Extensible Markup Language (XML)

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Objectives

- In this lesson, you will learn:
  - To understand XML.
  - To be able to mark up data using XML.
  - To become familiar with the types of markup languages created with XML.
  - To understand the relationships among DTDs, Schemas and XML.
  - To understand the fundamentals of DOM-based and SAX-based parsing.
  - To understand the concept of an XML namespace.
  - To be able to create simple XSL documents.
  - To become familiar with Web services and related technologies.

20.1 Introduction

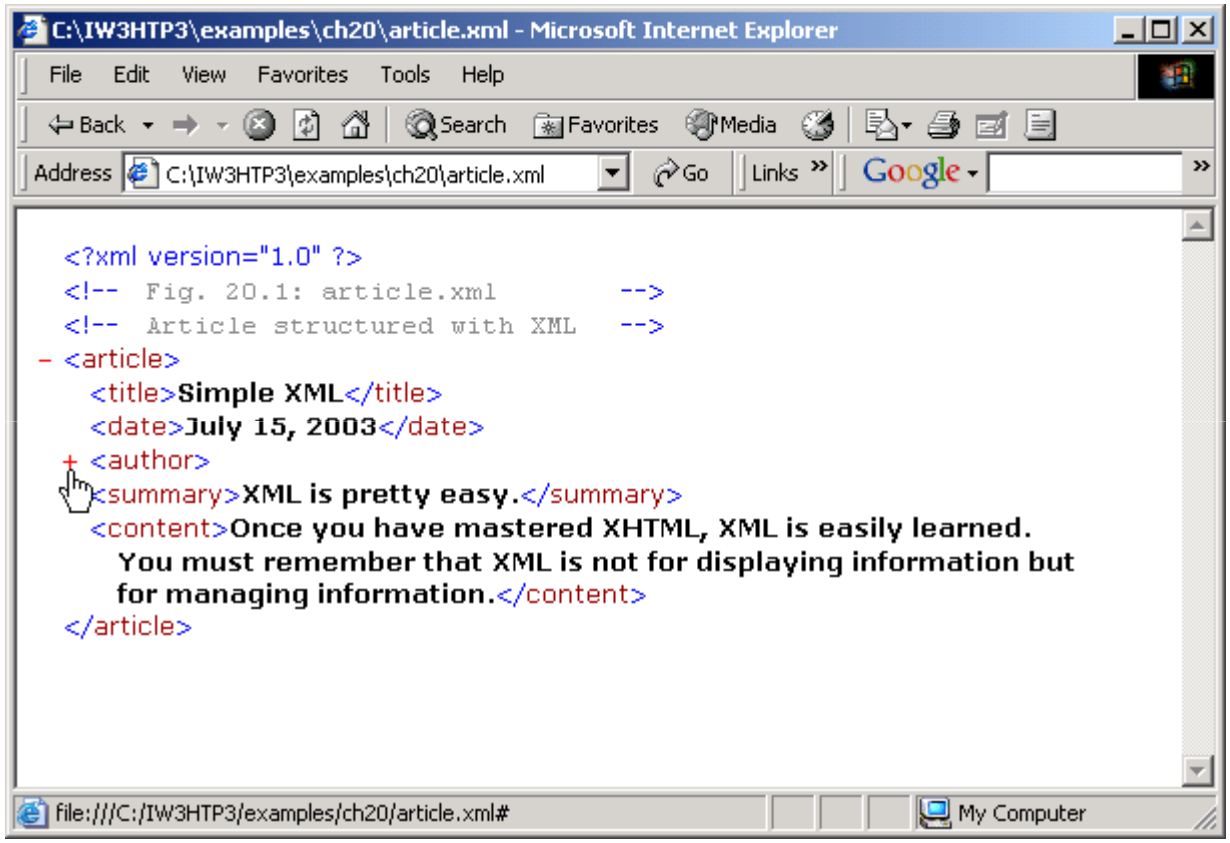
- XML (Extensible Markup Language)
  - Derived from Standard Generalized Markup Language (SGML)
  - Open technology for electronic data exchange and storage
  - Create other markup languages to describe data in structured manner
  - XML documents
    - Contain only data, not formatting instructions
    - Highly portable
    - XML parser
    - Support Document Object Model or Simple API XML
    - Document Type Definition (DTD, schema)
      - XML document can reference another that defines proper structure
  - XML-based markup languages
    - XML vocabularies

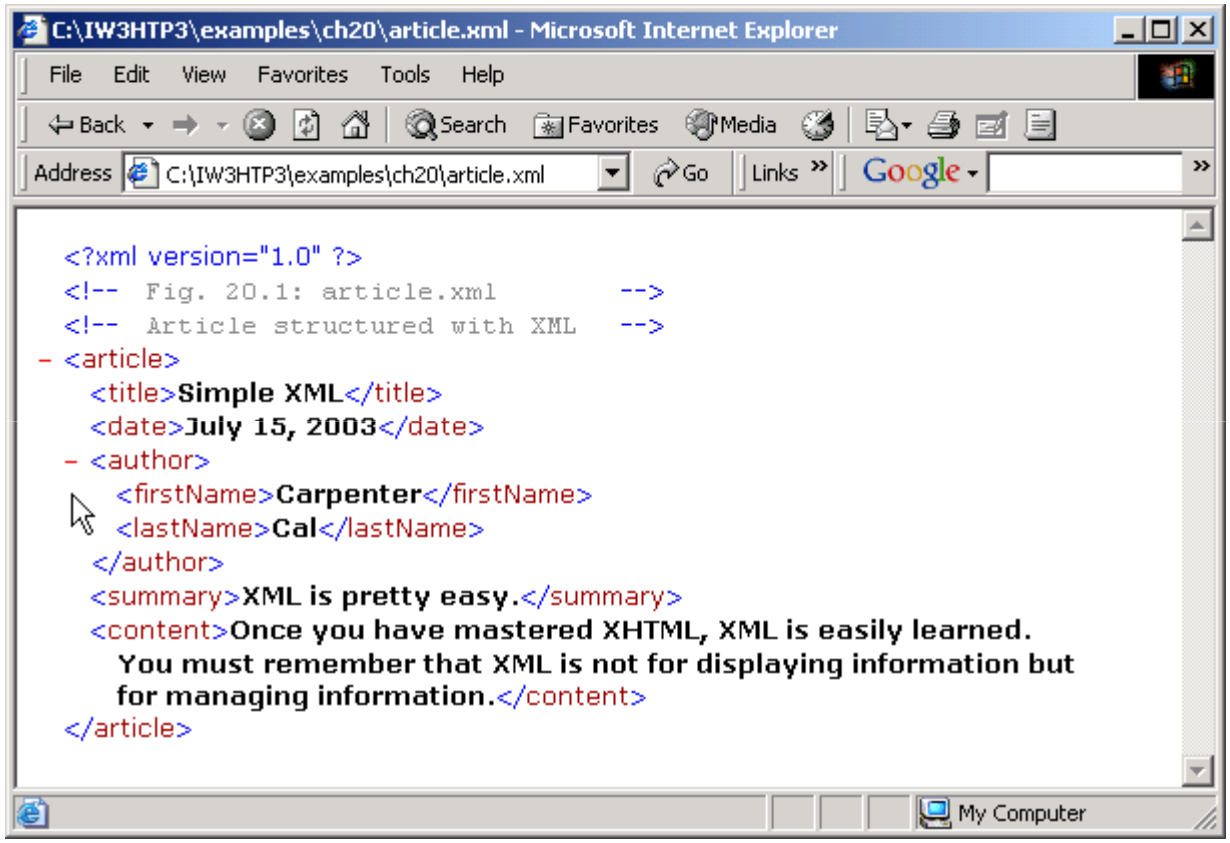
20.2 Structuring Data

- XML declaration
  - Value `version`
    - Indicates the XML version to which the document conforms
- Root element
  - Element that encompasses every other elements
- Container element
  - Any element contains other elements
- Child elements
  - Elements inside a container element
- Empty element `flag`
  - Does not contain any text
- DTD documents
  - End with `.dtd` extension

