

Files and Streams

Using Streams, Files, Serialization



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#java-advanced

1. Streams Basics

- Opening a File Stream
- Closing a File Stream

2. Types of Streams

- Combining Streams

3. Files and Directories

4. Serialization

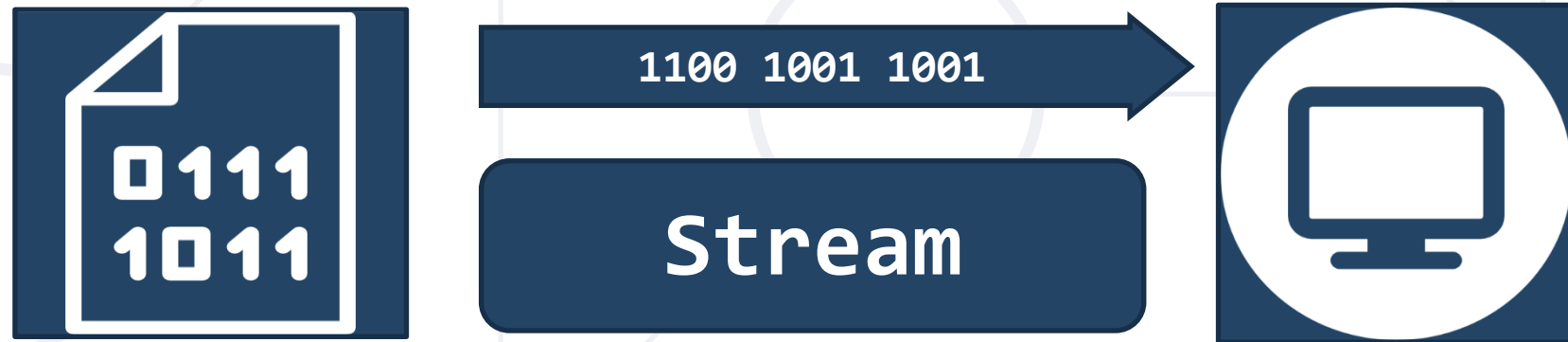




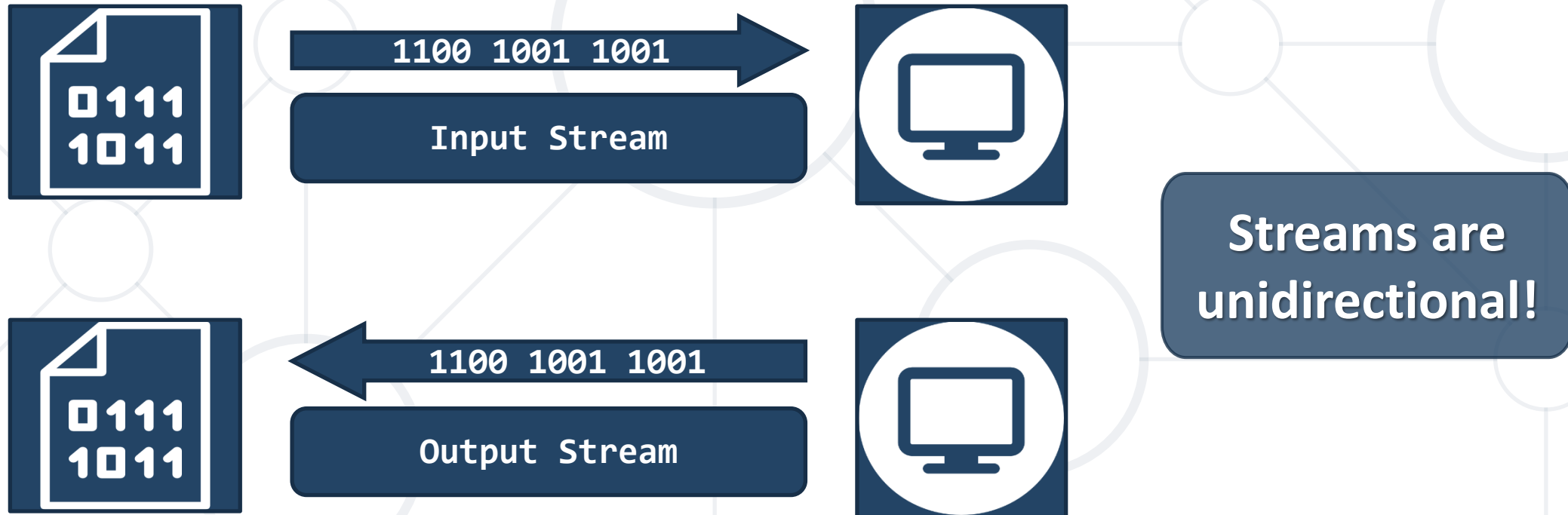
Streams

What is Stream?

