

XSLT

Web Data Management and Distribution

Serge Abiteboul Philippe Rigaux
Marie-Christine Rousset Pierre Senellart

<http://gemo.futurs.inria.fr/wdmd>

January 15, 2010

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
⇒ 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 `xs1:`, the XSLT namespace.

A Hello World! Stylesheet

```
<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, with a `version="1.0"` attribute.
- Some **declarations** (all elements except `<xsl:template>` ones), in this case just a `<xsl:output>` one.
- 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:

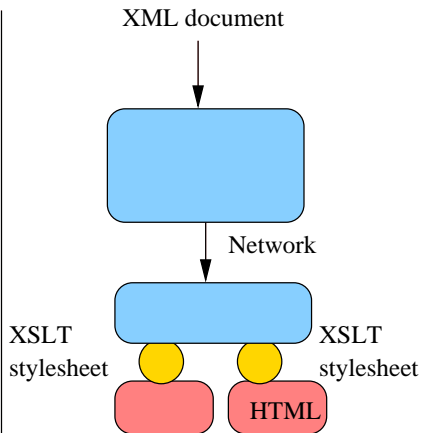
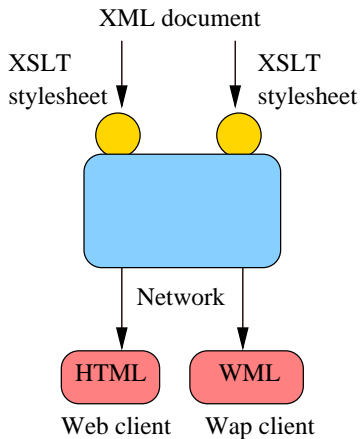
- **Programmatically**, through one of the various XSLT libraries.
- Through a **command line** interface.
- In a Web Publishing context, by including a styling processing instruction in the XML document

```
<?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.

Instantiation of a `<xsl:template>`

Main principles:

- **Literal elements** (those that don't belong to the XSLT namespace) and **text** are simply copied to the output document.
- **Context node**: A template is always instantiated in the context of a node from the input document.
- **XPath expressions**: all the (relative) XPath expression found in the template are evaluated with respect to the context node (an exception: `<xsl:for-each>`).
- **Calls with `xsl:apply-templates`**: find and instantiate a template for each node selected by the XPath expression `select`.
- **Template call substitution**: any call to other templates is eventually replaced by the instantiation of these templates.

The `xsl:apply-templates` element

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

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 `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>

```

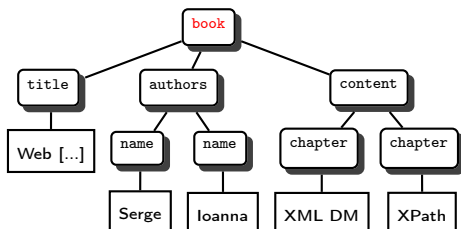


```

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

```

Combined templates instantiation



```

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

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

→

```

Title:  Web[...]

<h2>Authors</h2>
  <ul>
    <li>Serge</li>
    <li>Ioanna</li>
  </ul>
  
```

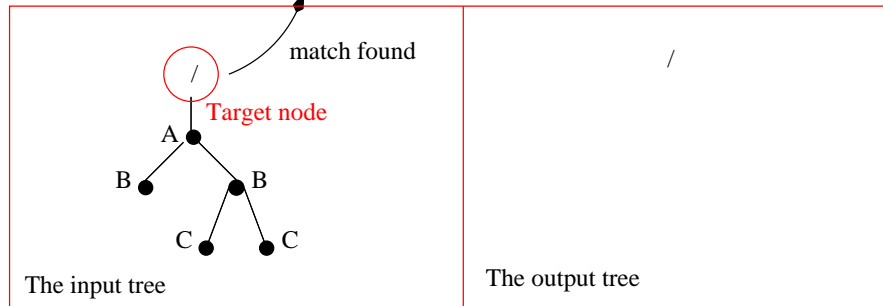
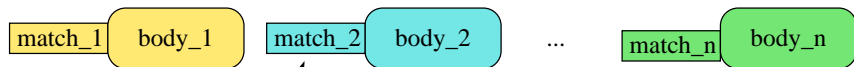
The execution model of XSLT

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.

