XML
Extensible Markup Language

What is XML

- XML stands for eXtensible Markup Language.
- A markup language is used to provide information about a document.
- Tags are added to the document to provide the extra information.
- HTML tags tell a browser how to display the document.
- XML tags give a reader some idea what some of the data means.

What is XML Used For?

- XML documents are used to transfer data from one place to another often over the Internet.
- XML subsets are designed for particular applications.
- One is RSS (Rich Site Summary or Really Simple Syndication). It is used to send breaking news bulletins from one web site to another.
- A number of fields have their own subsets. These include chemistry, mathematics, and books publishing.
- Most of these subsets are registered with the W3Consortium and are available for anyone’s use.

Advantages of XML

- XML is text (Unicode) based.
  - Takes up less space.
  - Can be transmitted efficiently.
- One XML document can be displayed differently in different media.
  - Html, video, CD, DVD,
  - You only have to change the XML document in order to change all the rest.
- XML documents can be modularized. Parts can be reused.

Example of an HTML Document

```
<html>
   <head><title>Example</title></head.
<body>
   <h1>This is an example of a page.</h1>
   <h2>Some information goes here.</h2>
</body>
</html>
```

Example of an XML Document

```
<?xml version=“1.0”/>
<address>
   <name>Alice Lee</name>
   <email>alee@aol.com</email>
   <phone>212-346-1234</phone>
   <birthday>1985-03-22</birthday>
</address>
```

Difference Between HTML and XML

- HTML tags have a fixed meaning and browsers know what it is.
- XML tags are different for different applications, and users know what they mean.
- HTML tags are used for display.
- XML tags are used to describe documents and data.

XML Rules

- Tags are enclosed in angle brackets.
- Tags come in pairs with start-tags and end-tags.
- Tags must be properly nested.
  - **<name><email>…</name></email> is not allowed.**
  - **<name><email>…</email><name> is.**
- Tags that do not have end-tags must be terminated by a ‘/’.
  - <br /> is an html example.

More XML Rules

- Tags are case sensitive.
  - **<address> is not the same as <Address>**
- XML in any combination of cases is not allowed as part of a tag.
- Tags may not contain ‘<‘ or ‘&’.
- Tags follow Java naming conventions, except that a single colon and other characters are allowed. They must begin with a letter and may not contain white space.
- Documents must have a single *root* tag that begins the document.

Encoding

- XML (like Java) uses Unicode to encode characters.
- Unicode comes in many flavors. The most common one used in the West is UTF-8.
- UTF-8 is a variable length code. Characters are encoded in 1 byte, 2 bytes, or 4 bytes.
- The first 128 characters in Unicode are ASCII.
- In UTF-8, the numbers between 128 and 255 code for some of the more common characters used in western Europe, such as ã, á, å, or ç.
- Two byte codes are used for some characters not listed in the first 256 and some Asian ideographs.
- Four byte codes can handle any ideographs that are left.
- Those using non-western languages should investigate other versions of Unicode.

Well-Formed Documents

- An XML document is said to be well-formed if it follows all the rules.
- An XML parser is used to check that all the rules have been obeyed.
- Recent browsers such as Internet Explorer 5 and Netscape 7 come with XML parsers.
- Parsers are also available for free download over the Internet. One is Xerces, from the Apache open-source project.
- Java 1.4 also supports an open-source parser.

XML Example Revisited

```
<?xml version=“1.0”/>
<address>
    <name>Alice Lee</name>
    <email>alee@aol.com</email>
    <phone>212-346-1234</phone>
    <birthday>1985-03-22</birthday>
</address>
```

- Markup for the data aids understanding of its purpose.
- A flat text file is not nearly so clear.

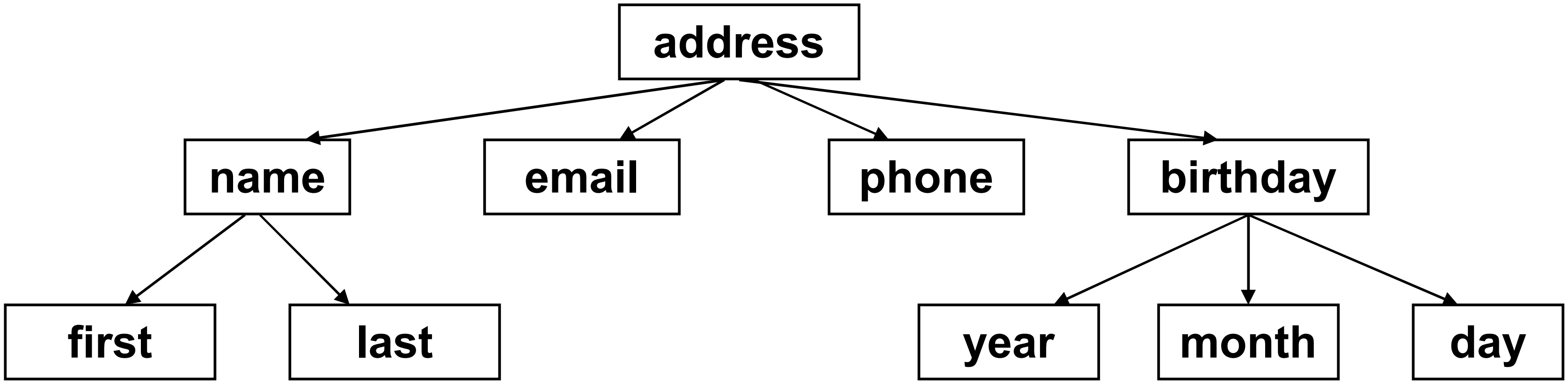
```
Alice Lee
alee@aol.com
212-346-1234
1985-03-22
```

