

MIBibT_EX's Architecture

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Abstract

This paper shows the architecture of MIBibT_EX, our reimplementation of BibT_EX focusing on multilingual features. Making precise the organisation and modules of this architecture allows us to show how MIBibT_EX works and focus on the differences between MIBibT_EX and BibT_EX from a conceptual point of view. We also explain why this implementation using the Scheme programming language allows users to scrutinise the result of intermediate steps.

Keywords L^AT_EX, BibT_EX, MIBibT_EX, bibliography files, bibliography styles, bst, nbst, XML, XSLT.

Sommario

Questo paper illustra l'architettura di MIBibT_EX, una reimplementazione di BibT_EX più adatta per lavorare in un contesto multilingua. Rendendo più precisa l'organizzazione ed i moduli è possibile mostrare come MIBibT_EX lavora evidenziando le principali differenze esistenti tra MIBibT_EX e BibT_EX da un punto di vista concettuale. Verrà inoltre spiegato perché quest'implementazione fatta usando il linguaggio di programmazione Scheme permette di verificare i risultati degli step intermedi.

Parole chiave L^AT_EX, BibT_EX, MIBibT_EX, bibliografia, stile bibliografico, bst, nbst, XML, XSLT.

Introduction

Often the L^AT_EX (LAMPORT (1994)) word processor and BibT_EX (PATASHNIK (1998)) bibliography processor are used in conjunction. Such an approach allows the 'References' section of a printed document to be given nice layout. Homogeneous typesetting for items being same type is provided by means of bibliography styles ruling the layout of articles, books, etc. As mentioned in (MITTELBAACH *et al.*, 2004, § 13.1), BibT_EX has been stable for a long time. However, modern features, such as multilingual capabilities, have not been incorporated and are possible only by means of workarounds, most often by inserting L^AT_EX commands inside field values. As a consequence, using BibT_EX to generate bibliographies for another output format than L^AT_EX may be difficult.

There are several projects aiming to develop BibT_EX's successors (MITTELBAACH *et al.*, 2004, § 13.1.2). Among them, MIBibT_EX—for

'MultiLingual BibT_EX—focuses on multilingual features. It uses XML¹ as a central formalism. Even if there is a compatibility mode for bibliography styles originating from BibT_EX (HUFFLEN (2006a)), style designers are encouraged to develop new styles using a new language ((HUFFLEN, 2003, App. A & B)), nbst², close to XSLT³ (W3C (1999)), the language of transformations used for XML texts.

The broad outlines of MIBibT_EX have already been shown at the 2004 G_UI⁴ conference and given in HUFFLEN (2005c). This present paper focuses on MIBibT_EX's architecture, in the sense that we explain how MIBibT_EX's modules are organised and how they interact. First, we recall how BibT_EX proceeds. So we can point out the differences between BibT_EX and MIBibT_EX from a conceptual point of view. Reading this article only requires basic knowledge about L^AT_EX, BibT_EX and XML. About its implementation, MIBibT_EX is written using the Scheme programming language (HUFFLEN (2005b)). We will not go thoroughly into technical points in Scheme⁵, but mention how intermediate results are built.

1 Situation

1.1 BibT_EX's behaviour

As a recent reference, (MITTELBAACH *et al.*, 2004, § 12.1.3) explains how L^AT_EX and BibT_EX can cooperate. *Citation keys*—e.g., 'eco1980' in '`\cite{eco1980}`'—are stored by L^AT_EX into an auxiliary (.aux) file also used by BibT_EX. Now let us describe BibT_EX's behaviour roughly. First, it takes an .aux file⁶ and searches it for citations. This .aux file also contains the information about a bibliography style. Then this bibliography style file is run. If we look at some standard bibliography files, some variables, functions and macros are defined, bibliographic databases are searched for citation keys, and the accurate functions of the style are applied. Figure 1 describes the organisation of a bibliography style file as it is sketched

1. eXtensible Markup Language. Readers interested in an introductory book to this formalism can refer to RAY (2001).

2. New Bibliography STyles.

3. eXtensible Stylesheet Language Transformations.

