CNXLᴬTEX: A LᴬTEX-based Syntax for Connexions Modules*

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Abstract

We present CNXLᴬTEX, a collection of LᴬTEX macros that allow to write CONNEXIONS modules without leaving the LᴬTEX workflow. Modules are authored in CNXLᴬTEX using only a text editor, transformed to PDF and proofread as usual. In particular, the LᴬTEX workflow is independent of having access to the CONNEXIONS system, which makes CNXLᴬTEX attractive for the initial version of single-author modules.

For publication, CNXLᴬTEX modules are transformed to CNXml via the LᴬTEXML translator and can be uploaded to the CONNEXIONS system.

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*Version ? (last revised ?)

Contents

1 Introduction

The Connexions project is a[1]

The CNXml format — in particular the embedded content MathML — is hard to write by hand, so we provide a set of environments that allow to embed the CNXml document model into LaTeX.

2 The User Interface

This document is not a manual for the Connexions XML encoding, or a practical guide how to write Connexions modules. We only document the LaTeX bindings for CNXml and will presuppose experience with the format or familiarity with[2]. Note that formatting CNXLaTeX documents with the LaTeX formatter does little to enforce the restrictions imposed by the CNXml document model. You will need to run the LaTeXML converter for that (it includes DTD validation) and any CNX-specific quality assurance tools after that. [3]

The CNXLaTeX class makes heavy use of the `KeyVal` package, which is part of your LaTeX distribution. This allows to add optional information to LaTeX macros in the form of key-value pairs: A macro `\foo` that takes a KeyVal argument and a regular one, so a call might look like `\foo{bar}` (no KeyVal information given) or `\foo[key1=val1,...,keyn=valn]{bar}`, where `key1,...,keyn` are predefined keywords and values are LaTeX token sequences that do not contain comma characters (though they may contain blank characters). If a value needs to contain commas, then it must be enclosed in curly braces, as in `\foo[args={a,comma,separated,list}]`. Note that the order the key/value pairs appear in a KeyVal Argument is immaterial.

2.1 Package Options

showmeta The `cnx` package takes a single option: `showmeta`. If this is set, then the metadata keys are shown (see [Koh10a] for details and customization options).

2.2 Document Structure

The first set of CNXLaTeX environments concern the top-level structure of the modules. The minimal Connexions document in LaTeX can be seen in Figure 1: cnxmodule we still need the LaTeX document environment, then the `cnxmodule` environment contains the module-specific information as a KeyVal argument with the two keys: `id` for the module identifier supplied by the Connexions system) and `name` for the title of the module.

ccontent The `content` environment delineates the module content from the metadata (see Section 2.6). It is needed to make the conversion to CNXml simpler.

c*section CNXml knows three levels of sectioning, so the CNXLaTeX class supplies three

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[1]EdNote: continue; copy from somewhere...
[2]EdNote: cite the relevant stuff here
[3]EdNote: talk about Content MathML and cmathml.sty somewhere

```
\documentclass{cnx}
\begin{document}
  \begin{cnxmodule}[name=Hello World,id=m4711]
    \begin{ccontent}
      \begin{cpara}[id=p01] Hello World\end{cpara}
    \end{ccontent}
  \end{cnxmodule}
\end{document}
```

Example 1: A Minimal CNXLᴬTᴇX Document

as well: `csection`, `csubsection` and `csubsubsection`. In contrast to regular LᴬTᴇX, these are environments to keep the tight connection between the formats. These environments take an optional KeyVal argument with key `id` for the identifier and a regular argument for the title of the section (to be transformed into the CNXᴍʟ `name` element).

cpara, cnote   The lowest levels of the document structure are given by paragraphs and notes. The `cpara` and `cnote` environment take a KeyVal argument with the `id` key for identification, the latter also allows a `type` key for the note type (an unspecified string[4]).

EdNote:4

2.3 Mathematics

Mathematical formulae are integrated into text via the LᴬTᴇX math mode, i.e. wrapped in `$` characters or between `\(` and `\)` for inline mathematics and wrapped in `$$` or between `\[` and `\]` for display-style math. Note that CNXᴍʟ expects Content Mᴀᴛʜᴍʟ as the representation format for mathematical formulae, while run-of-the-mill LᴬTᴇX only specifies the presentation (i.e. the two-dimensional layout of formulae). The LᴬTᴇXML converter can usually figure out some of the content Mᴀᴛʜᴍʟ from regular LᴬTᴇX, in other cases, the author has to specify it e.g. using the infrastructure supplied by the `cmathml` package.

cequation   For numbered equations, CNXᴍʟ supplies the `equation` element, for which CNXLᴬTᴇX provides the `cequation` environment. This environment takes a KeyVal argument with the `id` key for the (required) identifier.

