Files

CSE 142, Summer 2003

Computer Programming 1

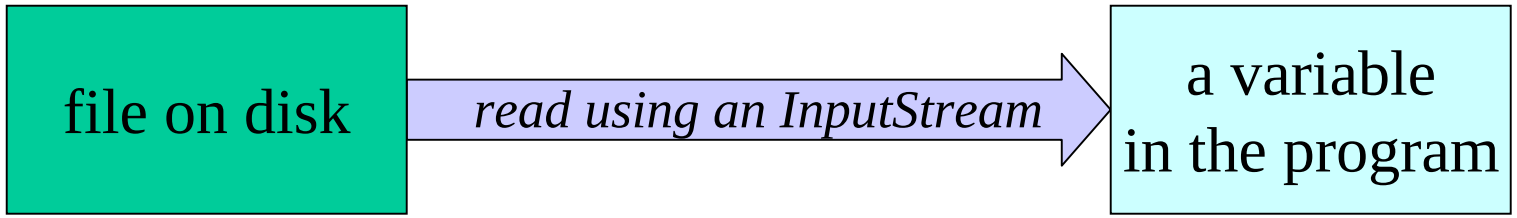
http://www.cs.washington.edu/education/courses/142/03su/

Sources and Sinks - Files

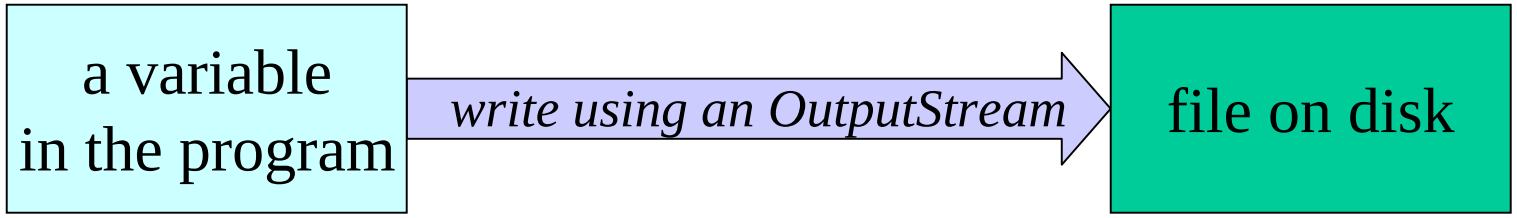
- When reading from a file
  - » the file is the source
  - » a data structure in your application is the sink
- When writing to a file
  - » a data structure in your application is the source
  - » the file is the sink

The stream model applied to files

- The *source* can be a file on disk



- The *sink* can be a file on disk



FileInputStream and FileOutputStream

- The file streams read or write from a file on the native file system
  - » FileInputStream
    - retrieve bytes from a file and provide them to the program
  - » FileOutputStream
    - send bytes to a file from your program
- If used by themselves, FileInputStream and FileOutputStream are for binary I/O
  - » just plain bytes in and out with no interpretation as characters or anything else

FileInputStream methods

```
int available()
    Returns the number of bytes that can be read from this file input stream without
    blocking.
void close()
    Closes this file input stream and releases any system resources associated with
    the stream.
protected void finalize()
    Ensures that the close method of this file input stream is called when there are
    no more references to it.
FileDescriptor getFD()
    Returns the FileDescriptor object that represents the connection to the actual
    file in the file system being used by this FileInputStream.
int read()
    Reads a byte of data from this input stream.
int read(byte[] b)
    Reads up to b.length bytes of data from this input stream into an array of bytes.
int read(byte[] b, int off, int len)
    Reads up to len bytes of data from this input stream into an array of bytes.
long skip(long n)
    Skips over and discards n bytes of data from the input stream.
void mark(int readlimit)
    Marks the current position in this input stream.
boolean markSupported()
    Tests if this input stream supports the mark and reset methods.
void reset()
    Repositions this stream to the position at the time the mark method was last
    called on this input stream.
```

"bytes from a file" and "bytes as text" ...

