ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

Ενότητα 12: Document Object Model (DOM) - 2

Χρήστος Νικολάου
Τμήμα Επιστήμης Υπολογιστών

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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

XML
Document Object Model (DOM)
Part 2
605.444 / 635.444

David Silberberg

Lecture 19

Creating a Document Through DOM

- Let‟s create a new document *school.xml*:

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/css" href="school.css"?>
<school id="0994">
      <name>Johns Hopkins University</name>
      <phone>800-548-3647</phone>
      <phone>410-516-8728</phone>
      <phone>443-778-6231</phone>
</school>
```

Imports

```
import java.io.*;

// DOM imports
import org.w3c.dom.Attr;
import org.w3c.dom.Comment;
import org.w3c.dom.Document;
import org.w3c.dom.DOMImplementation;
import org.w3c.dom.Element;
import org.w3c.dom.NamedNodeMap;
import org.w3c.dom.Node;
import org.w3c.dom.ProcessingInstruction;
import org.w3c.dom.Text;

// Parser import
import org.apache.xerces.dom.DOMImplementationImpl;
import org.apache.xerces.parsers.DOMParser;
```

Create File

```
public class MakeFile {
    private static final String FILE_DIR = "";
    private FileWriter file;
    private BufferedWriter fOut;
    private boolean fCanonical;

    public static void main(String[] args) {
        if (args.length != 1) {
            System.out.println("Usage: java MakeFile [filename]");
            System.exit(0);
        }
        System.out.println("Making new file: " + args[0] + "\n");
        new MakeFile(args[0]);
    }
```

Create Document and PI

```
public MakeFile(String filename) {
      try {
         // Create new DOM tree
         // This is Apache XERCES specific
         DOMImplementation domImpl = new DOMImplementationImpl();
         // Create root element
         Document doc = domImpl.createDocument(null /*namespace*/,
                                  "school" /*root*/, null /*doctype*/);


         // Create PI
         ProcessingInstruction pi =
            doc.createProcessingInstruction("xml-stylesheet",
                                  "type=\"text/css\" href=\"school.css\"");
         doc.appendChild(pi);  // appends child to top of document
```

Create the Document Root

```
// Get the root - in this case, the root is "school"
Element root = doc.getDocumentElement();

// Set the root attribute
root.setAttribute("id", "0994");

// Create child elements
Element schoolName = doc.createElement("name");
Text schoolText =
    doc.createTextNode("Johns Hopkins University");
root.appendChild(schoolName);
schoolName.appendChild(schoolText);
```

Create Children

```
// Create child elements
Element phoneName = doc.createElement("phone");
Text phoneText =
    doc.createTextNode("800-548-3647");
root.appendChild(phoneName);
phoneName.appendChild(phoneText);

phoneName = doc.createElement("phone");
phoneText =
    doc.createTextNode("410-516-8728");
root.appendChild(phoneName);
phoneName.appendChild(phoneText);
```

Write Document

```
        phoneName = doc.createElement("phone");
         phoneText = doc.createTextNode("443-778-6231");
         root.appendChild(phoneName);
         phoneName.appendChild(phoneText);

         // Write out the file.
         // Assume a routine that writes out the file (as in the last lecture)
         file = new FileWriter(FILE_DIR +  filename + ".xml");
         fOut = new BufferedWriter(file);
         write(doc);
      }
      catch (IOException ioe) {
         System.out.println(ioe.getMessage());
      }
   }
```

Document Writer

```
/*
   * The Apache Software License, Version 1.1
   *
   *
   * Copyright (c) 1999, 2000 The Apache Software Foundation.  All rights
   * reserved.
   *
   * Redistribution and use in source and binary forms, with or without
   * modification, are permitted provided that the following conditions
   * are met:
   *
   * yada yada yada */
```

Write Document Node

```
/** Writes the specified node, recursively. */
public void write(Node node) throws IOException {
    // is there anything to do?
    if (node == null)
        return;
    short type = node.getNodeType();
    switch (type) {
    case Node.DOCUMENT_NODE: {
        if (!fCanonical) {
            fOut.write("<?xml version=\"1.0\" encoding=\"UTF-8\"?>");
            fOut.flush();
        }
        Document document = (Document)node;
        write(document.getDocumentElement());
        break;
    }
```

Write Element Node

