputStream	It is used for Buffered Input Stream.
DataInputStream	It contains method for reading java standard datatypes.
FileInputStream	This is used to reads from a file
InputStream	This is an abstract class that describes stream input.
PrintStream	This contains the most used print() and println() method
BufferedOutputStream	This is used for Buffered Output Stream.
DataOutputStream	This contains method for writing java standard data types.
FileOutputStream	This is used to write to a file.
OutputStream	This is an abstract class that describe stream output.

Example:

```
// Java Program illustrating the
// Byte Stream to copy
// contents of one file to another file.
import java.io.*;
public class BStream {
    public static void main(
        String[] args) throws IOException
    {
```

```
        FileInputStream sourceStream = null;
        FileOutputStream targetStream = null;

        try {
            sourceStream
                = new FileInputStream("sorcefile.txt");
            targetStream
                = new FileOutputStream("targetfile.txt");

            // Reading source file and writing
            // content to target file byte by byte
            int temp;
            while ((
                        temp = sourceStream.read())
                   != -1)
                targetStream.write((byte)temp);
        }
        finally {
            if (sourceStream != null)
                sourceStream.close();
            if (targetStream != null)
                targetStream.close();
        }
    }
}
```

Output:

```
Shows contents of file test.txt
```

2. **CharacterStream:** In Java, characters are stored using Unicode conventions (Refer this for details). Character stream automatically allows us to read/write data character by character. Though it has many classes, the FileReader and the FileWriter are the most popular ones. FileReader and FileWriter are character streams used to read from the source and write to the destination respectively. Here is the list of various CharacterStream Classes:

Stream class	Description
BufferedReader	It is used to handle buffered input stream.
FileReader	This is an input stream that reads from file.
InputStreamReader	This input stream is used to translate byte to character.

Stream class	Description
OutputStreamReader	This output stream is used to translate character to byte.
Reader	This is an abstract class that define character stream input.
PrintWriter	This contains the most used print() and println() method
Writer	This is an abstract class that define character stream output.
BufferedWriter	This is used to handle buffered output stream.
FileWriter	This is used to output stream that writes to file.

Example:

```
// Java Program illustrating that
// we can read a file in a human-readable
// format using FileReader

// Accessing FileReader, FileWriter,
// and IOException
import java.io.*;
public class GfG {
    public static void main(
        String[] args) throws IOException
    {
        FileReader sourceStream = null;
        try {
            sourceStream
                = new FileReader("test.txt");

            // Reading sourcefile and
            // writing content to target file
            // character by character.
            int temp;
            while ((
                       temp = sourceStream.read())
                   != -1)
                System.out.println((char)temp);
        }
        finally {
            // Closing stream as no longer in use
            if (sourceStream != null)
                sourceStream.close();
        }
    }
}
```

Refer here for the complete difference between Byte and Character Stream Class in Java.