An Introduction to XML and Web Technologies

XML Documents

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Objectives

- What is **XML**, in particular in relation to HTML
- The XML **data model** and its **textual** representation
- The XML **Namespace** mechanism

What is XML?

- XML: *E**x**tensible **M**arkup **L**anguage*
- A **framework** for defining markup languages
- Each language is targeted at its own **application domain** with its own markup tags
- There is a common set of **generic tools** for processing XML documents
- **XHTML**: an XML variant of HTML
- Inherently **internationalized** and **platform independent** (Unicode)
- Developed by W3C, standardized in 1998

Recipes in XML

- Define our own "***Recipe Markup Language***"
- Choose markup tags that correspond to concepts in this application domain
  - *recipe*, *ingredient*, *amount*, ...
- No canonical choices
  - granularity of markup?
  - structuring?
  - elements or attributes?
  - ...

Example (1/2)

```
<collection>
  <description>Recipes suggested by Jane Dow</description>

  <recipe id="r117">
    <title>Rhubarb Cobbler</title>
    <date>Wed, 14 Jun 95</date>

    <ingredient name="diced rhubarb" amount="2.5" unit="cup"/>
    <ingredient name="sugar" amount="2" unit="tablespoon"/>
    <ingredient name="fairly ripe banana" amount="2"/>
    <ingredient name="cinnamon" amount="0.25" unit="teaspoon"/>
    <ingredient name="nutmeg" amount="1" unit="dash"/>

    <preparation>
      <step>
        Combine all and use as cobbler, pie, or crisp.
      </step>
    </preparation>
```


Example (2/2)

```
    <comment>
      Rhubarb Cobbler made with bananas as the main sweetener.
      It was delicious.
    </comment>

    <nutrition calories="170" fat="28%"
               carbohydrates="58%" protein="14%"/>
    <related ref="42">Garden Quiche is also yummy</related>
  </recipe>
</collection>
```

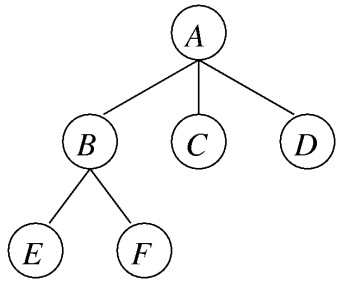

Building on the XML Notation

- Defining the **syntax** of our recipe language
  - DTD, XML Schema, ...
- Showing recipe documents in **browsers**
  - XPath, XSLT
- Recipe collections as **databases**
  - XQuery
- Building a **Web-based** recipe editor
  - HTTP, Servlets, JSP, ...
- ...

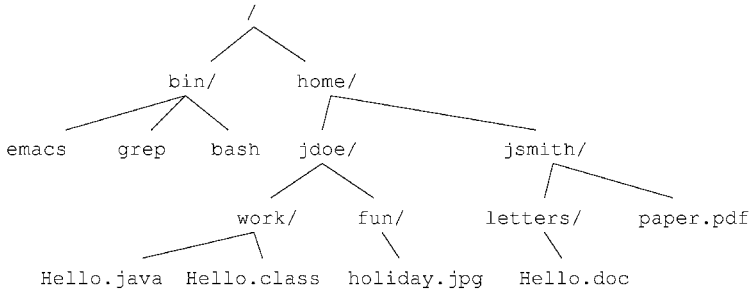
– the topics of the following weeks...

