XML Survival Skills

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Session Objectives

- Understand what XML extensible Markup Language (XML) and what it is not
- Use XML vocabulary effectively
- Know the rules for XML tags and "well-formed" XML documents
- Understand the relationship between XML, style sheets, DTDs, XSL, and XSLT
- Become aware of XML-supporting applications, databases, and servers

Major Keywords

- XML
- Tag
- Element
- Attribute
- Document
- Well-formed XML
- Stylesheet (CSS or XSL)
- Validation (DTD and Schema)

eXtensible Markup Language (XML)

- XML is a set of rules for defining tags to describe a document's structure and parts
- XML is a "meta-markup" language, providing the syntax used to define the syntax and structure of a document, not the presentation or the format
- The XML specification is authored by the W3C (World Wide Web Consortium www.w3.org)
- “Markup" is from typesetting: publishers "markup" a document telling the typesetter how to format the page
- Computer markup languages like HTML and Troff have fixed markup features, for example, HTML provides a set of predefined "tags" used to format data (<title>,<body>,<p>,<h1>, etc…)

Extensible

- XML is "extensible" because no tags are predefined
- XML is used to define your own tags or use other’s tags
- All XML-based languages use the same syntax

Ancient History of XML

- Based upon markup language created by IBM in the 1960's
  - Generalized Markup Language (GML) 1969 (IBM Text Description Language (TDL), renamed GML in 1971 (three developers: Charles F. Goldfarb, Ed Mosher, and Ray Lorie)
  - GML product released by IBM in 1973
  - Late 70's IBM product Document Control Facility (DCF) or "Script" introduced Document Type Descriptors (DTDs) and Document Types
  - SGML (Standard Generalized Markup Language) became a reality in the early 1980s, while powerful, SGML was deemed too complex for everyday use
- XML was created as a much simpler yet still powerful tool
- In February 1998 the Worldwide Web Consortium (W3C) proposed a recommendation for XML 1.0

Recent Updates

- XML 1.1 released by W3C as a recommendation in February 2004
- XML 1.0 R3 recommended in February 2004
- Extensible Stylesheet Language (XSL) Version 1.1 working draft released in December 2003
- XML Schema 1.1 draft released in January 2003
- XPath 2.0 recommended for release in December 2003
- Document Object Model (DOM) Level 3 available as of December 2003

Standardized

- The strength of XML lies in its standardization
  - More software uses XML every day
  - Tools for using XML are prevalent
  - Experienced XML people are widely availble
- XML uses the least common denominator of character strings; a universal format
- For more information about the XML standard see the W3C website http://www.w3c.org or http://www.w3.org

XML and HTML

- New XML developers often confuse HTML and XML
- XML looks like HTML but is NOT HTML
- HTML specifies what each tag means and how it will appear in the browser:

```
<html>
    <body>
          <h1>Introduction to XML</h1>
    </body>
</html>
```

- XML tags describe data, interpretation varies:

```
<myclasses>
    <class>
          <name>Introduction to XML</name>
          <author>John Jay King</author>
          <email>john@kingtraining.com</email>
    </class>
</myclasses>
```

XML and HTML

- XML rules are strict where HTML rules are often loose
- HTML tags describe the presentation of data, tags are predefined and have specific meanings to standard browsers
- XML tags describe the content of data in a document, tags are determined by the document's creator and may any valid name
- XHTML (eXtensible Hypertext Markup Language) is a hybrid of XML and HTML that provides precise HTML rules that conform to XML guidelines
(this is the latest HTML standard too)

XML "Family" of Software

- XML 1.0 defines what tags and attributes are
- XHTML (eXtensible Hypertext Markup Language) is an XML application to replace HTML
- DTD (Document Type Definition) is a non-XML file describing the elements and syntax used by an XML document
- Schema is an XML file describing the elements and syntax of an XML document
- XLink describes an XML-based hyperlink method
- XPointer describes XML-element specific hyperlinks
- XPath (XML Path Language) provides a mechanism for selecting XML document subsets
- XSL (Extensible Style Language) is an advanced style sheet language tailored to XML
- XSLT (XML Stylesheet Language Transformations) is used to transform XML to some other form (e.g. HTML)

Why XML?

- XML is non-proprietary providing a standardized mechanism available to all vendors
- Elements and tags may be defined as needed allowing specialized languages for different disciplines
- Document templates, files, and database data can all be stored using an XML-described format
- Standardized formats make it easier to share data across various platforms, cultures, and languages
- Industry groups and companies are working to use XML to build common tag sets to allow data exchange via common data structures
- XML is frequently being used by software vendors to specify configuration information including: Databases, Web Servers, and Communications
- XML is used to describe data files used for: Word processing, Electronic Data Interchange (EDI), Sequential data storage, and many other reasons

How Is XML Used?

