

OOP with Java

Yuanbin Wu
cs@ecnu

OOP with Java

- 考试通知

- 考试时间： 6 月 15 日上午 8 : 00-9 : 30 （随堂）
- 闭卷

OOP with Java

- Project 7 : 6 月 21 日晚 9 点

- 复习
 - 异常处理
- 语法
 - 抛出异常：throw
 - 处理异常：try, catch
 - 异常对象：Exception 类的子类
- 从方法中抛出异常
 - 方法的异常说明 :throws
 - 中断当前方法的执行，返回抛出的异常对象，在该方法的调用路径上寻找合适的 catch.

```
class SimpleException extends Exception { }

public class InheritingExceptions {

    public static void main(String[] args) {
        try {
            System.out.println("Throw SimpleException from f()");
            throw new SimpleException();
        } catch(Exception e) {
            System.out.println("Caught it!");
            System.out.println(e);
            System.out.println(e.printStackTrace(System.out));
        }
    }
}
```

```
bar() throws Type1Exception, Type2Exception{  
    ...  
    throw new Type1Exception ();  
    ...  
    throw new Type2Exception ();  
}
```

```
foo() {  
    try{  
        ...  
        bar();  
    }  
    catch (Type1Exception e){  
        ...  
    }  
    catch (Type2Exception e){  
        ...  
    }  
}
```

I/O

- Introduction
- Path Object
- InputStream/OutputStream
- Reader/Writer
- Typical usage of I/O streams
- Object Serialization

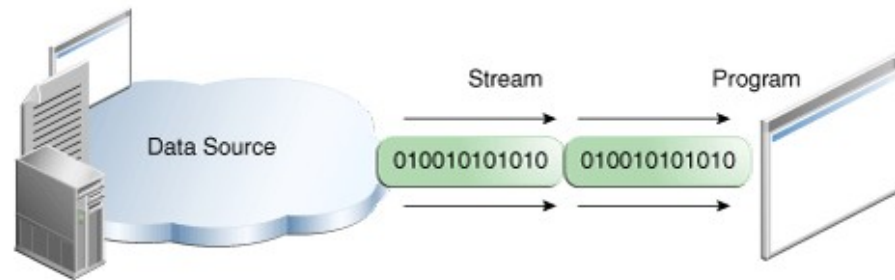
Introduction

- I/O
 - Input/output
 - 哪些行为有 I/O 操作？
- I/O 操作是复杂的
 - 多种交互的设备

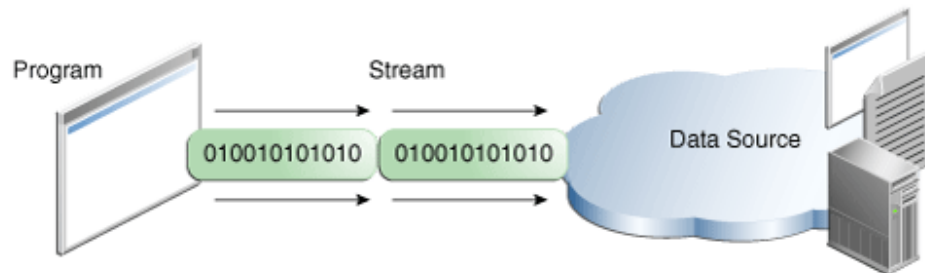
Introduction

- I/O 过程的抽象
 - 流 (Stream)

Input



Output



Introduction

- I/O 流
 - 数据的流向
 - 外界数据进入程序 (InputStream)
 - 程序数据进入外界 (OutputStream)
 - 数据的内容
 - 字节 (01 串): ByteArrayInputStream
 - 文件 : FileStream
 - 字符串 : StringStream
 - 对象 : ObjectStream

