Chapter 2
Structured Web Documents in XML

Adapted from slides from Grigoris Antoniou and Frank van Harmelen

Outline

(1) Introduction

(2) XML details

(3) Structuring

- DTDs
- XML Schema

(4) Namespaces

(5) Accessing, querying XML documents: XPath

(6) Transformations: XSLT

Role of XML in the Semantic Web

- Most of the Semantic Web involves ideas and languages at a fairly abstract level
  e.g., for defining ontologies, publishing data using them
- But we also need a practical way of encoding the abstract languages
- Much Web technology is (still) based on XML standards
- So XML is (1) the source for many key SW concepts technology bits; (2) a potential alternative the SW must improve on; and (3) a common serialization for SW data

To paraphrase Jamie Zawinski

Some people, when confronted with a problem, think, "I know, I'll use XML."

Now they have two problems.

"Some people, when confronted with a problem, think "I know, I'll use regular expressions." Now they have two problems."
-- Wikiquote

History

- XML's roots are in SGML
  - Standard Generalized Markup Language
  - A *metalanguage* for defining document markup languages
  - Very extensible, but very complicated
- HTML was defines using SGML
  - It's a markup language, not a *markup metalanguage*
- XML proposal to W3C in July 1996
  - Idea: a simplified SGML could greatly expand the power and flexibility of the Web
  - First XML Meeting, August 1996, Seattle
- Evolving series of W3C recommendations

An HTML Example

```
<h2>Nonmonotonic Reasoning: Context-
  Dependent Reasoning</h2>
<i>by <b>V. Marek</b> and
  <b>M. Truszczynski</b></i><br>
Springer 1993<br>
ISBN 0387976892
```


The Same Example in XML

```
<book>
  <title>Nonmonotonic Reasoning: Context-
  Dependent Reasoning</title>
  <author>V. Marek</author>
  <author>M. Truszczynski</author>
  <publisher>Springer</publisher>
  <year>1993</year>
  <ISBN>0387976892</ISBN>
</book>
```


HTML versus XML: Similarities

- Both use **tags** (e.g. *<h2>* and *</year>*)
- Tags may be nested (tags within tags)
- Human users can read and interpret both HTML and XML representations quite easily

… **But how about machines?**

Problems Interpreting HTML Documents

An intelligent agent trying to retrieve the names of the authors of the book

- Authors' names could appear immediately after the title
- or immediately after the word "*by*" or *"van"* if it's in Dutch
- Are there two authors?
- Or just one, called "*V. Marek and M. Truszczynski*"?

```
<h2>Nonmonotonic Reasoning:
Context-Dependent Reasoning</h2>
<i>by <b>V. Marek</b> and <b>M.
Truszczynski</b></i><br>
Springer 1993<br>
ISBN 0387976892
```


HTML vs XML: Structural Information

- HTML documents do not contain **structural information**: pieces of the document and their relationships.
- XML more easily accessible to machines because
  - Every piece of information is described
  - Relations are also defined through the nesting structure
  - E.g., **<author>** tags appear within the **<book>** tags, so they describe properties of the particular book

HTML vs XML: Structural Information

- A machine processing the XML document would be able to deduce that
  - the **author** element refers to the enclosing **book** element
  - rather than by *proximity* or other heuristics
- XML allows the definition of constraints on values
  - E.g.: a year must be a number of four digits

HTML vs. XML: Formatting

- The HTML representation provides more than the XML representation:
  - Formatting of the document is also described
- The main use of an HTML document is to display information: it must define formatting
- **XML: separation of content from display**
  - same information can be displayed in different ways
  - Presentation specified by documents using other XML standards (CSS, XSL)

HTML vs. XML: Another Example

In HTML

```
<h2>Relationship matter-energy</h2>
<i> E = M × c2 </i>
```

In XML

```
<equation>
  <gloss>Relationship matter energy </gloss>
  <leftside> E </leftside>
  <rightside> M × c2 </rightside>
</equation>
```


