

Software 1 with Java

Recitation No. 9 (Java IO)

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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

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Online Resources

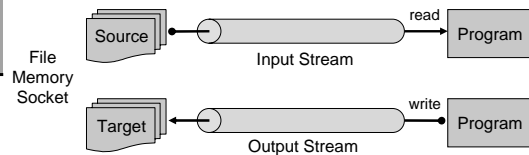
- JAVA API Specification:
 - <http://java.sun.com/j2se/1.5.0/docs/api/index.html>
- The Java Tutorial (Sun)
<http://java.sun.com/docs/books/tutorial/essential/io/>

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Streams

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



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Streams

- **Usage Flow:**
 - open a stream
 - while more information
 - Read/write information
 - close the stream
- All streams are automatically opened when created.

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Streams

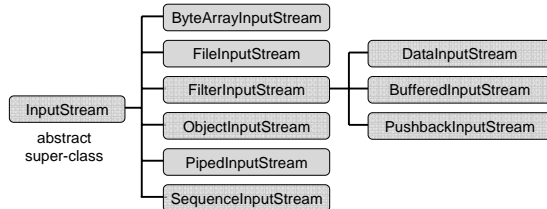
- There are two types of streams:
 - **Byte streams** for reading/writing raw bytes
 - **Character streams** for reading/writing text
- **Class Name Suffix Convention:**

	Byte	Character
Input	InputStream	Reader
Output	OutputStream	Writer

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InputStreams

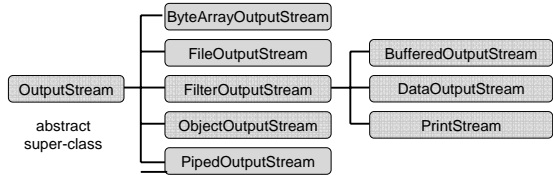


- ▣ - read from data sinks
- ▣ - perform some processing

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OutputStreams

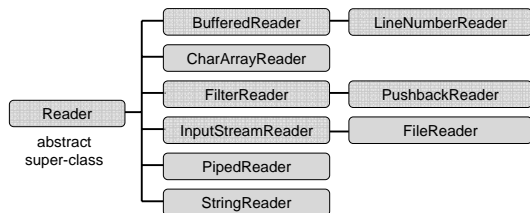


- ▣ - write to data sinks
- ▣ - perform some processing

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Readers

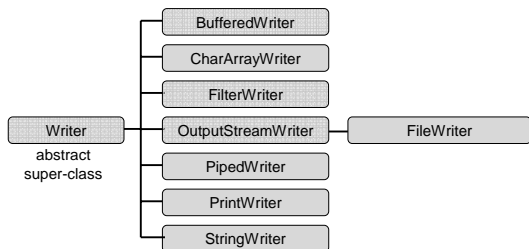


- ▣ - read from data sinks
- ▣ - perform some processing

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Writers



- ▣ - write to data sinks
- ▣ - perform some processing

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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;
```

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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 (...) { ...}
```

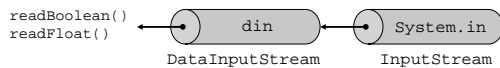
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Stream Wrappers

- 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();
```



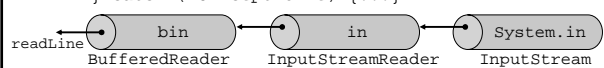
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Stream Wrappers (cont.)

- 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) {...}
```



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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

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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)

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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

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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`

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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]);
    }
}
```

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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]);
    }
}
```

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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);
    }
}
```

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Object Serialization

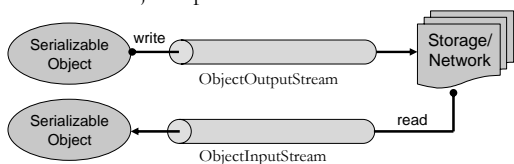
- A mechanism that enable objects to be:
 - saved and restored from byte streams
 - persistent (outlive the current process)
- Useful for:
 - persistent storage
 - sending an object to a remote computer

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The Default Mechanism

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



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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

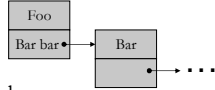
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Recursive Serialization

■ Can we serialize a Foo object?

```
public class Foo implements Serializable {  
    private Bar 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

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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

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Reading Objects

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

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Other Topics

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

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