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.1: article.xml      -->
4  <!-- Article structured with XML -->
5
6  <article>
7
8     <title>Simple XML</title>
9
10    <date>July 15, 2003</date>
11
12    <author>
13       <firstName>Carpenter</firstName>
14       <lastName>Cal</lastName>
15    </author>
16
17    <summary>XML is pretty easy.</summary>
18
19    <content>Once you have mastered XHTML, XML is easily
20       learned. You must remember that XML is not for
21       displaying information but for managing information.
22    </content>
23
24 </article>
```

article.xml
(1 of 1)


C:\IW3HTP3\examples\ch20\article.xml - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address C:\IW3HTP3\examples\ch20\article.xml
Go Links
Google
<?xml version="1.0" ?>
<!-- Fig. 20.1: article.xml -->
<!-- Article structured with XML -->
- <article>
<title>Simple XML</title>
<date>July 15, 2003</date>
+ <author>
<summary>XML is pretty easy.</summary>
<content>Once you have mastered XHTML, XML is easily learned.
You must remember that XML is not for displaying information but
for managing information.</content>
</article>
file:///C:/IW3HTP3/examples/ch20/article.xml#
My Computer

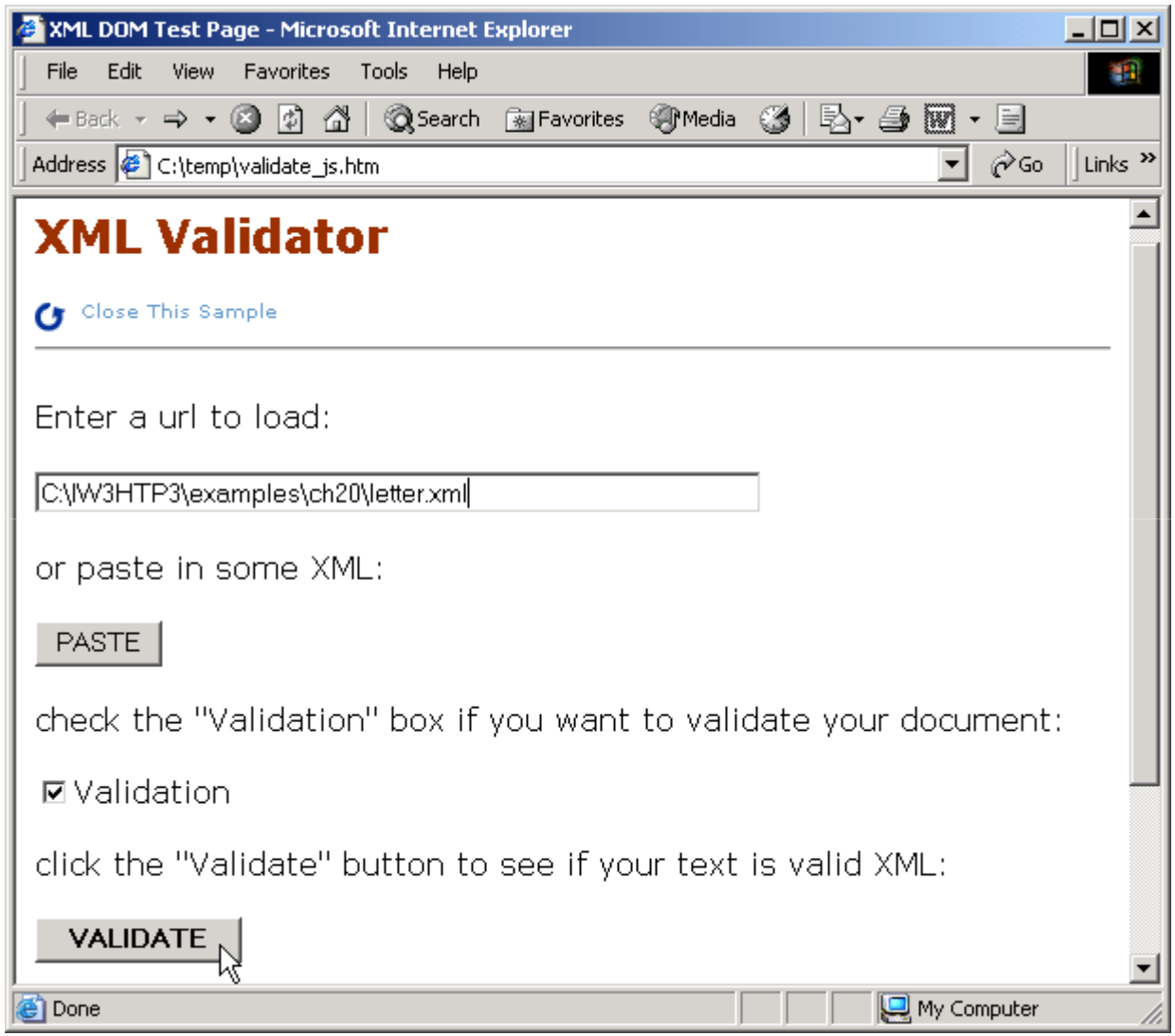

C:\IW3HTP3\examples\ch20\article.xml - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address C:\IW3HTP3\examples\ch20\article.xml
Go Links
Google
<?xml version="1.0" ?>
<!-- Fig. 20.1: article.xml -->
<!-- Article structured with XML -->
- <article>
<title>Simple XML</title>
<date>July 15, 2003</date>
- <author>
<firstName>Carpenter</firstName>
<lastName>Cal</lastName>
</author>
<summary>XML is pretty easy.</summary>
<content>Once you have mastered XHTML, XML is easily learned.
You must remember that XML is not for displaying information but
for managing information.</content>
</article>
My Computer

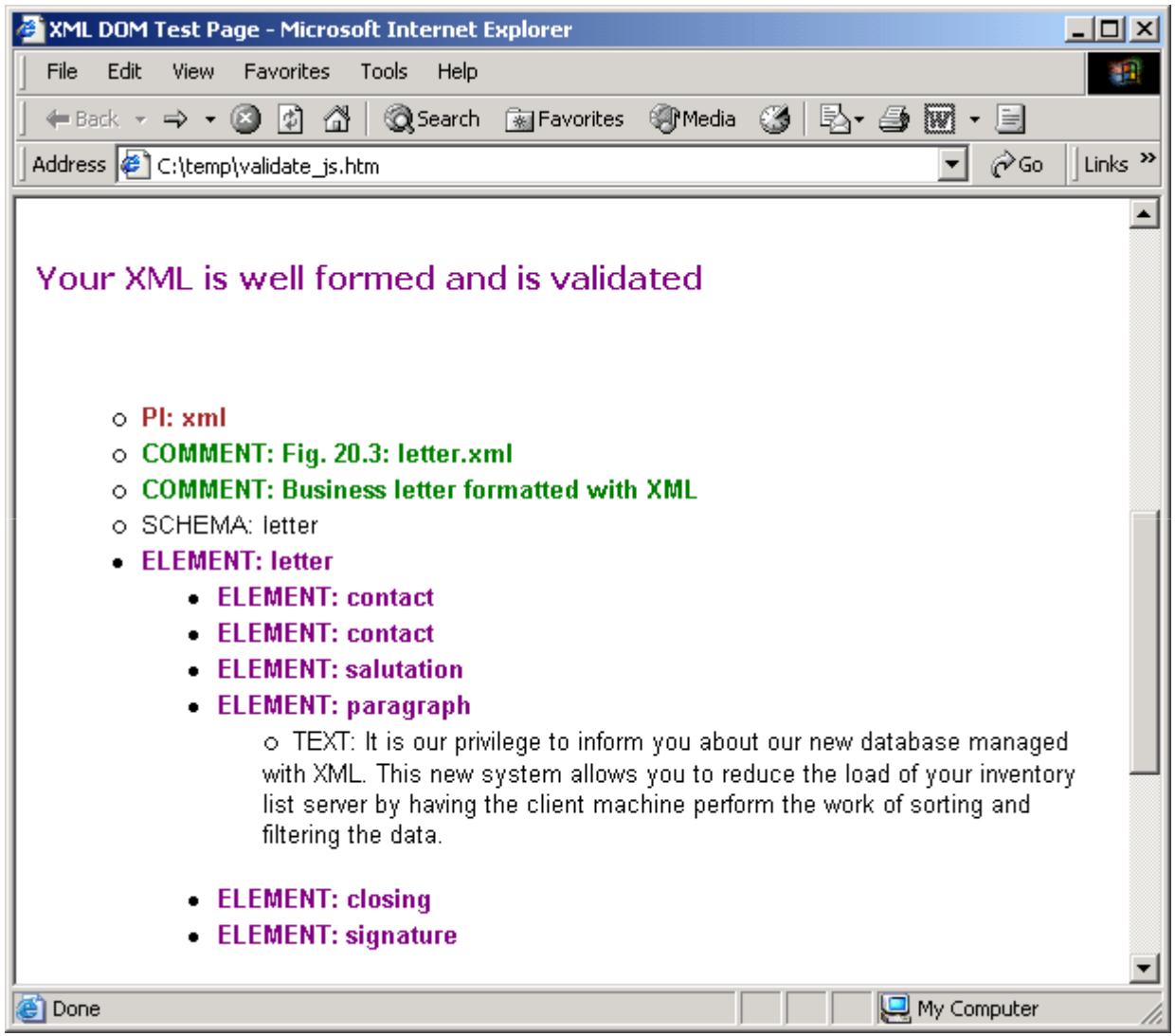
```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.3: letter.xml               -->
4  <!-- Business letter formatted with XML  -->
5
6  <!DOCTYPE letter SYSTEM "letter.dtd">
7
8  <letter>
9
10    <contact type = "from">
11       <name>John Doe</name>
12       <address1>123 Main St.</address1>
13       <address2></address2>
14       <city>Anytown</city>
15       <state>Anystate</state>
16       <zip>12345</zip>
17       <phone>555-1234</phone>
18       <flag gender = "M"/>
19    </contact>
20
21    <contact type = "to">
22       <name>Joe Schmoe</name>
23       <address1>Box 12345</address1>
24       <address2>15 Any Ave.</address2>
25       <city>Othertown</city>
```

letter.xml
(1 of 2)

```
26        <state>Otherstate</state>
27        <zip>67890</zip>
28        <phone>555-4321</phone>
29        <flag gender = "M"/>
30     </contact>
31
32     <salutation>Dear Sir:</salutation>
33
34     <paragraph>It is our privilege to inform you about our new
35        database managed with XML. This new system allows
36        you to reduce the load of your inventory list server by
37        having the client machine perform the work of sorting
38        and filtering the data.</paragraph>
39     <closing>Sincerely</closing>
40     <signature>Mr. Doe</signature>
41
42  </letter>
```

letter.xml
(2 of 2)


XML DOM Test Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address C:\temp\validate_js.htm
Go Links
XML Validator
Close This Sample
Enter a url to load:
C:\IW3HTP3\examples\ch20\letter.xml
or paste in some XML:
PASTE
check the "Validation" box if you want to validate your document:
Validation
click the "Validate" button to see if your text is valid XML:
VALIDATE
Done
My Computer


XML DOM Test Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address C:\temp\validate_js.htm
Go Links
Your XML is well formed and is validated
PI: xml
COMMENT: Fig. 20.3: letter.xml
COMMENT: Business letter formatted with XML
SCHEMA: letter
ELEMENT: letter
ELEMENT: contact
ELEMENT: contact
ELEMENT: salutation
ELEMENT: paragraph
TEXT: It is our privilege to inform you about our new database managed with XML. This new system allows you to reduce the load of your inventory list server by having the client machine perform the work of sorting and filtering the data.
ELEMENT: closing
ELEMENT: signature
Done
My Computer

20.3 XML Namespaces

- XML
  - Allows document authors to create custom elements
  - Naming collisions
  - XML namespace
    - Collection of element and attribute names
    - Uniform resource identifier (URI)
      - Uniquely identifies the namespace
      - A string of text for differentiating names
    - Any name except for reserved namespace `xml`
    - `Directory`
      - Root element and contains other elements

