XML

References

- Serge Abiteboul, Ioana Manolescu, Philippe Rigaux, et al., Web Data Management, Cambridge University Press, 2011, Chapter 1, http://webdam.inria.fr/Jorge/
- http://www.w3.org/TR/xml11: XML 1.1
- www.w3.org/TR/xpath-datamodel: XQuery/XPath data model (XDM)

XML

- A simplified version of SGML
- Designed to substitute HTML
- Became the standard for data exchange and web services
- Some related W3C standards:
  - XPath/XQuery
  - XML Infoset and XDM
  - XSLT
  - DTD, XSD
  - RDF, OWL
  - Many, many others

XML as first conceived

```
<doc><title>Sample databases included with Access<title>
<subtitle>Microsoft Access provides sample
databases.</subtitle>
<subtitle> <link ref= "./NT.mdb">Northwind Traders database
</link> </subtitle>
<body>
<para author= "JDM" font="times">The Northwind database
contains the sales data for a company called <emph>Northwind
Traders</emph>, which imports and exports specialty foods
from around the world. By viewing the <link ref=
"./NT.mdb">database objects</link>included in the Northwind
database.</para>
…</body></doc>
```

XML for data exchange

```
<trader ID="T12">
        <name>Wilman Kala</name>
        <address><country>….</ country>...</ address>
        <orders>
                <order OID="O121">
                        <date>1/3/2005</date>
                        <item>…</item> <item>…</item>
                </order>
                <order OID="O122">…</order>
        </orders>
</trader>
<trader ID="T13">
        <name>Hanari Cames</name>
        <address><city>…</city>...</address>
        <orders>
                <order OID=“T131">
                        <date>3/3/2005</date>
                        <item>…</item>
                </order>
         </orders>
</trader>
```

XML syntax

- '**markup**' and characters
- **<**link ref= "./Ag.mdb"**>**Agor**&agrave;** database **</**link**>**
- **<!-- comment <>&& -->**
- **<**XMLExample**>** **<![CDATA[**<greeting>Hi, world!</greeting>**]]>** **</**XMLExample **>**

Elements and attributes

- <link>**Agor&agrave; db**</link>
- <link>

      Agor&agrave; <a>db</a>

  </link>
- <link **ref= "./Ag.mdb"**>**Agor&agrave; db**</link>
- <a/> == <a></a>

Entity references

- Entity references:

  -
    ```
    <!DOCTYPE videocollection [
        <!ENTITY R "Romance">
        …
        <!ENTITY ACT "Action">
    ]>
    ```
  - <genre>**&R;**</genre>
- Predefined ERs:
  - &lt; &gt; &amp; &apos; &quot;

The prologue

-
  ```
  <?xml version="1.1"?>
  <!DOCTYPE greeting SYSTEM "hello.dtd">
  …
  ```

-
  ```
  <?xml version="1.1" encoding="UTF-8" ?>
  <!DOCTYPE greeting
      [ <!ELEMENT greeting (#PCDATA)> ]
  >
  …
  ```
- Default version: 1.0

Good formation

- Well formed:
  - Syntax entities are well formed (prologue, elements, attributes, processing instructions, comments)
  - Elements are ‘well nested’
  - No element has two attributes with the same name
  - Every ‘entity reference’ that is used has also been defined

Validity: DTD

- External DTD:
  <!DOCTYPE greeting **SYSTEM "hello.dtd"**>
  <greeting>Hello, world!</greeting>
- Internal DTD:
  <!DOCTYPE greeting
  [<!ELEMENT greeting (#PCDATA)>
  ]
  >
  <greeting>Hello, world!</greeting>

DTD: element declaration

- <!ELEMENT spec (front, body, back?)>
  <!ELEMENT div1 (head, (p | list | note)*, div2*)>
  <!ELEMENT note (#PCDATA)>
  Means:
  – spec ::= **<spec>** front body back? **</spec>**
  – div1 ::= **<div1>** head (p|list|note)* div2* **</div1>**
  – note ::= **<note>** **string** **</note>**
- PCDATA: parsed character data
- 'spec', 'front', etc.: are called 'types'; '(front, body, back?)' is a content model

Attribute declaration

- <!ATTLIST list
      type **(bullets|ordered|glossary)** **"ordered"**>
  <!ATTLIST termdef
      id **ID** **#REQUIRED**
      name **CDATA** **#IMPLIED**>
  <!ATTLIST form
      method **CDATA** **#FIXED** **"POST"**>
- **T** **#Required**: has type T, must be present;
  T **#Implied**: optional;
  T **#Fixed** **x**: must have “x” as its value;
  T **x**: “x” default, assigned at validation time

DTDs: main limitations

- No base types apart from PCDATA
- Cannot say that <address> inside <letter> is different from <address> inside <email>
- Types cannot be defined by restriction or by extension of other types
- XSD (XML Schema Definition) adds these features, and many others

Semantics of XML

- Is <a>11</a> the same as <a> 11 </a>?
- Is <weight>10</weight> the same as <weight>010</weight>?
- <a>11 12</a> and

