NPFL092 Technology for Natural Language Processing

Character Encoding

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eXtensible Markup Language

```
<?xml version="1.0" encoding="UTF-8"?>

<my_courses>

    <course id="NPFL092">
      <name>NLP Technology</name>
      <semester>winter</semester><hours_per_week>1/2</hours_per_week>
      <department>Institute of Formal and Applied Linguistics</department>
      <teachers>
        <teacher>Rudolf Rosa</teacher>
        <teacher>Zdeněk Žabokrtský</teacher>
      </teachers>
    </course>

</my_courses>
```

Outline

- basic properties of XML
- syntactic requirements
- well-formedness and validity
- pros and cons

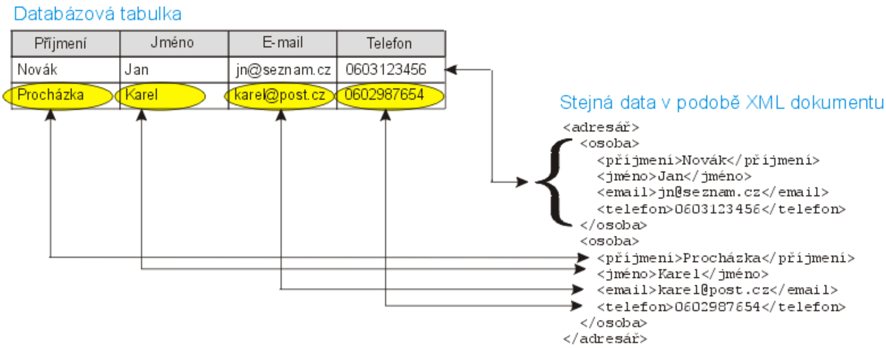
History

- markup used since 1960s
  - markup = inserted marks into a plain-text document
  - e.g. for formatting purposes (e.g. TeXin (1977
- 1969 – GML – Generalized Markup Language
  - Goldfarb, Mosher and Lorie, legal texts for IBM
- 1986 – SGML – Standard Generalized Markup Language, ISO 8879
  - too complicated!
- 1992 – HTML (Hypertext Markup Language)
  - only basics from SGML, very simple
- 1996 – W3C new directions for a new markup language specified, major design decisions
- 1998 – XML 1.0
- 2004 – XML 1.1, only tiny changes, XML 2.0 not under serious consideration now

Advantages of XML

- open file format, specification for free from W3C (as opposed to some proprietary file formats of database engines or text editors)
- easily understandable, self-documented files
- text-oriented – no specialized tools required, abundance of text editors
- possibly more semantic information content (compared e.g. to formatting markups - e.g. “use a 14pt font for this” vs “this is a subsection heading”)
- easily convertable to other formats
- easy and efficient parsing / structure checking
- support for referencing

Relational Databases vs. XML



Databázová tabulka

Příjmení	Jméno	E-mail	Telefon
Novák	Jan	jn@seznam.cz	0603123456
Procházka	Karel	karel@post.cz	0602987654

Stejná data v podobě XML dokumentu

```
<adresář>
  <osoba>
    <příjmení>Novák</příjmení>
    <jméno>Jan</jméno>
    <email>jn@seznam.cz</email>
    <telefon>0603123456</telefon>
  </osoba>
  <osoba>
    <příjmení>Procházka</příjmení>
    <jméno>Karel</jméno>
    <email>karel@post.cz</email>
    <telefon>0602987654</telefon>
  </osoba>
</adresář>
```

Credit: kosek.cz

Relational Databases vs. XML

Relational databases

- basic data unit – a table consisting of tuples of values for pre-defined “fields”
- tables could be interlinked
- binary file format highly dependent on particular software
- emphasis on computational efficiency (indexing)

XML

- hierarchical (tree-shaped) data structure
- inherent linear ordering
- self-documented file format independent of implementation of software
- no big concerns with efficiency (however, given the tree-shaped prior, some solutions are better than others)

XML: quick syntax tour

Basic notions:

- **XML document** is a text file in the XML format.
- Documents consists of nested **elements**.
- Boundaries of an element given by a **start tag** and an **end tags**.
- Another information associated with an element can be stored in **element attributes**.

```
<?xml version="1.0" encoding="UTF-8"?>
<my_courses>
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      <name>NLP Technology</name>
      <semester>winter</semester><hours_per_week>1/2</hours_per_week>
      <department>Institute of Formal and Applied Linguistics</department>
      <teachers>
        <teacher>Rudolf Rosa</teacher>
        <teacher>Zdeněk Žabokrtský</teacher>
      </teachers>
    </course>
</my_courses>
```