4. Gruppo Utilizzatori Italiani di T_EX (Italian T_EX user group).

5. The current reference manual of this language is KELSEY *et al.* (1998).

6. Let us recall that when BibT_EX is invoked by means of a command line such as '`bibtex <job-name>`', `<job-name>` refers to an .aux file.

```

ENTRY {...}{...}{...}      % Declaration of variables and functions.
FUNCTION {...}{...}
...
FUNCTION {article}{...}
...
MACRO {oct}{"October"}
...
READ                        % Search bibliography data base .bib files for entries.
...                          % Some preprocessing, including the sort of selected entries.
SORT
...
EXECUTE {begin.bib}        % Preamble and \begin{thebibliography}.
EXECUTE {...}              % Some initialisations.
ITERATE {call.type$}      % Loop over entries producing outputs.
EXECUTE {end.bib}         % Write \end{thebibliography} command.

```

Figure 1: Bibliography style file used by BIB_TE_X: framework and basic flow.

in (MITTELBA_CH *et al.*, 2004, § 13.6.2). To sum up: once the citation keys and the bibliography style are known, the latter is run. The result is a .bbl file containing a `thebibliography` environment ((MITTELBA_CH *et al.*, 2004, § 12.1.2)), each reference being prefixed by means of the `\bibitem` command.

1.2 Going further

At a first glance, a successor of BIB_TE_X might conserve the same *modus operandi*. That is not always possible. BIB_TE_X never reads the .tex file because the information it needs can be found in .aux files only. The same behaviour is unsuitable for MIBIB_TE_X—as a program managing multilingual bibliographies—when it generates a ‘References’ section for a L^AT_EX source text. Let us consider the following title, which uses a syntactical extension provided by MIBIB_TE_X:

```
TITLE = {[Danse macabre] : french}
```

This book of Stephen King is written in English—of course—but its title uses French words, what is specified by the ‘[...] : french’ notation, where ‘french’ is a *language identifier* (HUFFLE_N (2003)). Let us assume that we are building a ‘References’ section for a document in English. In order for L^AT_EX to use the right hyphenation patterns if need be, the .bbl file generated should include such a title as:

```
\foreignlanguage{french}{Danse macabre}
```

provided that the `babel` package is loaded with the `french` option when L^AT_EX processes this document ((MITTELBA_CH *et al.*, 2004, Ch. 9)). First, there are several ways to write in French with L^AT_EX with the `babel` package or with other *ad hoc* packages. Second, let us recall that all the languages used throughout a document must be specified as

options when the `babel` package is loaded. This package is static and the languages it uses cannot be extended dynamically. As we explain in HUFFLE_N (2005a), there are several solutions to this problem, but we think that the best consists of analysing the preamble of the .tex file, in order to get information about the multilingual capability chosen by a user. Let us go back to our title: if the `french` option has not been selected, MIBIB_TE_X will just produce ‘Danse macabre’ and warn the user that some words may be incorrectly hyphenated.

Another drawback of bibliography styles of BIB_TE_X is that they are monolithic: one file for one style. There is a tool, `custom-bib` ((MITTELBA_CH *et al.*, 2004, § 13.5.2)), that allows a bibliography style to be build automatically from users’ wishes. But there is no modular approach in the sense that a style designer could develop a new style from existing style fragments. In MIBIB_TE_X, a style is assembled dynamically, according to what is needed. For example, let us consider that a `plain` style⁷ is to be used for a document written in English and including some fragments in Italian. The files that can be used are:

`plain.nbst` general definitions for this style.

