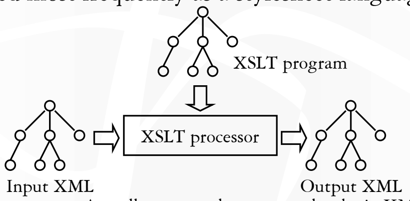
XSLT

CPS 196.3

Introduction to Database Systems

XSLT

- ❖ W3C recommendation
- ❖ XML-to-XML rule-based transformation language
- ❖ An XSLT program is an XML document itself
- ❖ Used most frequently as a stylesheet language



Actually, output does not need to be in XML in general

XSLT program

- ❖ An XSLT program is an XML document containing
  - ▪ Elements in the `<xsl:>` namespace
  - ▪ Elements in user namespace
- ❖ The result of evaluating an XSLT program on an input XML document =
  the XSLT document where each `<xsl:>` element has been replaced with the result of its evaluation
- ❖ Uses XPath as a sub-language

XSLT elements

- ❖ Element describing transformation rules
  - ▪ `<xsl:template>`
- ❖ Elements describing rule execution control
  - ▪ `<xsl:apply-templates>`
  - ▪ `<xsl:call-template>`
- ❖ Elements describing instructions
  - ▪ `<xsl:if>`, `<xsl:for-each>`, `<xsl:sort>`, etc.

XSLT example

- ❖ Find titles of books authored by "Abiteboul"

```
<?xml version="1.0"?>
<xsl:stylesheet
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  version="1.0">
<xsl:template match="book[author='Abiteboul']">
  <booktitle>
    <xsl:value-of select="title"/>
  </booktitle>
</xsl:template>
</xsl:stylesheet>
```

Standard header of an XSLT document

- ❖ Not quite; we will see why later

`<xsl:template>`

```
<xsl:template match="book[author='Abiteboul']">
  <booktitle>
    <xsl:value-of select="title"/>
  </booktitle>
</xsl:template>
```

- ❖ `<xsl:template match="`*match_expr*`">` is the basic XSLT construct describing a transformation rule
  - ▪ *match_expr* is an XPath-like expression specifying which nodes this rule applies to
- ❖ `<xsl:value-of select="`*xpath_expr*`"/>` converts the node-set returned by *xpath_expr* to a string
- ❖ `<booktitle>` and `</booktitle>` simply get copied to the output for each node match

Template in action

```
<xsl:template match="book[author='Abiteboul']">
  <booktitle>
    <xsl:value-of select="title"/>
  </booktitle>
</xsl:template>
```

❖ Example XML fragment

```
<book ISBN="ISBN-10" price="80.00">
  <title>Foundations of Databases</title>
  <author>Abiteboul</author>
  <author>Hull</author>
  <author>Vianu</author>
  <publisher>Addison Wesley</publisher>
  <year>1995</year>
  <section>…</section>…
</book>
```

Template applies

```
<booktitle>
  Foundations of Databases
</booktitle>
```

```
<book ISBN="ISBN-20" price="40.00">
  <title>A First Course in Databases</title>
  <author>Ullman</author>
  <author>Widom</author>
  <publisher>Prentice-Hall</publisher>
  <year>2002</year>
  <section>…</section>…
</book>
```

Template does not apply; default behavior is to process the node recursively and print out all text nodes

```
A First Course in Databases
Ullman
Widom
Prentice-Hall
2002
… …
```

Removing the extra output

❖ Add the following template:
`<xsl:template match="text()|@*"/>`

❖ This template matches all text and attributes

❖ XPath features
- `text()` is a node test that matches any text node
- `@*` matches any attribute
- `|` means "or" in XPath

❖ Body of the rule is empty, so all text and attributes become empty string
- This rule effectively filters out things not matched by the other rule

`<xsl:attribute>`

❖ Again, find titles of books authored by "Abiteboul"; but make the output look like `<book title="`*booktitle*`"/>`

```
… …
<xsl:template match="book[author='Abiteboul']">
  <book title="{title}"/>
</xsl:template>
… …
```

❖ A more general method

```
… …
<xsl:template match="book[author='Abiteboul']">
  <book>
    <xsl:attribute name="title">
      <xsl:value-of select="title"/>
    </xsl:attribute>
  </book>
</xsl:template>
… …
```