- XML is used for:
  - Data transfers between programs (usually one record/transaction at a time)
  - Configuration files
  - Persistence of data (either within databases or using “flat-files”)

Some XML Languages

- XML is used for creating Markup Languages:
  - Mathematical Markup Language (MathML)
  - Synchronized Multimedia Integration Language (SMIL)
  - Voice Extensible Markup Language (VoiceXML)
  - Web Ontology Language (OWL)
  - Web Services Description Language (WSDL)
  - Speech Synthesis Markup Language (SSML)
  - A P3P Preference Exchange Language (APPEL)
  - Extensible HyperText Markup Language (XHTML)
  - XML Path Language (XPath)
  - XML Pointer Language (XPointer)
  - XML Query Language (XQuery)

XML Tags and Elements

- XML provides the syntax necessary to define custom tags and with them custom elements
- Tags are delineated by "<" and ">" symbols:
  - Start tag <name>
  - End tag </name> (note slash)
- Elements are a tag pair and their contents, as in the "name" element below
- Tags and contents together are the tag element:

```
<name>Geoffrey Holder</name>
```

- "Empty" elements incorporate the start and end tags as one:
  - Tag <name/>

Element Hierarchy

```
<myBooks>
  <book>     <name>Learning XML</name>
             <author>Eric T Ray</author>
             <publisher>O’Reilly</publisher>        </book>
  <book>     <name>XML Bible</name>
             <author>Elliotte Rusty Harold</author>
             <publisher>IDG Books</publisher>       </book>
  <book>     <name>XML by Example</name>
             <author>Sean McGrath</author>
             <publisher>Prentice-Hall</publisher>   </book>
</myBooks>
```

- The "root" element above is <myBooks>
  (every XML document must have a "root" element)
- Three <book> elements are part of <myBooks>, each including subelements: <name>, <author>, and <publisher>
- Elements may be nested
- Start/end tags must entirely surround data

Tag/Element Naming

- XML has specific rules for naming of Tags/Elements
- Element names must begin with a letter or an underscore
- Element names may contain letters, underscores (_), numbers, hyphens (-), and colons (:)
- Start tags must match end tags exactly
- Names in XML are case-sensitive and may not contain blanks (officially there is no limit on the length of names…)
- Names should not begin with “xml” (regardless of case)

```
<name>Jones</lastname>         incorrect
<lastname>Jones</lastname>     correct
<last name>Jones</last name>incorrect
<lastname>Jones</lastname>     correct
<lastname>Jones</lastName>     incorrect
<lastName>Jones</lastName>     correct
```

Attributes

- XML elements may use descriptive attributes
- Attributes are added to an element’s start tag using the name of the attribute followed by an equal sign, followed by the value of the attribute (surrounded by quotes or apostrophes)

```
<book isbn="0-13-960162-7" binding="perfect">
    <name>Learning XML</name>
    <author>Eric T Ray</author>
    <publisher>O&apos;Reilly</publisher>
</book>
```

- Attribute naming rules are the same as for element naming, attribute names must be unique within an element. Usually, attributes are used to provide information about the data in an element
- Attribute values must be enclosed by quotation marks (") or apostrophes (')

"Well-Formed" XML

- XML has strict rules of what makes documents "well-formed":
  - Each document must declare itself an XML document using an XML declaration (not required by all parsers):
    ```
    <?xml version="1.0" encoding="UTF-8"?>
    ```
  - Each document must have a single "root" element completely containing all other elements
  - Elements including data must have start <name> and end </name> tags
  - Empty tags are marked using a slash before the close of the start tag and omitting the end tag<name/> (usually include attributes)
  - Tags may not overlap, but, may be nested
  - Attribute values are surrounded by quotes (") or apostrophes (')
  - Most XML tools refuse to process documents not well-formed

Character Entities

- XML parsers assign specific meanings to certain characters (e.g. "<")
- XML defines five "entity references" to allow documents to include the following characters:

– Ampersand	&amp;
– Apostrophe	&apos;
– Double quote	&quot;
– Greater than	&gt;
– Less than	&lt;

- Each entity begins with an ampersand (&) and is ended by a semicolon (;)

```
<company>AT&T</company>                 incorrect (maybe)
<company>AT&amp;T</company>             correct
```

XML Processors

- Software that reads and does something with XML is called an "XML Processor"
- Many web browsers, XML editors, and software products are XML processors
- XML Processors typically include all or some of the following features:
  – Parser translates XML markup and data into a stream of tokens
  – Event Switchers gets tokens and sort them by function
  – Tree representation of XML document structure
  – Tree processor that processes the XML tree for some purpose
- At the least, an XML processor reads an XML document and converts it into a form that may be used by other software; this is called "Parsing "

Parsers

- Parsers are the fundamental part of any XML processor, they are used to:
  - Read XML data
  - Translate data into recognizable tokens (the stream of characters is separated into instructions or hierarchical information)
  - Assemble data into a hierarchy
- By design Parsers are Strict! All documents must be "well-formed" and any error aborts the parsing operation

