CS203 Programming with Data Structures

Input and Output

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Overview

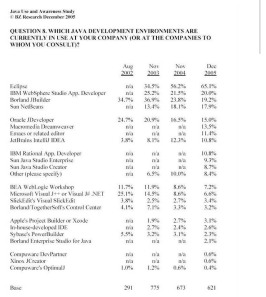
- Java IDEs
- Package
- Input and output
- Exception handling

Java IDEs

- JBuilder
  - Commercial with a scaled-down free version (`JBuilder Foundation`)
- Eclipse
  - http://www.eclipse.org
  - High quality and free
  - Many tools and plug-ins have to be installed separately
- Netbeans
  - http://www.netbeans.org
  - All-in-one package
  - Slow on older computers

IDE Usage Statistics

- Survey by *BZ Research* in December 2005
  - Eclipse: 65.1%
  - JBuilder: 19.2%
  - Netbeans: 17.9%



Java Use and Awareness Study
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QUESTION 8. WHICH JAVA DEVELOPMENT ENVIRONMENTS ARE CURRENTLY IN USE AT YOUR COMPANY (OR AT THE COMPANIES TO WHOM YOU CONSULT)?

	Aug 2002	Nov 2003	Nov 2004	Dec 2005
Eclipse	n/a	34.5%	56.2%	65.1%
IBM WebSphere Studio App. Developer	n/a	25.2%	21.5%	20.0%
Borland JBuilder	34.7%	30.9%	23.8%	19.2%
Sun NetBeans	n/a	13.4%	18.1%	17.9%
Oracle JDeveloper	24.7%	20.9%	16.5%	15.0%
Macromedia Dreamweaver	n/a	n/a	n/a	13.5%
Emacs or related editor	n/a	n/a	n/a	11.4%
JetBrains IntelliJ IDEA	3.0%	8.1%	12.3%	10.8%
IBM Rational App. Developer	n/a	n/a	n/a	10.8%
Sun Java Studio Enterprise	n/a	n/a	n/a	9.3%
Sun Java Studio Creator	n/a	n/a	n/a	8.7%
Other (please specify)	n/a	6.3%	10.0%	8.4%
BEA WebLogic Workshop	11.7%	11.9%	8.6%	7.2%
Microsoft's Visual Studio or Visual J# .NET	25.1%	14.9%	8.6%	6.4%
MetaMatrix Visual MetaEdit	3.4%	5.5%	3.7%	3.4%
Borland TogetherSoft's Control Center	4.1%	7.1%	3.3%	3.2%
Apple's Project Builder or Xcode	n/a	1.9%	2.7%	3.1%
In-house-developed IDE	n/a	2.7%	2.4%	2.6%
Sybase's PowerBuilder	5.9%	3.2%	3.1%	2.3%
Borland Enterprise Studio for Java	n/a	n/a	n/a	2.1%
Compuware DevPartner	n/a	n/a	n/a	0.8%
Xinox JCreator	n/a	n/a	n/a	0.6%
Compuware's OptimalJ	1.0%	1.2%	0.6%	0.4%
Base	291	775	673	621

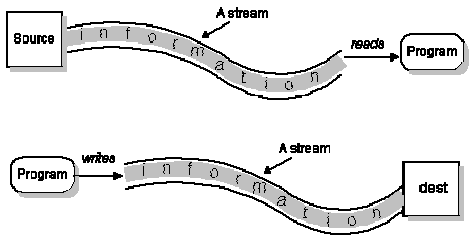
Package

- Why do we need it?
- What does it do?
- Package and directory

Input and Output

- Console
  - Scanner
  - System.out
- GUI
- File
  - Reader and Writer
  - InputStream and OutputStream
  - Scanner
- Command line parameters

Understand `java.io` Package

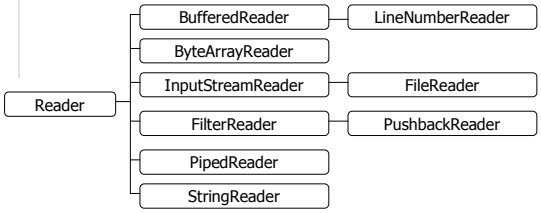


http://java.sun.com/j2se/1.5.0/docs/api/java/io/package-summary.html

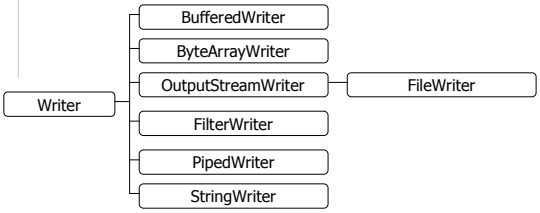
Stream Types

- Character streams
  - Textual information
  - Handled by *Reader* and *Writer* classes
- Byte streams
  - Binary information
  - Handled by *InputStream* and *OutputStream* classes

