Java + XML = JDOM

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Mountain View Java User's Group
April 26, 2000

Introductions

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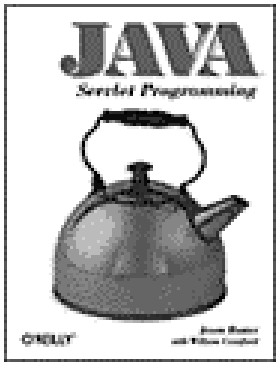

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Introductions

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What is JDOM?

- JDOM is the Java Document Object Model
- A way to represent an XML document for easy and efficient reading, manipulation, and writing
  - Straightforward API
  - Lightweight and fast
  - Java-optimized
- Despite the name similarity, it's not build on DOM or modeled after DOM
  - Although it integrates well with DOM and SAX
  - Name chosen for accuracy, not similarity to DOM
- An open source project with an Apache-style license

The JDOM Philosophy

- JDOM should be straightforward for Java programmers
  - Use the power of the language (Java 2)
  - Take advantage of method overloading, the Collections APIs, reflection, weak references
  - Provide conveniences like type conversions

- JDOM should hide the complexities of XML wherever possible
  - An Element has content, not a child Text node, which has content (ala DOM)
  - Exceptions should contain useful error messages
  - Give line numbers and specifics, use no SAX or DOM classes or constructs

More JDOM Philosophy

- JDOM should integrate with DOM and SAX
  - Support reading and writing DOM documents and SAX events
  - Support runtime plug-in of *any* DOM or SAX parser
  - Easy conversion from DOM/SAX to JDOM
  - Easy conversion from JDOM to DOM/SAX
- JDOM should stay current with the latest XML standards
  - DOM Level 2, SAX 2.0, XML Schema
- JDOM does not need to solve every problem
  - It should solve 80% of the problems with 20% of the effort
  - We think we got the ratios to 90% / 10%

The Historical Alternatives: DOM

- DOM is a large API designed for complex environments
  - Represents a document tree fully held in memory
  - Has to 100% accurately represent any XML document (well, it attempts to)
  - Has to have the same API on multiple languages
  - Reading and changing the document is non-intuitive
  - Fairly heavyweight to load and store in memory

The Historical Alternatives: SAX

- SAX is a lightweight API designed for fast reading
  - Callback mechanism reports when document elements are encountered
  - Lightweight since the document is never entirely in memory
  - Does not support modifying the document
  - Does not support random access to the document
  - Fairly steep learning curve to use correctly

Do you need JDOM?

- JDOM is a lightweight API
  - Benchmarks of "load and print" show performance on par with SAX
  - Manipulation and output are also lightning fast
- JDOM can represent a full document
  - Not all must be in memory at once
- JDOM supports document modification
  - And document creation from scratch, no "factory"
- JDOM is easy to learn
  - Optimized for Java programmers
  - Doesn't require in-depth XML knowledge
  - Allows easing into SAX and DOM, if needed
  - Simple support for namespaces, validation

The Document class

- Documents are represented by the **`org.jdom.Document`** class
  - A lightweight object holding a **`DocType`**, **`ProcessingInstruction`**s, a root **`Element`**, and **`Comment`**s

- It can be constructed from scratch:

```
Document doc =
  new Document(new Element("rootElement"));
```

- Or it can be constructed from a file, stream, or URL:

```
Builder builder = new SAXBuilder();
Document doc = builder.build(url);
```

The Build Process

- A Document can be constructed using any build tool
  - The SAX build tool uses a SAX parser to create a JDOM document

- Current builders are SAXBuilder and DOMBuilder
  - **`org.jdom.input.SAXBuilder`** is fast and recommended
  - **`org.jdom.input.DOMBuilder`** is useful for reading an existing DOM tree
  - A builder can be written that lazily constructs the Document as needed
  - Other possible builders: LDAPBuilder, SQLBuilder

Builder Classes

- Builders have optional parameters to specify implementation classes and whether DTD-based validation should occur.

```
SAXBuilder(String parserClass, boolean validate);
DOMBuilder(String adapterClass, boolean validate);
```

- Not all DOM parsers have the same API
  - Xerces, XML4J, Project X, Oracle (V1 and V2)
  - The DOMBuilder **`adapterClass`** implements **`org.jdom.adapters.DOMAdapter`**
  - Implements standard methods by passing through to an underlying parser
  - Adapters for all popular parsers are provided
  - Future parsers require just a small adapter class

