XML and XSLT

Christian Rinderknecht

31 October 2008

XML

The acronym XML stands for **eXtensible Markup Language**. It is a language for defining unranked trees with plain text, such that the syntax is easy to learn, write and understand, both for humans and computer programs.

These trees are used to model **structured text documents**.

To understand what XML is and how this modelling works, it is probably easier to start with a small example.

Consider an e-mail. What are the different **elements** and what is the **structure**, that is, how are the elements related to each other?

XML/Example

As far as the elements are concerned, an e-mail contains at least

- the recipient's address,
- a subject,
- the sender's address,
- a body of plain text.

The elements correspond to the tree nodes and the structure is modeled by the shape of the tree itself.

XML/Example (cont)

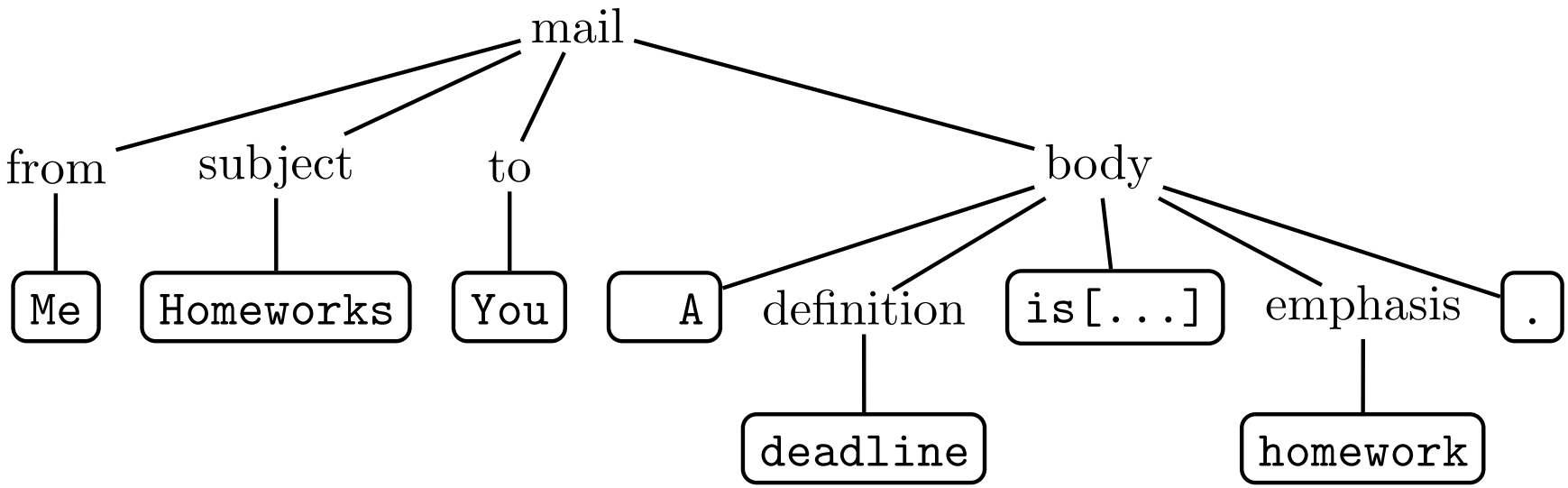
For example:

```
From: Me
Subject: Homeworks
To: You

  A deadline is a due date for your homework.
```

XML/Example (cont)

This e-mail can be modeled by a tree as follows:



Notice that the (boxed) leaves contain text whereas the inner nodes contain information **about** their subtrees, in particular the leaves.

XML/Example (cont)

Since the information of the inner nodes describes the information actually laid out, it is called **meta-data** or **mark-up**. The way to write this document in XML is as follows.

```
<mail>
  <from>Me</from>
  <subject>Homeworks</subject>
  <to>You</to>
  <body>
  A <definition>deadline</definition> is a due date for your
<emphasis>homework</emphasis>.
  </body>
</mail>
```

XML/Tags

Each subtree is denoted by an opening and a closing **tag**. An opening tag is a name enclosed between < and >. A closing tag is a name enclosed between </ and >.

The **tag name** is not part of the text, it is meta-data, so it suggests the meaning of the data contained in the subtree.

For example, the whole XML document is enclosed in tags whose name is "`mail`" because the document describes a mail.

Note the tag names "`body`", "`definition`" and "`emphasis`": this is the way we interpreted the red colour and the italics in the mail, but other interpretations are possible: such interpretations are **not** defined in XML.

XML/Elements, nodes and declaration

An XML tree is called an **element** in XML parlance. In particular, the element including all the others is called the **root element** (here, it is named "`mail`").

A node in the XML tree corresponds, for now, to the opening and closing tags only. The nodes have the same order as the elements.

The data (as opposed to the meta-data) is always contained in the leaves, and is always text.

Our example is not exactly a correct XML document because it lacks a special element which says that the document is indeed XML, and, more precisely, what is the version of XML used here, e.g.,

```
<?xml version="1.0"?>
```

XML/Declaration and empty elements

This special element is actually not an element, as the special markers <? and ?> tend to show. It is more a declaration, some information about the current file, to destination of the reader, whether it is a parsing software, usually called an **XML processor**, or a human.

Consider now the following element:

```
<axiom>
The empty set <empty/> contains no elements.
</axiom>
```

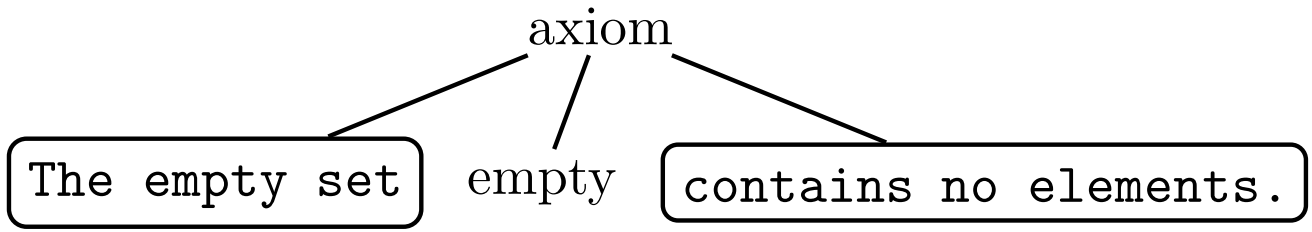
which could be interpreted as

Axiom: The empty set $\varnothing$ contains no elements.

XML/Empty elements (cont)

This `<empty/>` is an **empty element**, it has a special syntax for ending the tag, `/>`, and it is neither an opening nor a closing tag.

It is useful for denoting things, as symbols, that cannot be written as text and need to be distinguished from text.



An empty element corresponds to a leaf in the XML tree, despite it is meta-data data and not data.

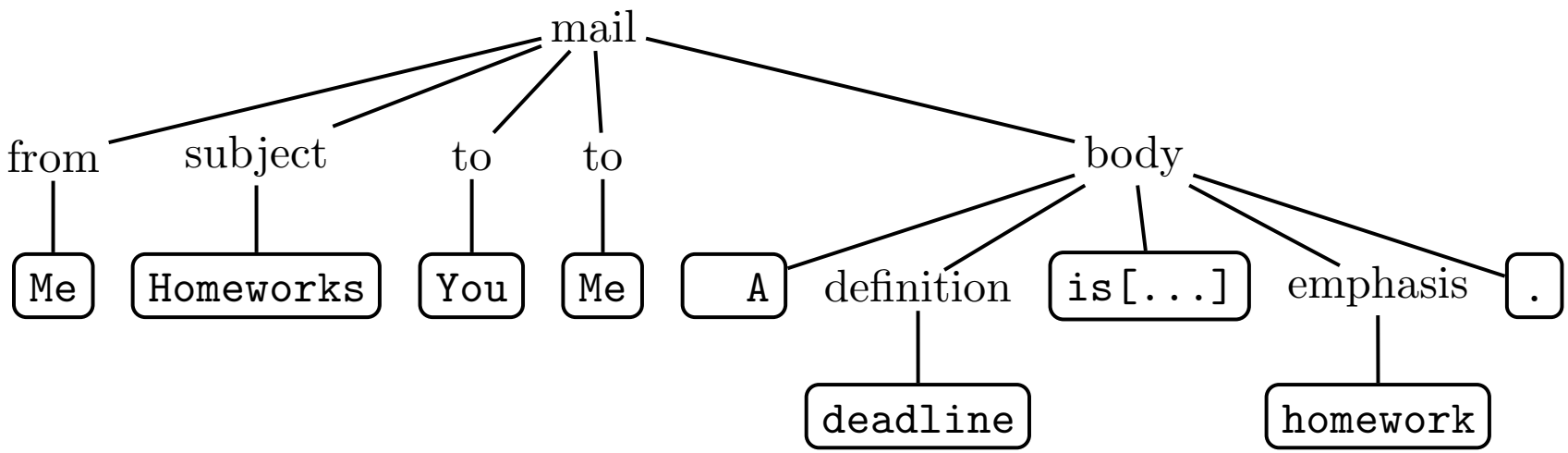
XML/Repeated nodes

Nodes do not need to be unique at a given tree level. For instance, if we want to send a mail to several recipients we would write:

```
<mail>
  <from>Me</from>
  <subject>Homeworks</subject>
  <to>You</to>
  <to>Me</to>
  <body>
  A <definition>deadline</definition> is a due date for your
<emphasis>homework</emphasis>.
  </body>
</mail>
```

XML/Repeated nodes (cont)

The XML tree associated to this XML document is



Note that there are two nodes "to" at the same level, and that their order must be the same as in the XML document.

