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# Advanced Techniques in XSLT\*

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## Abstract

This talk focus on some advanced techniques used within XSLT, such as sort procedures, keys, interface with identifier management, and priority rules among templates matching an XML node. We recall how these features work and propose some examples, some being related to bibliography styles. A short comparison between XSLT and `nbst`, the language used within `MIBIBTEX` for bibliography styles, is given, too.

**Keywords** XSLT, sort, keys, invoking rules, `nbst`.

## Streszczenie

W prezentacji skupimy się na zaawansowanych technikach używanych w XSLT, takich jak procedury sortowania, klucze, interfejs do zarządzania identyfikatorami i reguły pierwszeństwa szablonów dopasowanych do konkretnego węzła. Przypomnimy jak te własności działają i pokażemy kilka przykładów, w tym niektóre związane ze stylami bibliograficznymi. Krótko porównamy również XSLT i `nbst` — język używany przez `MIBIBTEX` do konstruowania stylów bibliograficznych.

**Słowa kluczowe** XSLT, sortowanie, klucze, reguły wywoływania, `nbst`.

## Introduction

This didactic demonstration of XSLT<sup>1</sup> [12] — the language of transformations used for XML<sup>2</sup> texts: XML nodes are matched by XSLT templates, in which case the corresponding rule is invoked — follows the more general introduction given at the `BachoTEX` 2005 conference [2]. We use the `xsltproc` program [10], belonging to the `libxslt` library and built out of the `libxml2` library [9]. Both are running on Windows and Linux, but our demonstration is performed on the latter.

The XML texts used hereafter are already given in [3, Fig. 1 & 2]: a Polish song (*Płonie ognisko*) and two bibliographical entries using `DocBook`. We assume that readers can understand the behaviour of simple stylesheets<sup>3</sup> written in XSLT. Basic knowledge of XPath [11], the language used to address

parts of an XML document — in particular within XSLT programs — is required, too. So we propose an introduction to some advanced techniques within XSLT, some representative examples being given. As we will see, some of these techniques can be put into action within bibliography styles. We begin with the use of sort procedures and XSLT keys. Then we show how XSLT manages identifiers, as members of the ID type, and how a template is chosen among several ones whose `match` attribute matches an XML node. We end with a short comparison between XSLT and `nbst`<sup>4</sup>, the language used within `MIBIBTEX`<sup>5</sup> [1] for bibliography styles.

## Sorting — Using keys

About the behaviour of XSLT programs, we think that the best approach is to view elements such as `xsl:apply-templates` and `xsl:for-each` as *producers* of XML nodes, whereas `xsl:template` elements can be viewed as node *consumers*. When

\* Title in Polish: `xslt` — *zaawansowane techniki*.

<sup>1</sup> eXtensible Stylesheet Language Transformations.

<sup>2</sup> eXtensible Markup Language. Readers interested in an introductory book to this formalism can refer to [5].

<sup>3</sup> A progressive coursebook is [8].

<sup>4</sup> New Bibliography Styles.

