



Software 1 with Java



Recitation No. 9 (Java IO)

The java.io package

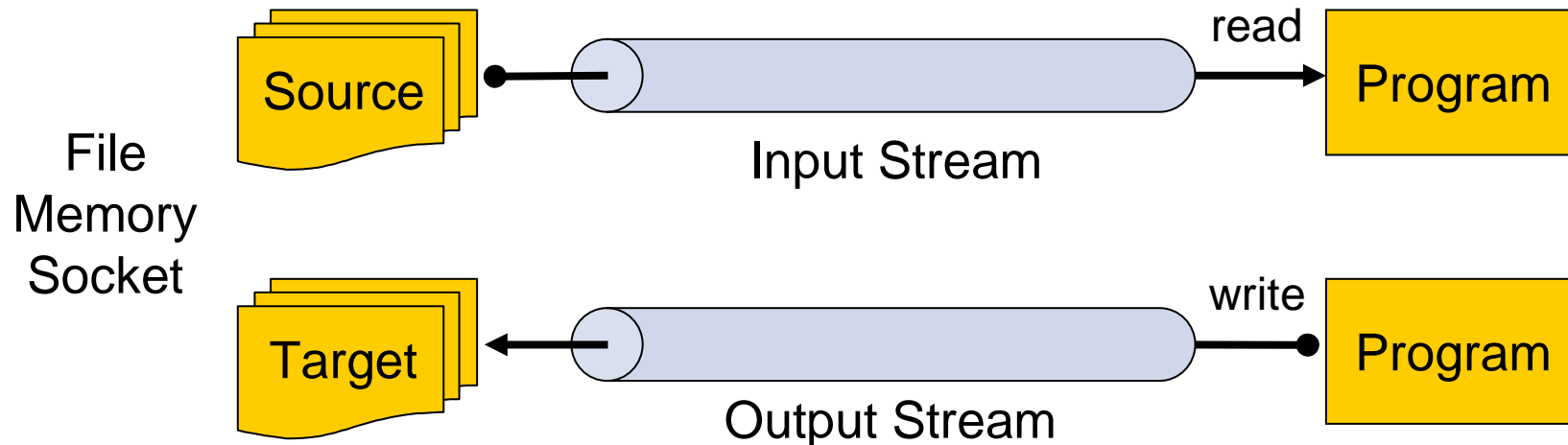
- The java.io package provides:
 - Classes for reading input
 - Classes for writing output
 - Classes for manipulating files
 - Classes for serializing objects

Online Resources

- **JAVA API Specification:**
 - <http://java.sun.com/j2se/1.5.0/docs/api/index.html>
- **The Java Tutorial (Sun)**
<http://java.sun.com/docs/books/tutorial/essential/io/>

Streams

- A ***stream*** is a sequential flow of data
- Streams are one-way streets.
 - ***Input streams*** are for reading
 - ***Output streams*** are for writing



Streams

- Usage Flow:

open a stream

while more information

 Read/write information

close the stream

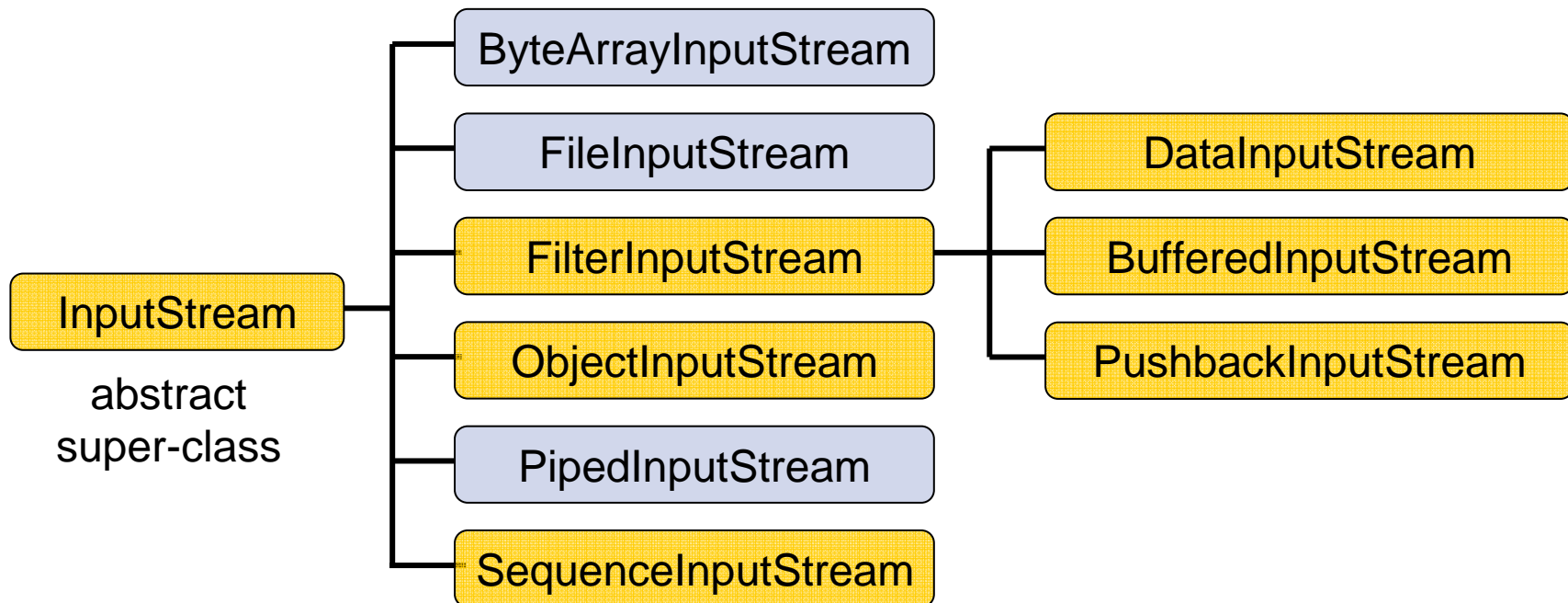
- All streams are automatically opened when created.

Streams

- There are two types of streams:
 - **Byte streams** for reading/writing raw bytes
 - **Character streams** for reading/writing text
- Class Name Suffix Convention:

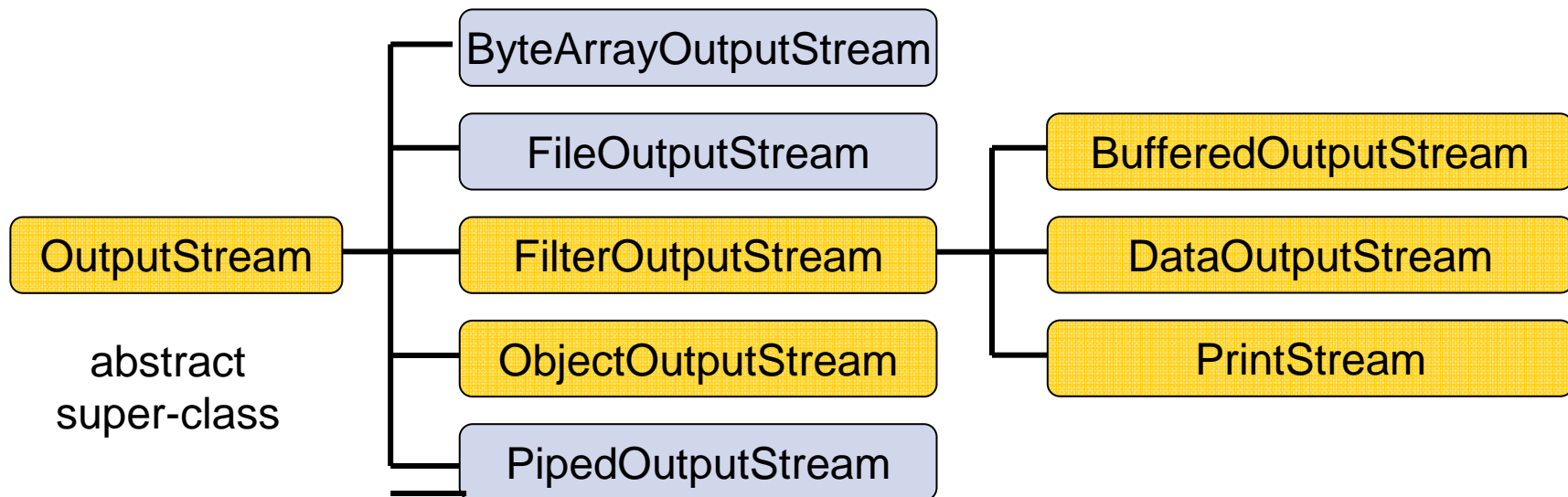
	Byte	Character
Input	InputStream	Reader
Output	OutputStream	Writer