```
case Node.ELEMENT_NODE: {
   fOut.write('<');
   fOut.write(node.getNodeName());
   Attr attrs[] = sortAttributes(node.getAttributes());
   for (int i = 0; i < attrs.length; i++) {
      Attr attr = attrs[i];
      fOut.write(' ');
      fOut.write(attr.getNodeName());
      fOut.write("=\"");
      normalizeAndPrint(attr.getNodeValue());
      fOut.write("");
   }
   fOut.write('>');
   fOut.flush();
   Node child = node.getFirstChild();
   while (child != null) {
      write(child);
      child = child.getNextSibling();
   }
   break;
}
```

Write Entity Reference Node

```
case Node.ENTITY_REFERENCE_NODE: {
   if (fCanonical) {
      Node child = node.getFirstChild();
      while (child != null) {
         write(child);
         child = child.getNextSibling();
      }
   }
   else {
      fOut.write('&');
      fOut.write(node.getNodeName());
      fOut.write(';');
      fOut.flush();
   }
   break;
}
```

Write CDATA and Text Nodes

```
case Node.CDATA_SECTION_NODE: {
    if (fCanonical) {
        normalizeAndPrint(node.getNodeValue());
    }
    else {
        fOut.write("<![CDATA[");
        fOut.write(node.getNodeValue());
        fOut.write("]]>");
    }
    fOut.flush();
    break;
}

case Node.TEXT_NODE: {
    normalizeAndPrint(node.getNodeValue());
    fOut.flush();
    break;
}
```

Write Processing Instruction Node

```
    case Node.PROCESSING_INSTRUCTION_NODE: {
        fOut.write("<?");
        fOut.write(node.getNodeName());
        String data = node.getNodeValue();
        if (data != null && data.length() > 0) {
            fOut.write(' ');
            fOut.write(data);
        }
        fOut.write("?>");
        fOut.flush();
        break;
    }
}
```

Write Element Node

```
 if (type == Node.ELEMENT_NODE) {
      fOut.write("</");
      fOut.write(node.getNodeName());
      fOut.write('>');
      fOut.flush();
   }

} // write(Node)
```

Sort Attributes

```
/** Returns a sorted list of attributes. */
protected Attr[] sortAttributes(NamedNodeMap attrs) {

    int len = (attrs != null) ? attrs.getLength() : 0;
    Attr array[] = new Attr[len];
    for (int i = 0; i < len; i++) {
        array[i] = (Attr)attrs.item(i);
    }
    for (int i = 0; i < len - 1; i++) {
        String name = array[i].getNodeName();
        int index = i;
        for (int j = i + 1; j < len; j++) {
            String curName = array[j].getNodeName();
            if (curName.compareTo(name) < 0) {
                name = curName;
                index = j;
            }
        }
```

Sort Attributes

```
        if (index != i) {
            Attr temp = array[i];
            array[i] = array[index];
            array[index] = temp;
        }
    }

    return array;

} // sortAttributes(NamedNodeMap):Attr[]
```

Normalize and Print Text

```
/** Normalizes and prints the given string. */
   protected void normalizeAndPrint(String s)
       throws IOException {

       int len = (s != null) ? s.length() : 0;
       for (int i = 0; i < len; i++) {
           char c = s.charAt(i);
           normalizeAndPrint(c);
       }

   } // normalizeAndPrint(String)
```

Normalize and Print Text

```
/** Normalizes and print the given character. */
protected void normalizeAndPrint(char c)
    throws IOException {

    switch (c) {
    case '<': {
        fOut.write("&lt;");
        break;
    }
    case '>': {
        fOut.write("&gt;");
        break;
    }
    case '&': {
        fOut.write("&amp;");
        break;
    }
```

Normalize and Print Text

```
        case "": {
            fOut.write("&quot;");
            break;
        }
        case '\r':
        case '\n': {
            if (fCanonical) {
                fOut.write("&#");
                fOut.write(Integer.toString(c));
                fOut.write(';');
                break;
            }
            // else, default print char
        }
        default: {
            fOut.write(c);
        }
        }
    } // normalizeAndPrint(char)
}
```

General Document Operations

- **DOMImplementation**
  - Attempts to provide a standard interface onto creating DOM documents
  - **import org.w3c.dom.DOMImplementation;**
  - Creates Documents
  - Creates DOCTYPEs

```
public DocumentType createDocumentType(
    String qualifiedName, String publicId, String systemId);

public Document createDocument(
    String NamespaceURI, String qualifiedName, DocumentType docType);
```

Example

- This DOM code:

```
DOMImplementation domImpl = new DOMImplementationImpl();
DocumentType docType = domImpl.createDocumentType(
      "student", null /* public id */, "file:///DTDs/student.dtd" /* sys id */);
Document doc = domImpl.createDocument(null /*uri*/, "student"
    /*qname*/, docType);
```

- Creates an internal representation of the following XML document:

```
<?xml version="1.0"?>
<!DOCTYPE student SYSTEM "file:///DTDs/student.dtd">
<student>
</student>
```

Document Methods

- General **Document** methods
- **import org.w3c.dom.Document;**

- public DocumentType getDoctype()
  - Gets the document type
- public DOMImplementation getImplementation()
  - Gets the document implementation
  - Not much that you can do with it except create a DocumentType or Document
- public Element getDocumentElement()
  - Gets the root element of the document
  - This is the starting point for navigating through the document
  - This is also the starting point for creating/modifying the document

Document Creation Methods

- Creates parts of the document
- Does not place it into the document until told to do so
  - Handled by the Node operations
  - Node.insertBefore(…)
  - Node.replaceChild(…)
  - Node.appendChild(…)
  - Will be covered in the Node operations section
- public Element createElement(String tagName)
  - Creates element with „tagName“
  - Throws DOMException

Document Creation Methods

- public Text createTextNode(String textData)
  - Creates text node to be attached to an element
- public Comment createComment(String commentData)
  - Creates a comment node with the comment data
- public ProcessingInstruction createProcessingInstruction (String target, String data)
  - Creates a PI with target and data
  - Data must be a String in the format „attr="val" attr="val" …“
- public Attribute createAttribute(String attributeName)
  - Creates attribute name
  - Append text to it later

Document Nodes - Retrieval

- public NodeList getElementsByTagName(String tagname)
  - Very useful
  - Gets a list of nodes that are named „tagname“
  - Each node contains the entire subtree beneath the node
- public NodeList getElementsByTagNameNS

  (String namespaceURI, String tagname)
  - Similar to getElementsByTagName
  - Gets a list of nodes that are named „tagname“ in the namespace „namespaceURI“

Example