```xml
<?xml version = "1.0"?>

<!-- Fig. 20.4 : namespace.xml -->
<!-- Demonstrating Namespaces  -->

<text:directory xmlns:text = "urn:deitel:textInfo"
   xmlns:image = "urn:deitel:imageInfo">

   <text:file filename = "book.xml">
      <text:description>A book list</text:description>
   </text:file>

   <image:file filename = "funny.jpg">
      <image:description>A funny picture</image:description>
      <image:size width = "200" height = "100"/>
   </image:file>

</text:directory>
```

namespace.xml
(1 of 1)

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.5 : defaultnamespace.xml -->
4  <!-- Using Default Namespaces         -->
5
6  <directory xmlns = "urn:deitel:textInfo"
7     xmlns:image = "urn:deitel:imageInfo">
8
9     <file filename = "book.xml">
10       <description>A book list</description>
11    </file>
12
13    <image:file filename = "funny.jpg">
14       <image:description>A funny picture</image:description>
15       <image:size width = "200" height = "100"/>
16    </image:file>
17
18 </directory>
```

defaultnamespace .xml (1 of 1)

20.4 Document Type Definitions (DTDs) and Schemas

- Two types of documents for specifying XML document structure
  - Document Type Definition (DTDs)
  - Schemas

20.4.1 Document Type Definitions

- Enables XML parser to verify whether XML document is valid
- Allow independent user groups to check structure and exchange data in standardized format
- Expresses set of rules for structure using EBNF grammar
- `ELEMENT` type declaration
  - Defines rules
- `ATTLIST` attribute-list declaration
  - Defines an attribute

```
<!-- Fig. 20.6: letter.dtd       -->
<!-- DTD document for letter.xml -->

<!ELEMENT letter ( contact+, salutation, paragraph+,
   closing, signature )>

<!ELEMENT contact ( name, address1, address2, city, state,
   zip, phone, flag )>
<!ATTLIST contact type CDATA #IMPLIED>

<!ELEMENT name ( #PCDATA )>
<!ELEMENT address1 ( #PCDATA )>
<!ELEMENT address2 ( #PCDATA )>
<!ELEMENT city ( #PCDATA )>
<!ELEMENT state ( #PCDATA )>
<!ELEMENT zip ( #PCDATA )>
<!ELEMENT phone ( #PCDATA )>
<!ELEMENT flag EMPTY>
<!ATTLIST flag gender (M | F) "M">

<!ELEMENT salutation ( #PCDATA )>
<!ELEMENT closing ( #PCDATA )>
<!ELEMENT paragraph ( #PCDATA )>
<!ELEMENT signature ( #PCDATA )>
```

letter.dtd
(1 of 1)

20.4.2 W3C XML Schema Documents

- Schemas
  - Specify XML document structure
  - Do not use EBNF grammar
  - Use XML syntax
  - Can be manipulated like other XML documents
  - Require validating parsers
  - XML schemas
    - Schema vocabulary the W3C created
    - Recommendation
    - Schema valid
      - XML document that conforms to a schema document
      - Use `.xsd` extension

20.4.2 W3C XML Schema Documents

- Root element `schema`
  - Contains elements that define the XML document structure
  - `targetNamespace`
    - Namespace of XML vocabulary the schema defines
  - `element` tag
    - Defines element to be included in XML document structure
  - `name` and `type` attributes
    - Specify element's name and data type respectively
  - Built-in simple types
    - `date`, `int`, `double`, `time`, etc

20.4.2 W3C XML Schema Documents

- Two categories of data types
  - Simple types
    - Cannot contain attributes or child elements
  - Complex types
    - May contain attributes and child elements
    - `complexType`
      - Define complex type
    - Simple content
      - Cannot have child elements
    - Complex content
      - May have child elements

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.7 : book.xml       -->
4  <!-- Book list marked up as XML -->
5
6  <deitel:books xmlns:deitel = "http://www.deitel.com/booklist">
7     <book>
8        <title>XML How to Program</title>
9     </book>
10    <book>
11       <title>C How to Program</title>
12    </book>
13    <book>
14       <title>Java How to Program</title>
15    </book>
16    <book>
17       <title>C++ How to Program</title>
18    </book>
19    <book>
20       <title>Perl How to Program</title>
21    </book>
22 </deitel:books>
```

book.xml
(1 of 1)

```xml
<?xml version = "1.0"?>

<!-- Fig. 20.8 : book.xsd           -->
<!-- Simple W3C XML Schema document -->

<schema xmlns = "http://www.w3.org/2001/XMLSchema"
        xmlns:deitel = "http://www.deitel.com/booklist"
        targetNamespace = "http://www.deitel.com/booklist">

   <element name = "books" type = "deitel:BooksType"/>

   <complexType name = "BooksType">
      <sequence>
         <element name = "book" type = "deitel:SingleBookType"
                  minOccurs = "1" maxOccurs = "unbounded"/>
      </sequence>
   </complexType>

   <complexType name = "SingleBookType">
      <sequence>
         <element name = "title" type = "string"/>
      </sequence>
   </complexType>

</schema>
```

book.xsd
(1 of 1)

```
Target: file:///usr/local/XSV/xsvlog/@11038.1uploaded
   (Real name: C:\IW3HTP3\examples\ch 20\book.xsd)
docElt: {http://www.w3.org/2001/XMLSchema}schema
Validation was strict, starting with type [Anonymous]
The schema(s) used for schema-validation had no errors
No schema-validity problems were found in the target
```

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig 20.9 : computer.xsd -->
4  <!-- W3C XML Schema document -->
5
6  <schema xmlns = "http://www.w3.org/2001/XMLSchema"
7          xmlns:computer = "http://www.deitel.com/computer"
8          targetNamespace = "http://www.deitel.com/computer">
9
10    <simpleType name = "gigahertz">
11       <restriction base = "decimal">
12          <minInclusive value = "2.1"/>
13       </restriction>
14    </simpleType>
15
16    <complexType name = "CPU">
17       <simpleContent>
18          <extension base = "string">
19             <attribute name = "model" type = "string"/>
20          </extension>
21       </simpleContent>
22    </complexType>
23
```

computer.xsd
(1 of 2)

```
24     <complexType name = "portable">
25        <all>
26           <element name = "processor" type = "computer:CPU"/>
27           <element name = "monitor" type = "int"/>
28           <element name = "CPUSpeed" type = "computer:gigahertz"/>
29           <element name = "RAM" type = "int"/>
30        </all>
31        <attribute name = "manufacturer" type = "string"/>
32     </complexType>
33
34     <element name = "laptop" type = "computer:portable"/>
35
36  </schema>
```

computer.xsd
(2 of 2)

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig 20.10 : laptop.xml             -->
4  <!-- Laptop components marked up as XML -->
5
6  <computer:laptop xmlns:computer = "http://www.deitel.com/computer"
7                   manufacturer = "IBM">
8
9     <processor model = "Centrino">Intel</processor>
10    <monitor>17</monitor>
11    <CPUSpeed>2.4</CPUSpeed>
12    <RAM>256</RAM>
13
14 </computer:laptop>
```

laptop.xml
(1 of 1)

20.5 XML Vocabularies

- W3C XML Schema
- XSL (Extensible Stylesheet Language)
- MathML (Mathematical Markup Language)
- SVG (Scalable Vector Graphics)
- WML (Wireless Markup Language)
- XBRL (Extensible Business Reporting Language)
- XUL (Extensible User Interface Language)
- PDML (Product Data Markup Language)

20.5.1 MathML

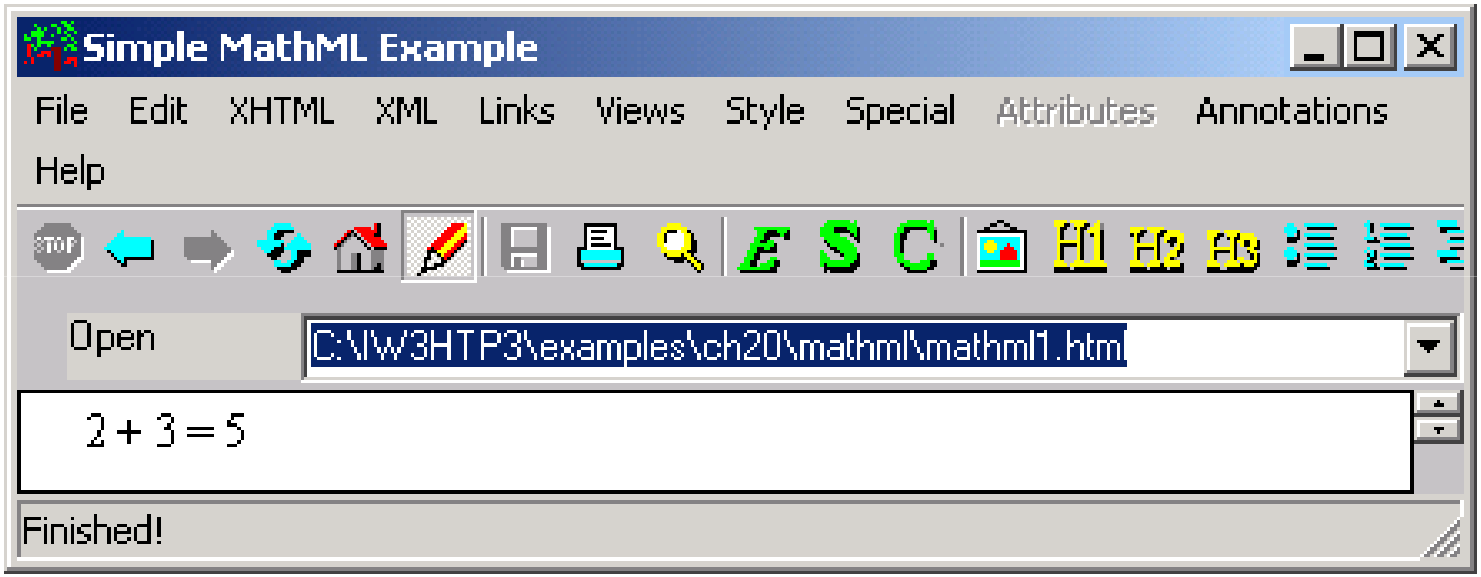
- Describe mathematical notations and expressions
- MathML markup
  - Content markup
    - Provides tags that embody mathematical concepts
    - Allows programmers to write mathematical notation specific to different areas of mathematics
    - Distinguishes between different uses of same symbol
  - Presentation markup
    - Directed towards formatting and displaying mathematical notation