2.4 Statements

CNXᴍʟ provides special elements that make various types of claims; we collectively call them statements.

cexample   The `cexample` environment and `definition` elements take a KeyVal argument with key `id` for identification.

crule, statement, proof   In CNXᴍʟ, the `rule` element is used to represent a general assertion about EdNote:5   the state of the world. The CNXLᴬTᴇX `rule`[5] environment is its CNXLᴬTᴇX coun-

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[4]EᴅNᴏᴛᴇ: what are good values?
[5]EᴅNᴏᴛᴇ: we have called this "crule", since "rule" is already used by TᴇX.

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terpart. It takes a KeyVal attribute with the keys `id` for identification, `type` to specify the type of the assertion (e.g. "Theorem", "Lemma" or "Conjecture"), and `name`, if the assertion has a title. The body of the `crule` environment contains the statement of assertion in the `statement` environment and (optionally) a proof in the `proof` environment. Both take a KeyVal argument with an `id` key for identification.

```
\begin{crule}[id=prop1,type=Proposition]
   \begin{statement}[id=prop1s]
        Sample statement
   \end{statement}
   \begin{proof}[id=prop1p]
        Your favourite proof
   \end{proof}
\end{crule}
```

Example 2: A Basic crule Example

definition, cmeaning   A definition defines a new technical term or concept for later use. The `definition` environment takes a KeyVal argument with the keys `id` for identification and `term` for the concept (definiendum) defined in this form. The definition text is given in the `cmeaning` environment[1], which takes a KeyVal argument with key `id` for identification. After the `cmeaning` environment, a `definition` can contain arbitrarily many `cexample`s.

```
\begin{definition}{term=term-to-be-defined, id=termi-def]
  \begin{cmeaning}[id=termi-meaning]
    {\term{Term-to-be-defined}} is defined as: Sample meaning
  \end{cmeaning}
\end{definition}
```

Example 3: A Basic `definition` and `cmeaning` Example

2.5 Connexions: Links and Cross-References

As the name CONNEXIONS already suggests, links and cross-references are very important for CONNEXIONS modules. CNXml provides three kinds of them. Module links, hyperlinks, and concept references.

cnxn   Module links are specified by the `\cnxn` macro, which takes a keyval argument with the keys `document`, `target`, and `strength`. The `document` key allows to specify the module identifier of the desired module in the repository, if it is empty, then the current module is intended. The `target` key allows to specify the document fragment. Its value is the respective identifier (given by its `id` attribute in

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[1]we have called this `cmeaning`, since `meaning` is already taken by TeX

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CNXml or the `id` key of the corresponding environment in CNXLᴬTEX). Finally, the `strength` key allows to specify the relevance of the link.

The regular argument of the `\cnxn` macro is used to supply the link text.

link   Hyperlinks can be specified by the `\link` macro in CNXLᴬTEX. It takes a KeyVal argument with the key `src` to specify the URL of the link. The regular argument of the `\link` macro is used to supply the link text.

term   The `\term` marco can be used to specify the[6]

EdNote:6

2.6 Metadata

Metadata is mostly managed by the system in Connexions, so we often do not need to care about it. On the other hand, it influences the system, so if we have work on the module extensively before converting it to CNXml, it may be worth-wile specify some of the data in advance.

```
\begin{metadata}[version=2.19,
                 created=2000/07/21,revised=2004/08/17 22:07:27.213 GMT-5]
\begin{authorlist}
  \cnxauthor[id=miko,firstname=Michael,surname=Kohlhase,
             email=m.kohlhase@iu-bremen.de]
\end{authorlist}
\begin{keywordlist}\keyword{Hello}\end{keywordlist}
\begin{cnxabstract}
  A Minimal CNXLaTeX Document
\end{cnxabstract}
\end{metadata}
```

Example 4: Typical CNXLᴬTEX Metadata

metadata   The `metadata` environment takes a KeyVal argument with the keys `version`, `created`, and `revised` with the obvious meanings. The latter keys take ISO 8601 norm representations for dates and times. Concretely, the format is `CCYY-MM-DDThh:mm:ss` where "`CC`" represents the century, "`YY`" the year, "`MM`" the month, and "`DD`" the day, preceded by an optional leading "`-`" sign to indicate a negative number. If the sign is omitted, "`+`" is assumed. The letter "`T`" is the date/time separator and "`hh`", "`mm`", "`ss`" represent hour, minutes, and seconds respectively.

