

XML

CPSC 315 - Programming Studio

These are slides from Dr. John Keyser's 315 lecture

Consistent Data Transfer

- Transfer of data has become increasingly important
- Can't assume control of all ways data is created and used
 - Cross-platform, cross-system, etc.
 - People want to access data for their own purposes
 - People want to use data from several sources
- Data may be more complicated than “traditional” formats would support
 - E.g. ASCII text only good for some text documents
- Need a more universal means of transferring data

Markup Languages

- Idea is to “tag” information to give a sense of its meaning/semantics
- How that is handled is up to reader
- Usually separates presentation from structure
- Examples:
 - HTML: standard web page information, interpreted by browsers
 - TeX/LaTeX: document specification, style descriptions determine how it is laid out

XML

- eXtensible Markup Language
- Extensible: able to define additional “tags”
 - Specific tags and the semantics associated with them allow specifications of different languages
- Developed by the World Wide Web Consortium (W3C) to help standardize internet information transfer
- Now used as the basis for many specialized languages
 - Each has its own semantic requirements

XML Characteristics

- Straightforward to use on the internet
- Easily processed/parsed
- Human-readable
- Capable of expressing wide range of applications
 - Including hierarchies, tables
- Can be very large/verbose

XML Document Text

- Intermingled character data and markups
- Markups:
 - Start/End tags (and empty element tags)
 - Entity/Character references
 - Comments
 - CDATA delimiters
 - Processing Instructions
 - XML/Text declarations
 - Document type declarations

Basic XML Syntax

- Some prolog/header
 - Possibly describing/referring to type of XML
- Single root element
- More elements forming a tree
 - Elements fully “nest” inside each other
 - Can have any number of children elements
- Elements begin with a start tag, end with an end tag
 - `<Elem>Stuff in element</Elem>`

Tag Format

- Starting Tags can declare attributes
 - `<TagName Attr1="..." Attr2='... '>`
 - Note that attributes can use “ or ‘
- Ending Tags match starting tag name, but with a / preceding
 - `</TagName>`
- Character data (and maybe other elements) in between start/end tags
- Empty element:
 - `<Elem/>`
 - Equivalent to `<Elem></Elem>`

Entity/Character References

- Note: Some character patterns are “reserved”
 - <, >, &, ‘, “
- An entity reference is a name given to a character or set of characters
 - Used for any other things to be repeated
 - General entity form: &Whatever;
 - Used for the “reserved” characters
 - < <, > >, & &, " “, ' ‘

Character References

- Character References are specialized
- Use the form &#...; where the ... is a reference to a character in an ISO standard
 - & is an &

Comments

- Begin with <!--
 - End with -->
 - Everything in between is ignored
- ```
<!-- This is a comment -->
```

## CDATA sections

- Used to note a section that would otherwise be viewed as markup data
  - <![CDATA[ ... ]]>
- ```
<![CDATA[ <b>This <a>is</b>not</a>bad ]]>
```

Processing Instructions

- Allow documents to contain instructions for applications reading them
 - “Outside” the main document
 - `<? Target ... ?>`
 - Target is the target application name
 - Any other instructions follow
- ```
<? MyReader -o3 -f input.dat ?>
```

## XML/Text Declarations

- Documents should start with declaration of XML type used, in a prolog:
  - `<?xml version="1.0" ?>`
- Other documents “included” should also have such a prolog, as the first line

## XML Semantics

- Semantics must be declared to determine what is valid syntax
  - Tags allowed and their attributes, entities
  - Does not say how it is processed
- Can be located in XML document itself
- Can be contained in separate Document Type Declaration (DTD)
- Newer XML Schema definitions, which capture semantics in an XML-like document
  - But drawbacks, including difficulty to use, not as universally implemented, large size, etc.