- Once built, documents are not tied to their build tool

The Output Process

- A Document can be written using any output tool
  - **`org.jdom.output.XMLOutputter`** tool writes the document as XML
  - **`org.jdom.output.SAXOutputter`** tool generates SAX events
  - **`org.jdom.output.DOMOutputter`** tool creates a DOM document (coming soon)
  - Any custom output tool can be used

- To output a **`Document`** as XML:

```
XMLOutputter outputter = new XMLOutputter();
outputter.output(doc, System.out);
```

- For machine-consumption, pass optional parameters
  - Zero-space indent, no new lines

```
outputter = new XMLOutputter("", false);
outputter.output(doc, System.out);
```

Pretty Printer

```
import java.io.*;
import org.jdom.*;
import org.jdom.input.*;
import org.jdom.output.*;

public class PrettyPrinter {
  public static void main(String[] args) {
    // Assume filename argument
    String filename = args[0];
    try {
      // Build w/ SAX and Xerces, no validation
      Builder b = new SAXBuilder();
      // Create the document
      Document doc = b.build(new File(filename));

      // Output as XML to screen
      XMLOutputter outputter = new XMLOutputter();
      outputter.output(doc, System.out);
    } catch (Exception e) {
      e.printStackTrace();
    }
  }
}
```

The DocType class

- A **`Document`** may have a **`DocType`**

```
<!DOCTYPE html PUBLIC
 "-//W3C//DTD XHTML 1.0 Transitional//EN"
 "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
```

- This specifies the DTD of the document
  - It's easy to read and write

```
DocType docType = doc.getDocType();
System.out.println("Element: " +
                   docType.getElementName());
System.out.println("Public ID: " +
                   docType.getPublicID());
System.out.println("System ID: " +
                   docType.getSystemID());

doc.setDocType(
  new DocType("html", "-//W3C...", "http://..."));
```

The Element class

- A **`Document`** has a root **`Element`**:

```
<web-app id="demo">
  <description>
    Gotta fit servlets in somewhere!
  </description>
  <distributable/>
</web-app>
```

- Get the root as an **`Element`** object:

```
Element webapp = doc.getRootElement();
```

- An **`Element`** represents something like **`web-app`**
  - Has access to everything from the open **`<web-app>`** to the closing **`</web-app>`**

Playing with Children

- An element may contain child elements

```
// Get a List of direct children as Elements
List allChildren = element.getChildren();
out.println("First kid: " +
            allChildren.get(0).getName());

// Get all direct children with a given name
List namedChildren = element.getChildren("name");

// Get the first kid with a given name
Element kid = element.getChild("name");

// Namespaces are supported
kid = element.getChild("nsprefix:name");
kid = element.getChild("nsprefix", "name");
```

- **`getChild()`** may throw **`NoSuchElementException`**

Playing with Grandchildren

```
<linux-config>
  <gui>
    <window-manager>
      <name>Enlightenment</name>
      <version>0.16.2</version>
    </window-manager>
    <!-- etc -->
  </gui>
</linux-config>
```

- Grandkids can be retrieved easily:

```
String manager =
     root.getChild("gui")
         .getChild("window-manager")
         .getChild("name")
         .getContent();
```

- Future JDOM versions are likely to support XPath

Managing the Population

- Children can be added and removed through **`List`** manipulation or convenience methods:

```
List allChildren = element.getChildren();

// Remove the fourth child
allChildren.remove(3);

// Remove all children named "jack"
allChildren.removeAll(
                  element.getChildren("jack"));
element.removeChildren("jack");

// Add a new child
allChildren.add(new Element("jane"));
element.addChild(new Element("jane"));

// Add a new child in the second position
allChildren.add(1, new Element("second"));
```

Making Kids

- Elements are constructed directly, no factory method needed

```
Element element = new Element("kid");
```

- Some prefer a nesting shortcut, possible since **`addChild()`** returns the **`Element`** on which the child was added:

```
Document doc = new Document(
  new Element("family")
    .addChild(new Element("mom"))
    .addChild(new Element("dad")
       .addChild("kidOfDad")));
```

- A subclass of **`Element`** can be made, already containing child elements and content

```
root.addChild(new FooterElement());
```

Making the linux-config Document

- This code constructs the **<linux-config>** seen previously:

```
Document doc = new Document(
  new Element("linux-config")
    .addChild(new Element("gui")
      .addChild(new Element("window-manager")
        .addChild(new Element("name")
          .setContent("Enlightenment"))
        .addChild(new Element("version")
          .setContent("0.16.2"))
    )
  );
```

Getting Element Attributes

- Elements often contain attributes:

```
<table width="100%" border="0"> </table>
```