HTML vs. XML: Different Use of Tags

- HTML documents typically use the same tags
- XML documents typically use different tags
- HTML tags come from and finite, pre-defined collection
  - They define properties for display: font, color, lists …
- XML tags not fixed: user definable tags
- XML *meta markup language*: language for defining markup languages

XML Vocabularies

- Web applications must agree on common vocabularies to communicate and collaborate
- Communities and business sectors define their specialized vocabularies
  - mathematics (MathML)
  - bioinformatics (BSML)
  - human resources (HRML)
  - Syndication (RSS)
  - Vector graphics (SVG)
  - …

Outline

The XML Language

An XML document consists of

- a **prolog**
- a number of **elements**
- an optional **epilog** (not discussed, not used much)

Prolog of an XML Document

The prolog consists of

- an XML declaration and
- an optional reference to external structuring documents

<?xml version="1.0" encoding="UTF-16"?>

<!DOCTYPE book SYSTEM "book.dtd">

XML Elements

- Elements are the “things” the XML document talks about
  - E.g., books, authors, publishers
- An element consists of:
  - an opening tag
  - the content
  - a closing tag

<lecturer> Alan Turing </lecturer>

XML Elements

- Tag names can be chosen almost freely
- The first character must be a letter, an underscore, or a colon
- No name may begin with the string “xml” in any combination of cases
  - E.g. “Xml”, “xML”

Content of XML Elements

- Content is what's between the tags
- It can be text, or other elements, or nothing

```
<lecturer>
  <name>Alan Turing</name>
  <phone> +61 − 7 − 3875 507 </phone>
</lecturer>
```

- If there is no content, then the element is called empty; it can be abbreviated as follows:

```
<lecturer/>  =  <lecturer></lecturer>
```


XML Attributes

- An empty element is not necessarily meaningless
  - It may have properties expressed as *attributes*
- An **attribute** is a name-value pair inside the opening tag of an element

```
<lecturer
  name="Alan Turing"
  phone="+61 − 7 − 3875 507“ />
```


XML Attributes: An Example

```
<order orderNo="23456“
       customer="John Smith"
       date="October 15, 2002” >
  <item itemNo="a528" quantity="1“ />
  <item itemNo="c817" quantity="3“ />
</order>
```


The Same Example without Attributes

```
<order>
  <orderNo>23456</orderNo>
  <customer>John Smith</customer>
  <date>October 15, 2002</date>
  <item>
      <itemNo>a528</itemNo>
      <quantity>1</quantity>
  </item>
  <item>
      <itemNo>c817</itemNo>
      <quantity>3</quantity>
      </item>
</order>
```

XML Elements vs. Attributes

- Attributes can be replaced by elements
- When to use elements and when attributes is a matter of taste
- **But attributes cannot be nested**

Further Components of XML Docs

- **Comments**
  - A piece of text that is to be ignored by parser

  <!-- This is a comment -->
- **Processing Instructions (PIs)**
  - Define procedural attachments

  <?stylesheet type="text/css“ href="mystyle.css"?>

  <?xml-stylesheet type="text/xsl" href="cdcatalog.xsl"?>

Well-Formed XML Documents

Syntactically correct documents must adhere to many rules

- Only one outermost element (the **root element**)
- Element contains an opening and corresponding closing tag (except self-closing tags like <foo/>)
- Tags may not overlap

  <author><name>Lee Hong</author></name>
- Attributes within an element have unique names
- Element and tag names must be permissible

Experiment with http://bit.ly/691PE in oxygen

The Tree Model of XML Docs

The tree representation of an XML document is an **ordered** labeled tree:

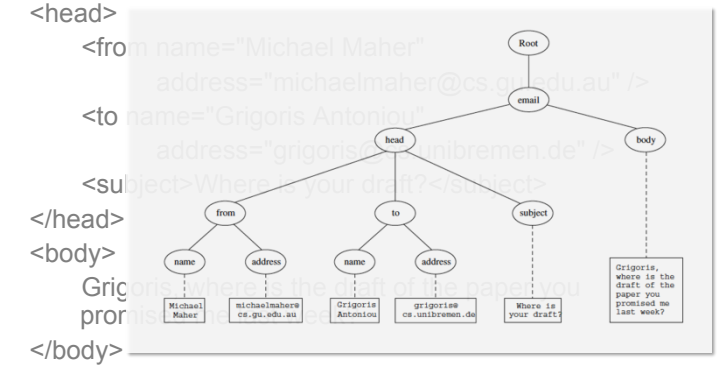
- Exactly one root
- No cycles
- Non-root nodes have exactly one parent
- Each node has a label
- Order of elements is important

  … but the order of attributes is not

Tree Model of XML Documents

```
<email>
  <head>
      <from name="Michael Maher"
            address="michaelmaher@cs.gu.edu.au" />
      <to name="Grigoris Antoniou"
            address="grigoris@cs.unibremen.de" />
      <subject>Where is your draft?</subject>
  </head>
  <body>
      Grigoris, where is the draft of the paper you
      promised me last week?
  </body>
</email>
```


Tree Model of XML Documents



Outline

Structuring XML Documents

- Some XML documents must follow constraints defined in a “template” that can define the
  - Names of allowable *elements* and *attributes*
  - Values an attribute may take
  - Constraints on which elements may or must occur within other elements, etc.
- Having a template is optional but facilitates
  - Data sharing (a key usecase)
  - Data file validation (of pragmatic importance)

Structuring XML Documents

- An XML document is **valid** if
  - it is well-formed
  - respects the structuring information it uses
- Ways to define the structure of XML documents:
  - **DTDs** (*Document Type Definition*) came first, is simple and was based on SGML's approach
  - **XML Schema** (aka *XML Schema Definition*, XSD) is more recent and expressive
  - RELAX NG and DSDs are two alternatives

DTD: Element Type Definition

```
<lecturer>
    <name>Alan Turing</name>
    <phone> +61 − 7 − 3875 507 </phone>
</lecturer>
```

DTD for above element (and all **lecturer** elements):

```
<!ELEMENT lecturer (name, phone) >
<!ELEMENT name (#PCDATA) >
<!ELEMENT phone (#PCDATA) >
```


The Meaning of the DTD

- The element types **lecturer**, **name**, and **phone** may be used in the document
- A **lecturer** element contains a **name** element and a **phone** element, in that order (*sequence*)
- A **name** element and a **phone** element may have any content
  - In DTDs, **#PCDATA** is the only atomic element type and stands for "*parsed character data*"

```
<!ELEMENT lecturer (name, phone) >
<!ELEMENT name (#PCDATA) >
<!ELEMENT phone (#PCDATA) >
```


Disjunction in Element Type Definitions

- We express that a **lecturer** element contains *either* a **name** *or* a **phone** element as follows:

  <!ELEMENT lecturer (name | phone)>
- A **lecturer** element contains a **name** element and a **phone** element in *any order*.

  <!ELEMENT lecturer((name,phone)|
  (phone,name))>
- Do you see a problem with this approach?

Example of an XML Element

Here's an example of how we want to represent customer orders in XML

```
<order orderNo="23456"
       customer="John Smith"
       date="October 15, 2002">
  <item itemNo="a528" quantity="1" />
  <item itemNo="c817" quantity="3" />
</order>
```


Corresponding DTD

```
<!ELEMENT order (item+)>
<!ATTLIST order
    orderNo     ID      #REQUIRED
    customer    CDATA   #REQUIRED
    date        CDATA   #REQUIRED >

<!ELEMENT item EMPTY>
<!ATTLIST item
    itemNo      ID      #REQUIRED
    quantity    CDATA   #REQUIRED
    comments    CDATA   #IMPLIED >
```