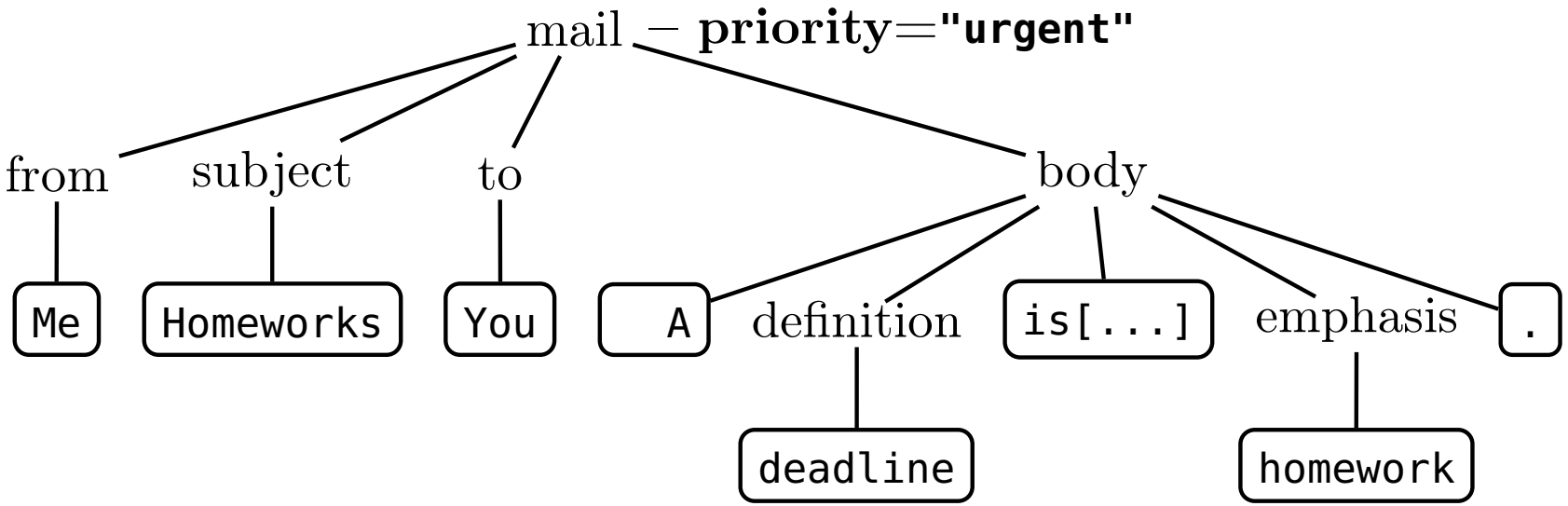
XML/Attributes

It is possible to annotate each meta-data node with some labeled strings, called **attributes**. For example, we may want to specify that our mail is urgent, which is a property of the mail as a whole, not a part of the contents per se:

```
<mail priority="urgent">
  <from>Me</from>
  <subject>Homeworks</subject>
  <to>You</to>
  <body>
  A <definition>deadline</definition> is a due date for your
<emphasis>homework</emphasis>.
  </body>
</mail>
```

XML/Attributes (cont)

It is possible to represent that XML document by the annotated tree



XML/Attributes (cont)

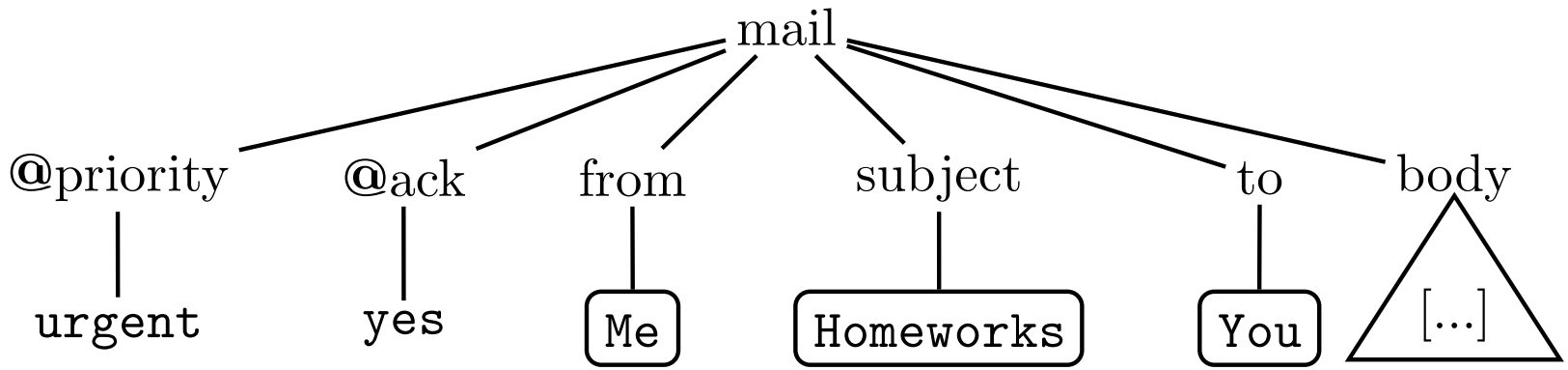
It is possible to attach several attributes to a given element, like

```
<mail priority="urgent" ack="yes">
  <from>Me</from>
  <subject>Homeworks</subject>
  <to>You</to>
  <body>
  A <definition>deadline</definition> is a due date for your
<emphasis>homework</emphasis>.
  </body>
</mail>
```

The order of the attributes matters. Any element can have attributes, including empty elements.

XML/Attributes (cont)

Attributes are considered to be a special kind of node, although they are not often represented as such for room's sake.



Note the symbol @ preceding the attribute name, which distinguishes it from element nodes. At a given tree level, the attribute nodes are placed *before* the element nodes.

XML/Attributes (cont)

The declaration can hold several attributes, besides `version`, like

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml version='1.1' encoding="US-ASCII"?>
<?xml version= '1.0' encoding='iso-8859-1'?>
```

The encoding is the **character encoding** of the XML document, which is particularly useful when using unicode or some Asian fonts.

Note that the attributes must be in lowercase, the *value* of the attributes can be enclosed in single or double quotes.

In the case of `version` and `encoding`, only some standardized values are valid.

XML/Escaping characters

All programming languages offer strings of characters to the programmer to use. For instance, in C, the strings are enclosed between double quotes: `"abc"`.

Thus, if the string contains double-quotes, we must take care of **escaping** them, so the compiler (more precisely: the parser) can distinguish the double-quotes in the contents from the enclosing double-quotes.

In C, character escaping is achieved by adding a backslash just before the character, e.g., `"He said: \"Hello!\"."` is a valid C string.

In XML, there is a similar problem. The attribute values can either be enclosed by single or double quotes. If the latter, the double-quotes in the contents need escaping; if the former, the quotes need escaping. Problems also stem from the characters used for the mark-up.

XML/Escaping characters (cont)

For example, the following element

```
<problem>For all integer n, we have n < n + 1.</problem>
```

is not valid because the text between the tags contains the character "<", which is confused by the XML parsers with the (expected) start of a tag:

```
<problem>For all integer n, we have n < n + 1.</problem>
```

The XML way to escape this character is to use instead the special sequence of characters `<` so the previous, corrected, element becomes

```
<valid>For all integer n, we have n &lt; n + 1.</valid>
```

XML/Predefined named entities

The sequence `<` is called a **predefined named entity**.

Such entities always

1. start with an ampersand (`&`),
2. continue with a predefined name (here, `lt`),
3. end with a semi-colon (`;`).

The choice of the ampersand to mark the start of a predefined named entity entails that this very character must itself be escaped...

So one must always use `&` instead.

XML/Predefined named entities (cont)

There are some other characters which can *sometimes* cause a problem to XML parsers (as opposed to always create a problem, as < and & do).

A summary of all the predefined named entities is given in the following table.

Character	Entity	Mandatory
&	`&`	always
<	`<`	always
>	`>`	in attribute values
"	`&quot;`	in double-quoted strings
'	`&apos;`	in single-quoted strings

XML/Predefined named entities (cont)

Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<escaping>
  <amp>&amp;amp;</amp>
  <lt>&lt;</lt>
  <quot>&quot;</quot>
  <quot attr="&quot;">"</quot>
  <apos attr='&apos;'>&apos;</apos>
  <apos>'</apos>
  <gt>&gt;</gt>
  <gt attr="&gt;">></gt>
  <other>&#100;</other>
  <other>&#x00E7;</other>
</escaping>
```

XML/Predefined numbered entities

The two last entities are **predefined numbered entities** because they denote characters by using their unicode code (which ranges from 0 to 65,536).

Check out `http://www.unicode.org/` for unicode.

If the code is given in decimal (i.e., using base 10), it is introduced by `&#`, e,g, `&#100`.

If the code is given in hexadecimal (i.e., using base 16), it is introduced by `&#x`, e.g., `&#x00E7`.

XML/User-defined internal entities and document type declarations

It can be annoying to use numbers to refer to characters, especially if one considers that unicode requires four digits.

To make life easier, it is possible to bind a name to an entity representing a character: a **user-defined internal entity**.

They are called internal because their definition must be in the same document where they are used.

XML/User-defined internal entities and document type declarations (cont)

For example, it is easier to use `&n;` instead of `&#241`, especially if the text is in Spanish (this represents the letter ñ).

This kind of entity must be declared in the **document type declaration**, which is located, if any, just after the declaration `<?xml ... ?>` and before the root element.

XML/User-defined internal entities and document type declarations (cont)

A document type declaration is made, from left to right, of

1. an opening tag `<!DOCTYPE`,
2. the root element name,
3. the character `[`,
4. the named character entity declarations,
5. the closing tag `]>`

XML/User-defined internal entities and document type declarations (cont)

A named character entity declaration is made, from left to right, of

1. the opening tag `<!ENTITY`,
2. the entity name,
3. the numbered character entity between double-quotes,
4. the closing tag `>`

For example:

```
<!ENTITY n "&#241;">
```

XML/User-defined internal entities and document type declarations (cont)

A complete example:

```
<?xml version="1.0"?>
<!DOCTYPE spain [
  <!ENTITY n "&#241;">
]>
<spain>
Viva Espa&n;a!
</spain>
```

One can think such an entity as being a macro in CPP, the C preprocessor language.

XML/User-defined internal entities and document type declarations (cont)

It is possible to extend user-defined internal entities to denote any character string, not just a single character.

Typically, if one wishes to repeat a piece of text, like a company name or a person's name, a good idea is to give a name to this string and, wherever one want its contents, an entity with the given name is put instead.

The syntax for the declaration is the same, but more characters are put between double-quotes. For example,

```
<!ENTITY univ "Konkuk University">
<!ENTITY motto "<spain>Viva Espa&n;a!</spain>">
<!ENTITY n "&#241;">
```

XML/External entities

Sometimes the XML document needs to include other XML documents and copying the external documents once is not a good strategy, since this avoids keeping track of the evolution of these external documents.

Fortunately, XML allows to specify the inclusion of other XML documents by means of **external entities**. The declaration of these entities is as follows:

1. an opening tag `<!ENTITY`,
2. the entity name,
3. the keyword `SYSTEM`,
4. the full name of the XML file between double-quotes,
5. the closing tag >

XML/External entities (cont)

For example,

```
<?xml version="1.0"?>
<!DOCTYPE longdoc [
  <!ENTITY part1 SYSTEM "p1.xml">
  <!ENTITY part2 SYSTEM "p2.xml">
  <!ENTITY part3 SYSTEM "p3.xml">
]>
<longdoc>
  The included files are:
  &part1;
  &part2;
  &part3;
</longdoc>
```

XML/External entities (cont)

At parsing time, the external entities are fetched and copied into the main XML document, replacing the entity.