InputStreams



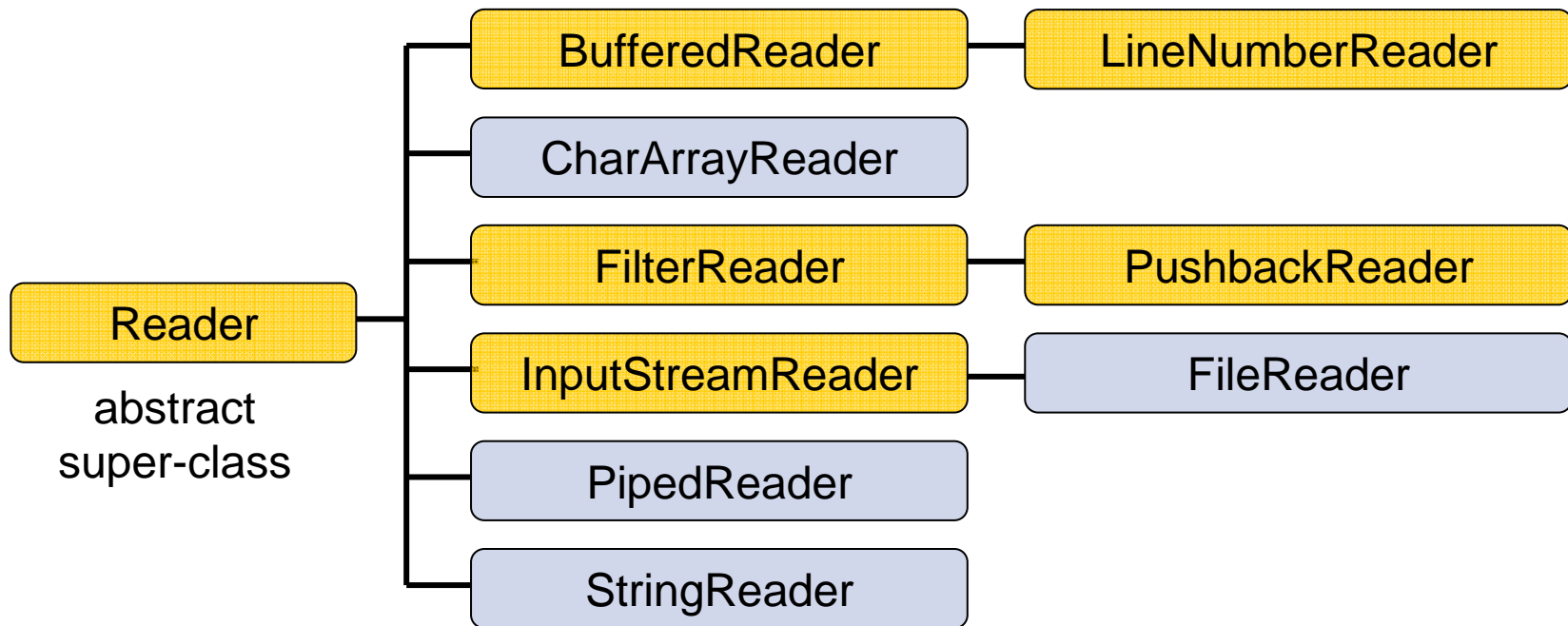
- - read from data sinks
- - perform some processing

