XSLT

Web Data Management and Distribution

Serge Abiteboul Ioana Manolescu Philippe Rigaux
Marie-Christine Rousset Pierre Senellart

Web Data Management and Distribution
http://webdam.inria.fr/textbook

March 20, 2013

What is XSLT?

XSLT = a specialized language for transforming an XML document into another XML document.

Main principles:

- An XSLT program, or stylesheet, consists of rules, or templates.
- A template applies to a specific kind of node of the input document, and produces a fragment of the output document.
  - by creating literal nodes,
  - by copying values and fragments from the input document,
  - by instantiating (= calling) other templates.
- Execution model: initially, a template is applied to the root node of the input document
  $\Rightarrow$ this first template may initiate a traversal of the input document.

Remark

An XSLT stylesheet is an XML document! XSLT element names are prefixed by (typically) `xsl:` that refers to the XSLT namespace.

A Hello World! Stylesheet

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

<xsl:stylesheet
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  version="1.0">

  <xsl:output method="xml" encoding="utf-8" />

  <xsl:template match="/">
    <hello>world</hello>
  </xsl:template>

</xsl:stylesheet>
```

General structure of a stylesheet:

- A top-level `<xsl:stylesheet>` element
- Some declarations (all elements except `<xsl:template>` ones)
- Some template rules, in this case a template that applies to the root node.

Invocation of an XSLT Stylesheet

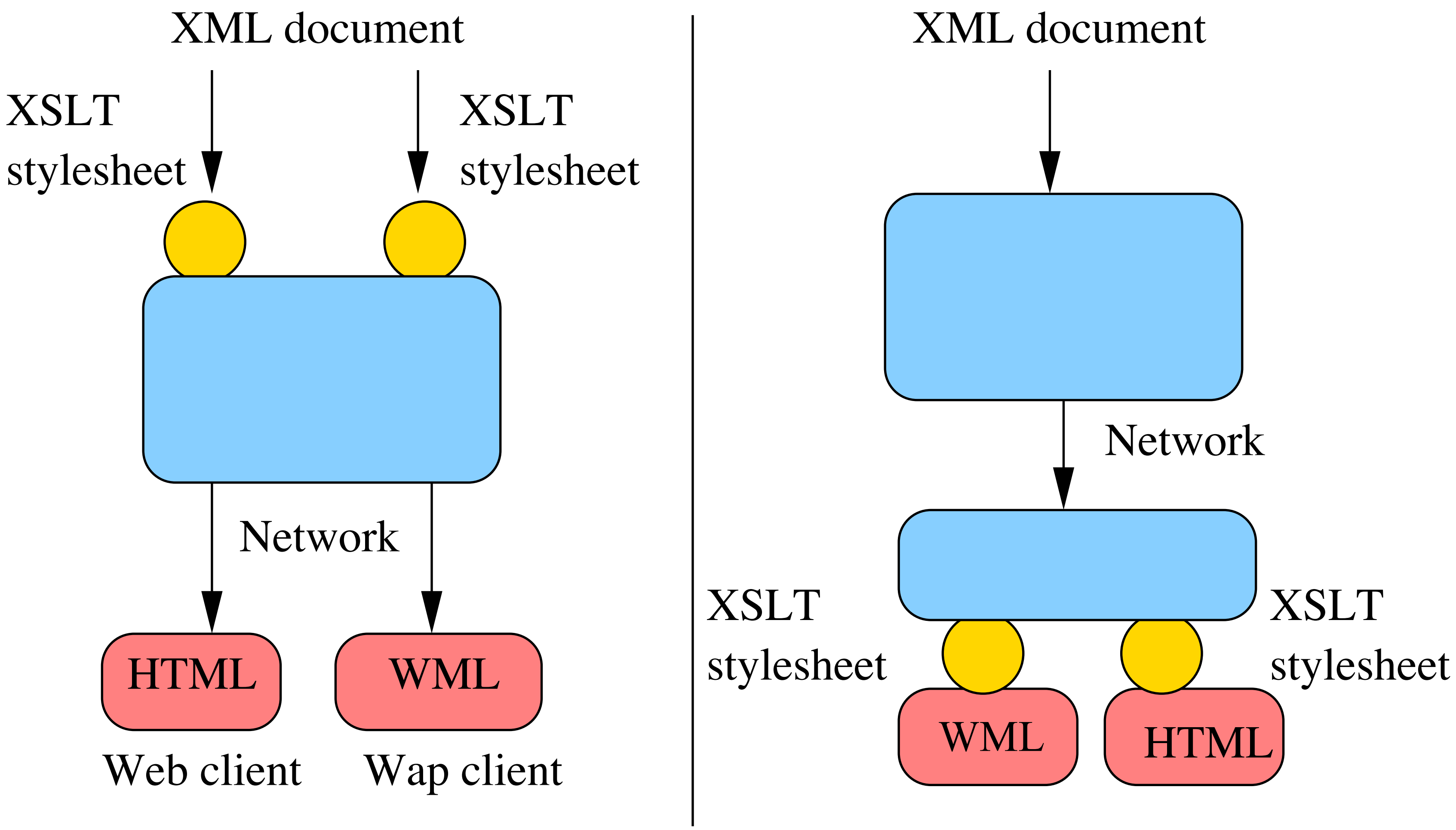
An XSLT stylesheet may be invoked:

- Programmatically, through one of the various XSLT libraries.
- Through a command line interface.
- In a Web Publishing context, by including a styling processing instruction in the XML document

