



CS205 Object Oriented Programming in Java

Module 3 - More features of Java (Part 3)

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Topics



- More features of Java :
 - **Input / Output:**
 - I/O Basics
 - Reading Console Input
 - Writing Console Output
 - PrintWriter Class

I/O Basics



- Only `print()` and `println()` are used frequently. All other I/O methods are not used significantly.
 - Because most real applications of Java are not text-based, console programs.
- Java's support for console I/O is limited.

Streams

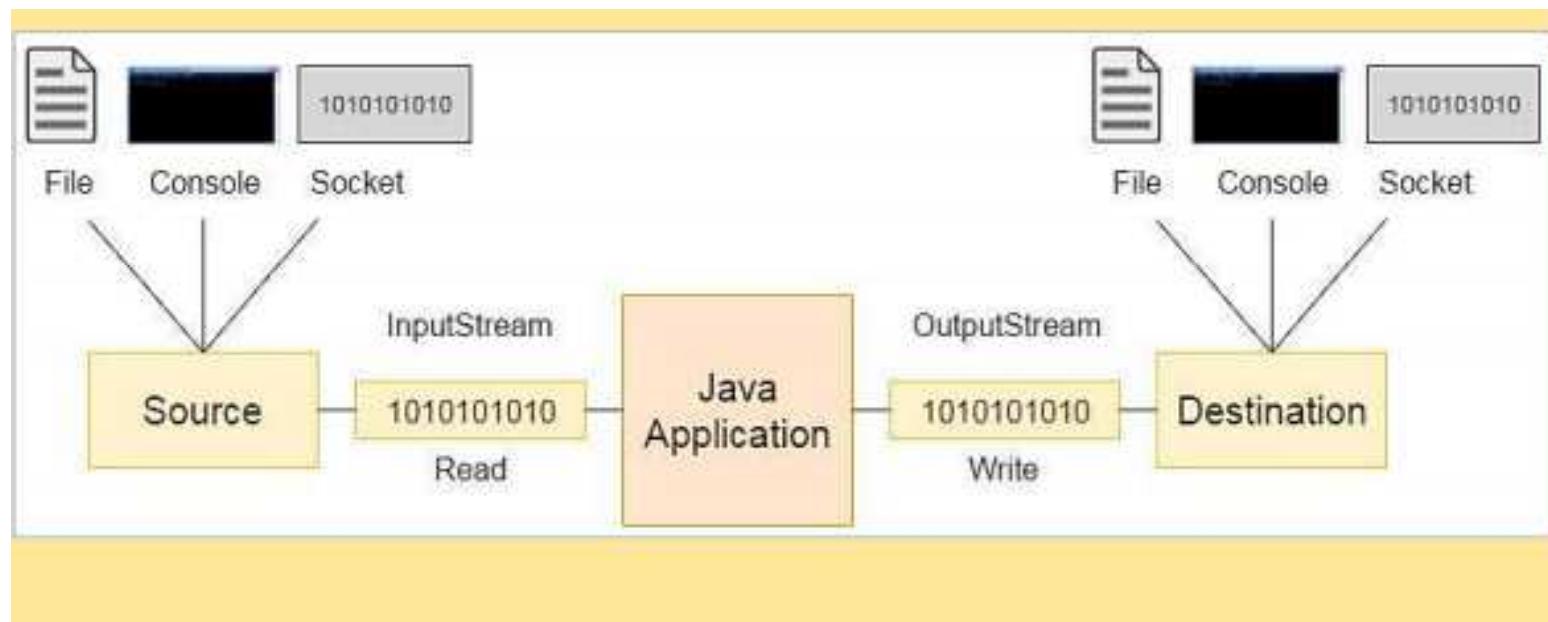


- Java programs perform I/O through **streams**.
- A stream is an abstraction that either **produces** or **consumes** information.
- A stream is a sequence of objects that supports various methods.
- A stream is linked to a physical device by the Java I/O system.
 - **Input stream** may refer to different kinds of input:
 - from a disk file, a keyboard, or a network socket
 - **Output stream** may refer to
 - the console, a disk file, or a network connection.