```
Document doc = domImpl.createDocument(null, "student",
    docType);
...
NodeList nodeList =
    (NodeList)doc.getElementsByTagName("phone");
System.out.println("The JHU telephone numbers are:");
for (int j=0; j<nodeList.getLength(); j++) {
      Node phoneNode = nodeList.item(j);
      // process Node
      String phoneNumber = phoneNode.getNodeValue();
      System.out.println("      " + phoneNumber + "\n");
}
```

Node Operations

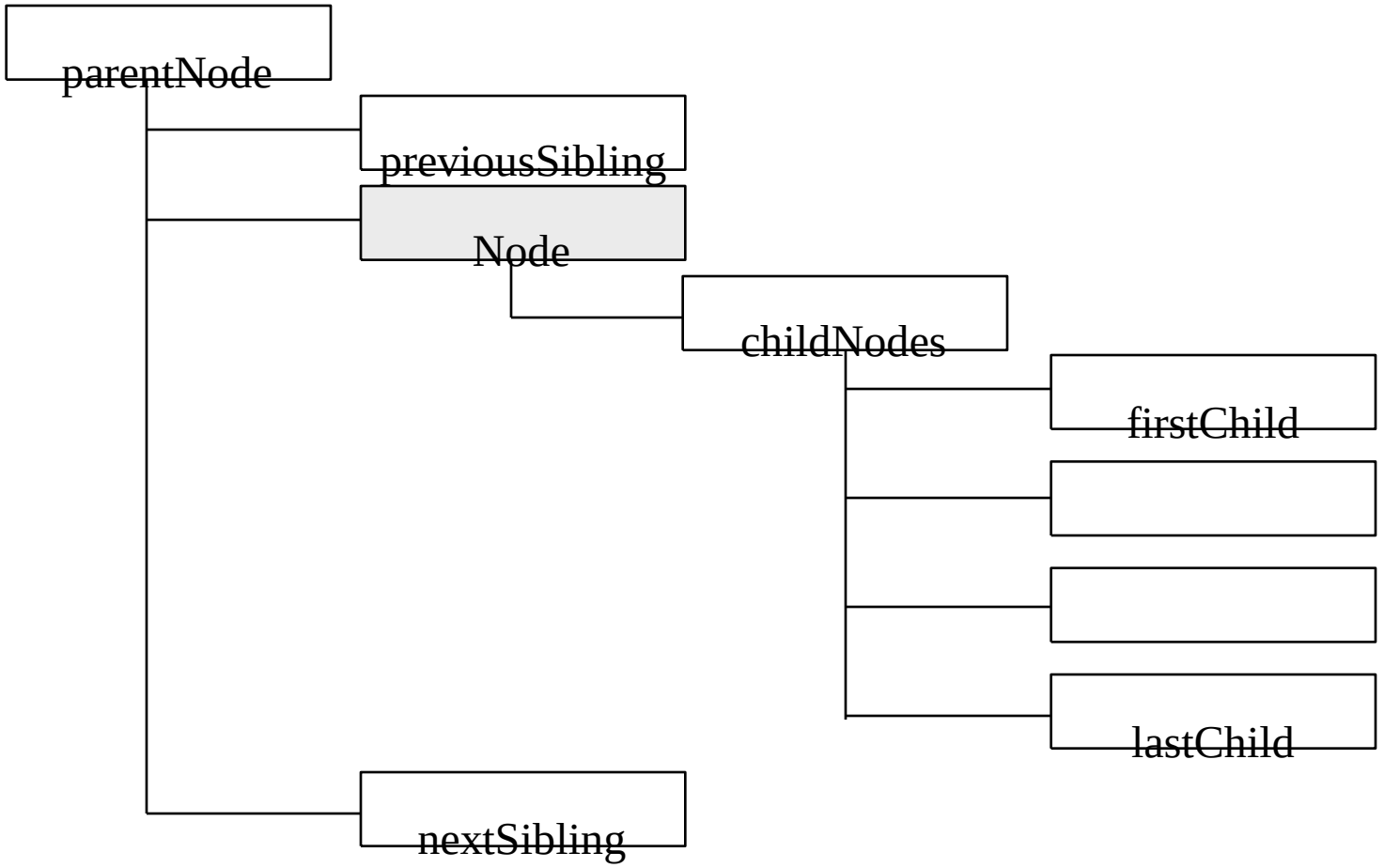
- Provides general operations on **Nodes**
- **import org.w3c.dom.Node;**

- public String getNodeName();
  - Retrieves node name
- public String getNodeValue() throws DOMException;
  - Retrieves the value of the node
  - Usually text, comment, etc.
- public void setNodeValue(String nodeValue) throws DOMException;
  - Sets the value of the node
  - Replaces value if it already exists

Node Operations (2)

- public short getNodeType()
  - Determines type of node for specific processing
  - ELEMENT_NODE
  - ATTRIBUTE_NODE
  - TEXT_NODE
  - CDATA_SECTION_NODE
  - ENTITY_REFERENCE_NODE
  - ENTITY_NODE
  - PROCESSING_INSTRUCTION_NODE
  - COMMENT_NODE
  - DOCUMENT_NODE
  - DOCUMENT_TYPE_NODE

Navigating a DOM Tree



Navigating a DOM Tree (2)

- These are very difficult to do in SAX
- public Node getParentNode();
  - Retrieves the parent node
- public NodeList getChildNodes();
  - Retrieves the child node
- public Node getFirstChild();
  - Retrieves the first child node
- public Node getLastChild();
  - Retrieves the last child node
- public Node getPreviousSibling();
  - Retrieves the previous node at the same level

Node Operations (3)

- public Node getNextSibling();
  - Retrieves the next node at the same level
- public NamedNodeMap getAttributes();
  - Retrieves a map of attributes

```
NamedNodeMap attrList = (NamedNodeMap)node.getAttributes();
for (int j=0; j<attrList.getLength(); j++) {
        Node attribute = attrList.item(j);
        // process attribute
}
```

Node Operations (4)

- public Document getOwnerDocument();
  - Gets the owner document for processing
  - (It is unlikely that you do not already have this.)
- public Node insertBefore (Node newChild, Node refChild) throws DOMException;
  - Places a new node before the referenced node
  - New node becomes the „previousSibling“ of the referenced node
- public Node replaceChild(Node newChild, Node oldChild) throws DOMException;
  - Removes the old child
  - Puts in its place the new Child

Node Operations (5)

- public Node removeChild(Node oldChild) throws DOMException;
  - Removed the child from the node
  - parentNode.removeChild(someChildNode);

- public Node appendChild (Node newChild) throws DOMException;
  - Appends the new child to the end of the child node list of the parent node
  - parentNode.appendChild(someChildNode);

Node Operations (6)

- public Node cloneNode(boolean deep)
  - Clones the current node
  - Either makes a deep or shallow copy
- public String getNamespaceURI();
  - Retrieves the URI of the namespace of the current node
- public String getPrefix();
  - Retrieves the prefix of the node name if it is a Namespace prefix
  - Otherwise, a zero-length string is returned
- public String setPrefix() throws DOMException
  - Sets the prefix of a node name

Example Node Operations