XML: quick syntax tour (2)

- Tags:
  - Start tag `<element_name>`
  - End tag `</element_name>`
  - Empty `element` `<element_name/>`
- Elements can be embeded, but they cannot cross → XML document = tree of elements
- There must be exactly one root element.
- Special symbols $<$ and $>$ must be encoded using entities (“escape sequences”) &lt; and &gt; , & → &amp;
- Attribute values must be enclosed in quotes or apostrophes; (another needed entities: &quot; and &apos;)

XML: quick syntax tour (3)

- XML document can (should) contain instructions for xml processor
- the most frequent instruction – a declaration header:

```
<?xml version="1.0" encoding="utf-8" ?>
```

- document type declaration:

```
<!DOCTYPE MojeKniha SYSTEM "MojeKniha.DTD">
```

- Comments (not allowed inside tags, cannot contain –)

```
<!-- bla bla bla -->
```

- If the document conforms to all syntactic requirements: a **well-formed** XML document
- Well-formedness does not say anything about the content (element and attribute names, the way how elements are embedded...)
- Checking the well-formedness using the Unix command line:

```
> xmllint --noout my-xml-file.xml
```

Time for an exercise

- Use a text editor for creating an XML file, then check whether it is well formed.

Need to describe the content formally too?

- well-formedness – only conforming the basic XML syntactic rules, nothing about the content structure
- but what if you need to specify the structure
- several solutions available
  - DTD – Document Type Definition
  - other XML schema languages such as RELAX NG (REgular LAnguage for XML Next Generation) or XSD (XML Schema Definition)

DTD – Document Type Definition

DTD

- Came from SGML
- Formal set of rules for describing document structure
- Declares element names, their embeding, attribute names and values...
- example: a document consisting of a sequence of chapters, each chapter contains a title and a sequence of sections, sections contain paragraphs...

DTD location

- external DTD – a stand-off file
- internal DTD – inside the XML document

DTD Validation

- the process of checking whether a document fulfills the DTD requirements
- if OK: the document is **valid with respect to the given DTD**
- of couse, only a well-formed document can be valid
- checking the validity from the command line:

```
> xmllint --noout --dtdvalid my-dtd-file.dtd  my-xml-file.xml
```

DTD structure

- Four types of declarations
- Declaration of elements <!ELEMENT ...>
- Declaration of attributes <!ATTLIST ...>
- Declaration of entities
- Declaration of notations

Declaration of elements

- Syntax: <!ELEMENT name content>
- A name must start with a letter, can contain numbers and some special symbols .-_:
- Empty element: <!ELEMENT název EMPTY>
- Element without content limitations: <!ELEMENT název ANY>

Declaration of elements (2)

- Text containing elements
  - Reserved name PCDATA (Parseable Character DATA)
  - Example: <!ELEMENT title (#PCDATA)>
- Element content description – regular expressions
- Sequence connector ,
- Alternative connector |
- Quantity ? + *
- Mixed content example: <!ELEMENT emph (#PCDATA|sub|super)* >

Declaration of attributes

- Syntax: <!ATTLIST element_name declaration_of_attributes>
- declaration of an attribute
  - attribute name
  - attribute type
  - default value (optional)
- example: <!ATTLIST author firstname CDATA surname CDATA>

Declaration of attributes (2)

- Selected types of attribute content:
  - CDATA – the value is character data
  - ID – the value is a unique id
  - IDREF – the value is the id of another element
  - IDREFS – the value is a list of other ids
  - NMTOKEN – the value is a valid XML name
  - ...
- Some optional information can be given after the type:
  - #REQUIRED – the attribute is required
  - ...

Time for an exercise

- What can go wrong with an XML file if you check its well-formedness and validity. How would you check whether the requirements are fulfilled?

Criticism of XML

- quite verbose (you can always compress the xml files, but still)
- computationally demanding when it comes to huge data or limited hardware capacity
- relatively complex, simpler and less lenghty alternatives exist now
  - JSON – suitable for interchange of structure data
  - markdown – for textual documents with simple structure

Summary

1. XML = an easy-to-process file format
2. open specification, no specialized software needed
3. tree-shaped self-documented structure, thus excellent for data interchange
4. a bit too verbose, not optimized if speed is an issue

References I