```
1  <?xml version="1.0"?>
2  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
3     "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
4
5  <!-- Fig. 20.11: mathml1.html -->
6  <!-- Simple MathML            -->
7
8  <html xmlns="http://www.w3.org/1999/xhtml">
9
10    <head><title>Simple MathML Example</title></head>
11
12    <body>
13
14       <math xmlns = "http://www.w3.org/1998/Math/MathML">
15
16          <mrow>
17             <mn>2</mn>
18             <mo>+</mo>
19             <mn>3</mn>
20             <mo>=</mo>
21             <mn>5</mn>
22          </mrow>
23
24       </math>
25
```

mathml1.html
(1 of 2)

```
26     </body>
27 </html>
```

mathml1.html
(2 of 2)



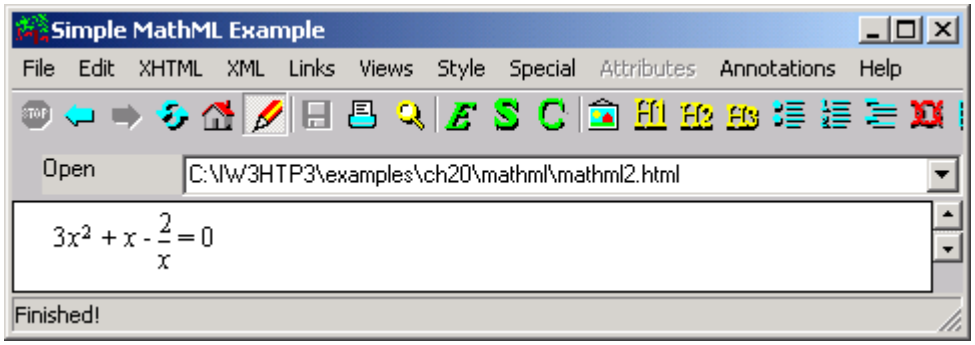
MathML displayed in the Amaya browser. [Courtesy of World Wide Web Consortium (W3C).]

```
1  <?xml version="1.0"?>
2  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
3     "HTTP://WWW.W3.ORG/TR/XHTML1/DTD/XHTML1-TRANSITIONAL.DTD">
4
5  <!-- FIG. 20.12: mathml2.html -->
6  <!-- Simple MathML            -->
7
8  <html xmlns="http://www.w3.org/1999/xhtml">
9
10    <head><title>Algebraic MathML Example</title></head>
11
12    <body>
13
14       <math xmlns = "http://www.w3.org/1998/Math/MathML">
15          <mrow>
16
17             <mrow>
18                <mn>3</mn>
19                <mo>&InvisibleTimes;</mo>
20
21                <msup>
22                   <mi>x</mi>
23                   <mn>2</mn>
24                </msup>
25
```

mathml2.html
(1 of 2)

```
26              </mrow>
27
28              <mo>+</mo>
29              <mi>x</mi>
30              <mo>-</mo>
31
32              <mfrac>
33                  <mn>2</mn>
34                  <mi>x</mi>
35              </mfrac>
36
37              <mo>=</mo>
38              <mn>0</mn>
39
40          </mrow>
41      </math>
42
43    </body>
44 </html>
```

mathml2.html
(2 of 2)



MathML displayed in the Amaya browser. [Courtesy of World Wide Web Consortium (W3C).]

```
1  <?xml version = "1.0"?>
2  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
3     "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
4
5  <!-- Fig. 20.13 mathml3.html       -->
6  <!-- Calculus example using MathML -->
7
8  <html xmlns="http://www.w3.org/1999/xhtml">
9
10    <head><title>Calculus MathML Example</title></head>
11
12    <body>
13
14       <math xmlns = "http://www.w3.org/1998/Math/MathML">
15          <mrow>
16             <msubsup>
17
18                <mo>&Integral;</mo>
19                <mn>0</mn>
20
21                <mrow>
22                   <mn>1</mn>
23                   <mo>-</mo>
24                   <mi>y</mi>
25                </mrow>
```

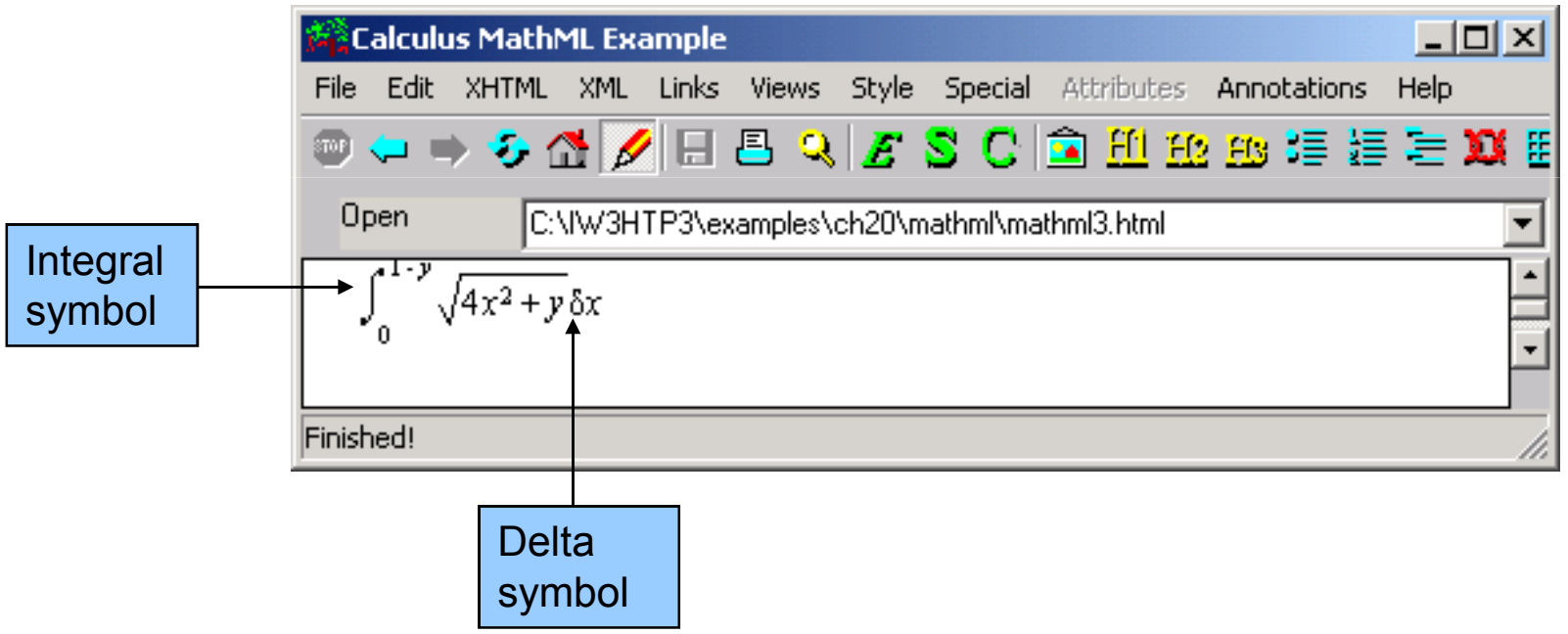
mathml3.html
(1 of 3)

```
26
27              </msubsup>
28
29              <msqrt>
30                 <mrow>
31
32                    <mn>4</mn>
33                    <mo>&InvisibleTimes;</mo>
34
35                    <msup>
36                       <mi>x</mi>
37                       <mn>2</mn>
38                    </msup>
39
40                    <mo>+</mo>
41                    <mi>y</mi>
42
43                 </mrow>
44              </msqrt>
45
46              <mo>&delta;</mo>
47              <mi>x</mi>
48           </mrow>
49        </math>
50     </body>
```

mathml3.html
(2 of 3)

```
51 </html>
```

mathml3.html
(3 of 3)



MathML displayed in the Amaya browser. [Courtesy of World Wide Web Consortium (W3C).]

20.5.2 Chemical Markup Language (CML)

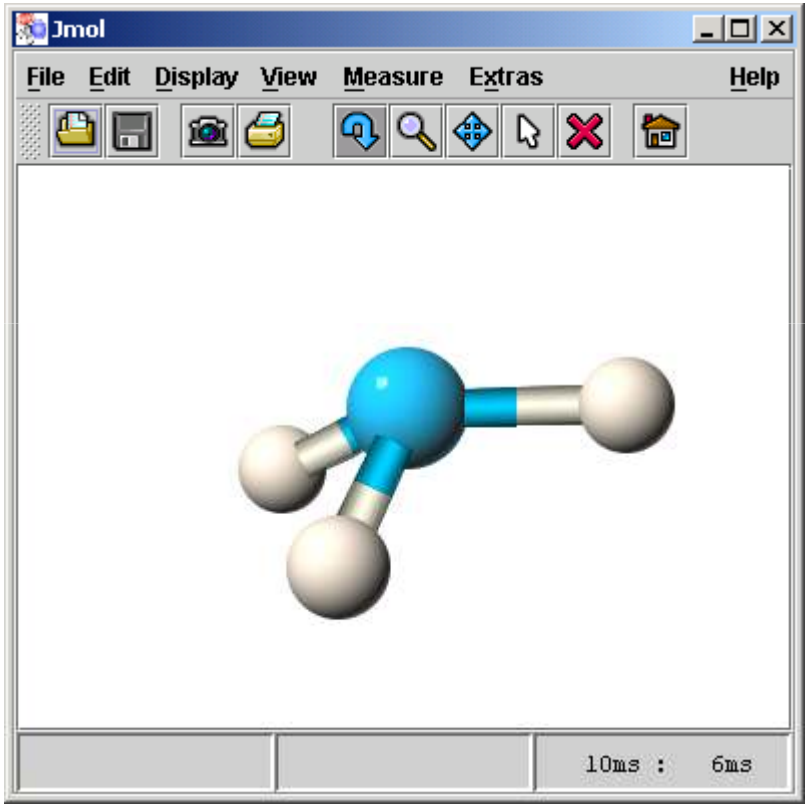
- XML vocabulary for representing molecular and chemical information