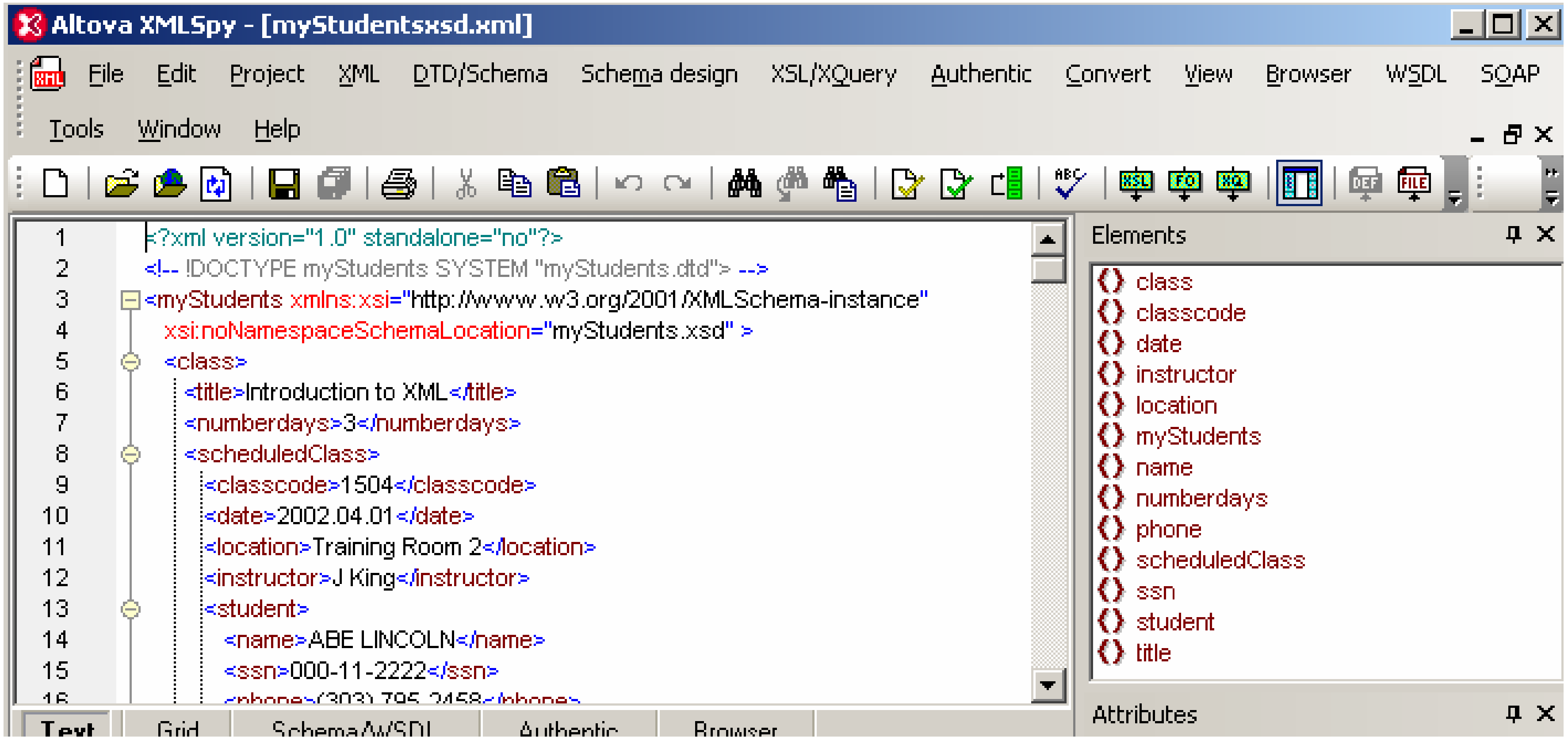
XML Tools

- Many tools are available to work with XML; three easily available are:
  - Altova XML Spy (expensive but excellent) www.altova.com
  - Oracle JDeveloper (free and pretty good) www.oracle.com
  - XMLWriter 2 (shareware and good) www.xmlwriter.net
- Many-many other tools are available!