```
<?xml-stylesheet
  href="toto.xsl" type="text/xsl" ?>

<doc>
  <titi />
</doc>
```

  - the transformation can be processed on the server side by a CGI, PHP, ASP, JSP... script
  - or on the client side through the XSLT engines integrated to most browsers.

Web Publishing with XSLT



The `<xsl:template>` Element

```
<xsl:template  match="book">
  The book title is:
     <xsl:value-of select="title" />

   <h2>Authors list</h2>
    <ul>
      <xsl:apply-templates select="authors/name" />
    </ul>
</xsl:template>
```

A template consists of

A pattern: an XPath expression (restricted) which determines the node to which the template applies.
The pattern is the value of the `match` attribute.

A body: an XML fragment (well-formed!) which is inserted in the output document when the template is instantiated.

XPath patterns in XSLT

The role of the XPath expression of the `match` attribute is quite specific: it describes the nodes which can be the target of a template instantiation. Those expressions are called patterns. They must comply to the following requirements

- A pattern always denotes a node set.
  Example: `<xsl:template match='1'>` is incorrect.
- It must be easy to decide whether a node is denoted or not by a pattern.
  Example: `<xsl:template match='preceding::*[12]'>` is meaningful, but quite difficult to evaluate.

Patterns syntax

A pattern is a valid XPath expression which uses only the `child` and `@` axes, and the abbreviation `//`. Predicates are allowed.

Pattern examples

Recall: a pattern is interpreted as the nodes to which a template applies.

- `<xsl:template match='B'>`
  applies to any `B` element.
- `<xsl:template match='A/B'>`
  applies to any `B` element, child of an `A` element.
- `<xsl:template match='@att1'>`
  applies to any `att1` attribute, whatever its parent element.
- `<xsl:template match='A//@att1'>`
  applies to any `att1` attribute, if its parent element is a descendant of an `A` element.

General rule

Given an XML tree T, a pattern P matches a node N if there exists a node C (the context node) in T such that $N \in P(T, C)$.

Content of a template body

Basically, the content of `<xsl:template>` may consist of:

- Literal elements and text.
  Example: `<h2>Authors</h2>`. This creates in the output document an element `h2`, with a **Text** child node 'Authors'.
- Values and elements from the input document.
  Example: `<xsl:value-of select='title'/>`. This inserts in the output document a node set, result of the XPath expression `title`.
- Call to other templates.
  Example: `<xsl:apply-templates select='authors'/>`. Applies a template to each node in the node set result of the XPath expression `authors`.

Remark

Only the basic of XSLT programming! Many advanced features (modes, priorities, loops and tests) beyond this core description.

The `xsl:apply-templates` element

```
<xsl:apply-templates select="authors/name" />
```

select	an XPath expression which, if relative, is interpreted with respect to the context node, Note: the default value is `child::node()`, i.e., select all the children of the context node
mode	a label which can be used to specify which kind of template is required.

The execution model of XSLT

An XSLT stylesheet consists of a set of templates. The transformation of an input document *I* proceeds as follows:

1. The engine considers the root node *R* of *I*, and selects the template that applies to *R*.
2. The template body is copied in the output document *O*.
3. Next, the engine considers all the `<xsl:apply-templates>` that have been copied in *O*, and evaluate the `select` XPath expression, taking *R* as context node.
4. For each node result of the XPath evaluation, a template is selected, and its body replaces the `<xsl:apply-templates>` call.
5. The process iterates, as new `<xsl:apply-templates>` may have been inserted in *O*.
6. The transform terminates when *O* is free of `xsl:` instructions.

The `xsl:apply-templates` mechanism