Introduction

- 核心 I/O Stream 操作
 - InputStream: read()
 - OutputStream: write()
 - close()
- 为生活带来便利的 I/O Stream 操作
 - 从文件读取一行 : readLine()
 - 读取一个基本类型 : readInt(), readDouble()...
 - 读取对象

```
public static void fileOutput() throws IOException{
    String str = "hello world!";
    File file = new File("d:\\test2.txt"); // 创建文件
    if(!file.exists()){
        file.createNewFile(); // 如果文件不存在，则进行创建
    }
    FileOutputStream fOutput = new FileOutputStream(file);
    BufferedOutputStream bOutput = new
BufferedOutputStream(fOutput);
    byte[] buffer = str.getBytes(); // 将字符串文本转换成字节数组
    bOutput.write(buffer);
    bOutput.close();
    fOutput.close();
}
```

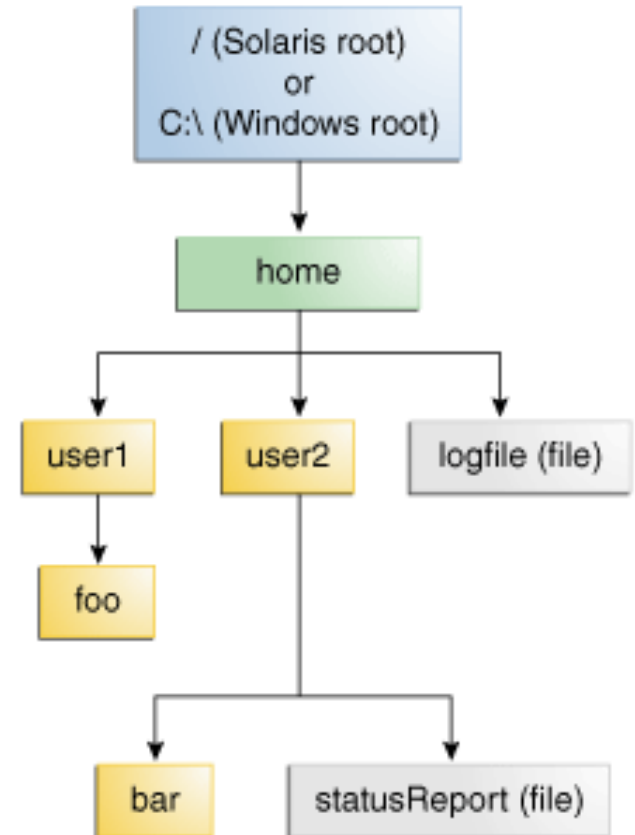
```
public static void fileInput() throws IOException{
    File file = new File("d:\\test2.txt"); // 创建文件
    FileInputStream finput = new FileInputStream(file);
    BufferedInputStream bfinput = new BufferedInputStream(finput);
    int temp = 0;
    while((temp = bfinput.read())!= -1){ // 当 temp 为 -1 时，数据读取完
        System.out.print((char)temp);
    }
    bfinput.close();
    finput.close();
}
```

Path 接口

- File 类
 - Java 7 之前
- Path 接口
 - Java 7 引入，用于替代 File 类
 - File 类对象可通过 `toPath()` 得到对应的 Path 对象

Path 接口

- 文件路径
 - 绝对路径
 - C:/Documents/tmp/Hello.java
 - 相对路径
 - ../../tmp/Hello.java



Path 接口

- Path 接口
 - java.nio.file
 - 提供对文件路径字符串的操作

Path 接口

- 创建 Path 类型的对象

```
Path p1 = Paths.get("C:/Document/tmp/Hello.java");
```

```
Path p2 = FileSystems.getDefault().getPath("C:/Document/tmp/Hello.java");
```

Path 接口

```
// Microsoft Windows syntax
```

```
Path path = Paths.get("C:\\home\\joe\\foo");
```

```
// Solaris syntax
```

```
Path path = Paths.get("/home/joe/foo");
```

```
System.out.format("toString: %s%n", path.toString());
```

```
System.out.format("getFileName: %s%n", path.getFileName());
```

```
System.out.format("getName(0): %s%n", path.getName(0));
```

```
System.out.format("getNameCount: %d%n", path.getNameCount());
```

```
System.out.format("subpath(0,2): %s%n", path.subpath(0,2));
```

```
System.out.format("getParent: %s%n", path.getParent());
```

```
System.out.format("getRoot: %s%n", path.getRoot());
```

```
// C:\home\joe\foo
```

```
// foo
```

```
// home
```

```
// 3
```

```
// home\joe
```

```
// home\joe\
```

```
// C:\
```

Files 类

- 包含文件操作的静态方法
 - 文件是否存在
 - 创建文件？
 - 删除文件
 - 拷贝 / 移动
 - 重命名
 - 列出目录下所有文件
 - ...

