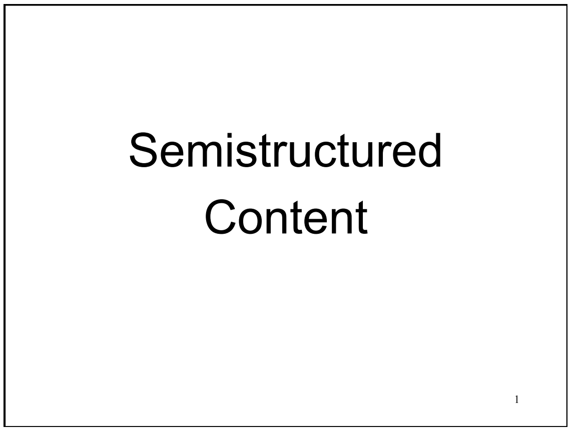
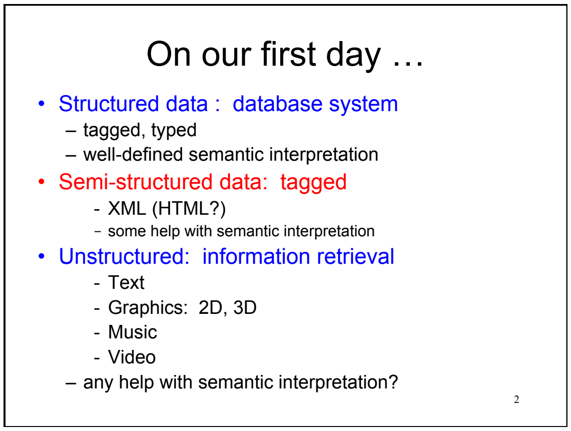
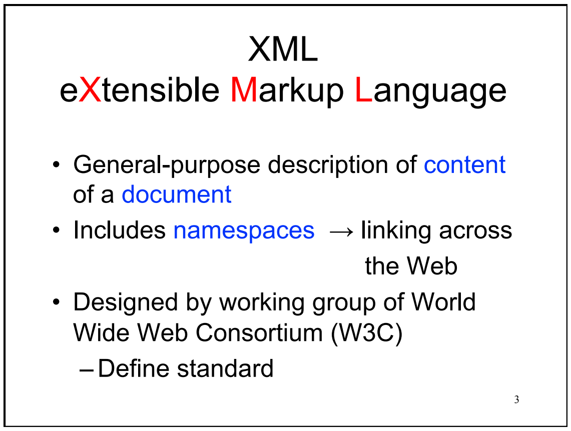


Semistructured Content



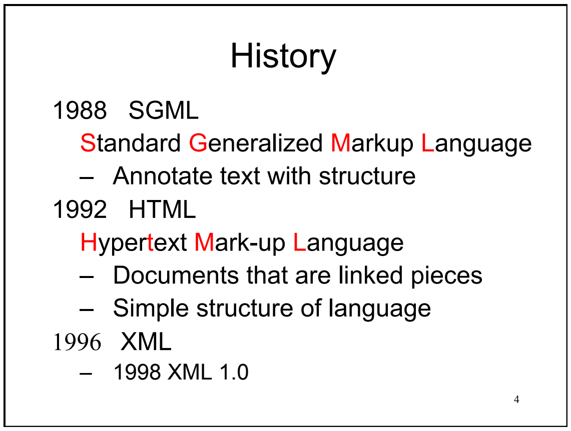
On our first day …

- Structured data : database system
  - tagged, typed
  - well-defined semantic interpretation
- Semi-structured data: tagged
  - XML (HTML?)
  - some help with semantic interpretation
- Unstructured: information retrieval
  - Text
  - Graphics: 2D, 3D
  - Music
  - Video
  - any help with semantic interpretation?