authorlist, maintainerlist   The lists of authors and maintainers can be specified in the `authorlist` and `maintainerlist` environments, which take no arguments.

cnxauthor,maintainer   The entries on this lists are specified by the `\cnxauthor` and `\maintainer` macros. Which take a KeyVal argument specifying the individual. The `id` key is the identifier for the person, the `honorific`, `firstname`, `other`, `surname`, and `lineage` keys are used to specify the various name parts, and the `email` key is used to specify the e-mail address of the person.

keywordlist, keyword   The keywords are specified with a list of `keyword` macros, which take the

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[6]EdNote: continue, pending Chuck's investigation.

6

respective keyword in their only argument, inside a `keyword` environment. Neither take any KeyVal arguments.

cnxabstract   The abstract of a CONNEXIONS module is considered to be part of the metadata. It is specified using the `cnxabstract` environment. It does not take any arguments.

2.7 Exercises

cexercise, cproblem, csolution   An exercise or problem in CONNEXIONS is specified by the `cexercise` environment, which takes an optional keyval argument with the keys `id` and `name`. It must contain a `cproblem` environment for the problem statement and a (possibly) empty set of `csolution` environments. Both of these take an optional keyval argument with the key `id`.

2.8 Graphics, etc.

cfigure   For graphics we will use the `cfigure`[7] macro, which provides a non-floating environment for including graphics into CNXML files. `cfigure` takes three arguments first an optional CNXML keys, then the keys of the `graphicx` package in a regular argument (leave that empty if you don't have any) and finally a path. So

EdNote:7

```
\cfigure[id=foo,type=image/jpeg,caption=The first FOO]{width=7cm,height=2cm}{../images/f
```

Would include a graphic from the file at the path `../images/foo`, equip this image with a caption, and tell LaTeXML that[8] the original of the images has the MIME type `image/jpeg`.

EdNote:8

3 Limitations

In this section we document known limitations. If you want to help alleviate them, please feel free to contact the package author. Some of them are currently discussed in the STEX TRAC [Ste].

1. none reported yet

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[7]EDNOTE: probably better call it `cgraphics`

[8]EDNOTE: err, exactly what does it tell latexml?

4 The Implementation

The `cnx` package generates to files: the LaTeX package (all the code between ⟨*package⟩ and ⟨/package⟩) and the LaTeXML bindings (between ⟨*ltxml⟩ and ⟨/ltxml⟩). We keep the corresponding code fragments together, since the documentation applies to both of them and to prevent them from getting out of sync.

4.1 Package Options

We declare some switches which will modify the behavior according to the package options. Generally, an option `xxx` will just set the appropriate switches to true (otherwise they stay false). First we have the general options

```
1 ⟨*package⟩
2 \DeclareOption{showmeta}{\PassOptionsToPackage{\CurrentOption}{metakeys}}
3 \DeclareOption*{\PassOptionsToPackage{\CurrentOption}{omdoc}}
```

Finally, we need to declare the end of the option declaration section to LaTeX.

```
4 \ProcessOptions
5 ⟨/package⟩
```

We first make sure that the `sref` [Koh10b] and `graphicx` packages are loaded.

```
6 ⟨*cls⟩
7 \RequirePackage{sref}
8 \RequirePackage{graphicx}
```

The next step is to declare (a few) class options that handle the paper size; this is useful for printing.

```
9 \DeclareOption{letterpaper}
10    {\setlength\paperheight {11in}%
11      \setlength\paperwidth  {8.5in}}
12 \DeclareOption{a4paper}
13    {\setlength\paperheight {297mm}%
14      \setlength\paperwidth  {210mm}}
15 \ExecuteOptions{letterpaper}
16 \ProcessOptions
```

Finally, we input all the usual size settings. There is no sense to use something else, and we initialize the page numbering counter and tell it to output the numbers in arabic numerals (otherwise label and reference do not work).

```
17 \input{size10.clo}
18 \pagenumbering{roman}
19 ⟨/cls⟩
```