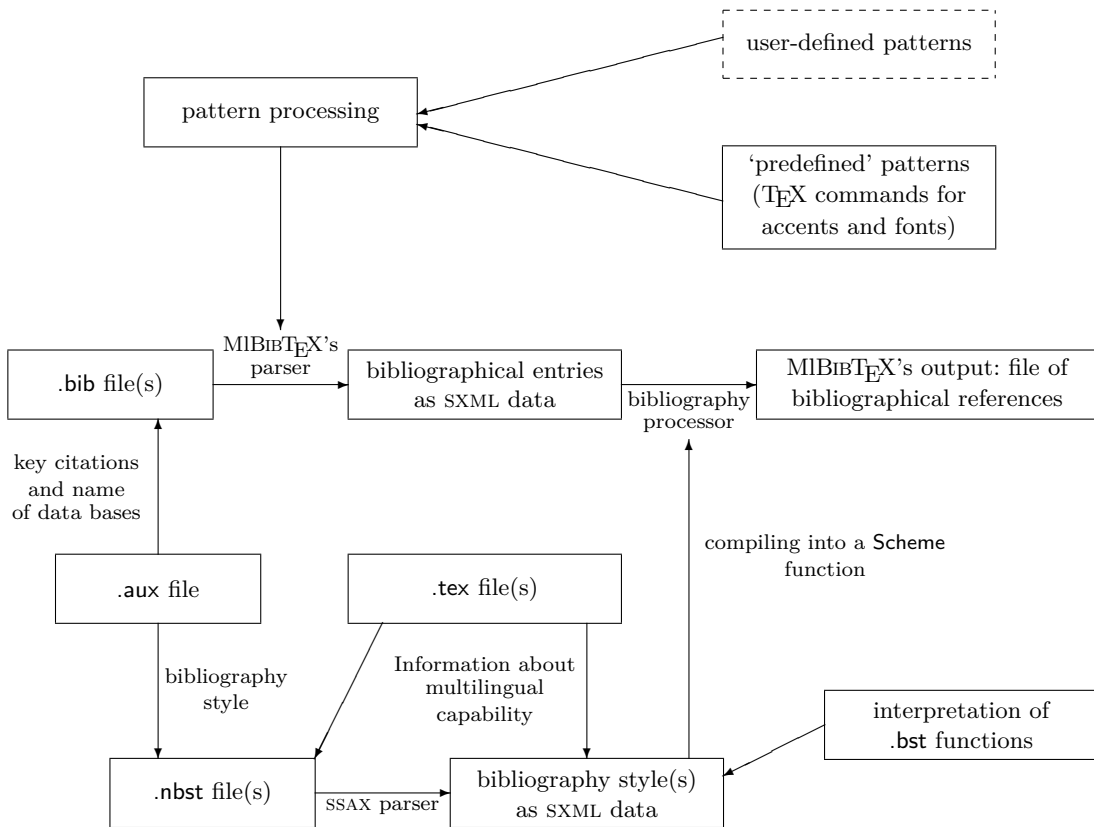
`plain-{english,italian}.nbst` definitions suitable for the English and Italian languages and belonging to this style.

`{-english,-italian}.nbst` general definitions for the English and Italian languages.

So we need this information about available languages before applying a style.

There is another difference, which can be noticed by an end-user, about abbreviations usable in a .bib file. Some may be defined using the `@STRING{...}`

7. That is, items are labelled by numbers.



' $A \leftarrow B$ ' means that A uses B . More precisely, functions or data put in A use functions of B or data from B . A dashed box means that the corresponding module is planned, but not fully implemented yet.

Figure 2: Data flow in MIBibT_EX.

command of BibT_EX ((MITTELBACH *et al.*, 2004, § 13.2.3)), some may be defined as macros within the bibliography style ((MITTELBACH *et al.*, 2004, Table 13.7)), for example, month names:

```
MONTH = oct
```

(cf. Figure 1). When BibT_EX reads a .bib file, all the abbreviations must be expanded into strings. That is, all must be known at this time. On the contrary, in the styles of MIBibT_EX, you can perform different operations whether or not a symbol is defined:

```
<nbst:choose>
  <nbst:when test="is-defined('roma')">
    ...
    <!-- The is-defined function does not exist
         in XSLT, but exists in nbst.
    -->
  </nbst:when>
  ...
</nbst:choose>
```

We think that all these differences between MIBibT_EX and BibT_EX are improvements but they lead to a redesign of the data flow in MIBibT_EX.

2 Organisation of MIBibT_EX

The organisation of MIBibT_EX is pictured at Figure 2. Like BibT_EX, MIBibT_EX reads an .aux file and gets a list of citation keys. It also gets information about some bibliography data base files and a bibliography style.