- **Streams** are used to **transfer data**
- We **open a stream** to:
 - **Read** a file
 - **Write** to a file



- Two fundamental types of streams:



Opening a File Stream

```
String path = "C:\\input.txt";  
  
FileInputStream fileStream =  
    new FileInputStream(path);  
  
int oneByte = fileStream.read();  
while (oneByte >= 0) {  
    System.out.print(oneByte);  
    oneByte = fileStream.read();  
}
```

Returns -1 if
empty

Closing a File Stream (1)

- Using **try-catch-finally**

```
InputStream in = null;  
try {  
    in = new FileInputStream(path);  
} catch (IOException e) {  
    // TODO: handle exception  
} finally {  
    if (in != null) {  
        in.close();  
    }  
}
```

Always free
resources!

close() can also
throw an exception

Closing a File Stream (2)

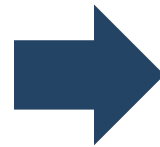
- Using **try-with-resources**

```
try (InputStream in = new FileInputStream(path)) {  
    int oneByte = in.read();  
    while (oneByte >= 0) {  
        System.out.print(oneByte);  
        oneByte = in.read();  
    }  
} catch (IOException e) {  
    // TODO: handle exception  
}
```

Problem: Read File

- You are given a file
- Read and print all of its contents **as a sequence of bytes**
- Submit in Judge **only the output** of the program

Two households, both
alike in dignity,
In fair Verona, where we
lay our scene,



```
1010100 1110111 1101111
100000 1101000 1101111
1110101 1110011 1100101
1101000...
```

Solution: Read File

```
String path = "D:\\input.txt";

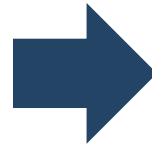
try (InputStream in = new FileInputStream(path)) {
    int oneByte = in.read();
    while (oneByte >= 0) {
        System.out.printf("%s ",
            Integer.toBinaryString(oneByte));
        oneByte = in.read();
    }
}
catch (IOException e) {
    e.printStackTrace();
}
```



Problem: Write to File

- Read a file and write all its content while **skipping any punctuation** (skip ' , ' , ' . ' , ' ! ' , ' ? ')
- Submit in Judge **only the output** of the program

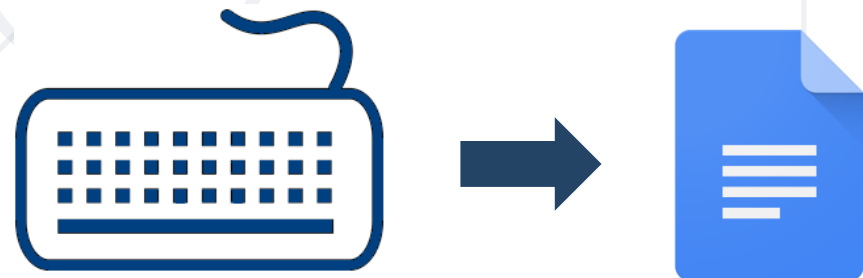
Two households, both
alike in dignity.
In fair Verona, where
we lay our scene.



Two households both
alike in dignity
In fair Verona where
we lay our scene

Solution: Write to File (1)

```
String inputPath = "D:\\input.txt";  
String outputPath = "D:\\output.txt";  
  
List<Character> symbols = new ArrayList<>();  
Collections.addAll(symbols, '.', ',', '!', '?');  
  
// continues...
```



Solution: Write to File (2)

```
try (InputStream in = new FileInputStream(inputPath);
    OutputStream out = new FileOutputStream(outputPath))
{
    int oneByte = 0;
    while ((oneByte = in.read()) >= 0) {
        if (!symbols.contains((char)oneByte)) {
            out.write(oneByte);
        }
    }
} // TODO: handle exceptions
```



Basic Stream Types in Java

Byte and Character

- Byte streams are the **lowest level streams**
 - Byte streams can read or write **one byte at a time**
 - All byte streams **descend** from **InputStream** and **OutputStream**

