Software 1 with Java

Recitations No. 10
(Java IO)

The java.io package

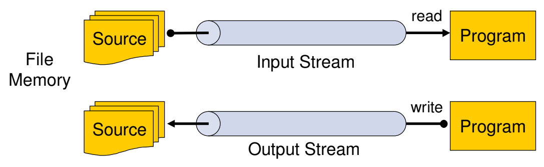
- The java.io package provides:
  - Classes for reading input
  - Classes for writing output
  - Classes for manipulating files
  - Classes for serializing objects

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
```

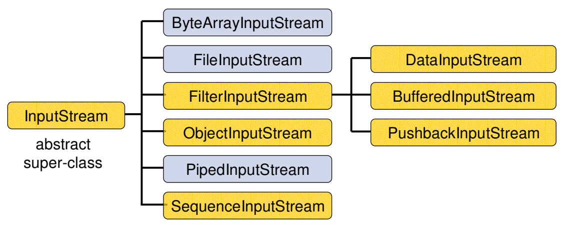
- All streams are automatically opened when created.

Streams

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

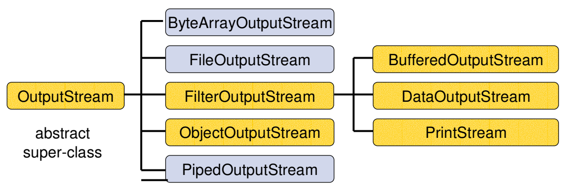
	Byte	Character
Input	InputStream	Reader
Output	OutputStream	Writer

InputStreams



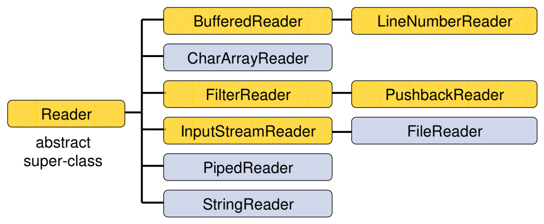
- 🟦 - read from data sinks
- 🟨 - perform some processing

OutputStreams



- 🟦 - write to data sinks
- 🟨 - perform some processing

Readers



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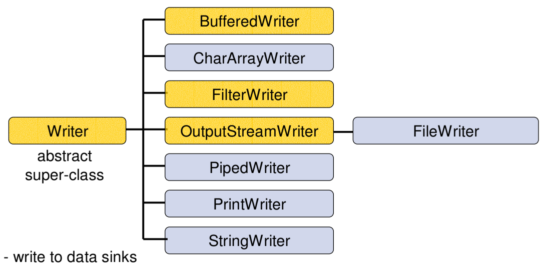
Writers



- 🟦 - write to data sinks
- 🟨 - perform some processing

Terminal I/O

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

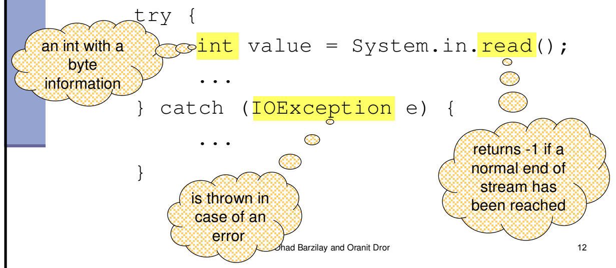
  InputStream stdin = System.in;

  OutputStream stdout = System.out;

  OutputStream stderr = System.err;

InputStream Example

- Reading a single byte from the standard input stream:


an int with a byte information
returns -1 if a normal end of stream has been reached
is thrown in case of an error

```
try {
    int value = System.in.read();
    ...
} catch (IOException e) {
    ...
}
```

InputStream Example

- Another implementation:

```
try {
   int value = System.in.read();
   if (value != -1) {
      byte bValue = (byte) value;
   }
   ...
} catch (IOException e) {...}
```

end-of-stream condition

casting

The Scanner Class

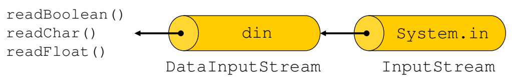
- Breaks its input into tokens using a delimiter pattern (matches whitespace by default)
- The resulting tokens may then be converted into values