Comments on the DTD

- The **item** element type is defined to be empty
  - i.e., it can contain no elements
- **+** (after **item)** is a **cardinality operator**:
  - Specifies how many item elements can be in an order
  - **?**: appears zero times or once
  - *****: appears zero or more times
  - **+**: appears one or more times
  - No cardinality operator means exactly once

```
<!ELEMENT order (item+)>
<!ATTLIST order
   orderNo ID #REQUIRED
   customer CDATA #REQUIRED
   date CDATA #REQUIRED >
<!ELEMENT item EMPTY>
<!ATTLIST item
    itemNo ID #REQUIRED
    quantity CDATA #REQUIRED
    comments CDATA #IMPLIED >
```


Comments on the DTD

- In addition to defining elements, we define attributes
- This is done in an **attribute list** containing:
  - Name of element type to which the list applies
  - A list of triples: name, type, and value type
- *Attribute name*: A name that may be used in an XML document using a DTD

```
<!ELEMENT order (item+)>
<!ATTLIST order
   orderNo ID #REQUIRED
   customer CDATA #REQUIRED
   date CDATA #REQUIRED >
<!ELEMENT item EMPTY>
<!ATTLIST item
    itemNo ID #REQUIRED
    quantity CDATA #REQUIRED
    comments CDATA #IMPLIED >
```

DTD: Attribute Types

- Finite list of predefined data types, including
  - **CDATA**, a string (sequence of characters)
  - **ID**, name that is *unique* across the entire XML document (~DB key)
  - **IDREF**, reference to another element with an ID attribute matching the IDREF attribute (~DB foreign key)
  - **IDREFS**, a series of IDREFs
  - **(v1| . . . |vn)**, an enumeration of all possible values
- Limitations: no dates, number ranges, user-defined types, etc.

DTD: Attribute Value Types

- **#REQUIRED**
  - Attribute must appear in every occurrence of the element type in the XML document
- **#IMPLIED**
  - The appearance of the attribute is optional
- **#FIXED "value"**
  - Every element must have this attribute
- **"value"**
  - This specifies the default value for the attribute

Referencing with IDREF and IDREFS

Suppose we want to model people and their family relationships

```
<!ELEMENT family (person*)>
<!ELEMENT person (name)>
<!ELEMENT name (#PCDATA)>
<!ATTLIST person
    id        ID      #REQUIRED
    mother    IDREF   #IMPLIED
    father    IDREF   #IMPLIED
    children  IDREFS  #IMPLIED >
```


XML Document using the DTD

```
<family>
    <person id="bob42" mother="mary87" father="peter13">
        <name>Bob Marley</name>
    </person>
    <person id="bridget6" mother="mary87">
        <name>Bridget Jones</name>
    </person>
    <person id="mary87" children="bob42 bridget6">
        <name>Mary Poppins</name>
    </person>
    <person id="peter13" children="bob42">
        <name>Peter Marley</name>
    </person>
</family>
```

Remarks on DTDs

- A DTD can be interpreted as an Extended Backus-Naur Form (EBNF)
  - **<!ELEMENT email (head,body)>**
  - is equivalent to **email ::= head body**
- Recursive definitions possible in DTDs
  - **<!ELEMENT bintree**
    ((bintree root bintree)|emptytree)>
- Experiment with http://bit.ly/691book in oxygen

Outline

XML Schema

- XML Schema is a significantly richer language for defining the structure of XML documents
- Syntax is based on XML itself
  => separate tools to handle them not needed
- Reuse and refinement of schemas
  => can expand or delete existing schemas
- Sophisticated set of **data types**, compared to DTDs (which only supports strings)
- W3C published the XML Schema recommendation in 2001 and version 1.1 in 2012

XML Schema

- An XML schema is an element with an opening tag like

  <schema
  "http://www.w3.org/2000/10/XMLSchema"
  version="1.0">
- The schema element contains element and attribute types using data types

Element Types

```
<element name="email"/>
<element name="head“
   minOccurs="1“
   maxOccurs="1"/>
<element name="to" minOccurs="1"/>
```

Cardinality constraints:

- **minOccurs="x"** (default value 1)
- **maxOccurs="x"** (default value 1)
- Generalizations of *,?,+ offered by DTDs

Attribute Types

```
<attribute name="id" type="ID" use="required"/>
<attribute name="speaks" type="Language"
   use="default" value="en"/>
```

