Standards for digital encoding

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Lecture 1: XML

3.11.2006

Overview

1. a few words about me
2. a few words about you
3. a short introduction to standards
4. and some words on XML

Lab session:

writing a (small) valid XML document

Lecturer

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- http://nl.ijs.si/et/
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- corpora and other language resources, standards, annotation, text-critical editions
- Web page for this course:
  http://nl.ijs.si/et/teach/graz06/standards/

Students

- background: field of study, exposure to XML/TEI?
- emails?
- expectations?

Overview of the course

1. XML
2. Introducing TEI
3. TEI for corpora
4. TEI for text critical editions
5. …

Standards

- dictionary: an obligatory uniform regulation for measurement, quantity or quality // that which specifies how something can or must be
- consensually accepted regulations, which are public and contain explicit definitions
- the main purpose is to harmonise industrial practice in various fields in order to enable interchange

Standardisation bodies

publish standards according to strictly defined procedures:

- national standards: ANSI, DIN, ÖN, SIST
- international standards: IEC, ISO
- ISO International Organization for Standardization, Geneva (1947)
- ISO structure: Technical Committees are composed of members from participating countries, who then develop and approve standards from their field
- ISO TCs can be further composed sub-committees (SC) and these can containing Working Groups (WG)

ISO TC 37

- Technical Committee on Terminology
- important for all other standards, as each standard must contain a section on terminology
- basic definitions,…, ISO 639, MARTIF
- in 2001 name of TC 37 changed to:
  … **and other language and content resources**
- ISO TC 34 SC4: Language Resources Management

W3C

- The World Wide Web Consortium
- first recommendation was HTML (1992)
- best known versions of HTML: 3.2, 4.1
- XML 1.0 released February 1998
- Many XML related standards:
  - DOM Level 1 V1.0 (October 1998)
  - XML Namespaces V1.0 (January 1999)
  - XPath V1.0 (November 1999)
  - XSLT V1.0 (November 1999)
  - XHTML V1.0 (January 2000)
  - XML Schema V1.0 (May 2001)
  - XLink V1.0 (June 2001)
  - XPointer V1.0 (September 2001)
  - XSL V1.0 (October 2001)
  - XML Information Set V1.0 (October 2001)
  - XPath 2.0 WD (April 2002)
  - …

Why standards for encoding of digital data?

The encoding of digital data is (was) typically bound to a particular piece of software e.g. a text editor.

Problems:

- *longevity:* rapid advances in technology make programs obsolete very soon, and the data bound to these programs becomes unreadable
- *interchange*: difficult to use data on other platforms
- *exploitation:* difficult to re-use the data for other purposes
- *intelligibility:* the data are understandable only to the program (no public and stable specifications of the format)
- *validation:* we don't know whether certain data is written according to the format specification or not

How to encode language data?

- format of text editors: very loose encoding, too oriented to the visual appearance of text
- databases: too rigid encoding, does not allow for mixture of content (text) and structure (markup)
- ISO 8879 SGML (Standard Generalised Markup Language), 1986
- defined a language for the representation of texts that will be processed by computer programs

SGML

defined an encoding which is:

- very general, as it is a "meta-language" (a language for describing other languages) and lets you design your own customised markup languages for different types of documents
- interchangeable between computer platforms
- resistant to changes in technology
- enables the use of documents for various purposes
- enables automatic validation whether a certain document is compliant with the standard

Problems with SGML

- the standard is very complex
- software for using it was either very expensive or very “academic”
- the conversion of existing documents into SGML was expensive
- so, the use of SGML was limited to large companies or academia

The Web

- best known application of SGML: HTML
- but SGML compliant HTML is used by very few web pages..
- HTML is also not expressive enough for the encoding of arbitrary (web) data
- the need for a new standard for encoding web data that would have all the advantages of SGML without its weaknesses
- → eXtended Markup Language, XML

XML now

- XML became very popular, and is becoming the universal medium for interchange of (language) data
- many supporting standards
- many freely available tools for processing XML
- many programs implement importing and exporting data in XML

What is XML?