```
<xsl:template match="book">
  <ul><xsl:apply-templates
           select="authors/name" /></ul>
</xsl:template>

<xsl:template match="name">
  <li><xsl:value-of select="." /></li>
</xsl:template>
```

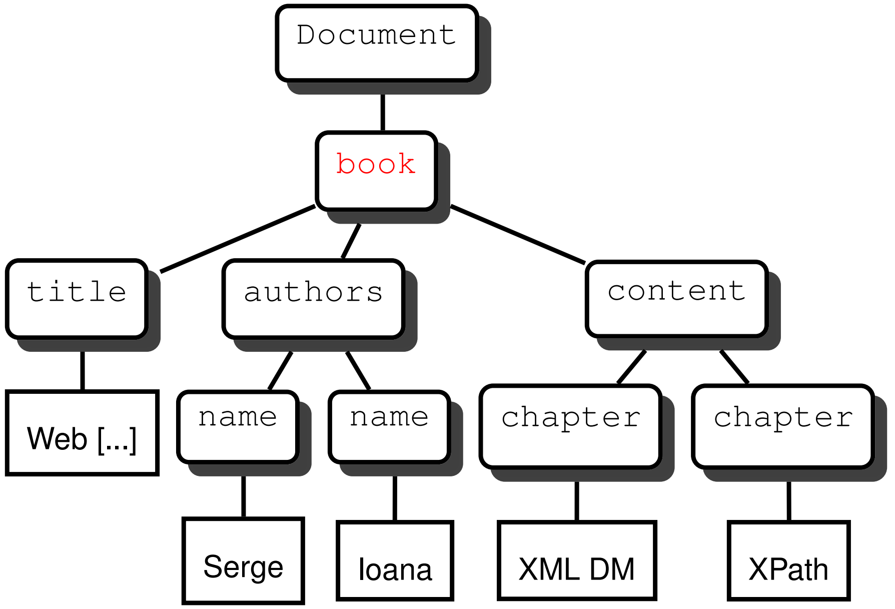
```
<book>
...
 <authors>
  <name>Serge</name>
  <name>Ioana</name>
 </authors>
</book>
```

$\longrightarrow$

```
<ul>
  <li>Serge</li>
  <li>Ioana</li>
</ul>
```

The input document in serialized and tree forms

```
<?xml version="1.0"
    encoding="utf-8"?>
<book>
  <title>Web [...]</title>
  <authors>
    <name>Serge</name>
    <name>Ioana</name>
  </authors>
  <content>
    <chapter id="1">
      XML data model
    </chapter>
    <chapter id="2">
     XPath
    </chapter>
  </content>
</book>
```



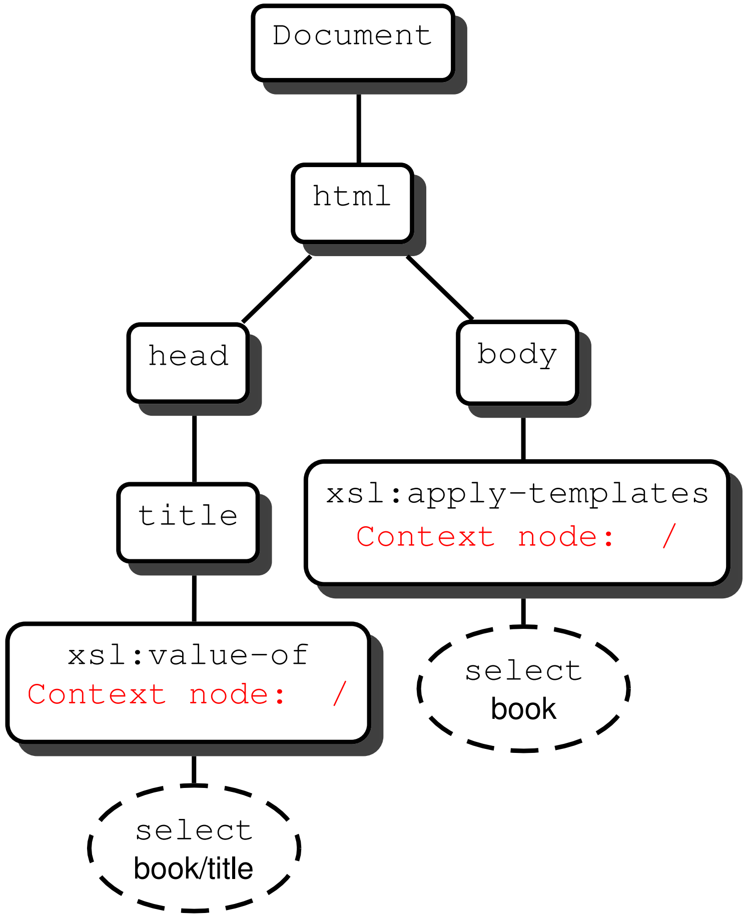
The XSLT template that matches the root node