Working of Java I/O stream



- Stream is like a flow of data.



Streams



- The `java.io` package contains all the classes required for input and output operations.
- Java defines two types of streams: **byte** and **character**.
- **Byte streams** provides a means for handling input and output of **bytes**.
 - Byte streams are used when reading or writing binary data.
- **Character streams** provide a means for handling input and output of characters.
 - they use Unicode.
 - in some cases, character streams are more efficient than byte streams.

Scanner nu pakaram use cheyunna sathanangal anu
buuferreader read() and readLine()

ByteStream classes



- Byte streams are defined by using two class hierarchies.

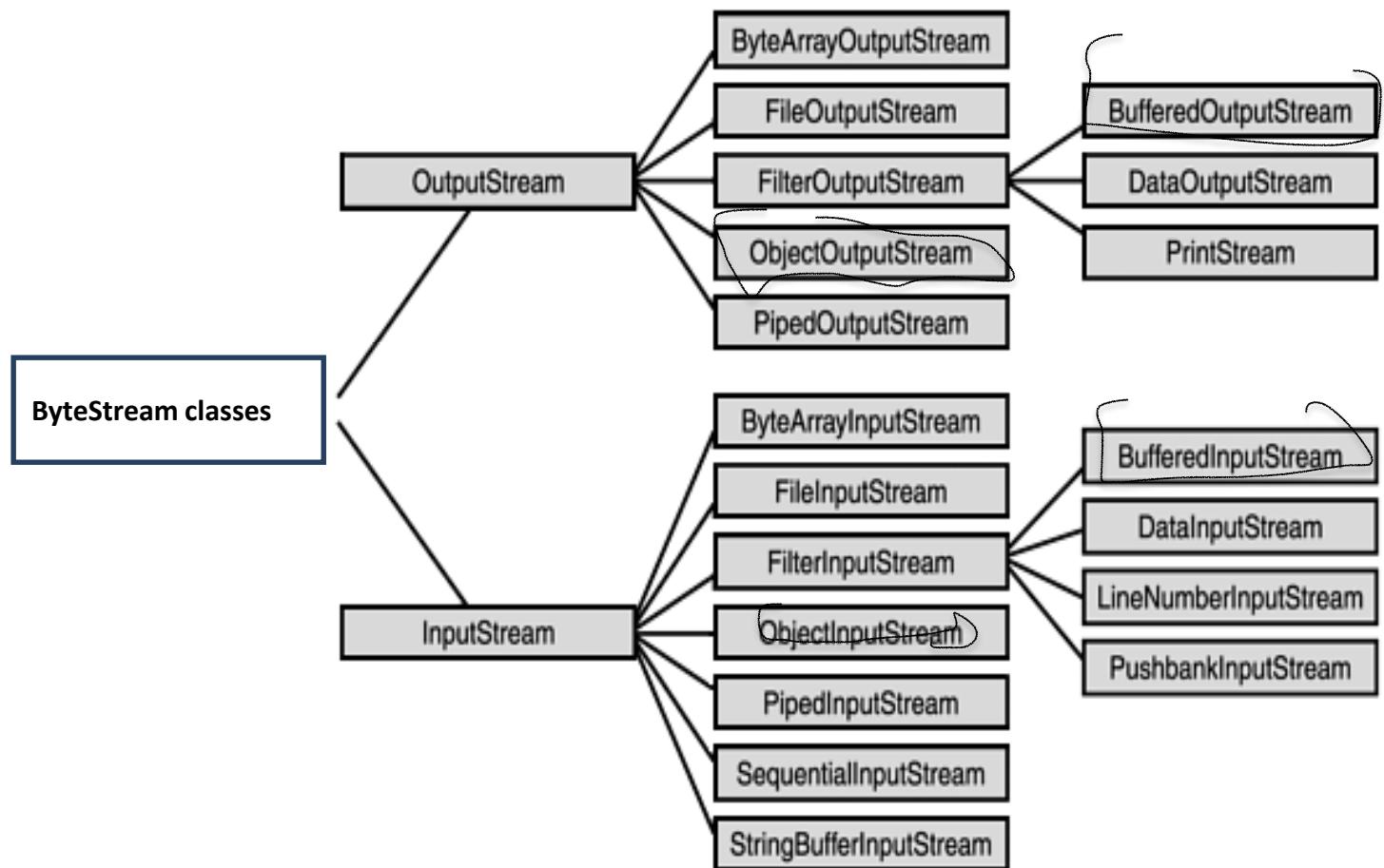
At the top are two **abstract classes**:

- **InputStream** and **OutputStream**.
- Each of these abstract classes has several concrete **subclasses**
 - that **handle the differences between various devices**, such as disk files, network connections, and even memory buffers.
- Two of the most important are **read()** and **write()**,
 - These methods are **overridden** by derived stream classes.



ByteStream classes

- **ByteStream classes**





Byte Stream I/O classes

Stream Class	Meaning
BufferedInputStream	Buffered input stream
BufferedOutputStream	Buffered output stream
ByteArrayInputStream	Input stream that reads from a byte array
ByteArrayOutputStream	Output stream that writes to a byte array
DataInputStream	An input stream that contains methods for reading the Java standard data types
DataOutputStream	An output stream that contains methods for writing the Java standard data types
FileInputStream	Input stream that reads from a file
FileOutputStream	Output stream that writes to a file
FilterInputStream	Implements InputStream
FilterOutputStream	Implements OutputStream
InputStream	Abstract class that describes stream input
ObjectInputStream	Input stream for objects
ObjectOutputStream	Output stream for objects
OutputStream	Abstract class that describes stream output
PipedInputStream	Input pipe
PipedOutputStream	Output pipe
PrintStream	Output stream that contains print() and println()
PushbackInputStream	Input stream that supports one-byte "unget," which returns a byte to the input stream
RandomAccessFile	Supports random access file I/O
SequenceInputStream	Input stream that is a combination of two or more input streams that will be read sequentially, one after the other

Character streams



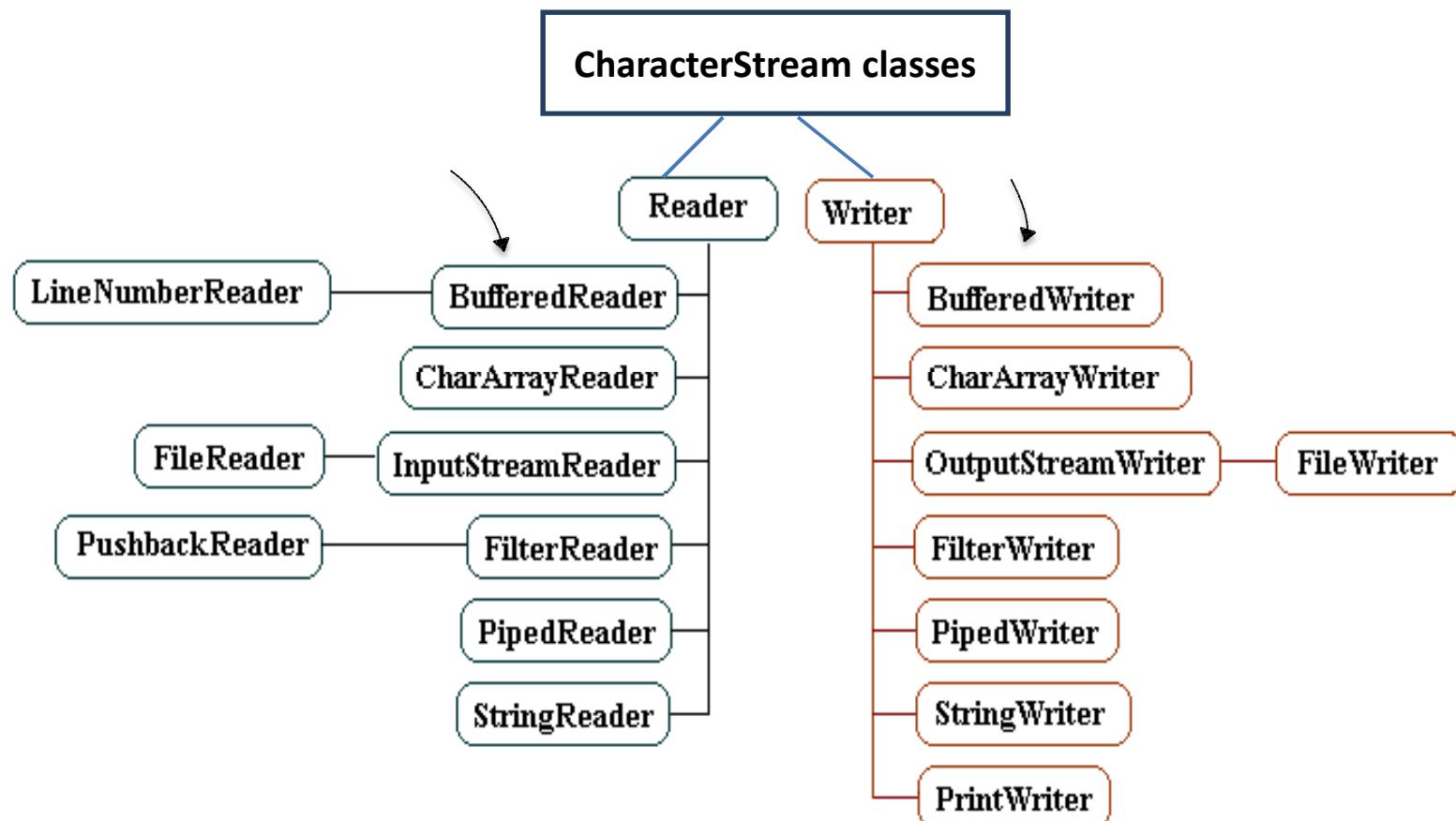
- Character streams are defined by using two class hierarchies.