InputStream

100101

111111

100011

-1

OutputStream

100101

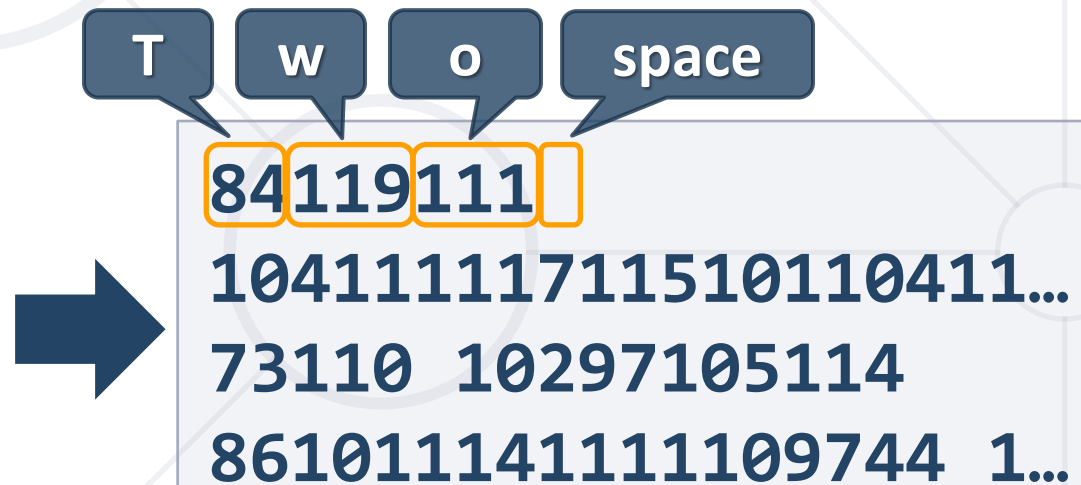
111111

100011

Problem: Copy Bytes

- **Read a file** and **copy** its contents **to another text file**
- Write characters **as bytes** in decimal
- Write **every space or new line as it is**, e.g. as a space or new line

Two households, both
alike in dignity.
In fair Verona, where
we lay our scene.



T w o space
84119111
10411111711510110411...
73110 10297105114
861011141111109744 1...

Solution: Copy Bytes

```
// TODO: Open input and output streams
int oneByte = 0;
while ((oneByte = in.read()) >= 0) {
    if (oneByte == 10 || oneByte == 32) {
        out.write(oneByte);
    } else {
        String digits = String.valueOf(oneByte);
        for (int i = 0; i < digits.length(); i++)
            out.write(digits.charAt(i));
    }
} // TODO: handle exceptions
```

Character Streams

- All character streams descend from **FileReader** and **FileWriter**

```
String path = "D:\\input.txt";
```

```
FileReader reader = new FileReader(path);
```



- Character streams are often "**wrappers**" for byte streams
 - **FileReader** uses **FileInputStream**
 - **FileWriter** uses **FileOutputStream**

```
String path = "D:\\input.txt";
```

```
Scanner reader =  
    new Scanner(new FileInputStream(path));
```

Wrapping a
Stream

Problem: Extract Integers

- **Read a file** and **extracts all integers** in a separate file
- Get only numbers that are **not a part of a word**
- Submit in Judge **only the output** of the program

2 households, **22** alike
in 3nity,
In fair Verona, where
we lay our scene



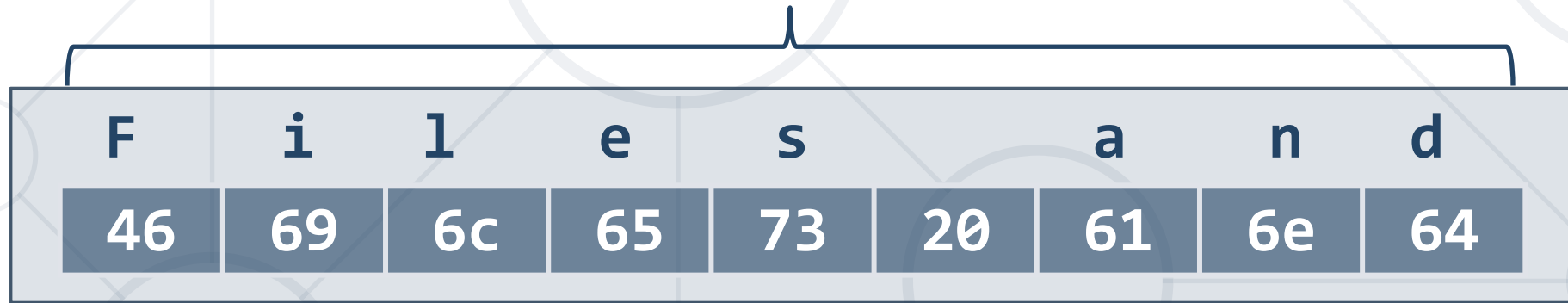
2
22

Solution: Extract Integers

```
Scanner scanner =  
    new Scanner(new FileInputStream(inputPath));  
  
PrintWriter out =  
    new PrintWriter(new FileOutputStream(outputPath));  
  
while (scanner.hasNext()) {  
    if (scanner.hasNextInt())  
        out.println(scanner.nextInt());  
  
    scanner.next();  
}  
out.close();
```