Therefore the included parts cannot contain any prolog, i.e., the XML declaration `<?xml ... ?>` and the document type declaration `<!DOCTYPE ... ]>`, if any.

XML processors are required, when reading an external entity, to copy verbatim the content of the referred external document, and then parse it as if it always belonged to the master document (that is, the one which imports the others).

XML/Unparsed entities and notations

Unparsed entities allow to refer to a binary objects, like images, or some text which is not XML, like a program. They are declared by

1. the opening tag `<!ENTITY`,
2. the entity name,
3. the keyword `SYSTEM`,
4. the full name of the non-XML external file between double-quotes,
5. the keyword `NDATA`,
6. a notation (the kind of the file),
7. the closing tag >

XML/Unparsed entities and notations (cont)

Had we used external entities, the included object had been copied in place of the reference and parsed as XML — which it is not. Consider

```
<?xml version="1.0"?>
<!DOCTYPE doc [
  <!NOTATION gif
     SYSTEM "CompuServe Graphics Interchange Format 87a">
  <!ENTITY picture SYSTEM "picture.gif" NDATA gif>
  <!ENTITY me "Christian Rinderknecht">
]>
<doc>
  <para>The following element refers to my picture:</para>
  <graphic image="picture" alt="A picture of &me;"/>
</doc>
```

XML/Unparsed entities and notations (cont)

Notice the notation "`gif`", which is the kind of the unparsed entity. Notations must be defined in the document type declarations as

1. the opening tag `<!NOTATION`,
2. the notation name,
3. the keyword `SYSTEM`,
4. a description of the kind of unparsed entity the notation refers to (it can be a MIME type, an URL, plain English...)
5. the closing tag >

XML/Unparsed entities and notations (cont)

Notice also that unparsed entities

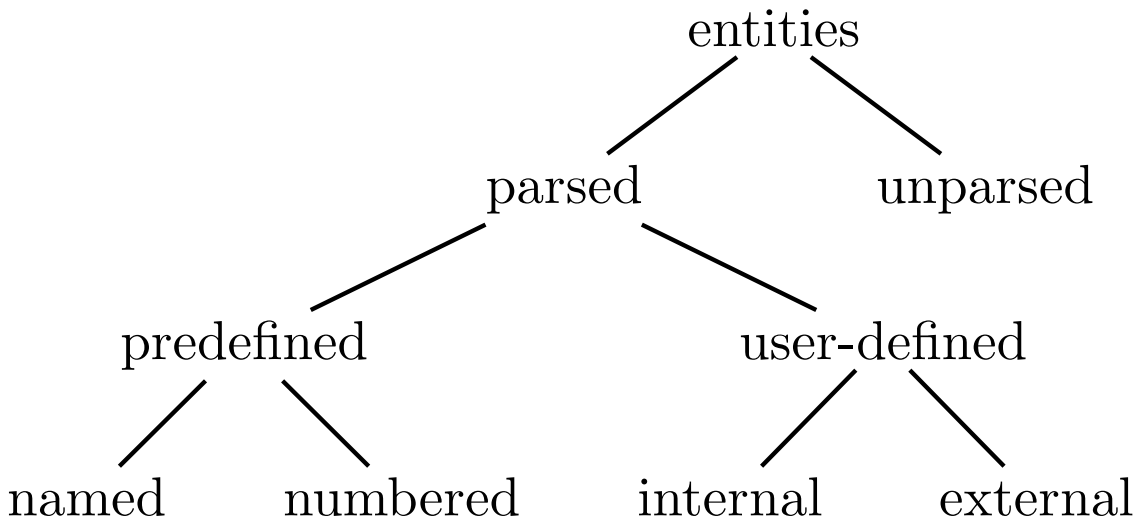
- must be used as attribute values (in our example, the attribute name is "`image`"),
- are names ("`picture`"), instead of the usual entity syntax ("`&picture;`").

XML/Unparsed entities and notations (cont)

This example is **not** well-formed.

```
<?xml version="1.0"?>
<!DOCTYPE doc [
  <!NOTATION jpeg SYSTEM "image/jpeg">
  <!ENTITY pic "pictures/me.jpeg" NDATA jpeg>
]>
<doc>
  &pic;
</doc>
```

XML/A summary of all kinds of entities



XML/Unparsed character data

It is sometimes tiresome to have to escape characters, i.e., use character entities.

To avoid the need of escaping, there is a special construct: **CDATA sections** (short for "Character DATA"), made of

1. an opening tag `<!CDATA[`,
2. some text without escaping and without the sequence `]]>`,
3. a closing tag `]]>`.

For example

```
<para>A test in C:
  <c><![CDATA[if (x < y) return &r;]]></c>
</para>
```

XML/Internal linking

Consider a document representing a technical book, like a textbook. It is common to find cross-references in such kind of books, i.e., references in some chapters to other chapters or sections, or bibliographical entries.

One easy way to achieve this is to use some attributes as labels and some attributes as references.

The problem is that the writer is then in charge of checking whether

- a given label is unique in the whole document,
- every reference is linked to a label.

XML/Internal linking (cont)

XML provides a way to ensure that any validating parser will check this kind of internal linking automatically: using `ID` and `IDREF`.

The former is the kind of all the (attribute) labels and the latter is the kind of all the (attribute) references.

The attributes used either as label or reference must be declared in the `DOCTYPE` section using `ATTLIST`.

XML/Internal linking/Labels

For the labels, use

1. an opening tag `<!ATTLIST`,
2. the name of the element being labelled,
3. the names of the label attributes separated by spaces,
4. the keyword `ID`,
5. the keyword `#REQUIRED` if the element must always be labelled, otherwise `#IMPLIED`,
6. a closing tag >

XML/Internal linking/References

For the references, use

1. an opening tag `<!ATTLIST`,
2. the name of the referring element,
3. the names of the reference attributes separated by spaces,
4. the keyword `IDREF`,
5. the keyword `#REQUIRED` if the element must always carry a reference, otherwise `#IMPLIED`,
6. a closing tag >

XML/Internal linking (cont)

For example,

```
<?xml version='1.0'?>
<!DOCTYPE map [
  <!ATTLIST country code   ID    #REQUIRED>
  <!ATTLIST country name   CDATA #REQUIRED>
  <!ATTLIST country border IDREF #IMPLIED>
]>
<map>
  <country code="uk" name="United Kingdom" border="ie"/>
  <country code="ie" name="Ireland" border="uk"/>
</map>
```

XML/Comments

It is possible to include comments in an XML document. They are made of

1. an opening tag "<!--",
2. some text without the sequence "--",
3. a closing tag "-->".

For example

```
<p>Our store is located at</p>
<!- <address>Eunpyeong-gu, Seoul</address> ->
<address>Gangnam-gu, Seoul</address>
```

Contrary to programming languages, comments are **not** ignored by the parsers and are nodes of the XML tree.

XML/Namespaces

Each XML document defines its own element tags, we can call its *vocabulary*.

In case we use external entities which refer to other XML document using, by coincidence, the same tags, we end with an ambiguity in the master document.

A good way to avoid these name clashes it to use **namespaces**. A namespace is a user-defined annotation of each element tag names and attribute names.

Therefore, if two XML documents use two different namespaces, i.e., two different tag annotations, there is no way to mix their elements when importing one document into the other, because each element tag carries an extra special annotation which is different.

XML/Namespaces (cont)

The definition of a namespace can be done at the level of any element by using a special attribute with the following syntax:

```
xmlns:prefix = "URL"
```

where *prefix* is the space name and *URL* (*Universal Resource Location*) points to a web page describing in natural language (e.g., in English) the namespace.

```
<?xml version="1.0"?>
<syllabus:journal
 xmlns:syllabus="http://konkuk.ac.kr/~rinderkn/syllabus.html">
 <syllabus:date>26 August 2006</syllabus:date>
 <syllabus:subject syllabus:hard="no">
   XML and company</syllabus:subject>
 <syllabus:abstract>
   We will study XML, XPath and XSLT.</syllabus:abstract>
</syllabus:journal>
```

XML/Namespaces (cont)

The scope of a namespace, i.e., the part of the document where it is usable, applies to the subtree whose root is the element declaring the namespace.

By default, if the prefix is missing, the element and all its sub-elements without prefix belong to the namespace. So, the previous example could be simply rewritten

```
<?xml version="1.0"?>
<journal xmlns="http://konkuk.ac.kr/~rinderkn/syllabus.html">
 <date>26 August 2006</date>
 <subject hard="no">XML and company</subject>
 <abstract>We will study XML, XPath and XSLT.</abstract>
</journal>
```

Note that the colon is missing in the namespace attribute.

XML/Namespaces/Example

An example of avoided clash name. File `fruits.xml` contains HTML code:

```
<table>
  <tr>
    <td>Bananas</td>
    <td>Oranges</td>
  </tr>
</table>
```

File `furniture.xml` contains a description of pieces of furniture:

```
<table>
  <name>Round table</name>
  <wood>Oak</wood>
</table>
```

XML/Namespaces/Example (cont)

The master document `main.xml` includes both files:

```
<?xml version="1.0"?>
<!DOCTYPE eclectic [
  <!ENTITY part1 SYSTEM "fruits.xml">
  <!ENTITY part2 SYSTEM "furniture.xml">
]>
<eclectic>
  &part1;
  &part2;
</eclectic>
```

The problem is that `table` has a different meaning in the two included files, so they should not be confused: this is a clash name.

XML/Namespaces/Example (cont)

The solution consists in using two different namespaces. First

```
<html:table xmlns:html="http://www.w3.org/TR/html4/">
  <html:tr>
    <html:td>Bananas</html:td>
    <html:td>Oranges</html:td>
  </html:tr>
</html:table>
```

Second

```
<f:table xmlns:f="http://www.e-shop.com/furnitures/">
  <f:name>Round table</f:name>
  <f:wood>Oak</f:wood>
</f:table>
```

XML/Namespaces/Example (cont)

But this is a heavy solution... Fortunately, namespaces can be defaulted:

```
<table xmlns="http://www.w3.org/TR/html4/">
  <tr>
    <td>Bananas</td>
    <td>Oranges</td>
  <tr>
</table>
```

Second

```
<table xmlns="http://www.e-shop.com/furnitures/">
  <name>Round table</name>
  <wood>Oak</wood>
</table>
```

XML/Namespaces/Example (cont)

The two kinds of tables can be mixed. For example

```
<mix xmlns:html="http://www.w3.org/TR/html4/"
     xmlns:f="http://www.e-shop.com/furnitures/">
<html:table>
...
  <f:table>
...
  </f:table>
...
<html:table>
</mix>
```

Note that element `mix` has no namespace associated (it is neither `html` nor `f`).