At the top are two **abstract classes**,

- **Reader** and **Writer**.

byte stream abstract classes inputstream and output stream
Character stream abstract classes reader and writer

- Java has several concrete subclasses of each of these.
- Two of the most important methods are **read()** and **write()**.
 - These methods are **overridden** by derived stream classes.



Character Stream I/O classes



Stream Class	Meaning
BufferedReader	Buffered input character stream
BufferedWriter	Buffered output character stream
CharArrayReader	Input stream that reads from a character array
CharArrayWriter	Output stream that writes to a character array
FileReader	Input stream that reads from a file
FileWriter	Output stream that writes to a file
FilterReader	Filtered reader
FilterWriter	Filtered writer
InputStreamReader	Input stream that translates bytes to characters
LineNumberReader	Input stream that counts lines
OutputStreamWriter	Output stream that translates characters to bytes
PipedReader	Input pipe
PipedWriter	Output pipe
PrintWriter	Output stream that contains <code>print()</code> and <code>println()</code>
PushbackReader	Input stream that allows characters to be returned to the input stream
Reader	Abstract class that describes character stream input
StringReader	Input stream that reads from a string
StringWriter	Output stream that writes to a string
Writer	Abstract class that describes character stream output

The Predefined Streams



- All Java programs automatically import the **java.lang** package. This package defines a class called **System**.
- **System** contains three **predefined stream variables**:
 - in, out, and err.
 - These fields are declared as **public, static, and final** within System.
- **System.out** refers to the standard output stream.
- **System.in** refers to standard input, which is the keyboard by default.
- **System.err** refers to the standard error stream, which is the console by default.
- **System.in** is an object of type **InputStream**; **System.out** and **System.err** are objects of type **PrintStream**. *Byle*

Reading Console Input



- The preferred method of reading console input is to use a **character-oriented stream**.
- In Java, console input is accomplished by reading from System.in.
 - To obtain a character based stream that is attached to the console, wrap System.in in a BufferedReader object.

character

Reading Console Input(contd.)