- Reading the information in **chunks**
- Significantly **boost performance**

Length = 9



Position



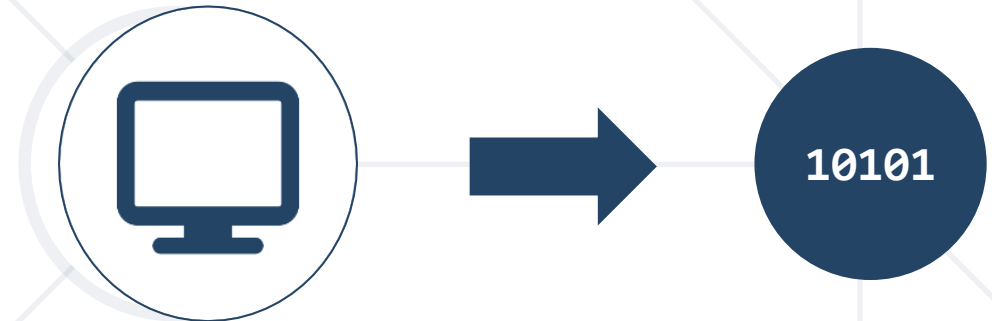
Buffer



Problem: Write Every Third Line

- Read a file and **write all lines which number is divisible by 3** in a separate file
- Line numbers start from **one**

Two households, both
alike in dignity,
In fair Verona, where
we lay our scene,
From ancient grudge
break to new mutiny...



Solution: Write Every Third Line

```
try (BufferedReader in =  
    new BufferedReader(new FileReader(inputPath));  
    PrintWriter out =  
        new PrintWriter(new FileWriter(outputPath))) {  
    int counter = 1;  
    String line = in.readLine();  
    while (line != null) {  
        if (counter % 3 == 0)  
            out.println(line);  
        counter++;  
        line = in.readLine();  
    }  
} // TODO: handle exceptions
```

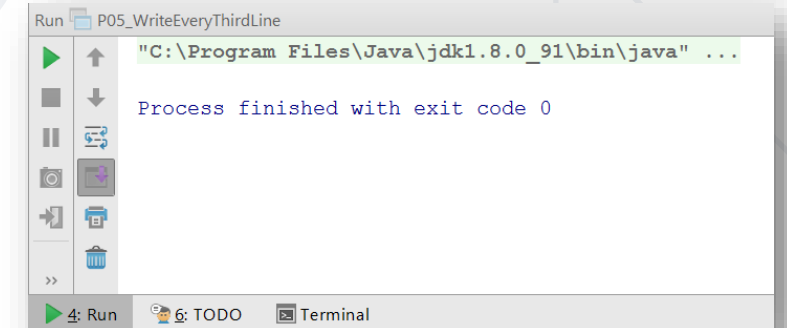
Command Line I/O (1)

- Standard Input - **System.in**
- Standard Output - **System.out**
- Standard Error - **System.err**

```
Scanner scanner = new Scanner(System.in);  
String line = scanner.nextLine();  
System.out.println(line);
```

Input Stream

Output Stream



```
public static void main(String[] args) throws IOException {  
    BufferedReader reader =  
        new BufferedReader(new InputStreamReader(System.in));  
  
    String hello = reader.readLine(); // Hello BufferedReader  
    System.out.println(hello);       // Hello BufferedReader  
}
```



Files and Paths

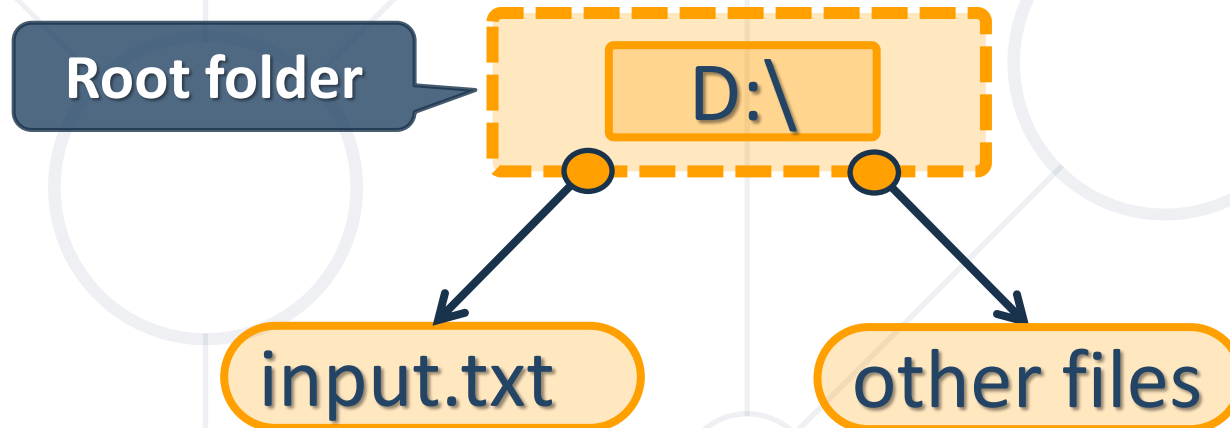
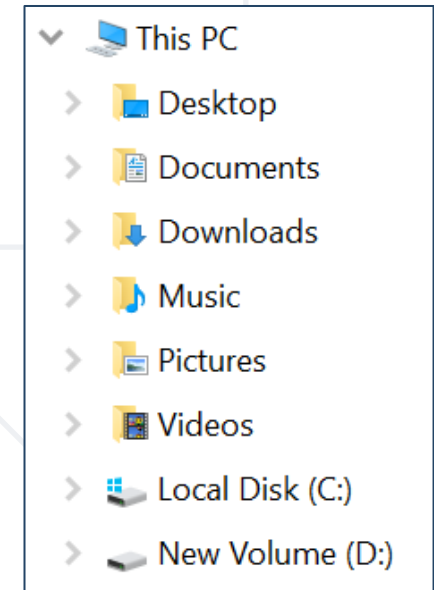
Easily Working With Files