`<xsl:attribute name="`*attr*`">`*body*`</xsl:attribute>` adds an attributed named *attr* with value *body* to the parent element in the output

`<xsl:copy-of>`

❖ Another slightly different example: return (entire) books authored by "Abiteboul"

```
<?xml version="1.0">
<xsl:stylesheet
  xmlns:xsl="http://www.w3.org/1999/XSLT/Transform"
  version="1.0">
<xsl:template match="text()|@*"/>
<xsl:template match="book[author='Abiteboul']">
  <xsl:copy-of select="."/>
</xsl:template>
</xsl:stylesheet>
```

❖ `<xsl:copy-of select="`*xpath_expr*`"/>` copies the entire contents (including tag structures) of the node-set returned by *xpath_expr* to the output

Formatting XML into HTML

❖ Example templates to
- Render a book title in italics in HTML
- Render the authors as a comma-separated list

```
<xsl:template match="book/title">
  <i><xsl:value-of select="."/></i>
</xsl:template>
<xsl:template match="book/author[1]">
  <xsl:value-of select="."/>
</xsl:template>
<xsl:template match="book/author[position()>1]">
  , <xsl:value-of select="."/>
</xsl:template>
```

`<xsl:apply-templates>`

❖ Example: generate a table of contents
- Display books in an HTML unordered list
- For each book, first display its title, and then display its sections in an HTML ordered list
- For each section, first display its title, and then display its subsections in an HTML ordered list

```
<xsl:template match="title">
  <xsl:value-of select="."/>
</xsl:template>
<xsl:template match="section">
  <li>
    <xsl:apply-templates select="title"/>
    <ol><xsl:apply-templates select="section"/></ol>
  </li>
</xsl:template>
```

(Continue on next slide)

`<xsl:apply-templates select="`*xpath_expr*`"/>` applies templates recursively to the node-set returned by *xpath_expr*

Example continued

```
<xsl:template match="book">
  <li>
    <xsl:apply-templates select="title"/>
    <ol><xsl:apply-templates select="section"/></ol>
  </li>
</xsl:template>
<xsl:template match="bibliography">
  <html>
    <head><title>Bibliography</title></head>
    <body>
      <ul><xsl:apply-templates select="book"/></ul>
    </body>
  </html>
</xsl:template>
```

❖ One problem remains
  - Even if a book or a section has no sections, we will still generate an empty `<ol></ol>` element

`<xsl:if>`

❖ A fix using `<xsl:if>`: replace
```
<ol><xsl:apply-templates select="section"/></ol>
```
with
```
<xsl:if test="section">
  <ol><xsl:apply-templates select="section"/></ol>
</xsl:if>
```
❖ The body of `<xsl:if test="`*xpath_cond*`">` is processed only if *xpath_cond* evaluates to true

Whitespace control

❖ Whitespace is everywhere in XML
```
… …
<book ISBN="ISBN-10" price="80.00">↵
␣␣<title>↵
␣␣␣␣Foundations of Databases↵
␣␣</title>… …
```
  - "↵␣␣" goes into a text node
  - "↵␣␣␣␣Foundations of Databases↵␣␣" goes into another text node

❖ Specify `<xsl:strip-space elements="*"/>` to remove text nodes (under any element) containing only whitespace

❖ To strip leading and trailing whitespace and replace any sequence of whitespace characters by a single space, specify
```
<xsl:template match="text()">
  <xsl:value-of select="normalize-space()"/>
</xsl:tempalte>
```

`<xsl:for-each>`

❖ `<xsl:for-each select="`*xpath_expr*`">`
    body
  `</xsl:for-each>`
  - Process *body* for each node in the node-set returned by *xpath_expr*

❖ Another way to render authors as a comma-separated list
```
<xsl:tempalte match="book">
  … …
  <xsl:for-each select="author">
    <xsl:if test="position()>1">, </xsl:if>
    <xsl:value-of select="."/>
   </xsl:for-each>
  … …
</xsl:template>
```
  - No need to have separate templates for authors

XSLT summary

❖ Used often as a stylesheet language, but can be considered a query language too
  - Very expressive, with full recursion
    - Cannot be replaced by XQuery
  - Easily non-terminating, difficult to optimize
    - Cannot replace XQuery

❖ So many features, so little time!