- BufferedReader supports a **buffered input stream**.
 - Its most commonly used constructor is:

BufferedReader(Reader inputReader)

- Here, inputReader is the stream that is linked to the instance of BufferedReader that is being created.
Reader is an abstract class.

Reading Console Input(contd.)



- One of the concrete subclasses of **Reader** is **InputStreamReader**.
- **InputStreamReader** converts bytes to characters.
 - It reads bytes and decodes them into characters using a specified charset.
- To obtain an InputStreamReader object that is linked to System.in, the constructor that can be used is :

InputStreamReader(InputStream inputStream)



- Following line of code creates a **BufferedReader** that is connected to the keyboard:

```
BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
```

- By wrapping the **System.in** (standard input stream) in an **InputStreamReader** which is wrapped in a **BufferedReader**, we can **read input from the user in the command line**.
- After this statement executes, **br** is a character-based stream that is linked to the console through **System.in**

Reading console-summary



To accept data from keyboard, we use **System.in**. (bytestream)

We need to **connect keyboard** to an **input stream object**.

Here we can use InputStreamReader that can read data from the keyboard
(convert byte stream to character stream)

Now our data reaches InputStreamReader..

BufferedReader class is used to read the text from a character-based input stream.

To make program run fast and to make reading efficient , ***buffering can be done using BufferedReader class***. It can read data from stream.

Create BufferedReader object and connect InputStreamReader object to it

System.in
(Keyboard)



InputStreamReader



BufferedReader

Byte stream---.....→

character stream -----→ Buffer stream

```
InputStreamReaer in = new InputStreamReader(System.in);
```

```
BufferedReader br = new BufferedReader(in)
```

```
BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
```



```
BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
```

- **System.in → keyboard(Byte stream)**
- Convert **byte steam** to **character stream** using **InputStreamReader**.
- Then wrap that character stream in a **buffered stream** **BufferedReader**

Reading Characters



- To read a character from a **BufferedReader**, use **read()**.

The version of **read()** is

int read() throws IOException

- Each time that **read()** is called, it **reads a character** from the input stream and **returns it as an integer value**. It returns **-1** when the end of the stream is encountered

Buffered reader vechu buffer il charcaters indu to read it we use read method that returns integer values

Reading Characters(E.g.)



```
import java.io.*;
class Readinp
{
    public static void main(String a[]) throws IOException
    {
        char c;
        BufferedReader br=new BufferedReader(new InputStreamReader(System.in));
        System.out.println("Enter a letter");
        c=(char)br.read(); → ent
        System.out.println("Letter="+c);
    }
}
```

OUTPUT

```
Enter a letter
a
Letter=a
```

Enter characters one by one when you type q it will stop reading

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

 **OUTPUT**
Enter characters, 'q' to quit.
123abcq
1
2
3
a
b
c
q

No input is actually passed to the program until you press ENTER.

Reading Strings



- To read a **string** from the keyboard, use the version of **readLine()** that is a member of the **BufferedReader** class.
- Its general form is

String readLine() throws IOException

This returns a **String** object.

read int

Reading Strings(E.g.)



```
import java.io.*;
class Readinp
{
    public static void main(String a[]) throws IOException
    {
        char c;
        BufferedReader br=new BufferedReader(new InputStreamReader(System.in));
        System.out.println("Enter a line of text");
        c=(char)br.read();
        s=br.readLine();
        System.out.println("Line is "+s);
    }
}
```

Enter a line of text
hola ninjas
Line is ola ninjas
c is h

```
class Readinp{
    public static void main(String a[]) throws IOException {
        {
            char c;
            BufferedReader br=new BufferedReader(new
                InputStreamReader(System.in));
            System.out.println("Enter a line of text");
            c=(char)br.read();
            String s=br.readLine();
            System.out.println("Line is "+s);
            System.out.println("c is "+c);
        }
    }
}
```