XML Spy

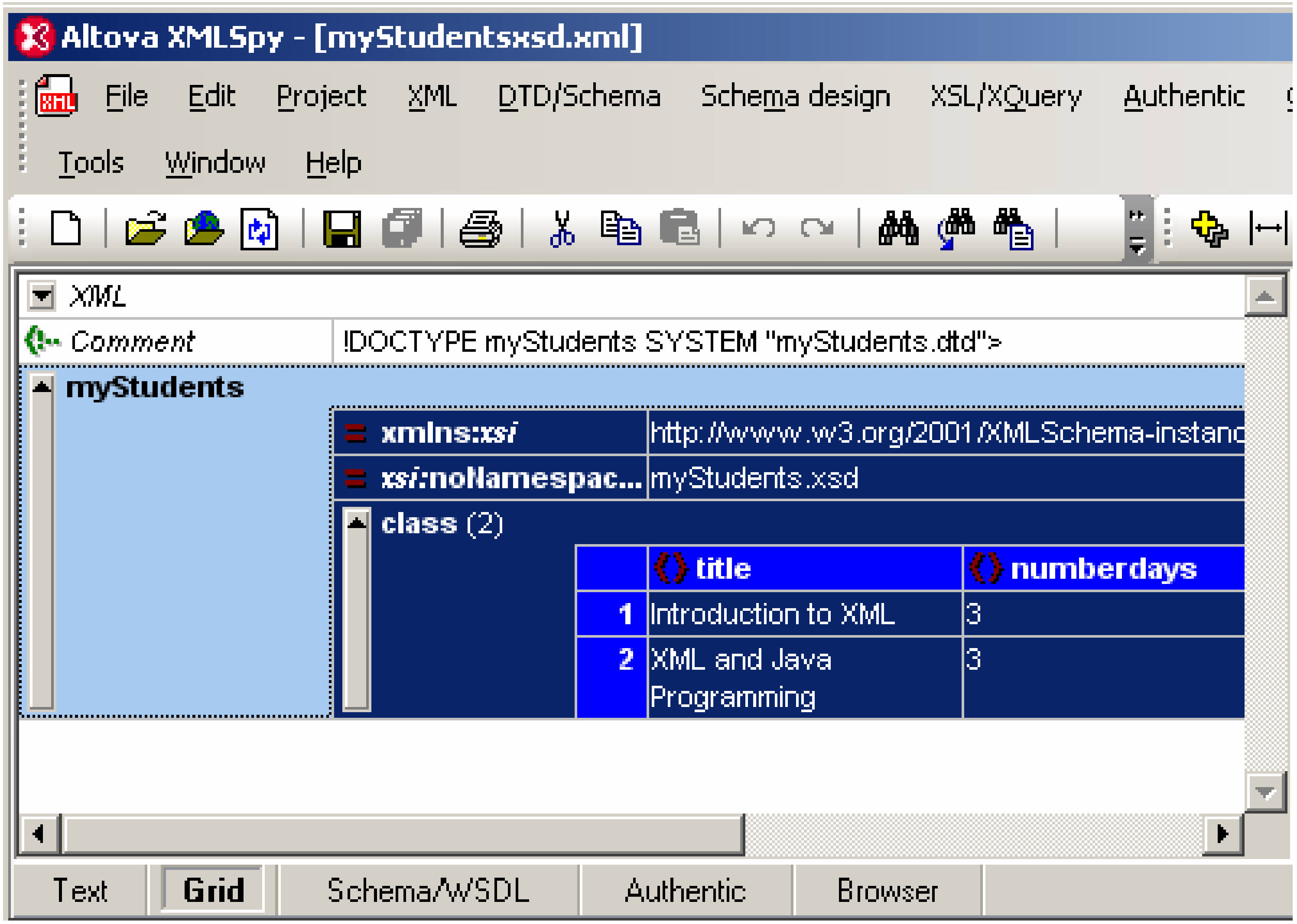
- XML Spy is probably the “premier” product available today including
  - File creation and manipulation (text or graphical)
  - Verifying that a document is “well-formed”
  - Validating a document against a Schema or DTD
  - Creation of Schema or DTD from document
  - XSL Transformation

XML Spy Text Editor


Altova XMLSpy - [myStudentsxsd.xml]
File Edit Project XML DTD/Schema Schema design XSL/XQuery Authentic Convert View Browser WSDL SOAP Tools Window Help
Elements
class
classcode
date
instructor
location
myStudents
name
numberdays
phone
scheduledClass
ssn
student
title
Attributes
Text Grid Schema/WSDL Authentic Browser

```
<?xml version="1.0" standalone="no"?>
<!-- !DOCTYPE myStudents SYSTEM "myStudents.dtd"> -->
<myStudents xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="myStudents.xsd" >
  <class>
    <title>Introduction to XML</title>
    <numberdays>3</numberdays>
    <scheduledClass>
      <classcode>1504</classcode>
      <date>2002.04.01</date>
      <location>Training Room 2</location>
      <instructor>J King</instructor>
      <student>
        <name>ABE LINCOLN</name>
        <ssn>000-11-2222</ssn>
        <phone>(303) 795 2458</phone>
```

XML Spy Graphic Editor



XML

Comment !DOCTYPE myStudents SYSTEM "myStudents.dtd">

myStudents

xmlns:xsi	http://www.w3.org/2001/XMLSchema-instanc
xsi:noNamespac...	myStudents.xsd