- XML is a definition of device-independent, system-independent methods of storing and processing texts in electronic form
- XML is a project of W3C; hence, it is an open and non-proprietary specification
- XML is a subset of SGML
- XML is a “metalanguage” -- a language for describing other languages -- which lets you design your own customised markup languages for different types of documents

What is a Markup Language?

- *markup* (equivalently, *encoding*)
  - making explicit an interpretation of text
- *markup language*
  - a set of markup conventions used together for encoding texts.
- A markup language must specify:
  - how markup is to be distinguished from text,
  - what the markup means,
  - what markup is allowed,
  - what markup is required

Structure of XML documents

```
<poem>
 <title>The SICK ROSE</title>
 <stanza>
  <line>O Rose thou art sick.</line>
  <line>The invisible worm,</line>
  <line>That flies in the night</line>
  <line>In the howling storm:</line>
 </stanza>
 <stanza>
  <line>Has found out thy bed</line>
  <line>Of crimson joy:</line>
  <line>And his dark secret love</line>
  <line>Does thy life destroy.</line>
 </stanza>
</poem>
```

- **document = text + mark-up**
- **element = start tag + content + end tag**
- **generic identifier = name of the tag**
- **element contains text or elements or both (or nothing)**

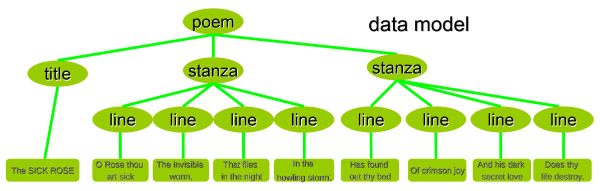
XML data model

<poem><title>The SICK ROSE</title> <stanza><line>O Rose thou art sick.</line> <line>The invisible worm,</line> <line>That flies in the night</line> <line>In the howling storm:</line></stanza> <stanza><line>Has found out thy bed</line> <line>Of crimson joy:</line> <line>And his dark secret love</line> <line>Does thy life destroy.</line></stanza></poem>

serialization

~

data model



Empty elements

- elements with content:
  <tag> … </tag>
- empty elements have no content:
  <tag/>
- used for indicating “points” in the document, for example page breaks
- formally
  <tag/> = <tag></tag>

Attributes

used to describe properties of elements
Example: <table id="P1" status='revised'> ... </table>

- given as *attribute-value pairs* inside the start-tag
- value must be inside matching quotation marks, single or double;
- order in which attribute-value pairs are supplied inside a tag has no significance;
- an XML processor can use the values of the attributes in any way it chooses; the id attribute is a slightly special case in that, by convention, it is always used to supply a unique value to identify a particular element occurrence, which may be used for cross reference purposes.

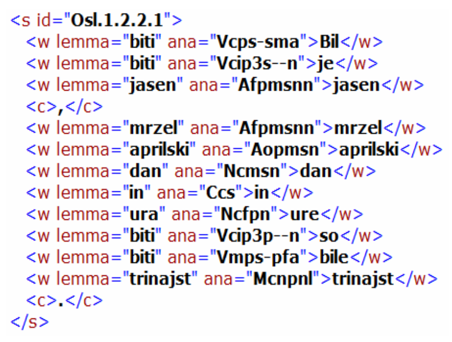
Comments

- Comments can appear anywhere in text (but not in markup)
- Comments start with <!-- and end with -->
- Comments cannot be nested and cannot contain --
- e.g.

```
 <poem>
  <title>The SLICK <!-- is this an typo? --> ROSE</title>
  <stanza>
    <line>O Rose thou art sick.</line>
    <!-- some lines missing -->
  </stanza>
  <!-- here comes the second stanza -->
 </poem>
```

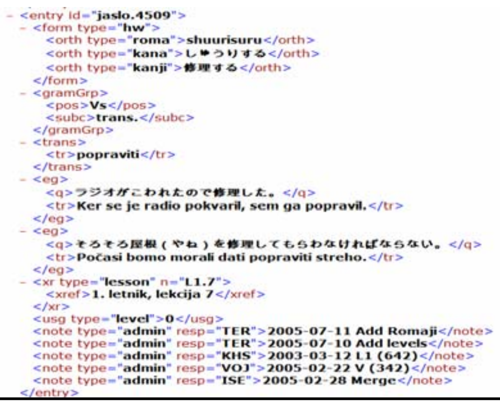
- Note that in XML 'meta-markup' starts with <! or <?