- The location of a file in the file system

`D:\input.txt`

- Represented in Java by the Path class

```
Path path = Paths.get("D:\\input.txt");
```



- Provides **static methods** for **creating streams**

```
Path path = Paths.get("D:\\input.txt");  
  
try (BufferedReader reader =  
    Files.newBufferedReader(path)) {  
    // TODO: work with file  
} catch (IOException e) {  
    // TODO: handle exception  
}
```



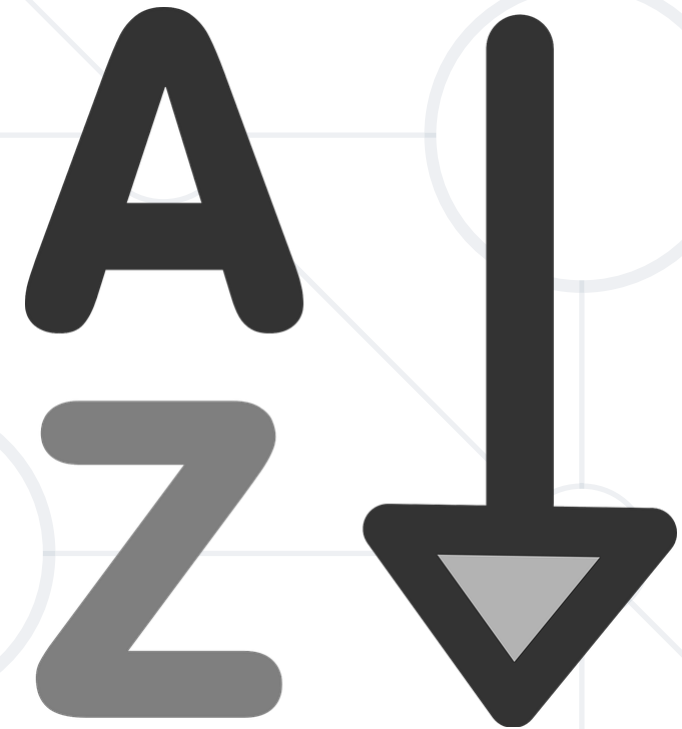
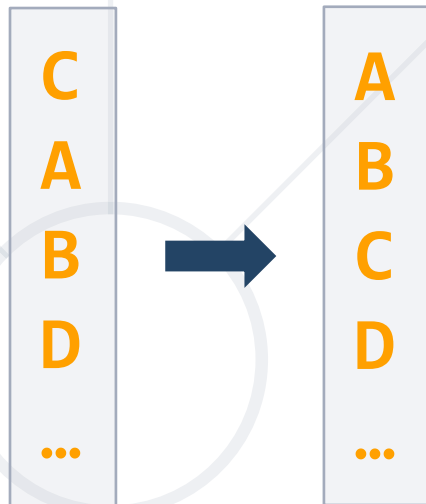
- Provides **utility** methods for easy file manipulation

```
Path inPath = Paths.get("D:\\input.txt");  
Path outPath = Paths.get("D:\\output.txt");  
  
List<String> lines = Files.readAllLines(inPath);  
Files.write(outPath, lines);  
  
// TODO: handle exceptions
```



Problem: Sort Lines

- **Read** a text **file** and **sort all lines**
- **Write** the result to another text **file**
- Use Paths and Files classes



