ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

Ενότητα 12: Document Object Model (DOM) - 1

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

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επένδυση στην κοινωνία της γνώσης
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

XML
Document Object Model (DOM)
605.444 / 635.444

David Silberberg

Lecture 18

Introduction to DOM

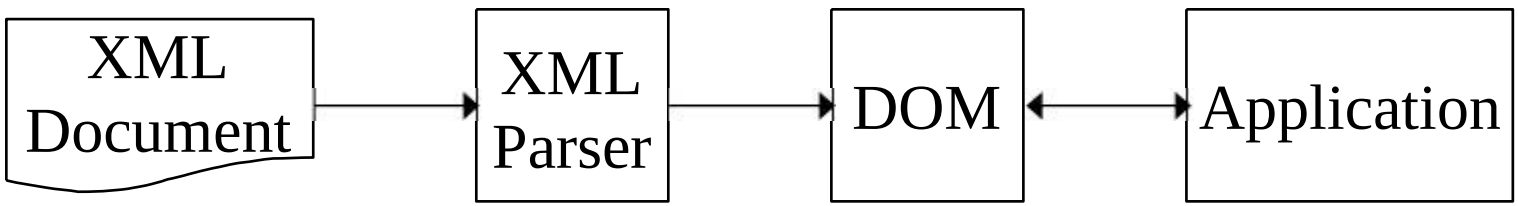
- Origins in the World Wide Web Consortium (W3C)
  - DOM is a standard, like XML itself
  - SAX is different
    - Public-domain software
    - Developed through XML-dev mailing list
- Not designed specifically for Java
  - Represents content across all programming languages and tools
  - Bindings exist for
    - JavaScript
    - Java
    - CORBA
  - Cross-platform and cross-language specification

Introduction (continued)

- DOM is organized by levels, not versions
  - Each level gets more specific for different representations
    - XML
    - HTML
    - Cascading Stylesheets
  - Level 1 an accepted recommendation
    - http://www.w3c.org/TR/REC-DOM-Level-1/
    - Details the navigation of content within an XML-like document
  - Level 2
    - http://www.w3c.org/TR/REC-DOM-Level-2/
    - Supplies modules and options for specific content models
    - Specifically address representations unique to XML, HTML, CSS, etc.
  - Level 3
    - http://www.w3.org/TR/DOM-Level-3-Core/
    - Recommendation 07-April-2004

What is the DOM?

- The Document Object Model (DOM) is an abstract representation of an XML document
- A structural representation of a document
- Process
  - Parse an XML document
  - Create a representative model
  - Allow application(s) to interact with and manipulate the model



Why Not SAX?

- SAX is sequential
  - SAX acquires and loses the data as the parser does
  - DOM provides an entire document model at once
  - Access to DOM can be random
    - Can access multiple elements simultaneously
    - Can access elements out of order
- SAX has no concept of siblings
  - It is a depth-first parser
  - Does not inherently keep track of parents, children, or siblings
  - DOM provides the entire hierarchy at once

Getting a DOM Parser

- Apache Xerces: http://xml.apache.org
- IBM XML4J: http://alphaworks.ibm.com/tech/xml4j
- Aelfred: http://www.microstar.com/aelfred.html
- James Clark's XP: http://www.jclark.com/xml/xp
- Datachannel DXP:
  http://www.datachannel.com/products/xjparser.html
- OpenXML: http://www.openxml.org
- Oracle XML Parser: http://technet.oracle.com/tech/xml
- Sun Microsystems Project X: http:// java.sun.com/products/xml
- Tim Bray's Lark and Larval: http://www.textuality.com/Lark
- W3C Web site: http://www.w3c.org

- Microsoft MSXML parser does not conform to W3C standards

Getting Started with DOM

- DOM does not specify structure of hierarchy
- DOM specifies interfaces
  - Enables multi-language binding
  - Enables freedom of representation or DOM vendors
- Classes to import
  - import org.w3c.dom.*;
- Most parsers and XSLT packages already contain DOM

Importing DOM Parser

```
import org.apache.xerces.parsers.DOMParser;    // vendor DOM parser


public class DOMParserDemo {

    pubic void performDemo(String uri) {
        System.out.println("Parsing XML File: " + uri + "\n");
        DOMParser parser = new DOMParser();
        try {
            // parser.parse(uri);
        } catch (Exception ex) {
            System.out.println(ex.getMessage());
        }
    }
```

Importing DOM Parser (2)

```
    public static void main(String[] args) {

        String uri = args[0];

        if (args.length != 1) {
            System.out.println("Usage: java DOMParser [URI]");
            System.exit(0);
        }
        DOMParserDemo pDemo = new DOMParserDemo();
        pDemo.performDemo(uri);
    }
}
```