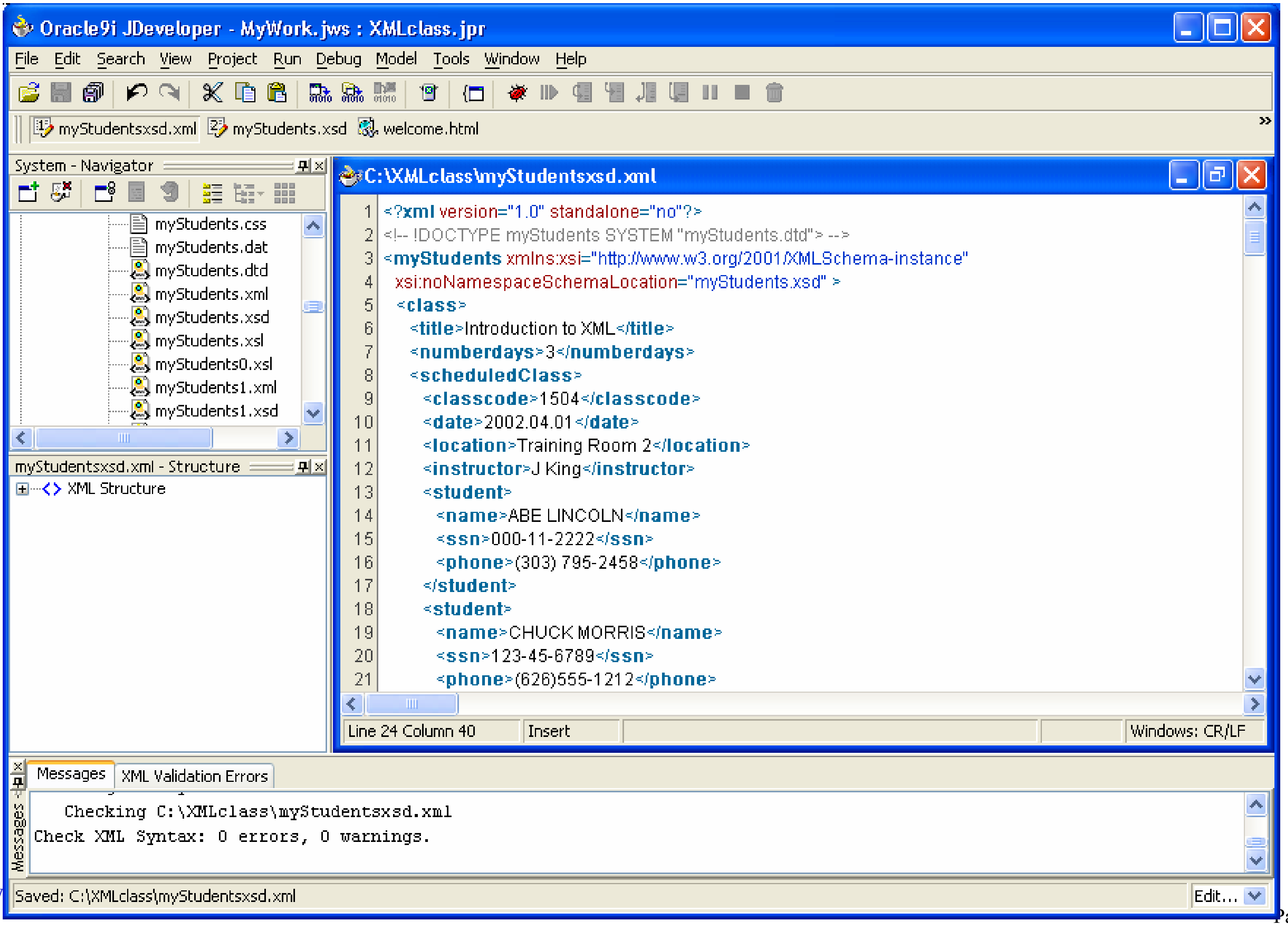
class (2)

	title	numberdays
1	Introduction to XML	3
2	XML and Java Programming	3

JDeveloper

- JDeveloper10g offers support for XML file editing including:
  – File creation and manipulation
  – Verifying that a document is “well-formed”
  – Validating a document against a schema
  – XML editing supported by code-insight

JDeveloper XML Editor



```
<?xml version="1.0" standalone="no"?>
<!-- !DOCTYPE myStudents SYSTEM "myStudents.dtd"> -->
<myStudents xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="myStudents.xsd" >
  <class>
    <title>Introduction to XML</title>
    <numberdays>3</numberdays>
    <scheduledClass>
      <classcode>1504</classcode>
      <date>2002.04.01</date>
      <location>Training Room 2</location>
      <instructor>J King</instructor>
      <student>
        <name>ABE LINCOLN</name>
        <ssn>000-11-2222</ssn>
        <phone>(303) 795-2458</phone>
      </student>
      <student>
        <name>CHUCK MORRIS</name>
        <ssn>123-45-6789</ssn>
        <phone>(626)555-1212</phone>
```

```
  Checking C:\XMLclass\myStudentsxsd.xml
Check XML Syntax: 0 errors, 0 warnings.
```

Saved: C:\XMLclass\myStudentsxsd.xml

Database Capability

- XML-Specific Database products are available today
- Most Relational Database products available today support storage and use of XML data including:
  - Oracle
  - IBM DB2 UDB
  - Microsoft SQL Server

ISO SQL/XML Functions

- An ISO standard for SQL and XML provides functions for creating XML:
  - XMLAGG(exp) - Generate single XML document from aggregate of XML data specified by "exp"
  - XMLELEMENT(name,exp) - Generates XML element using name and exp as data
  - XMLATTRIBUTES(exp,list) - Generates XML attributes using expression
  - XMLFOREST(exp,exp2 as name) – Generates XML elements from list

XMLElement

- XMLELEMENT(name,exp) Generates an XML element using name and exp as data:

```
select xmlelement("employee",
       xmlelement("empid",empno),
       xmlelement("empname",ename)) myxml
    from emp

<employee> <empid>7369</empid>
    <empname>SMITH</empname> </employee>
<employee> <empid>7499</empid>
    <empname>ALLEN</empname> </employee>
<employee> <empid>7521</empid>
    <empname>WARD</empname> </employee>
<employee> <empid>7566</empid>
    <empname>JONES</empname> </employee>
<employee> <empid>7654</empid>
    <empname>MARTIN</empname> </employee>
```

