JAVA

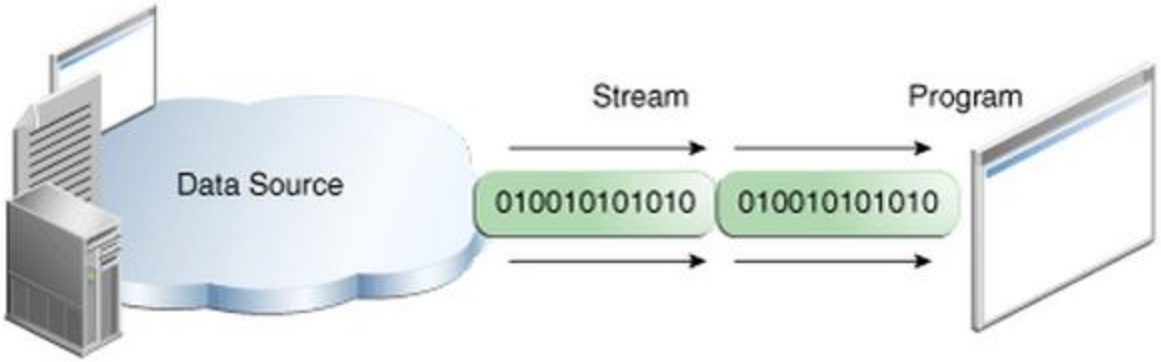
Agenda

- IO Fundamentals
- File IO

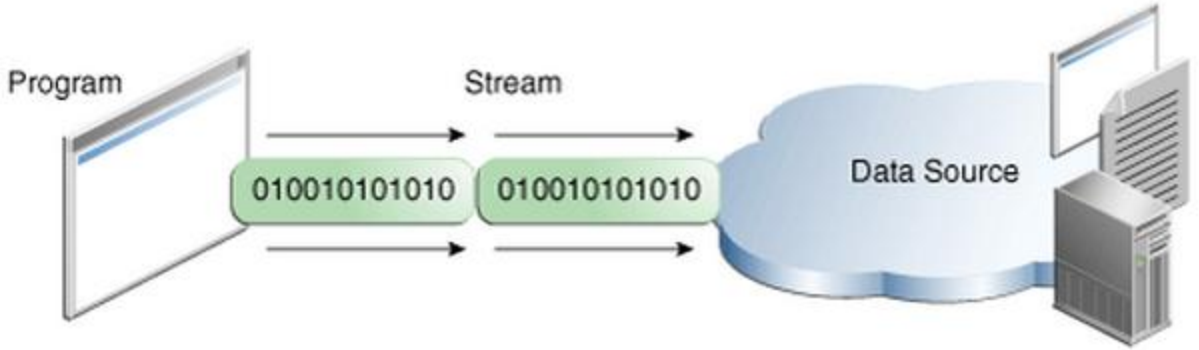
Input Output Fundamentals

I/O Fundamentals

- A *stream* is a flow of data from a source or to a sink.
- A *source* stream initiates the flow of data, also called an input stream.
- A *sink* stream terminates the flow of data, also called an output stream.
- Sources and sinks are both *node streams*.
- Types of node streams are files, memory, and pipes between threads or processes.



Reading information into a program.



Writing information from a program.

Data Within Streams

- Java technology supports two types of streams: character and byte.
- Input and output of character data is handled by readers and writers.
- Input and output of byte data is handled by input streams and output streams:
  - Normally, the term *stream* refers to a byte stream.
  - The terms *reader* and *writer* refer to character streams.

Fundamental Stream Classes

Stream	Byte Streams	Character Streams
Source streams	`InputStream`	`Reader`
Sink streams	`OutputStream`	`Writer`

Byte Streams

- Programs use *byte streams* to perform input and output of 8-bit bytes.
- All byte stream classes are descended from Input Stream and Output Stream.