Files 类

- 判断文件是否存在

```
Path p = Paths.get("C:/Document/tmp/Hello.java");  
System.out.println(Files.exists(p));
```

- 判断文件是否可读 / 可写 / 可执行

```
Path p = Paths.get("C:/Document/tmp/Hello.java");  
System.out.println(Files.isReadable(p));  
System.out.println(Files.isWritable(p));  
System.out.println(Files.isExecutable(p));
```

Files 类

- 删除文件

```
try {  
    Files.delete(path);  
} catch (NoSuchFileException x) {  
    System.out.format("%s: no such" + " file or directory%n", path);  
} catch (DirectoryNotEmptyException x) {  
    System.out.format("%s not empty%n", path);  
} catch (IOException x) {  
    // File permission problems are caught here.  
    System.out.println(x);  
}
```

Files 类

- 获得文件相关的信息

```
size(Path)
isDirectory(Path, LinkOption)
isRegularFile(Path, LinkOption...)
isSymbolicLink(Path)
getLastModifiedTime(Path, LinkOption...)
setLastModifiedTime(Path, FileTime)
getOwner(Path, LinkOption...)
setOwner(Path, UserPrincipal)
```

Stream

- I/O 流
 - InputStream 抽象类
 - read(), close()
 - OutputStream 抽象类
 - write(), close()
 - 每次读入 / 写出一个字节

InputStream

- 从不同的源头产生输入
 - Byte arrays
 - String objects
 - files
 - ...
- 对应于不同的 InputStream 子类
 - ByteArrayInputStream
 - StringBufferInputStream
 - FileInputStream
 - ...

OutputStream

- 输出到不同的目的地
 - Byte arrays
 - String objects
 - files
 - ...
- 对应于不同的 OutputStream 子类
 - ByteArrayOutputStream
 - FileOutputStream

Stream

InputStream

ByteArrayInputStream
StringBufferInputStream
FileInputStream
...

OutputStream

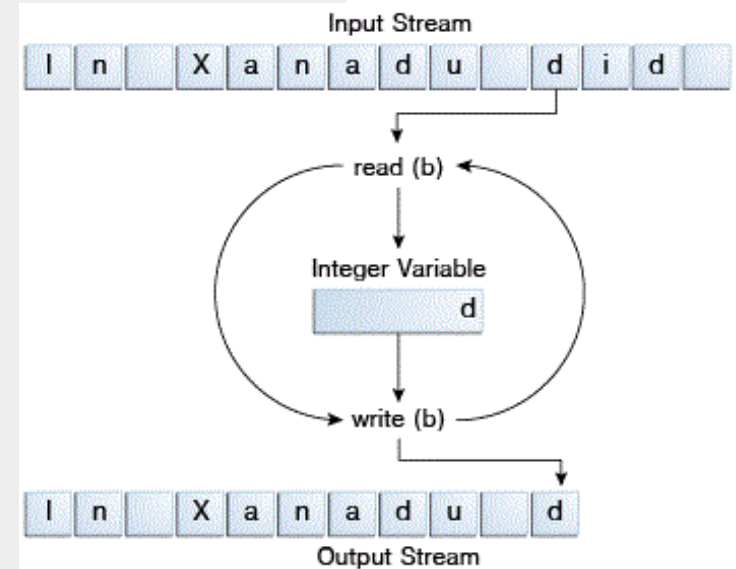
ByteArrayOutputStream

FileOutputStream
...

```

import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.IOException;
public class CopyBytes {
    public static void main(String[] args) throws IOException {
        FileInputStream in = null;
        FileOutputStream out = null;
        try {
            in = new FileInputStream("xanadu.txt");
            out = new FileOutputStream("outagain.txt");
            int c;
            while ((c = in.read()) != -1)
                out.write(c);
        } finally {
            if (in != null)
                in.close();
            if (out != null)
                out.close();
        }
    }
}