XML/Namespaces/Unbinding and rebinding

It is possible to unbind or rebind a prefix namespace:

```
<?xml version="1.1"?>
<x xmlns:n1="http://www.w3.org">
  <n1:a/> <!-- valid; the prefix n1 is bound to
               http://www.w3.org -->
    <x xmlns:n1="">
      <n1:a/> <!-- invalid; the prefix n1 is not bound here -->
      <x xmlns:n1="http://www.w3.org">
        <n1:a/> <!-- valid; the prefix n1 is bound again -->
      </x>
   </x>
</x>
```

XML/Namespaces/Unbinding the default namespace

```
<?xml version='1.0'?>
<Beers>
  <table xmlns='http://www.w3.org/1999/xhtml'>
    <!-- default namespace is now XHTML -->
    <th><td>Name</td><td>Origin</td><td>Description</td></th>
    <tr>
      <!-- Unbinding XHTML namespace inside table cells -->
      <td><brandName xmlns="">Huntsman</brandName></td>
      <td><origin xmlns="">Bath, UK</origin></td>
      <td><details xmlns="">
            <class>Bitter</class>
            <hop>Fuggles</hop>
            <pro>Wonderful hop, good summer beer</pro>
            <con>Fragile; excessive variance pub to pub</con>
          </details></td>
    </tr>
  </table>
</Beers>
```

XML/Namespaces/More name scoping

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- initially, the default namespace is "books" -->
<book xmlns='http://loc.gov/books'
    xmlns:isbn='http://isbn.org/0-395-36341-6'
    xml:lang="en" lang="en">
  <title>Cheaper by the Dozen</title>
  <isbn:number>1568491379</isbn:number>
  <notes>
    <!-- make HTML the default namespace
         for a hypertext commentary -->
    <p xmlns='http://www.w3.org/1999/xhtml'>
        This is also available
        <a href="http://www.w3.org/">online</a>.
    </p>
  </notes>
</book>
```

XML/Namespaces/Attributes

For example, each of the bad empty-element tags is invalid in the following:

```
<!-- http://www.w3.org is bound to n1 and n2 -->
<x xmlns:n1="http://www.w3.org"
   xmlns:n2="http://www.w3.org" >
  <bad a="1"    a="2"/>     <!-- invalid -->
  <bad n1:a="1" n2:a="2"/>  <!-- invalid -->
</x>
```

XML/Namespaces/Attributes (cont)

However, each of the following is valid, the second because **the default namespace does not apply to attribute names**:

```
<!-- http://www.w3.org is bound to n1 and is the default -->
<x xmlns:n1="http://www.w3.org"
   xmlns="http://www.w3.org" >
  <good a="1" b="2"/>    <!-- valid -->
  <good a="1" n1:a="2"/> <!-- valid -->
</x>
```

XML/Namespaces (cont)

Namespaces will be very important when learning XSLT.

Although namespaces are declared as attributes, they are present in the XML tree corresponding to the document as a special node, different from the attribute nodes.

XML/Processing instructions

In some exceptional cases, it may be useful to include in an XML document some data that is targeted to a specific XML processor.

This data is then embedded in a special element, and the data itself is called a **processing instruction** because it tells to a specific processor, e.g., Saxon, what to do at this point.

The syntax is

```
<?target data?>
```

The *target* is a string supposed to be recognised by a specific XML processor and the *data* is then used by this processor. Note that the data may be absent and that it contains attributes. For example:

```
<?xml version="1.0"?>
```

XML/Checking the well-formedness

All XML processors must check whether the input document satisfy the *syntactical* requirements of a well-formed XML document.

In particular,

- element tags must be closed, except for empty elements (this has to be contrasted with HTML),
- the predefined entities must be really predefined (unicodes are checked),
- internal entities must be declared in the prolog, etc.

Validating processors also check that the external entities are found (their well-formedness is checked after they have been inserted in the master document).

XML/Checking the well-formedness (cont)

There are several XML parsers available for free on the internet, implemented in several languages.

Most of them are actually libraries (API) for the programmer of an XML-handling application would need to link with.

The textbook provides a very basic standalone parser, `dbstat.pl`, written in Perl, which provides also some statistics about the document (like the number of elements of different kinds).

There is another, more complete, parser called `xmllint`.

XHTML

The **eXtensible Hyper-Text Markup Language** (**XHTML**) is a subset of XML so that it becomes very close to **HTML 4.01**, the language for specifying web pages.

The user-agents, e.g., web browsers, are encouraged to accept XHTML. If this policy becomes widespread, it will enable the following step of using full XML.

See the W3C Recommendations for XHTML and HTML at

`http://www.w3.org/TR/xhtml1/`
`http://www.w3.org/TR/html401/`

XHTML/Global Structure

All XHTML file containing English should have the following pattern:

```
<?xml version="1.0" encoding="encoding"?>
<!DOCTYPE html
    PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xml:lang="en" lang="en">
  <head>
    <title>the title of the window</title>
  </head>
  <body>
     ...contents and markup...
  </body>
</html>
```

XHTML/Headings

Elements `h1`, `h2`, ..., `h6` allow six kinds of headers, of decreasing font size. Consider the following document:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
          "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xml:lang="en" lang="en">
  <head><title>Comparing heading sizes</title></head>
  <body>
    <h1>The biggest</h1>
    <h2>Just second</h2>
    <h3>Even smaller</h3>
  </body>
</html>
```

XHTML/Text

- The empty element `<br/>` is interpreted by user-agents as a **line break**;
- element `em` marks text to be **emphasized** (e.g., by using an italic font);
- element `strong` marks text to be emphasized stronger than with `em` (e.g., by using a bold font);
- element `p` delimits a **paragraph**.

XHTML/Lists

There are three kinds of lists:

1. unordered lists;
2. ordered lists;
3. lists of definitions.

XHTML/Unordered lists

Unordered lists are the well-known “bullet lists”, where each line is displayed after an indentation followed by a bullet, like the following.

- element `ul` contains an unordered list;
- element `li` (“list item”) contains an item in the list.

XHTML/Unordered lists/Example

Try

```
<h3>The ingredients:</h3>
<ul>
  <li>100 g. flour,</li>
  <li>10 g. sugar,</li>
  <li>1 cup of water,</li>
  <li>2 eggs,</li>
  <li>salt and pepper.</li>
</ul>
```

XHTML/Ordered lists

Ordered lists are lists whose items are introduced by an indentation followed by a number, in increasing order, like the following.

1. element `ol` contains the ordered list,
2. element `li` is the same as in unordered lists.

XHTML/Ordered lists/Example

Try

```
<h3>Procedure:</h3>
<ol>
  <li>Mix dry ingredients thoroughly;</li>
  <li>Pour in wet ingredients;</li>
  <li>Mix for 10 minutes;</li>
  <li>Bake for one hour at 300 degrees.</li>
</ol>
```

XHTML/Lists of definitions

A list of definition is a list whose items are introduced by a few words in a bold font followed by the contents of the item itself. Consider

hacker
: A clever programmer.

nerd

geek
: A technically bright but socially misfit person.

XHTML/Lists of definitions (cont)

The elements involved are

- `dl` ("definition list"), which contains the whole list of definitions;
- `dt` ("definition term"), which contains every term to be defined;
- `dd` ("definition description"), which contains every definitition of a term.

XHTML/Lists of definitions (cont)

The example before corresponds to

```
<h3>Excerpt:</h3>
<dl>
  <dt><strong>hacker</strong></dt>
    <dd>A clever programmer.</dd>
  <dt><strong>nerd</strong></dt>
  <dt><strong>geek</strong></dt>
    <dd>A technically bright but socially misfit person.</dd>
</dl>
```

XHTML/Tables

A **table** is a rectangle divided into smaller rectangles, called **cells**, which contain atomic pieces of data.

When read vertically, cells are said to belong to **columns**, whilst horizontally, they belong to **rows**.

A row or a column can have a **header**, i.e., a cell at their beginning containing a name in bold face.

A table can have a **caption**, which is a short text describing the contents of the table and displayed just above it, like a title.

Columns can be divided themselves into sub-columns, when needed.

XHTML/Tables (cont)

A test table with merged cells

	Average		**Red eyes**
	height	**weight**	
Males	1.9	0.003	40%
Females	1.7	0.002	43%

Males and **Females** are row headers. The column headers are **Average**, **Red eyes**, **height** and **weight**. The column **Average** spans two columns; in other words, it contains two sub-columns, **height** and **weight**.
The caption reads "*A test table with merged cells*".

XHTML/Tables (cont)

- Element `table` contains the table; its attribute `border` specifies the width of the table borders, i.e., of the lines separating the cells from the rest.
- Element `caption` contains the caption.
- Element `th` ("table header") contains a row or column header, i.e., the title of the row of column in bold type.
- Element `td` ("table data") contains the data of a cell (if not a header).
- Element `tr` ("table row") contains a row, i.e., a series of `td` elements, perhaps starting with a `th` element.

XHTML/Tables (cont)

The corresponding HTML code is

```
<table border="1">
  <caption><em>A test table with merged cells</em></caption>
  <tr><th rowspan="2"/>
      <th colspan="2">Average</th>
      <th rowspan="2">Red<br/>eyes</th>
  </tr>
  <tr><th>height</th><th>weight</th></tr>
  <tr><th>Males</th><td>1.9</td><td>0.003</td><td>40%</td></tr>
  <tr><th>Females</th>
      <td>1.7</td>
      <td>0.002</td>
      <td>43%</td>
  </tr>
</table>
```

XHTML/Tables (cont)

Notice the attributes **`rowspan`** and **`colspan`** of the `th` element.

Attribute `rowspan` allows to specify how many rows the current cell spans. For example, the first row, i.e., the one on the top-left corner, is empty and covers two rows because `<th rowspan="2"/>`.

Attribute `colspan` allows to specify how many columns the current cell spans. For example, the second cell (right next to the first one) contains the text "**Average**" and covers two columns because `<th colspan="2">Average</th>`.

Notice the line break `<br/>` in the third cell (first row, last column) and how **height** and **weight** are automatically at the right place.

XHTML/Hyperlinks

Hyperlinks in XHTML are specificied by the element “a” with its mandatory attribute `href`.

For example, consider the following hyperlink to the author's web page:

```
<a href="http://konkuk.ac.kr/~rinderkn/">See my web page.</a>
```

XHTML/Validation

Just like XML documents, XHTML documents can be and should be validated before being published on the web or distributed.

The page `http://validator.w3.org/` allows you to do that.