- Attributes can be retrieved several ways:

```
String value =
   table.getAttribute("width").getValue();

// Get "border" as an int, default of 2
int value =
  table.getAttribute("border").getIntValue(2);

// Get "border" as an int, no default
try {
  value =
   table.getAttribute("border").getIntValue();
}
catch (DataConversionException e) { }
```

- **`getAttribute()`** may throw **`NoSuchAttributeException`**

Setting Element Attributes

- Element attributes can easily be added or removed

```
// Add an attribute
table.addAttribute("vspace", "0");

// Add an attribute more formally
table.addAttribute(
  new Attribute("prefix", "name", "value"));

// Remove an attribute
table.removeAttribute("border");

// Remove all attributes
table.getAttributes().clear();
```

Element Content

- Elements can contain text content:

```
<description>A cool demo</description>
```

- The content is directly available:

```
String content = element.getContent();
```

- And can easily be changed:

```
// This blows away all current content
element.setContent("A new description");
```

Mixed Content

- Sometimes an element may contain comments, text content, and children

```
<table>
  <!-- Some comment -->
  Some text
  <tr>Some child</tr>
</table>
```

- Text and children can be retrieved as always:

```
String text = table.getContent();
Element tr = table.getChild("tr");
```

- This keeps the standard uses simple

Reading Mixed Content

- To get all content within an **`Element`**, use **`getMixedContent()`**
  - Returns a **`List`** containing **`Comment`**, **`String`**, and **`Element`** objects

```
List mixedContent = table.getMixedContent();
Iterator i = mixedContent.iterator();
while (i.hasNext()) {
  Object o = i.next();
  if (o instanceof Comment) {
    // Comment has a toString()
    out.println("Comment: " + o);
  }
  else if (o instanceof String) {
    out.println("String: " + o);
  }
  else if (o instanceof Element) {
    out.println("Element: " +
                ((Element)o).getName());
  }
}
```

The ProcessingInstruction class

- Some documents have **`ProcessingInstruction`**s

```
<?cocoon-process type="xslt"?>
```

- PIs can be retrieved by name and their "attribute" values are directly available:

```
ProcessingInstruction cp =
    doc.getProcessingInstruction(
                    "cocoon-process");
cp.getValue("type");
```

- All PIs can be retrieved as a **`List`** with **`doc.getProcessingInstructions()`**
  - For simplicity JDOM respects PI order but not the actual placement

- **`getProcessingInstruction()`** may throw **`NoSuchProcessingInstructionException`**

Namespaces

- Namespaces are a DOM Level 2 addition
  - JDOM always supports even with DOM Level 1 parsers and even with validation on!

- Namespace prefix to URI mappings are held in the Document object
  - Element knows prefix and local name
  - Document knows prefix to URI mapping
  - Lets Elements easily move between Documents

- Retrieve and set a namespace URI for a prefix with:

```
String uri = doc.getNamespaceURI("linux");
doc.addNamespaceMapping(
  "linux", "http://www.linux.org");
```

- This mapping applies even for elements added previously

Using Namespaces

- Elements have "full names" with a prefix and local name
  - Can be specified as two strings
  - Can be specified as one "**`prefix:localname`**" string

```
kid = elt.getChild("JavaXML", "Contents");
kid = elt.getChild("JavaXML:Contents");
kid = elt.getChild("Contents");
```

- Allows apps to ignore namespaces if they want.

- Element constructors work the same way.

List Details

- The current implementation uses **`LinkedList`** for speed
  - Speeds growing the **`List`**, modifying the **`List`**
  - Slows the relatively rare index-based access
- All **`List`** objects are mutable
  - Modifications affect the backing document
  - Other existing list views do not see the change
  - Same as SQL **`ResultSet`**s, etc.

Exceptions

- **`JDOMException`** is the root exception
  - Thrown for build errors
  - Always includes a useful error message
  - May include a "root cause" exception

- Subclasses include:
  - **`NoSuchAttributeException`**
  - **`NoSuchElementException`**
  - **`NoSuchProcessingInstructionException`**
  - **`DataConversionException`**

Future

- There may be a new high-speed builder
  - Builds a skeleton but defers full analysis
  - Use of the List interface allows great flexibility
- There could be other implementations outside **`org.jdom`**
  - The should follow the specification
  - The current implementation is flexible
  - We don't expect alternate implementations to be necessary

Get Involved

- Download the software
  - **`http://jdom.org`**
- Read the specification
  - Coming soon
- Sign up for the mailing lists (see **`jdom.org`**)
  - **`jdom-announce`**
  - **`jdom-interest`**
- Watch for JavaWorld and IBM developerWorks articles
  - **`http://www.javaworld.com`**
  - **`http://www.ibm.com/developerWorks`**
- Help improve the software!