```



Stream

- 是否高效
 - InputStream/OutputStream 每次读 / 写一个字节
 - 缓冲区 (buffer) 可以帮助提高效率
- 是否易用
 - 有时需要读入 / 写出一个基本类型，而不是字节
 - readInt(), readDouble()
- 是否易读
 - 需要格式化的输出
 - println(), print(), printf(),...

Stream

- 希望：对每一种输入输出流都可以
 - 选择是否带缓冲
 - 选择读入字节还是基本类型
 - 提供格式化的输出
- How?

Stream

- 如何实现带缓冲的输入 / 输出流？
- 方案 1:
 - `read()` 方法增加参数
 - `read(byte[], int off, int len)`
- 缺点
 - buffer 长度需要用户指定
 - 用户需要知道更多实现细节

Stream

- 如何实现带缓冲的输入 / 输出流？
- 方案 2
 - 继承
 - BufferedByteArrayInputStream, BufferedByteArrayOutputStream
 - BufferedStringBufferInputStream, BufferedStringBufferOutputStream
 - BufferedFileInputStream, BufferedFileOutputStream
 - ...
- 缺点
 - 类过多
 - 无法动态加载

Stream

- 如何实现带缓冲的输入 / 输出流？
- 方案 3
 - 组合
 - 定义 `BufferedInputStream` 类
 - 包含一个 `InputStream` 对象作为成员
 - 调用该 `InputStream` 对象的 `read(byte[], int off, int len)` 实现缓冲
 - 该调用在不同系统上有不同的优化，并且被封装


```
FileInputStream fin = new FileInputStream("xanadu.txt");  
BufferedInputStream bf = new BufferedInputStream(fin);  
bf.read(); // buffered read
```

```
FileOutputStream fout = new FileOutputStream("xanadu.txt");  
BufferedOutputStream bf = new BufferedOutputStream(fout);  
bf.write(1); // buffered write
```

```
ByteArrayInputStream bin = new ByteArrayInputStream("xanadu.txt".getBytes());  
BufferedInputStream bf = new BufferedInputStream(bin);  
bf.read(); // buffered read
```

```
ByteArrayOutputStream bout = new ByteArrayOutputStream("xanadu.txt".getBytes());  
BufferedOutputStream bf = new BufferedOutputStream(bout);  
bf.write(1); // buffered read
```

Stream

- 添加缓冲功能
 - BufferedInputStream
- 添加读取基本类型功能
 - DataInputStream
 - readInt(), readDouble(), readFloat(), ...

```
FileInputStream fin = new FileInputStream("xanadu.txt");  
DataInputStream din = new DataInputStream(fin);  
din.read(); din.readInt(); din.readDouble();
```

```
FileOutputStream fout = new FileOutputStream("xanadu.txt");  
DataOutputStream dout = new DataOutputStream(fout);  
dout.write(1); dout.writeInt(10); dout.writeDouble(3.14);
```

```
ByteArrayInputStream bin = new ByteArrayInputStream("xanadu.txt".getBytes());  
DataInputStream din = new DataInputStream(bin);  
din.read(); din.readInt(); din.readDouble();
```

```
ByteArrayOutputStream bout = new ByteArrayOutputStream("xanadu.txt".getBytes());  
DataOutputStream dout = new DataOutputStream(bout);  
bout.write(1); bout.writeInt(10); bout.writeDouble(3.14);
```

Stream

- 添加缓冲功能
 - BufferedInputStream
- 添加读取基本类型功能
 - DataInputStream
 - readInt(), readDouble(), readFloat(), ...
- 添加格式化输出功能
 - PrintStream
 - println(), print(),