```
1  <?xml version = "1.0" ?>
2
3  <!-- Fig. 20.14 : ammonia.xml -->
4  <!-- Structure of ammonia -->
5
6  <molecule id = "ammonia">
7
8     <atomArray>
9
10       <stringArray builtin = "id" >
11          Nitrogen Hydrogen1 Hydrogen2 Hydrogen3
12       </stringArray>
13
14       <stringArray builtin = "elementType">
15          N H H H
16       </stringArray>
17
18       <floatArray builtin = "x3">
19          -0.7 -1.3 -1.2 -0.7
20       </floatArray>
21
22       <floatArray builtin = "y3">
23          -0.0 0.2 0.8 -0.9
24       </floatArray>
25
```

ammonia.xml
(1 of 2)

```
26        <floatArray builtin = "z3">
27           0.0 -0.9 0.6 0.6
28        </floatArray>
29
30     </atomArray>
31
32  </molecule>
```

ammonia.xml
2 of 2



(Courtesy of the Jmol Project.)

20.5.3 MusicXML

- Music distribution
- Simplifies exchange of musical scores over Internet
- Developed by Recordare
- Mark up all type of music
- DTD
  - Less powerful than Schema
  - Simpler to program
- Relies heavily on elements rather than attributes

20.5.3 MusicXML

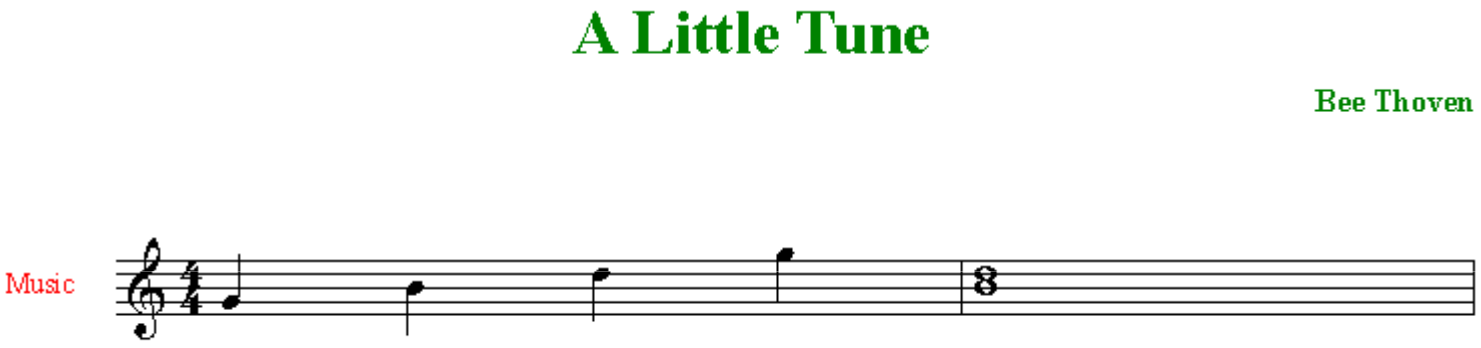


Fig. 20.15 MusicXML markup rendered by Finale 2003 (Courtesy of MakeMusic! Inc.).

20.5.4 RSS

- RDF Site summary
- Popular and simple XML format designed to share headlines and Web content between Web sites
- RSS file
  - RSS feed
  - Container `rss` element
    - Denotes the RSS version
  - Container channel elements
    - Descriptive tags
    - Item elements
      - Describe the news or information
      - `title` element
      - `description` element
      - `link` element

```
1  <?xml version = "1.0" ?>
2
3  <!-- Fig. 20.16 deitel.rss  -->
4  <!-- RSS feed               -->
5
6  <rss version = "2.0">
7     <channel>
8        <title>Deitel</title>
9        <link>http://www.deitel.com</link>
10       <description>CS textbooks</description>
11       <language>en-us</language>
12       <item>
13          <title>Simply VB How To Program</title>
14          <description>
15             This book combines the DEITEL signature live-code approach
16             with a new application-driven methodology, in which readers
17             build real-world applications that incorporate Visual
18             Basic .NET programming fundamentals.
19          </description>
20          <link>
21             http://www.deitel.com/books/downloads.html#vbnetHTP2
22          </link>
23       </item>
24       <item>
25          <title>Visual C++ </title>
```

deitel.rss
(1 of 2)

```
26          <description>
27             For experienced programmers. Pictures of pyramids
28             on the cover.
29          </description>
30          <link>
31            http://www.deitel.com/books/vbnetFEP1
32          </link>
33       </item>
34    </channel>
35 </rss>
```

deitel.rss
(2 of 2)

20.5.5 Other Markup Languages

Markup language	Description
VoiceXML	The VoiceXML Forum founded by AT&T, IBM, Lucent and Motorola developed VoiceXML. It provides interactive voice communication between humans and computers through a telephone, PDA (personal digital assistant) or desktop computer. IBM's VoiceXML SDK can process VoiceXML documents. Visit `www.voicexml.org` for more information on VoiceXML. We introduce VoiceXML in Chapter 29, Accessibility.
Synchronous Multimedia Integration Language (SMIL)	SMIL is an XML vocabulary for multimedia presentations. The W3C was the primary developer of SMIL, with contributions from some companies. Visit `www.w3.org/AudioVideo` for more on SMIL. We introduce SMIL in Chapter 28, Multimedia.
Research Information Exchange Markup Language (RIXML)	RIXML, developed by a consortium of brokerage firms, marks up investment data. Visit `www.rixml.org` for more information on RIXML.
ComicsML	A language developed by Jason MacIntosh for marking up comics. Visit `www.jmac.org/projects/comics_ml` for more information on ComicsML.
Geography Markup Language (GML)	OpenGIS developed the Geography Markup Language to describe geographic information. Visit `www.opengis.org` for more information on GML.
Extensible User Interface Language (XUL)	The Mozilla Project created the Extensible User Interface Language for describing graphical user interfaces in a platform-independent way.

Fig. 20.17 Various markup languages derived from XML.

20.6 Document Object Model (DOM)

- Document Object Model (DOM) tree
  - Nodes
  - Parent node
    - Ancestor nodes
  - Child node
    - Descendant nodes
    - Sibling nodes
  - One single root node
    - Contains all other nodes in document
- Application Programming Interface (API)

20.6 Document Object Model (DOM)

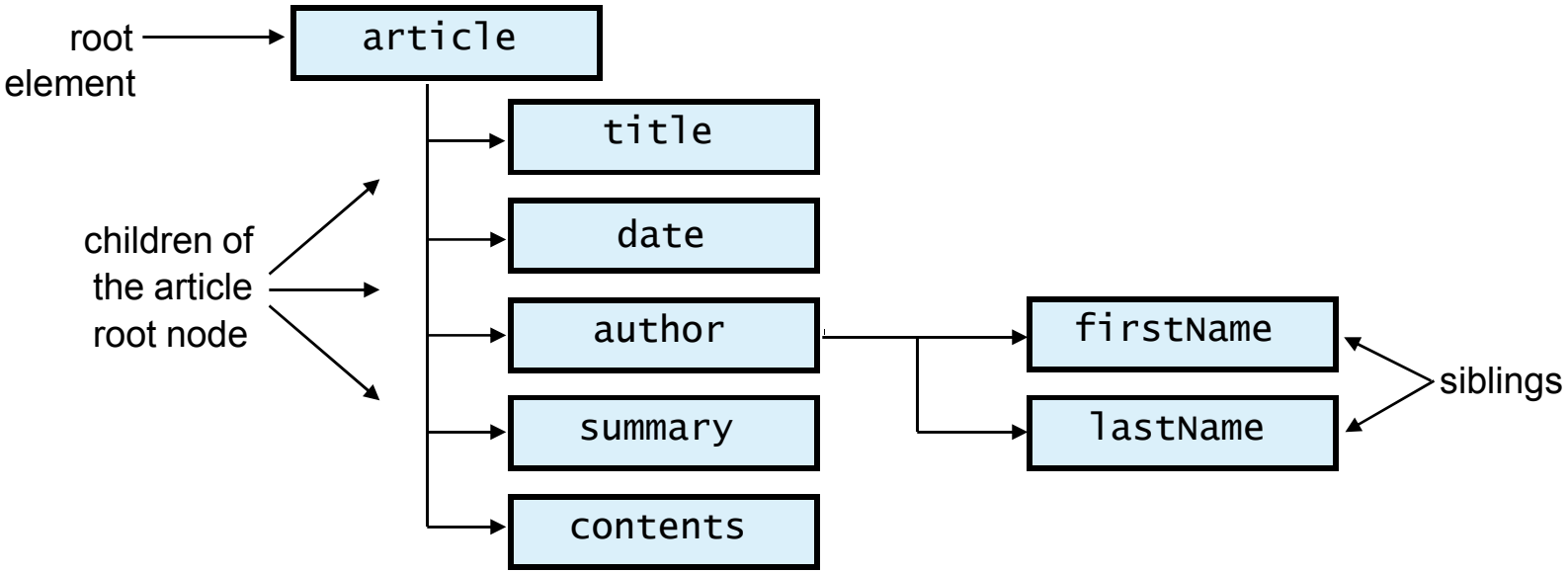


Fig. 20.18 Tree structure for article.xml.

20.7 DOM Methods

- `nodeName`
  - Name of an element, attribute, or so on
- `NodeList`
  - List of nodes
  - Can be accessed like an array using method `item`
- Property `length`
  - Returns number of children in root element
- `nextSibling`
  - Returns node's next sibling
- `nodeValue`
  - Retrieves value of text node
- `parentNode`
  - Returns node's parent node