- Create new FileInputStream and connect it to a specific file
- "decorate" the stream with an InputStreamReader that will do Unicode translation for you

```
FileInputStream(String name)
    Create a FileInputStream by opening a connection to an actual file, the
    file named by the path name in the file system.

InputStreamReader(InputStream in)
    Create an InputStreamReader that uses the default character encoding.

InputStreamReader(InputStream in, String enc)
    Create an InputStreamReader that uses the named character encoding.
```

prepare to read a text file

1

open an InputStream connected to the filename provided

```
public TextFileRead(String fn) throws IOException {
    InputStream in = new FileInputStream(fn);
    textReader = new BufferedReader(new InputStreamReader(in));
}
```

3

add buffering capability so that we read many bytes in one operation

2

make it a Reader so that we get valid Unicode characters

... or "bytes from a file as text"

- Create new FileReader and connect it to a file
  - » FileReader is a convenience class for reading character files. The constructors of this class assume that the default character encoding and the default byte-buffer size are appropriate. To specify these values yourself, construct an InputStreamReader on a FileInputStream.

```
FileReader(String fileName)
    Creates a new FileReader, given the name of the file to read from.
```

prepare to read a text file

```
public TextFileRead(String fn) throws IOException {
    textReader = new BufferedReader(new FileReader(fn));
}
```

1

Open a new Reader with an implicit InputStream connected to the filename provided

2

add buffering capability so that we read many bytes in one operation

readline()

- Read one line from a BufferedReader
  - » returns a String containing the contents of the line, not including any line-termination characters, or null if the end of the stream has been reached

```
/**
 * Read one line from the text file and return it as a String
 * to the caller.
 * The line might be null (at end of file), empty (0 characters),
 * or blank (all whitespace).  Of course, it might also be a
 * non-blank String with some useful characters in it.
 * @return a String containing the next line or null if
 * we are at the end of the file
 * @throws IOException if there is an error reading the file
 */
 public String getNextLine() throws IOException {
     return textReader.readLine();
 }
```

Detecting end of file

- End of file is expected when using readline()
  - » you will eventually read all the characters in a file
- So the method returns **`null`** if we are end of file
  - » you must check for null after every readline() call

```
String myLine = tr.getNextLine();
while (myLine != null) {
        System.out.println(">> "+myLine);
        myLine = tr.getNextLine();
}
```

close when done

- After reading through the file, you should close the stream, since an open file takes up system resources and prevents other programs from using the file

```
/**
* Close the stream.
*/
public void close() throws IOException {
        textReader.close();
}
```

"bytes to a file as text"

- Create new PrintWriter and connect it to a file using a FileWriter
  - » PrintWriter provides the text formatting capabilities
  - » FileWriter provides the connection between the PrintWriter and the actual file
  - » FileWriter is a convenience class like FileReader
    - could use OutputStreamWriter with a FileOutputStream

```
PrintWriter(Writer out)
    Create a new PrintWriter, without automatic line flushing.

FileWriter(String fileName)
    Constructs a FileWriter object given a file name.
```

prepare to write a file

1

create a new file with the name given to us for writing

```
public TextFileWrite(String fn) throws IOException {
    File sink = new File(fn);
    sink.createNewFile();
    System.out.println("Created "+sink.getAbsolutePath());
    textWriter = new PrintWriter(new BufferedWriter(new FileWriter(sink)));
}
```

4

add formatting so that Java can convert values to character strings for us

3

add buffering for efficiency

2

open the file as a Writer so Unicode works correctly

println(...)

- Print formatted representations of objects and primitive type to a text-output stream
  - » does not contain methods for writing raw bytes, for which a program should use unencoded byte streams

```
/**
* Write one line on the output file.
* @param line the line of text to write out
*/
public void writeOneLine(String s) {
        textWriter.println(s);
}
```

close when done

- After writing the file, you should close the stream
  - » the last data that you have written may not actually have gotten all the way out to the disk - closing makes sure that the data is flushed to disk
  - » an open file takes up system resources and prevents other programs from using the file

```
/**
* Close the stream.
*/
public void close() throws IOException {
    textWriter.close();
}
```

The File class

- Manages an entry in a directory (a pathname)
- Several constructors are available
  - » File(String pathname)
    - pathname string
  - » File(String parent, String child)
    - parent pathname string and a child pathname string.
  - » File(File parent, String child)
    - parent pathname File object and a child pathname string.
- The File() constructors create a pathname object in memory, NOT a new file on disk

File class example

```
File wd = new File("uwcse.jar");
System.out.println("Path: "+wd.getPath());
System.out.println("Absolute Path: "+wd.getAbsolutePath());
System.out.println("Canonical Path: "+wd.getCanonicalPath());
System.out.println("Exists? "+wd.exists());
System.out.println("Is directory? "+wd.isDirectory());
```

- Creating a new File object just creates a tool for managing files, it does not create a new file on disk!
  - » Creating a new Dog object did not create a new dog running around the room ...
- Use the methods of the File class to actually do things

File class methods

- Create, rename, delete a file
  - » createNewFile(), createTempFile(), renameTo(), delete()
- Determine whether a file exists and access limitations
  - » exists(), canRead(), canWrite()
- Get file info
  - » getParent(), getCanonicalPath(), length(), lastModified()
- Create and get directory info
  - » mkdirs(), list(), listFiles(), getParent()
- Etc, etc