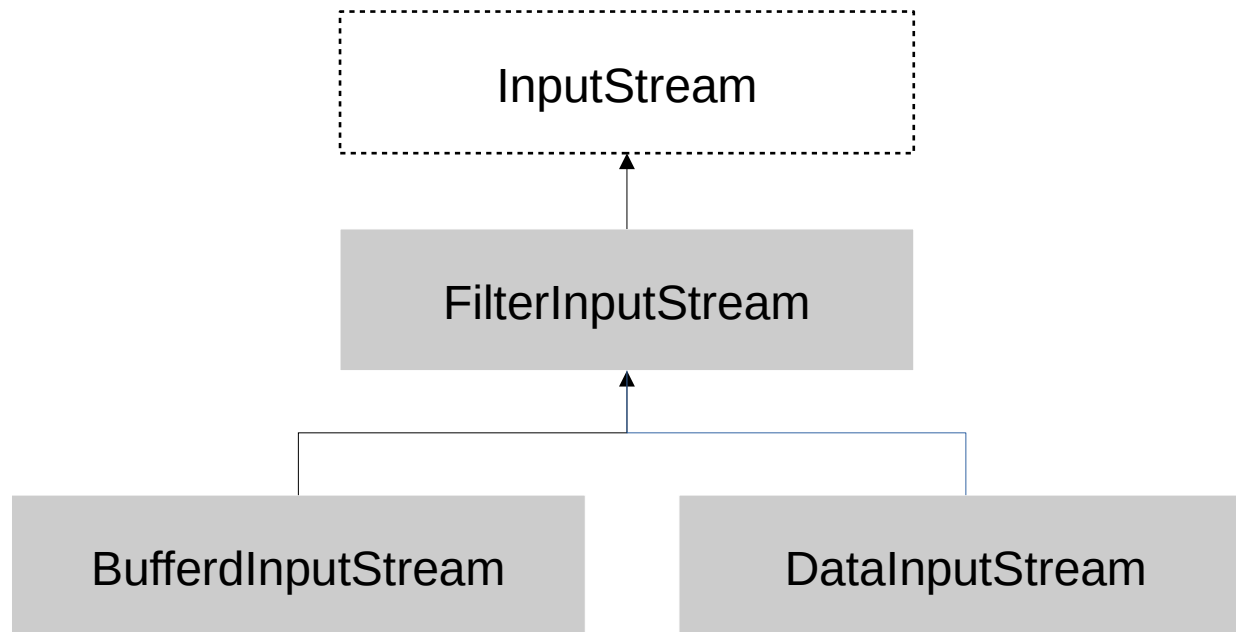
```
FileOutputStream fout = new FileOutputStream("xanadu.txt");  
PrintStream ps = new PrintStream(fout);  
ps.write(1); ps.println("hello"); ps.print("world");
```

```
ByteArrayOutputStream bout = new ByteArrayOutputStream("xanadu.txt".getBytes());  
PrintStream ps = new PrintStream(bout);  
ps.write(1); ps.println("hello"); ps.print("world");
```

