Introduction to XML: DTD

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Document type definition: structure

Topics:

- Elements
- Attributes
- Entities
- Processing instructions (PI)
- DTD design

DTD

<!– Document type description (DTD) example (part) -->

<!ELEMENT university (department+)>
<!ELEMENT department (name, address)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT address (#PCDATA)>

- Document type description, structural description
- one rule /element
  - name
  - content
- a grammar for document instances
- ”regular clauses"
- (not necessary)

DTD: advantages

- validating parsers check that the document conforms to the DTD
- enforces logical use of tags
- there are existing DTD standards for many application areas
  - common vocabulary

Well-formed documents

- An XML document is **well-formed** if
  - its elements are properly nested
    so that it has a hierarchical tree structure,
    and all elements have an end tag (or are empty elements)
  - it has one and only one root element
  - complies with the basic syntax and structural rules of the XML 1.0 specification:
    - rules for characters, white space, quotes, etc.
  - and its every parsed entity is well-formed

Validity

- An XML-document is valid if
  - it is well-formed
  - it has an attached DTD (or schema)
  - it conforms to the DTD (or schema)
- Validity is checked with a validating parser, either
  - the whole document at once (”batch")
  - interactively

Document type declaration

Shared
<!DOCTYPE catalog PUBLIC ”-//ORG_NAME//DTD CATALOG//EN">

- flag(-/+) indicates a less important standard
ISO –standards start with ”ISO
ORG_NAME the owner of the DTD
DTD file type
CATALOG document name
EN language

the document type definition can be included in the internal database of the processor (no connection needed)
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN">

External or internal DTD

Document type declaration format:

<!DOCTYPE document_element source location
[internal subset of DTD] >

internal DTD, DTD and instance in the same file:
<!DOCTYPE catalog SYSTEM
[<!ELEMENT catalog … and so on …]>

simple example:

<!DOCTYPE Mymessage SYSTEM
[<!ELEMENT Mymessage (#PCDATA)]>

external DTD, examples

<!DOCTYPE dictionary SYSTEM ”dictionary.dtd”>

<!DOCTYPE dictionary SYSTEM
”http://www.evtek.fi/DTD/dictionary.dtd”>

External or internal DTD

internal and external:

<!DOCTYPE Mymessage SYSTEM ”myDTD.dtd”
[<!ELEMENT Mymessage … and so on…
… (#PCDATA)]>

Shared document type:

<!DOCTYPE Dictionary PUBLIC
”http://www.evtek.fi/DTD/dictionary.dtd”>

Element type declaration

- **<!ELEMENT country (capital)>**
- element name
- element content
  - content declaration, content model
- delimiters (**<!**, **>**, **(**, **)**) and keyword (**ELEMENT**)

Sub-elements, children

- Children in specified order:
  <!ELEMENT country (cname, capital, population)>
- choice of a child (”pipe” |):
  <!ELEMENT country (cname | official_name)>
- optional singular element ? only one or zero:
  <!ELEMENT country (cname, capital, population?)>

Cardinality operators

Number of occurrences

* zero or more, optional

```
<!ELEMENT country (cname, capital, city*)>
```

\+ one or more elements, required

```
<!ELEMENT country (cname, neighbour_country+)>
```

? optional singular element

[none] one required singular element

repeating group:

```
<!ELEMENT country (cname, (city, city_population)*)>
```

Element content model

- Data
  <!ELEMENT cname (#PCDATA)>
  - "parsed character data"
- Elements
    - sub-elements (child elements)
- Mixed content
    - data and elements
    - <!ELEMENT para (#PCDATA | sub | super)*>
    - #PCDATA must be first in content model, group has options
    - child element sequence, choices and cardinality cannot be specified

Empty element and ANY

- <!ELEMENT image EMPTY>
  - in document instance must be <image/>
  - not allowed: <image></image>
- a regular declaration <!ELEMENT im (...)>
  - allows both ways <im/>, <im></im> or <im>...</im>
- <!ELEMENT some ANY>
  - element can contain any declared element,
  - flexible, maybe too flexible?

Short example: Dictionary

```
<!ELEMENT dictionary (word_article)*>
<!ELEMENT word_article (head_word,
   pronunciation, sense+)>
<!ELEMENT head_word (#PCDATA)>
<!ELEMENT pronunciation (#PCDATA)>
<!ELEMENT sense (definition, example*)>
<!ELEMENT definition (#PCDATA)>
<!ELEMENT example (#PCDATA)>
```

Dictionary XML

```
<?xml version="1.0" ?>
<!DOCTYPE dictionary SYSTEM "dict.dtd">
<dictionary>
  <word_article>
    <head_word>
      carry
    </head_word>
    <pronunciation>
      kaeri
    </pronunciation>
```

```
<sense>
    <definition>
     support the weight of and move from place to place
    </definition>
    <example>
     Railways and ships carry goods.
    </example>
    <example>
     He carried the news to everyone.
    </example>
 </sense>
<sense>
    <definition>
     wear, possess      </definition>
    <example>
     I never carry much money with me.
    </example>
   </sense>
  </word_article>
```

```
<word_article>
   <head_word>gossamer
   </head_word>
   <pronunciation>
    gosomo
   </pronunciation>
   <sense>
     <definition>fine, silky substance of webs made by
      small spiders
     </definition>
   </sense>
 </word_article>
</dictionary>
```