Example: annotated corpus



```
<s id="Osl.1.2.2.1">
  <w lemma="biti" ana="Vcps-sma">Bil</w>
  <w lemma="biti" ana="Vcip3s--n">je</w>
  <w lemma="jasen" ana="Afpmsnn">jasen</w>
  <c>,</c>
  <w lemma="mrzel" ana="Afpmsnn">mrzel</w>
  <w lemma="aprilski" ana="Aopmsn">aprilski</w>
  <w lemma="dan" ana="Ncmsn">dan</w>
  <w lemma="in" ana="Ccs">in</w>
  <w lemma="ura" ana="Ncfpn">ure</w>
  <w lemma="biti" ana="Vcip3p--n">so</w>
  <w lemma="biti" ana="Vmps-pfa">bile</w>
  <w lemma="trinajst" ana="Mcnpnl">trinajst</w>
  <c>.</c>
</s>
```

Example: dictionary



```
- <entry id="jaslo.4509">
  - <form type="hw">
      <orth type="roma">shuurisuru</orth>
      <orth type="kana">しゅうりする</orth>
      <orth type="kanji">修理する</orth>
    </form>
  - <gramGrp>
      <pos>Vs</pos>
      <subc>trans.</subc>
    </gramGrp>
  - <trans>
      <tr>popraviti</tr>
    </trans>
  - <eg>
      <q>ラジオがこわれたので修理した。</q>
      <tr>Ker se je radio pokvaril, sem ga popravil.</tr>
    </eg>
  - <eg>
      <q>そろそろ屋根（やね）を修理してもらわなければならない。</q>
      <tr>Počasi bomo morali dati popraviti streho.</tr>
    </eg>
  - <xr type="lesson" n="L1.7">
      <xref>1. letnik, lekcija 7</xref>
    </xr>
    <usg type="level">0</usg>
    <note type="admin" resp="TER">2005-07-11 Add Romaji</note>
    <note type="admin" resp="TER">2005-07-10 Add levels</note>
    <note type="admin" resp="KHS">2003-03-12 L1 (642)</note>
    <note type="admin" resp="VOJ">2005-02-22 V (342)</note>
    <note type="admin" resp="ISE">2005-02-28 Merge</note>
  </entry>
```

Entities

- XML documents can also contain entity references, which are, when processing the document, substituted by their interpretation (the entity)
- an entity reference starts with the character ampersand and ends with the semicolon: &…;
- a few entities are predefined in XML:
  &lt; = < &gt; = >
  &amp; = &
  &apos; = ' &quot; = "
- < and & are "magic" characters and must always be escaped when using them in the text:
- 1 < 2 must be written as 1 &lt; 2
- Procter & Gamble must be written as Procter &amp; Gamble
- entities are also used for other purposes

XML declaration

Every XML document must begin with an *XML declaration* which does two things:

- specifies that this *is* an XML document, and which version of the XML standard it follows
- specifies which character encoding the document uses:
  - <?xml version="1.0" ?>
  - <?xml version="1.0" encoding="iso-8859-1" ?>
- The default, and recommended, encoding is UTF-8

Minimal requirements

- the document starts with the XML declaration
- tags and entitiy references are written correctly
  Wrong: <p 1 &lt 2</p
- the document must be a tree:
  - every start tag has a matching end-tag
    (<name> ≠ <Name> ≠ <NAME>)
  - elements are correctly nested
    Wrong: <a>…<b>…</a>…</b>
  - the document has a single top-level element

→ a well-formed XML document

Splot the mistake

```
<greeting>Hello world!</greeting>
<greeting>Hello world!</Greeting>

<greeting><grunt>Ho</grunt> world!</greeting>
<grunt>Ho <greeting>world!</greeting></grunt>
<greeting><grunt>Ho world!</greeting></grunt>

<grunt type=loud>Ho</grunt>
<grunt type="loud"></grunt>

<grunt type= "loud">
<grunt type ="loud"/>
```