XML
eXtensible Markup Language

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

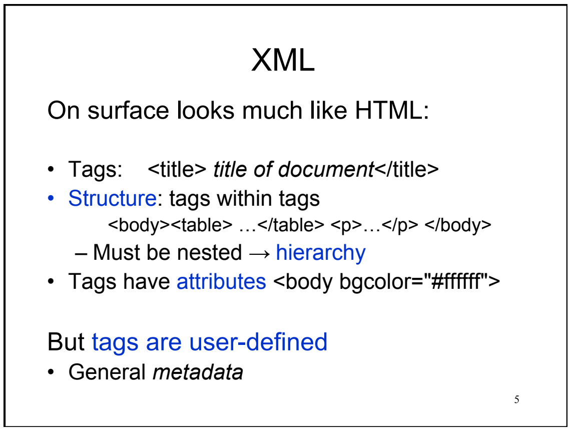


History

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
– 1998 XML 1.0

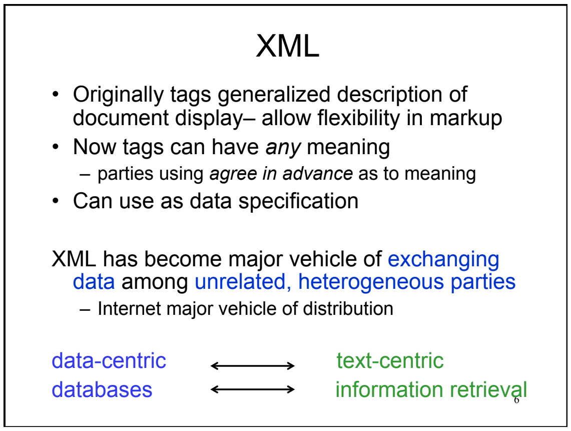


XML

On surface looks much like HTML:

- Tags: <title> *title of document*</title>
- Structure: tags within tags
  <body><table> …</table> <p>…</p> </body>
  - Must be nested → hierarchy
- Tags have attributes <body bgcolor="#ffffff">

But tags are user-defined
- General *metadata*

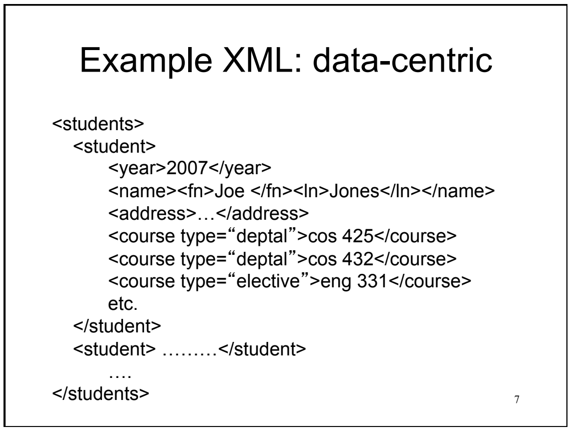


XML

- 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

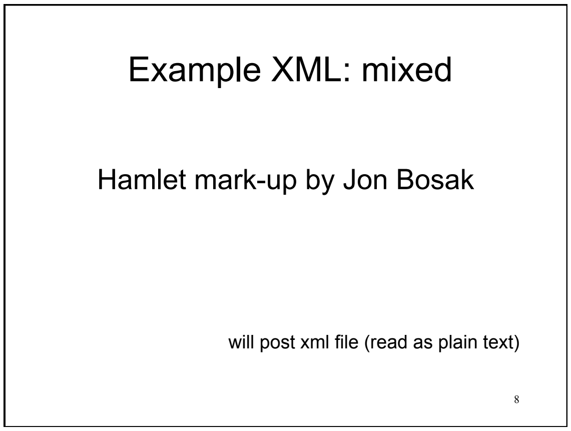
XML has become major vehicle of exchanging data among unrelated, heterogeneous parties
- Internet major vehicle of distribution