XML Trees

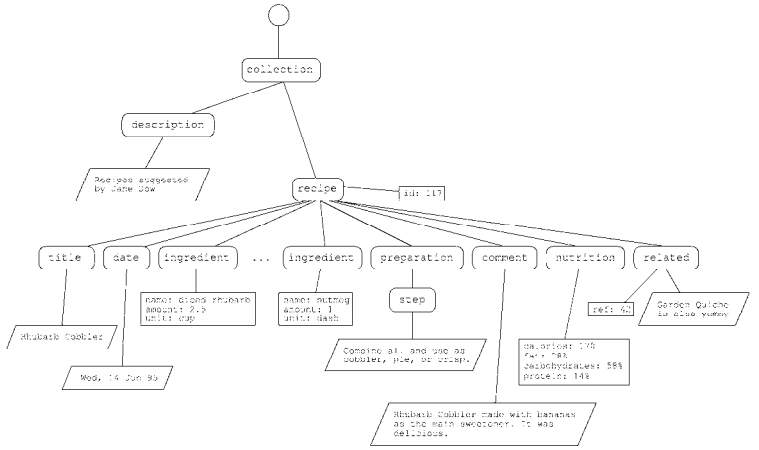
- Conceptually, an XML document is a **tree structure**
  - node, edge
  - root, leaf
  - child, parent
  - sibling (ordered), ancestor, descendant



An Analogy: File Systems



Tree View of the XML Recipes



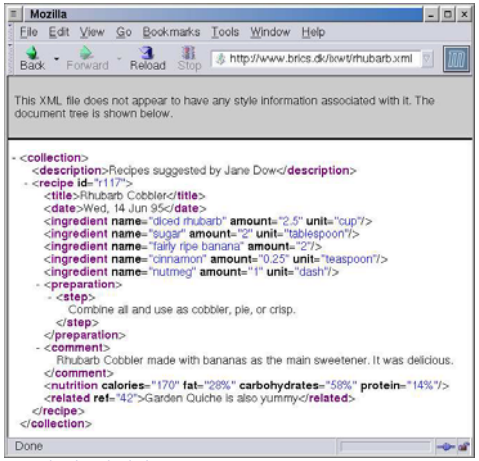
Nodes in XML Trees

- **Text nodes**: carry the actual contents, leaf nodes
- **Element nodes**: define hierarchical logical groupings of contents, each have a *name*
- **Attribute nodes**: unordered, each associated with an element node, has a *name* and a *value*
- **Comment nodes**: ignorable meta-information
- **Processing instructions**: instructions to specific processors, each have a *target* and a *value*
- **Root nodes**: every XML tree has one root node that represents the entire tree

Textual Representation

- **Text nodes**: written as the text they carry
- **Element nodes**: start-end tags
  - *<bla ...> ... </bla>*
  - short-hand notation for empty elements: *<bla/>*
- **Attribute nodes**: *name="value"* in start tags
- **Comment nodes**: <!-- *bla* -->
- **Processing instructions**: <?*target value*?>
- **Root nodes**: implicit

Browsing XML (without XSLT)



More Constructs

- XML declaration
- Character references
- CDATA sections
- Document type declarations and entity references explained later...
- Whitespace?

Example

```
<?xml version="1.1" encoding="ISO-8859-1"?>
<!DOCTYPE features SYSTEM "example.dtd">
<features a="b">
  <?mytool here is some information specific to mytool?>
  El señor está bien, garçon!
  Copyright &#169; 2005
  <![CDATA[ <this is not a tag> ]]>
  <!-- always remember to specify the
       right character encoding -->
</features>
```


Well-formedness

- Every XML document must be ***well-formed***
  - start and end tags must **match** and **nest** properly
    - <x><y></y></x> ✓
    - ~~</z><x><y></x></y>~~
  - exactly one **root element**
  - ...
- in other words, it defines a proper tree structure
- **XML parser**: given the textual XML document, constructs its tree representation

Simpler Alternatives?

S-expressions, 1958:

```
(collection
  (recipe
    (title "Rhubarb Cobbler") (date "Wed, 14 Jun 95")
    ...
  )
)
```

- XML is defined as a simplified subset of SGML
- XML could have been designed simpler...
- ... but it wasn't [end of discussion]

Applications

Rough classification:

- Data-oriented languages
- Document-oriented languages
- Protocols and programming languages
- Hybrids

Example: XHTML

```
<?xml version="1.0" encoding="UTF-8"?>
<html xmlns="http://www.w3.org/1999/xhtml">
  <head><title>Hello world!</title></head>
  <body>
    <h1>This is a heading</h1>
    This is some text.
  </body>
</html>
```