Lack of DOM Portability

- SAX provides a SAXParserFactory(*SAXObject*) class
  - Import the class name
  - Factory instantiates a call Class.forName(*SAXObject*)
- DOM does not provide this portability
  - Vendor differences prevent this
  - Some DOM **parse()** routines return an **org.w3c.dom.Document** object
  - Some DOM **parse()** routines provide a **getDocument()** method
  - Sometimes different parameters are required for the parse
- However, routines that access and manipulate the DOM tree are standard

Performing the Parse and Getting the Document

- SAX uses callbacks
  - Programmer creates methods to deal with events
  - Events are called during the parse
  - Callbacks are like "hooks" into the data
- DOM creates a tree structure first
  - Program looses control until the parse is complete
  - Program gets a "handle" on the document
  - Programmer writes routines to access and manipulate the DOM Document tree

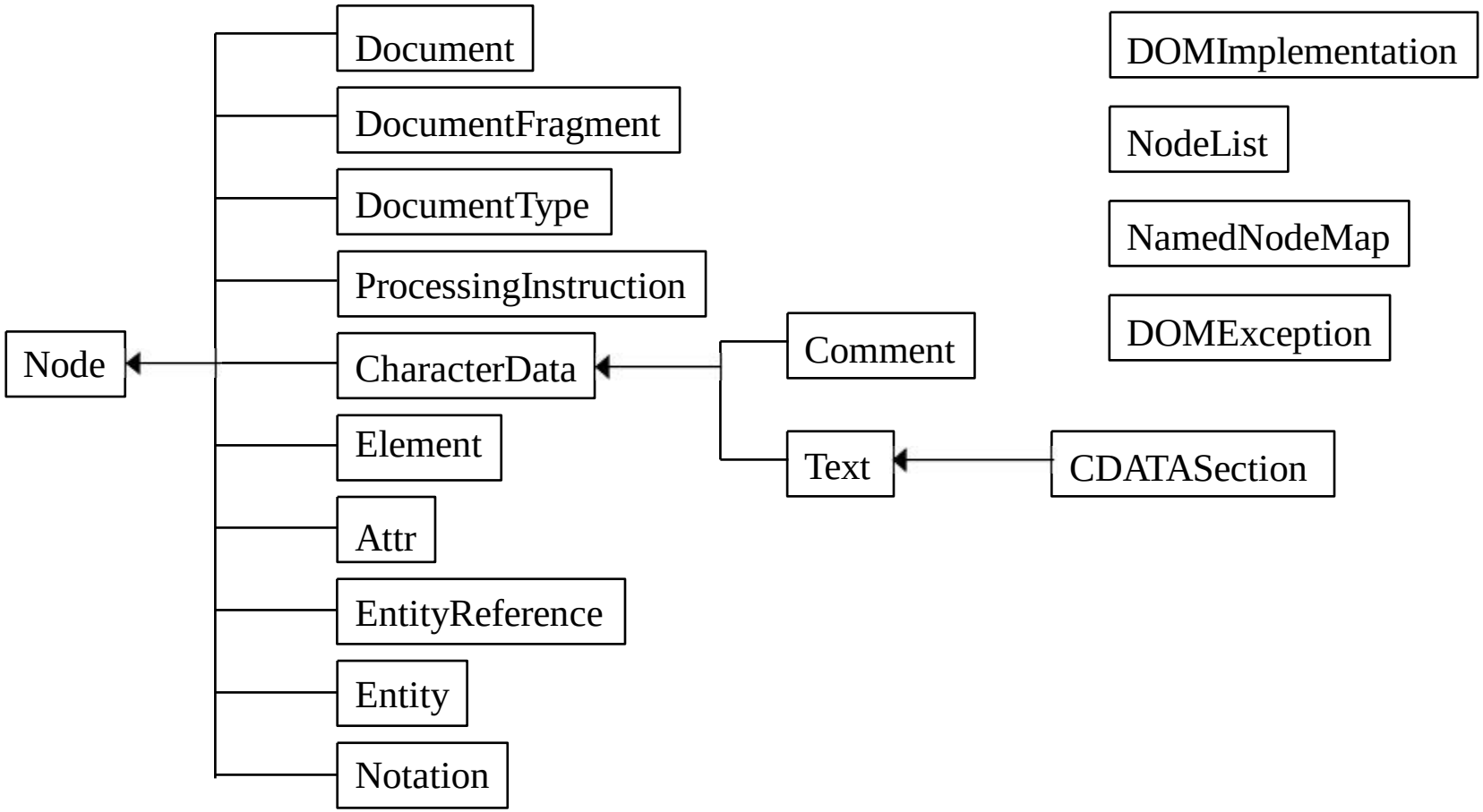
Example (Xerces Xalan)

```
import org.apache.xerces.parsers.DOMParser;          // vendor DOM parser
import org.w3c.dom.Document;                         // Document class


public class DOMParserDemo {

    pubic void performDemo(String uri) {
        System.out.println("Parsing XML File: " + uri + "\n");
        DOMParser parser = new DOMParser();
        try {
            parser.parse(uri);
            Document doc = parser.getDocument();
        } catch (Exception ex) {
            System.out.println(ex.getMessage());
        }
    }
```