Then it parses .bib files, searching them for the citation keys. This step results in an SXML⁸ tree, that is, a representation of an XML tree using Scheme (KISELYOV (2005)). Let us consider that the entry given in Figure 3 is to be put within a bibliography. Conceptually, it can be viewed as the XML tree given in Figure 4, represented in SXML by the Scheme lists of Figure 5. Bibliography styles use XPath⁹ expressions related to XML trees resulting from parsing a .bib file, that is, XML trees comparable with the example given in Figure 4.

Some symbols are not expanded because they have not been defined by a @STRING command in a .bib file—e.g., the roma symbol in Figure 3, see also Appendix A—and are retained for future pro-

8. Scheme implementation of XML.

9. XPath is the language used to address parts of an XML document (W3C (1993)).

```
@BOOK{eco1980,
  AUTHOR = {Umberto Eco},
  TITLE = {Il nome della rosa},
  PUBLISHER = {Bompiani},
  ADDRESS = roma,
  YEAR = 1980,
  LANGUAGE = italian}
```

Notice the `LANGUAGE` field and language identifier used to specify this entry for a book written in Italian.

Figure 3: MIBIB_TE_X's bibliographical entry.

cessing. In other words, that is a kind of ‘benefit of the doubt’. The commands generating accented letters and other signs belonging to the Latin 1 encoding are expanded: for example, ‘\’{e}’ is expanded to the accented letter ‘é’ of this encoding¹⁰. As a consequence, the accented and special letters included in the values of MIBIB_TE_X's fields are viewed as single letters when entries are sorted. Besides, this sort operation can be performed w.r.t. a language's lexicographical order. The `nbst` language provides a `nbst:sort` element ((HUFFLEN, 2003, App. A)) that is analogous to the `xsl:sort` element of XSLT ((W3C, 1999, § 10)): if the data to be sorted are strings, a `language` attribute allows sorting w.r.t. a particular language (English, Italian, Spanish, ...)

Likewise, some predefined commands of L^AT_EX for fonts (`\emph`, `\textbf`, ...) are recognised and expanded to XML elements. This is done by means of patterns, expressed in Scheme. Now, only some predefined patterns are processed, e.g.:

```
(define-pattern "\'e" "é")
(define-pattern "\'e" "é")
```

we plan to extend this capability to user-defined patterns, so users will be able to mark up their `.bib` files, and tell MIBIB_TE_X how it can understand this markup (HUFFLEN (2004a)).

During the next step, MIBIB_TE_X deduces the source `.tex` file's name from the `.aux` file's¹¹. Then it parses the preamble of this file and try to know:

- which languages are used throughout this document and how;
- which encoding may be used: pure ASCII¹² or Latin 1. So, users can type accented letters directly inside field values of `.bib` files processed by MIBIB_TE_X, even if they do not use the `inputenc` package of L^AT_EX, for dealing

10. Now, most Scheme interpreters can only deal with the Latin 1 encoding. Future versions should be Unicode-compliant (UNICODE CONSORTIUM (2003)) and able to deal with more encodings, such as Latin 2, UTF-8, ...

11. You can specify this `.tex` file's name by means of an option of MIBIB_TE_X, if need be.

12. American Standard Code for Information Interchange.

```
<book id="eco1980" language="italian">
  <author>
    <name>
      <personname>
        <first>Umberto</first>
        <last>Eco</last>
      </personname>
    </name>
  </author>
  <title>Il nome della rosa</title>
  <publisher>Bompiani</publisher>
  <year>1980</year>
  <address><symbol name="roma"/></address>
</book>
```

Figure 4: Entry as an XML tree (Fig. 3 cont'd).

with encodings other than ASCII ((MITTELBACH *et al.*, 2004, § 7.5.2)). In this last case, the commands for generating accents will be used, for example, ‘é’ will be transformed into ‘\’{e}’.

This step results in:

- a list of possible file names¹³ whose union is the multilingual bibliography style;
- updating a set of Scheme functions controlling MIBIB_TE_X's output.