Example: CML

```
<molecule id="METHANOL">
 <atomArray>
  <stringArray builtin="id">a1 a2 a3 a4 a5 a6</stringArray>
  <stringArray builtin="elementType">C O H H H H</stringArray>
  <floatArray builtin="x3" units="pm">
    -0.748 0.558 ...
  </floatArray>
  <floatArray builtin="y3" units="pm">
    -0.015 0.420 ...
  </floatArray>
  <floatArray builtin="z3" units="pm">
    0.024 -0.278 ...
  </floatArray>
 </atomArray>
</molecule>
```

Example: ebXML

```
<MultiPartyCollaboration name="DropShip">
 <BusinessPartnerRole name="Customer">
  <Performs initiatingRole='//binaryCollaboration[@name="Firm Order"]/
                            InitiatingRole[@name="buyer"]' />
 </BusinessPartnerRole>
 <BusinessPartnerRole name="Retailer">
  <Performs respondingRole='//binaryCollaboration[@name="Firm Order"]/
                            RespondingRole[@name="seller"]' />
  <Performs initiatingRole='//binaryCollaboration[...]/
                            InitiatingRole[@name="buyer"]' />
 </BusinessPartnerRole>
 <BusinessPartnerRole name="DropShip Vendor">
  ...
 </BusinessPartnerRole>
</MultiPartyCollaboration>
```


Example: ThML

```
<h3 class="s05" id="One.2.p0.2">Having a Humble Opinion of Self</h3>
<p class="First" id="One.2.p0.3">EVERY man naturally desires knowledge
  <note place="foot" id="One.2.p0.4">
    <p class="Footnote" id="One.2.p0.5"><added id="One.2.p0.6">
      <name id="One.2.p0.7">Aristotle</name>, Metaphysics, i. 1.
    </added></p>
  </note>;
  but what good is knowledge without fear of God? Indeed a humble
  rustic who serves God is better than a proud intellectual who
  neglects his soul to study the course of the stars.
  <added id="One.2.p0.8"><note place="foot" id="One.2.p0.9">
    <p class="Footnote" id="One.2.p0.10">
      Augustine, Confessions V. 4.
    </p>
  </note></added>
</p>
```


XML Namespaces

```
<widget type="gadget">
  <head size="medium"/>
  <big><subwidget ref="gizmo"/></big>
  <info>
    <head>
      <title>Description of gadget</title>
    </head>
    <body>
      <h1>Gadget</h1>
      A gadget contains a big gizmo
    </body>
  </info>
</widget>
```

- When combining languages, element names may become **ambiguous**!
- Common problems call for common solutions

The Idea

- Assign a URI to every (sub-)language

  e.g. `http://www.w3.org/1999/xhtml` for XHTML 1.0

- Qualify element names with URIs:

  `{http://www.w3.org/1999/xhtml}`head

The Actual Solution

- *Namespace declarations* bind URIs to *prefixes*

```
<... xmlns:foo="http://www.w3.org/TR/xhtml1">
   ...
   <foo:head>...</foo:head>
   ...
</...>
```

- Lexical scope
- Default namespace (no prefix) declared with **xmlns="..."**
- Attribute names can also be prefixed

Widgets with Namespaces

```
<widget type="gadget" xmlns="http://www.widget.inc">
  <head size="medium"/>
  <big><subwidget ref="gizmo"/></big>
  <info xmlns:xhtml="http://www.w3.org/TR/xhtml1">
    <xhtml:head>
      <xhtml:title>Description of gadget</xhtml:title>
    </xhtml:head>
    <xhtml:body>
    <xhtml:h1>Gadget</xhtml:h1>
      A gadget contains a big gizmo
    </xhtml:body>
  </info>
</widget>
```

Namespace map: for each element, maps prefixes to URIs

Summary

- XML: a notation for hierarchically structured text
- Conceptual tree model vs.
  concrete textual representation
- Well-formedness
- Namespaces

Essential Online Resources

- http://www.w3.org/TR/xml11/
- http://www.w3.org/TR/xml-names11
- http://www.unicode.org/