JAVA程序设计

第8章 IO流

《Java程序设计》

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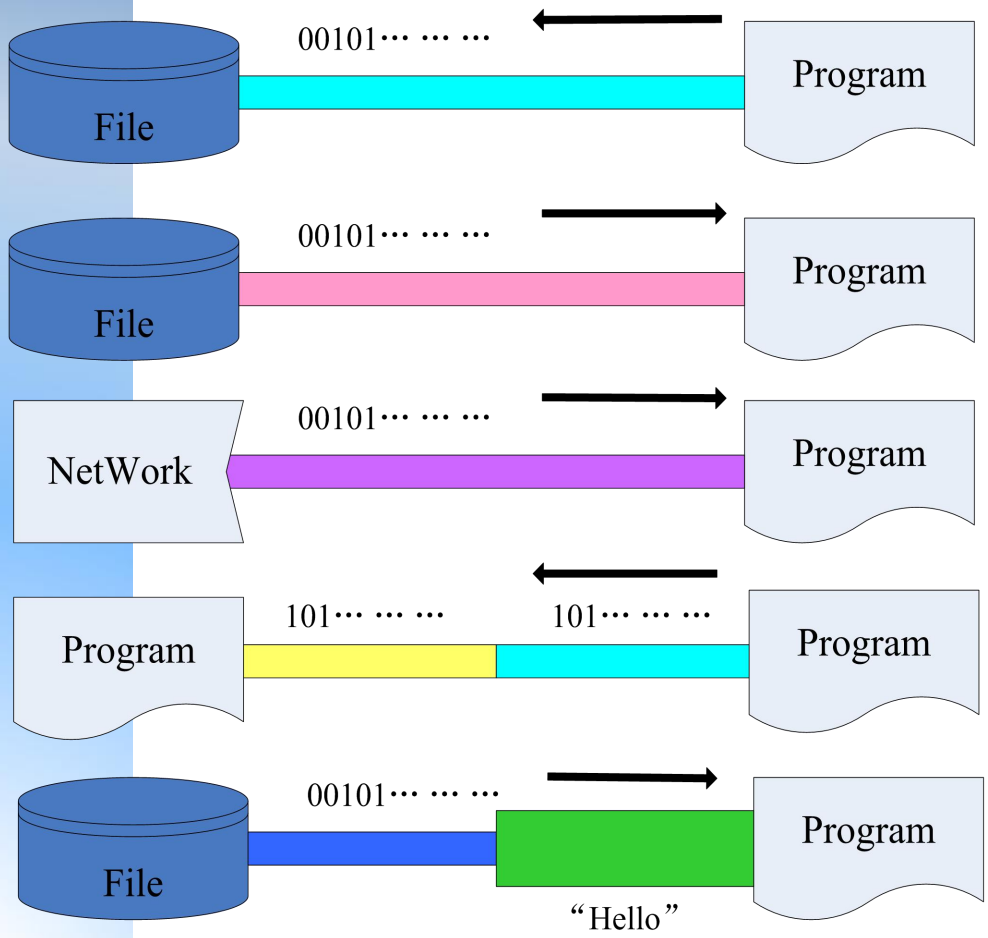
本章目录

I/O介绍

- 创建一个好的输入/输出系统是一项艰难的任务。
  - 与不同的源和目的端进行交互，包括文件、控制台、网络链接等；
  - 以不同的方式与它们进行通信（顺序、随机存取、缓冲、二进制、按照字符、按行、按字节等）；
  - 大多数I/O需要进行异常处理。

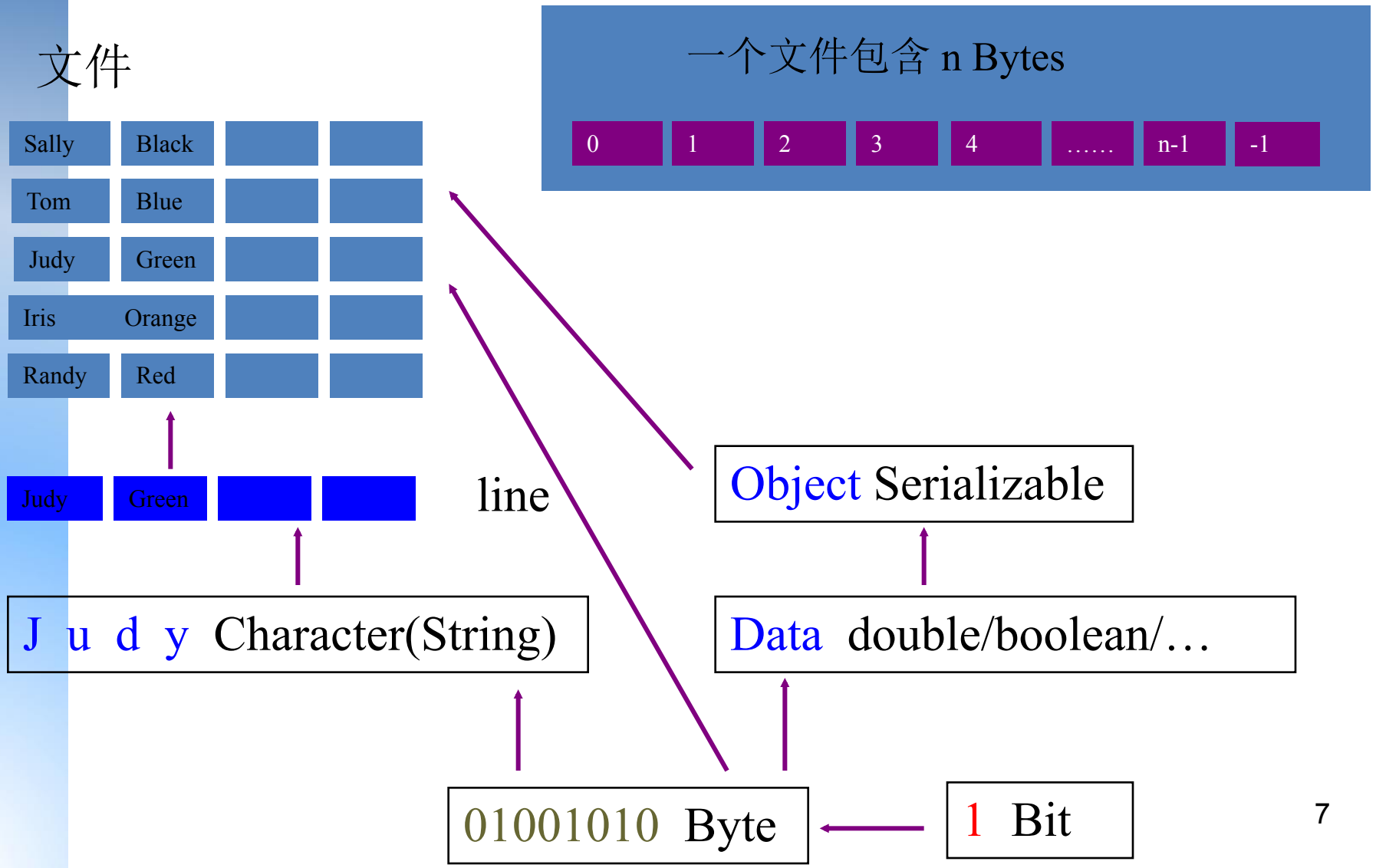
I/O介绍

1. 流的概念



- 流是Java语言输入/输出的方式，Java语言程序通过流来完成输入/输出工作。
- Java提供了各种各样的流类，来实现IO，封装了数据处理的细节。

8.1 文件的读取


文件
Sally Black
Tom Blue
Judy Green
Iris Orange
Randy Red
Judy Green
line
一个文件包含 n Bytes
0 1 2 3 4 …… n-1 -1
Object Serializable
Data double/boolean/…
J u d y Character(String)
01001010 Byte
1 Bit

8.1 文件的读取

File类

java.io.File

➢文件和目录路径名的抽象表示形式，用来获取文件或目录的信息。

File类的构造器：

- **public File (String pathname)**

  //以pathname为路径创建File对象，如果pathname为相对路径则在默认的当前路径下进行存储

- **public File(String parent, String child)**

  //以parent为父路径，child为子路径创建File对象

8.1 文件的读取

File类的方法：

- public boolean canRead()
- public boolean canWrite()
- public boolean exists()
- public boolean isDirectory()
- public boolean isFile()
- public boolean isHidden()
- public long lastModified()
- public long length()
- public String getName()
- public String getPath()
- public boolean createNewFile()
- public boolean delete()
- public boolean mkdir()
- public boolean mkdirs ()

8.1 文件的读取

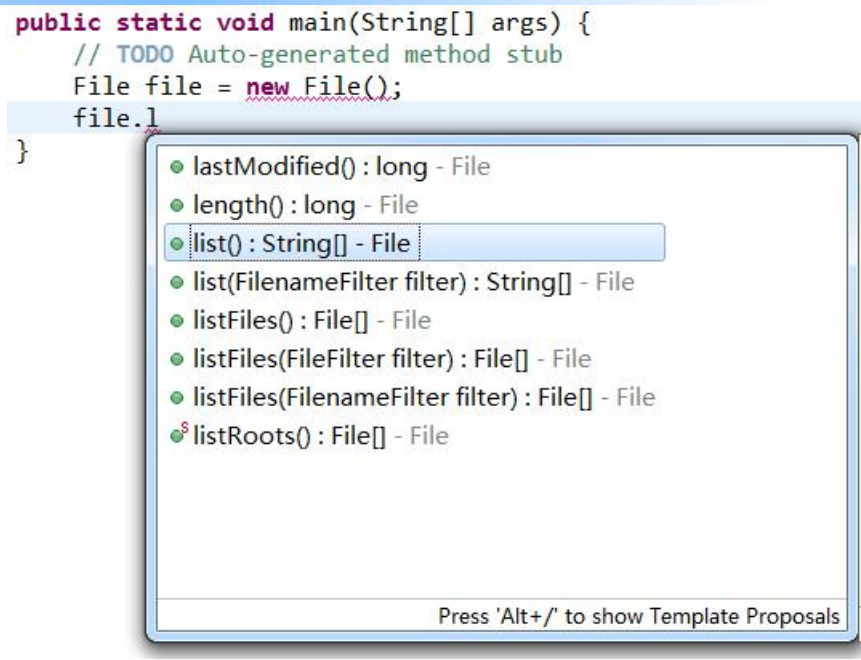
```
import java.io.*;
public class Test {
      public static void main (String[] args) {
            String filename = "myfile.txt";
            String directory = “mydir1" + "/" + "mydir2";
            File f = new File(directory, filename);
            if (f.exists()) {
                  System.out.println("File Name: " + f.getAbsolutePath());
                  System.out.println("File Length: " + f.length());
            } else {
                  f.getParentFile().mkdirs();
                 try {
                  f.createNewFile() ;
            } catch (IOException e) {
            e.printStackTrace() ;
}}}}
```

```
File Name: D:\workspace\test2\mydir1\mydir2\myfile.txt
File Length: 0
```

8.1 文件的读取

File类的方法：

- public boolean canRead()
- public boolean canWrite()
- public boolean exists()
- public boolean isDirectory()
- public boolean isFile()
- public boolean isHidden()
- public long lastModified()
- public long length()
- public String getName()
- public String getPath()
- public boolean createNewFile()
- public boolean delete()
- public boolean mkdir()
- public boolean mkdirs ()



8.1 文件的读取

- 读文件

示例：用**FileReader**读入一个文件并显示在屏幕上。

```
import java.io.*;

public class TestFileReader {
        public static void main(String[] args) {
                // TODO Auto-generated method stub
                //加入中文
                FileReader fr = null;
                int c = 0;
                try {
                        fr = new FileReader("./src/TestFileReader.java");
                        int ln = 0;
                        while ((c = fr.read()) != -1) {
                                System.out.print((char) c);
                        }
                        fr.close();
                } catch (FileNotFoundException e) {
                } catch (IOException e) {
                }
        }
}
```

8.1 文件的读取

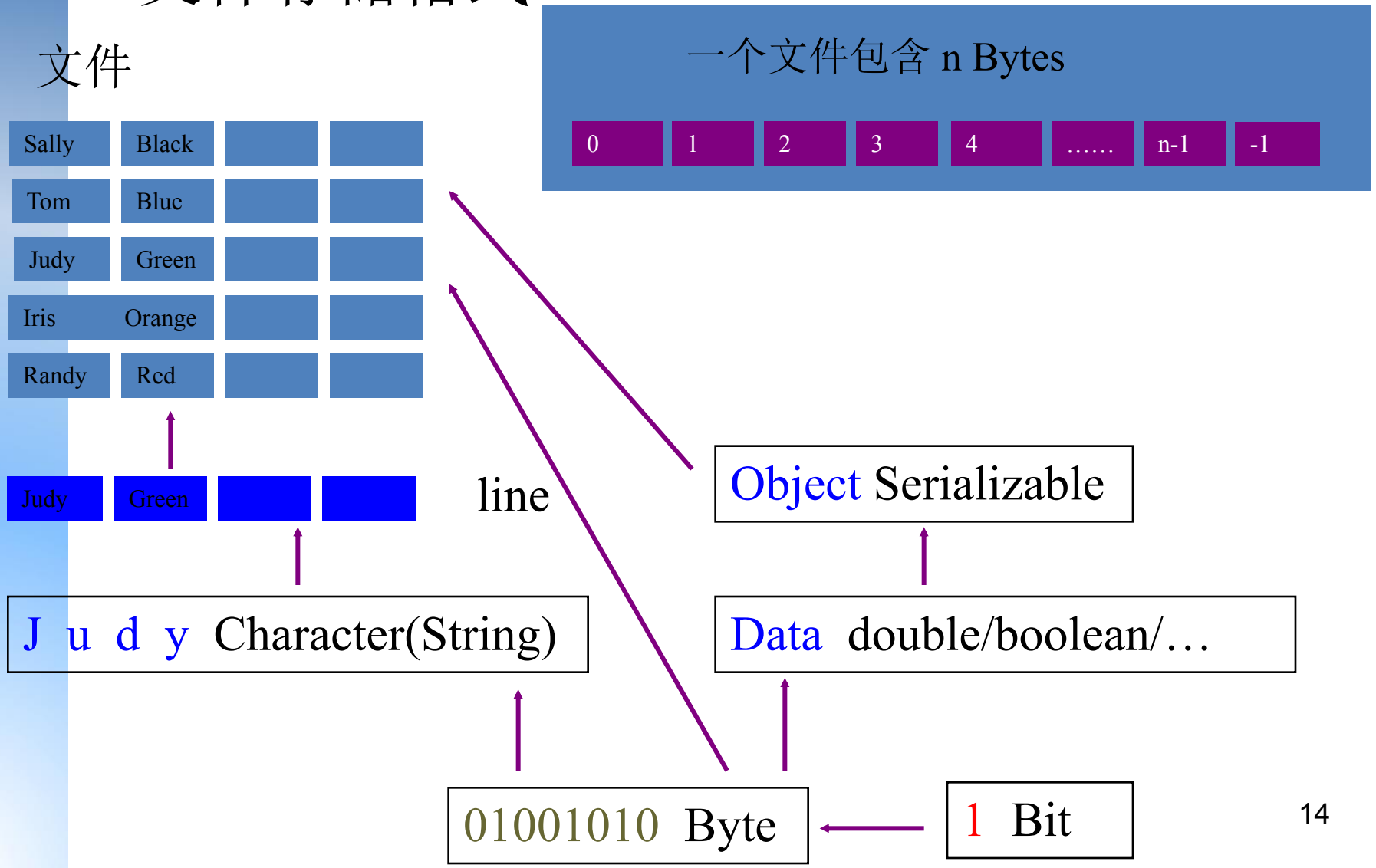
- 写文件

示例：用FileWriter写一个包含字母A-Z的文件。

```
import java.io.*;
public class TestFileWriter {
        public static void main(String[] args) {
        FileWriter fw = null;
        try {
        fw = new FileWriter("./unicode.dat");
        for(char c='A';c<='Z';c++){
                fw.write(c); }
                fw.close();
        } catch (IOException e1) {
           e1.printStackTrace();
           System.out.println("File write error");
           System.exit(-1); }}}
```