DTD

We saw at page 26 that the **Document Type Declaration** may contain markup which constrains the XML document it belongs to (elements, attributes etc.).

The content of a Document Type Declaration is made of a **Document Type Definition**, abbreviated DTD. So the former is the container of the latter.

It is possible to have all or part of the DTD in a separate file, usually with the extension "`.dtd`".

DTD/Attribute lists

We already saw **attribute lists** at page 41 when setting up internal linking.

In general, the `ATTLIST` can be used to specify any kind of attributes of an element, not just label and references.

Consider the attribute declarations for element `memo`:

```
<!ATTLIST memo
          ident      CDATA           #REQUIRED
          security   (high | low)    "high"
          keyword    NMTOKEN         #IMPLIED>
```

`CDATA` stands for **character data** and represents any string. A **named token** (`NMTOKEN`) is a string starting with a letter and which may contain letters, numbers and certain punctuation.

DTD/Element declarations

In order for a document to be validated, which requires more constraints than to be merely well-formed, all the elements used must be declared in the DTD.

The name of each element must be associated a **content model**, i.e., a description of what it is allowed to contain, in terms of textual data and sub-elements (mark-up).

This is achieved by means of the DTD `ELEMENT` declarations. There are five kinds of content models.

DTD/Element declarations (cont)

The first kind is the **empty element**:

```
<!ELEMENT padding EMPTY>
```

The second is elements with **no content restriction**:

```
<!ELEMENT open ALL>
```

The third is elements containing **only text**:

```
<!ELEMENT emphasis (#PCDATA)>
```

which means **parsed-character data**.

DTD/Element declarations (cont)

The fourth is elements containing **only elements**:

```
<!ELEMENT section (title, para+)>
<!ELEMENT chapter (title, section+)>
<!ELEMENT report (title, subtitle?, (section+ | chapter+))>
```

where `title`, `subtitle` and `para` are elements.

The last is elements containing **both text and elements**:

```
<!ELEMENT para (#PCDATA | emphasis | ref)+>
```

where `emphasis` and `ref` are element names.

DTD/Element declarations (cont)

The technique to define the content model is similar to **regular expressions**. Such an expression can be made up by combining the following:

- (`e1, e2, ..., en`) represents the elements represented by e_1, followed by the elements represented by e_2 etc. until e_n;
- e_1 | e_2 represents the elements represented by e_1 or e_2;
- (`e`) represents the elements represented by e;
- e? represents the elements represented by e or none;
- e+ represents the non-empty repetition of the elements represented by e;
- $e*$ represents the repetition of the elements represented by e.

DTD/Element declarations (cont)

Warning. When mixing text and elements, the only possible regular expression is either

```
(#PCDATA)
```

or

```
(#PCDATA | ...)*
```

DTD/Internal and external subsets

The part of a DTD which is included in the same file as the XML document it applies to is called the **internal subset**. See again the example page 44.

The part of a DTD which is in an independent file (`.dtd`) is called the **external subset**.

If there is no internal subset and everything is in the external subset we have a declaration like

```
<!DOCTYPE some_root_element SYSTEM "some.dtd">
```

DTD/Validating parsers

In order to validate an XML document, its DTD must completely describe the elements and attributes used.

This is not mandatory when well-formedness is required.

Therefore, the example page 44 is well-formed but not valid in the sense above, because the elements `map` and `country` are not declared.

For example:

```
<!ELEMENT map     (country+)>
<!ELEMENT country EMPTY>
```

would be sufficient to validate the document.

XSLT

Given one or several XML documents, it may be useful

- to search for information in the documents,
- to output what is found in a format suitable for another application or reader.

so one needs XSLT (**eXtensible Stylesheet Language Transformations**).

An XSLT processor

- reads an XML document,
- an XSLT file,

and applies the transformations to the XML and the result is printed out.

XSLT/Saxon

I recommend the open source, Java-based, XSLT processor available at

`http://sourceforge.net/projects/saxon/files/Saxon-HE/9.3/saxonhe9-3-0-4j.zip/download`

Its name is Saxon. You only need the archive `saxon9he.jar`.

The command-line syntax for using Saxon is

```
java -jar saxonhe9.jar -o output doc.xml trans.xsl
```

If no *output* file is specified, the output is the terminal.

XSLT

An XSLT file is actually an XML document, in the sense that XML is both the infrastructure and its contents, which is interpreted by some other application.

For example, if we use an element <book> in an XML document, XML itself does not imply that this element models a book: some application using the document perhaps will precisely do that.

One can think of XML as syntactic rules (see page 61), but with no semantics attached to the constructs.

An XSLT document is thus XML with a special interpretation (which makes it XSLT).

XSLT/Empty transformation

For reason explained later, XSLT documents require the usage of a namespace, usually `xsl`, defined at
`http://www.w3.org/1999/XSL/Transform`

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
</xsl:transform>
```

Note the first line of this transformation, which says that this is an XML document. The second line declares the namespace for XSLT and makes use of an XSLT tag name, `transform`, which means that the interpretation of this XML is done according to XSLT. The version of XSLT is declared to be `2.0`.

XSLT/Empty transformation (cont)

Assume the following XML document to be transformed:

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

<cookbook>
  <title>XSLT Cookbook</title>
  <author>Salvatore Mangano</author>
  <chapter>XPath</chapter>
  <chapter>Selecting and Traversing</chapter>
  <chapter>XML to Text</chapter>
  <chapter>XML to XML</chapter>
  <chapter>XML to HTML</chapter>
</cookbook>
```

XSLT/Empty transformation (cont)

The result of applying the empty transformation page 94 to this document yields

```
XSLT Cookbook
Salvatore Mangano
XPath
Selecting and Traversing
XML to Text
XML to XML
XML to HTML
```

XSLT/Empty transformation (cont)

Note that if the element `<xsl:output method="text"/>` were missing, the output would be considered XML and `<?xml ...?>` would be outputted by default.

Then it prints the contents of the text nodes of the input XML document *in the same order*.

More precisely, the order corresponds to a prefix traversal: this is the implicit traversal supported by XSLT processors, also called **document order**. The rationale is that since the aim is often to rewrite a document into another, this traversal corresponds to the order in which the input is read.

The attributes are not copied by default.

XSLT/Matching

More precisely, the concepts underlying XSLT transformations are

- an implicit prefix traversal of the XML tree,
- each element is matched against a **template**,
- as a result, some output may be produced.

A template allows to identify an element by specifying a part of it, like its name, some of its attribute names etc.

When a template identifies an input element, one says it **matches** the element.

If no template matches the current node, the children nodes are visited and tried for matching. Text nodes implicitly match and their contents are printed (this is the default behaviour).

XSLT/Matching (cont)

Consider the following XSLT transformation

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="chapte">A chapter.</xsl:template>
</xsl:transform>
```

Note the XSLT predefined element `template`, which defines a template, and its predefined attribute `match`, whose value is the element name one wishes to match in the input XML document.
The content of the template is output only if a `chapte` (**wrong spelling**) element is matched (i.e., found).

XSLT/Matching (cont)

The result of applying the previous transformation to the document page 95 is

```
XSLT Cookbook
Salvatore Mangano
XPath
Selecting and Traversing
XML to Text
XML to XML
XML to HTML
```

because the template matched no node in the input tree, but **text nodes always implicitly match**.

XSLT/Matching (cont)

Let us try to match also the root element and try the next transformation.

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="cookbook">Chapters:</xsl:template>
</xsl:transform>
```

The result is now:

```
Chapters:
```

Why?

XSLT/Applying several templates

The reason is that when a template matches the current element, this element is transformed and the prefix traversal goes on *without visiting the children of the current element*.

Therefore, after the element `cookbook` is matched, the XSLT processor ignores everything else since it is the root element (hence, no element `chapter` is matched).

In order to try to match the children elements of a matched element, one must tell so the processor by using the special empty element

```
<xsl:apply-templates/>
```

The meaning of all the XSLT elements is implicitly relative to the last matched element, called the **context node**.

XSLT/Applying several templates (cont)

The following transformation

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="cookbook">
    <xsl:apply-templates/>
  </xsl:template>
</xsl:transform>
```

instructs the XSLT processor to match the root element `cookbook` and then try to apply any available template to the child elements, i.e., `chapter` elements.

XSLT/Applying several templates (cont)

Since there is no template matching `chapter` elements, their child text nodes will be printed.

The result is now:

```
XSLT Cookbook
Salvatore Mangano
XPath
Selecting and Traversing
XML to Text
XML to XML
XML to HTML
```

XSLT/Applying several templates (cont)

What if we do not want to print the name of the book and the author's name?

The first solution consists in adding two templates matching the elements to be ignored and do nothing (empty `template` elements):

```
<xsl:template match="cookbook">
  <xsl:apply-templates/>
</xsl:template>

<xsl:template match="title"/>

<xsl:template match="author"/>
```

XSLT/Applying several templates (cont)

When several templates do the same thing (or do nothing), it is possible to write down only one `template` element with a `match` attribute containing all the element names to be matched.

For example, instead of

```
<xsl:template match="title"/>
<xsl:template match="author"/>
```

one can write

```
<xsl:template match="title|author"/>
```

The symbol "|" means "or" and this kind of `match` attribute is called a **disjunctive pattern**.

XSLT/Selecting children to be matched

The second solution consists in specifying that only some child elements of a given context node should be matched against the available templates.

This **selection** of the required children is done by means of the `select` attribute of the `apply-templates` element.

The content of the attribute is the name of the children, relatively to the context node.

Therefore, the `select` attribute evaluates to a **sequence of nodes** (the children) to the matched in document order.

XSLT/Selecting children to be matched (cont)

Consider the following XSLT transformation

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="cookbook">
    <xsl:apply-templates select="chapter"/>
  </xsl:template>
</xsl:transform>
```

XSLT/Selecting children to be matched (cont)

The result is now

```
XPathSelecting and TraversingXML to TextXML to XMLXML to HTML
```

Note that only the chapter titles have been printed, not the book title, nor the author's name. This is due to the selection of `chapter` elements only.

Note also that the text nodes of the selected chapters have been printed without spacing. This is due to having a sequence of nodes to apply templates to.

Let us improve the printing.

XSLT/Selecting children to be matched (cont)

Since we want to handle explicitly how the children of `chapter` are printed, we need to have a dedicated template matching `chapter`:

```
<xsl:template match="chapter">
...
</xsl:template>
```

Now, when the context node is `chapter`, we want to print its text node.

XSLT/Selecting children to be matched (cont)

The XSLT element that creates a text node is

`value-of`

This element, like `apply-templates` has a `select` attribute.

