Semistructured content: XML

1

XML
eXtensible Markup Language

History

1988 SGML: Standard Generalized Markup Language
- Annotate text with structure

1992 HTML: Hypertext Mark-up Language
- Documents that are linked pieces
- Simple structure of language

1996 XML
- General-purpose description of content of a *document*
- Includes namespaces → linking across the Web
- Designed by working group of W3C (World Wide Web Consortium)
  - Define standard

2

XML

On surface looks much like HTML:

- Tags: <title> *title of document*</title>
- Structure: tags within tags

  <body><table> …</table> … </body>

  – Must be nested → hierarchy
- Tags have attributes <body bgcolor="#ffffff">

But **Tags are User-defined**

- General *metadata*

3

XML

- Originally tags generalized description of document display– allow flexibility in markup
- Now tags can have *any* meaning
  – parties using *agree in advance* as to meaning
- Can use as data specification

XML has become major vehicle of exchanging data among unrelated, heterogeneous parties

– Internet major vehicle of distribution

data-centric ⟷ text-centric

databases ⟷ information retrieval

4

Example XML: data-centric

```
<students>
    <student>
        <year>2007</year>
        <name><fn>Joe </fn><ln>Jones</ln></name>
        <address>…</address>
        <course type="deptal">cos 425</course>
        <course type="deptal">cos 432</course>
        <course type="elective">eng 331</course>
        etc.
    </student>
    <student> ……</student>
        ….
</students>
```

5

Example XML: mixed

See eXist-db example:
Hamlet

Hamlet mark-up by Jon Bosak

6

Important XML concepts

- Information/data contained in a document
- Tags contain text and other tags
- Tags can be repeated arbitrary number of times
- Tags may or may not appear
  - Example for <student>: …<sport>football</sport>…
- Attributes of tags (strings) may or may not appear
- Tags need not appear in rigid order

7

Benefits of XML representation

- Self documenting by tag names
- Flexible formatting
  - Can introduce new tags or values
- Format can evolve without invalidating old
- Can have multi-valued components
  - e.g. courses of student, authors of book
- Wide variety of tools can process
  - Browsers
  - DB tools

8

Undesirable properties of XML representation

- Verbose representation:

  repetition of tag names
  - Inefficient
- Redundant representation
  - Strict hierarchy
    - e.g. shared text in two sections of a document must be repeated

9

Specification

Need exchange syntax (semantics?) as well as XML document:

- XSL – eXtensible Style Language
  - How display information
- DTD = Document Type Declaration
  - User specifies own tags and attributes
  - User-defined grammar for syntax

➢ XML Schema – similar to but more general than DTD

10

Semistructured Data Model

- XML gives structure, but not fully or rigidly specified
- Tag <> … </> defines XML element
  - Elements may contain sub-elements
  - Elements may contain values
  - Elements may have attributes

- Use labeled tree model
  - Element → node: atomic or compound object
  - Leaves: values and attributes

11

XML Schema Example (simplified)

```
< xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<xs:element name="books" type="ListBooksType"/>
<xs:element name="book" type="BookType"/>
<xs:element name="author" type="AuthorType"/>
<xs:complexType  name="ListBooksType">
        <xs:sequence>
            <xs:element ref="book" minOccurs="1" maxOccurs="unbounded"/>
            <xs:element ref="author" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
</xs:complexType>
<xs:complexType  name="BookType">
        <xs:attribute name="in_print"/>
        <xs:sequence>
            <xs:element name="title" type="xs:string"/>
            <xs:element name="isbn" type="xs:string"/>
            <xs:element name="date" type="xs:string"/>
            <xs:element name="summary" type="xs:string"/>
        </xs:sequence>
</xs:complexType>
```

12

XML Schema Example (continued)

```
<xs:complexType  name="AuthorType">
        <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="dob" type="xs:string"/>
            <xs:element name="place_ob" type="xs:string"/>
            <xs:element name="do_death" type="xs:string"/>
                <xs:element name= "isbn" type="xs:string" minOccurs= "0"
                  maxOccurs=  "unbounded"/>
        </xs:sequence>
</xs:complexType>
</xs:schema>
```

13

XML Schema example: Graph model

SEE PDF

14

XML Tools

- Display
  - Very flexible what and how display
- Convert to different representation
  - Example: put in relational database?
  - Example: build inverted index?
- Extract information from XML document
  - Querying

15

Querying XML

- Storing data in XML; want to query
- Several querying languages
  - XPath : now building block
  - Quilt : historic
  - XQuery
  - XSLT : designed for style sheets but general
  - NEXI: extended XPath

16

XQUERY

- Specified by W3C working group
  - Circa 2000
- Derived from older languages
- Modeled after SQL
  - data-centric
- Also useful for IR
  - want at minimum path spec.
  - sometimes want attribute spec.