- Existence: **use="x",** where **x** may be **optional** or **required**
- Default value: **use="x" value="..."**, where **x** may be **default** or **fixed**

Data Types

- There are many **built-in data types**
  - Numerical data types: **integer**, **Short,** etc.
  - String types: **string**, **ID**, **IDREF**, **CDATA,** etc.
  - Date and time data types: **time**, **Month,** etc.
- There are also **user-defined data types**
  - **simple data types**: can't use elements or attributes
  - **complex data types**: can use these

Complex Data Types

Complex data types are defined from existing data types by defining some attributes (if any) and using:

- **Sequence**: a sequence of existing data type elements (order is important)
- **All**: a collection of elements that must appear (order is not important)
- **Choice**: a collection of elements, of which one will be chosen

A Data Type Example

```
<complexType name="lecturerType">
    <sequence>
        <element name="firstname" type="string"
            minOccurs="0" maxOccurs="unbounded"/>
        <element name="lastname" type="string"/>
    </sequence>
    <attribute name="title"
                type="string"
                use="optional"/>
</complexType>
```


XML Schema: The Email Example

```
<element name="email" type="emailType"/>

<complexType name="emailType">
    <sequence>
        <element name="head" type="headType"/>
        <element name="body" type="bodyType"/>
    </sequence>
</complexType>
```


XML Schema: The Email Example

```
<complexType name="headType">
    <sequence>
        <element name="from" type="nameAddress"/>
        <element name="to" type="nameAddress"
                minOccurs="1" maxOccurs="unbounded"/>
        <element name="cc" type="nameAddress"
                minOccurs="0" maxOccurs="unbounded"/>
        <element name="subject" type="string"/>
    </sequence>
</complexType>
```


XML Schema: The Email Example

```
<complexType name="nameAddress">
        <attribute name="name" type="string"
          use="optional"/>
        <attribute name="address"
          type="string" use="required"/>
</complexType>
```

- Similar for bodyType

Outline

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(2) Detailed Description of XML

(3) Structuring

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- XML Schema

(4) Namespaces

(5) Accessing, querying XML documents: XPath

(6) Transformations: XSLT

Namespaces

- XML namespaces provide uniquely named elements and attributes in an XML document
- An XML document may use more than one DTD or schema
- Since each was developed independently, name clashes may appear
- Solution: use different prefix for each DTD or schema

  prefix:name
- Namespaces are even more important in RDF

An Example

```
<vu:instructors   xmlns:vu="http://www.vu.com/empDTD"
                  xmlns:gu="http://www.gu.au/empDTD"
                  xmlns:uky="http://www.uky.edu/empDTD" >
    <uky:faculty uky:title="assistant professor"
                 uky:name="John Smith"
                 uky:department="Computer Science"/>

     <gu:academicStaff  gu:title="lecturer"
                        gu:name="Mate Jones"
                        gu:school="Information Technology"/>
</vu:instructors>
```


Namespace Declarations

- Namespaces are declared within an element and can be used in that element and any of its children (elements and attributes)
- A namespace declaration has the form:
  - **xmlns:prefix="location"**
  - **location** is the address of the DTD or schema
- If a prefix is not specified: **xmlns="location"** then the **location** is used as the *default* prefix

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Addressing & Querying XML Documents

- In relational databases, parts of a database can be selected and retrieved using SQL
  - Also very useful for XML documents
  - **Query languages**: XQuery, XQL, XML-QL
- The central concept of XML query languages is a **path expression**
  - Specifies how a node or a set of nodes, in the tree representation of the XML document can be reached

XPath

- XPath is core for XML query languages
- Language for addressing XML document parts
  - It operates on the tree data model of XML
  - It has a non-XML syntax
- Versions
  - XPath 1.0 (1999) is widely supported
  - XPath 2.0 (2007) is a more expressive subset of Xquery
  - XPath 3.0 became a proposed recommendation in October 2013