Content models

- Try to make definitions unambiguous (clear)
  - wrong: (item?, item)
  - right: (item, item?)
  - wrong ((surname, employee) | (surname, customer))
  - right: (surname, (employee | customer))

- <!ELEMENT BookCatalog (Catalog, Publisher+, Book*)>
  - document must have <BookCatalog> top level element
  - contains always one <Catalog> and at least one <Publisher> child
  - <Book> elements may not be present

Attribute declarations ATTLIST

- Attributes can be used to describe the metadata or properties of the associated element
- attributes are also an alternative way to markup data

```
<!ATTLIST country
        population NMTOKEN #IMPLIED
        language   CDATA #REQUIRED
        continent  (Europe | America | Asia ) "Europe">
```

- CDATA
  - character data, any text
- enumerated values (choice list)
  - <!ATTLIST country continent (Europe | America | Asia) "Europe">
  - remember that XML is case sensitive
  - default value given above
  - the parser *may* supply a default value if it is not given

Attribute defaults

- #REQUIRED
  - the attribute must appear in every instance of the element
- #IMPLIED
  - optional
- enumerated values can have a default
- no default for implied/required

```
<!ATTLIST catalog type CDATA #REQUIRED>

<!ATTLIST catalog type NMTOKEN #IMPLIED>

<!ATTLIST catalog type (phone | e-mail)>

<!ATTLIST catalog type (phone | e-mail) "phone">
```

Attribute types

- NMTOKEN
  - name token <country population = "100">
- NMTOKENS
  - a list of name tokens delimited by white space
  - These types are useful primarily to processing applications. The types are used to specify a valid name(s). You might use them when you are associating some other component with the element, such as a Java class or a security algorithm

<!ATTLIST DATA AUTHORIZED_USERS NMTOKENS
#IMPLIED>

<DATA SECURITY="ON"
AUTHORIZED_USERS = "IggieeB SelenaS GuntherB">

element content

</DATA>

Attribute types

- ID
  - attribute value is the *unique* identifier for this element instance, must be a valid XML name
- IDREF
  - reference to the element that has the same value as that of the IDREF
- IDREFS
  - a list of IDREFs delimited by white space

Attribute defaults

- <!ATTLIST country position #FIXED "independent">
  - attribute must match the default value
  - why: for example to supply a value for an application

- reserved attributes,
  - xml:lang
  - xml:space
  - prefix 'xml:'

Element vs attribute

- When to mark up with an element, when to use attributes?
- Element
  - to describe structures, expandable
  - when shown in the output
  - contents cannot be defined as strictly as with attributes
- Attribute
  - no structure, no multiple values
  - “internal” information
  - default values possible

Entities

- Each XML document is an entity, could comprise of several entities
- document entity
- ”subdocuments" = entities
- general entities:
  - internal or external
  - parsed or unparsed (external only)
- a parsed entity can include any well-formed content (replacement text)
- entity declaration
- entity reference
- all unparsed entities must have an associated notation

Internal text entities

- Predefined string

<!ENTITY evitech ”Espoo Vantaa Institute of Technology">
I study at the &evitech;

- Single versus double quotes
  - <!ENTITY sent 'His foot is 12" long'>
  - <!ENTITY sent "His foot is 12" long">

Entity reference	character string
>	>
<	<
"	"
'	'
&amps;	&
<	<
A	A
<	< (hexadecimal)
￸	... (Unicode)

CDATA: special characters in XML

```
<action>
<script language ='Javascript'>
<![CDATA[
   function Fhello()
   {    if (n >1 && m > 8)
                alert ("Hello");
   }
]]>
</script>
</action>
```

External entity

- Outside the document entity itself
- within the same resource:
  - <!ENTITY myfile SYSTEM "extra_files/file.xml">
- public location
  - <!ENTITY myfile PUBLIC "... description...">
  - needs an index
- an unparsed external entity is a reference to an external resource (I.e. an image file)
  - Binary file
  - file type has to be declared
  - <!ENTITY myphoto SYSTEM "/figures/photo.gif" NDATA GIF>
  - Use:
    Take a look at my photo <picture name="myphoto"/>.