Accessing the DOM Tree

- A DOM document is a tree
- To print out a document backwards (sort of), you need to traverse the tree
- Each element of the tree is a Node
- Depending on the type of node, different methods are available
  - Different nodes are subclasses of the Node class
  - Methods are inherited
- Find children and recursively process them

Core DOM Data Type Inheritance Hierarchy



Setup for Print Reverse

```
import org.apache.xerces.parsers.DOMParser;          // vendor DOM parser
import org.w3c.dom.Document;                         // Document class
import org.w3c.dom.Node;                             // Node class
import java.io.File;
import java.io.FileWriter;
import java.io.OutputStream;
import java.io.OutputStreamWriter;
import org.w3c.dom.DocumentType;
import org.w3c.dom.NamedNodeMap;
import org.w3c.dom.NodeList;
```

Setup for Print Reverse (2)

```
public class DOMParserDemo {

    pubic void writeReverse(String uri, String fileName) {
        System.out.println("Parsing XML File: " + uri + "\n");
        System.out.println("Writing reverse XML File: " + fileName + "\n");
        DOMParser parser = new DOMParser();
        try {
            parser.parse(uri);
            Document doc = parser.getDocument();
            printReverse(doc, fileName);
        } catch (Exception ex) {
            System.out.println(ex.getMessage());
        }
    }
```

Setup for Print Reverse (3)

```
public static void main(String[] args) {

    String uri = args[0];
    String fileName = args[1];

    if (args.length != 2) {
        System.out.println("Usage: java DOMParser [URI] [Outfile]");
        System.exit(0);
    }
    DOMParserDemo pDemo = new DOMParserDemo();
    pDemo.writeReverse(uri, fileName);
}
```

Setup for Print Reverse (4)

```
int indent = -4;          // The number of characters to indent the output


public void printReverse(Document doc, String fileName)  {
      try{
         FileWriter fw = new FileWriter(fileName);
         BufferedWriter bw = new BufferedWriter(fw);
         printReverseNodes(doc, bw);
      } catch (IllegalArgumentException iae) {
         System.out.println("Illegal argument : " + iae.getMessage());
      } catch (IOException ioe) {
         System.out.println("IO exception: " + ioe.getMessage());
      }
}
```

Setup for Print Reverse (5)

```
public void printReverseNodes(Node node, Writer writer)  {
    int iter;
    indent +=4;
    switch (node.getNodeType()) {
    case Node.DOCUMENT_NODE:
        break;

    case Node.ELEMENT_NODE:
        break;

    case Node.TEXT_NODE:
        break;

    case Node.CDATA_SECTION_NODE:
        break;
```

Setup for Print Reverse (6)

```
            case Node.COMMENT_NODE:
                break;

            case Node.PROCESSING_INSTRUCTION_NODE:
                break;

            case Node.ENTITY_REFERENCE_NODE:
                break;

            case Node.DOCUMENT_TYPE_NODE:
                break;

            indent = indent - 4;
        }
    }
```

Printing Out the Document Level Information

- Not everything should be reversed
  - Just the body of the document
  - Therefore, just print the document and processing information first
- Cast the document to a node
- Call the **printReverseNodes()** routine recursively

```
case Node.DOCUMENT_NODE:
    writer.write("<?xml version=\"1.0\"?>\n");
    Document doc = (Document)node;
    indent = -4;  // start at the front
    printReverseNodes(doc.getDocumentElement(), writer);
    break;
```

Printing Elements

- Most common task
- Elements have names, attributes, and children
  - getNodeName()
  - getAttributes()
  - getChildNodes()
- Children are represented as a node list
- Need to iterate through list of children to process children
- Need to iterate through list of attributes to process attributes

Printing Elements (2)

```
case Node.ELEMENT_NODE:
    String eltName = node.getNodeName();
    writeIndent(writer);

    // Write element
    writer.write("<" + eltName);
    // recurse on attributes - reverse their orders as well
    NamedNodeMap attributes = node.getAttributes();
    for (iter=attributes.getLength()-1; iter>=0; iter--) {
        Node attribute = attributes.item(iter);
        writer.write(" " +  attribute.getNodeName() +
                     "=\"" + attribute.getNodeValue() + "\"");
    }
    writer.write(">\n");
```