- **The last line looks like a date, but what is it for?**

Expanded Example

```
<?xml version = “1.0” ?>
<address>
    <name>
        <first>Alice</first>
        <last>Lee</last>
    </name>
    <email>alee@aol.com</email>
    <phone>123-45-6789</phone>
    <birthday>
        <year>1983</year>
        <month>07</month>
        <day>15</day>
    </birthday>
</address>
```

XML Files are Trees



XML Trees

- An XML document has a single root node.
- The tree is a general ordered tree.
  - A parent node may have any number of children.
  - Child nodes are ordered, and may have siblings.
- Preorder traversals are usually used for getting information out of the tree.

Validity

- A well-formed document has a tree structure and obeys all the XML rules.
- A particular application may add more rules in either a DTD (document type definition) or in a schema.
- Many specialized DTDs and schemas have been created to describe particular areas.
- These range from disseminating news bulletins (RSS) to chemical formulas.
- DTDs were developed first, so they are not as comprehensive as schema.

Document Type Definitions

- A DTD describes the tree structure of a document and something about its data.
- There are two data types, PCDATA and CDATA.
  - PCDATA is parsed character data.
  - CDATA is character data, not usually parsed.
- A DTD determines how many times a node may appear, and how child nodes are ordered.

DTD for address Example

```
<!ELEMENT address (name, email, phone, birthday)>
<!ELEMENT name (first, last)>
<!ELEMENT first (#PCDATA)>
<!ELEMENT last (#PCDATA)>
<!ELEMENT email (#PCDATA)>
<!ELEMENT phone (#PCDATA)>
<!ELEMENT birthday (year, month, day)>
<!ELEMENT year (#PCDATA)>
<!ELEMENT month (#PCDATA)>
<!ELEMENT day (#PCDATA)>
```

Schemas

- Schemas are themselves XML documents.
- They were standardized after DTDs and provide more information about the document.
- They have a number of data types including string, decimal, integer, boolean, date, and time.
- They divide elements into simple and complex types.
- They also determine the tree structure and how many children a node may have.

Schema for First address Example

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<xs:element name="address">
   <xs:complexType>
        <xs:sequence>
                <xs:element name="name" type="xs:string"/>
                <xs:element name="email" type="xs:string"/>
                <xs:element name="phone" type="xs:string"/>
                <xs:element name="birthday" type="xs:date"/>
        </xs:sequence>
   </xs:complexType>
</xs:element>
</xs:schema>
```

Explanation of Example Schema

<?xml version="1.0" encoding="ISO-8859-1" ?>

- **ISO-8859-1, Latin-1, is the same as UTF-8 in the first 128 characters.**

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">

- **www.w3.org/2001/XMLSchema contains the schema standards.**

<xs:element name="address">

<xs:complexType>

- **This states that address is a complex type element.**

<xs:sequence>

- **This states that the following elements form a sequence and must come in the order shown.**

<xs:element name="name" type="xs:string"/>

- **This says that the element, name, must be a string.**

<xs:element name="birthday" type="xs:date"/>

- **This states that the element, birthday, is a date. Dates are always of the form yyyy-mm-dd.**

XSLT

Extensible Stylesheet Language Transformations

- XSLT is used to transform one xml document into another, often an html document.
- The Transform classes are now part of Java 1.4.
- A program is used that takes as input one xml document and produces as output another.
- If the resulting document is in html, it can be viewed by a web browser.
- This is a good way to display xml data.

A Style Sheet to Transform address.xml

```
<?xml version="1.0" encoding="ISO-8859-1"?>
   <xsl:stylesheet version="1.0"
   xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
        <xsl:template match="address">
                <html><head><title>Address Book</title></head>
                <body>
                        <xsl:value-of select="name"/>
                        <br/><xsl:value-of select="email"/>
                        <br/><xsl:value-of select="phone"/>
                        <br/><xsl:value-of select="birthday"/>
                </body>
                </html>
        </xsl:template>
   </xsl:stylesheet>
```

The Result of the Transformation

Alice Lee
alee@aol.com
123-45-6789
1983-7-15

Parsers

- There are two principal models for parsers.
- SAX – Simple API for XML
  - Uses a call-back method
  - Similar to javax listeners
- DOM – Document Object Model
  - Creates a parse tree
  - Requires a tree traversal

References

- Elliotte Rusty Harold, *Processing XML with Java,* Addison Wesley, 2002.
- Elliotte Rusty Harold and Scott Means, *XML Programming*, O'Reilly & Associates, Inc., 2002.
- W3Schools Online Web Tutorials, http://www.w3schools.com.