OutputStreams



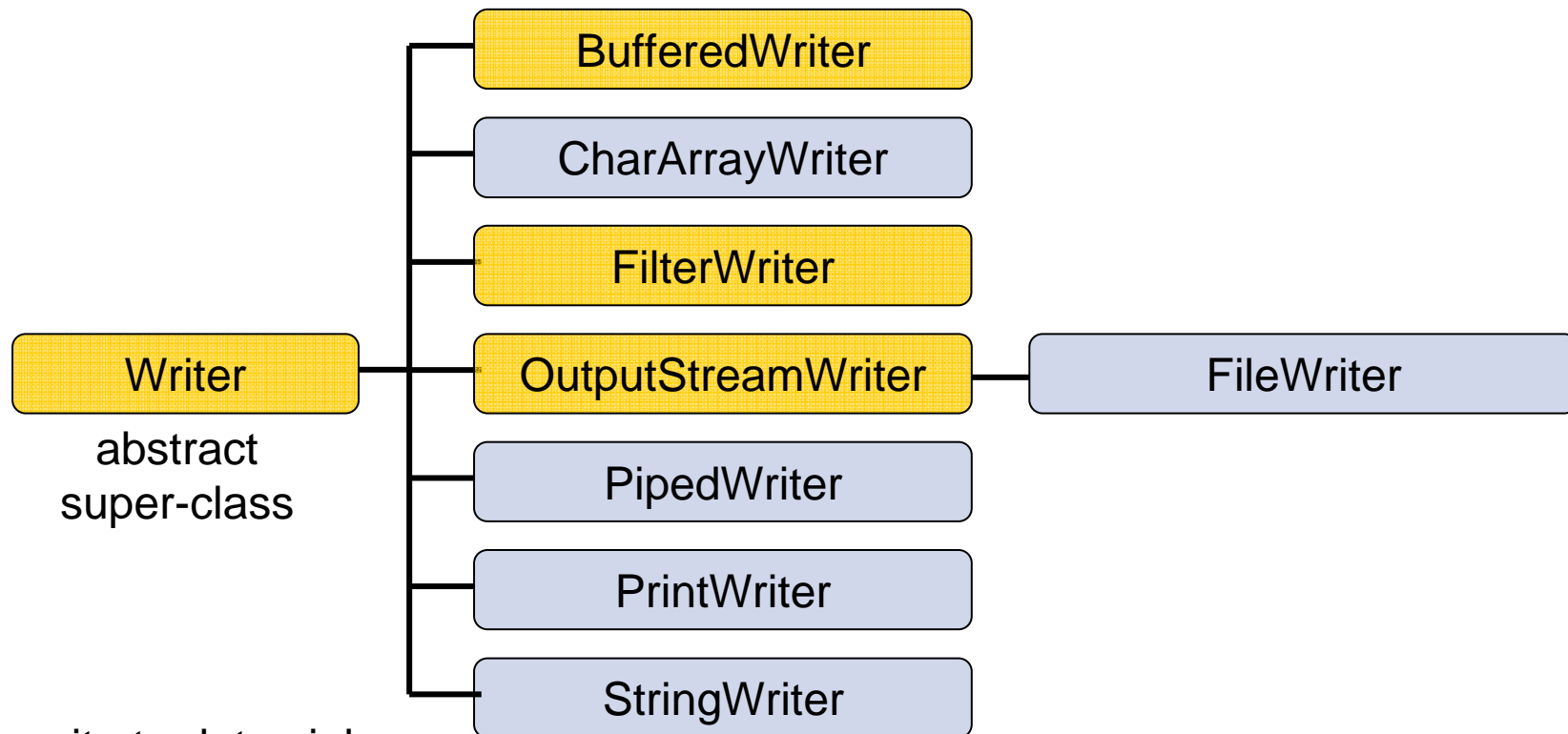
- - write to data sinks
- - perform some processing

Readers



- - read from data sinks
- - perform some processing

Writers



- - write to data sinks
- - perform some processing

Terminal I/O

- The `System` class provides references to the standard input, output and error streams:

```
InputStream stdin = System.in;
```

```
PrintStream stdout = System.out;
```

```
PrintStream stderr = System.err;
```

The Scanner Class

- Breaks its input into tokens using a delimiter pattern (matches whitespace by default)
- The resulting tokens may then be converted into values

```
try {  
    Scanner s = new Scanner(System.in);  
    int anInt = s.nextInt();  
    float aFloat = s.nextfloat();  
    String aString = s.next();  
    String aLine = s.nextLine();  
} catch (...) { ...}
```