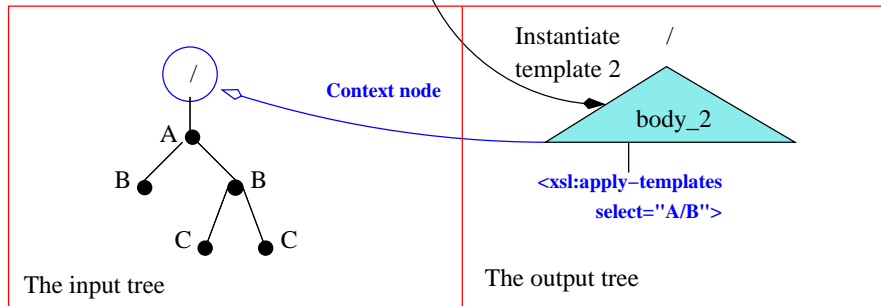
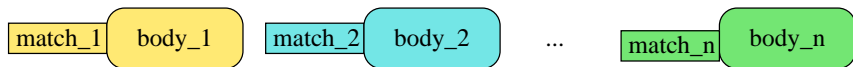
The execution model: illustration

The templates list



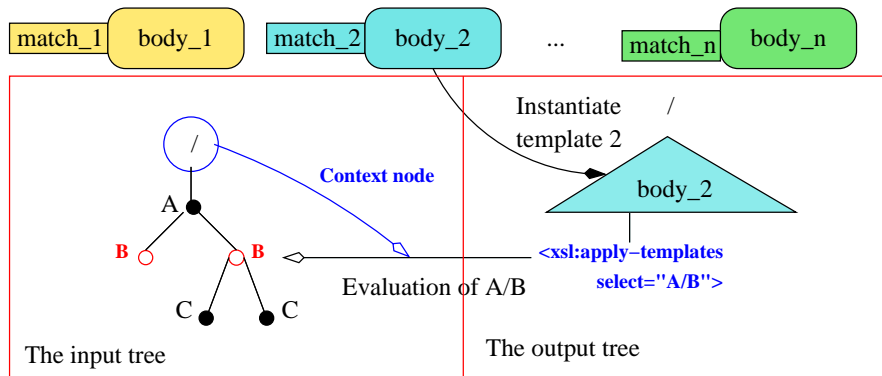
The execution model: illustration

The templates list



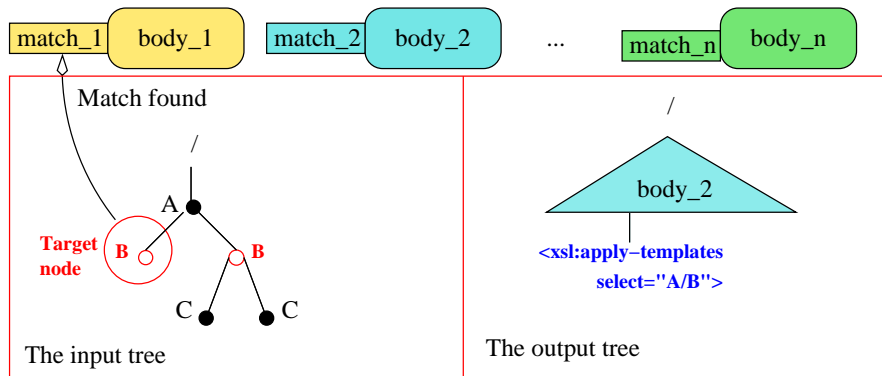
The execution model: illustration

The templates list



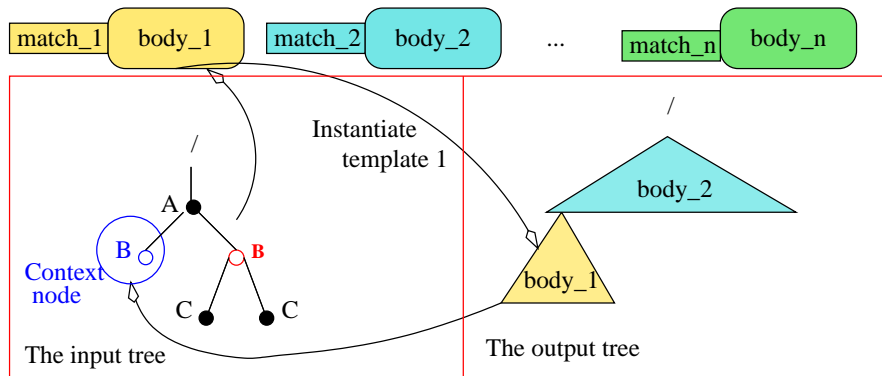
The execution model: illustration

The templates list



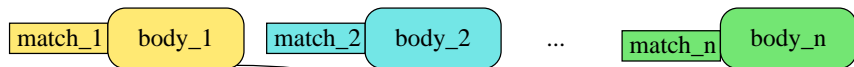
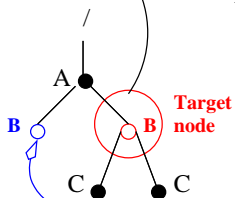
The execution model: illustration