<sup>5</sup> MultiLingual `BIBTEX`.

```

<?xml version="1.0" encoding="ISO-8859-2"?>
<xsl:stylesheet version="1.0" id="try-keys"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text" encoding="ISO-8859-2"/>
  <xsl:strip-space elements="*" />
  <!-- Rules blank nodes out from the source text [12, § 3.4]. -->
  <xsl:variable name="eol" select="'&#10;'" />
  <!-- Convenient way to write the end-of-line character. -->
  <xsl:key name="char-nb" match="verse" use="string-length(string())" />
  <!-- Applies to verse elements. The string function makes a conversion of inner tags. -->
  <xsl:template match="poem0">
    <xsl:call-template name="by-char-nb">
      <xsl:with-param name="remaining" select="count(body/stanza/verse)" />
    </xsl:call-template>
  </xsl:template>
  <xsl:template name="by-char-nb">
    <xsl:param name="nb" select="1" /> <!-- select gives the default value. -->
    <xsl:param name="remaining" /> <!-- The default value is the empty string. -->
    <xsl:if test="$remaining &gt; 0">
      <xsl:variable name="buffer" select="key('char-nb', $nb)" />
      <!-- Computes the inverse image char-nb-1({$nb}) -->
      <xsl:if test="$buffer"> <!-- [*] If this node list is not empty: -->
        <xsl:value-of select="concat('&lt;==== ', $nb, $eol)" />
        <xsl:apply-templates select="$buffer" />
      </xsl:if> <!-- [**] -->
      <xsl:call-template name="by-char-nb">
        <xsl:with-param name="nb" select="$nb + 1" />
        <xsl:with-param name="remaining" select="$remaining - count($buffer)" />
        <!-- No side-effect: new variables are created by using the value of present ones. -->
      </xsl:call-template>
    </xsl:if>
  </xsl:template>
  <xsl:template match="verse">
    <xsl:apply-templates />
    <xsl:value-of select="$eol" />
  </xsl:template>
  <xsl:template match="indent" /> <!-- If some indentation is used, do nothing. -->
</xsl:stylesheet>

```

Figure 1: Stylesheet using XSLT's keys.

an `xsl:template` element is invoked, it consumes the node matched by the value of the `match` attribute, and this node can have been produced by an `xsl:apply-templates` element of another template.

We know how to use the `xsl:sort` element if we keep this *modus operandi* in mind. We cannot

physically change the order of appearance within a node list resulting from an XPath expression<sup>6</sup>, since side-effects do not exist in XSLT. The solution is to consider that a sort order is to be put *between*

<sup>6</sup> Within the 'official' terminology [11, § 4.1], such lists are called 'node sets', but the order is relevant, that is why we prefer using the word 'list'.

the producer and the consumers [12, § 5.4]. The producer gives us a node list, this list is sorted before being sent to the corresponding consumer of each member of this list. For example, the following templates sorts all the `verse` elements, by increasing order, regarding the number of their characters, regardless of stanzas:

```
<xsl:template match="body">
  <xsl:apply-templates
    select="stanza/verse">
    <xsl:sort
      select="string-length(string())"
      data-type="number"/>
  </xsl:apply-templates>
</xsl:template>
```

some variants about parameterising the `xsl:sort` template being possible [12, § 10]. If several sort orders are used, each order sorts the elements viewed as equal by the previous sort statement. As an example, let us look at a bibliography w.r.t. DocBook [3, Fig. 2] and consider the `biblioentry` elements having an `author` child<sup>7</sup>. To use authors' last names as a primary sort key, first names as a secondary sort key, and middle name as a last sort key, just write:

```
<xsl:sort select="author/surname"/>
<xsl:sort select="author/firstname"/>
<xsl:sort
  select="author/othername[role='mi']"/>
```

Let us go back to *Płonie ognisko*; if `verse` elements are given default behaviour, that is, displaying text nodes inside these elements, a program using the template given above displays verses, sorted w.r.t. the number of their characters. But the verses appear, in turn, without any other information. If we want to group the lines being  $n$ -character long and display them after a header, then do the same for  $(n+1)$ -character long lines, and so on... we cannot do that efficiently with the `xsl:sort` template. For such an application, the best technique consists of using the inverse images of a function, this function being called **key** w.r.t. XSLT's terminology. The complete program illustrating the use of keys for this application is given in Fig. 1. By the way, we can see how information is passed to (resp. received by) a template by means of `xsl:with-param` (resp. `xsl:param`) elements. A simple container for a value — that is, a variable in the sense of programming languages — is built by an `xsl:variable` element. Last but not at least, this example shows that a template (e.g., `by-char-nb`) may be called recursively.

<sup>7</sup> The solution suitable for both one author or several ones carried out by an `authorgroup` element is given in Fig. 3.