8.1 文件的读取

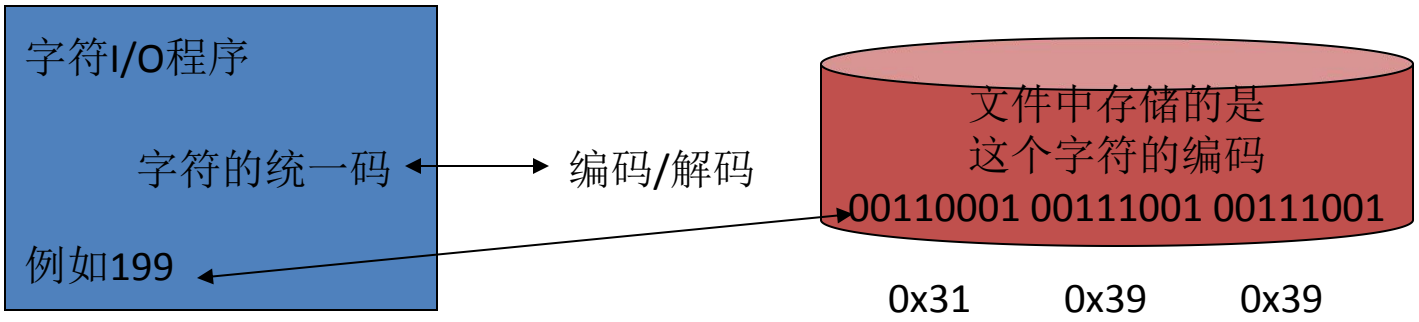
- 文件存储格式

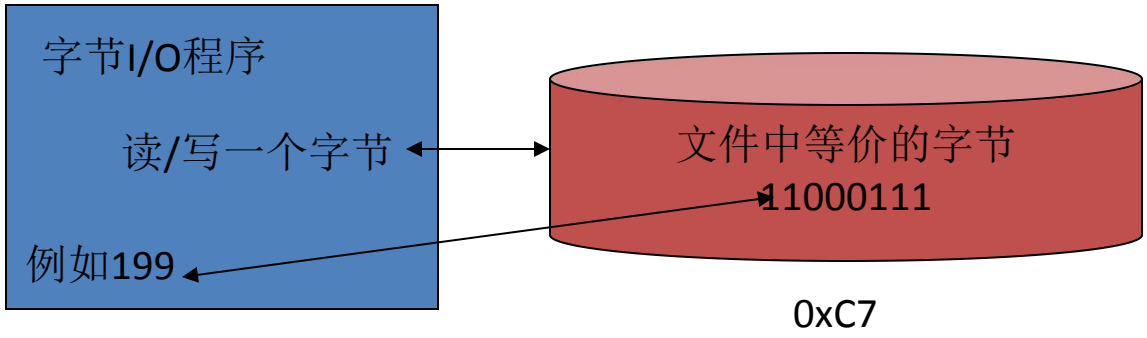



TestFileReader.java -
文件(F) 编辑(E) 格式(O) 查看
import java.io.*;
public class TestFileRea
public static vo
// TODO
//加入中
FileReac
int c =
try {
} catch
} catch
}
}
}
TestFileReader.class - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
TestFileReader
java/lang/Object
<init>
Code
LineNumberTable
LocalVariableTable
this
LTestFileReader;
main
([Ljava/lang/String;)V
./src/TestFileReader.java
(Ljava/lang/String;)V
java/lang/System
out
Ljava/io/PrintStream;
java/io/PrintStream
print
(C)V
read
()I
close
java/io/FileNotFoundException
java/io/IOException
args
[Ljava/lang/String;
fr
Ljava/io/FileReader;
in
StackMapTable
SourceFile
TestFileReader.java

8.1 文件的读取

- 文件存储格式





8.1 文件的读取

- 字节文件读（二进制）

示例：用FileInputStream读入一个文件并显示在屏幕上。

```
import java.io.*;
    public class TestFileInputStream {
        public static void main(String[] args) {
        int b = 0;
        FileInputStream in = null;
        try {
          in = new
              FileInputStream("./TestFileReader.java");
        } catch (FileNotFoundException e) {
          System.out.println("Can't find file");
          System.exit(-1);
          }
```

8.1 文件的读取

- 字节文件读（二进制）

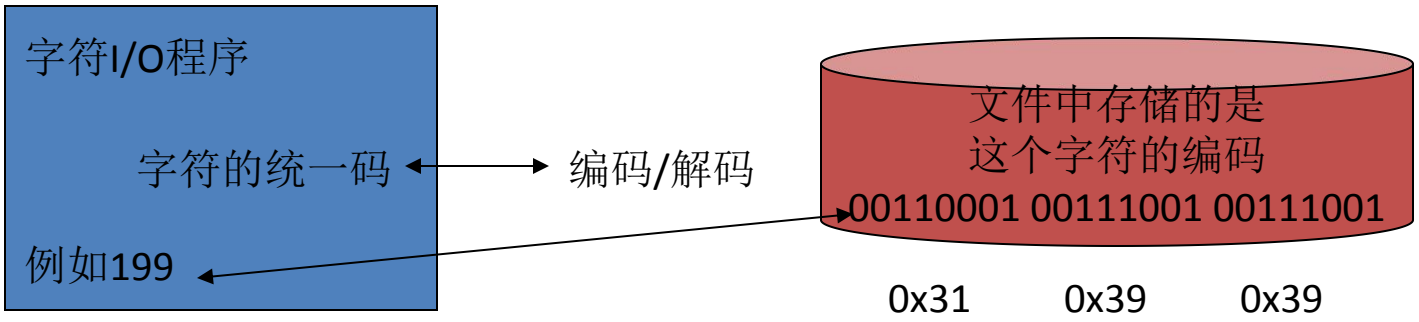
```
try {
        long num = 0;
        while((b=in.read())!=-1){
                System.out.print((char)b);
                 num++;
         }
        in.close();
        System.out.println();
        System.out.println("read "+num+" Byte");
      } catch (IOException e1) {
        System.out.println("File read error");
        System.exit(-1);
   }}}
```

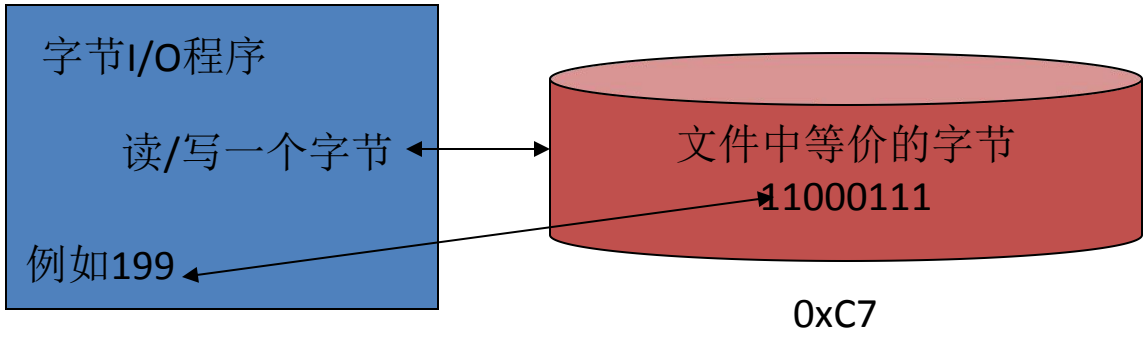
……（显示源程序码）
read 768 Byte

```
import java.io.*;

public class TestFileReader {
        public static void main(String[] args) {
                // TODO Auto-generated method stub
                //????????
                FileReader fr = null;
                int c = 0;
                try {
                        fr = new FileReader("./src/TestFileReader.java");
                        int ln = 0;
                        while ((c = fr.read()) != -1) {
                                System.out.print((char) c);
                        }
                   import java.io.*;
                } ca
                } ca
                }  public class TestFileReader {
        }                       public static void main(String[] args) {
}                                       // TODO Auto-generated method stub
                                        //加入中文
read 436 Byte                           FileReader fr = null;
                                        int c = 0;
                                        try {
                                                fr = new FileReader("./src/TestFileReader.java");
                                                int ln = 0;
                                                while ((c = fr.read()) != -1) {
                                                        System.out.print((char) c);
                                                }
                                                fr.close();
                                        } catch (FileNotFoundException e) {
                                        } catch (IOException e) {
                                        }
                                }
                        }
```

8.1 文件的读取

- 文件存储格式





参考：http://www.cnblogs.com/liujinhong/p/5995946.html
https://home.unicode.org/

8.1 文件的读取

- 字节文件写（二进制）

示例：用FileInputStream和FileOutputStream实现文件的复制。

```
import java.io.*;
public class TestFileOutputStream {
        public static void main(String[] args) {
        int b = 0;
        FileInputStream in = null;
        FileOutputStream out = null;
  try {
    in = new FileInputStream("./HelloWorld.java");
    out = new FileOutputStream("./HW.java");
    while((b=in.read())!=-1){
      out.write(b);
    }
```

8.1 文件的读取

```
            in.close();
            out.close();
            } catch (FileNotFoundException e2) {
              System.out.println("Can't find file");
              System.exit(-1);
            } catch (IOException e1) {
            System.out.println("File copy error");
            System.exit(-1);
        }
            System.out.println("File copy finished");
        }
}
```

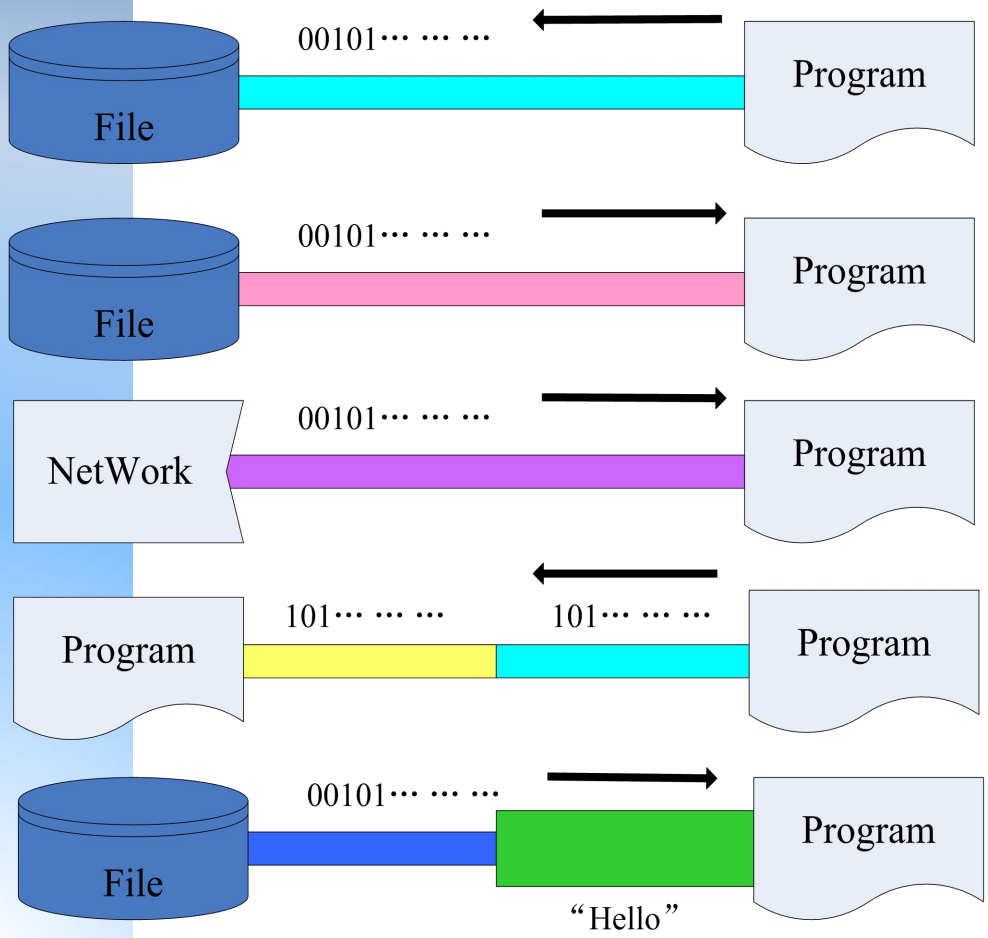
File copy finished

8.1 文件的读取

- 字符文件
  - FileReader
  - FileWriter
- 字节文件
  - FileInputStream
  - FileOutputStream