data-centric ⟷ text-centric
databases ⟷ information retrieval



Example XML: data-centric

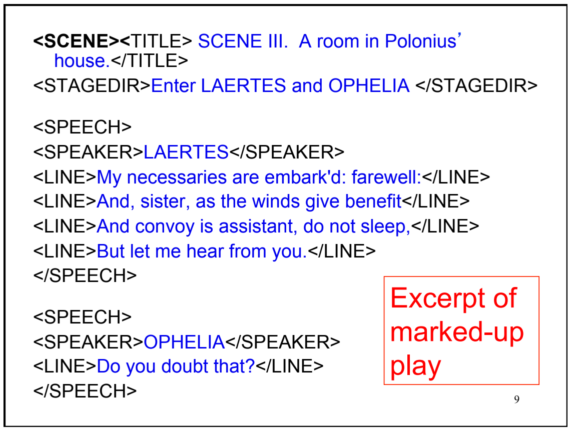
```
<students>
   <student>
        <year>2007</year>
        <name><fn>Joe </fn><ln>Jones</ln></name>
        <address>…</address>
        <course type="deptal">cos 425</course>
        <course type="deptal">cos 432</course>
        <course type="elective">eng 331</course>
        etc.
   </student>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



Example XML: mixed

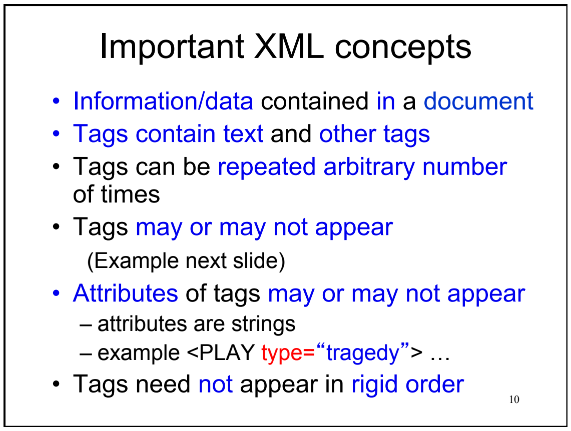
Hamlet mark-up by Jon Bosak

will post xml file (read as plain text)



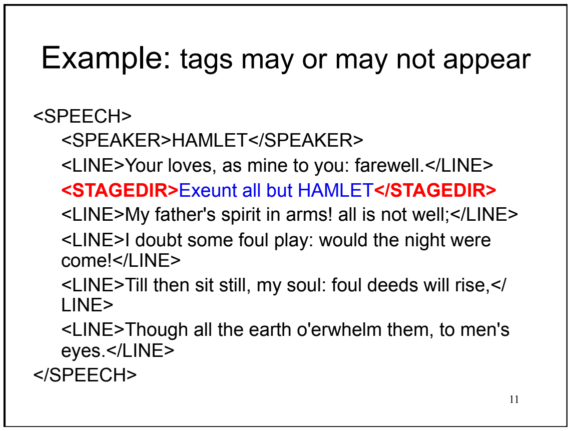
```
<SCENE><TITLE> SCENE III.  A room in Polonius'
   house.</TITLE>
<STAGEDIR>Enter LAERTES and OPHELIA </STAGEDIR>

<SPEECH>
<SPEAKER>LAERTES</SPEAKER>
<LINE>My necessaries are embark'd: farewell:</LINE>
<LINE>And, sister, as the winds give benefit</LINE>
<LINE>And convoy is assistant, do not sleep,</LINE>
<LINE>But let me hear from you.</LINE>
</SPEECH>

<SPEECH>
<SPEAKER>OPHELIA</SPEAKER>
<LINE>Do you doubt that?</LINE>
</SPEECH>
```

Excerpt of marked-up play



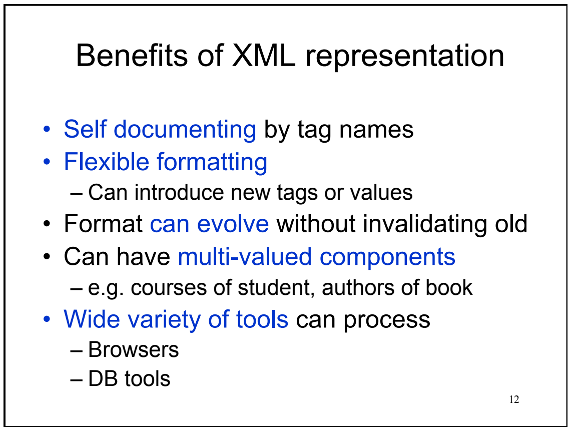
Important XML concepts

- 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 next slide)
- Attributes of tags may or may not appear
  - attributes are strings
  - example <PLAY type="tragedy"> …
- Tags need not appear in rigid order



Example: tags may or may not appear