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

<xsl:template match="verse">
  <xsl:apply-templates/>
  <xsl:if test="position() &lt; last()">
    <br/>
  </xsl:if>
</xsl:template>
```

**Figure 2:** How to display stanzas on a Web page.

## Managing identifiers

[3, Fig. 1] is a good use of attributes being types ID and IDREF. If we would like to display this song on a Web page, we may build an XSLT program whose output is an (X)HTML<sup>8</sup> file, this program including the templates given in Fig. 2. The default behaviour for `resume` elements causes no display since this element is empty. To display the contents of such a stanza, XSLT provides the `id` function, that returns the node labelled by its argument:

```
<xsl:template match="resume">
  <xsl:apply-templates
    select="id(@ref)/verse"/>
</xsl:template>
```

provided that this argument is an attribute being IDREF type: XSLT processors check that by looking into the DTD<sup>9</sup> associated with the XML text. That is why using this function can be heavy. Such identifiers can be automatically generated within an XSLT program, by means of the `generate-id` function [12, § 12.4]. For example, this template allows a HTML hyperlink to point to each stanza:

```
<xsl:template match="stanza">
  <p>
    <a name="{generate-id()}" />
    <xsl:apply-templates/>
  </p>
</xsl:template>
```

When this function is applied, either it has already been applied to the same node — in which case the previous result is retained — or a new identifier is created. Using both `key` and `generate-id` functions

<sup>8</sup> (eXtensible) HyperText Markup Language. [4] is a good introduction to these two languages, the 'official' documents being located at [13]. Let us recall that all the tags included in an XSLT program must conform to XML syntax, so XHTML tags must be used. Then the result is serialised according to HTML conventions [12, § 16.2].

<sup>9</sup> Document Type Definition.

allow XSLT developers to create identifiers from keys partitioning a node set. The correspondence is one-to-one if the key is bijective. Otherwise, only the first member of an inverse image is labelled. As an example, if we adapt the program given in Fig. 1 to yield HTML pages, each group of same-sized lines can be accessed by a hyperlink put as follows:

```
<p>  <!-- Corresponds to '[*]...[*]*'.  -->
  <a name="{generate-id($buffer)}"/>
  <xsl:apply-templates select="$buffer"/>
</p>
```

### Managing priority

Let us look at [3, Fig. 2] and recall that the three kinds of titles are not to be displayed the same way when this bibliography is listed [3, § 1]. Within such an example, this means that a template devoted to processing `title` elements should be able to deal with a *context* information, the name of the parent (`bibliography`, `biblientry`, `biblioset`) in such a case. A better solution is to use three different templates, having different priorities.

The rules governing priority among XSLT templates are given in [12, § 5.5]. To sum up what is useful in most practical cases, let us say that only one template is invoked if several ones with the same priority match the same node<sup>10</sup>. The priority may be managed explicitly by a namesake attribute: in practice, such an attribute is useful for specifying default rules with lower priority, or disabling imported templates by overriding them by other templates with highest priority. If the priority is not put explicitly, it is computed from the patterns used within `match` attributes: several-step patterns supersede one-step patterns. As an example, let us consider the XSLT program given in Fig. 3 and 4, which builds a L<sup>A</sup>T<sub>E</sub>X environment — `thebibliography` — from a bibliography expressed in DocBook. The template matching `title` elements — one step — is viewed as a default template for such elements and is used for books' titles in practice. It is superseded by two-step templates — the length of the corresponding XPath expression (`step1/step2`) — when a `title` element is a child of a `bibliography` or `biblioset` element. Likewise, a constraint also counts for a step (within a XPath expression like `step1[step2]`), so a template just matching `othername` elements would be superseded by the last template<sup>11</sup>.

<sup>10</sup> According to [12, § 5.5], such a case is an error. In practice, most XSLT processors invoke a template and ignore others.

<sup>11</sup> Besides, this XSLT stylesheet gives some examples of using modes [12, § 5.7] when several distinct procedures are to be applied to the same elements.

### nbst vs XSLT

A comprehensive of differences between XSLT and `nbst` — close but not identical to XSLT — has already come out in [1, App. C]. Here are the differences related to the abovementioned points.

- `nbst` does not provide equivalent elements for:
  - `xsl:apply-imports` [12, § 5.6],
  - `xsl:import` [12, § 2.6.2].

To implement the behaviour of these XSLT elements, use `priority` and `mode` attributes.

- The XSLT function `generate-id` is replaced by a function `generate-newly` with three arguments. `generate-newly(s1, s2, ns)` returns a unique string associated with the first node of the node list *ns* — if *ns* is not expressed, this function considers the current node — like `generate-id`. If *s*<sub>1</sub> is not empty, it is used as result's prefix. If *s*<sub>2</sub> is not empty, it must be a format for numbers [12, § 7.7] and is used to generate result's suffixes. If both *s*<sub>1</sub> and *s*<sub>2</sub> are empty, this function behaves like the `generate-id` function from XSLT.

Let us give an example with a 'References' section built by MIBIB<sub>T</sub>E<sub>X</sub> w.r.t. an 'alpha' bibliography style, that is, labels are like '[Donaldson 1982]'. If the symbol<sup>12</sup> whose print name is Donaldson 1982 has not been used yet, the expression:

```
generate-newly("Donaldson 1982", "a")
```

returns this string itself. Otherwise, it builds Donaldson 1982a, Donaldson 1982b, ... until it reaches a 'new' symbol. So this function is very useful to build this kind of keys, including the generation of several labels for the same author and year. As an other example:

```
generate-newly("Donaldson 1982", "i")
```

appends Roman lower-case digits and generates Donaldson 1982i, Donaldson 1982ii, ... in turn.

### Going on

Readers interested in XSLT stylesheets applied to DocBook documents can find interesting and real-sized examples on the CD-ROM associated with [6] and in [7].

<sup>12</sup> We use the 'symbol' word, rather than 'identifier', because whitespace characters cannot be used within identifiers w.r.t. XML conventions, whereas this `generate-newly` function may be used with any string as first parameter, as shown by the example. 'Symbol' can be related to the definition used for Lisp dialects.

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<xsl:stylesheet version="1.0" id="process-dbk" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="text" encoding="ISO-8859-1"/>
  <xsl:strip-space elements="*" />          <!-- Do not discard blank nodes inside some mixed -->
  <xsl:preserve-space elements="title..." /> <!-- elements. -->
  <xsl:variable name="eol" select="'&#10;'" />
  <xsl:template match="bibliography">
    <xsl:value-of select="concat('\documentclass{article}', $eol, '\usepackage[T1]{fontenc}', $eol,
      '\usepackage[latin1]{inputenc}', $eol, $eol, '\title{')" />
    <xsl:apply-templates select="title" />
    <xsl:value-of select="concat(' ', $eol, '\author{', $eol, '\date{', $eol, $eol, '\begin{document}',
      $eol, $eol, '\maketitle', $eol, $eol, '\begin{thebibliography}{')" />
    <xsl:apply-templates select="biblioentry[1]" mode="longest-label" />
    <xsl:value-of select="concat(' ', $eol, $eol)" />
    <xsl:apply-templates select="biblioentry">
      <xsl:sort select="//author[1]/surname" />          <!-- The first author, even if it is specified -->
      <xsl:sort select="//author[1]/firstname" />      <!-- within an authorgroup element, so we -->
      <xsl:sort select="//author[1]/othername[role = 'mi']" /> <!-- use the descendent axis -->
    </xsl:apply-templates>
    <xsl:value-of select="concat('\end{thebibliography}', $eol, $eol, '\end{document}', $eol, $eol)" />
  </xsl:template>
  <xsl:template match="biblioentry" mode="longest-label">
    <xsl:param name="the-longest-label" />
    <xsl:param name="current-maximum" select="0" />
    <xsl:variable name="label-0" select="@xreflabel" />
    <xsl:variable name="length-0" select="string-length($label-0)" />
    <xsl:variable name="longer-than" select="$length-0 > $current-maximum" />
    <xsl:variable name="new-longest-label">
      <xsl:choose>
        <xsl:when test="$longer-than"><xsl:value-of select="$label-0" /></xsl:when>
        <xsl:otherwise><xsl:value-of select="$the-longest-label" /></xsl:otherwise>
      </xsl:choose>
    </xsl:variable>
    <xsl:variable name="new-current-maximum">
      <xsl:choose>
        <xsl:when test="$longer-than"><xsl:value-of select="$length-0" /></xsl:when>
        <xsl:otherwise><xsl:value-of select="$current-maximum" /></xsl:otherwise>
      </xsl:choose>
    </xsl:variable>
    <xsl:variable name="next-biblioentries" select="following-sibling::biblioentry" />
    <xsl:choose>
      <xsl:when test="$next-biblioentries">
        <xsl:apply-templates select="$next-biblioentries[1]" mode="longest-label">
          <xsl:with-param name="the-longest-label" select="$new-longest-label" />
          <xsl:with-param name="current-maximum" select="$new-current-maximum" />
        </xsl:apply-templates>
      </xsl:when>
      <xsl:otherwise><xsl:value-of select="$new-longest-label" /></xsl:otherwise>
    </xsl:choose>
  </xsl:template>
  <xsl:template match="bibliography/title">
    <xsl:apply-templates />
  </xsl:template>