8.2 流与相关类

1. 流的概念



- 流是Java语言输入/输出的方式，Java语言程序通过流来完成输入/输出工作。
- Java提供了各种各样的流类，来实现IO，封装了数据处理的细节。

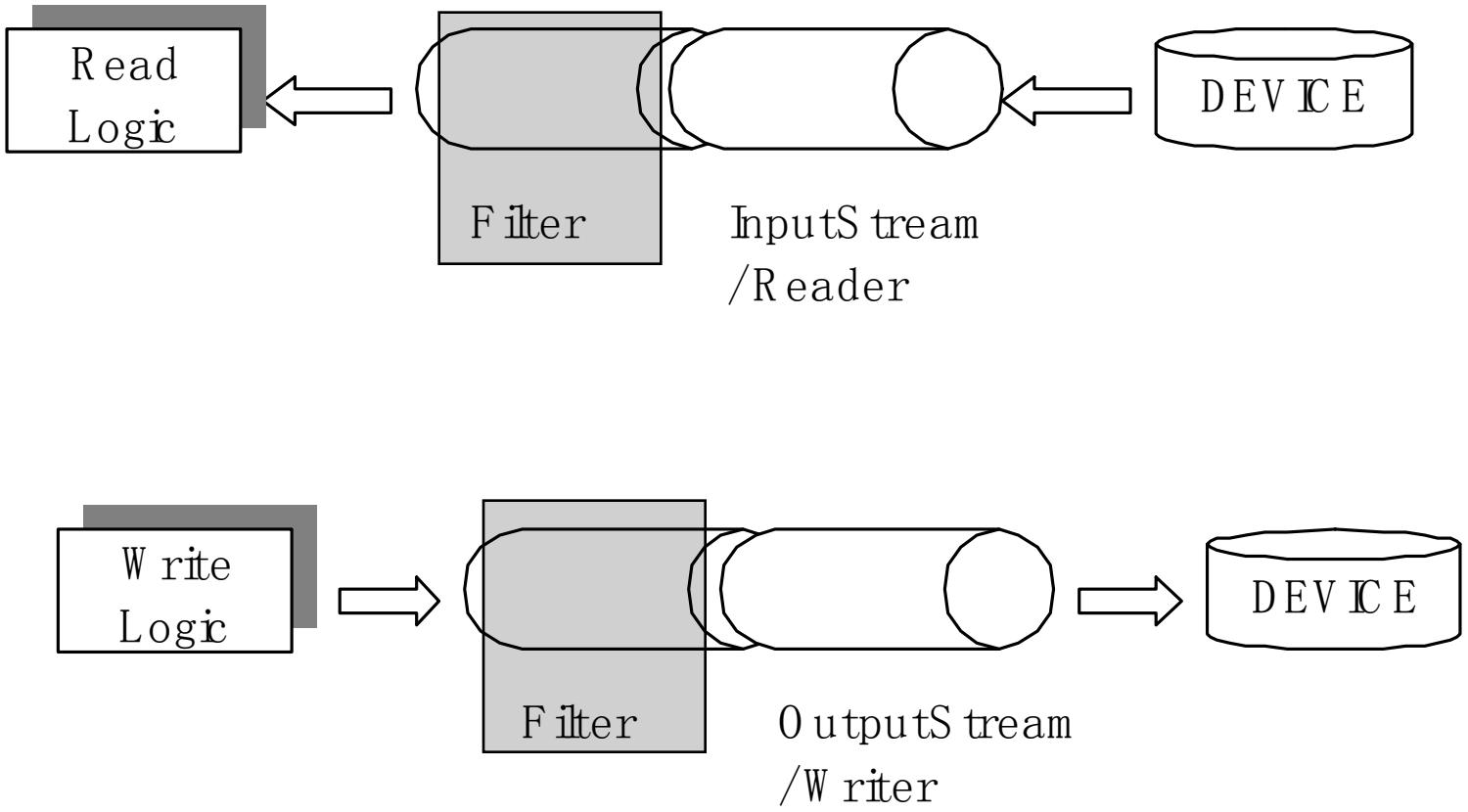
8.2 流与相关类

流（stream）是一个想象中的无限长的数据序列。

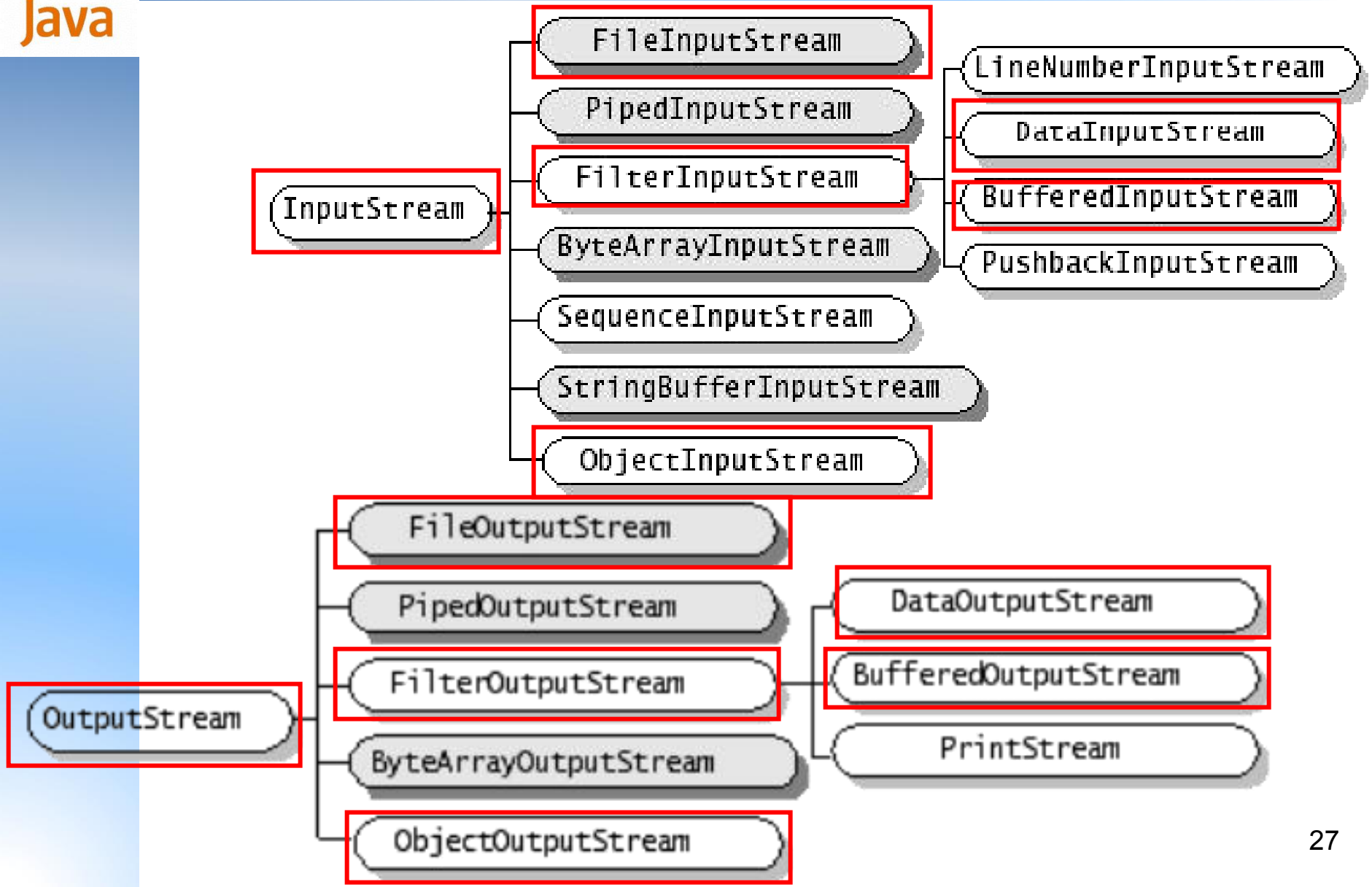
- 按数据流向分为：输入流、输出流
- 按处理数据单位分为：字节流、字符流
- 按功能分为：节点流、处理流

	字节流	字符流
输入流	InputStream	Reader
输出流	OutputStream	Writer

1. 流的概念


Read
Logic
Filter
InputStream
/Reader
DEVICE
Write
Logic
Filter
OutputStream
/Writer
DEVICE

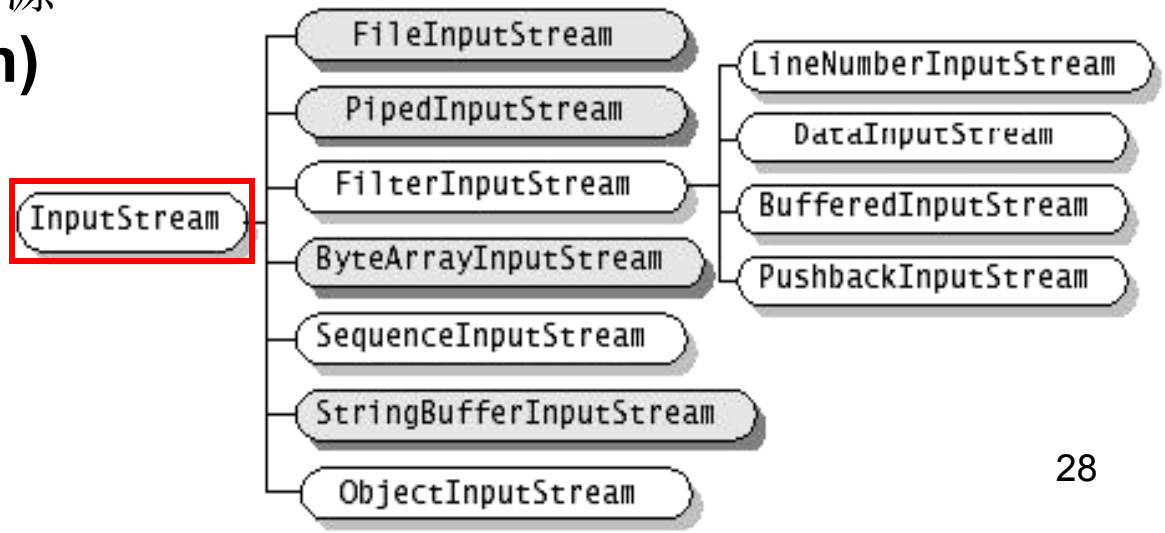
字节流


InputStream
FileInputStream
PipedInputStream
FilterInputStream
ByteArrayInputStream
SequenceInputStream
StringBufferInputStream
ObjectInputStream
LineNumberInputStream
DataInputStream
BufferedInputStream
PushbackInputStream
OutputStream
FileOutputStream
PipedOutputStream
FilterOutputStream
ByteArrayOutputStream
ObjectOutputStream
DataOutputStream
BufferedOutputStream
PrintStream

字节流

InputStream的方法 (throws IOException)

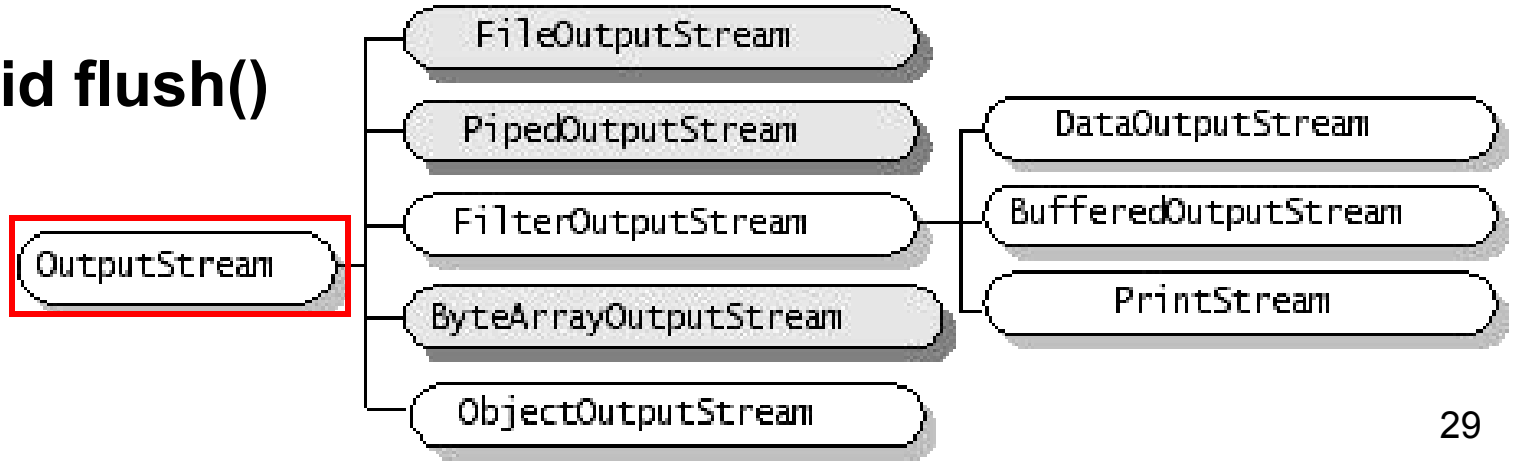
- **int read()**
  - 读取一个字节并以整数的形式返回
- **int read(byte[] buffer)**
  - 读取一系列字节并存储到一个数组buffer中，返回读取的字节数
- **int read(byte[] buffer, int offset, int length)**
  - 从offset位置存储到一个数组buffer中
- **void close()**
  - 关闭释放内存资源
- **long skip(long n)**
  - 跳过n个字节



字节流

OutputStream的方法 (throws IOException)

- void write (int b)
- void write (byte[] b)
- void write (byte[] b, int off, int len)
- void close()
- void flush()



字节流

InputStream的子类型

类	功能
ByteArray-InputStream	允许将内存的缓冲区当作 **InputStream**使用
StringBuffer-InputStream	将**String**转换成**InputStream**
File-InputStream	用于从文件中读取信息
Piped-InputStream	产生用于写入相关**PipedOutput-Stream**的数据。 实现“管道化”概念。
Sequence-InputStream	将两个或多个**InputStream**对象转换成单一**InputStream**。