Solution: Sort Lines

```
Path path = Paths.get("D:\\input.txt");
Path output = Paths.get("D:\\output.txt");

try {
    List<String> lines = Files.readAllLines(path);
    lines = lines.stream().filter(l ->
        !l.isBlank()).collect(Collectors.toList());
    Collections.sort(lines);
    Files.write(output, lines);
} catch (IOException e) {
    e.printStackTrace();
}
```

Don't use for large files



File Class in Java

Easily Working With Files

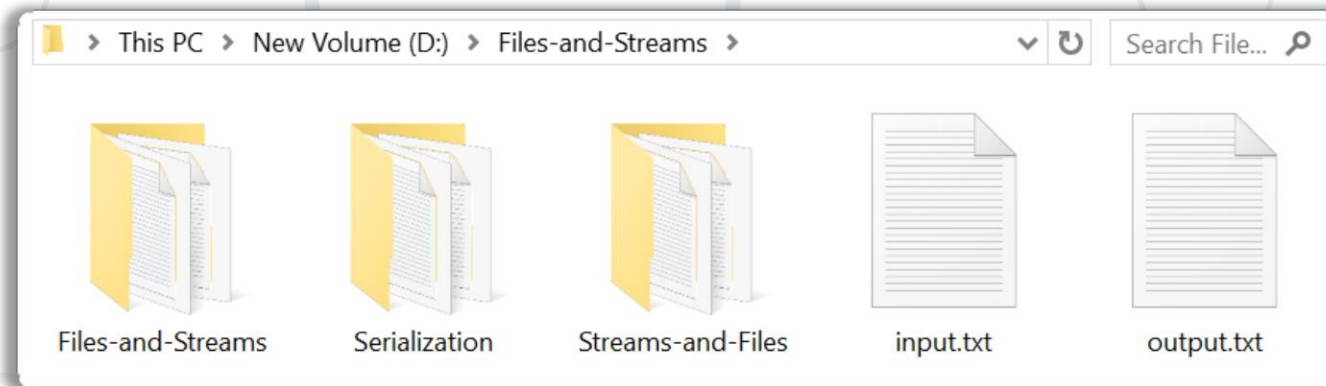
- Provides methods for quick and easy manipulation of files

```
import java.io.File;  
  
File file = new File("D:\\input.txt");  
  
boolean isExisting = file.exists();  
long length = file.length();  
boolean isDirectory = file.isDirectory();  
File[] files = file.listFiles();
```



Problem: List Files

- **Print names and sizes** of all files in "Files-and-Streams" directory
- Skip **child** directories



`input.txt: [size in bytes]`
`output.txt: [size in bytes]`

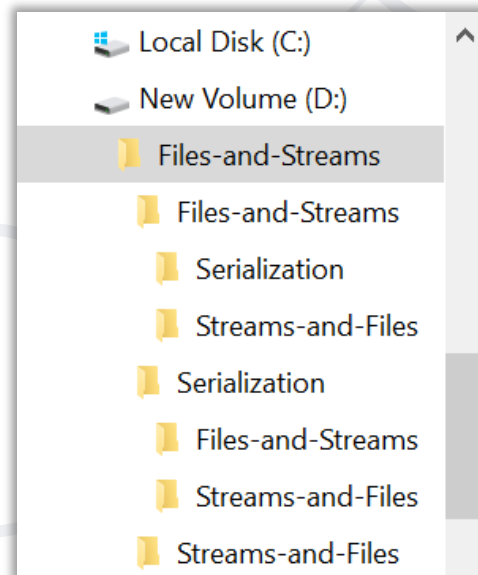
Solution: List Files

```
if (file.exists()) {  
    if (file.isDirectory()) {  
        File[] files = file.listFiles();  
        for (File f : files) {  
            if (!f.isDirectory()) {  
                System.out.printf("%s: [%s]%n",  
                                f.getName(), f.length());  
            }  
        }  
    }  
}
```



Problem: Nested Folders

- You are **given** a folder named "Files-and-Streams"
- **List all folder names**, starting with the root
- **Print folder count** on the last line (including the root)



...

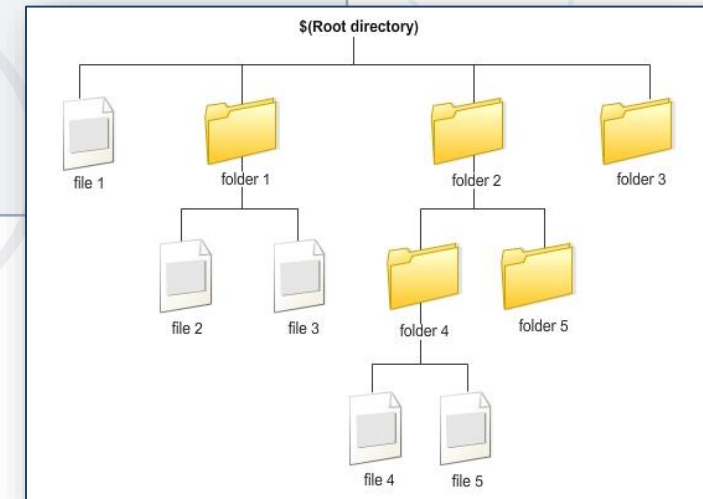
Streams-and-Files
Serialization
Streams-and-Files
[count] folders