```
<SPEECH>
   <SPEAKER>HAMLET</SPEAKER>
   <LINE>Your loves, as mine to you: farewell.</LINE>
   <STAGEDIR>Exeunt all but HAMLET</STAGEDIR>
   <LINE>My father's spirit in arms! all is not well;</LINE>
   <LINE>I doubt some foul play: would the night were
   come!</LINE>
   <LINE>Till then sit still, my soul: foul deeds will rise,</
   LINE>
   <LINE>Though all the earth o'erwhelm them, to men's
   eyes.</LINE>
</SPEECH>
```



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

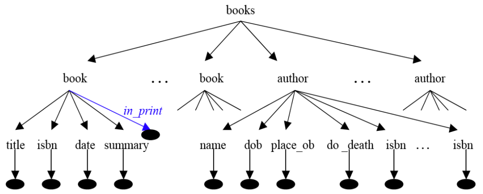
Undesirable properties of XML representation

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

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 (Document Object Model)
  - Element → node: atomic or compound object
  - Leaves: values and attributes
- Several specification languages
  - "XML Schema"

Graph model



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

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
  - …

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

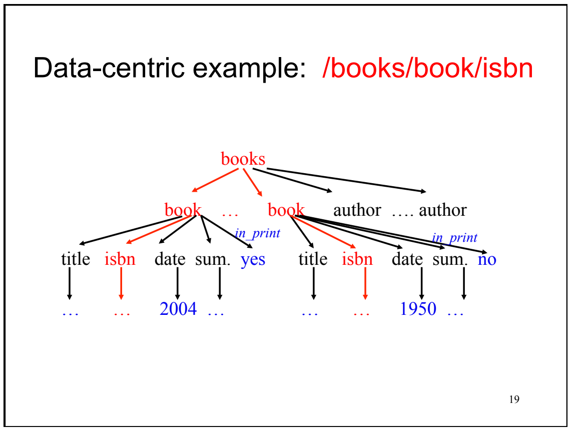
Doc. Identifier
e.g. URL
root of tree

//
indicates element
nested anywhere-
jump down tree
at this point in path

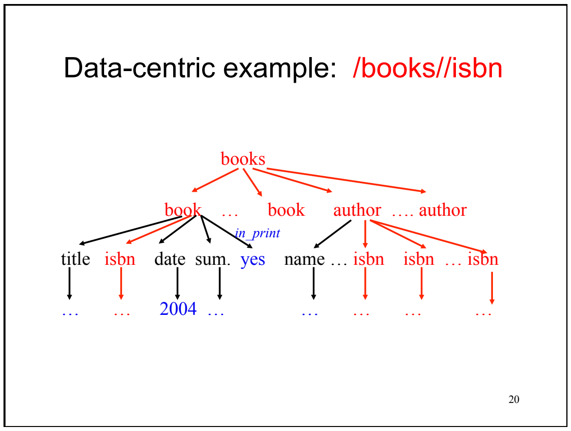