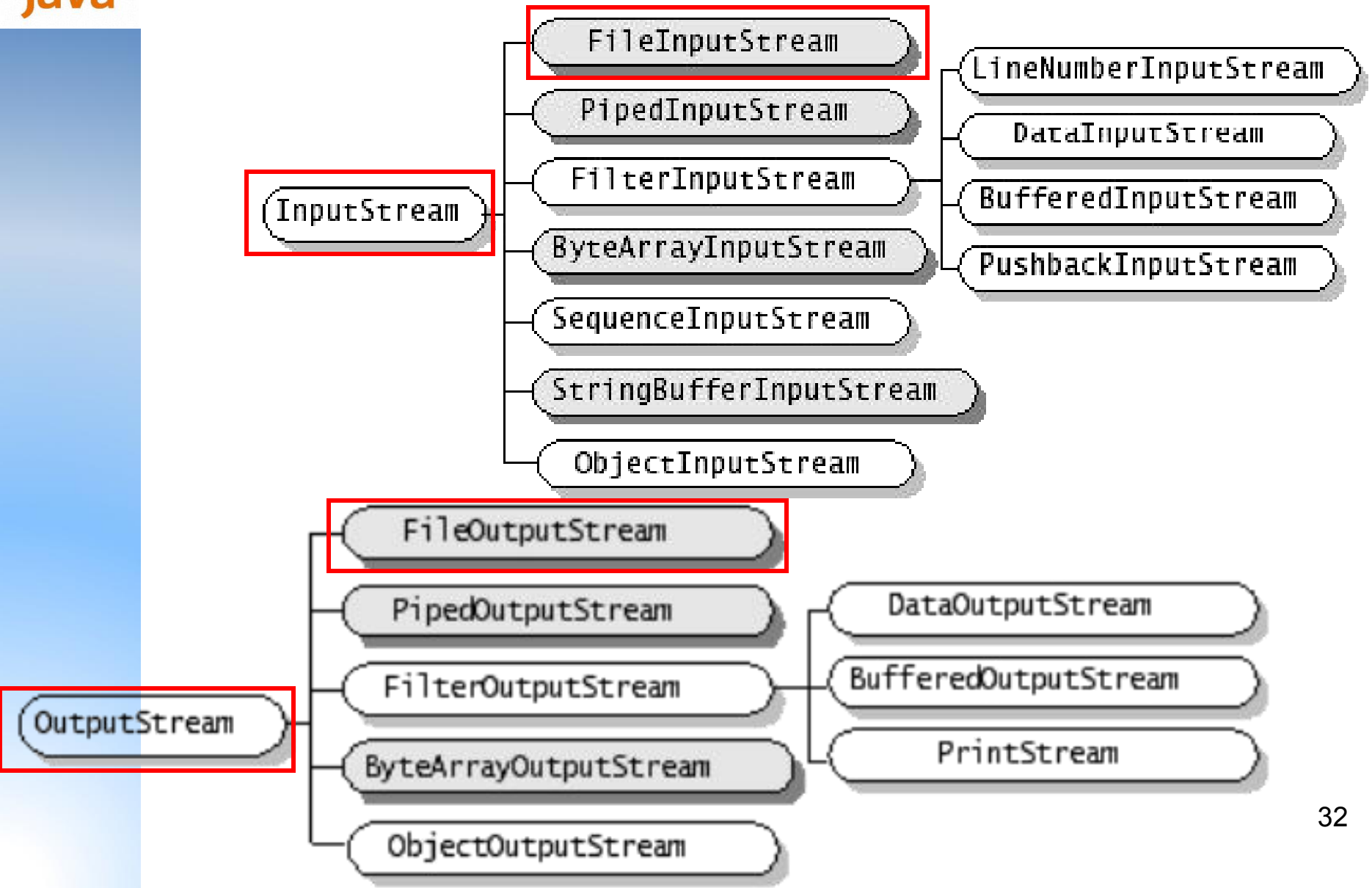
字节流

FilterInputStream的子类型

Data-InputStream	与**DataOutputStream**搭配使用，因此我们可以参照可移植方式从流读取基本数据类型 (**int**, **char**, **long**, etc.)
Buffered-InputStream	使用它可以防止每次读取时都得进行实际的读操作。代表“使用缓冲区”。
LineNumber-InputStream	跟踪输入流中的行号；可调用**getLineNumber( )**和**setLineNumber(int).**
Pushback-InputStream	具有一个字节的回退缓冲区，因此可以将读到的最后一个字符回退。

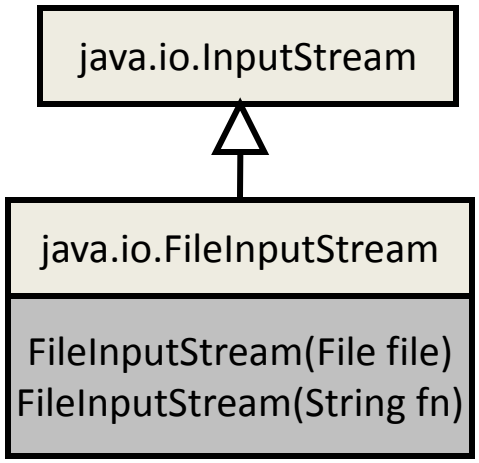
ObjectInputStream 将会在下一部分进行介绍.
OutputStream和**FilterOutputStream**的类型和**InputStream**、**FilterInputStream**类似

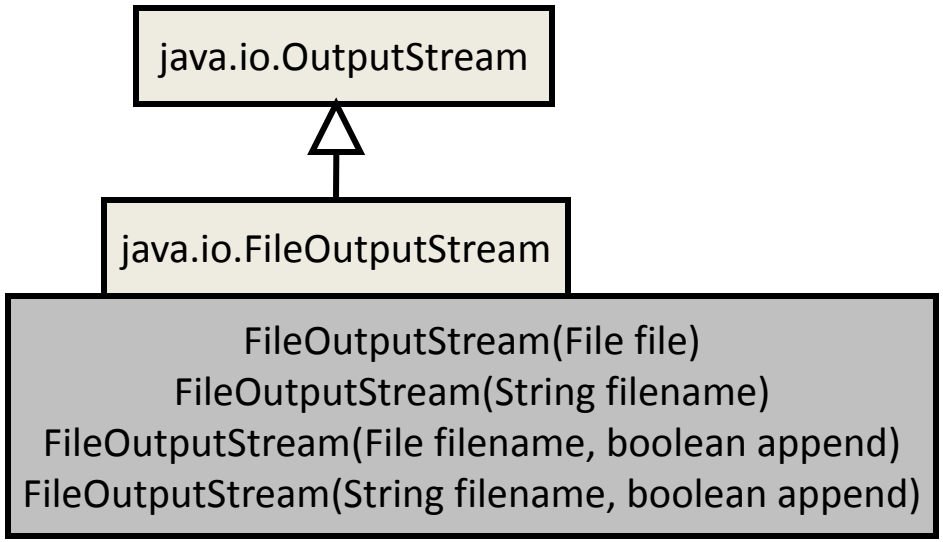
字节流


InputStream
FileInputStream
PipedInputStream
FilterInputStream
ByteArrayInputStream
SequenceInputStream
StringBufferInputStream
ObjectInputStream
LineNumberInputStream
DataInputStream
BufferedInputStream
PushbackInputStream
OutputStream
FileOutputStream
PipedOutputStream
FilterOutputStream
ByteArrayOutputStream
ObjectOutputStream
DataOutputStream
BufferedOutputStream
PrintStream

字节流

- FileInputStream类、FileOutputStream类
  - 所有方法都是从InputStream和OutputStream继承
- 构造方法





字节流

- FileInputStream类、FileOutputStream类
  - 为不存在文件创建FileInputStream对象，会发生java.io.File NotFoundException异常。
  - FileOutputStream，如果文件存在，前两个构造方法删除文件当前内容，后两个方法当append为true时为文件追加内容。
  - 几乎所有的I/O类中的方法都会抛出异常java.io.IOException，必须在方法中声明或用try-catch

字节流

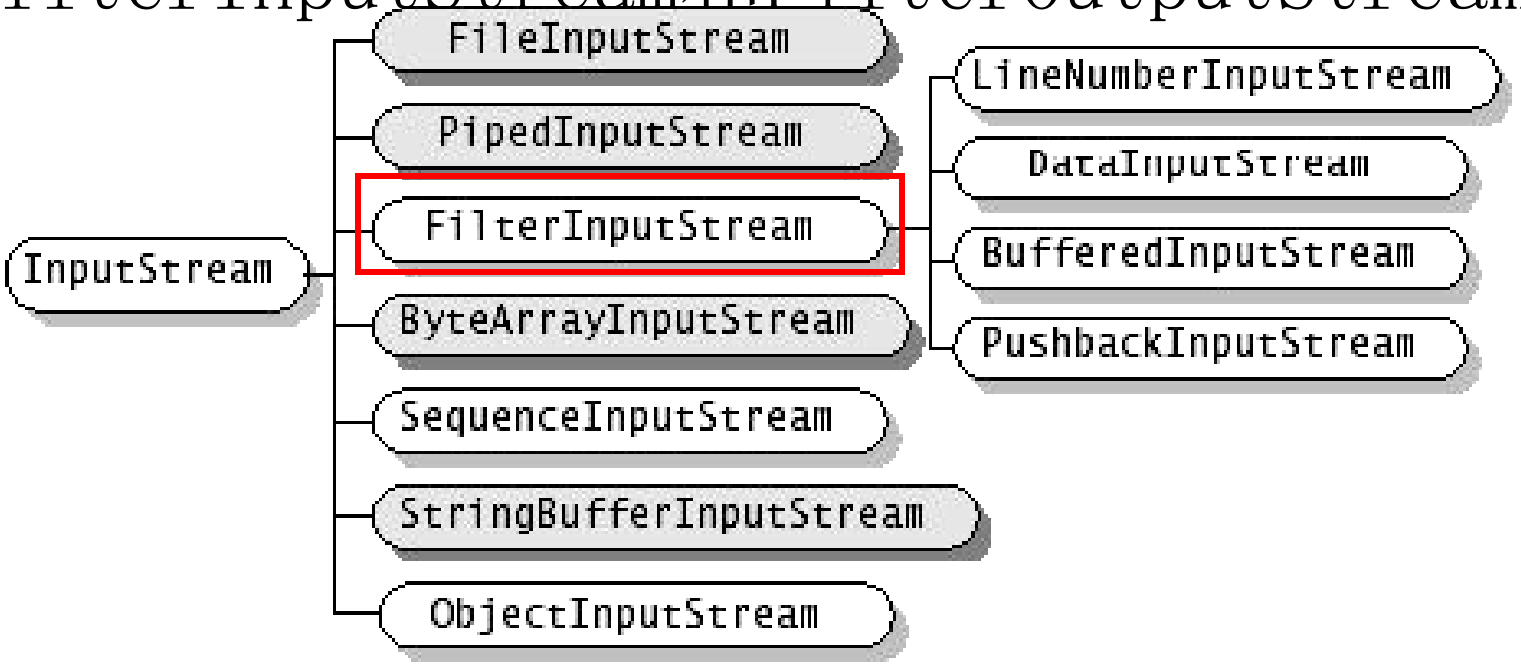
- FileInputStream类、FileOutputStream

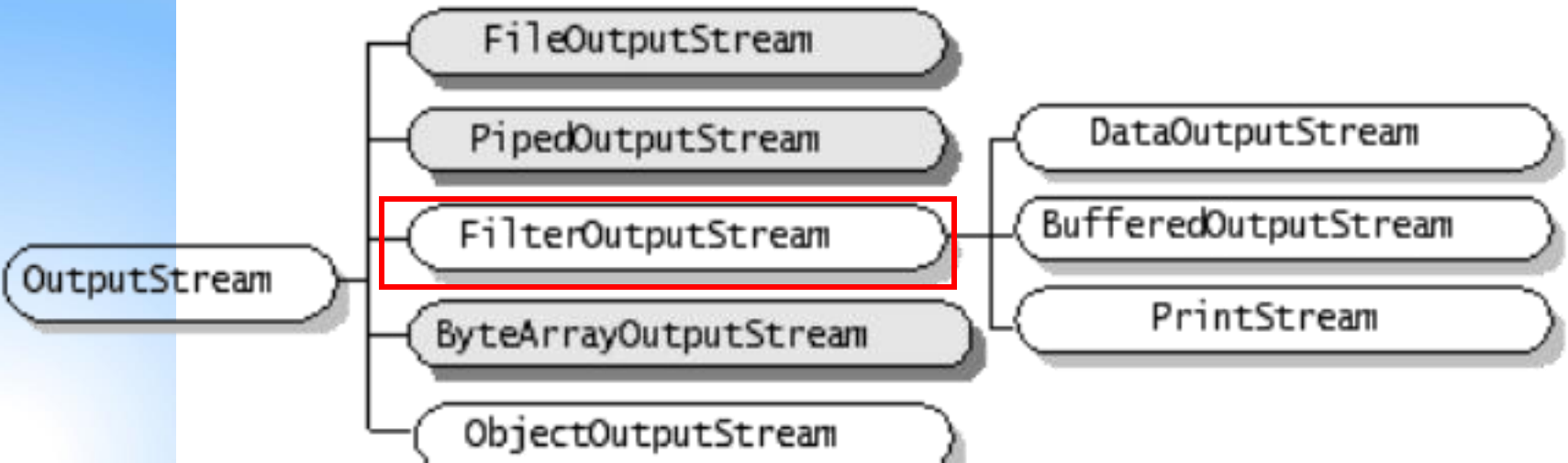
```
import java.io.*;
public class TestFileStream {
    public static void main(String[] args) throws IOException{
        FileOutputStream output = new FileOutputStream("temp.txt");
        for(int i =1; i<10; i++)
            output.write(i);
        output.close();

        FileInputStream input = new FileInputStream("temp.txt");
        int value;
        while((value = input.read()) != -1)
            System.out.print(value + " ");
        input.close();
    }
}
```

```
<terminated> TestFileStream [Ja
1 2 3 4 5 6 7 8 9
```