Since the text nodes which are children of `chapter` (there is only one by chapter, actually) are to be selected, we write

```
<xsl:template match="chapter">
  <xsl:value-of select="text()"/>
</xsl:template>
```

The expression `text()` denotes **all** the text nodes which are children of the context node `chapter`, i.e., the current chapter. The effect of `value-of` here is thus to duplicate the selected text node.

XSLT/Selecting children to be matched (cont)

Unfortunately, this changes nothing, because `apply-templates` serialises the results of the matchings as a sequence of strings with no inter-spaces.

The solution is thus to force a **new line** after getting the value of each text node.

This can be done by means of the element

```
<xsl:text>&#10;</xsl:text>
```

The numbered entity `
` corresponds to the new line character in the ASCII.

The XSLT element `text` can be used to write text verbatim.

It is useful when the complex rules of XML about space characters have to be bent.

XSLT/From XML to XHTML

One application of XML, server-side, is to generate XHTML or, in general, HTML.

Following a client's request for a web page, the web server retrieves its content as XML (stored in a database, for instance) and runs an XSLT transformation, depending perhaps on the client's user-agent (e.g., the kind of browser) or display device (e.g., a mobile device with a small screen or limited number of colours) to produce (perhaps dedicated) HTML, which is then sent back to the client.

This way, the content of the page (XML specifies semi-structured data, without a specific interpretation) is stored independently of any presentation style (HTML specifies both contents and style).

XSLT/From XML to XHTML (cont)

The first step when designing an XSLT stylesheet (i.e., transformation or transform) to produce XHTML is to write an instance of expected output.

Once the shape of the general output is clearly in mind, think backwards to the input and, by doing so, write the transformation.

Technically, the difficulty in the XSLT comes from managing the namespaces: one for the XSLT elements and one for the XHTML elements.

XSLT/From XML to XHTML (cont)

First, the start of the XSLT stylesheet must be

```
<xsl:output
  method="xhtml"
  doctype-public="-//W3C//DTD XHTML 1.0 Strict//EN"
  doctype-system=
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
  indent="yes"/>
```

XSLT/From XML to XHTML/Example

Let us try to transform the XML page 95 into some XHTML displayed as

XSLT Cookbook
by Salvatore Mangano

1. XPath
2. Selecting and Traversing
3. XML to Text
4. XML to XML
5. XML to HTML

Also, the title of the browser window should be "XSLT Cookbook".

XSLT/From XML to XHTML/Example (cont)

First, we must decide that the XHTML should look as follows.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html
  PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xml:lang="en" lang="en">
   <head>
      <meta http-equiv="Content-Type"
            content="text/html; charset=UTF-8"/>
      <title>XSLT Cookbook</title>
   </head>
   <body>
      <h2>XSLT Cookbook</h2>
      <p><em>by Salvatore Mangano</em></p>
```

XSLT/From XML to XHTML/Example (cont)

```
      <h3>Table of contents</h3>
      <ol>
         <li>XPath</li>
         <li>Selecting and Traversing</li>
         <li>XML to Text</li>
         <li>XML to XML</li>
         <li>XML to HTML</li>
      </ol>
   </body>
</html>
```

XSLT/From XML to XHTML/Example (cont)

Therefore, it becomes clear that the infrastructure of the XHTML, made of the XML processing instruction, XHTML elements `html`, `head` and `body`, should be output first.

Then, the title and author.

The last part being the ordered list of chapters.

XSLT/From XML to XHTML/Example (cont)

From this analysis, we deduce the following structure for the XSLT stylesheet.

- A template to match the root element, `cookbook`, is needed to output the XHTML elements `html`, `head`, `body` **and** the `title`, `author` **and** an *empty* XHTML element `ol`.
- Another template is needed to match the `chapter` elements and fill the empty XHTML element `ol` with the list items corresponding to the chapters.

XSLT/From XML to XHTML/Example (cont)

```
<xsl:template match="cookbook">
  <html xmlns="http://www.w3.org/1999/xhtml"
        xml:lang="en" lang="en">
    <head>
      <title><xsl:value-of select="title/text()"/></title>
    </head>
    <body>
      <h2><xsl:value-of select="title/text()"/></h2>
      <p>
        <em>by <xsl:value-of select="author/text()"/></em>
      </p>
      <h3>Table of contents</h3>
      <ol>
        <xsl:apply-templates select="chapter"/>
      </ol>
    </body>
  </html>
</xsl:template>
```

XSLT/From XML to XHTML/Example (cont)

Notice the `select` values "`title/text()`" and "`author/text()`."

To understand the meaning of such expressions, one must decompose them step by step. Let us consider the first one as an example.

First, `title` as an expression means "all the child elements of the context node." So, in general, this is a sequence of nodes, but here the sequence contains only one node.

Then `.../text()` means "all the text nodes which are children of **every** element in the previous sequence." In this case, the `title` elements have only one text node as a child.

XSLT/Selecting children to be matched (cont)

In this case, it is possible to write

```
<xsl:value-of select="title"/>
```

instead of

```
<xsl:value-of select="title/text()"/>
```

The former means "**all** the text nodes descendant of the `title` element, which are the children of the context node." But since there is only one text node below `title`, it means the same as the selection `title/text()`.

XSLT/From XML to XHTML/Example (cont)

Let us resume our stylesheet. Another template is needed for the chapters:

```
<xsl:template match="chapter">
  <li xmlns="http://www.w3.org/1999/xhtml">
    <xsl:value-of select="text()"/>
  </li>
</xsl:template>
```

Note here the obligation to specify the XHTML namespace as default in the XHTML `li` element. Otherwise it will be output without namespace, instead of having the XHTML namespace implicitly. In other words, if one writes `<li>` instead of `<li xmlns="http://www.w3.org/1999/xhtml">`, the output will be `<li xmlns="">`, because the XHTML namespace is the default for the embedding `html` element.

XSLT/From XML to XHTML/Example (cont)

The last step consists in checking the conformity to XHTML by means of the W3C validator available at

`http://validator.w3.org/`

XSLT/Variables

Sometimes it is handy to define **variables** to hold some intermediary result. Consider

```
<?xml version="1.0" encoding="iso-8859-1"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="/">
    <xsl:variable name="v" select="0"/>
    <xsl:variable name="w" select="1 + $v"/>
    <xsl:value-of select="$w"/>
  </xsl:template>
</xsl:transform>
```

XSLT/Variables (cont)

The `match` expression `"/"` means: "the document root".

The document root is not the root element.

The latter is the unique element at the root of the XML tree, e.g., `cookbook` is the root element of the document page 95.

The former is the implicit node that contains all the elements in the XSLT file. It is not written.

Therefore, the root element is always a child of the document root and `"/"` matches any XML document.

Also, `"/*"` matches any root element.

XSLT/Variables (cont)

The variable `v` is set to the selected value `0`. Note that it is possible to select basic types, like integers, not just nodes.

Also, as variable `w` demonstrates it, it is possible to select the contents of another variable by prefixing its name with the symbol `$`, and then operate on it as an arithmetic expression, e.g., `"1 + $v"`.

Important: Variables in XSLT are immutable.

In other words, their value cannot be changed. That explains why there is no assignment on variables, like `a = a + 1;` in C.

XSLT/Conditionals

It is possible to choose a sequence of nodes rather than another one, based on a given criterion.

The pure XSLT way to achieve this is by means of the `if`, `choose`, `when` and `otherwise` elements. Consider first the input

```
<?xml version='1.0' encoding='iso-8859-1'?>
<numbers>
  <num>18</num>
  <num>-1.3</num>
  <num>3</num>
  <num>5</num>
  <num>23</num>
</numbers>
```

XSLT/Conditionals (cont)

Let us output all the text nodes in order, **separated by a comma**. But the last string must not be followed by a comma, i.e., we expect

```
18, -1.3, 3, 5, 23
```

The solution is

```
<xsl:template match="num">
  <xsl:value-of select="text()"/>
  <xsl:if test="position() ne last()">
    <xsl:value-of select="', '"/>
  </xsl:if>
</xsl:template>
```

XSLT/Conditionals (cont)

Notice the XSLT element `if` and its `test` attribute. The value of this attribute is evaluated to either `true()` or `false()` — or a dynamic error happens. If the value is true, then the children of `if` are computed and outputted (here, a comma).

The comma must be written in a **string**, i.e., enclosed in single quotes: `', '`.

The conditional expression is `position() ne last()`. The comparison operator is ne, which means "not equal". The built-in function `position` returns the integer index of the context node in the sequence where it comes from (first node has index 1). Here, the context node corresponds to a `num` element in the sequence of all the children of the element root `numbers`.

XSLT/Conditionals (cont)

If one wants to see the explicit sequence of nodes `num`, suffices to write

```
<xsl:template match="numbers">
  <xsl:apply-templates select="num"/>
</xsl:template>
```

The other built-in function is `last`, which returns the last index of the context node in the original sequence it belongs to.

Thus, a comma is outputted if, and only if, the current number is not the last.

XSLT/Conditionals (cont)

Imagine now that we want

```
18, -1.3, 3, 5, 23.
```

That is to say, we want to terminate the comma-separated list by a period. We would need a `else` element, but it does not exist and a more general construct is needed: we can no longer use `if`.

XSLT/Conditionals (cont)

The solution is now:

```
<xsl:template match="num">
  <xsl:value-of select="text()"/>
  <xsl:choose>
    <xsl:when test="position() ne last()">
      <xsl:value-of select="', '"/>
    </xsl:when>
    <xsl:otherwise>
      <xsl:value-of select="'.'"/>
    </xsl:otherwise>
  </xsl:choose>
</xsl:template>
```

XSLT/Template parameters

Sometimes it is useful that templates be provided parameters.

Imagine that we have a document in XML describing part of the table of contents of a book, with `chapter` and `section` elements. Each chapter and section contains a first child `title`.

We want to output an unordered XHTML list of the chapter and section titles with a twist: the title should be annotated with the depth of the parent chapter or section. Chapters have depth 1, then child sections have depth 2 etc.

XSLT/Template parameters (cont)

An excerpt of the input:

```
<chapter>
  <title>Instances and schemas</title>
  <section>
    <title>Using the instance attributes</title>
  </section>
  <section>
    <title>Schema processing</title>
    <section>
      <title>Validation</title>
    </section>
    <section>
      <title>Augmenting the instance</title>
    </section>
  </section>
</chapter>
```

XSLT/Template parameters (cont)

The corresponding expected result:

- [1] Instances and schemas
  - [2] Using the instance attributes
  - [2] Schema processing
    - [3] Validation
    - [3] Augmenting the instance

XSLT/Template parameters (cont)

We need to pass down the tree the depth, output the titles at this depth (which are all siblings) and apply further templates on the children:

```
<xsl:template match="section|chapter">
  <xsl:param name="depth"/>
  <li xmlns="http://www.w3.org/1999/xhtml">
    <xsl:value-of select="concat('[',$depth,'] ',title)"/>
    <xsl:if test="not(empty(section))">
      <ul><xsl:apply-templates select="section">
            <xsl:with-param name="depth" select="$depth + 1"/>
          </xsl:apply-templates></ul>
    </xsl:if>
  </li>
</xsl:template>
```

XSLT/Template parameters (cont)

Note the new XSLT element `param` and its attribute `name`. It defines a parameter to the template.

The function `concat` takes an arbitrary number of arguments, evaluate them, transform them into strings and join the strings together, in order.

Note that the element `apply-templates` is not empty anymore: it contains a new XSLT element named `with-param`, which carries attributes `name` and `select`. This defines an argument, i.e., a sequence of nodes or basic types passed to the children.

The value of the `name` attribute must be the same as the one defined by the attribute `name` in the called template (with element `param`).

XSLT/Selecting nodes

```
<?xml version="1.0" encoding="UTF-8"?>
<menu>
  <entrees title="Starters">
    <dish id="1" price="8.95">Crab Cakes</dish>
    <dish id="2" price="9.95">Jumbo Prawns</dish>
    <dish id="3" price="10.95">Smoked Salmon</dish>
  </entrees>
  <main title="Main course">
    <dish id="4" price="19.95">Grilled Salmon</dish>
    <dish id="5" price="17.95">Seafood Pasta</dish>
    <dish id="6" price="16.95">Linguini al Pesto</dish>
  </main>
  <desserts title="Sweet End">
    <dish id="7" price="6.95">Dame Blanche</dish>
    <dish id="8" price="5.95">Chocolat Mousse</dish>
  </desserts>
</menu>
```

XSLT/Selecting nodes (cont)

XSLT allows the selection of any node in a sequence by putting the index of the node, following document order, between square brackets or using the `position` function.

For example, to select the third dish in `entrees`:
`"/menu/entrees/dish[3]"` or `/menu/entrees/dish[position() eq 3]`.
Remember that the first node has always index 1.

This kind of notation is a special case of **predicate**, which we shall study more in detail later.

Exercise. Propose a transformation that prints `Today's menu` followed by the third *entree*, the first main dish and the last dessert, on different lines and preceded by a dash.

XSLT/Selecting attributes

Let us say that the dessert of day is the second on the menu page 140 and that we want to know its price. This information is stored as an attribute node, not as a text node, so we need a special construct @ as in the transformation

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="menu">
     Dessert of the Day:
     <xsl:value-of select="desserts/dish[2]" />
     Price: <xsl:value-of select="desserts/dish[2]/@price" />
  </xsl:template>
</xsl:transform>
```

XSLT/Selecting attributes (cont)

The result is

```
Dessert of the Day:
Chocolat Mousse
Price: 5.95
```

Note that attributes of a given element must have different names, so selecting `"@foo"` results either in one or no attribute.

XSLT/Using wildcards

Wildcards can be used to select nodes whose names do not matter, e.g.,

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="menu">
     Dessert of the Day:
     <xsl:value-of select="*[3]/dish[2]" />
     Price: <xsl:value-of select="*[3]/dish[2]/@*[2]" />
  </xsl:template>
</xsl:transform>
```

gives the same result as the transform page 142.

XSLT/Location paths

A **location path** contains **test nodes** and, optionally, **predicates**. For example,

```
/menu/*[3]/dish[2]/@*[2]
```

is a location path; `menu`, `*`, `dish` and `@*` are node tests and `[3]` and `[2]` are predicates.

XSLT/*n*-th node

Let us try to select the sixth dish in the document using the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="menu">
    -<xsl:value-of select="*/dish[6]"/> </xsl:template>
</xsl:transform>
```

The output contains no dishes! Why? Because `value-of` select no element... Indeed, the location path `*/dish[6]` does **not** yield the sixth dish node in the menu but, instead, the first dish in the menu which is the sixth child of any parent.

XSLT/*n*-th node (cont)

In other words, the expression `*/dish[6]` actually means `*/(dish[6])`, i.e. the sixth element in all parent contexts which are children of the `menu` element, thus there is no matched node. What we want is `(*/dish)[6]`, as in the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="menu">
    -<xsl:value-of select="(*/dish)[6]"/>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting elements (cont)

Consider two documents with the same content but different structure:

```
<?xml version="1.0" encoding="UTF-8"?>
<cars>
  <car model="Matiz" manufacturer="Daewoo"/>
  <car model="Sonata" manufacturer="Hyundai"/>
</cars>
```

and

```
<?xml version="1.0" encoding="UTF-8"?>
<cars>
  <car>
    <model>Matiz</model><manufacturer>Daewoo</manufacturer>
  </car>
  <car>
    <model>Sonata</model><manufacturer>Hyundai</manufacturer>
  </car>
</cars>
```

XSLT/Inserting elements (cont)

Using the same technique, we can make a transform that converts the first car list, i.e. using attributes, into the second one, i.e. using elements. Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>

  <xsl:template match="cars">
    <cars>
      <xsl:apply-templates/>
    </cars>
  </xsl:template>
```

XSLT/Inserting elements (cont)

```
<xsl:template match="car">
  <car>
    <xsl:apply-templates select="attribute()"/>
  </car>
</xsl:template>

<xsl:template match="@model">
  <model>
    <xsl:value-of select="."/>
  </model>
</xsl:template>
```

XSLT/Inserting elements (cont)

```
  <xsl:template match="@manufacturer">
    <manufacturer>
      <xsl:value-of select="." />
    </manufacturer>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting elements (cont)

Notice the XSLT element `value-of` when matching an attribute:

```
<xsl:template match="@model">
  ... <xsl:value-of select="."/> ...
</xsl:template>
```

Selecting `"."` is the only way to get the attribute value, in particular `text()` does not work because attributes are different from elements.

For instance, the empty transformation does not print the attribute values because they are considered different from text nodes.

XSLT/Inserting elements (cont)

Applying it to the first car list page 148 yields

```
<?xml version="1.0" encoding="UTF-8"?>
<cars>
  <car>
      <model>Matiz</model>
      <manufacturer>Daewoo</manufacturer>
   </car>
  <car>
      <model>Sonata</model>
      <manufacturer>Hyundai</manufacturer>
   </car>
</cars>
```

which is exactly the second car list (same page).

XSLT/Inserting elements (cont)

The name of the inserted elements was until now written in the transform, but it is possible to insert elements whose names are made at run-time. Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="cars">
    <models><xsl:apply-templates/></models>
  </xsl:template>
  <xsl:template match="car">
    <xsl:element name="{@manufacturer}">
      <xsl:value-of select="@model"/>
    </xsl:element> </xsl:template>
</xsl:transform>
```

XSLT/Inserting elements (cont)

Notice that element `<xsl:element name="td">Matiz</xsl:element>` is equivalent to `<td>Matiz</td>`. Also, remember the braces around `@manufacturer` to select the attribute **value**: `{@manufacturer}`.

Then, the result of applying it to the first car list page 148 yields

```
<?xml version="1.0" encoding="UTF-8"?>
<models>
  <Daewoo>Matiz</Daewoo>
  <Hyundai>Sonata</Hyundai>
</models>
```

XSLT/Inserting elements (cont)

In the transform page 149 we had a template for each attribute (`model` and `manufacturer`).

It would be better to have only one template for all the attributes, since we process them in the same way, i.e., insert in the output an element with the same name as the attribute and with a text node whose contents is the same as the attribute value.

We need a function named `name` which returns the name of the context node when called as `name()`.

XSLT/Inserting elements (cont)

Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="cars">
    <cars><xsl:apply-templates/></cars></xsl:template>
  <xsl:template match="car">
    <car><xsl:apply-templates select="attribute()"/></car>
  </xsl:template>
  <xsl:template match="attribute()">
    <xsl:element name="{name()}">
      <xsl:value-of select="."/>
    </xsl:element>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting elements (cont)

Applying it to the first car list page 148 yields the second car list:

```
<?xml version="1.0" encoding="UTF-8"?>
<cars>
  <car>
      <model>Matiz</model>
      <manufacturer>Daewoo</manufacturer>
   </car>
  <car>
      <model>Sonata</model>
      <manufacturer>Hyundai</manufacturer>
   </car>
</cars>
```

XSLT/Inserting elements (cont)

We can even generalize the transform and make it work on any kind of document, by converting every attribute into an element of the same name. Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="element()">
    <xsl:element name="{name()}">
      <xsl:apply-templates select="element()|attribute()"/>
    </xsl:element>
  </xsl:template>
  <xsl:template match="attribute()">
    <xsl:element name="{name()}">
      <xsl:value-of select="."/>
    </xsl:element>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting elements (cont)

Apply it to the first car list page 148 yields the second car list again:

```
<?xml version="1.0" encoding="UTF-8"?>
<cars>
   <car>
      <model>Matiz</model>
      <manufacturer>Daewoo</manufacturer>
   </car>
   <car>
      <model>Sonata</model>
      <manufacturer>Hyundai</manufacturer>
   </car>
</cars>
```

XSLT/Inserting attributes

Inserting attributes is akin to inserting elements. Consider the straightforward

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="cars">
    <table border="1" width="500">
      <xsl:apply-templates/>
    </table>
  </xsl:template>
  <xsl:template match="car">
    <tr bgcolor="#dddddd">
      <xsl:apply-templates select="attribute()"/>
    </tr>
  </xsl:template>
  <xsl:template match="attribute()">
    <td> <xsl:value-of select="."/> </td>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting attributes (cont)

Instead of writing

```
<xsl:template match="car">
  <tr bgcolor="#dddddd">
    <xsl:apply-templates select="attribute()"/>
  </tr>
</xsl:template>
```

one can write

```
<xsl:template match="car">
  <tr>
    <xsl:attribute name="bgcolor">#dddddd</xsl:attribute>
    <xsl:apply-templates select="attribute()"/>
  </tr>
</xsl:template>
```

XSLT/Inserting attributes (cont)

Converting the second car list to the first one is thus achieved by the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="cars">
    <cars><xsl:apply-templates/></cars> </xsl:template>
  <xsl:template match="car">
    <car><xsl:apply-templates/></car> </xsl:template>
  <xsl:template match="element()">
    <xsl:attribute name="{name()}">
      <xsl:value-of select="text()" />
    </xsl:attribute>
  </xsl:template>
</xsl:transform>
```

XSLT/Inserting attributes (cont)

Note that the last template matches `"element()"`, which means, in general, “any element node.”

The XSLT processor always select the first template matching the current node (element or attribute) most precisely, so templates must be ordered carefully.