```
<xsl:template match="/">
 <html>
   <head>
     <title>
      <xsl:value-of select="/book/title"/>
     </title>
    </head>
    <body bgcolor="white">

     <xsl:apply-templates select="book"/>

    </body>
  </html>
</xsl:template>
```

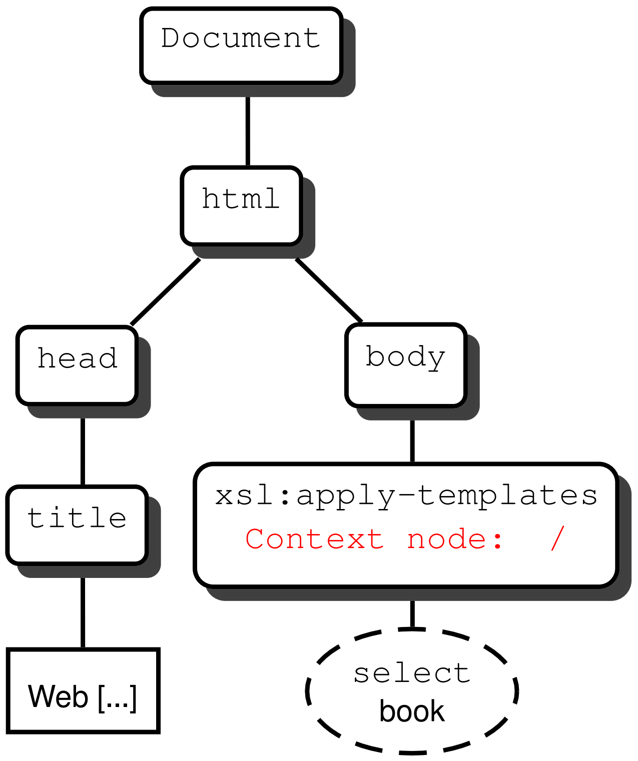