字节流

- FilterInputStream和FilterOutputStream

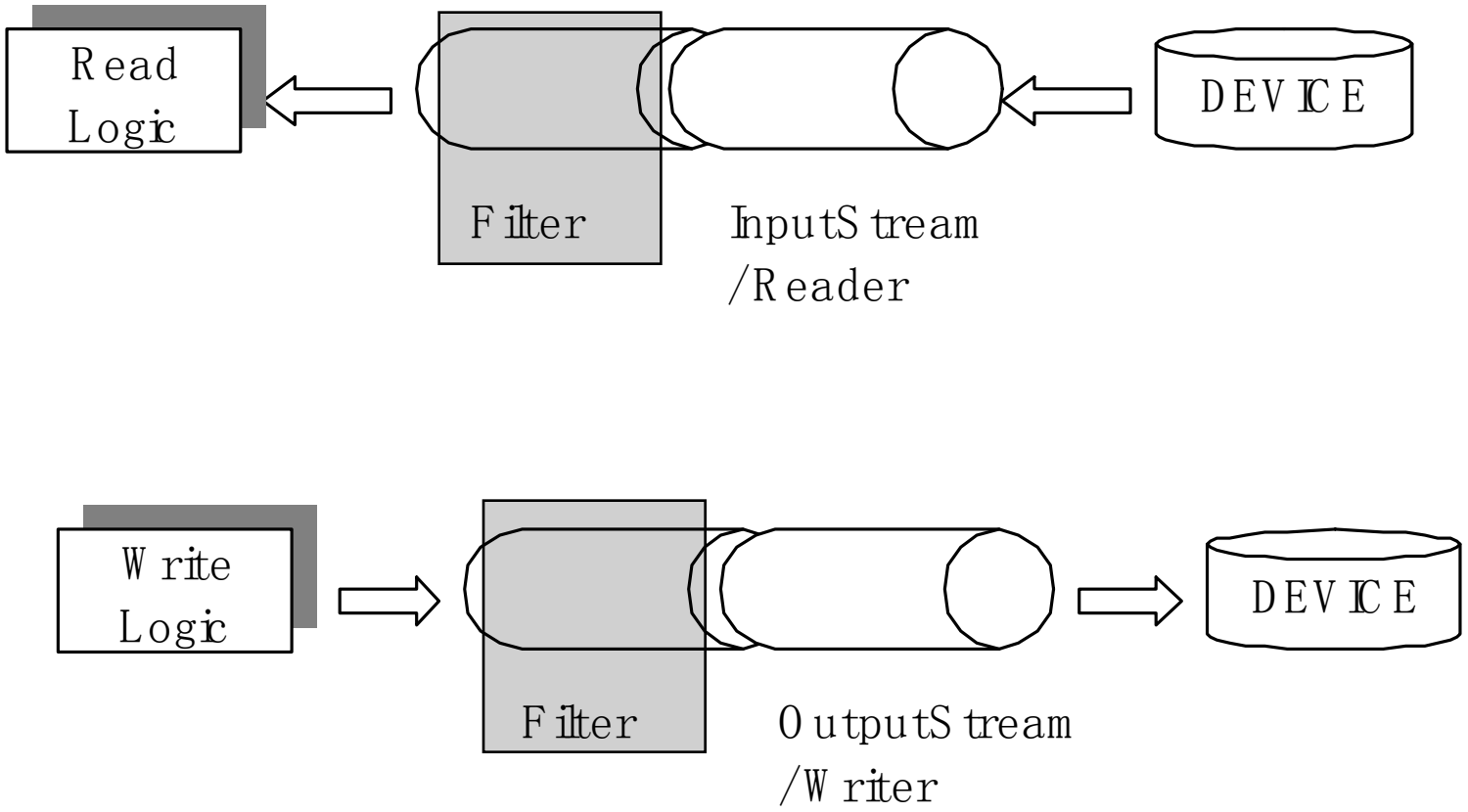




字节流

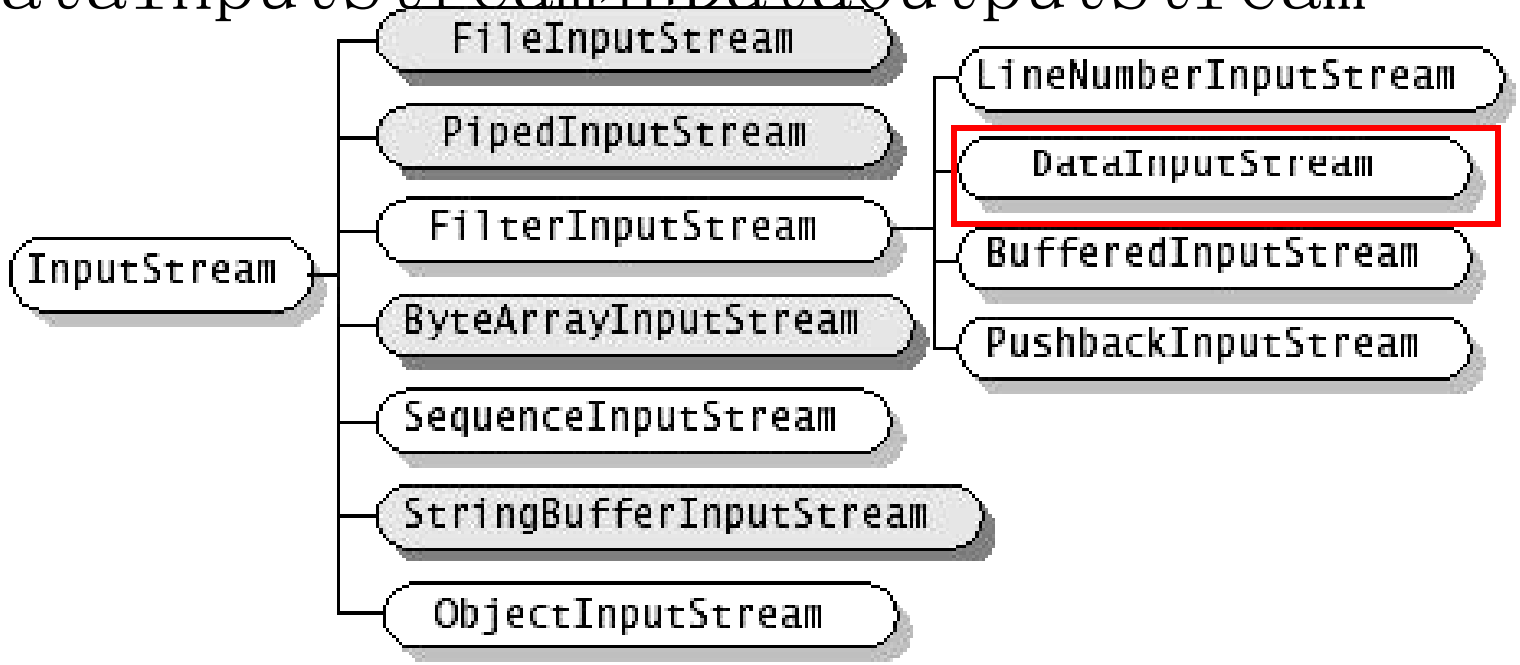
- FilterInputStream和FilterOutputStream
  - FileInputStream和FileOutputStream只能读取字节，如果要读写整数、双精度值或字符串，那么就需要过滤器类来包装输入流。
  - FilterInputStream和FilterOutputStream是过滤数据的基类，如果处理基本数值类型时，就使用DataInputStream和DataOutputStream类。

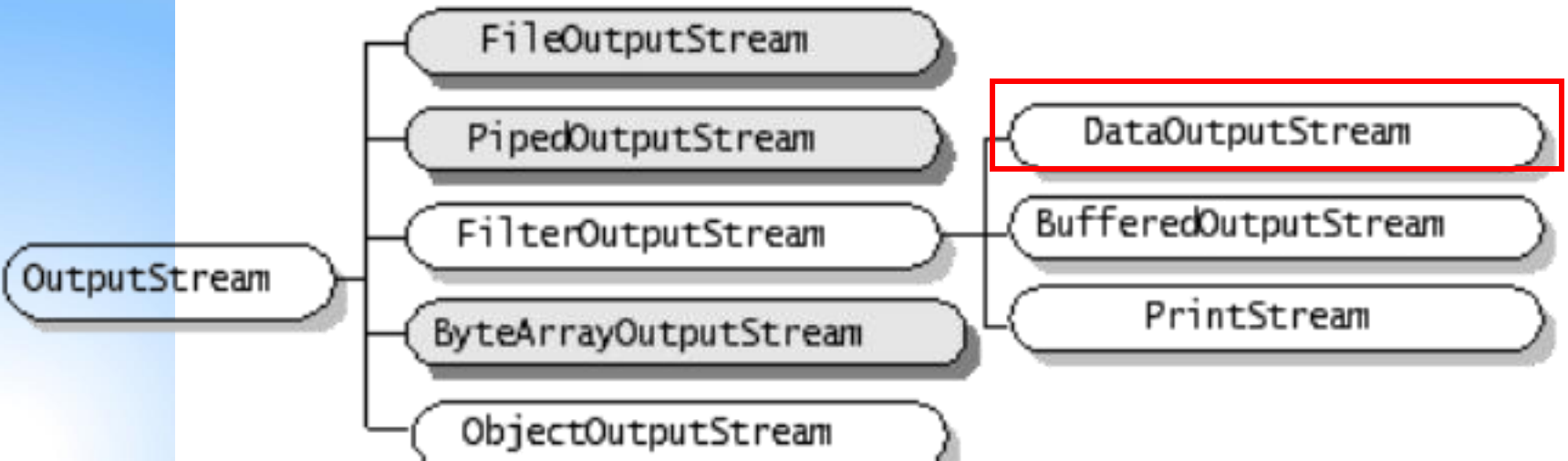
1. 流的概念


Read
Logic
Filter
InputStream
/Reader
DEVICE
Write
Logic
Filter
OutputStream
/Writer
DEVICE

字节流

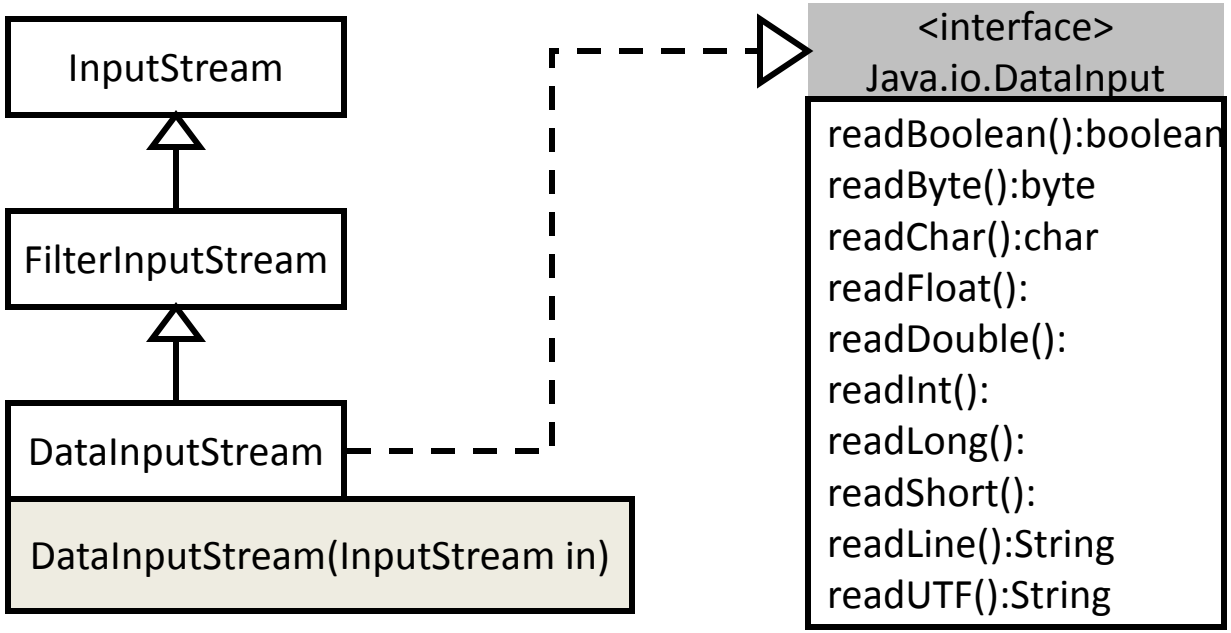
- DataInputStream和DataOutputStream





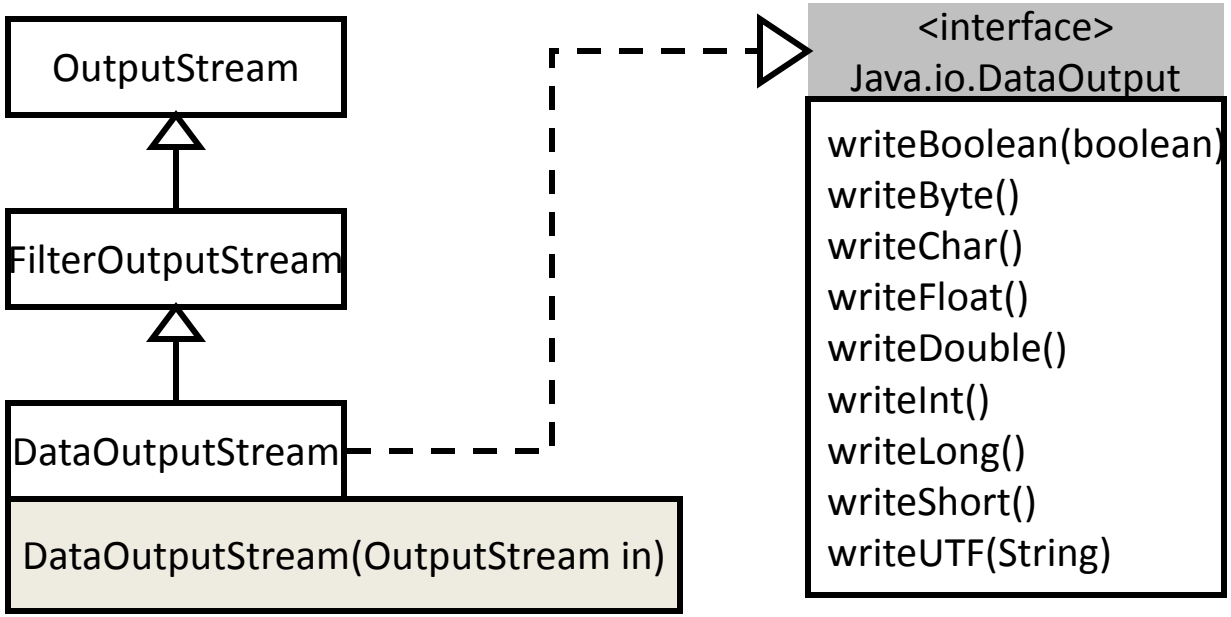
字节流

- DataInputStream和DataOutputStream



字节流

- DataInputStream和DataOutputStream



字节流

- DataInputStream和DataOutputStream
  - 用于对已经存在的输入/输出流进行**包装**，以便在原始流中过滤数据。
  - public DataInputStream(InputStream instream)
  - public DataOutputStream(OutputStream outstream)

  - DataInputStream input =

    new DataInputStream(new FileInputStream(“in.dat”))
  - DataOutputStream output =

    new DataOutputStream(new FileOutputStream(“in.dat”))