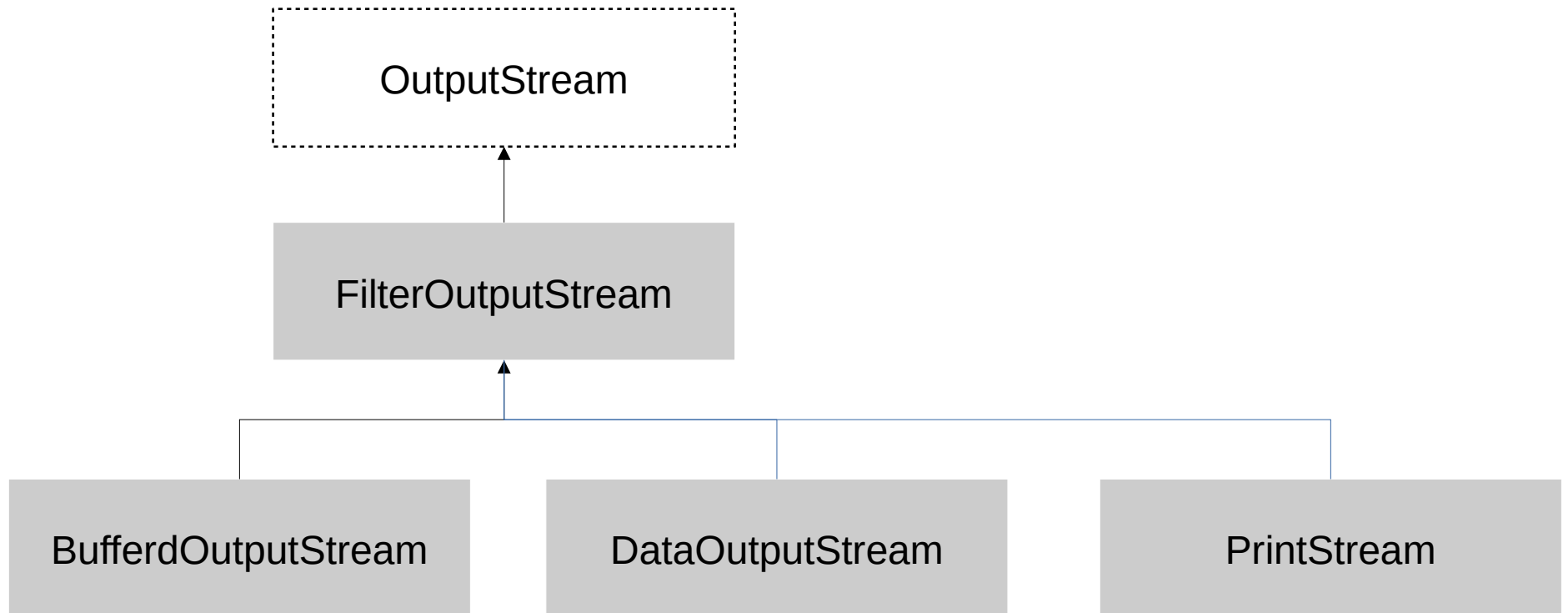
FilterInputStream

- 特点
 - InputStream 的子类
 - 构造函数：
 - protected FilterInputStream(InputStream in)
 - 包含一个 InputStream 类型的数据成员
 - 子类 :BufferedInputStream, DataInputStream