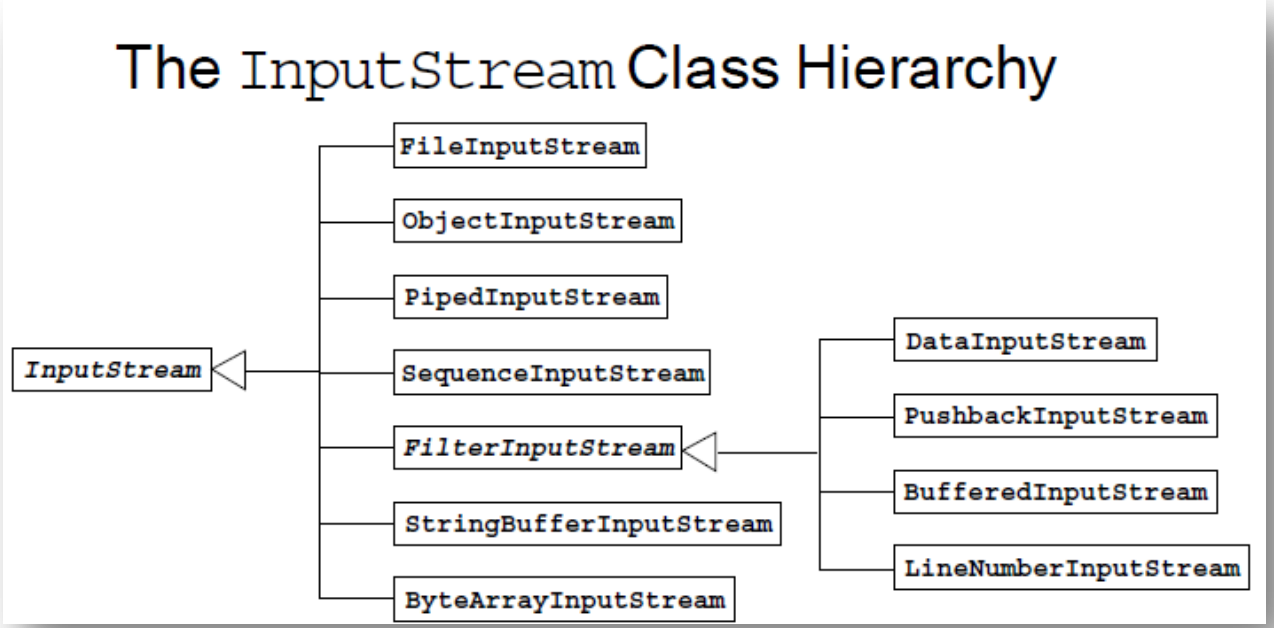
The InputStream Methods

- The three basic `read` methods are:

```
int read()
int read(byte[] buffer)
int read(byte[] buffer, int offset, int length)
```

- Other methods include:

```
void close()
int available()
long skip(long n)
boolean markSupported()
void mark(int readlimit)
void reset()
```


The InputStream Class Hierarchy
InputStream
FileInputStream
ObjectInputStream
PipedInputStream
SequenceInputStream
FilterInputStream
StringBufferInputStream
ByteArrayInputStream
DataInputStream
PushbackInputStream
BufferedInputStream
LineNumberInputStream