字节流

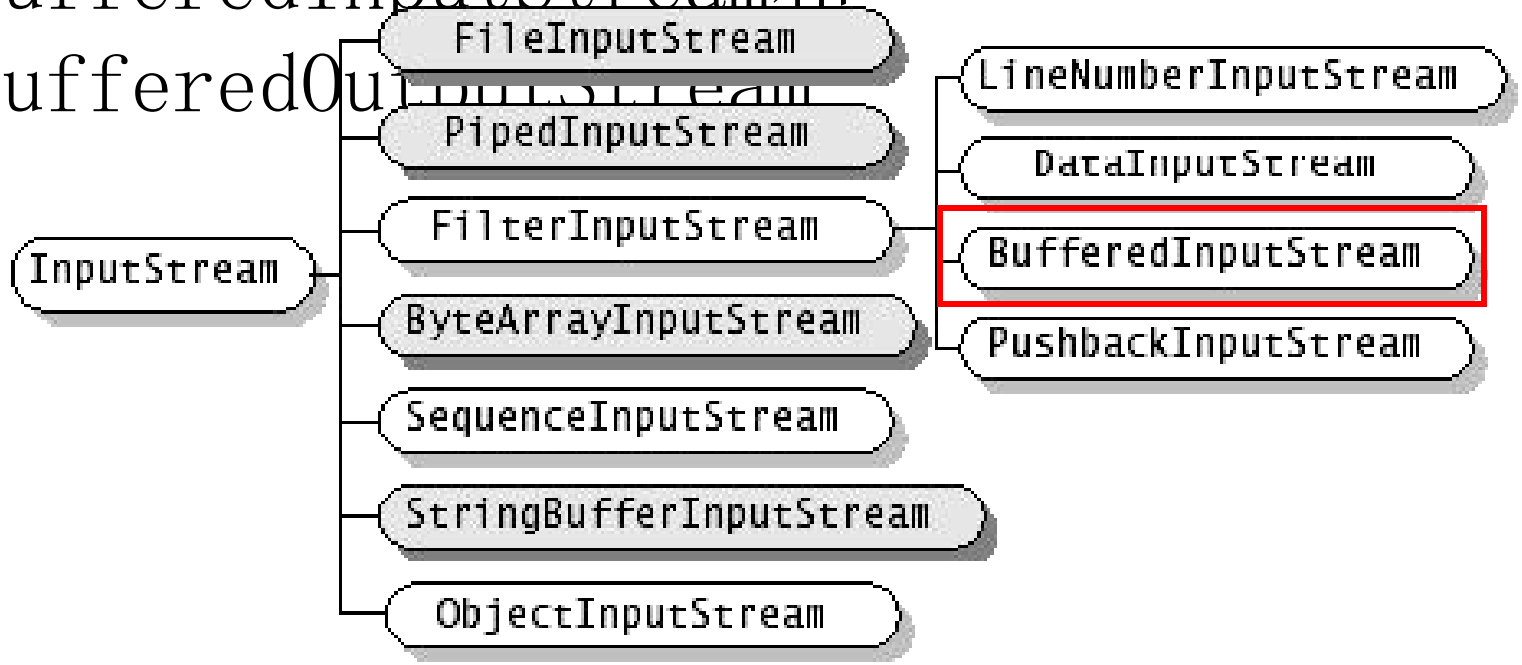
- DataInputStream和DataOutputStream

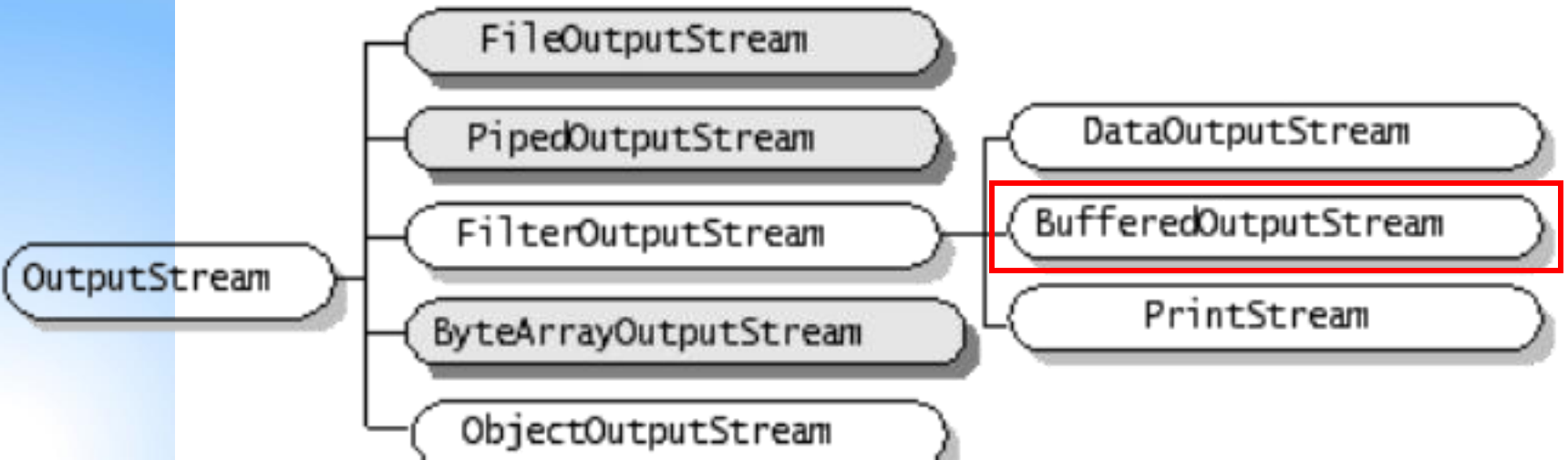
```
import java.io.*;
public class TestDataStream {
    public static void main(String[] args) throws IOException {
        DataOutputStream output = new DataOutputStream(new FileOutputStream("temp.dat"));
        output.writeUTF("John");
        output.writeDouble(85.5);
        output.writeUTF("Jim");
        output.writeDouble(90.5);
        output.writeUTF("George");
        output.writeDouble(80.7);
        output.close();

        DataInputStream input = new DataInputStream(new FileInputStream("temp.dat"));
        System.out.println(input.readUTF() + " " + input.readDouble());
        System.out.println(input.readUTF() + " " + input.readDouble());
        System.out.println(input.readUTF() + " " + input.readDouble());
        input.close();
    }
}
```

```
John 85.5
Jim 90.5
George 80.7
```

字节流

- BufferedInputStream和BufferedOutputStream



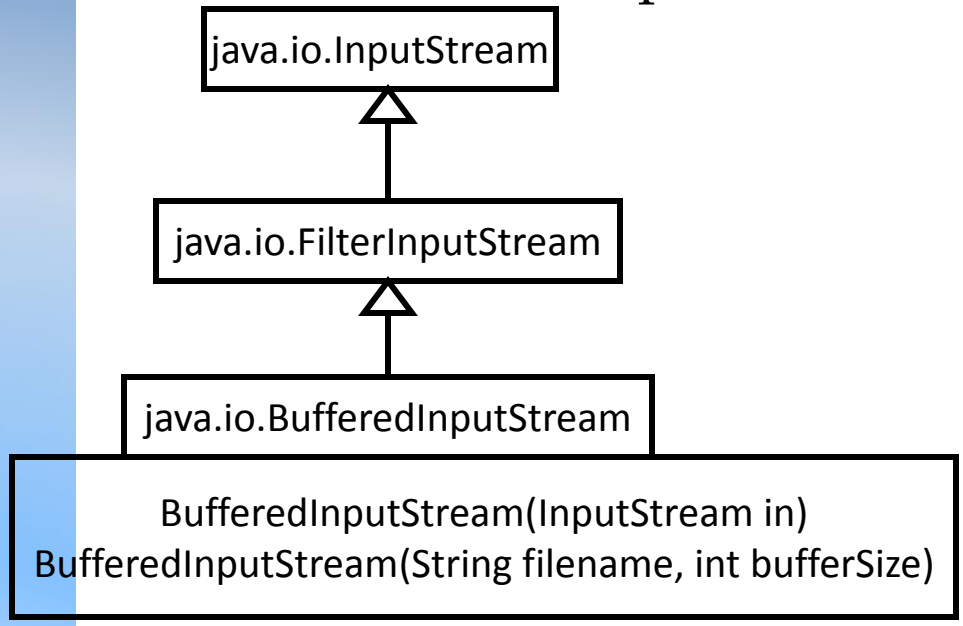


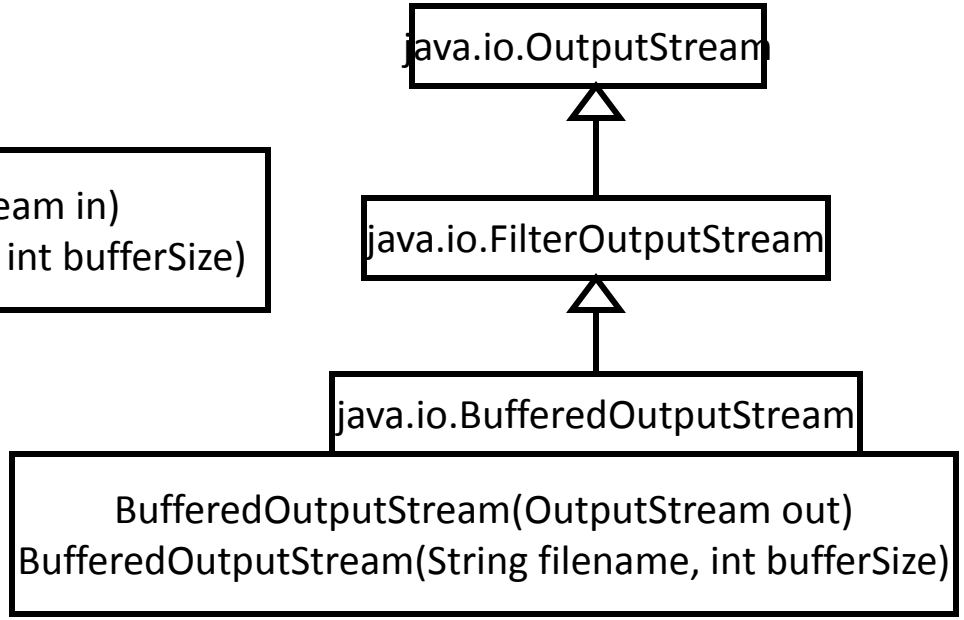
字节流

- BufferedInputStream和BufferedOutputStream
  - 减少读写次数（高速设备与低速设备之间）
  - 方法从InputStream和OutputStream继承而来
  - 没有新方法
  - 提高效率

字节流

- BufferedInputStream和BufferedOutputStream



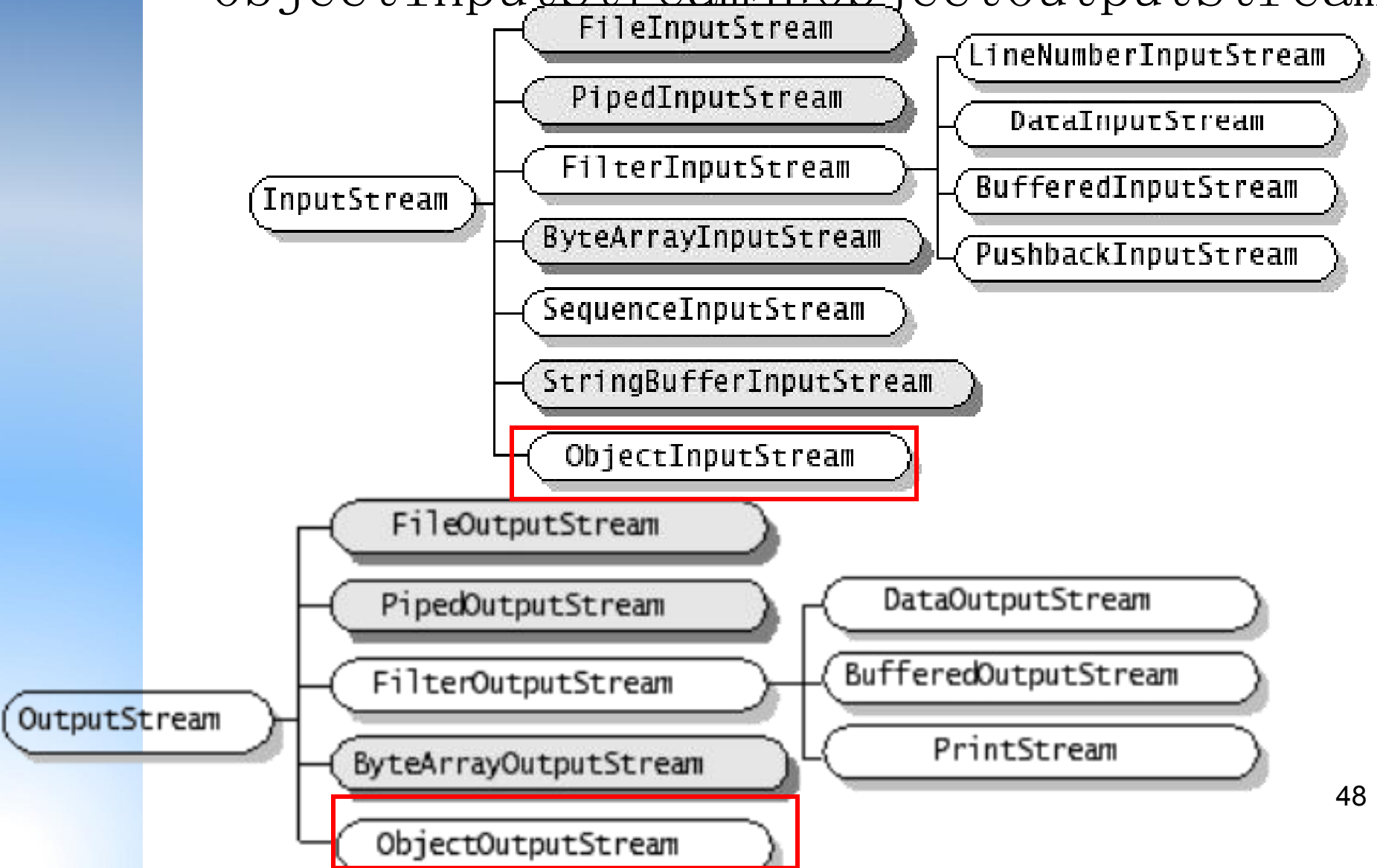


字节流

- BufferedInputStream和BufferedOutputStream
  - 缓冲区默认大小512字节
  - 当缓冲满或者flush方法调用时，缓冲流写入
  - 提高前面例子的效率
  - DataOutputStream output = new DataOutputStream(new BufferedOutputStream(new FileOutputStream(“temp.dat”)))
  - 应该使用缓冲区I/O来加速输入和输出。