XMLAttributes

- Generates XML attributes using an expression list:

```
select xmlelement("employee",
       xmlelement("emp", xmlattributes(empno as "empno",
                                  ename as "ename")),
       xmlelement("job",job),
       xmlelement("hiredate",hiredate),
       xmlelement("pay", xmlattributes(nvl(sal,0) as "sal",
                                  nvl(comm,0) as "comm"))
       ) as myxml
from emp;

<employee>
  <emp empno="7782" ename="CLARK"/>
  <job>MANAGER</job>
  <hiredate>09-JUN-81</hiredate>
  <pay sal="2450" comm="0"/>
</employee>
*** More like the above ***
```

Putting them Together

```
select xmlelement("employee",
          xmlagg(xmlelement("emp",xmlattributes(empno as "empno",
                                                    ename as "ename"),
                                           xmlelement("job",job),
                                           xmlelement("hiredate",hiredate),
                                           xmlelement("pay",
                                           xmlattributes(nvl(sal,0) as "sal",
                                                  nvl(comm,0) as "comm")))))
   from emp;
<employee>
   <emp empno="7839" ename="O&apos;BRIAN">
      <job>PRESIDENT</job>
      <hiredate>17-NOV-81</hiredate>
      <pay sal="5000" comm="0"/>
   </emp>
   <emp empno="7698" ename="BLAKE">
      <job>MANAGER</job>
      <hiredate>01-MAY-81</hiredate>
      <pay sal="2850" comm="0"/>
   </emp>
   *** More like above ***
</employee>
```

Other XML Functions

- XMLColattval
  - Creates series of XML fragments using an element name of "column" and column names and values as attributes
- XMLConcat
  - Concatenates a series of XMLType objects (opposite of XMLElement)
- XMLForest
  - Creates XML fragments from a list of arguments/parameters
- XMLSequence
  - Creates Varray of XMLType instances
- XMLTransform
  - Uses input XMLType and XSL style sheet (also XMLType) to create a new XMLType
- UpdateXML
  - Uses an XMLType and an XPATH reference and returns an updated XMLType

Style Sheets

- XML describes data contents, not presentation
- Style sheets are used to provide presentation specifications for XML documents
- XML supports both CSS and XSL stylesheets
  - Cascading Style Sheets (CSS) have been supported by browsers for some time now and provides a tag-like language, but, is not XML itself
  - The eXtensible Style Sheet Language (XSL) is an XML application designed specifically for formatting XML documents! XSL uses XML syntax and more-modern browsers interpret XSL
- XML documents use a PI (Processing Instruction) to define the stylesheet type and name:

```
<?xml-stylesheet type="text/css" href="myBooks.css"?>
```

Using XSL Stylesheets

- To use an XSL Stylesheet from an XML File the syntax is similar to when using a .css file.

```
<?xml version="1.0" ?>
<?xml-stylesheet type="text/xsl"
   href="myfile.xsl" ?>
<RootyTooty>
   <!-- xml document goes here -->
</RootyTooty>
```

XSL and CSS

- eXtensible Stylesheet Language (XSL) is a well-formed and validated XML document providing a treasure-trove of data waiting to be used
- Unfortunately, the format of XML data is easy for computers to understand and not so easy for the average human (too many characters & tags!)
- CSS gives us some formatting capability, but, its not XML and can't take advantage of many of XML's features
- The eXtensible Style Sheet Language (XSL) was designed specifically to transform XML data from one form to another: XML document to XML document, XML document to text, Text to XML document, XML document to PDF, XML database interactions, and more!

XSLT

- With XSL we can use eXtensible Stylesheet Language for Transformations (XSLT) to display data in different form than stored
- XSLT can also trim away unwanted portions of the XML document so that the output has only what is required
- XSLT is subset derived from XSL to use style elements for the purpose of transforming data from one format to another to describe the desired output for specific fields
- Unlike CSS which generates HTML, XSLT generates XML output
- Java programmers might use the SAX or DOM object model to read and process XML transformations, fortunately, XSL/XSLT will accomplish the same thing with the help of a browser!
- XSL and XSLT are the responsibility of the World Wide Web Consortium (W3C), please consult the W3C website for the latest information about XSL and XSLT
- XSL/XSLT provide many elements to help in the transforming or presentation of XML data
- The xsl namespace prefix is usually used when processing XSL/XSLT

Stylesheet Elements

- Some of the Stylesheet elements include:
  - xsl:template - Creates a template "step"

```
<xsl:template match="/">
<xsl:template match="element">
```

  - xsl:apply-templates - Matches templates with input data and outputs when matches occur

```
<xsl:apply-templates
   select="element/subelement">
<xsl:apply-templates select="element">
<xsl:apply-templates />
```