  ```
  <a>
      11       12
  </a>?
  ```
- Order of attributes? Comments?

XML Information Set

- A document has an *Infoset* if it is well formed, and namespaces are correctly used
- *Infoset*: a tree of *information items*:
- 11 kinds of *infoitems*: **Document**, **element**, **attribute**, **PI**, unexpanded ER, **character information**, **comment**, DTD, unparsed entity, notation, **namespace**
- Every *infoitem* has some properties:
  - Element infoitem: namespace name, local name, prefix, children, attributes, namespace attributes, in-scope namespaces, base URI, parent

Post Schema-Validation Infoset

- Validation according XML Schema Definition (XSD) transforms an Infoset in a PSVI:
  - Every infoitem gets an XSD type
  - Missing attributes that have a default value, are initialized with their default value

XDM (XQuery/XPath Data Model)

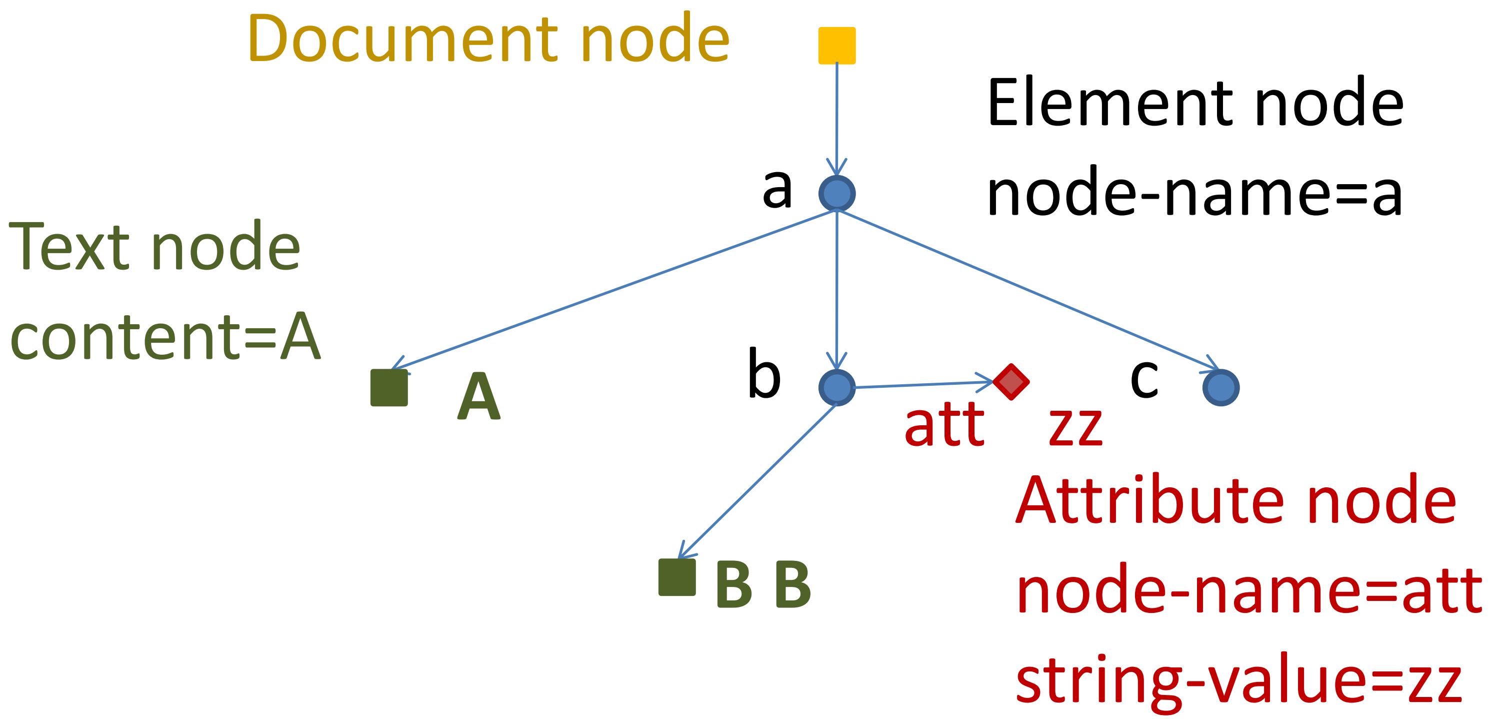
- XQuery and XPath manipulate XDM *values*; every value is a sequence of items: atoms or nodes
- XDM is based on PSVI
- A node is essentially a PSVI infoitem, but consecutive CharInfo's are merged into a unique Text node
- Node identity: a document is a forest-shaped graph <N,E>, and a node is an element of N, with its own identity
  - <b>t</b> $\neq$ <b>t</b>
- Every node has a value and a type

Other details

- 7 types of nodes: document, element, attribute, namespace, PI, comment, text
- Attributes: are NOT *children* of their *parent*
- ID – IDREFs: pointers inside a document
- Namespaces to avoid clashes when documents are merged
- Type annotations, validation

A document and its tree (XDM)