The OutputStream Methods

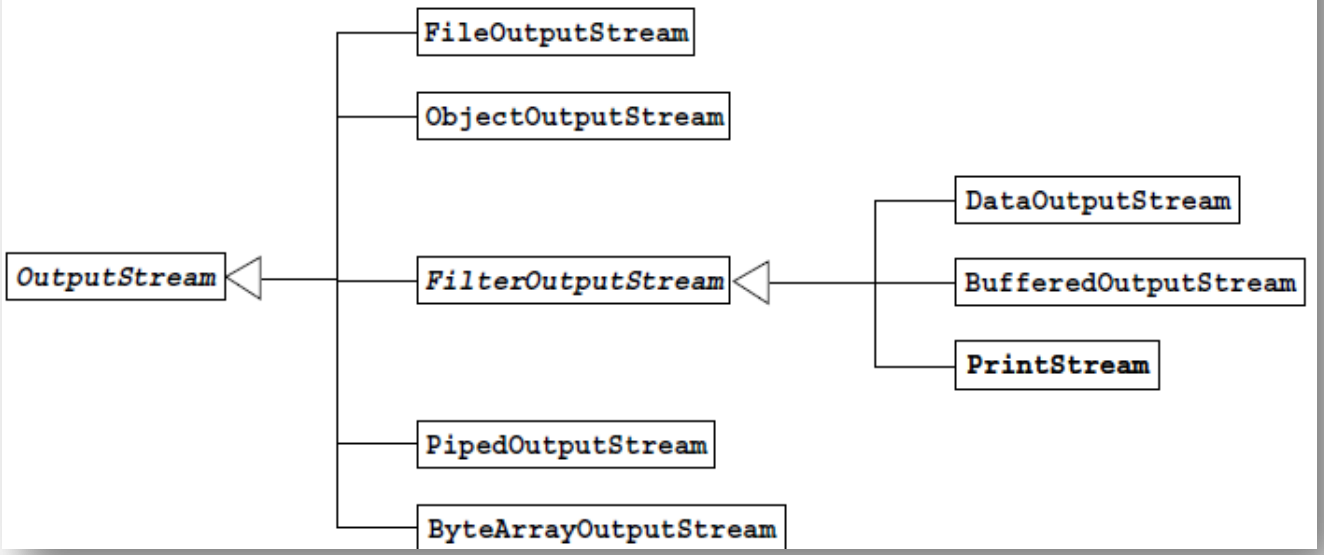
- The three basic `write` methods are:

```
void write(int c)
void write(byte[] buffer)
void write(byte[] buffer, int offset, int length)
```

- Other methods include:

```
void close()
void flush()
```

The `OutputStream` Class Hierarchy



Character Stream

- The Java platform stores character values using Unicode conventions.
- Character stream I/O automatically translates this internal format to and from the local character set.
- All character stream classes are descended from Reader and Writer

Reader

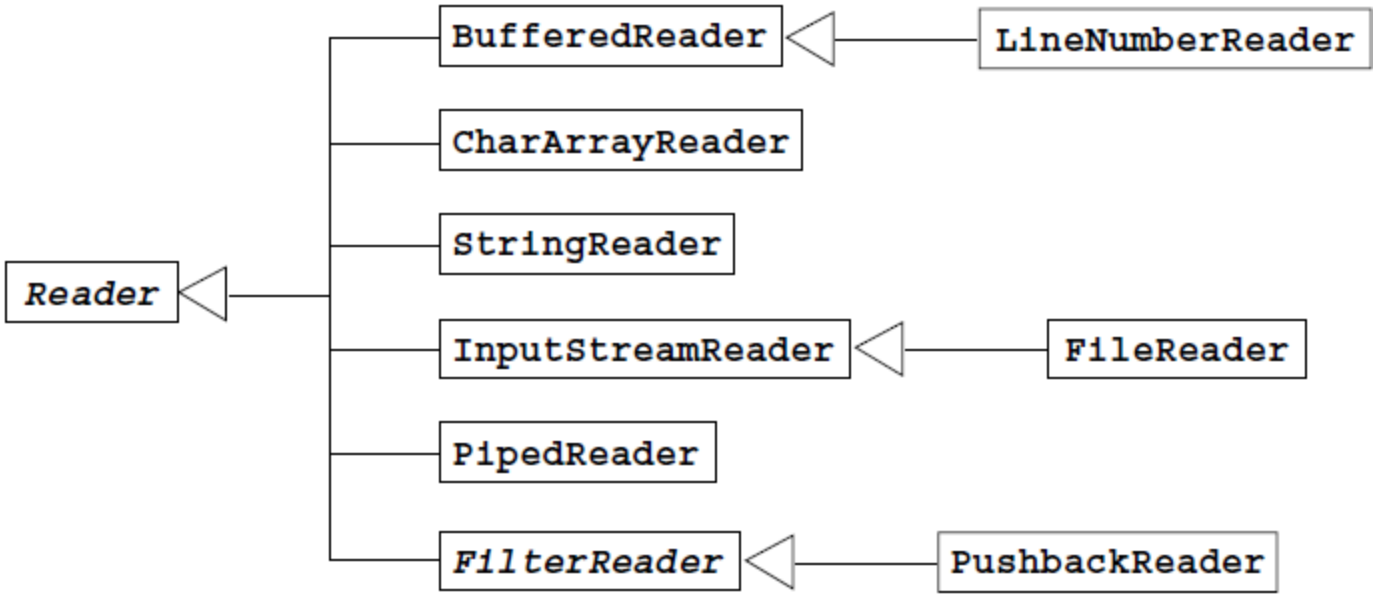
- The three basic `read` methods are:

```
int read()
int read(char[] cbuf)
int read(char[] cbuf, int offset, int length)
```