```
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 others streams and add new features.
- A wrapper stream accepts another stream in its constructor:

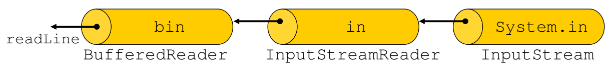
```
DataInputStream din =
   new DataInputStream(System.in);
double d = din.readDouble();
```



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()`
- No method to create a new file
- 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 of the Java interpreter:

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

Note: `System.getProperty('user.dir')` returns the current directory of the interpreter

The File Class
Constructors (cont)

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

  directory pathname ↑ "/doc" — file name ↑ "foo.txt"

- `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 excepts 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.)

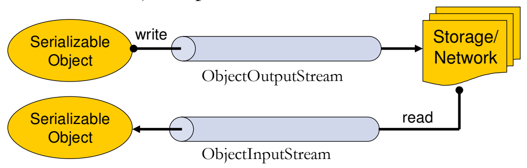
```
public class SuffixFileFilter implements
  FilenameFilter {
   private String suffix;

   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



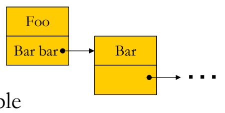
The Serializable Interface

- 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) {...}
```

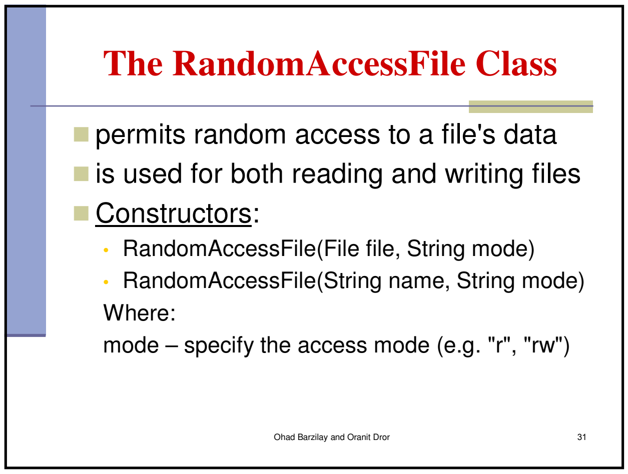
* HashMap is Serializable

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

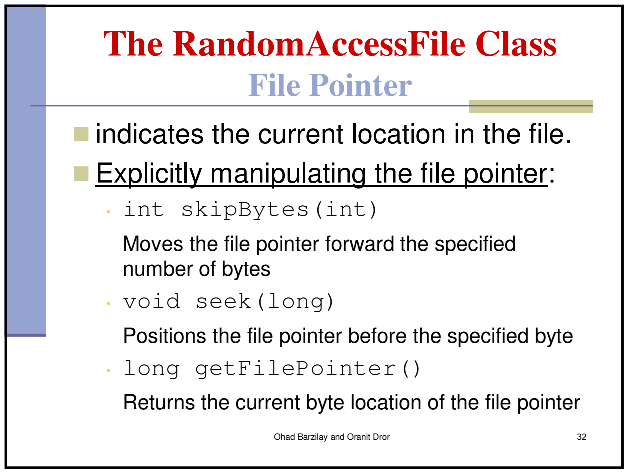


The RandomAccessFile Class

- permits random access to a file's data
- is used for both reading and writing files
- Constructors:
  - RandomAccessFile(File file, String mode)
  - RandomAccessFile(String name, String mode)

  Where:

  mode – specify the access mode (e.g. "r", "rw")



The RandomAccessFile Class
File Pointer

- indicates the current location in the file.
- Explicitly manipulating the file pointer:
  - `int skipBytes(int)`

    Moves the file pointer forward the specified number of bytes
  - `void seek(long)`

    Positions the file pointer before the specified byte
  - `long getFilePointer()`

    Returns the current byte location of the file pointer