- ENTITY

  <!ENTITY mypicture "123.jpg">

  <!ELEMENT pic EMPTY>

  <!ATTLIST pic picfile ENTITY mypicture>

  – in the document instance:
    <pic picfile="mypicture”/>
- ENTITIES
  – a list of ENTITY names
- Notation
  – <!ATTLIST image format NOTATION (TeX | TIFF)>

Entity references, summary

- General parsed entity reference
  - in the document instance
  - not in the DTD
  - entity hierarchy
- unparsed entity
  - no references from the text
  - given as attribute values
- parameter entity
  - in DTD, not in the document instance

Parameter entity

Only usable within a DTD (not in an XML document)

```
<!ENTITY % parapart "(emph | supersc | subsc)">

<!ELEMENT paragraph (%parapart | bold)>
<!ELEMENT list (%parapart | item)*>


<!ELEMENT paragraph (emph | supersc | subsc | bold)>
```

Notation declaration

<!NOTATION PIXI SYSTEM "">

<!NOTATION TIFF SYSTEM "C:\APPS\Show_tiff.exe">

Entity declaration refers to notation:
<!ENTITY Logo SYSTEM "logo.tif" NDATA TIFF>

Notation provides information for an application how to process unparsed entities

Without a DTD:

- Attributes have no default values
- attributes are always text type CDATA
- all attributes are optional
- entities cannot be declared
- only standard entities are possible (')
- element contents are not clearly defined
  - elements, data or mixed

DTD design

- XML often replaces a previous system
- when transforming to XML
  - a standard DTD could be selected (with possible modifications)
    - partners, affiliations
  - a new DTD is designed
- DTD design based on
  - existing document models in the company
  - (representative) model documents
    - other designers consulted

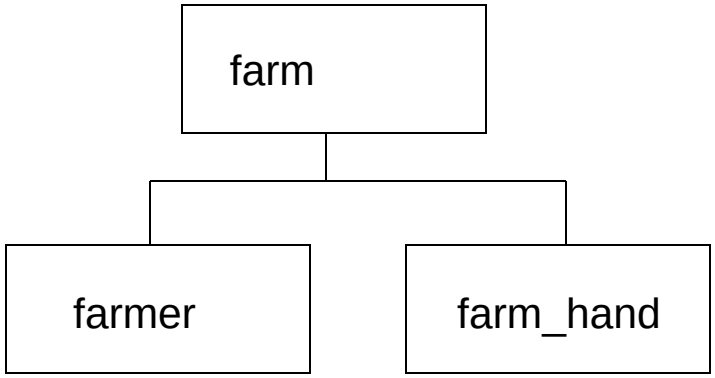
Document analysis

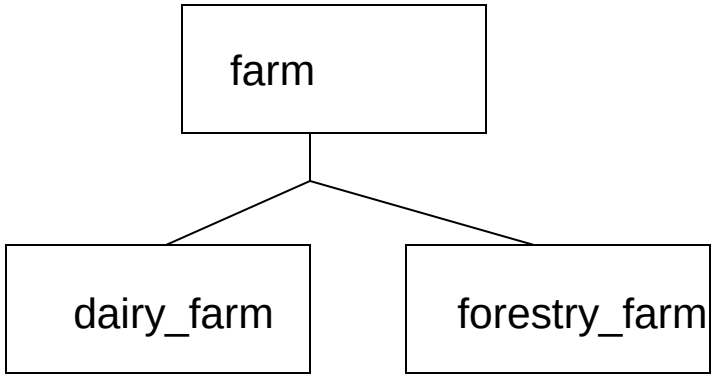
- Document features
  - name, could it be without a name?
  - how many occurrences
  - preceding/ following information, regularity
  - parts of the document
  - standard contents (automatically generated)
- XML document (or parts of it) maybe generated from a data base
  - use data base relation, descriptions and models (UML) when designing DTD

DTD design

- Standard DTD or new?
  - Compatibility and data exchange
  - processing needs, applications
  - future needs, linking
  - consistent names
- Element order, granularity, structure
- element vs. attribute?
- Rules? Order of rules ?
- comments?
- modularity?
- Naming style: short or descriptive, upper or lower case?

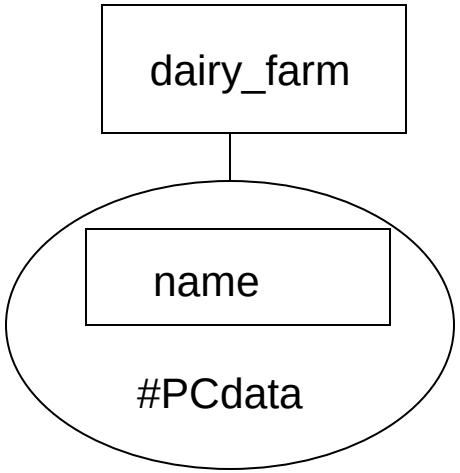
Tree diagrams





<!ELEMENT farm (farmer, farm_hand)>

<!ELEMENT farm (dairy_farm | forestry_farm)>



Standard DTDs

- http://www.xml.com/pub/rg/DTDs
- http://www.xml.org/
- http://xml.coverpages.org/
- http://www.ebxml.org/specs/ebBPSS.dtd
- http://www.w3.org/QA/2002/04/valid-dtd-list.html

- MathML,
- CML (chemistry),
- UXF (UML eXchange Format),
- SMIL (multimedia),
- RDF (Resource Description Framework),
- DocBook, etc.