Now comes the equivalent for LaTeXML: this is something that we will have throughout this document. Every part of the TeX/LaTeX implementation has a LaTeXML equivalent. We keep them together to ensure that they do not get out of sync.

```
20 ⟨*ltxml⟩
21 # -*- CPERL -*-
22 package LaTeXML::Package::Pool;
```

8

```
23 use strict;
24 use LaTeXML::Package;
25 RequirePackage('metakeys');
```

We set up the necessary namespaces, the first one is the default one for CNXml

```
26 RegisterNamespace('cnx'=>"http://cnx.rice.edu/cnxml");
27 RegisterNamespace('md'=>"http://cnx.rice.edu/mdml/0.4");
28 RegisterNamespace('bib'=>"http://bibtexml.sf.net/");
29 RegisterNamespace('m'=>"http://www.w3.org/1998/Math/MathML");
```

For LaTeXML we also have to set up the correct document type information. The first line gives the root element. The second gives the public identifier for the CNX DTD, then we have its URL, and finally the CNX namespace.

```
30 DocType("cnx:document",
31 "-//CNX//DTD CNXML 0.5 plus LaTeXML//EN",
32 "../dtd/cnxml+ltxml.dtd",
33 '#default'=>"http://cnx.rice.edu/cnxml",
34         'md'=>"http://cnx.rice.edu/mdml/0.4",
35         'bib'=>"http://bibtexml.sf.net/",
36         'm'=>"http://www.w3.org/1998/Math/MathML",
37         'ltx'=>"http://dlmf.nist.gov/LaTeXML");
```

And finally, we need to set up the counters for itemization, since we are defining a class file from scratch.[9]

```
38 NewCounter('@itemizei',   'document',   idprefix=>'I');
39 NewCounter('@itemizeii',  '@itemizei',  idprefix=>'I');
40 NewCounter('@itemizeiii', '@itemizeii', idprefix=>'I');
41 NewCounter('@itemizeiv',  '@itemizeiii',idprefix=>'I');
42 NewCounter('@itemizev',   '@itemizeiv', idprefix=>'I');
43 NewCounter('@itemizevi',  '@itemizev', idprefix=>'I');
44
45 NewCounter('enumi',   '@itemizei',  idprefix=>'i');
46 NewCounter('enumii',  '@itemizeii', idprefix=>'i');
47 NewCounter('enumiii','@itemizeiii', idprefix=>'i');
48 NewCounter('enumiv',  '@itemizeiv', idprefix=>'i');
49 # A couple of more levels, since we use these for ID's!
50 NewCounter('enumv',   '@itemizev',  idprefix=>'i');
51 NewCounter('enumvi',  '@itemizevi', idprefix=>'i');
52
53 DefMacro('\theenumi',             '\arabic{enumi}');
54 DefMacro('\theenumii',            '\alph{enumii}');
55 DefMacro('\theenumiii',           '\roman{enumiii}');
56 DefMacro('\theenumiv',            '\Alph{enumiv}');
57
58 NewCounter('equation', 'document', idprefix=>'E');
59 DefMacro('\theequation', '\arabic{equation}');
60 DefMacro('\textwidth','16cm');
```

And another thing that is now needed:

---

[9]EDNOTE: this will have to change, when Bruce updates to the next version (0.6?)

9

61 `Let('\thedocument@ID','\@empty');`
62 ⟨/ltxml⟩

4.2 Document Structure

Now, we start with the document structure markup. The `cnxmodule` environment does not add anything to the LATEX output, it's attributes only show up in the XML. There we have a slight complication: we have to put an `id` attribute on the `document` element in CNXML, but we cannot redefine the `document` environment in LATEX. Therefore we specify the information in the `cnxmodule` environment. This means however that we have to put in on the `document` element when we are already past this. The solution here is that when we parse the `cnxmodule` environement, we store the value and put it on the `document` element when we leave the `document` environment (thanks for Ioan Sucan for the code).