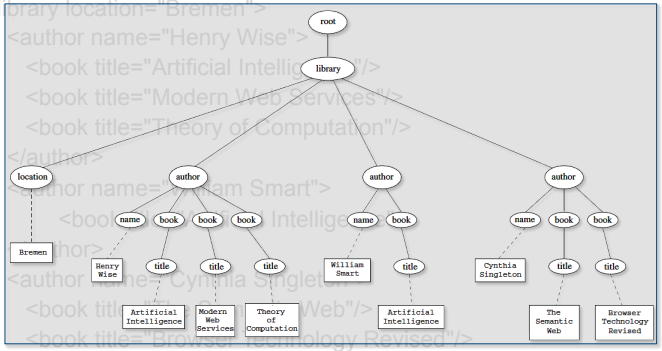
Types of Path Expressions

- **Absolute** (starting at the root of the tree)
  - Syntactically they begin with the symbol */*
  - It refers to the root of the document (situated one level above the root element of the document)
- **Relative** to a context node

An XML Example

```
<library location="Bremen">
  <author name="Henry Wise">
    <book title="Artificial Intelligence"/>
    <book title="Modern Web Services"/>
    <book title="Theory of Computation"/>
  </author>
  <author name="William Smart">
      <book title="Artificial Intelligence"/>
  </author>
  <author name="Cynthia Singleton">
    <book title="The Semantic Web"/>
    <book title="Browser Technology Revised"/>
  </author>
</library>
```

Tree Representation



Examples of Path Expressions in XPath

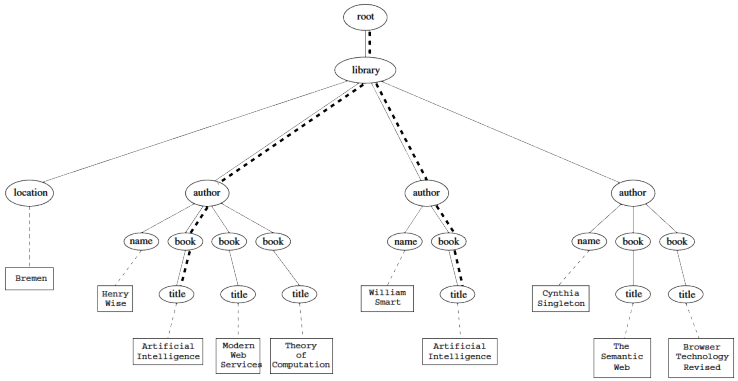
- **Q1: /library/author**
  - Addresses all **author** elements that are children of the **library** element node immediately below the root
  - **/t1/.../tn**, where each **ti+1** is a child node of **ti**, is a path through the tree representation
- **Q2: //author**
  - Here **//** says that we should consider all elements in the document and check whether they are of type **author**
  - This path expression addresses all **author** elements anywhere in the document

Examples of Path Expressions in XPath

- **Q3: /library/@location**
  - Addresses the location attribute nodes within library element nodes
  - The symbol **@** is used to denote attribute nodes
- **Q4: //book/@title="Artificial Intelligence"**
  - Adresses all title attribute nodes within book elements anywhere in the document, which have the value "Artificial Intelligence"

Tree Representation of Query 4

//book/@title="Artificial Intelligence"



Examples of Path Expressions in XPath

- **Q5: /book[@title="Artificial Intelligence"]**
  - Addresses all books with title “Artificial Intelligence”
  - A test in brackets is a **filter expression** that restricts the set of addressed nodes.
  - Note differences between Q4 and Q5:
    - Query 5 addresses **book** elements, the **title** of which satisfies a certain condition.
    - Query 4 collects **title** attribute nodes of **book** elements

Outline

Displaying XML Documents

```
<author>
  <name>Grigoris Antoniou</name>
  <affiliation>University of Bremen</affiliation>
  <email>ga@tzi.de</email>
</author>
```

may be displayed in different ways:

Grigoris Antoniou
University of Bremen
ga@tzi.de

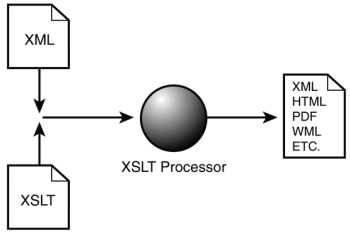
Grigoris Antoniou
University of Bremen
ga@tzi.de

Idea: use an external style sheet to transform an XML tree into an HTML or XML tree

Style Sheets

- Style sheets can be written in various languages
  - E.g. CSS2 (cascading style sheets level 2)
  - XSL (extensible stylesheet language)
- XSL includes
  - a transformation language (XSLT)
  - a formatting language
  - Both are XML applications

XSL Transformations (XSLT)



- XSLT specifies rules to transform a XML document to
  - another XML document
  - an HTML document
  - plain text
- The output document may use the same DTD or schema, or a completely different vocabulary
- XSLT can be used independently of the formatting language

XSLT Use Cases

- Move data and metadata from one XML representation to another
- XSLT is chosen when applications that use different DTDs or schemas need to communicate
- XSLT can be used for machine processing of content without any regard to displaying the information for people to read.
- In the following example we use XSLT only to display XML documents as HTML

XSLT Transformation into HTML

```
<author>
  <name>Grigoris Antoniou</name>
  <affiliation>University of Bremen</affiliation>
  <email>ga@tzi.de</email>
</author>
```

```
<xsl:template match="/author">
  <html>
      <head><title>An author</title></head>
      <body bgcolor="white">
          <b><xsl:value-of select="name"/></b><br>
          <xsl:value-of select="affiliation"/><br>
          <i><xsl:value-of select="email"/></i>
      </body>
  </html>
</xsl:template>
```

Style Sheet Output

```
<author>
  <name>Grigoris Antoniou</name>
  <affiliation>University of Bremen</affiliation>
  <email>ga@tzi.de</email>
</author>
```

```
<xsl:template match="/author"> <html>
    <head><title>An author</title></head>
    <body bgcolor="white">
      <b><xsl:value-of select="name"/></b><br>
      <xsl:value-of select="affiliation"/><br>
      <i><xsl:value-of select="email"/></i>
    </body>
  </html></xsl:template>
```

```
<html>
  <head><title>An author</title></head>
  <body bgcolor="white">
      <b>Grigoris Antoniou</b><br>
      University of Bremen<br>
      <i>ga@tzi.de</i>
  </body>
</html>
```


Observations About XSLT

- XSLT documents are XML documents
  - XSLT resides on top of XML
- The XSLT document defines a **template**
  - In this case an HTML document, with some placeholders for content to be inserted
- **xsl:value-of** retrieves the value of an element and copies it into the output document
  - It places some content into the template

Auxiliary Templates

- We have an XML document with details of several authors
- It is a waste of effort to treat each **author** element separately
- In such cases, a special template is defined for **author** elements, which is used by the main template

Example of an Auxiliary Template

```
<authors>
  <author>
      <name>Grigoris Antoniou</name>
      <affiliation>University of Bremen</affiliation>
      <email>ga@tzi.de</email>
  </author>
  <author>
      <name>Alan Turing</name>
      <affiliation>Griffith University</affiliation>
      <email>david@gu.edu.net</email>
  </author>
</authors>
```

Example of an Auxiliary Template (2)

```
<xsl:template match="/">
  <html>
    <head><title>Authors</title></head>
    <body bgcolor="white">
      <xsl:apply-templates select="author"/>
      <!-- apply templates for AUTHORS children -->
    </body>
  </html>
</xsl:template>
```


Example of an Auxiliary Template (3)

```
<xsl:template match="authors">
      <xsl:apply-templates select="author"/>
</xsl:template>

<xsl:template match="author">
  <h2><xsl:value-of select="name"/></h2>
  <p> Affiliation:<xsl:value-of select="affiliation"/><br/>
  Email: <xsl:value-of select="email"/> </p>
</xsl:template>
```