```
1  <?xml version="1.0"?>
2  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
3     "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
4  <html xmlns="http://www.w3.org/1999/xhtml">
5
6  <!-- Fig. 20.19: DOMExample.html -->
7  <!-- DOM with JavaScript         -->
8
9     <head>
10       <title>A DOM Example</title>
11    </head>
12
13    <body>
14
15    <script type = "text/javascript" language = "JavaScript">
16       <!--
17       var xmlDocument = new ActiveXObject( "Microsoft.XMLDOM" );
18
19       xmlDocument.load( "article.xml" );
20
21       // get the root element
22       var element = xmlDocument.documentElement;
23
24       document.writeln(
25          "<p>Here is the root node of the document: " +
```

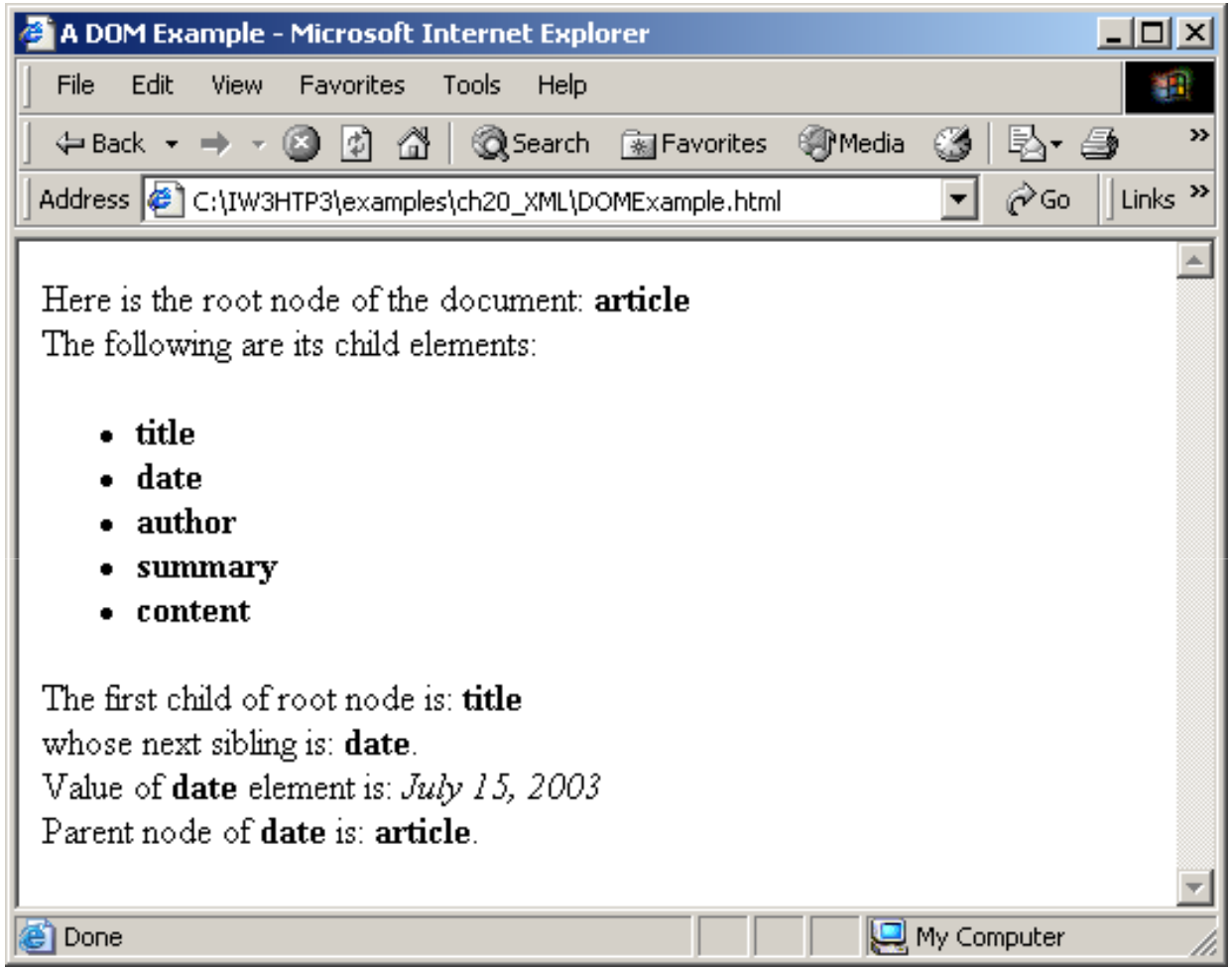
DOMExample.html
(1 of 3)

```
26          "<strong>" + element.nodeName + "</strong>" +
27          "<br />The following are its child elements:" +
28          "</p><ul>" );
29
30       // traverse all child nodes of root element
31       for ( var i = 0; i < element.childNodes.length; i++ ) {
32          var curNode = element.childNodes.item( i );
33
34          // print node name of each child element
35          document.writeln( "<li><strong>" + curNode.nodeName
36             + "</strong></li>" );
37       }
38
39       document.writeln( "</ul>" );
40
41       // get the first child node of root element
42       var currentNode = element.firstChild;
43
44       document.writeln( "<p>The first child of root node is: " +
45          "<strong>" + currentNode.nodeName + "</strong>" +
46          "<br />whose next sibling is:" );
47
48       // get the next sibling of first child
49       var nextSib = currentNode.nextSibling;
50
```

DOMExample.html
(2 of 3)

```
51       document.writeln( "<strong>" + nextSib.nodeName +
52          "</strong>.<br />Value of <strong>" +
53          nextSib.nodeName + "</strong> element is: " );
54
55       var value = nextSib.firstChild;
56
57       // print the text value of the sibling
58       document.writeln( "<em>" + value.nodeValue + "</em>" +
59          "<br />Parent node of <strong>" + nextSib.nodeName +
60          "</strong> is: <strong>" +
61          nextSib.parentNode.nodeName + "</strong>.</p>" );
62          -->
63    </script>
64
65    </body>
66 </html>
```

DOMExample.html (3 of 3)


A DOM Example - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address C:\IW3HTP3\examples\ch20_XML\DOMExample.html
Go Links
Here is the root node of the document: article
The following are its child elements:
title
date
author
summary
content
The first child of root node is: title
whose next sibling is: date.
Value of date element is: July 15, 2003
Parent node of date is: article.
Done
My Computer

20.7 DOM Methods

Method	Description
`getNodeType`	Returns an integer representing the node type.
`getNodeName`	Returns the name of the node. If the node does not have a name, a string consisting of `#` followed by the type of the node is returned.
`getNodeValue`	Returns a string or null depending on the node type.
`getParentNode`	Returns the parent node.
`getChildNodes`	Returns a `NodeList` (Fig. 20.21) with all the children of the node.
`getFirstChild`	Returns the first child in the `NodeList`.
`getLastChild`	Returns the last child in the `NodeList`.
`getPreviousSibling`	Returns the node preceding this node, or null.
`getNextSibling`	Returns the node following this node, or null.
`getAttributes`	Returns a `NamedNodeMap` (Fig. 20.22) containing the attributes for this node.
`insertBefore`	Inserts the node (passed as the first argument) before the existing node (passed as the second argument). If the new node is already in the tree, it is removed before insertion. The same behavior is true for other methods that add nodes.

20.7 DOM Methods

`replaceChild`	Replaces the second argument node with the first argument node.
`removeChild`	Removes the child node passed to it.
`appendChild`	Appends the node passed to it to the list of child nodes.
`getElementsByTagName`	Returns a `NodeList` of all the nodes in the subtree with the name specified as the first argument ordered as they would be encountered in a preorder traversal. An optional second argument specifies either the direct child nodes (0) or any descendant (1).
`getChildAtIndex`	Returns the child node at the specified index in the child list.
`addText`	Appends the string passed to it to the last `Node` if it is a `Text` node, otherwise creates a new `Text` node for the string and adds it to the end of the child list.
`isAncestor`	Returns `true` if the node passed is a parent of the node or is the node itself.

Fig. 20.20 Some DOM `Node` object methods.

20.7 DOM Methods

Method	Description
`item`	Passed an index number, returns the element node at that index. Indices range from 0 to *length* – 1.
`getLength`	Returns the total number of nodes in the list.

Fig. 20.21 Some DOM `NodeList` methods.

Method	Description
`getNamedItem`	Returns either a node in the `NamedNodeMap` with the specified name or null.
`setNamedItem`	Stores a node passed to it in the `NamedNodeMap`. Two nodes with the same name cannot be stored in the same `NamedNodeMap`.
`removeNamedItem`	Removes a specified node from the `NamedNodeMap`.
`getLength`	Returns the total number of nodes in the `NamedNodeMap`.
`getValues`	Returns a `NodeList` containing all the nodes in the `NamedNodeMap`.

Fig. 20.22 Some DOM `NamedNodeMap` methods.

20.7 DOM Methods

Method	Description
`getDocumentElement`	Returns the root node of the document.
`createElement`	Creates and returns an element node with the specified tag name.
`createAttribute`	Creates and returns an attribute node with the specified name and value.
`createTextNode`	Creates and returns a text node that contains the specified text.
`createComment`	Creates a comment to hold the specified text.

Fig. 20.23 Some DOM `Document` methods.

20.7 DOM Methods

Method	Description
`getTagName`	Returns the name of the element.
`setTagName`	Changes the name of the element to the specified name.
`getAttribute`	Returns the value of the specified attribute.
`setAttribute`	Changes the value of the attribute passed as the first argument to the value passed as the second argument.
`removeAttribute`	Removes the specified attribute.
`getAttributeNode`	Returns the specified attribute node.
`setAttributeNode`	Adds a new attribute node with the specified name.

Fig. 20.24 Some DOM `Element` methods.

Method	Description
`getValue`	Returns the specified attribute's value.
`setValue`	Changes the value of the attribute to the specified value.
`getName`	Returns the name of the attribute.

Fig. 20.25 Some DOM `Attr` methods.

Method	Description
`getData`	Returns the data contained in the node (text or comment).
`setData`	Sets the node's data.
`getLength`	Returns the number of characters contained in the node.

Fig. 20.26 Some DOM `Text` and `Comment` methods.

20.8 Simple API for XML (SAX)

- Developed by members of XML-DEV mailing list
- Parse XML documents using event-based model
- Provide different APIs for accessing XML document information
- Invoke listener methods
- Passes data to application from XML document
- Better performance and less memory overhead than DOM-based parsers

20.9 Extensible Stylesheet Language (XSL)

- Specify how programs should render XML document data
  - XSL-FO (XSL Formatted Objects)
    - Vocabulary for specifying formatting
  - XSLT (XSL Transformation)
    - Source tree
    - Result tree
  - Xpath
    - Locate parts of the source tree document that match templates defined in the XSL stylesheet

20.9 Extensible Stylesheet Language (XSL)

Element	Description
`<xsl:apply-templates>`	Applies the templates of the XSL document to the children of the current node.
`<xsl:apply-templates match = "`*expression*`">`	Applies the templates of the XSL document to the children of *expression*. The value of the attribute `match` (i.e., *expression*) must be some XPath expression that specifies elements.
`<xsl:template>`	Contains rules to apply when a specified node is matched.
`<xsl:value-of select = "`*expression*`">`	Selects the value of an XML element and adds it to the output tree of the transformation. The required `select` attribute contains an XPath expression.
`<xsl:for-each select = "`*expression*`">`	Implicitly contains a template that is applied to every node selected by the XPath specified by the `select` attribute.
`<xsl:sort select = "`*expression*`">`	Used as a child element of an `<xsl:apply-templates>` or `<xsl:for-each>` element. Sorts the nodes selected by the `<apply-template>` or `<for-each>` element so that the nodes are processed in sorted order.
`<xsl:output>`	Has various attributes to define the format (e.g., xml, html), version (e.g., 1.2, 2.0), document type and media type of the output document. This tag is a top-level element, which means that it can be used only as a child element of a `stylesheet`.
`<xsl:copy>`	Adds the current node to the output tree.

Fig. 20.27 Commonly used XSL stylesheet elements.