Sample Stylesheet, page 1

```
<?xml version="1.0" ?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">
 <xsl:template match="/">
 <html> <head> <title>XML Class List</title> </head>
  <body>
    <h1 align="center">XML Class List</h1>
    <table>
    <xsl:apply-templates select="myStudents/class"/>
    </table>
  </body>
 </html>
 </xsl:template>
 <xsl:template match="class">
    <tr> <td> <h2><xsl:value-of select="title"/></h2> </td>
  </tr>
    <tr> <td>
      <h2>Number of days = <xsl:value-of
  select="numberdays"/></h2>
      </td> </tr>
   <xsl:apply-templates select="scheduledClass"/>
 </xsl:template>
```

Sample Stylesheet, page 2

```
 <xsl:template match="scheduledClass">
  <tr>  <td>  Class code = <xsl:value-of select="classcode"/>
            Date = <xsl:value-of select="date"/>  </td>  </tr>
  <tr>  <td> Location = <xsl:value-of select="location"/>
            Instructor = <xsl:value-of select="instructor"/>
             </td> </tr>
  <xsl:apply-templates select="student"/>
 </xsl:template>
 <xsl:template match="student">
  <tr> <td> <xsl:value-of select="name"/> </td> </tr>
  <xsl:apply-templates />
 </xsl:template>
</xsl:stylesheet>
```

- The statement select="student" locates a specific node and apply-templates select="myStudents/class" matches up with the node xsl:template match="class"

DTDs & Schemas: "Valid" Documents

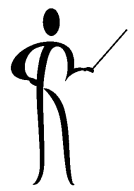
- To be well-formed:
  - Documents must include an XML declaration
  - Root element appears only once
  - Each start tag has a matching end tag
  - Elements may not overlap
- To be well-formed may not be enough, what if you want to share your XML with others?
- What guarantees that your elements will match those used by others?
- XML provides two mechanisms for validating XML files, Document Type Definitions (DTDs) and Schemas

Document Tag Definition (DTD)

- Document Type Definitions (DTDs) specify the elements a document must contain, the element sequence, and the contents of each element
- Schemas (discussed later) are also used for validation purposes
- The DTD was the first mechanism used in XML to ensure that document definitions matched
- Using a common definition means that team members may collaborate by merging documents
- Creating DTDs can be complex, DTD syntax is different from standard XML
- Using DTDs ensures that XML documents follow rules
- DTDs may be specified internally inside the XML file or externally in a separate file
- XML tags are allowed to be just about anything the document creator feels is reasonable, when passing XML documents it seems like a good idea for the recipient of a document to have a mechanism for validating the XML

DTD Rules

- A DTD is responsible for:
  - Naming document type
  - Defining each element a document might use
  - Defining the data type of each element
  - Defining the number of occurrences allowed for each element (zero, one, many)
  - Defining attributes used for each element and the allowed attribute values
- XML Schema definitions (recommended by W3C in May 2001) are intended to replace DTD use eventually (XML Schemas are written using XML).



DTD Syntax

- DTDs include many features including:
  - Document type: name of the document
  - Elements: fields in the document
  - Data type: PCDATA (parsed character) most common (tags will be interpreted)
  - Field occurrences:

• Plus-sign (+)	- one or more
• Asterisk (*)	- zero or more
• Question mark (?)	- zero or one
• Default	- exactly one

  - Attributes for a field and permissible values may be specified
  - DTDs may use standard XML comments <!-- comment -->
- DOCTYPE is the high-level (root) tag in a DTD, it includes the DTD text or reference a URI that points to a file containing the DTD
- If a DTD is included in the same file as the XML document, the DOCTYPE and associated specifications are included at the top of the file (might use standalone="yes" if no external files are used)

Sample DTD

```
<?xml version="1.0"?>
 <!ELEMENT myStudents (class+)>
 <!ELEMENT class (title, numberdays, scheduledClass+)>
 <!ELEMENT title (#PCDATA)> <!ELEMENT numberdays (#PCDATA)>
 <!ELEMENT scheduledClass
   (classcode,date,location,instructor,student*)>
 <!ELEMENT classcode (#PCDATA)> <!ELEMENT date (#PCDATA)>
 <!ELEMENT location (#PCDATA)> <!ELEMENT instructor (#PCDATA)>
 <!ELEMENT student (name)> <!ELEMENT name (#PCDATA)>
```

Training Resources

Using XML DTDs

- To reference an XML DTD from an XML document, use a PI as follows:

```
<?xml version="1.0" standalone="no" ?>
<!DOCTYPE myStudents SYSTEM "myStudents.dtd">
<myStudents>
    <class>
          <title>Introduction to XML</title>
    ...
```

Problems with DTDs

- DTDs have their own syntax, different from standard XML
- All DTD elements are global in nature
- DTD's have no mechanism for specifying the type of data that belongs in a field

Schemas

- W3C has created a new, improved method for validating XML documents called a Schema
- Schemas are well-formed XML documents themselves that describe the XML document's format
- With Schemas, XML documents and their format descriptions use the same basic formatting rules (XML) perhaps making it easier to work with both
- Schemas are used for XML document validation
- Schemas are also useful as documentation tools, since they follow the rigid XML standard they are machine-readable!
- As members of the XML family are updated (e.g. XPath, XSLT, XQuery), Schemas are incorporated into their design