Remark

Typical of Web publishing templates.

The output document after instantiating the template



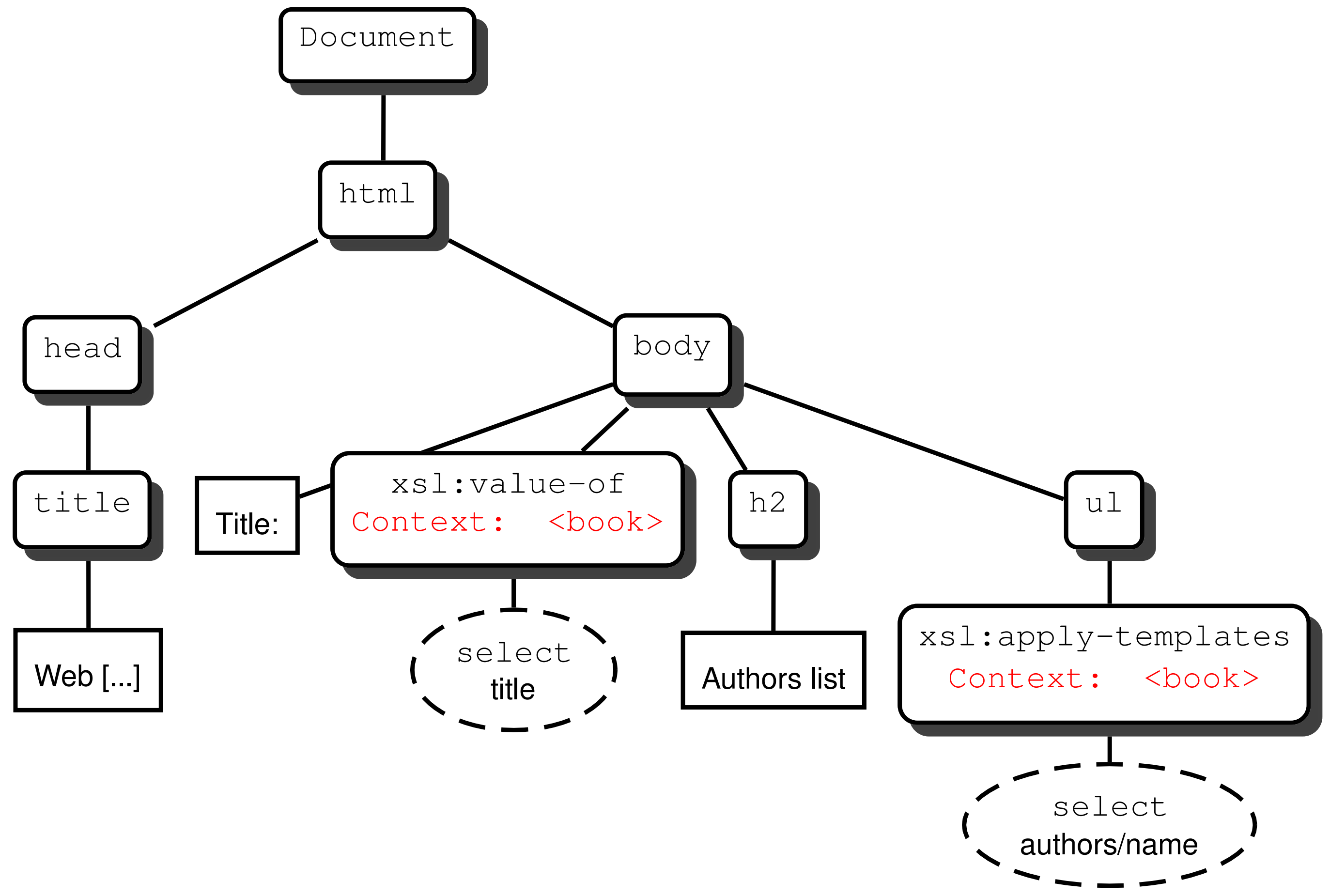
The output document after evaluation of `<xsl:value-of>`



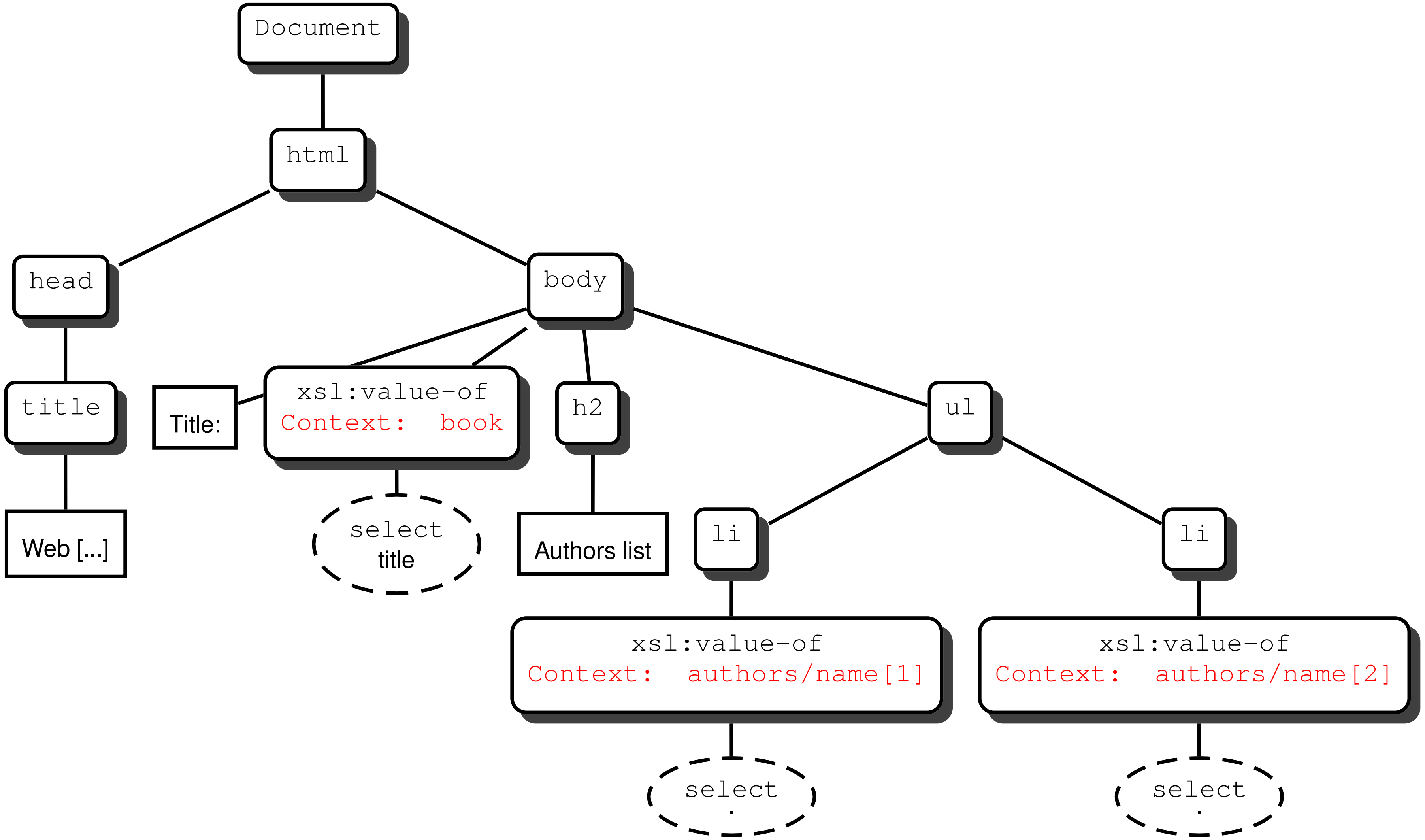
The remaining templates