OUTPUT

Enter a line of text
How are you
Line is How are you

Enter lines of text one by one when you type
stop it will stop reading

```
import java.io.*;  
class Readlinetillstop  
{  
public static void main(String a[]) throws IOException  
{  
String s[] = new String[100];
```

```
BufferedReader br=new BufferedReader(new InputStreamReader(System.in));  
System.out.println("Enter a line of text");  
System.out.println("Enter 'stop' to quit.");  
for(int i=0; i<100; i++)  
{  
s[i] = br.readLine();  
if(s[i].equals("stop")) break;  
}
```



```
System.out.println("Lines are ");  
for(int i=0; i<100; i++)  
{  
if(s[i].equals("stop")) break;  
System.out.println(s[i]);  
} }
```

OUTPUT

```
Enter a line of text  
Enter 'stop' to quit.  
what  
how are you  
ok  
Stop  
Lines are  
what  
how are you  
ok
```

Read console inputs



```
BufferedReader br = new BufferedReader(new InputStreamReader (System.in));
```

Single Character	→	char ch = br.read();
String	→	String str = br.readLine();
Integer	→	String str = br.readLine(); int n = Integer.parseInt(str); int n = Integer.parseInt(br.readLine());
Float	→	Float f = Float.parseFloat(br.readLine());
Double	→	double d = Double.parseDouble(br.readLine());
Byte	→	byte t = Byte.parseByte(br.readLine());
short	→	short s = Short.parseShort(br.readLine());
long	→	long l = Long.parseLong(br.readLine());
Boolean	→	boolean b = Boolean.parseBoolean(br.readLine());

Writing Console Output



- Console output is usually done through `print()` and `println()`.
- These methods are defined by the class **PrintStream**.
 - It is the type of object referenced by `System.out`.
 - `System.out` is a **byte stream**,
- **PrintStream** is an output stream derived from **OutputStream**,
 - **PrintStream** also implements the low-level method `write()`.
 - `write()` can be used to write to the console.

Writing Console Output



- The simplest form of write() defined by PrintStream is

void write(int *byteval*)

- This method writes the byte specified by *byteval* to the stream
- byteval* is declared as an integer, only the low-order eight bits are written.

// Demonstrate System.out.write(). Write letter ‘A’ to console.

```
class WriteDemo {  
    public static void main(String args[]) {  
        int b;  
        b = 'A';  
        System.out.write(b);  
        System.out.write('\n');  
    }  
}
```

OUTPUT
A

PrintWriter class



- For real-world programs, the recommended method of writing to the console using Java is through a **PrintWriter stream**.
- **PrintWriter** is one of the **character-based classes**.
- **PrintWriter** defines several constructors.

`PrintWriter(OutputStream outputStream, boolean flushOnNewline)`

- Here, *outputStream* is an object of type `OutputStream`, and *flushOnNewline* controls whether Java flushes the output stream every time a `println()` method is called.
 - If *flushOnNewline* is true, flushing automatically takes place.
 - If false, flushing is not automatic.



- **PrintWriter** supports the **prin()** and **println()** methods
- If an argument is not a simple type, the **PrintWriter** methods call the object's **toString()** method and then print the result.
- To write to the console by using a **PrintWriter**, specify **System.out** for the output stream and flush the stream after each new line.

instead of `System.out.println` we write the thing below

PrintWriter pw = new PrintWriter(System.out, true);



```
// Demonstrate PrintWriter  
import java.io.*;  
public class PrintWriterDemo {  
    public static void main(String args[])  
    {  
        PrintWriter pw = new PrintWriter(System.out, true);  
        pw.println("This is a string");  
        int i = -7;  
        pw.println(i);  
        double d = 4.5e-7;  
        pw.println(d);  
    }  
}
```

OUTPUT
This is a string
-7
4.5E-7



System.out

- System.out is a **byte stream**.
- **System.out** refers to the standard output stream(monitor).
- **System:** It is a final class defined in the java.lang package.
- **out:** This is an instance of PrintStream type, which is a public and static member field of the System class.

PrintWriter

- **PrintWriter** should be used to write a **stream of characters**
- PrintWriter is a subclass of **Writer** (character stream class)
- It is used in real world programs to make it easier to internationalize the program

Reference



- Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.