Then the files of the bibliography style are parsed by means of SSAX¹⁴ (KISELYOV (2005)). This parser returns the SXML representation of an XML tree. So, the result is comparable to the expression given in Figure 5, but concerns the elements of a bibliography style. Finally, the fragments of a bibliography style are assembled and compiled into a Scheme function¹⁵ (HUFFLEN (2006c)). Then this function is applied to the list of bibliographical entries selected.

Last, bibliography styles may use functions written using the `bst` language of BIB_TE_X. That allows ‘old’ bibliography styles to be replaced progressively and explains the arrow, in Figure 2, from the box concerning `bst` functions to the box concerning bibliography styles expressed using the new language `nbst`.

3 Conclusion

When we started to develop MIBIB_TE_X's first version (HUFFLEN (2001a)), we only aimed to provide a ‘better BIB_TE_X’. The only changes from end-users’

13. ‘Possible files’ because some files specific to a particular language may be inexistent, in which case they are ignored.

14. Scheme implementation of SAX (Simple API for XML).

15. Displaying a function's body is difficult and often not provided by most Scheme interpreters, that is why we do not give more details about this step. But we plan to develop tools for browsing bibliography styles.

```
(*top* ...
(book (@ (id "eco1980") (language "italian"))
  (author
    (name (personname (first "Umberto")
                      (last "Eco"))))
  (title "Il nome della rosa")
  (publisher "Bompiani") (year "1980")
  (address (symbol (@ (name "roma"))))))
```

Figure 5: Entry in SXML (Fig. 4 cont'd).

point of view were additional syntactic features. This approach was not satisfactory enough and we decided to design a new language for bibliography styles (HUFFLEN (2001b)), taking advantage of XML features as far as possible. This design choice and the implementation of multilingual features led to an architecture quite far from BibT_EX's. It may appear as more complicated, but we think that the role of each module is precise and can be understood by end-users, provided that they have got first experience with the Scheme programming language. But this architecture seems to us to be stable and robust. In particular, we succeeded in using MIBibT_EX for deriving 'References' sections for ConT_EXt (HUFFLEN (2006b)), another format built out of T_EX¹⁶ and very different from L^AT_EX. So, extending MIBibT_EX to other output formats is possible.

A Abbreviations in MIBibT_EX

This appendix aims to make precise how abbreviations—possibly multilingual—can be specified in MIBibT_EX. As an example, we consider the `roma` symbol, that appears in the `eco1980` entry of Figure 3. Another example is given in HUFFLEN (2004b).

You can use a `@STRING` command, like in 'old' BibT_EX ((MITTELBACH *et al.*, 2004, § 13.2.3)):

```
@STRING{roma = {[Roma] * italian
                [Rome] * english
                [Rom] * german}}
```

the sequence of '[...] * ...' notations being a syntactical extension of MIBibT_EX for information that *must* be put, possibly in another language if no translation is available (HUFFLEN (2003)). In other words, processing such a sequence never yields an empty string. But this `@STRING` command is expanded *verbatim* when a `.bib` file is processed—as in 'old' BibT_EX—so it must be put in every `.bib` file where this `roma` symbol is used.

16. T_EX provides a powerful framework to format texts nicely, but to be fit for use, the definitions of this framework need to be organised in a *format*. The first formats were *Plain T_EX* and L^AT_EX, another format, more modern, is ConT_EXt (HAGEN (2001)).

A better solution, from our point of view, is to define this symbol like month names or predefined names of journals within the standard `bst` styles of BibT_EX. If the `roma` symbol is not defined by a `@STRING` command, it is processed as we show in Figure 4 when a `.bib` file is parsed. It can be defined within a bibliography style—that is, within a `.nbst` file—as follows:

```
<nbst:variable name="roma">
  <nonemptyinformation>
    <group language="italian">Roma</group>
    <group language="english">Rome</group>
    <group language="german">Rom</group>
  </nonemptyinformation>
</nbst:variable>
```

These two ways to define a symbol are close together, since a sequence of '[...] * ...' yields a `nonemptyinformation` element when `.bib` files are parsed. However, if an abbreviation has not been defined in 'old' BibT_EX, a warning message is issued and the undefined symbol is just replaced by an empty string. As mentioned in § 1.2, the `nbst` language allows you to check that a symbol has been defined or not.

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