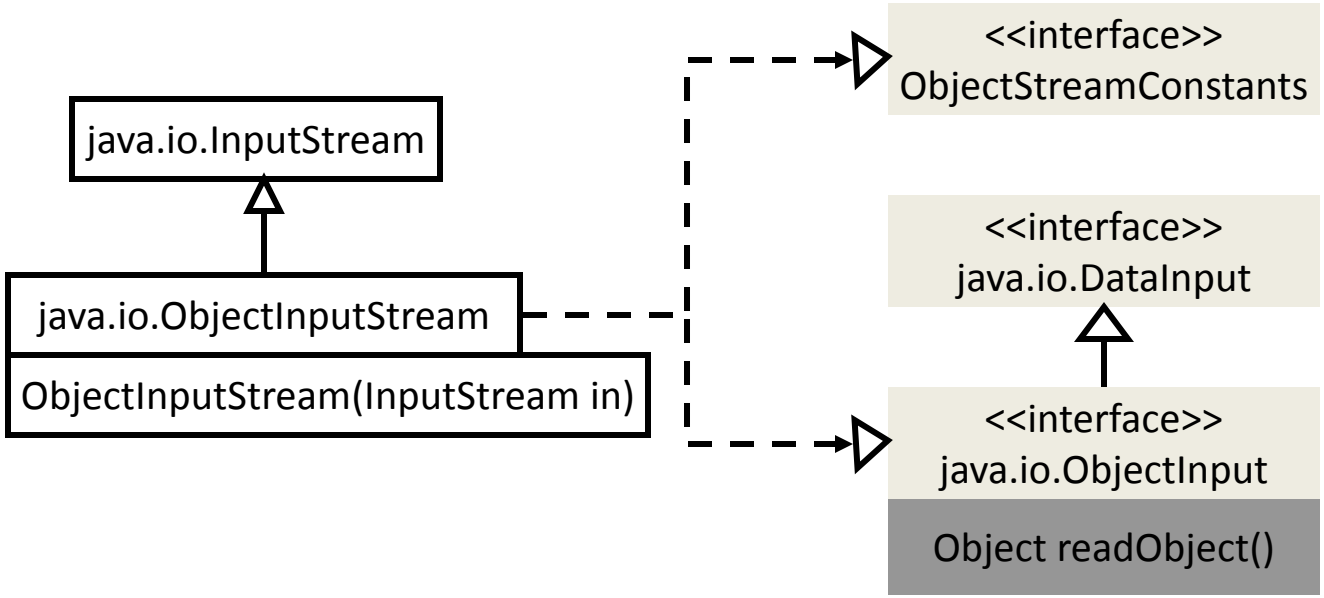
字节流

- ObjectInputStream和ObjectOutputStream



字节流

- ObjectInputStream和ObjectOutputStream



字节流

- ObjectInputStream和ObjectOutputStream
  - DataInputStream能处理的ObjectInputStream都能处理
  - 可以包装InputStream和OutputStream

```
public OjbectInputStream(InputStream in)
Public OjbectOutputStream(OutputStream out)
```

字节流

- ObjectInputStream和ObjectOutputStream

```
import java.io.*;
public class TestObjectOutputStream {
    public static void main(String[] args) throws IOException{
        ObjectOutputStream output = new ObjectOutputStream(
                new BufferedOutputStream(new FileOutputStream("object.dat")));
        output.writeUTF("John");
        output.writeDouble(85.5);
        output.writeObject(new java.util.Date());
        output.close();
    }
}
```

字节流

- ObjectInputStream和ObjectOutputStream

```
import java.io.*;
public class TestObjectInputStream {
    public static void main(String[] args)
    throws ClassNotFoundException, IOException {
        ObjectInputStream input = new ObjectInputStream(
                new BufferedInputStream(new FileInputStream("object.dat")));
        String name = input.readUTF();
        double score = input.readDouble();
        java.util.Date date = (java.util.Date) (input.readObject());
        System.out.println(name + " " + score + " " + date);
        input.close();
    }
}
```

```
John 85.5 Mon Sep 03 10:34:54 CST 2012
```

字节流

- ObjectInputStream和ObjectOutputStream
  - 从ObjectInputStream读回对象时，必须与写入时的类型顺序一致
  - 要使用读回的对象，必须使用java安全类型转换

字节流

- 对象流的可序列化接口Serializable
  - 并不是每个对象都可以写到输出流，可以写到输出流中的对象称为可序列化的
  - 可序列化对象实现了java.io.Serializable接口
  - Serializable接口是一种标记性接口，没有方法
  - 实现这个接口可以启动java的序列化机制，自动完成
  - Java API中许多类都实现了Serializable接口。java.util.Date以及所有的Swing GUI组件

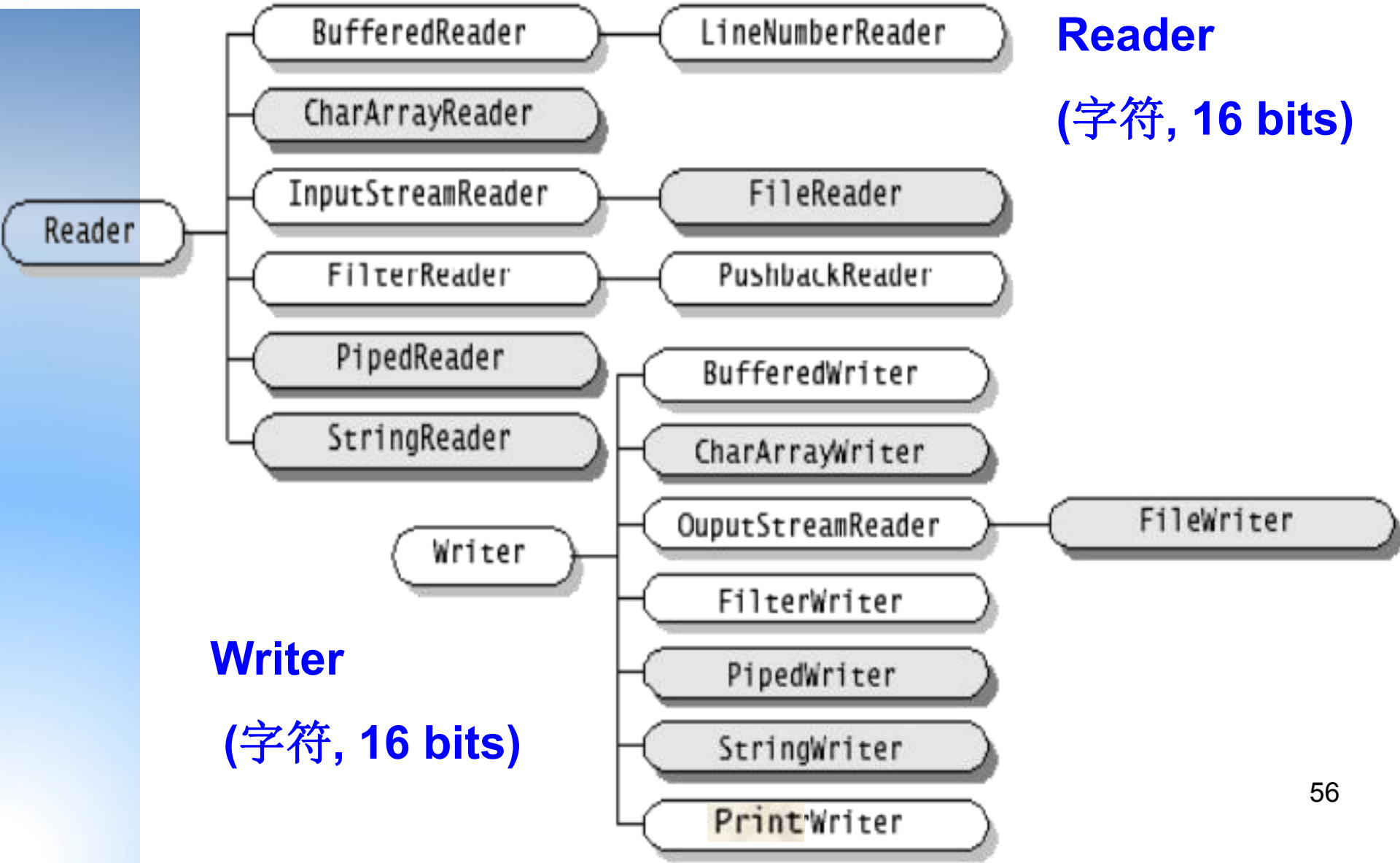
字节流

- 序列化数组

```
import java.io.*;
public class TestObjectStreamForArray {
    public static void main(String[] args) throws ClassNotFoundException, IOException{
        int[] numbers = {1,2,3,4,5};
        String[] strings = {"John","Jim","Jake"};
        ObjectOutputStream output = new ObjectOutputStream(
                new FileOutputStream("array.dat",true));
        output.writeObject(numbers);
        output.writeObject(strings);
        output.close();

        ObjectInputStream input = new ObjectInputStream(
                new FileInputStream("array.dat"));
        int[] newnumbers = (int[])(input.readObject());
        String[] newstrings = (String[])(input.readObject());
        for(int i=0;i<newnumbers.length;i++)
            System.out.print(newnumbers[i]+" ");
        System.out.println();
        for(int i=0;i<newstrings.length;i++)
            System.out.print(newstrings[i]+" ");
    }
}
```

```
1 2 3 4 5
John Jim Jake
```

3. 字符流及其方法



Reader

(字符, 16 bits)

Writer

(字符, 16 bits)

字节流与字符流类型比较

来源与去处:Java 1.0类	相应的Java 1.1类
InputStream	Reader 适配器: InputStreamReader
OutputStream	Writer 适配器: OutputStreamWriter
FileInputStream	FileReader
FileOutputStream	FileWriter
StringBufferInputStream(已弃用)	StringReader
(无相应的类)	StringWriter
ByteArrayInputStream	CharArrayReader
ByteArrayOutputStream	CharArrayWriter
PipedInputStream	PipedReader
PipedOutputStream	PipedWriter

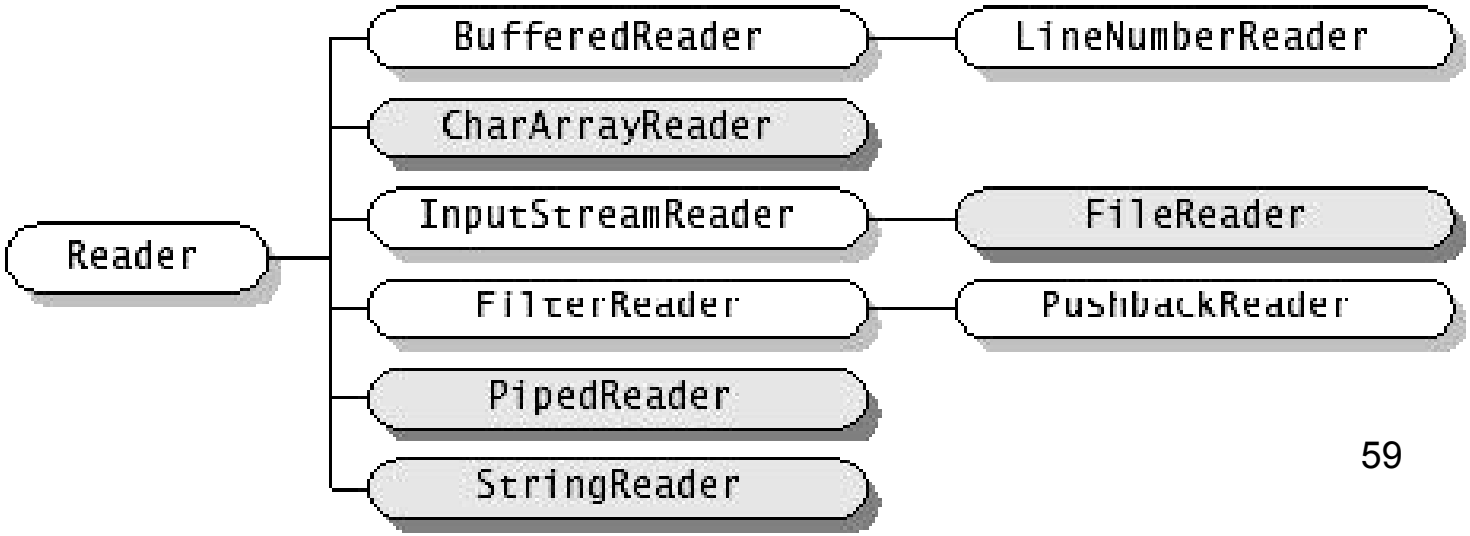
字节流与字符流类型比较

过滤器:Java 1.0类	相应的Java 1.1类
FilterInputStream	FilterReader
FilterOutputStream	FilterWriter (抽象类，没有子类)
BufferedInputStream	BufferedReader (也有readLine( ))
BufferedOutputStream	BufferedWriter
DataInputStream	使用DataInputStream (当你需要使用readLine( ), 应该使用BufferedReader)
PrintStream	PrintWriter
LineNumberInputStream	LineNumberReader
StreamTokenizer	StreamTokenizer (使用接受 Reader 的构造器)
PushBackInputStream	PushBackReader

Reader的方法

Reader的方法 (throws IOException)

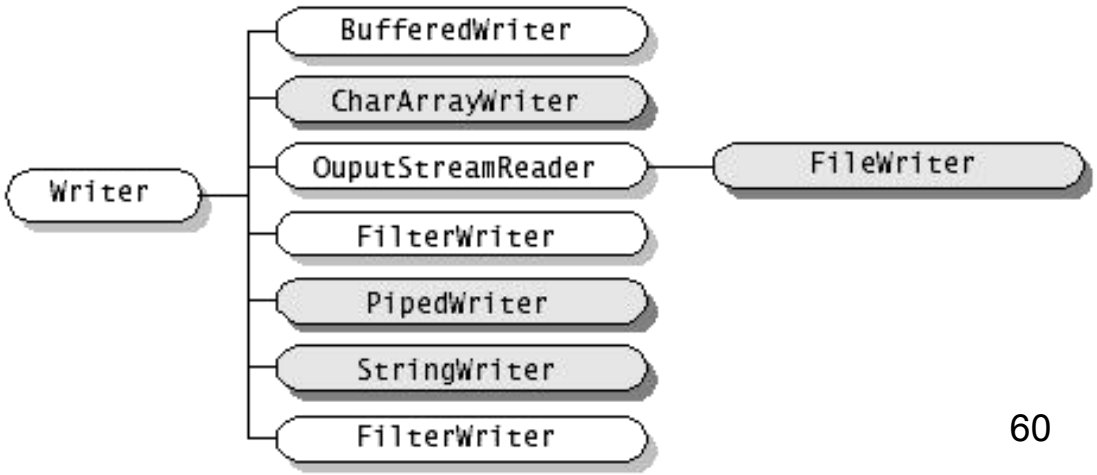
- **int read()**
- **int read(char[] cbuf)**
- **int read(char[] cbuff, int offset, int length)**
- **void close()**
- **long skip(long n)**