Stream Wrappers

- Some streams wrap other streams and add new features.
- A wrapper stream accepts another stream in its constructor:

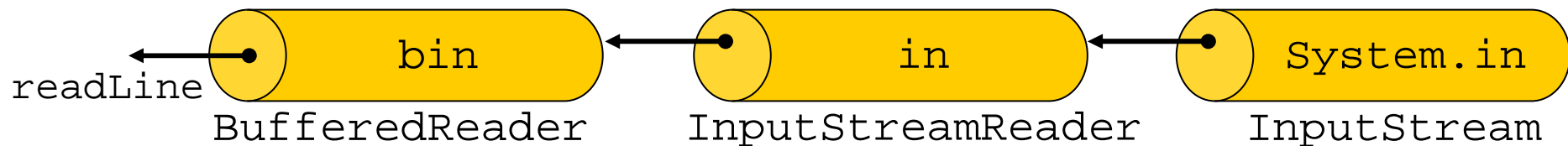
```
DataInputStream din =  
    new DataInputStream(System.in);  
double d = din.readDouble();
```



Stream Wrappers (cont.)

- Reading a text string from the standard input:

```
try {  
    InputStreamReader in  
        = new InputStreamReader(System.in);  
    BufferedReader bin  
        = new BufferedReader(in);  
    String text = bin.readLine();  
    ...  
} catch (IOException e) {...}
```



The File Class

- Represents a file or directory pathname
- Performs basic file system operations:
 - removes a file: `delete()`
 - creates a new directory: `mkdir()`
 - checks if the file is writable: `canWrite()`
 - creates a new file: `createNewFile()`
- No direct access to file data
- Use file streams for reading and writing

The File Class

Constructors

- Using a full pathname:

```
File f = new File("/doc/foo.txt");  
File dir = new File("/doc/tmp");
```

- Using a pathname relative to the current directory defined in `user.dir`:

```
File f = new File("foo.txt");
```

Note: Use `System.getProperty('user.dir')` to get the value of `user.dir`

(Usually the default is the current directory of the interpreter. In Eclipse it is the project's directory)

The File Class

Constructors (cont)

■ `File f = new File("/doc", "foo.txt");`

↑
directory
pathname

↑
file
name

■ `File dir = new File("/doc");`

`File f = new File(dir, "foo.txt");`

■ A `File` object can be created for a non-existing file or directory

- Use `exists()` to check if the file/dir exists

The File Class

Pathnames

- Pathnames are system-dependent
 - `"/doc/foo.txt"` (UNIX format)
 - `"D:\doc\foo.txt"` (Windows format)
- On Windows platform Java accepts path names either with `'/'` or `'\'`
- The system file separator is defined in:
 - `File.separator`
 - `File.separatorChar`

The File Class

Directory Listing

- Printing all files and directories under a given directory:

```
public static void main(String[] args) {
    File file = new File(args[0]);

    String[] files = file.list();
    for (int i=0 ; i< files.length ; i++) {
        System.out.println(files[i]);
    }
}
```

The File Class

Directory Listing (cont.)

- Printing all files and directories under a given directory with ".txt" suffix:

```
public static void main(String[] args) {
    File file = new File(args[0]);
    FilenameFilter filter = new
        SuffixFileFilter(".txt");

    String[] files = file.list(filter);
    for (int i=0 ; i<files.length ; i++) {
        System.out.println(files[i]);
    }
}
```