Printing Elements (3)

```
// Recurse on children elements
NodeList children = node.getChildNodes();

if (children != null) {
      // Write a line break
      if (children.item(0) != null &&
         children.item(children.getLength()-1).getNodeType() ==
         Node.ELEMENT_NODE) {
         writer.write("\n");
      }
      // Recurse in reverse on the children
      for (iter=children.getLength()-1; iter>=0; iter--) {
          printReverseNodes(children.item(iter), writer) ;
      }
```

Printing Elements (4)

```
        // Write another line break at the end
        if (children.item(0) != null &&
            children.item(0).getNodeType() ==
            Node.ELEMENT_NODE) {
            writer.write("\n");
        }
}

//Finish up the element
writeIndent(writer);
writer.write("</" + eltName + ">\n");
break;
```

Writing Data and Comments

```
case Node.TEXT_NODE:
    writer.write(node.getNodeValue());
    break;

case Node.CDATA_SECTION_NODE:
    writer.write("<![CDATA[" + node.getNodeValue() + "]]>");
    break;

case Node.COMMENT_NODE:
    writer.write("\n");
    writeIndent(writer);
    writer.write("<!-- " + node.getNodeValue() + " -->\n");
    break;
```

Processing Instructions

```
// Processing instructions are divided into names and values.
// The name is the processing instruction name.
// The value is a string which contains the list of data values.
// If you want to process these (e.g., reverse them), you need to
// parse and process the value string.

case Node.PROCESSING_INSTRUCTION_NODE:
    writer.write("\n");
    writeIndent(writer);
    writer.write("<?" + node.getNodeName() + " " +
                 node.getNodeValue() + "?>\n");
    break;
```

DOCTYPES

```
case Node.DOCUMENT_TYPE_NODE:
    DocumentType docType = (DocumentType)node;
    writer.write("\n");
    writeIndent(writer);
    writer.write("<!DOCTYPE " + docType.getName());
    if (docType.getPublicId() != null) {
        writer.write("PUBLIC \"" + docType.getPublicId() +
            "\"");
    } else {
        writer.write("SYSTEM ");
    }
    writer.write("\""+ docType.getSystemId() + "\">");
    writer.write("\n");
    break;
```

Entity Reference Nodes

```
        // Entity references are like #DEFINEs in C or C++
        // DOM parsers do not always pass them through -- they may
        // be preprocessed

        case Node.ENTITY_REFERENCE_NODE:
            writer.write("\n");
            writeIndent(writer);
            writer.write("&" + node.getNodeName() + ";");
            break;
    }
```

Write Indent

```
public void writeIndent(Writer writer)  {
        StringBuffer sb = new StringBuffer();
        for (int j = 0; j < indent; j++)
                sb.append(" ");
        writer.write(sb.toString());
}
```

Printing Processing Instructions

- We want to reverse the elements of the document
- The call to **doc.getDocumentElement()** actually retrieves processing the document root element
- However, the PI's and DOCTYPE's are at the same level as the root object.
- Therefore, they will not be printed out
- Furthermore, one doesn't want these reversed
- PI's and DOCTYPE's need to remain at the top of the document

Ensure that the Document Element is Last

```
case Node.DOCUMENT_NODE:
    writer.write("<?xml version=\"1.0\"?>\n");
    // recurse on highest children
    NodeList nodes = node.getChildNodes();
    if (nodes != null) {
        for (iter = 0; iter < nodes.getLength()-1; iter++) {
            indent = -4;
            printReverseNodes(nodes.item(iter), writer);
        }
    }
    Document doc = (Document)nodes.item(nodes.getLength()-1);
    indent = -4;
    printReverseNodes(doc.getDocumentElement(), writer);
    break;
```

SAX Exceptions

- DOM is a standard interface
- Nothing standardizes the internal structure of the DOM tree
- Often, DOM parsers use SAX
  - Parses document
  - Places results in DOM tree
- This means that SAX exceptions may be thrown
  - Need to catch SAX exceptions
  - Need to import **org.xml.sax.SAXException** in code

SAX Exception Code

```
pubic void writeReverse(String uri, String fileName) {
        System.out.println("Parsing XML File: " + uri + "\n");
        System.out.println("Writing reverse XML File: " + fileName + "\n");
        DOMParser parser = new DOMParser();
        try {
                parser.parse(uri);
                Document doc = parser.getDocument();
                printReverse(doc, fileName);
        } catch (Exception ex) {
                System.out.println(ex.getMessage());
        } catch (SAXException saxe) {
                System.out.println(saxe.getMessage());
        }
}
```

Τέλος Ενότητας