```
1  <?xml version = "1.0"?>
2  <?xml:stylesheet type = "text/xsl" href = "games.xsl"?>
3
4  <!-- Fig. 20.28 : games.xml -->
5  <!-- Sports Database        -->
6
7  <sports>
8
9     <game id = "783">
10       <name>Cricket</name>
11
12       <paragraph>
13          Popular in Commonwealth nations.
14       </paragraph>
15    </game>
16
17    <game id = "239">
18       <name>Baseball</name>
19
20       <paragraph>
21          Popular in America.
22       </paragraph>
23    </game>
24
```

games.xml
(1 of 2)

```
25    <game id = "418">
26       <name>Soccer (Football)</name>
27
28       <paragraph>
29          Popular sport in the world.
30       </paragraph>
31    </game>
32
33 </sports>
```

games.xml
(2 of 2)

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.29 : games.xsl      -->
4  <!-- A simple XSLT transformation   -->
5
6  <!-- reference XSL stylesheet URI   -->
7  <xsl:stylesheet version = "1.0"
8     xmlns:xsl = "http://www.w3.org/1999/XSL/Transform">
9
10    <xsl:output method = "html" omit-xml-declaration = "no"
11       doctype-system =
12          "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
13       doctype-public = "-//W3C//DTD XHTML 1.0 Strict//EN"/>
14
15 <xsl:template match = "/">
16
17   <html xmlns="http://www.w3.org/1999/xhtml">
18
19     <head>
20        <title>Sports</title>
21     </head>
22
23     <body>
24
25        <table border = "1" bgcolor = "cyan">
```

games.xsl
(1 of 3)

```
26
27          <thead>
28
29            <tr>
30              <th>ID</th>
31              <th>Sport</th>
32              <th>Information</th>
33            </tr>
34
35          </thead>
36
37           <!-- insert each name and paragraph element value  -->
38           <!-- into a table row.                              -->
39           <xsl:for-each select = "/sports/game">
40
41              <tr>
42                <td><xsl:value-of select = "@id"/></td>
43                <td><xsl:value-of select = "name"/></td>
44                <td><xsl:value-of select = "paragraph"/></td>
45              </tr>
46
47           </xsl:for-each>
48
49           </table>
50
```

games.xsl
(2 of 3)

```
51        </body>
52
53     </html>
54
55  </xsl:template>
56
57  </xsl:stylesheet>
```

games.xsl
(3 of 3)

```xml
<?xml version = "1.0"?>

<!-- Fig. 20.30 : sorting.xml         -->
<!-- Usage of elements and attributes -->

<?xml:stylesheet type = "text/xsl" href = "sorting.xsl"?>

<book isbn = "999-99999-9-X">
   <title>Deitel&apos;s XML Primer</title>

   <author>
      <firstName>Paul</firstName>
      <lastName>Deitel</lastName>
   </author>

   <chapters>
      <frontMatter>
         <preface pages = "2"/>
         <contents pages = "5"/>
         <illustrations pages = "4"/>
      </frontMatter>

      <chapter number = "3" pages = "44">
         Advanced XML</chapter>
```

sorting.html
(1 of 2)

```
25        <chapter number = "2" pages = "35">
26           Intermediate XML</chapter>
27        <appendix number = "B" pages = "26">
28           Parsers and Tools</appendix>
29        <appendix number = "A" pages = "7">
30           Entities</appendix>
31        <chapter number = "1" pages = "28">
32           XML Fundamentals</chapter>
33     </chapters>
34
35     <media type = "CD"/>
36  </book>
```

sorting.html
(2 of 2)

```
1  <?xml version = "1.0"?>
2
3  <!-- Fig. 20.31 : sorting.xsl                          -->
4  <!-- Transformation of Book information into XHTML -->
5
6  <xsl:stylesheet version = "1.0"
7     xmlns:xsl = "http://www.w3.org/1999/XSL/Transform">
8
9     <xsl:output method = "html" omit-xml-declaration = "no"
10
11       doctype-system =
12          "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
13       doctype-public = "-//W3C//DTD XHTML 1.0 Strict//EN"/>
14
15    <xsl:template match = "/">
16       <html xmlns = "http://www.w3.org/1999/xhtml">
17          <xsl:apply-templates/>
18       </html>
19    </xsl:template>
20
21    <xsl:template match = "book">
22       <head>
23          <title>ISBN <xsl:value-of select = "@isbn"/> -
24             <xsl:value-of select = "title"/></title>
25       </head>
```

sorting.xsl
(1 of 4)

```
26
27        <body>
28           <h1><xsl:value-of select = "title"/></h1>
29
30           <h2>by <xsl:value-of select = "author/lastName"/>,
31              <xsl:value-of select = "author/firstName"/></h2>
32
33           <table border = "1">
34              <xsl:for-each select = "chapters/frontMatter/*">
35                 <tr>
36                    <td align = "right">
37                       <xsl:value-of select = "name()"/>
38                    </td>
39
40                    <td>
41                       ( <xsl:value-of select = "@pages"/> pages )
42                    </td>
43                 </tr>
44              </xsl:for-each>
45
46              <xsl:for-each select = "chapters/chapter">
47                 <xsl:sort select = "@number" data-type = "number"
48                       order = "ascending"/>
49                 <tr>
50                    <td align = "right">
```