17

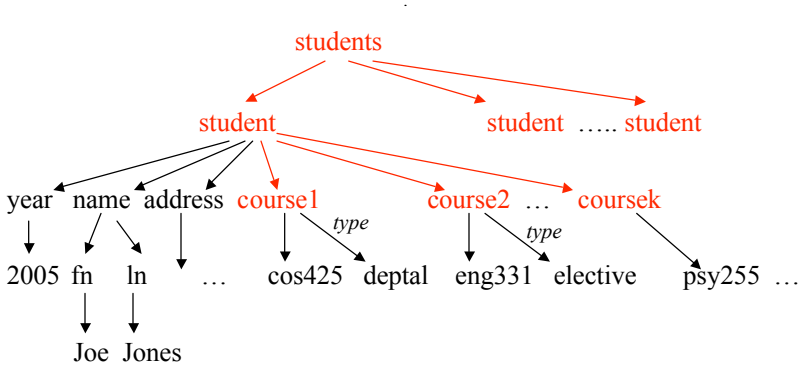
Path expression

- Traverse paths of tree
  - Use element names to name path
- Take ***all*** matching branches
- Returns sequence of nodes of tree
  - Node = XML elements

Doc. Identifier	//	element name	/
e.g. URL root of tree	indicates element nested anywhere- jump down tree at this point in path		indicates immed. child of path so far

e.g. /students/student/course

18



19

Path expressions – *some* details

- Returns sequence of matching elements
  - Includes tags of those elements
  - Sequence ordered by appearance in document
- Attributes can be accessed: @attribute_name
- … /* denotes *all children* of elements …/
- Predicates at any point in path
  - Prunes out paths
  - e.g. /students/student/course[@type='deptal']
- Doc(*document name*) returns root of a named document
  - File name
  - URL (URI)

20

Example

FOR $x IN doc_id//name/ln
RETURN < LastName >{$x/text()}</LastName >

Gives: ?
For : <students>
<student>
<year>2007</year>
<name><fn>Joe </fn><ln>Jones</ln></name>
…
</student>
<student>
<year>2008</year>
<name><fn>Jane </fn><ln>Smith</ln></name>
…
</student>

</students>

21

Examples

FOR $x IN doc_id//name/ln
RETURN < LastName >{$x/text()}</LastName >

Gives: <LastName>Jones</LastName>
< LastName >Smith</LastName >

- Many functions

22

What about information retrieval?

- How do we want to search an XML document with unstructured content?

23

Issues in XML text-centric retrieval

1. What is structure of document?
   - fine-grain structure
     - Shakespeare plays tagged to line
     - may want full path specification
     - simple search may suffice within text elements
   - course-grain structure
     - entire body of document one text block
     - simple path specification
     - full IR search capability

24

Issues in XML text-centric retrieval

2. How fine-grained does user want result?
   - document, section, paragraph, …
   - user interface to support path-based or schema-based queries?
3. How index document?
   - what parts of document indexed?
   - what is unit of document indexed?
     - know entire path of text element?
     - problems if too course-grained?
     - problems if too fine-grained?

25

Issues in XML text-centric retrieval

4. Heterogeneous or homogeneous collection
   - homogeneous: usually one (possibly distributed) source
     - e.g. Library of Congress
   - homogeneous: can have customized search interfaces
   - heterogeneous: many uncoordinated or loosely coordinated sources
     - e.g. Web
   - heterogeneous: schema may not be uniform
     - different labels
     - variations on structure

26

Other issues

- structural constraints as mandatory or hints?
- how structure affect ranking?
- removing redundancy due to results in nested elements

27