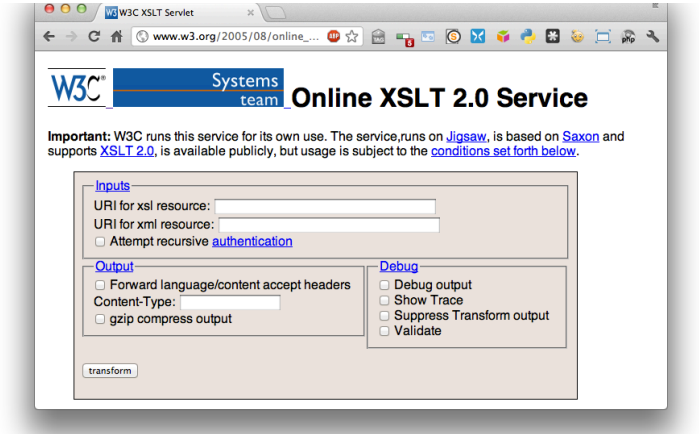

Multiple Authors Output

```
<html>
  <head><title>Authors</title></head>
  <body bgcolor="white">
        <h2>Grigoris Antoniou</h2>
        <p>Affiliation: University of Bremen<br/>
        Email: ga@tzi.de</p>
        <h2>Alan Turing</h2>
        <p>Affiliation: Griffith University<br/>
        Email: david@gu.edu.net</p>
  </body>
</html>
```


How to apply XSLT transforms

- When a modern browsers loads an XML file, it will will apply a linked XSLT and display the results (hopefully HTML!)
- Use an external Web service
- Use an XML editor
- Use a module or library for your favorite programming language

An XSLT Web Service



http://www.w3.org/2005/08/online_xslt/

CD Catalog example

```
<?xml-stylesheet type="text/xsl"
href="cdcatalog.xsl"?>
<catalog>
<cd>
 <title>Empire Burlesque</title>
 <artist>Bob Dylan</artist>
 <country>USA</country>
 <company>Columbia</company>
 <price>10.90</price>
 <year>1985</year>
</cd>
<cd>
 <title>Hide your heart</title>
 <artist>Bonnie Tyler</artist>
 <country>UK</country>
 <company>CBS Records</company>
…
</cd> …
```

```
<xsl:template match="/">
 <html> <body>
 <h2>My CD Collection</h2>
  <table border="1">
   <tr bgcolor="#9acd32">
    <th align="left">Title</th>
    <th align="left">Artist</th>
   </tr>
   <xsl:for-each select="catalog/cd">
    <tr>
     <td><xsl:value-of select="title"/></td>
     <td><xsl:value-of select="artist"/></td>
    </tr>
   </xsl:for-each>
  </table>
 </body> </html>
</xsl:template>
</xsl:stylesheet>
```

See http://bit.ly/VQfLVV

Viewing an XML file in a Browser

```
~> curl http://www.csee.umbc.edu/courses/graduate/691/
spring12/03/examples/xml/cdcatalog/cdcatalog.xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<?xml-stylesheet type="text/xsl" href="cdcatalog.xsl"?>
<catalog>
<cd>
 <title>Empire Burlesque</title>
 <artist>Bob Dylan</artist>
 <country>USA</country>
 <company>Columbia</company>
 <price>10.90</price>
 <year>1985</year>
</cd>
<cd>
 <title>Hide your heart</title>
 <artist>Bonnie Tyler</artist>
 <country>UK</country>
 <company>CBS Records</company>
 <price>9.90</price>
 <year>1988</year>
</cd>
...
```

Summary

- XML is a metalanguage that allows users to define markup
- XML separates content and structure from formatting
- XML is (one of the) the de facto standard to represent and exchange structured information on the Web
- XML is supported by query languages

Comments for Discussion

- Nesting of tags doesn't have standard meaning
- Semantics of XML documents not accessible to machines, only to people
- Collaboration and exchange are supported if there is underlying shared understanding of the vocabulary
- XML is well-suited for close collaboration where domain or community-based vocabularies are used and less so for global communication
- Databases went from tree structures (60s) to relations (80s) and graphs (10s)