- Other methods include:

```
void close()
boolean ready()
long skip(long n)
boolean markSupported()
void mark(int readAheadLimit)
void reset()
```

The Reader Class Hierarchy



Writer

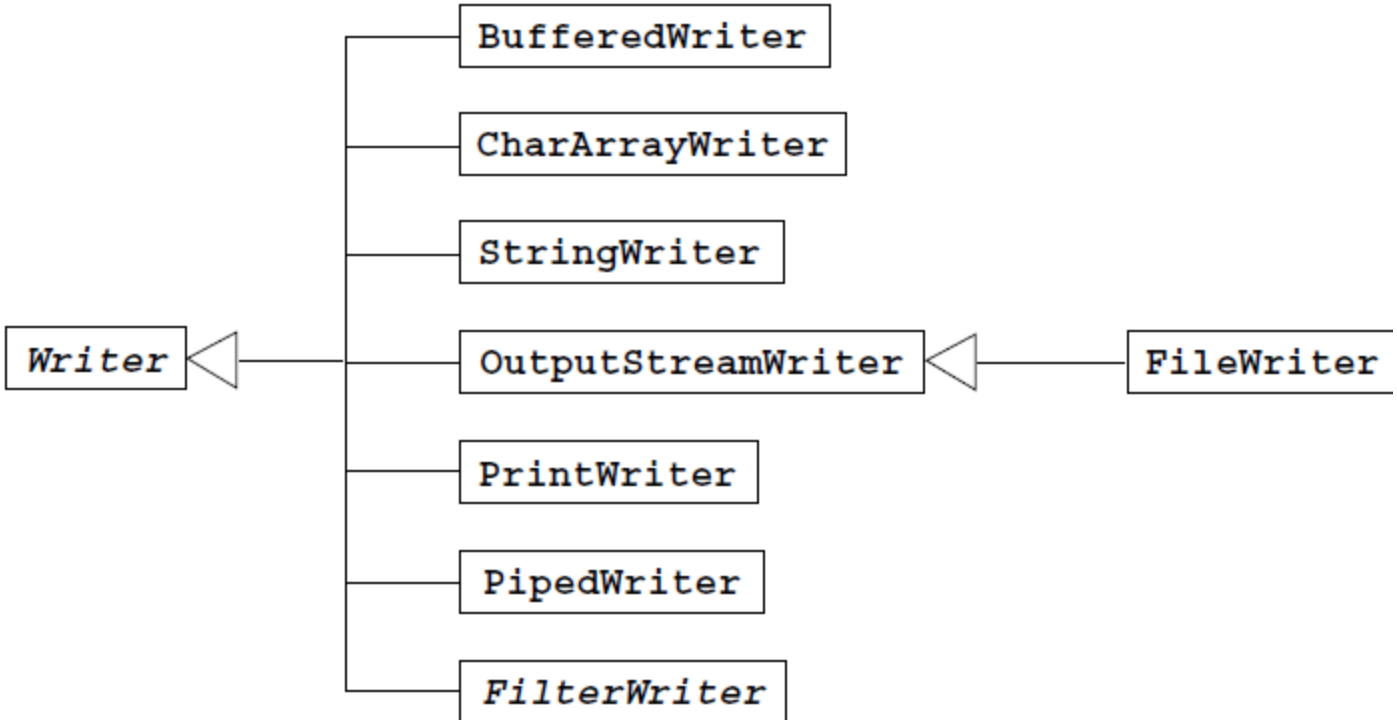
- The basic `write` methods are:

```
void write(int c)
void write(char[] cbuf)
void write(char[] cbuf, int offset, int length)
void write(String string)
void write(String string, int offset, int length)
```