Therefore, here, the template matching `element()` will match any element node whose name is neither `car` nor `cars`, because of the two first templates.

XSLT/Copying elements

Sometimes one wants to copy an element from the source document to the output.

One way is the so-called **shallow copy**, i.e. the *context node and its text nodes* are copied but neither the children element nodes nor the attribute nodes:

```
<xsl:copy> ... </xsl:copy>
```

or

```
<xsl:copy/>
```

In the latter, the context node is copied without modification, whilst, in the former, attributes and children elements can be added.

XSLT/Copying elements (cont)

Consider the simple template

```
<xsl:template match="car">
  <xsl:copy/>
</xsl:template>
```

When matching

```
<car>
  <model>Matiz</model>
  <manufacturer>Daewoo</manufacturer>
</car>
```

produces

```
<car/>
```

XSLT/Copying elements (cont)

Consider the template

```
<xsl:template match="car">
  <xsl:copy>
    <xsl:attribute name="model">Matiz</xsl:attribute>
    <xsl:attribute name="manufacturer">Daewoo</xsl:attribute>
  </xsl:copy>
</xsl:template>
```

which, when matching the same element, now produces

```
<car model="Matiz" manufacturer="Daewoo">
```

XSLT/Copying elements (cont)

There is a way to copy the node and the whole subtree below it by using the XSLT element `copy-of`. Consider

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:template match="cars">
  <xsl:copy-of select="."/>
</xsl:template>
</xsl:transform>
```

When applied to either the car lists page 148 yields the same document.

XSLT/Copying elements (cont)

If the selection in the `copy-of` element is a node set, *all the nodes and their subtrees will be copied verbatim to the output*. For example, the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:template match="cars">
    <xsl:copy>
      <xsl:copy-of select="car[1]|car[2]"/>
    </xsl:copy>
  </xsl:template>
</xsl:transform>
```

will also entirely copy the car list to the output.

XSLT/Copying elements (cont)

It is often useful to copy verbatim the source document *except some parts*. To achieve this, we cannot use `copy-of`. So, first, we need to define an identity transform and then modify it to take into account some exceptions. First try

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="element()">
    <xsl:copy>
      <xsl:apply-templates select="node()"/>
    </xsl:copy>
  </xsl:template>
</xsl:transform>
```

XSLT/Copying elements (cont)

Notice the function `node` whose call `"node()"`, allows the selection of the child element **and** child text nodes. (`"element()"` would select only the child element nodes, `"text()"` only the child text nodes, and `"."` the context node.)

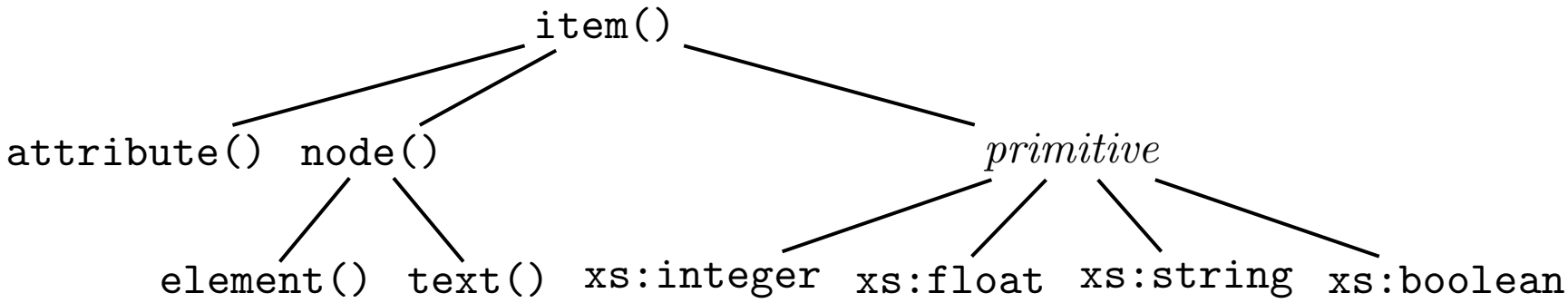
When applied to the second car list page 148, we get the same document, but when applied to the first car list (same page) it yields

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

because `"node()"` does not match/select attribute nodes.

XSLT/Copying elements (cont)

The relationship between the different tests or types can be summarised in a tree:



This means, for example, that a node is either an element or a text node. The items are the most general data type in XSLT.

XSLT/Copying elements (cont)

Indeed, the previous transform is equivalent to the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="element()">
    <xsl:copy>
      <xsl:apply-templates select="element()|text()"/>
    </xsl:copy>
  </xsl:template>
</xsl:transform>
```

XSLT/Copying elements (cont)

The way to extend our identity transform to include attributes is to match any attribute and, after matching an element node, to select any of its attributes. The identity transform is therefore

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="node()|attribute()">
    <xsl:copy>
      <xsl:apply-templates select="node()|attribute()"/>
    </xsl:copy>
  </xsl:template>
</xsl:transform>
```

XSLT/Copying elements (cont)

Now it is easy to override the identity template by adding new templates which are more precise, like matching a specific element name:

```
<xsl:template match="broken">
   <fixed>
     <xsl:apply-templates select="node()|attribute()"/>
   </fixed>
</xsl:template>
```

Now, all the elements will be copied verbatim, as well as the attributes, *except* elements named `broken`, which will be changed into `fixed`.

XSLT/Copying elements/Importing stylesheets

The typical idiom for copying with modification is to import the identity stylesheet and then add new templates which override the corresponding templates in the imported stylesheet:

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:import href="identity.xsl"/>
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="broken">
    <fixed>
      <xsl:apply-templates select="node()|attribute()"/>
    </fixed>
  </xsl:template>
</xsl:transform>
```

XSLT/Copying elements (cont)

There is an alternative identity transform, using `copy-of` for the attributes only, thus allowing to be extended to handle special cases for element nodes:

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <xsl:template match="node()">
    <xsl:copy>
      <xsl:copy-of select="attribute()"/>
      <xsl:apply-templates/>
    </xsl:copy>
  </xsl:template>
</xsl:transform>
```

XSLT/Functions

It is possible to define functions in XSLT.
As an example, consider the need to debug a transform. The usual technique consists in using an XSLT element `message`, as in

```
<xsl:message>This is a debug message.</xsl:message>
```

One may print the value of attributes or text nodes:

```
<xsl:message>
  Price: <xsl:value-of select="@price"/>
</xsl:message>
```

What if the programmer wants to know the names of all the elements in a sequence? She needs a function!

XSLT/Functions/Namespace

The first thing to do, when defining or using functions is to declare the namespace to which they belong. For the purpose of this simple example, let us imagine that the namespace is named `my`, at a dummy URL:

```
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
               xmlns:my="file://functions.uri">
```

A name must be found. For instance, `my:names`. Note and remember that **the function name contains the namespace**. The definition is made in the XSLT element `function`:

```
<xsl:function name="my:names">
...
</xsl:function>
```

XSLT/Functions/Parameters

The function here takes one argument, the sequence of nodes, so we need to declare a parameter. This is the purpose of the XSLT element `param`:

```
<xsl:function name="my:names">
  <xsl:param name="nodes"/>
...
</xsl:function>
```

As usual in other programming languages, the parameter must be named.
If a function requires more parameters, other `param` elements are added.
The order is significant.

XSLT/Functions/Recursivity

We need to write a recursive function, because it needs to access all the nodes in a sequence. The idea is to check first whether the sequence is empty or not. If empty, do nothing. Otherwise, print the name of the first node and call again the function on the remaining ones (maybe none, it does not matter at that moment):

```
<xsl:function name="my:names">
  <xsl:param name="nodes"/>
  <xsl:if test="not(empty($nodes))">
    <xsl:value-of select="(name($nodes[1]),
                           my:names($nodes[position()>1]))"/>
  </xsl:if>
</xsl:function>
```

XSLT/Sequences revisited

Remark the notation in the `select` attribute `(... , ...)`. It means "Create a sequence by appending the first sequence to the second sequence." This operation is called **concatenation**.

Here `my:names($nodes[position()>1])` is a sequence of names, possibly empty. If empty, it disappear from the concatenation, e.g., `(1,(),2) eq (1,2)`.

Here, also, `name($nodes[1])` is a sequence of one element, because there is no difference, in XSLT, between a sequence of one and the item itself.

The concatenation is flat, so `((1,2,3),(4,5,(6,7),8,9,10))` is the same as `(1,2,3,4,5,6,7,8,9,10)`. The built-in function `empty` tests if a sequence is empty, e.g., `empty($seq)`.

XSLT/Named templates

It is possible to call a template by name instead of it being applied when matching an element. Consider the transform

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="car">
    <xsl:call-template name="the_car"/>
  </xsl:template>
  <xsl:template name="the_car">
    Manufacturer: <xsl:value-of select="@manufacturer" />
    Model:        <xsl:value-of select="@model" />
  </xsl:template>
</xsl:transform>
```

XSLT/Named templates (cont)

Named template and matching templates never interfere with each other. For example, the name can be the same as an element name, as in

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="car">
    <xsl:call-template name="car"/>
  </xsl:template>
  <xsl:template name="car">
    Manufacturer: <xsl:value-of select="@manufacturer" />
    Model:        <xsl:value-of select="@model" />
  </xsl:template>
</xsl:transform>
```

XSLT/Modes

It is sometimes useful to traverse the same document several times and match the same elements in a different way each time. This can be done using templates with modes.

One needs to define a template element with a `match` attribute and a `mode` attribute. The value of the latter can be any string with the condition that two templates with the same `match` attribute value have a different `mode` attribute value.

XSLT/Modes (cont)

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:transform version="2.0"
               xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text"/>
  <xsl:template match="/">
    <xsl:text>INDEX</xsl:text>
    <xsl:apply-templates mode="index"/>
    <xsl:text>INFO</xsl:text>
      <xsl:apply-templates mode="info"/>
  </xsl:template>
```

XSLT/Modes (cont)

```
  <xsl:template match="car" mode="index">
    <xsl:value-of select="@model" />
  </xsl:template>
  <xsl:template match="car" mode="info">
    <xsl:text>Model: </xsl:text>
    <xsl:value-of select="@model" />
    <xsl:text>, Manufacturer: </xsl:text>
    <xsl:value-of select="@manufacturer"/>
  </xsl:template>
</xsl:transform>
```

XSLT/Modes (cont)

The result of applying it to the first car list page 148 is

```
INDEX
  Matiz
  Sonata
INFO
  Model: Matiz, Manufacturer: Daewoo
  Model: Sonata, Manufacturer: Hyundai
```

Notice the two different runs on the input, distinguished by two different outputs in sequence.