The File Class

Directory Listing (cont.)

```
public class SuffixFileFilter implements
    FilenameFilter {
    private String suffix;

    public SuffixFileFilter(String suffix) {
        this.suffix = suffix;
    }

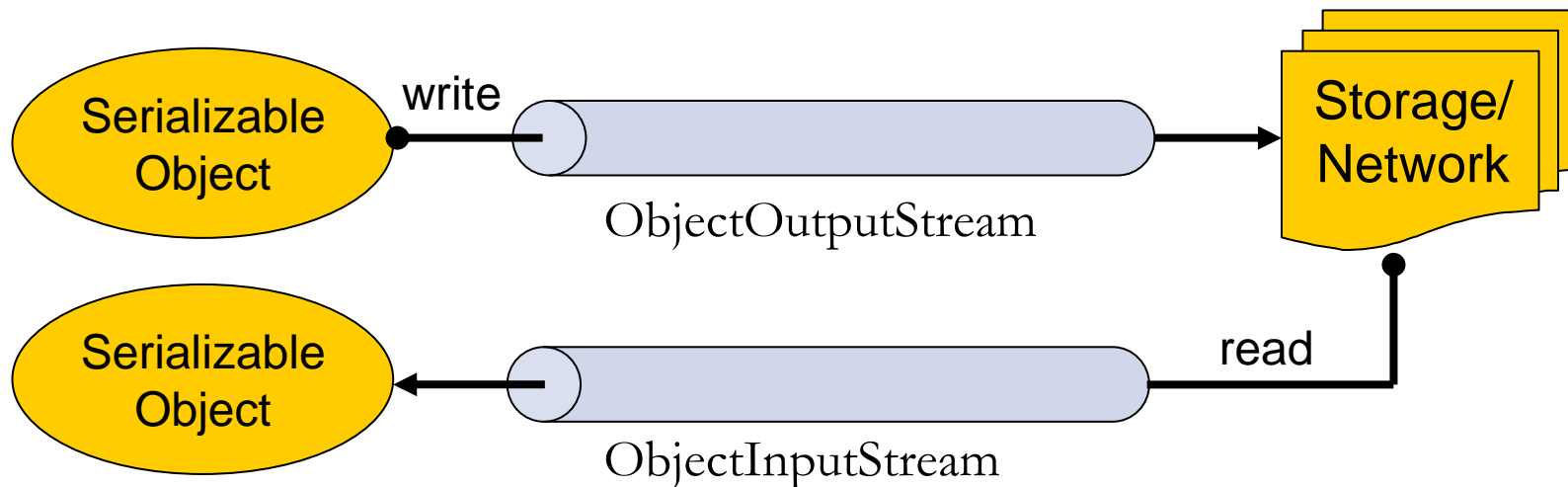
    public boolean accept(File dir, String name) {
        return name.endsWith(suffix);
    }
}
```

Object Serialization

- A mechanism that enable objects to be:
 - saved and restored from byte streams
 - persistent (outlive the current process)
- Useful for:
 - persistent storage
 - sending an object to a remote computer

The Default Mechanism

- The default mechanism includes:
 - The Serializable interface
 - The ObjectOutputStream
 - The ObjectInputStream



The Serializable Interface

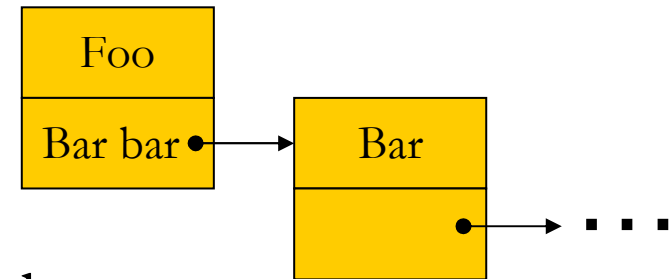
- Objects to be serialized must implement the `java.io.Serializable` interface
- An empty interface
- Most objects are Serializable:
 - Primitives, Strings, GUI components etc.
- Subclasses of Serializable classes are also Serializable

Recursive Serialization

■ Can we serialize a Foo object?

```
public class Foo implements Serializable {  
    private Bar bar;  
    ...  
}
```

```
public class Bar {...}
```



■ No, since Bar is not Serializable

■ Solution:

- Implement Bar as Serializable
- Mark the bar field of Foo as transient (will not be discussed in the course)
- And, so on recursively

Writing Objects

- Writing a HashMap object (map) to a file*:

```
try {
    FileOutputStream fileOut =
        new FileOutputStream("map.s");
    ObjectOutputStream out =
        new ObjectOutputStream(fileOut);
    out.writeObject(map);
} catch (Exception e) {...}
```

* HashMap is Serializable

Reading Objects

```
try {  
    FileInputStream fileIn = new  
        FileInputStream("map.s");  
  
    ObjectInputStream in = new  
        ObjectInputStream(fileIn);  
  
    Map h = (Map)in.readObject();  
} catch (Exception e) {...}
```

Other Topics

- The `java.nio` package
- The `java.util.zip` package