```
<a>   A
    <b att="zz">B B</b>
    <c/>
</a>
```



Namespaces

- Ref: http://www.w3.org/TR/xml-names/
- Amazon defines book with a given structure, B&N define book with a different structure; how to merge them in a unique document?
- Namespaces: every name is a pair URI:local-name
- Every organization uses its own URIs, such as:
  - http://www.w3.org/1999/xhtml
- A URI is not necessarily a meaningful URL!

The default URI

- Defining a default URI:
- <?xml version="1.0"?>
   <!-- elements are in the HTML namespace, in this case by default -->
  <html **xmlns='http://www.w3.org/1999/xhtml'**>
      <head><title>Frobnostication</title></head>
      <body><p>Moved to <a href='http://frob.example.com'>here</a>.
      </body>
  </html>

Prefixes instead of URIs

-
  ```
  <!-- unprefixed element types are from "books" -->
  <book xmlns="urn:loc.gov:books"
        xmlns:isbn="urn:ISBN:0-395-3631-6">
        <title>Cheaper by the Dozen</title>
        <isbn:number>15684913</isbn:number>
   </book>
  ```
- title abbreviates (**urn:loc.gov:books**, title)
- book abbreviates (**urn:loc.gov:books**, book)
- **isbn:**number abbreviates (**urn:ISBN:0-395-3631-6**, number)

Expanded QNames

- QName: book, isbn:number
- An expanded QName is a URI – local name pair, obtained from the QName as follows
  - If there is no prefix, we use the default URI (if defined)
  - If there is a prefix, it is substituted by the associated URI
- Two QNames are equal if, and only if, their expansion is the same

QNames in XDM

- Lexical space (used for input/output): prefix (optional) – local name
- Semantic space (equality and other operations): URI (optional) – local name
- In XDM an expanded QName is a triple: prefix – URI – local name (XDM keeps track of the original prefix)