```

Figure 3: Processing a bibliography expressed using DocBook.

```

<xsl:template match="title">
  <xsl:text>"</xsl:text>
  <xsl:apply-templates/>
  <xsl:value-of select='concat("&apos;&apos;.", $eol)'/>
</xsl:template>

<xsl:template match="biblioset/title">
  <xsl:text>\emph{</xsl:text>
  <xsl:apply-templates/>
  <xsl:value-of select="concat('}.', $eol)"/>
</xsl:template>

<xsl:template match="biblioentry">
  <xsl:value-of select="concat('\bibitem[',@xreflabel,']{', @id, '}')"/>
  <xsl:variable name="the-author" select="author"/>
  <xsl:choose>
    <xsl:when test="$the-author"><xsl:apply-templates select="$the-author"/></xsl:when>
    <xsl:otherwise><xsl:apply-templates select="authorgroup"/></xsl:otherwise>
  </xsl:choose>
  <xsl:value-of select="concat(':', $eol)"/>
  <xsl:apply-templates select="title"/>
  <xsl:apply-templates select="biblioset">
    <xsl:with-param name="seriesvolnums" select="seriesvolnums"/>
  </xsl:apply-templates> <!-- ... (The end of this template is skipped.) -->
</xsl:template>

<xsl:template match="author">
  <xsl:apply-templates select="firstname"/>
  <xsl:apply-templates select="othername"/>
  <xsl:apply-templates select="surname"/>
</xsl:template>

<xsl:template match="authorgroup">
  <xsl:variable name="the-authors" select="author"/>
  <xsl:apply-templates select="$the-authors[1]"/>
  <xsl:choose>
    <xsl:when test="count($the-authors) = 2">
      <xsl:text> and </xsl:text>
      <xsl:apply-templates select="$the-authors[2]"/>
    </xsl:when>
    <xsl:otherwise>
      <xsl:apply-templates select="$the-authors[position() > 1]" mode="within-authorgroup"/>
    </xsl:otherwise>
  </xsl:choose>
</xsl:template>

<xsl:template match="author" mode="within-authorgroup">
  <xsl:text>, </xsl:text>
  <xsl:if test="position() = last()"><xsl:text> and </xsl:text></xsl:if>
  <xsl:apply-templates select="."/>
</xsl:template>

<xsl:template match="othername[@role = 'mi']">
  <xsl:apply-templates/>
  <xsl:text> </xsl:text>
</xsl:template>

<!-- ... (Other templates are skipped. The complete stylesheet is available on CD-ROM.) -->
</xsl:stylesheet>

```

**Figure 4:** Processing a bibliography expressed using DocBook (Figure 3 continued).

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