```
<xsl:template  match="book">
  Title:
     <xsl:value-of select="title" />

   <h2>Authors list</h2>
    <ul>
      <xsl:apply-templates select="authors/name" />
    </ul>
</xsl:template>

<xsl:template match="authors/name">
 <li><xsl:value-of select="."/></li>
</xsl:template>
```

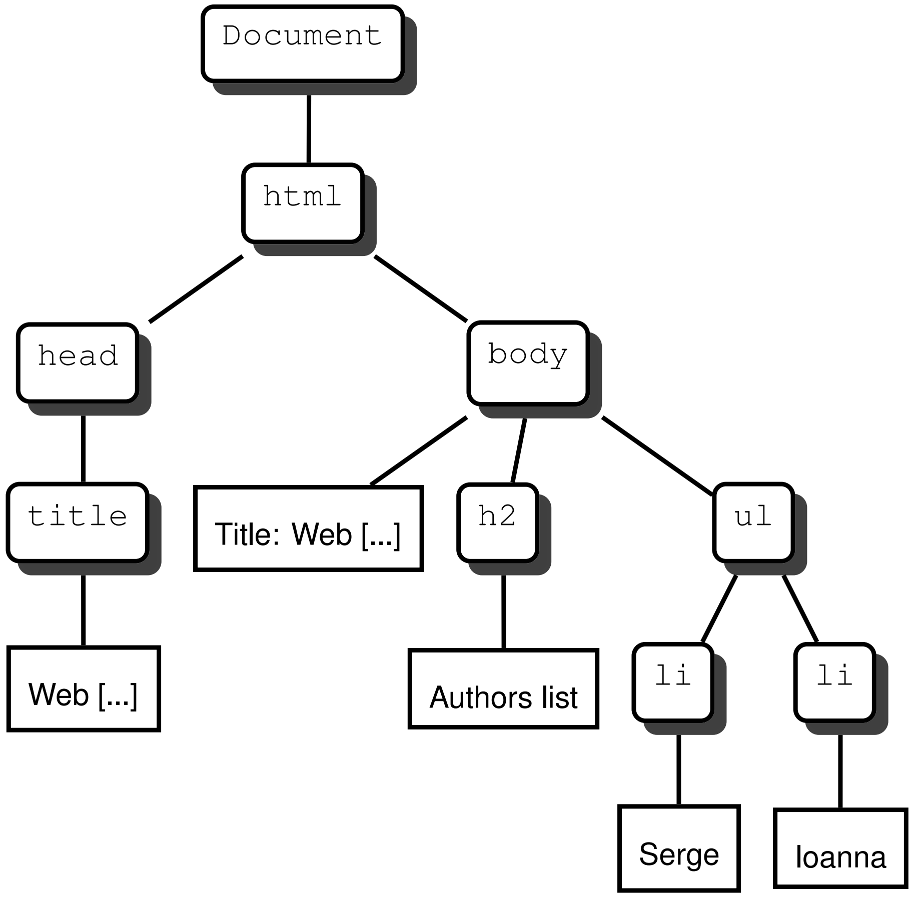
The `<book>` element is selected ⇒ the book template is instantiated



The `authors/name` template is instantiated twice, one for each author



The final output document



Importing Stylesheets