Solution: Nested Folders (1)

```
String path = "D:\\Files-and-Streams";  
File root = new File(path);
```

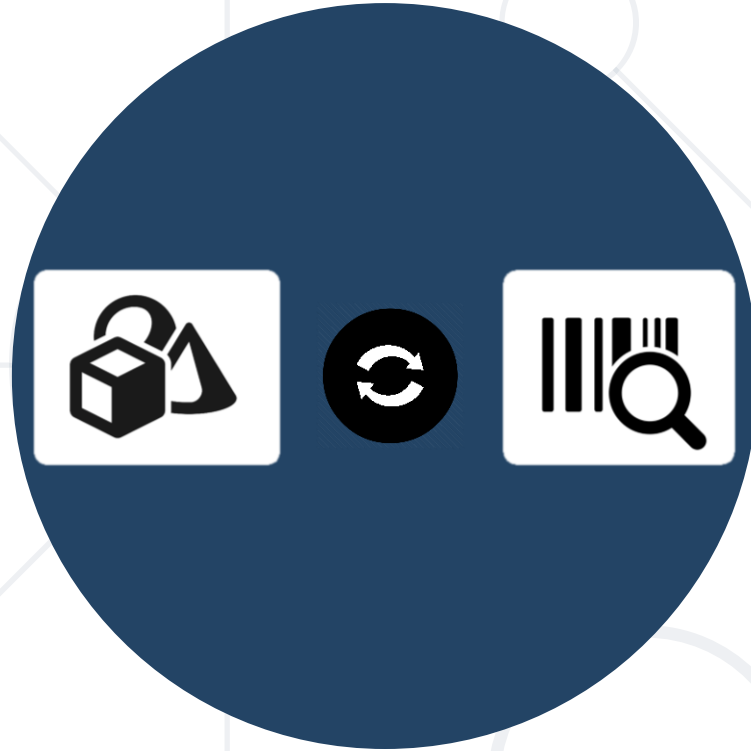
```
Deque<File> dirs = new ArrayDeque<>();  
dirs.offer(root);
```

```
// continue...
```



Solution: Nested Folders (2)

```
int count = 0;
while (!dirs.isEmpty()) {
    File current = dirs.poll();
    File[] nestedFiles = current.listFiles();
    for (File nestedFile : nestedFiles)
        if (nestedFile.isDirectory())
            dirs.offer(nestedFile);
    count++;
    System.out.println(current.getName());
}
System.out.println(count + " folders");
```

Serialization

Serializing and Deserializing Objects

- **Save** objects to a file

```
List<String> names = new ArrayList<>();  
Collections.addAll(names, "Mimi", "Gosho");
```

```
FileOutputStream fos = new FileOutputStream(path);  
ObjectOutputStream oos =  
    new ObjectOutputStream(fos);
```

```
oos.writeObject(names);
```

```
// TODO: handle exceptions
```

Save objects
to **.ser** file



- **Load** objects from a file

```
FileInputStream fis =  
    new FileInputStream(path);  
ObjectInputStream oos =  
    new ObjectInputStream(fis);  
  
List<String> names =  
    (List<String>) oos.readObject();  
  
// TODO: handle exceptions
```



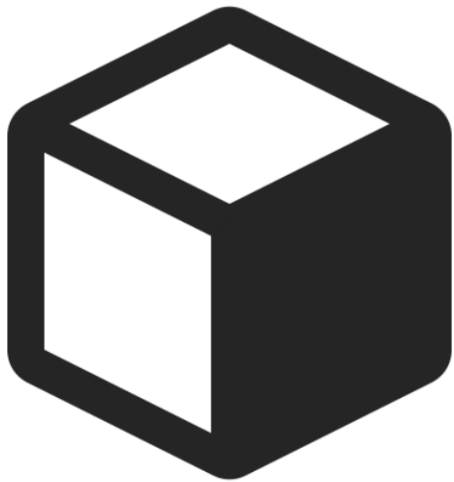
- Custom objects should **implement** the **Serializable** interface

```
class Cube implements Serializable {  
    String color;  
    double width;  
    double height;  
    double depth;  
}
```