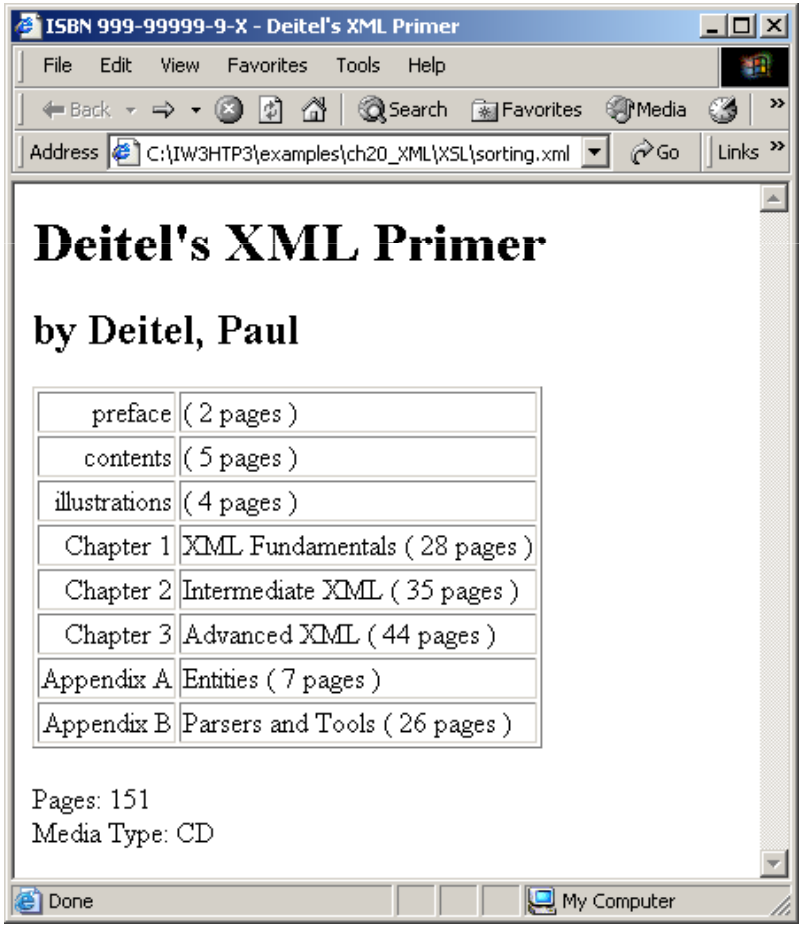
sorting.xsl
(2 of 4)

```
51                      Chapter <xsl:value-of select = "@number"/>
52                   </td>
53
54                   <td>
55                      <xsl:value-of select = "text()"/>
56                      ( <xsl:value-of select = "@pages"/> pages )
57                   </td>
58                </tr>
59             </xsl:for-each>
60             <xsl:for-each select = "chapters/appendix">
61                <xsl:sort select = "@number" data-type = "text"
62                     order = "ascending"/>
63                <tr>
64                   <td align = "right">
65                      Appendix <xsl:value-of select = "@number"/>
66                   </td>
67
68                   <td>
69                      <xsl:value-of select = "text()"/>
70                      ( <xsl:value-of select = "@pages"/> pages )
71                   </td>
72                </tr>
73             </xsl:for-each>
74          </table>
75
```

sorting.xsl
(3 of 4)

```
76          <br />Pages:
77             <xsl:variable name = "pagecount"
78                select = "sum(chapters//*/@pages)"/>
79             <xsl:value-of select = "$pagecount"/>
80          <br />Media Type: <xsl:value-of select = "media/@type"/>
81       </body>
82    </xsl:template>
83
84 </xsl:stylesheet>
```

sorting.xsl
(4 of 4)



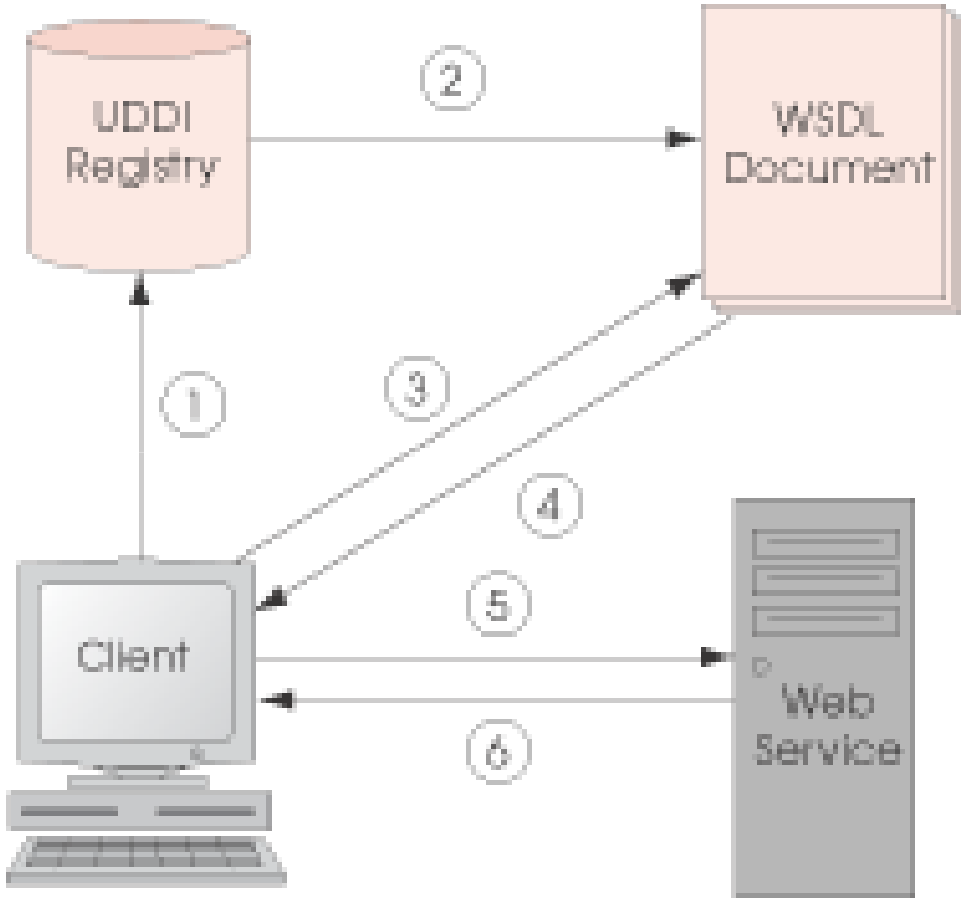
20.10 Simple Object Access Protocol (SOAP)

- Developed by IBM, Lotus Development Corporation, Microsoft, DevelopMentor, and Userland Software
- XML-based protocol
- Allows applications to communicate over Internet
- SOAP message
  - Envelope
    - A structure describes a method call
  - Body
    - Request
      - Remote Procedure Call (RPC)
    - Response
      - HTTP response document contains results from other method call

20.11 Web Services

- Standards
  - XML
  - SOAP
  - Web Services Description Language (WSDL)
  - Universal Description, Discovery and Integration (UDDI)
  - Modular programming
    - Modularization
      - Less error prone and promotes software reuse

20.11 Web Services



1. Client queries registry to locate service
2. Registry refers client to WSDL document
3. Client accesses WSDL document
4. WSDL provides data to interact with Web service
5. Client sends SOAP-message request
6. Web Service returns SOAP-message response

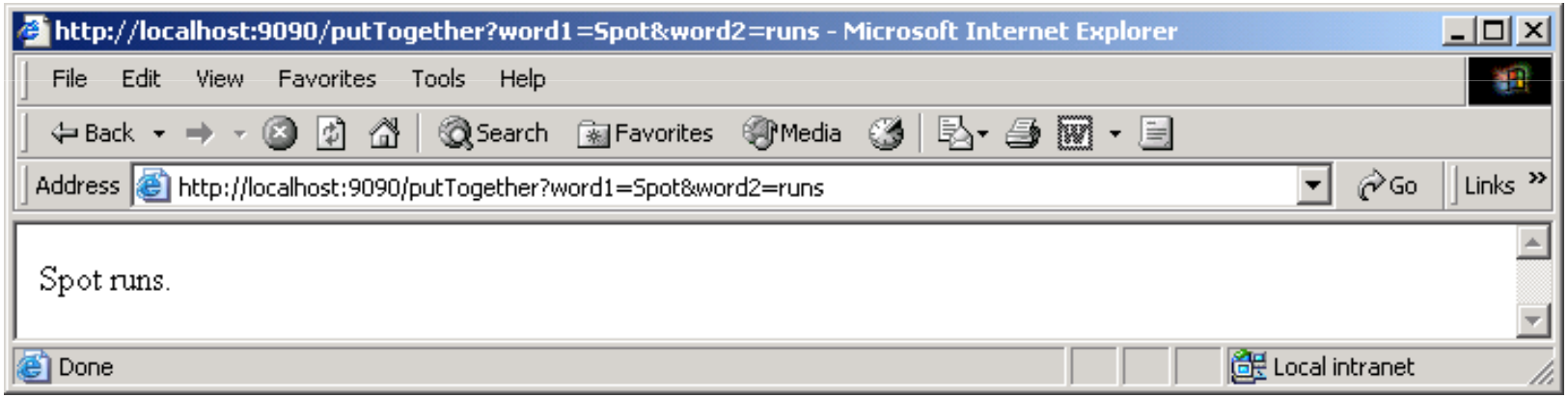
20.12 Water XML-Based Programming Language

- Simplifies XML and Web services programming
- Represents all objects and data as XML

```
1  <!-- 20.33: concatenate.h2o           -->
2  <!-- Form Input and Output with Water -->
3
4  <defclass concatenate>
5     <defmethod start>
6        <FORM action = "/putTogether">
7          Type in a subject: <INPUT name = "word1"/>
8          Type in a verb: <INPUT name = "word2"/>
9          <INPUT type = "submit"/>
10       </FORM>
11    </defmethod>
12
13    <defmethod putTogether word1 word2>
14       <vector word1 " " word2 "."/>
15    </defmethod>
16 </defclass>
17
18 <server concatenate port = 9090/>
19 <open_browser_window "http://localhost:9090"/>
```

concatenate.h2o
1 of 1


http://localhost:9090/ - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost:9090/
Go Links
Type in a subject: Spot
Type in a verb: runs
Submit Query
Done
Local intranet


http://localhost:9090/putTogether?word1=Spot&word2=runs - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost:9090/putTogether?word1=Spot&word2=runs
Go Links
Spot runs.
Done
Local intranet

20.13 Web Resources

- www.w3.org/xml
- www.xml.org
- www.w3.org/style/XSL
- www.w3.org/TR
- xml.apache.org
- www.xmlbooks.com
- www.xmlsoftware.com
- www.xml-zone.com
- wdvl.internet.com/Authoring/Languages/XML
- www.xml.com
- msdn.microsoft.com/xml/default.asp
- www.oasis-open.org/cover/xml.html
- www.gca.org/whats_xml/default.htm
- www.xmlinfo.com
- www.ibm.com/developer/xml
- developer.netscape.com/tech/xml/index.html
- www.projectcool.com/developer/xmlz

20.13 Web Resources

- www.ucc.ie/xml
- www.xml-cml.org
- backend.userland.com/rss
- www.w3.org/2002/ws
- www.oasis-open.org
- www.clearmethods.com
- www.textuality.com/xml
- www.zvon.org