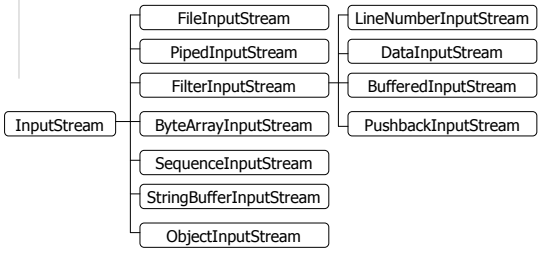
Reader Classes



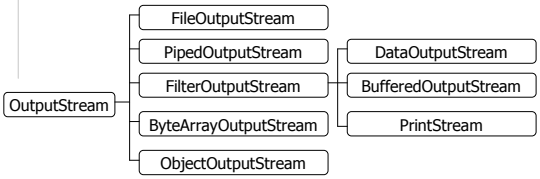
Writer Classes



InputStream Classes



OutputStream Classes



Basic Streams by Source/Destination

- Files
  - FileReader/Writer/InputStream/OutputStream
- Threads
  - PipedReader/Writer/InputStream/OutputStream
- Memory
  - ByteArrayReader/Writer/InputStream/OutputStream
  - StringReader/Writer
  - StringBufferInputStream
- General
  - InputStream, InputStreamReader
  - OutputStream, OutputStreamWriter

Basic Stream Operations

- Basic streams only recognize *bytes* or *characters*
- Operations
  - Read/write a single byte or character
  - Read/write an array of bytes or characters
- Inconvenient

Wrapper Streams by Function

- Data conversion
  - DataInputStream/OutputStream
- Printing
  - PrintStream
- Buffering
  - BufferedReader/Writer/InputStream/OutputStream
- Object serialization
  - ObjectInputStream/OutputStream
- Others

Important Wrapper Streams and Operations

- DataInputStream and DataOutputStream
  - Read and write primitive types
  - readInt(), readDouble(), …
  - writeInt(int i), writeDoube(double d), …
- BufferedReader
  - readLine()
- BufferedWriter
  - write(String s)

"Wrapping" Examples

```
// buffered text file read/write
BufferedReader br = new BufferedReader( new FileReader("file") );
BufferedWriter bw = new BufferedWriter( new FileWriter("file") );

// un-buffered binary file read/write
DataInputStream di = new DataInputStream( new FileInputStream("file") );
DataOutputStream do = new DataOutputStream( new FileOutputStream("file") );

// buffered binary file read/write
DataInputStream di2 = new DataInputStream( new BufferedInputStream(
                                    new FileInputStream() ) );
DataOutputStream do2 = new DataOutputStream( new BufferedOutputStream(
                                    new FileOutputStream() ) );
```

How to Choose from Stream Classes

- Step 1: Is the data in **binary** form or **textual** form?
  - Binary: Input/OutputStream
  - Textual: Reader/Writer
- Step 2: What's the data **source** or data **destination**?
  - Files, threads, memory, general
- Step 3: How to **process** the data?
  - Primitive data types, buffering, …

File Input Example

- Read from a file in the following format, and sum up all numbers

```
31    20    30
22    33    –1    43
23    33    44    45
79    1
-10
```

Paths

- Windows
  - Absolute path
    - c:\path\to\file
  - Relative path
    - path\to\file
- Unix
  - Absolute path
    - /path/to/file
  - Relative path
    - path/to/file
- File separators – "**/**", "****", **File.separator**

Exception Handling

- `throw` and `throws`
- `try`, `catch`, and `finally`
- `Exception` class
  - `getMessage()`
  - `printStackTrace()`

`Scanner` Class

- A Java 1.5 feature
- In `java.util` package

```
Scanner s = new Scanner(System.in);
String param = s.next();
int value = s.nextInt();
s.close();

int sum = 0;
Scanner s2 = new Scanner( new File("test") );
while( s2.hasNext() ) sum += s2.nextInt();
s2.close()
```

`File` Class

- Not directly related to I/O
- Check file status
  - Is a file or a directory
  - Exist, readable, writable
  - Name, path, parent
  - Length
- Perform common file/directory operations
  - Get parent, list children
  - Delete, rename, mkdir

Binary File vs. Text File

- If we can save data in either binary or text form, which one do we choose?
  - File size
  - Convenience
  - Speed
- Either way, always use buffering!

Random Access File

- The problem with the *stream* model
- Advantages of `RandomAccessFile`
  - Deal with both binary and text files
  - Provide both read and write methods
  - `seek(long pos)`
- … but we don't use it often. Why?