Another bad XML document

```
<HTML>
<HEAD><TITLE>Links</TITLE></HEAD>
<BODY>
<H1 align=center>Interesting<BR>WWW links</H1>
<UL>
<li><A HREF="http://www.w3.org/XML">W3C XML</A>
<li><A HREF="http://xml.coverpages.org/">Cover's pages</A>
</ul>
<FORM action="http://www.google.com/search" method=get>
<A href="http://www.google.com/">Google</a>
<input type=text name=q size=28 maxlength=256>
<input type=hidden name=meta value="lr=&hl=en">
</FORM>
</BODY>
</HTML>
```

Defining the rules

- A valid XML document conforms to rules which are stated in an external schema (“element grammar”) of some sort.
- A schema specifies:
  - names for all elements used
  - names and datatypes and (occasionally) default values for their attributes
  - rules about how elements can nest
  - and a few other things, depending on the schema
  - language
- n.b. A schema does *not* specify anything about what elements "mean"

In XML a schema is optional!

- XML allows you to make up your own tags, and doesn't *require* a schema...
- The XML concept is dangerously powerful:
  - XML elements are light in semantics
  - one man's <p> is another's <para> (or is it?)
  - the appearance of interchangeability may be worse than its absence
- But XML is too good to ignore
  - mainstream software development
  - proliferation of tools
  - the language of the web

What can a schema (or DTD) do for you?

- ensure that your documents use only predefined elements, attributes, and entities
- enforce structural rules such as 'every chapter must begin with a heading' or 'recipes must include an ingredient list'
- make sure that the same thing is always called by the same name
- schema languages vary in the amount of validation they support

Schema languages

- Schemas can be written in:
  - XML DTD Language (inherited from SGML)
  - The W3C schema language (main successor of DTDs)
  - The ISO Relax NG schema language (mostly used by latest version of TEI)

A simple DTD

XML document:

```
<city>
   <name>Graz</name>
   <inhabitants>285,470</inhabitants>
   <country>Austria</country>
</city>
```

DTD:

```
<!ELEMENT city (name, inhabitants, country)>
<!ELEMENT name          (#PCDATA)>
<!ELEMENT inhabitants   (#PCDATA)>
<!ELEMENT country       (#PCDATA)>
```

A more complex DTD

```
<!ELEMENT anthology (poem+)>
<!ELEMENT poem (title?, stanza+)>
<!ELEMENT title (#PCDATA) >
<!ELEMENT stanza (line+) >
<!ELEMENT line (#PCDATA) >
```

An element definition gives:

- the name of the element
- its content model

```
<anthology>
 <poem>
  <title>The SICK ROSE</title>
  <stanza>
   <line>O Rose thou art sick.</line>
   <line>The invisible worm,</line>
   <line>That flies in the night</line>
   <line>In the howling storm:</line>
  </stanza>
  <stanza>
   <line>Has found out thy bed</line>
   <line>Of crimson joy:</line>
   <line>And his dark secret love</line>
   <line>Does thy life destroy.</line>
  </stanza>
 </poem>
</anthology>
```

Content Model Operators

- (open bracket for grouping
-) close bracket
- , follows
- | or
- ? maybe
- * repeated 0 or more times
- + repeated once or more times

```
<!ELEMENT poem
                (title?,
                        (line+
                         |
                         (refrain?, (stanza, refrain?)+)
                        )
                )
>
```

Mixed content

If an element contains #PCDATA and element content, #PCDATA must always appear as the first option in an alternation; the group containing it must use the star operator; it may appear once only, and in the outermost model group.

```
<!ELEMENT Item1 (#PCDATA | para)*>    <!-- OK -->
<!ELEMENT item2 (#PCDATA | para | note)*> <!-- OK -->
<!ELEMENT item3 (#PCDATA , para)*> <!-- WRONG! -->
<!ELEMENT item4 (para | #PCDATA)*> <!-- WRONG! -->
<!ELEMENT item5 (#PCDATA | para)+> <!-- WRONG! -->
<!ELEMENT item6 (para | (#PCDATA | note)*)> <!-- WRONG! -->
```

Content model ambiguity

XML parsing is deterministic so content model must not be ambiguous.

```
<!ELEMENT x (a, (b | c) )>     <!-- OK -->
<!ELEMENT x ((a, b)|(a, c))> <!-- WRONG! -->
```

Empty Content

Empty elements do not have content. To distinguish them from those with content in well-formed XML documents, they have a special form: the tag ends with a slash.