## Document Type Declaration: DTD

- Defines constraints on the structure of the XML
- Comes before first element
- Either defines or points to external definition of Document Type Definition (DTD)
- External: `<!DOCTYPE Name SYSTEM url>`
- Internal: `<!DOCTYPE Name [...]>`
- The DTD can be standalone (no further external references) or not

## Element Declarations

- Define elements and allowed content (character data, subelements, attributes, etc.)
- `<!ELEMENT Name Content>`
  - Name is the unique name
  - Content describes that type of element
- Options for Content:
  - EMPTY – nothing allowed in the element
  - ANY – no restrictions
  - Children elements only
  - Mixed character and children elements

## Example of Child elements

```
<!Element book (
 title,
 coverpage,
 tableofcontents?,
 editionnote*,
 preface?,
 (chapternumber, chaptertitle, chaptertext)+,
 index?
)>
```

## Element Declarations: Child element content

- When an element has (only) child elements within it
- Specify using:
  - Parentheses ( ) for grouping
  - The , for sequencing
  - The | for “choice of”
  - The + (one or more), \* (zero or more), or ? (zero or one) modifiers.
    - If no modifier, means “exactly once”

## Element Declarations: Mixed element content

- When an element can contain both character and child elements
  - The character text is denoted as a kind of special element name: #PCDATA
- ```
<!ELEMENT story (#PCDATA|a|b|c)*>
```

Attribute Declarations

- Define allowed attribute names, their types, and default values
- `<!ATTLIST ElementName Attribute*>`
 - ElementName is the name of the element those attributes belong to
 - Repeat attribute definition as many times as needed

Attribute Declaration: Types

- Name Type DefaultValue
- Name is the attribute name
- Type:
 - CDATA : string
 - Enumerated: specified via a comma-separated list in parentheses
 - Tokenized: a limited form, specified by some other rule defined in the DTD
 - Several variations

Attribute Declaration: Defaults

- Specify a default value
 - Also specify whether attribute is needed in the element
- #REQUIRED
 - This attribute must be specified each time (no default)
- #IMPLIED
 - No default is specified
- Otherwise, use the default value given
 - Precede by #FIXED if it must always take that default

Attribute Declaration Example

```
<!ATTLIST Book
  title      CDATA #REQUIRED
  author     CDATA "anonymous"
  publisher  CDATA #IMPLIED
  category   (fiction,nonfiction) "fiction"
  language   CDATA #FIXED 'English'
>
```

Entity Declarations

- Entity References should be declared
 - Internal Entity:
 - `<!ENTITY Name ReplacementText >`
- ```
<!ENTITY CR "Copyright 2008">
```
- ...
- ```
&CR;
```
- External Entity:
 - `<!ENTITY Name SYSTEM url >`
- ```
<!ENTITY BP SYSTEM "http://this.com/BP.xml">
```
- ...
- ```
&BP;
```
- There are also other variations on external entities

Parameter Entities

- Like general entities, but refer to entities to be used in the Document Type Declaration
 - Use a % instead of an &
- ```
<!ENTITY % newdef SYSTEM
 "http://this.com/newdef-xml.entities">
```
- ...
- ```
%newdef;
```

Conditionals (in the DTD)

- Used in the DTD to apply different rules
 - `<![Condition[...]]>`
 - If Condition is INCLUDE then keep
 - If Condition is IGNORE then skip
 - Combine with parameter entities:
- ```
<!ENTITY % addborder 'INCLUDE'>
```
- ...
- ```
<![%addborder; [  
... (stuff to draw border) ...  
]]>
```

XML Namespaces

- Different XML definitions could define the same element name.
 - If we want to use both, could have conflict.
 - Can distinguish using namespaces.
- ```
<a:book>...</a:book>
<b:book>...</b:book>
```

## Defining XML Namespaces

- xmlns attribute in definition of element  
xmlns:prefixname="URL"
- ```
<a:book  
  xmlns:a=http://this.com/adef>
```
- Can be defined in first use of element or in XML root element.
 - Can define a "default"
 - No prefix needed, leave off : also

Summary/More Information

- XML has become a standard way of transferring information, especially over the internet
- Provides flexibility to represent a wide range of data.
- Many texts/online tutorials about XML
- W3C "official" pages:
<http://www.w3.org/XML/>
See in particular the XML 1.0 specs (more than the 1.1 specs)