- Other methods include:

```
void close()
void flush()
```

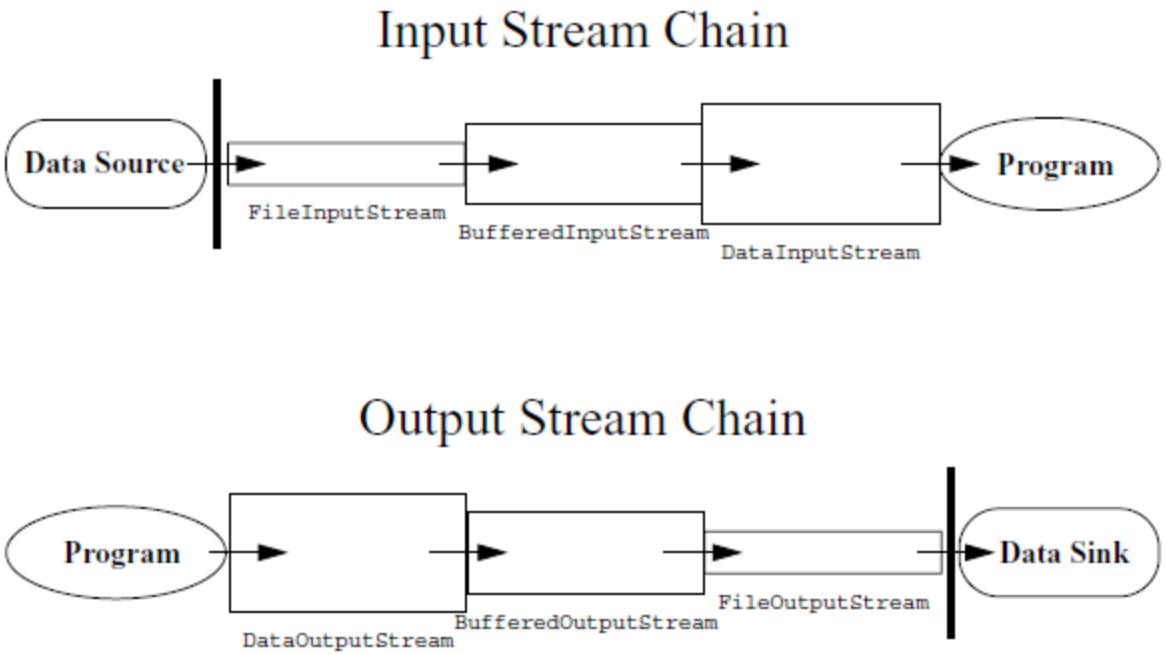
The `Writer` Class Hierarchy



Node Streams

Type	Character Streams	Byte Streams
File	`FileReader` `FileWriter`	`FileInputStream` `FileOutputStream`
Memory: array	`CharArrayReader` `CharArrayWriter`	`ByteArrayInputStream` `ByteArrayOutputStream`
Memory: string	`StringReader` `StringWriter`	N/A
Pipe	`PipedReader` `PipedWriter`	`PipedInputStream` `PipedOutputStream`

I/O Stream Chaining



Processing Streams

Type	Character Streams	Byte Streams
Buffering	`BufferedReader` `BufferedWriter`	`BufferedInputStream` `BufferedOutputStream`
Filtering	*`FilterReader`* *`FilterWriter`*	*`FilterInputStream`* *`FilterOutputStream`*
Converting between bytes and character	`InputStreamReader` `OutputStreamWriter`	
Performing object serialization		`ObjectInputStream` `ObjectOutputStream`
Performing data conversion		`DataInputStream` `DataOutputStream`
Counting	`LineNumberReader`	`LineNumberInputStream`
Peeking ahead	`PushbackReader`	`PushbackInputStream`
Printing	`PrintWriter`	`PrintStream`

Console I/O

- The variable `System.out` enables you to write to *standard output*.

  `System.out` is an object of type `PrintStream`.
- The variable `System.in` enables you to read from *standard input*.

  `System.in` is an object of type `InputStream`.
- The variable `System.err` enables you to write to *standard error*.