```
<xsl:import href="lib_templates.xsl" />
```

Templates are imported this way from another stylesheet. Their precedence is less that that of the local templates.
`<xsl:import>` must be the first declaration of the stylesheet.

```
<xsl:include href="lib_templates.xsl" />
```

Templates are included from another stylesheet. No precedence rule: works as if the included templates were local ones.

Template Rule Conflicts

- Rules from imported stylesheets are overridden by rules of the stylesheet which imports them.
- Rules with highest priority (as specified by the `priority` attribute of `<xsl:template>`) prevail. If no priority is specified on a template rule, a default priority is assigned according to the specificity of the XPath expression (the more specific, the highest).
- If there are still conflicts, it is an error.
- If no rules apply for the node currently processed (the document node at the start, or the nodes selected by a `<xsl:apply-templates>` instruction), built-in rules are applied.

Built-in templates

- A first built-in rule applies to the **Element** nodes and to the root node:

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

  Interpretation: recursive call to the children of the context node.

- Second built-in rule: applies to **Attribute** and **Text** nodes.

```
<xsl:template match="@*|text()">
  <xsl:value-of select="." />
</xsl:template>
```

  Interpretation: copy the textual value of the context node to the output document.

Exercise: what happens when an empty stylesheet is applied to an XML document?

Named templates

```
<xsl:template name="print">
  <xsl:value-of select="position()"/>:
     <xsl:value-of select="."/>
</xsl:template>

<xsl:template match="*">
 <xsl:call-template name="print"/>
</xsl:template>

<xsl:template match="text()">
 <xsl:call-template name="print"/>
</xsl:template>
```

Named templates play a role analogous to functions in traditional programming languages.

Remark

A call to a named template does not change the context node.

Conditional Constructs: `<xsl:if>`

```
<xsl:template match="Movie">
  <xsl:if test="year &lt; 1970">
    <xsl:copy-of select="."/>
  </xsl:if>
</xsl:template>
```

`<xsl:copy-of>` makes a deep copy of a node set; `<xsl:copy>` copies the nodes without their descendant.

Remark

- An XSLT program is an XML document: we must use entities for $<$ and &.
- XSLT is closely associated to XPath (node select, node matching, and here data manipulation)

Conditional Constructs: `<xsl:choose>`

```
<xsl:choose>
  <xsl:when test="$year mod 4">no</xsl:when>
  <xsl:when test="$year mod 100">yes</xsl:when>
  <xsl:when test="$year mod 400">no</xsl:when>
  <xsl:otherwise>yes</xsl:otherwise>
</xsl:choose>

<xsl:value-of select="count(a)"/>
<xsl:text> item</xsl:text>
<xsl:if test="count(a)>1">s</xsl:if>
```

`<xsl:otherwise>` is optional. There can be any number of `<xsl:when>` , only the content of the first matching one will be processed.

Loops

`<xsl:for-each>` is an instruction for looping over a set of nodes.
It is more or less an alternative to the use of
`<xsl:template>` / `<xsl:apply-templates>` .

- The set of nodes is obtained with an XPath expression (attribute `select`);
- Each node of the set becomes in turn the context node (which temporarily replaces the template context node).
- The body of `<xsl:for-each>` is instantiated for each context node.

$\Rightarrow$ no need to call another template: somewhat simpler to read, and likely to be more efficient.

The `<xsl:for-each>` element

Example (`<xsl:sort>` is optional):

```
<xsl:template match="person">
[...]
  <xsl:for-each select="child">
    <xsl:sort select="@age" order="ascending"
                  data-type="number"/>

    <xsl:value-of select="name" />
    <xsl:text> is </xsl:text>
    <xsl:value-of select="@age" />
</xsl:for-each>
[...]
</xsl:template>
```

`<xsl:sort>` may also be used as a direct child of an `<xsl:apply-templates>` element.