XML Schema Syntax, page 1

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  elementFormDefault="qualified">
  <xs:element name="myStudents">
      <xs:complexType>
            <xs:sequence>
               <xs:element ref="class"
                         maxOccurs="unbounded"/>
            </xs:sequence>
      </xs:complexType>
  </xs:element>
  <xs:element name="class">
      <xs:complexType>
            <xs:sequence>
                  <xs:element ref="title"/>
                  <xs:element ref="numberdays"/>
                  <xs:element ref="scheduledClass"
                          maxOccurs="unbounded"/>
            </xs:sequence>
      </xs:complexType>
  </xs:element>
```

XML Schema Syntax, page 2

```
<xs:element name="title" type="xs:string"/>
  <xs:element name="numberdays" type="xs:byte"/>
                ...
  <xs:element name="classcode">
      <xs:simpleType>
            <xs:restriction base="xs:short">
                  <xs:enumeration value="1504"/>
                  <xs:enumeration value="1508"/>
                  <xs:enumeration value="1511"/>
            </xs:restriction>
      </xs:simpleType>
  ...
</xs:schema>
```

Using XML Schemas

- To reference an XML Schema from an XML document, modify the root element to include the schema:

```
<?xml version="1.0" standalone="no" ?>
<?xml-stylesheet href="myStudents.css" type="text/css" ?>
<myStudents
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance“
    xsi:noNamespaceSchemaLocation="myStudents.xsd">
    <class>
          <title>Introduction to XML</title>
    ...
```

XPath and Xlink

- XML Path Language (XPath) is designed to provide quick and easy access to any node in our document's hierarchy
- Having lots of information in XML is of little use if we cannot get to data when it is needed, XPath to the rescue!
- XPath provides a mechanism to address any element or attribute
- XLink (XML Linking Language) provides a hyperlink-type capabilty to XML
- The XLink specification is in a state of flux and is not supported by many browsers and tools, it is most useful from within programs
- XLink allows links to be constructed using any element (XML does not have any pre-defined element tags)
- XLinks build on the capability of HTML linking and avoid some of the problems

XML and JSP (User Tag Libraries)

- JSP developers write HTML and enclose Java code in JSP tags
- JSP tags are coded into HTML and start with "<%" and end with " %>“
- Separating Java and HTML makes code more useful to web designers
- JSP Custom Tags allow elimination of most Java code from JSPs
- Custom Tags are probably the most powerful feature of JSPs
  - Web Page designers may concentrate on using tags to create functional web sites
  - Developers may concentrate on the nitty-gritty details necessary to make the tags work
- A few simple steps are required to create and use Custom Tags:
  - Create Java class to provide the low-end code
  - Create a Tag Library Descriptor (TLD) connecting the .class file (or .jar file) to a tag name
  - Reference and use the TLD
  - Use Taglib to connect TLD to a prefix used in the JSP
  - Use prefix and tag name in JSP source

XML and Java (DOM, SAX, SOAP)

- Java is relatively new (1995) promising portable code; write-once, run-everwhere
- XML's text base and standardization provide portable data; store-once, use-everywhere
- XML and Java seem made for each other!
- Programs use XML via Application Programming Interfaces (APIs)
- Low-level APIs allow programmers to deal with the XML document and its data
  - DOM, SAX, and JDOM are the most commonly-used low-level APIs
  - JAXP (Java API for XML Programming) is relatively new and is becoming popular
- High-level APIs provide a simpler interface that calls one of the lower-level APIs "under-the-covers"
  - High-level APIs tend to be easier to develop with but usually add processing costs (no free-lunch!)
  - XML data binding is an example of a high-level interface

Programmer APIs

- DOM (Document Object Model) has been around for many years and is frequently used
- SAX (Simple API for XML) is newer than DOM and offers many Java-specific features
- JDOM (Java Document Object Model) is a Java-specific API tailored specifically to the needs of Java programmers
- JAXP (Java API for XML Programming) is really a higher-level API designed to take some of the complexity out of using DOM, SAX, or JDOM
- StAX (Streaming API for XML) provides a “pull” type of access to XML documents

Wrapping it all Up

- XML provides portable data to compliment the portable programming that Java provides
- XML is increasingly being used for data interchange and configuration
- IT professionals must become aware of the basics of XML and its use

XML in “The Real World”

- Okay, what will we use XML for?
  - Passing data between computer systems
    - Transaction data (new EDI standards)
    - SOAP, WSDL, UDDI, and WSIL (web services)
    - Transmission/exchange of data in universal format
  - Control files (database/server/software configuration)
- XML is not intended to be a replacement for database management systems
  - Silly things I’ve heard smart people say…
  - Database management systems like Oracle increasingly hold non-standard data (photos, sound, etc…)
  - Oracle, DB2 and other databases now have the ability to:
    - Produce query output in XML form
    - Store XML data in its native form (unstructured data)
    - Parse XML data and store it in relational form (structured data)

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Thanks for your attention!

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