Problem: Serialize Custom Object

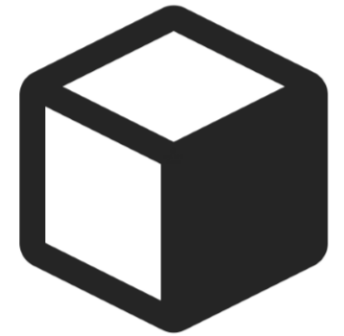
- Create a **Cube class** with color, width, height and depth
- Create a cube – **color: "green", w: 15.3, h: 12.4 and d: 3**



Check your solution here: <https://judge.softuni.bg/Contests/1493/Streams-Files-And-Directories-Lab>

Solution: Serialize Custom Object (1)

```
class Cube implements Serializable {  
    String color;  
    double width;  
    double height;  
    double depth;  
}
```



Solution: Serialize Custom Object (2)

//TODO: Create Cube object

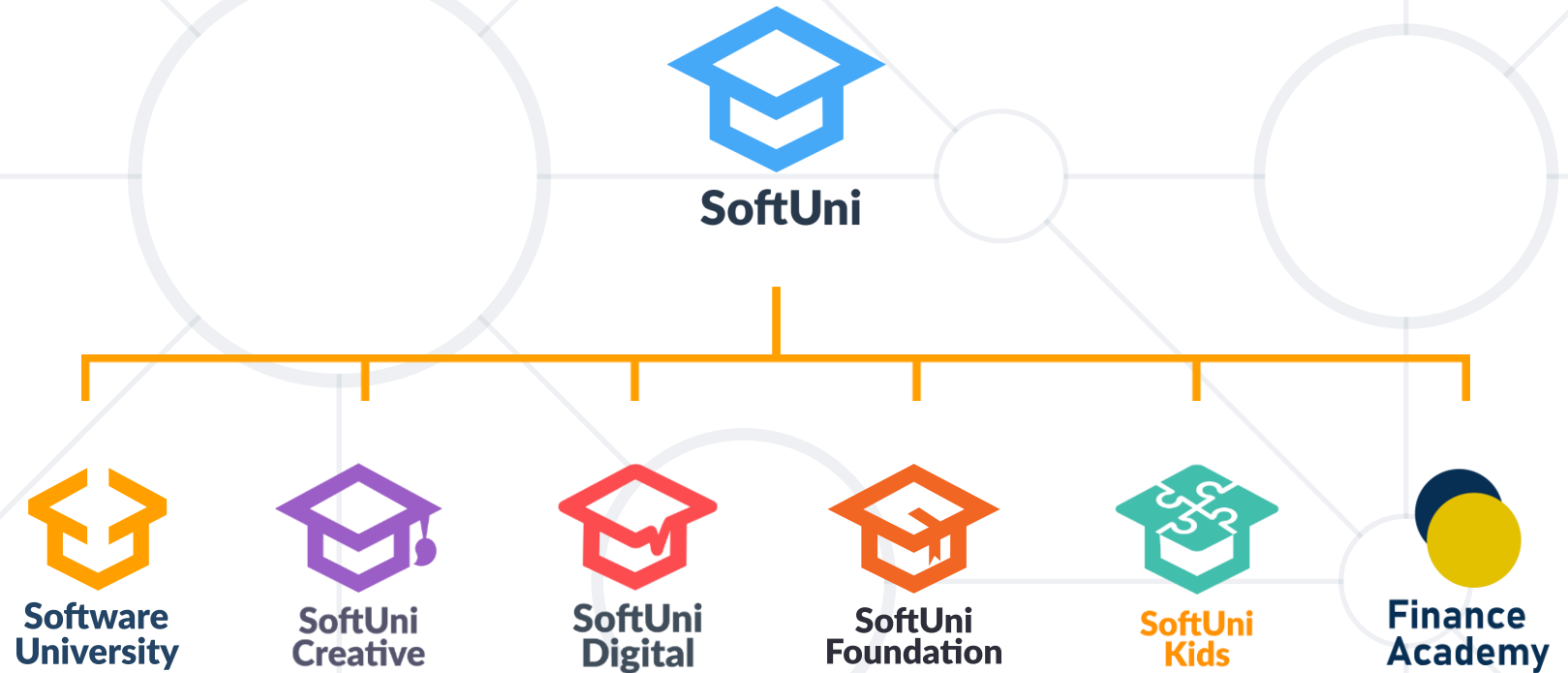
```
String path = "D:\\save.ser";  
try (ObjectOutputStream oos = new ObjectOutputStream(  
    new FileOutputStream(path))) {  
    oos.writeObject(cube);  
} catch (IOException e) {  
    e.printStackTrace();  
}
```



- **Streams** are used to **transfer data**
- **Two** main **types** of streams
 - **Input** Streams
 - **Output** Streams
- **Buffered** streams boost **performance**
- Streams **can be chained together**
- You can **save objects** state into a file



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