```
// Assume that „doc“ is the current Document
Document doc = domImpl.createDocument(null, "student", docType);
// Create document
…
// Process document
Element root = doc.getDocumentElement();
Node node = root.getFirstChild();
System.out.println("The JHU telephone numbers are:");
while (node != null) {
        if (node.getNodeName().equalsIgnoreCase("phone") {
                System.out.println("      " + node.getNodeValue() + "\n");
        }
        node = node.getNextSibling();
}
```

Element Operations

- Represent XML **Elements**
- **import org.w3c.dom.Element;**
- Elements are types of nodes
  - Element-specific methods mostly deal with the element name, attributes, and namespaces
  - Methods that deal with children are mostly found in Node methods because these are common to all nodes
- public String getTagName();
  - Gets the name of the element
- public String getAttribute(String name)
  - Gets the attribute value of a specific attribute

Element Operations (2)

- public void setAttribute(String name, String value) throws DOMException
  - Sets an attribute‟s value
- public void removeAttribute (String name) throws DOMException
  - Removes an attribute
- public Attr getAttributeNode(String name)
  - Gets the attribute as a node
- public void setAttributeNode (Attr newAttr) throws DOMException
  - Defines a new attribute for the element
- public void removeAttribute (Attr oldAttr)
  - Removes old attribute

Attribute Operations

- **Attr**ibutes are children of Elements
- **import org.w3c.dom.Attr;**

- public String getName()
  - Gets the name of the Attribute
- public String getValue()
  - Gets the value of the Attribute
- public void setValue(String value) throws DOMException;
  - Sets the attribute value
- public Element getOwnerElement()
  - Gets the owner element.

Setting Attributes

```
// Give each phone number a unique id
int id = 0;
Element root = doc.getDocumentElement();
Node node = root.getFirstChild();
while (node != null) {
        if (node.getNodeType() == Node.ELEMENT_NODE ) {
                Element  elt = (Element)node;
                if (elt.getTagName().equalsIgnoreCase("phone") {
                        Attr idAttr = doc.createAttribute("id");
                        idAttr.setValue(new String(++id));
                        elt.setAttributeNode(idAttr);
                }
        }
        node = node.getNextSibling();
}
```

Result

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/css" href="school.css"?>
<school id="0994">
        <name>Johns Hopkins University</name>
        <phone id=“1”>800-548-3647</phone>
        <phone id=“2”>410-516-8728</phone>
        <phone id=“3”>443-778-6231</phone>
</school>
```

Character Data Methods

- **CharacterData** is a „super“ interface for
  - **import org.w3c.dom.CharacterData;**
  - **import org.w3c.dom.CDATASection;**
  - **import org.w3c.dom.Comment;**
  - **import org.w3c.dom.Text;**
- Methods for accessing and setting data within a character data node

- public String getData() throws DOMException;
  - Gets the actual data

Character Data Methods (2)

- public String setData(String data) throws DOMException;
  - Sets the actual data
- public int getLength();
  - Gets the length of the data string
- public String substringData(int offset, int count) throws DOMException;
  - Gets a subset of the data
- public String appendData(String data) throws DOMException;
  - Appends data onto the pre-existing text

Character Data Methods (3)

- public String insertData(int offset, String data) throws DOMException;
  - Inserts the data into the character string
- public String deleteData(int offset, String data) throws DOMException;
  - Deletes the data from the character string
- public String replaceData(int offset, int count, String data) throws DOMException;
  - Replaces the data in the character string

Example Character Data

```
// Remove the area code from the telephone number and place it as an attribute
// in the element tag
Element root = doc.getDocumentElement();
Node node = root.getFirstChild();
while (node != null) {
      if (node.getNodeType() == Node.ELEMENT_NODE ) {
            Element  elt = (Element)node;
            if (elt.getTagName().equalsIgnoreCase("phone") {
                  moveAreaCode(elt);
            }
      }
      node = node.getNextSibling();
}
```

Example Character Data (2)

```
public void moveAreaCode(Element elt) {
    Document doc = elt.getOwnerDocument();
    Text  phoneNumber = (Text)elt.getFirstChild();
    if (phoneNumber.getLength() >= 3) {
        String areaCode = phoneNumber.substringData(0, 3);
        Attr idAttr = doc.createAttribute("areacode");
        idAttr.setValue(areacode);
        elt.setAttributeNode(idAttr);
        phoneNumber.deleteData(0,4);
    }
}
```

Result

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/css" href="school.css"?>
<school id="0994">
        <name>Johns Hopkins University</name>
        <phone areacode=“800”>548-3647</phone>
        <phone areacode=“410”>516-8728</phone>
        <phone areacode=“443”>778-6231</phone>
</school>
```

Τέλος Ενότητας

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