FilterInputStream



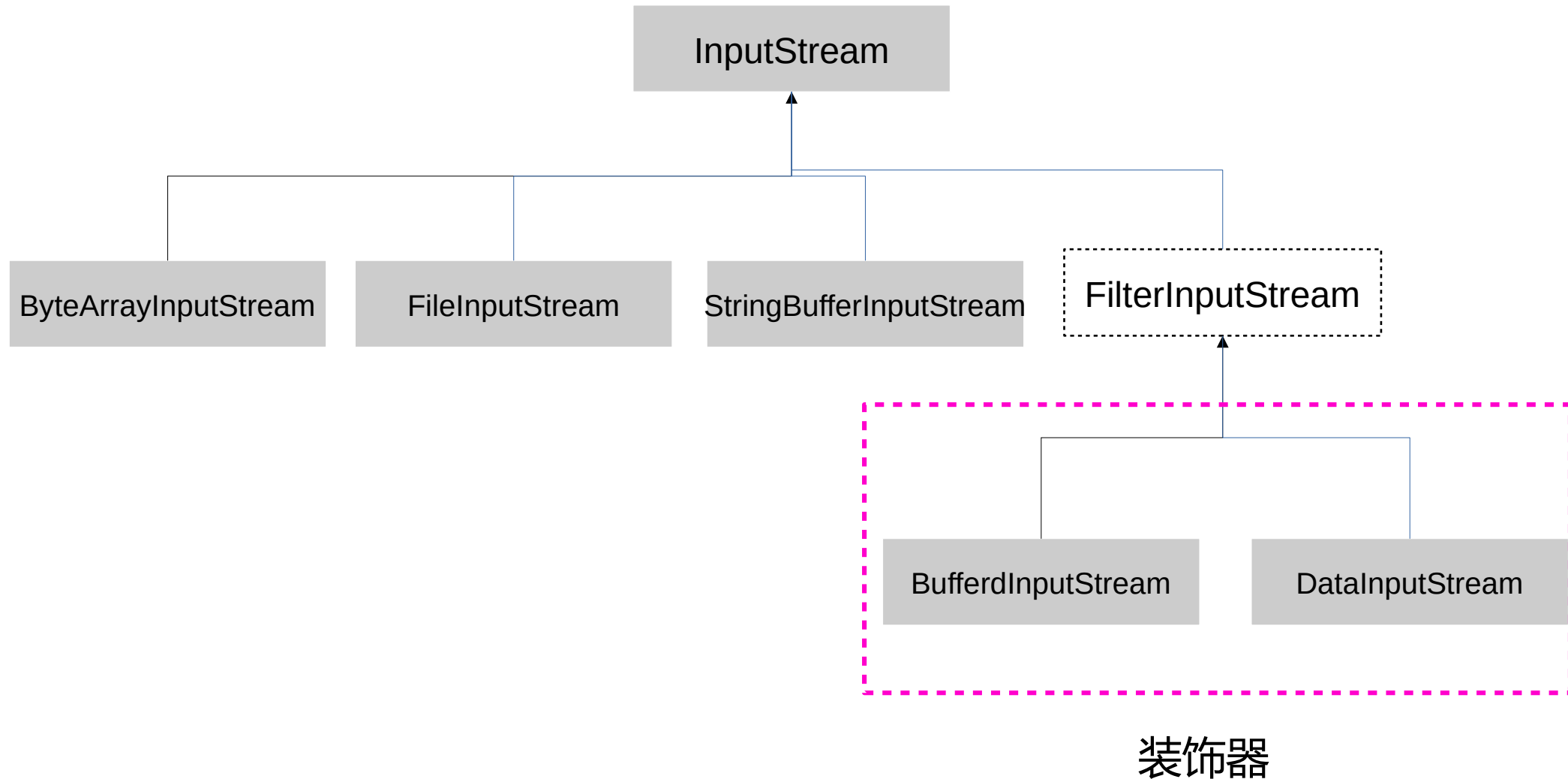
FilterOutputStream




```
FileInputStream fin = new FileInputStream("xanadu.txt");  
BufferedInputStream bf = new BufferedInputStream(fin);  
DataInputStream din = new DataInputStream(bf);  
  
din.read(); din.readInt(); din.readDouble();
```

```
FileOutputStream fout = new FileOutputStream("xanadu.txt");  
BufferedOutputStream bf = new BufferedOutputStream(fout);  
DataOutputStream dout = new DataOutputStream(bf);  
  
dout.write(1); dout.writeInt(10); dout.writeDouble(3.14);
```

Decorator pattern



总结

- Stream
 - InputStream, OutputStream
- 根据数据源的不同，分为
 - FileInputStream, ByteArrayInputStream ...
 - FileOutputStream, ByteArrayOutputStream...
- 可以有不同的装饰器
 - BufferedInputStream, DataInputStream
 - PrintStream

```
public static void fileOutput() throws IOException{
    String str = "hello world!";
    File file = new File("d:\\test2.txt"); // 创建文件
    if(!file.exists()){
        file.createNewFile(); // 如果文件不存在，则进行创建
    }
    FileOutputStream fOutput = new FileOutputStream(file);
    BufferedOutputStream bOutput = new BufferedOutputStream(fOutput);
    byte[] buffer = str.getBytes(); // 将字符串文本转换成字节数组
    bOutput.write(buffer);
    bOutput.close();
    fOutput.close();
}
```

```
public static void fileInput() throws IOException{
    File file = new File("d:\\test2.txt"); // 创建文件
    FileInputStream flutput = new FileInputStream(file);
    BufferedInputStream blutput = new BufferedInputStream(flutput);
    int temp = 0;
    while((temp = blutput.read())!= -1){ // 当 temp 为 -1 时，数据读取完
        System.out.print((char)temp);
    }
    blutput.close();
}
```