The templates list

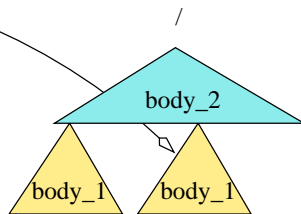


The execution model: illustration

The templates list

Instantiate
template 1

The input tree



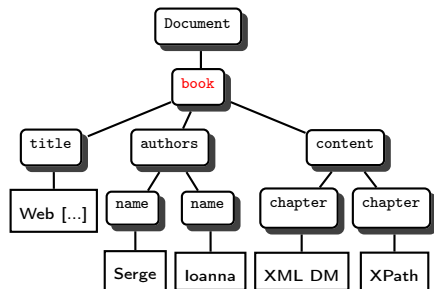
The output tree

The input document in serialized and tree forms

```

<?xml version="1.0"
  encoding="utf-8"?>
<book>
  <title>Web [...]</title>
  <authors>
    <name>Serge</name>
    <name>Ioanna</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">

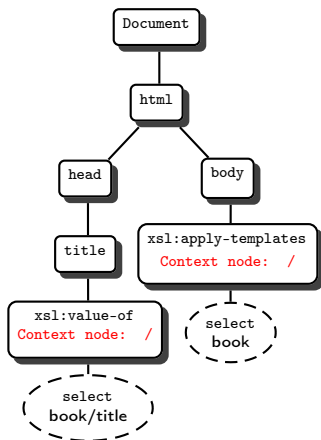
      <xsl:apply-templates select="book"/>

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

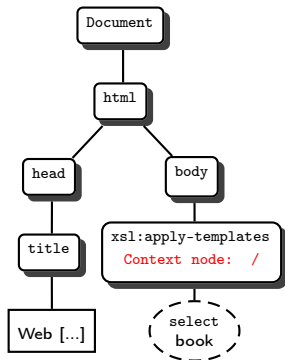
Remark

Typical of Web publishing templates.

The output document after instantiating the template



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



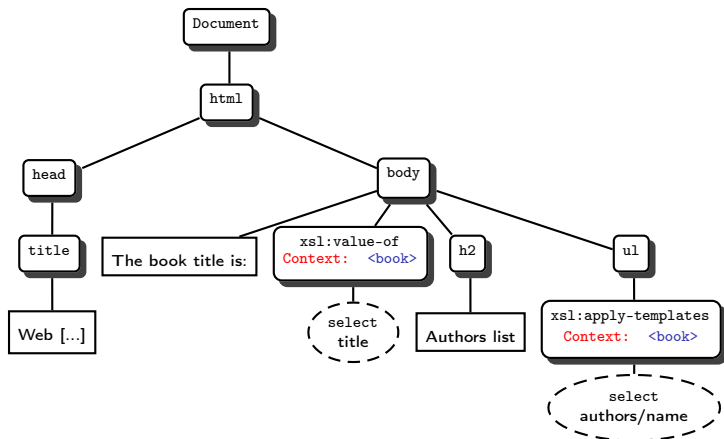
The remaining templates

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

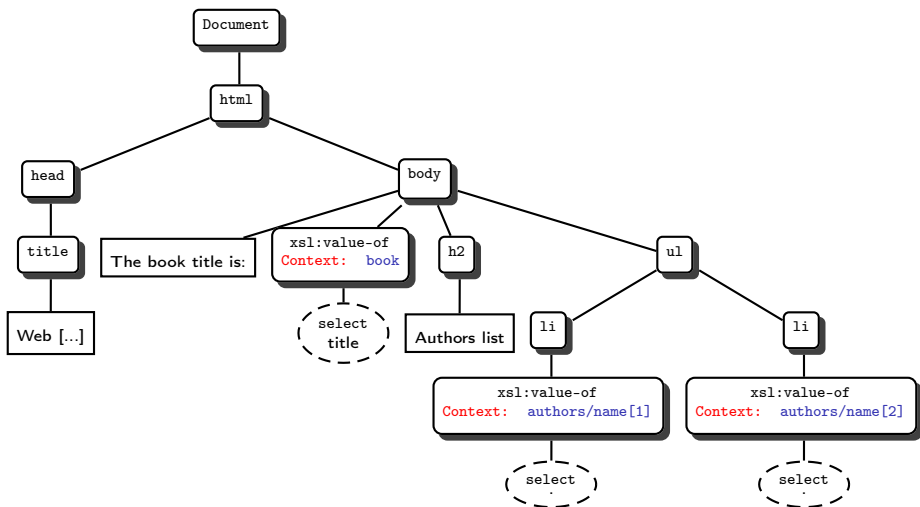
  <h2>Authors list</h2>
  <ul>
    <xsl:apply-templates select="authors/name" />
  </ul>
</xsl:template>

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

The `<book>` element is selected \Rightarrow the book template is instantiated



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



The final output document