- In the DTD:
  `<!ELEMENT pageBreak EMPTY>`
- In the document:
  ... `<p> The page ends here. <pageBreak/> Here starts a new one. </p>` ...

Attributes

- In the DTD:

```
attribute name;  type         default
<!ATTLIST table
    type         CDATA        #IMPLIED       allowed
    id           ID           #REQUIRED      necessary
    status       (draft |
                  revised |
                  final)      "draft"        default value
>
```

- In the XML document:

`<table id="tab.12" type= "summary" status= "revised">`

Entities

- in the DTD:
  `<!ENTITY xml-url "http://www.w3.org/XML/">`
  `<!ENTITY xml-ref "<A href='&xml-url;'>&xml-url;</A>">`
- in the document:
  `<hint>Read about XML at &xml-ref;.</hint>`
- after processing:
  `<hint>Read about XML at <A href='http://www.w3.org/XML/'>http://www.w3.org/XML/</A>.</hint>`

Character references

- Character references are used for cases where certain characters cannot represented (entered, stored, transmitted, displayed) directly.
- Character reference starts with
  - &# followed by the decimal number of the character, e.g.: Saarbr&#252;cken
    or by
  - &#x followed by the hexadecimal number of the character, e.g. Saarbr&#xFC;cken
- When processing, such references are substituted by their codepoint
- Codepoints can be found on the Unicode Web pages

External Entities

- External entity references are substituted by the contents of files:
  ```
  <!ENTITY Chap1 SYSTEM
    "P4X/p4chap2.xml">
  <!ENTITY Chap2 SYSTEM
    "http://www.tei-c.org/P4X/p4chap2.xml">
  ```
- External entities are referenced in the document just as internal ones are:
  `<body> &Chap1; &Chap2; </body>`

The Document Type Declaration

specifies:

- the root element of the document,
- the external entity containing the DTD
- and/or the (part of the) DTD contained in the internal subset

e.g.

- external:
  ```
  <!DOCTYPE anthology SYSTEM "anthology.dtd">
  ```
- internal:
  ```
  <!DOCTYPE anthology [
        <!ELEMENT anthology (poem+)>
        <!ELEMENT poem (title?, stanza+)>
        <!ELEMENT title (#PCDATA) >
        <!ELEMENT stanza (line+) >
        <!ELEMENT line (#PCDATA) >
  ]>
  ```
- mixed:
  ```
  <!DOCTYPE anthology SYSTEM "anthology.dtd" [
        <!ENTITY jbw "Jabberwocky">
  ]>
  ```

A Complete Valid XML Document

```
<?xml version="1.0" encoding="us-ascii"?>
<!DOCTYPE anthology [
      <!ELEMENT anthology (poem+)>
      <!ELEMENT poem (title?, stanza+)>
      <!ELEMENT title (#PCDATA) >
      <!ELEMENT stanza (line+) >
      <!ELEMENT line (#PCDATA) >
]>
<anthology>
  <poem>
    <title>The SICK ROSE</title>
    <stanza>
      <line>O Rose thou art sick.</line>
      <line>The invisible worm,</line>
      <line>That flies in the night</line>
      <line>In the howling storm:</line>
    </stanza>
    <stanza>
      <line>Has found out thy bed</line>
      <line>Of crimson joy:</line>
      <line>And his dark secret love</line>
      <line>Does thy life destroy.</line>
    </stanza>
  </poem>
</anthology>
```

Conclusion

- presented a brief introduction to XML
- Lab session: writing a (small) document in XML
  - select document, choose elements, write DTD, validate
  - maybe Bavarian-Style Pork Roast with Cabbage and Knödel?