Writer的方法

Writer的方法 (throws IOException**)**

- **void write (int c)**
- **void write (char[] cbuf)**
- **void write (char[] cbuff int offset, int length)**
- **void write (String string)**
- **void write (String string, int offset, int length)**
- **void close()**
- **void flush()**



8.3 标准I/O流

标准I/O (与文件File)

➢三个标准I/O流

– *System.in* ： InputStream类的对象实例in作为标准输入流对象，对应于键盘输入

– *System.out*：PrintStream类的对象实例out作为标准输出流对象，对应于显示器输出

– *System.err*：PrintStream类的对象实例err作为标准错误输出流对象，对应于显示器输出

示例：标准I/O操作实现回音

```
import java.io.*;
public class Echo {
    public static void main(String[] args)
    throws IOException {
        BufferedReader stdin = new BufferedReader(
            new InputStreamReader(System.in));
        String s;
        while((s = stdin.readLine()) != null && s.length()!= 0)
            System.out.println(s);
        // An empty line or Ctrl-Z terminates the program
    }
}
```

示例：标准I/O重定向实现文件复制

```
import java.io.*;
public class Redirecting {
    public static void main(String[] args)
      throws IOException {
        PrintStream consoleout = System.out;
        InputStream consolein = System.in
        BufferedInputStream in = new BufferedInputStream(
            new FileInputStream("Redirecting.java"));
        PrintStream out = new PrintStream(
            new BufferedOutputStream(
                new FileOutputStream("test.out")));
```

示例：标准I/O重定向实现文件复制

```
        System.setIn(in);
        System.setOut(out);
        System.setErr(out);
        BufferedReader br = new BufferedReader(
                new InputStreamReader(System.in));
        String s;
        while((s = br.readLine()) != null)
                System.out.println(s);
        out.close(); // Remember this!
        System.setOut(consoleout);
        in.close();
        System.setIn(consloein)
  }
}
```

8.4 随机访问文件

RandomAccessFile

- 适用于由大小已知的记录组成的文件，可以使用seek()将记录从一处转移到另一处
- 不是继承自InputStream和OutputStream，而是像DataInputStream和DataOutputStream一样实现了DataInput和DataOutput接口
- 类似于把DataInputStream和DataOutputStream结合在一起使用
- 只有RandomAccessFile类在文件上支持搜寻方法

8.4 随机访问文件

构造器和方法：

- **RandomAccessFile(File file, String mode)**
- **RandomAccessFile(String name, String mode)**

- **void seek(long pos)**

// 用于文件内移至新位置

- **long getFilePointer()**

// 得到当前的位置

- **long length()**

// 判断文件的大小

示例：随机访问文件

```
import java.io.*;
public class UsingRandomAccessFile {
  static String file = "rtest.dat";

  static void display() throws IOException {
   RandomAccessFile rf = new RandomAccessFile(file, "r");
   for(int i = 0; i < 7; i++)
      System.out.println("Value " + i + ": " + rf.readDouble());
   System.out.println(rf.readUTF());
   rf.close();
 }
```

```
public static void main(String[] args) throws IOException
{
  RandomAccessFile rf = new RandomAccessFile(file, "rw");
    for(int i = 0; i < 7; i++)
        rf.writeDouble(i*1.414);
    rf.writeUTF("The end of the file");
    rf.close();
    display();
    rf = new RandomAccessFile(file, "rw");
    rf.seek(5*8);
    System.out.println(rf.length());
    System.out.println(rf.getFilePointer());
    rf.writeDouble(47.0001);
    rf.close();  display(); }}
```

```
Value 0: 0.0
Value 1: 1.414
Value 2: 2.828
Value 3: 4.242
Value 4: 5.656
Value 5: 7.069999999999999
Value 6: 8.484
The end of the file
77
40
Value 0: 0.0
Value 1: 1.414
Value 2: 2.828
Value 3: 4.242
Value 4: 5.656
Value 5: 47.0001
Value 6: 8.484
The end of the file
```

压缩

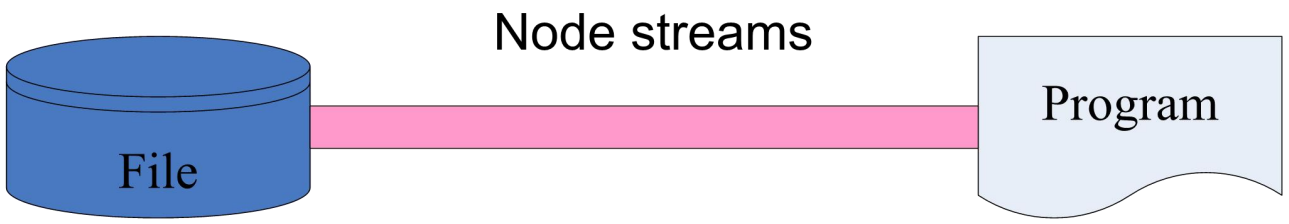
- ZipOutputStream 压缩数据，生成Zip格式文件
- GZIPOutputStream 生成GZip格式文件
- ZipIutputStream 解压缩已经生成的ZIP文件
- GZIPIutputStream 解压缩已经生成的GZIP文件
- 继承于InputStream和OutputStream

4. IO流

- 节点流
- 处理流
- 缓冲流
- 打印流
- 数据流
- 对象流

（1）节点流

- 节点流
  - 包含从特殊位置读、写的基本功能
  - 节点流的包括文件，内容和管道

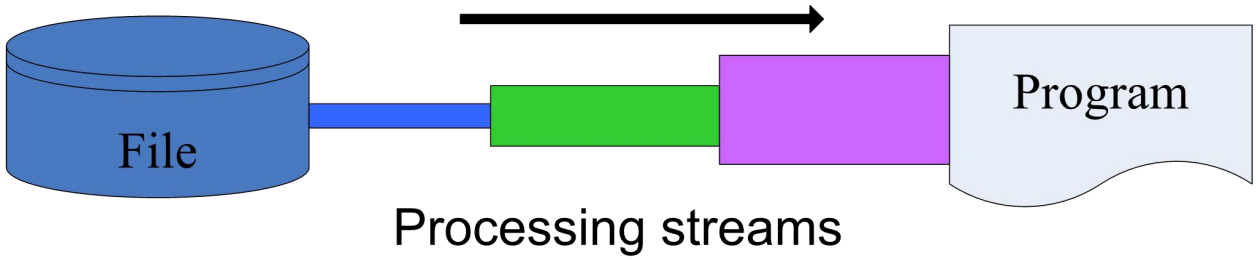


（1）节点流

类型	字节流	字符流
文件	FileInputStream FileOutputStream	FileReader FileWriter
内存数组	ByteArrayInputStream ByteArrayOutputStream	CharArrayReader CharArrayWriter
内存字符串	------- -------	StringReader StringWriter
管道	PipedInputStream PipedOutPutStream	PipedReader PipedWriter

（2）处理流

- 处理流
  - 结合在其他流之上
  - 修改或管理流中数据，并提供额外的功能



（2）处理流

字符	字节流	字符流
缓冲	BufferedInputStream BufferedOutputStream	BufferedReader BufferedWriter
过滤	FilterInputStream FilterOutputStream	FilterReader FilterWriter
字节与字符间转换	------- -------	InputStreamReader OutputStreamWriter
数据转换	DataInputStream DataOutputStream	------- -------
对象序列化	ObjectInputStream ObjectOutputStream	------- -------
打印	PrintStream	PrintWriter

（3）缓冲流

- 没有缓冲的I/O，直接读写效率低，对硬盘损害大

- 带缓冲的输入流从一个类似于缓冲区的内存区域中读取数据，当缓冲区为空时，调用基本的输入API；同样地，缓冲输出流向缓冲区中写数据，在缓冲区已满时调用基本的输出API

- 嵌套在其他节点流之上，对读写数据提供缓冲功能，提高了读写的效率，增加了一些新的方法

（3）缓冲流

- BufferedReader(Reader in)
- BufferedReader (Reader in, int sz)
- BufferedWriter(Writer out)
- BufferedWriter(Writer out, int sz)
- BufferedInputStream(InputStream in)
- BufferedInputStream(InputStream in, int size)
- BufferedOutputstream (Outputstream out)
- BufferedOutputstream(Outputstream out, int size)

(3) 缓冲流

- **void mark()**

//标记流中的当前位置.

- **void reset()**

//尝试将该流重新定位到最近标记的点.

- **void readLine()**

// 仅适用于BufferedRead，读文本中的一行

- **void newLine()**

//仅适用于BufferedWriter，写入一个行分隔符

- **void flush()**

// 刷新流

（4）打印流

- **PrintStream** (字节)
- **PrintWriter** (字符)

- 为其他输出流添加了功能，使它们能够方便地打印各种数据值表示形式。分别针对字节和字符，提供了重载的print和println方法用于多种数据类型的输出

- 不抛出**IOException**
- 自动的**Flush**

（4）打印流

- PrintWriter(Writer out)
- PrintWriter(File file)
- PrintWriter(OutputStream out)
- PrintWriter(String fileName)
- PrintStream(OutputStream out)
- PrintStream(File file)
- PrintStream(String fileName)

（5）数据流

数据流 (DataInputStream/DataOutputStream)

- 数据流提供了可以存取与机器无关的**java**原始类型的数据的方法，支持原始数据类型的输入输出，包括：**boolean, char, byte, short, int, long, float** 和 **double**类型
- 所有的数据流分别继承自**InputStream**和**OutputStream**,实现了**DataInput**和**DateOutput**接口
- 需要在**InputStream**和**OutputStream**类型的流上，也就是字节流之上进行构造
- 构造器

- DataInputStream (InputStream in)
- DataOutputStream (OutputStream out)

示例：数据流操作

```
import java.io.*;
public class TestDataStream {
    public static void main(String[] args) {
        ByteArrayOutputStream baos =
                        new ByteArrayOutputStream();
        DataOutputStream dos =
                        new DataOutputStream(baos);
        try {
            dos.writeDouble(Math.random());
            dos.writeBoolean(true);
```

示例：数据流操作

```
        ByteArrayInputStream bais =
                new ByteArrayInputStream(baos.toByteArray());
        System.out.println(bais.available());
        DataInputStream dis = new DataInputStream(bais);
        System.out.println(dis.readDouble());
        System.out.println(dis.readBoolean());
        dos.close();
        dis.close();
        } catch (IOException e) {
           e.printStackTrace();
    }
  }
}
```

```
9
0.9220506705720964
true
```

（6）对象流

- **对象流支持Object的输入输出**
  - 像数据流一样支持对象的输入输出
  - 对象需要是可序列化的类型

- **ObjectInputStream和ObjectOutputStream**
  - 这些类实现了DataInput 和 DataOutput的子接口 ObjectInput 和 ObjectOutput 接口
  - 一个对象流可以包含基本类型和引用类型数据的混合

示例：对象流操作

```
import java.io.*;
import java.util.*;
public class Logon implements Serializable {
      private Date date = new Date();
      private String username;
      private String password;
      public Logon(String name, String pwd) {
                  username = name;
                  password = pwd;
      }
      public String toString() {
         return "logon info: \n   username: " + username +
         "\n   date: " + date + "\n   password: " + password;
  }
```

示例：对象流操作

```
public static void main(String[] args) throws Exception {
    Logon a = new Logon("Hulk", "myLittlePony");
    System.out.println("logon a = " + a);
    ObjectOutputStream o = new ObjectOutputStream(
      new FileOutputStream("Logon.out"));
    o.writeObject(a);
    o.close();
    ObjectInputStream in = new ObjectInputStream(
      new FileInputStream("Logon.out"));
    System.out.println("Recovering object at " + new Date());
    a = (Logon)in.readObject();
    System.out.println("logon a = " + a);
  }
}
```

```
logon a = logon info:
   username: Hulk
   date: Fri Aug 31 18:11:01 CST 2012
   password: myLittlePony
Recovering object at Fri Aug 31 18:11:01 CST 2012
logon a = logon info:
   username: Hulk
   date: Fri Aug 31 18:11:01 CST 2012
   password: myLittlePony
```

Scanner

- Java5 添加了java.util.Scanner
- 使用正则表达式,正则表达式通常被用来检索、替换那些符合某个模式(规则)的文本。
- public boolean hasNext(Pattern pattern)
- public boolean hasNextInt()
- public String next();
- public int nextInt();

Scanner

```
import java.util.Scanner;
public class ScannerDemo {
    public static void main(String[] args) {
        Scanner scan = new Scanner(System.in);
        // 从键盘接收数据
        // next方式接收字符串
        System.out.println("next方式接收：");
        // 判断是否还有输入
        if (scan.hasNext()) {
            String str1 = scan.next();
            System.out.println("输入的数据为：" + str1);
        }
        scan.close();
    }
}
```

```
next方式接收：
java scanner
输入的数据为：java
```

Scanner

```
import java.util.Scanner;
public class ScannerDemo {
    public static void main(String[] args) {
        Scanner scan = new Scanner(System.in);
        // 从键盘接收数据
        // nextLine方式接收字符串
        System.out.println("nextLine方式接收：");
        // 判断是否还有输入
        if (scan.hasNextLine()) {
            String str2 = scan.nextLine();
            System.out.println("输入的数据为：" + str2);
        }
        scan.close();
    }
}
```

```
nextLine方式接收：
java scanner
输入的数据为：java scanner
```

Scanner

```
import java.util.Scanner;
public class ScannerDemo {
	public static void main(String[] args) {
		Scanner scan = new Scanner(System.in);
		// 从键盘接收数据
		int i = 0;
		System.out.print("输入整数：");
		if (scan.hasNextInt()) {// 判断输入的是否是整数
			i = scan.nextInt();// 接收整数
			System.out.println("整数数据：" + i);
		}
}}
```

输入整数：12
整数数据：12

Scanner

```
public static void main(String[] args)  {
Scanner s = new Scanner("123 asdf sd 45 789 sdf asdfl,sdf.sdfl,asdf    .....asdfkl    las");
            //s.useDelimiter(" |,|\\.");
            while (s.hasNext()) {
                  System.out.println(s.next());
            }
      }
```

```
123
asdf
sd
45
789
sdf
asdfl,sdf.sdfl,asdf
.....asdfkl
las
```

```
123
asdf
sd
45
789
sdf
asdfl
sdf
sdfl
asdf

asdfkl

las
```

本章小结

- 流与相关类
  - InputStream/OutputStream
  - Reader/Writer
- 标准I／O流
  - System.in
  - System.out
  - System.err
- 文件输入输出流
  - FileInputStream/FileOutputStream
  - FileReader/FileWriter
- 随机访问文件
  - RamdomAccessFile