element name

/
indicates immed.
child of path so
far

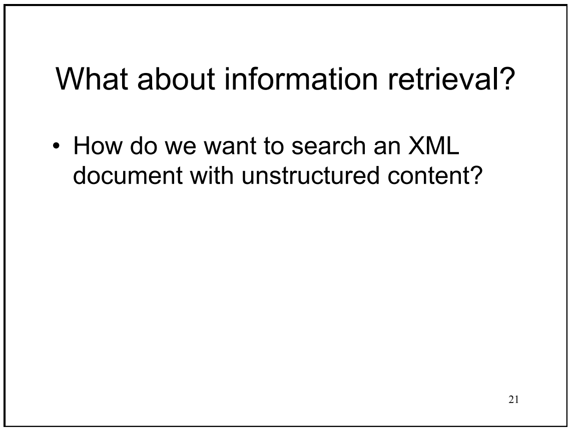
e.g. hamlet.xml/play//scene/title   title tag not only for scenes



Data-centric example: /books/book/isbn

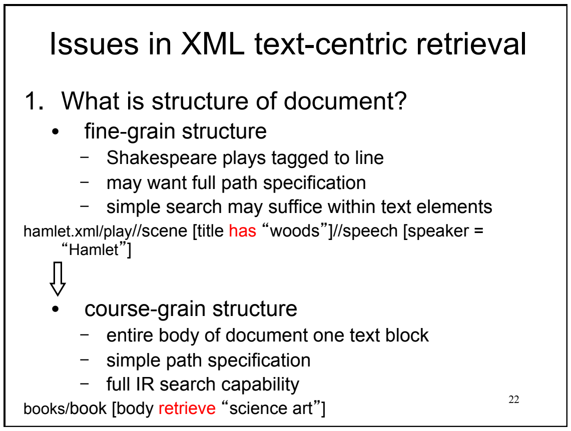


Data-centric example: /books//isbn



What about information retrieval?

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



Issues in XML text-centric retrieval

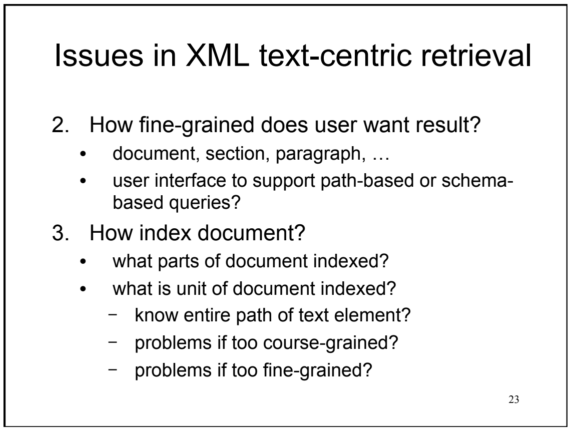
1. What is structure of document?
   - fine-grain structure
     - Shakespeare plays tagged to line
     - may want full path specification
     - simple search may suffice within text elements

hamlet.xml/play//scene [title has "woods"]//speech [speaker = "Hamlet"]

⇩

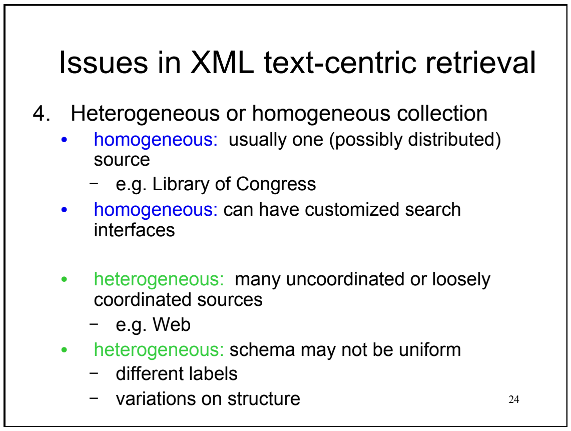
   - course-grain structure
     - entire body of document one text block
     - simple path specification
     - full IR search capability

books/book [body retrieve "science art"]



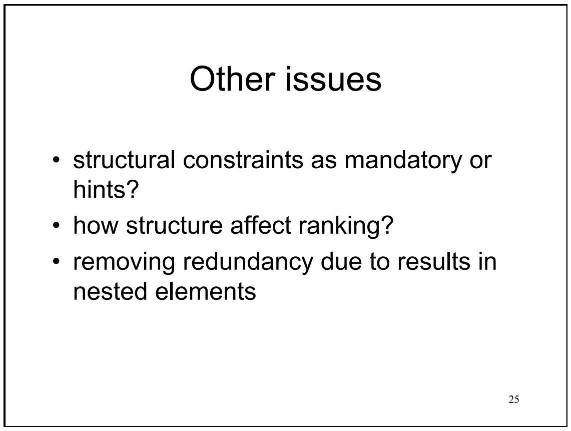
Issues in XML text-centric retrieval

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?



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



Other issues

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