  `System.err` is an object of type `PrintStream`.

Reading from standard input

```
import java.io.*;

public class KeyboardInput {
  public static void main (String args[]) {
    String s;
    // Create a buffered reader to read
    // each line from the keyboard.
    InputStreamReader ir
      = new InputStreamReader(System.in);
    BufferedReader in = new BufferedReader(ir);

    System.out.println("Unix: Type ctrl-d to exit." +
                       "\nWindows: Type ctrl-z to exit");

      try {
        // Read each input line and echo it to the screen.
        s = in.readLine();
        while ( s != null ) {
          System.out.println("Read: " + s);
          s = in.readLine();
        }

        // Close the buffered reader.
        in.close();
      } catch (IOException e) { // Catch any IO exceptions.
        e.printStackTrace();
      }
    }
  }
```

Simple Formatted Input

- The Scanner class provides a formatted input function.
- A Scanner class can be used with console input streams as well as file or network streams.
- You can read console input as follows:

```
import java.io.*;
import java.util.Scanner;
public class ScanTest {
  public static void main(String [] args) {
    Scanner s = new Scanner(System.in);
    String param = s.next();
    System.out.println("the param 1" + param);
    int value = s.nextInt();
    System.out.println("second param" + value);
    s.close();
  }
}
```

Files and File I/O

- The java.io package enables you to do the following:
  - Create File objects
  - Manipulate File objects
  - Read and write to file streams

Creating a New File Object

- The File class provides several utilities:
  - File myFile;
  - myFile = new File("myfile.txt");
  - myFile = new File("MyDocs", "myfile.txt");

- Directories are treated like files in the Java programming language.

```
File myDir = new File("MyDocs");
myFile = new File(myDir, "myfile.txt");
```

The File Tests and Utilities

- File information:
  - String getName()
  - String getPath()
  - String getAbsolutePath()
  - String getParent()
  - long lastModified()
  - long length()
- File tests:
  - boolean exists()
  - boolean canWrite()
  - boolean canRead()
  - boolean isFile()
  - boolean isDirectory()
  - boolean isAbsolute();
  - boolean is Hidden();
- File modification:
  - boolean renameTo(File newName)
  - boolean delete()
- Directory utilities:
  - boolean mkdir()
  - String[] list()

File Stream I/O

- For file input:
  - Use the FileReader class to read characters.
  - Use the BufferedReader class to use the readLine method.
- For file output:
  - Use the FileWriter class to write characters.
  - Use the PrintWriter class to use the print and println methods.

File Input Example

```
import java.io.*;
public class ReadFile {
  public static void main (String[] args) {
    // Create file
    File file = new File(args[0]);

    try {
      // Create a buffered reader
      // to read each line from a file.
      BufferedReader in
        = new BufferedReader(new FileReader(file));
      String s;

    // Read each line from the file and echo it to the screen.
    s = in.readLine();
    while ( s != null ) {
      System.out.println("Read: " + s);
      s = in.readLine();
    }
    // Close the buffered reader
    in.close();

  } catch (FileNotFoundException e1) {
    // If this file does not exist
    System.err.println("File not found: " + file);

  } catch (IOException e2) {
    // Catch any other IO exceptions.
    e2.printStackTrace();
  }
 }
}
```

File Output Example

```
import java.io.*;

public class WriteFile {
  public static void main (String[] args) {
    // Create file
    File file = new File(args[0]);

    try {
      // Create a buffered reader to read each line from standard in.
      InputStreamReader isr
        = new InputStreamReader(System.in);
      BufferedReader in
        = new BufferedReader(isr);
      // Create a print writer on this file.
      PrintWriter out
        = new PrintWriter(new FileWriter(file));
      String s;
      System.out.print("Enter file text.  ");
      System.out.println("[Type ctrl-d to stop.]");

      // Read each input line and echo it to the screen.
      while ((s = in.readLine()) != null) {
        out.println(s);
      }

      // Close the buffered reader and the file print writer.
      in.close();
      out.close();

    } catch (IOException e) {
    // Catch any IO exceptions.
      e.printStackTrace();
    }
  }
}
```