毕

Reader / Writer

- InputStream, OutputStream
 - 每次读入 / 写出一个字节
- Reader, Writer
 - 每次读入 / 写出一个**字符**
 - Utf-16
 - 每次读入 / 写出 16bit, 或者 32bit

Reader / Writer

读写字节	读写字符
InputStream	Reader
OutputStream	Writer
FileInputStream	FileReader
FileOutputStream	FileWriter
StringBufferInputStream	StringReader
(no corresponding class)	StringWriter
ByteArrayInputStream	CharArrayReader
ByteArrayOutputStream	CharArrayWriter

Reader / Writer decorators

读写字节	读写字符
FilterInputStream	FilterReader
FilterOutputStream	FilterWriter
BufferedInputStream	BufferedReader
BufferedOutputStream	BufferedWriter
DataInputStream	DataInputStream
DataOutputStream	DataOutputStream
PrintStream	PrintWriter

PrintWriter
可以用 OutputStream
作为参数

Typical uses of I/O streams

- 例子


```
import java.io.*;
public class BufferedInputFile {
    // Throw exceptions to console:
    public static String read(String filename) throws IOException {
        // Reading input by lines:
        BufferedReader in = new BufferedReader(new
FileReader(filename));
        String s;
        StringBuilder sb = new StringBuilder();
        while((s = in.readLine()) != null)
            sb.append(s + "\n");
        in.close();
        return sb.toString();
    }
    public static void main(String[] args) throws IOException {
        System.out.print(read("BufferedInputFile.java"));
    }
}
```

```
import java.io.*;
public class MemoryInput {
    public static void main(String[] args) throws IOException {
        StringReader in = new StringReader(
            BufferedInputFile.read("MemoryInput.java"));
        int c;
        while((c = in.read()) != -1)
            System.out.print((char)c);
    }
}
```

```
import java.io.*;
public class FormattedMemoryInput {
    public static void main(String[] args) throws IOException {
        try {
            DataInputStream in = new DataInputStream(
                new ByteArrayInputStream(BufferedInputFile.read(
                    "FormattedMemoryInput.java").getBytes()));
            while(true)
                System.out.print((char)in.readByte());
        } catch(EOFException e) {
            System.err.println("End of stream");
        }
    }
}
```

```
import java.io.*;
public class TestEOF {
    public static void main(String[] args) throws IOException {
        DataInputStream in = new DataInputStream(
            new BufferedInputStream(
                new FileInputStream("TestEOF.java")));
        while(in.available() != 0)
            System.out.print((char)in.readByte());
    }
}
```

Short cut:

```
PrintWriter out = new PrintWriter(file);
```

```
import java.io.*;
public class BasicFileOutput {
    static String file = "BasicFileOutput.out";
    public static void main(String[] args) throws IOException {

        BufferedReader in = new BufferedReader(
            new StringReader(
                BufferedInputFile.read("BasicFileOutput.java")));

        PrintWriter out = new PrintWriter(
            new BufferedWriter(new FileWriter(file)));

        int lineCount = 1;
        String s;
        while((s = in.readLine()) != null )
            out.println(lineCount++ + ": " + s);
        out.close();
        // Show the stored file:
        System.out.println(BufferedInputFile.read(file));
    }
}
```

```
import java.io.*;
public class StoringAndRecoveringData {
    public static void main(String[] args) throws IOException {
        DataOutputStream out = new DataOutputStream(
            new BufferedOutputStream(new FileOutputStream("Data.txt")));
        out.writeDouble(3.14159);
        out.writeUTF("That was pi");
        out.writeDouble(1.41413);
        out.writeUTF("Square root of 2");
        out.close();
        DataInputStream in = new DataInputStream(
            new BufferedInputStream(new FileInputStream("Data.txt")));
        System.out.println(in.readDouble());
        // Only readUTF() will recover the
        // Java-UTF String properly:
        System.out.println(in.readUTF());
        System.out.println(in.readDouble());
        System.out.println(in.readUTF());
    }
}
```

问题：Why not overloading?

Standard I/O

- System.out
 - PrintStream
- System.err
 - PrintStream
- System.in
 - 需要一些预处理

```
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);
    }
}
```