cnxmodule

```
63 ⟨*cls⟩
64 \addmetakey{cnxmodule}{name}
65 \srefaddidkey{cnxmodule}{id}
66 \newenvironment{cnxmodule}[1][]{\metasetkeys{cnxmodule}{#1}}{}
67 ⟨/cls⟩
68 ⟨*ltxml⟩
69 DefKeyVal('cnxmodule','name','Semiverbatim');
70 DefKeyVal('cnxmodule','id','Semiverbatim');
71 DefEnvironment('{document}','<cnx:document>#body</cnx:document>',
72        beforeDigest=> sub { AssignValue(inPreamble=>0); },
73        afterDigest=> sub { $_[0]->getGullet->flush; return; });
74 DefEnvironment('{cnxmodule} OptionalKeyVals:cnxmodule',
75        "<cnx:name>&KeyVal('#1','name')</cnx:name>\n#body\n",
76        afterDigestBegin => sub {
77 AssignValue('cnxmodule_id',
78     KeyVal($_[1]->getArg(1), 'id')->toString,
79     'global');
80        });#$
81 Tag('cnx:document', afterClose => sub {
82     $_[1]->setAttribute('id', LookupValue('cnxmodule_id'));
83    });
84 ⟨/ltxml⟩
```

ccontent The `ccontent` environment is only used for transformation. Its optional `id` attribute is not taken up in the LATEX bindings.

```
85 ⟨*cls⟩
86 \newenvironment{ccontent}{}{}
87 ⟨/cls⟩
88 ⟨*ltxml⟩
89 DefEnvironment('{ccontent}',"<cnx:content>#body</cnx:content>");
90 ⟨/ltxml⟩
```

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c*section The sectioning environments employ the obvious nested set of counters.

```
 91 ⟨∗cls⟩
 92 \newcounter{section}
 93 \srefaddidkey{sectioning}{id}
 94 \newenvironment{csection}[2][]%
 95 {\stepcounter{section}\strut\\[1.5ex]\noindent%
 96 {\Large\bfseries\arabic{section}.~{#2}}\\[1.5ex]
 97 \metasetkeys{sectioning}{#1}}
 98 {}
 99 \newcounter{subsection}[section]
100 \newenvironment{csubsection}[2][]
101 {\refstepcounter{subsection}\strut\\[1ex]\noindent%
102 {\large\bfseries{\arabic{section}.\arabic{subsection}.~#2\\[1ex]}}%
103 \metasetkeys{sectioning}{#1}}%
104 {}
105 \newcounter{subsubsection}[subsection]
106 \newenvironment{csubsubsection}[2][]
107 {\refstepcounter{subsubsection}\strut\\[.5ex]\noindent
108 {\bfseries\arabic{section}.\arabic{subsection}.\arabic{subsubsecction}~#2\\[.5ex]}%
109 \metasetkeys{sectioning}{#1}}{}
110 ⟨/cls⟩
111 ⟨∗ltxml⟩
112 DefKeyVal('sectioning','id','Semiverbatim');
113 DefEnvironment('{csection}OptionalKeyVals:sectioning{}',
114       "<cnx:section %&KeyVals(#1)>\n"
115            . "?#2(<cnx:name>#2</cnx:name>\n)()"
116            . "#body\n</cnx:section>\n");
117 DefEnvironment('{csubsection}OptionalKeyVals:sectioning{}',
118       "<cnx:section %&KeyVals(#1)>\n"
119            . "?#2(<cnx:name>#2</cnx:name>\n)()"
120            . "#body\n</cnx:section>\n");
121 DefEnvironment('{csubsubsection}OptionalKeyVals:sectioning{}',
122       "<cnx:section %&KeyVals(#1)>\n"
123            . "?#2(<cnx:name>#2</cnx:name>\n)()"
124            . "#body\n</cnx:section>\n");
125 ⟨/ltxml⟩
```

cpara For the `<cnx:para>` element we have to do some work, since we want them to be numbered. This handling is adapted from Bruce Miller's `LaTeX.ltxml` numbered.

```
126 ⟨∗cls⟩
127 \srefaddidkey{para}{id}
128 \newenvironment{cpara}[1][]{\metasetkeys{para}{#1}}{\par}
129 ⟨/cls⟩
130 ⟨∗ltxml⟩
131 DefKeyVal('para','id','Semiverbatim');
132 DefEnvironment('{cpara} OptionalKeyVals:para','<cnx:para %&KeyVals(#1)>#body</cnx:para>');
133 sub number_para {
134   my($document,$node,$whatsit)=@_;
135   # Get prefix from first parent with an id.
```

```
136    my(@parents)=$document->findnodes('ancestor::*[@id]',$node); # find 1st id'd parent.
137    my $prefix= (@parents ? $parents[$#parents]->getAttribute('id')."." : '');
138    # Get the previous number within parent; Worried about intervening elements around para's, bu
139    my(@siblings)=$document->findnodes("preceding-sibling::cnx:para",$node);
140    my $n=1;
141    $n = $1+1  if(@siblings && $siblings[$#siblings]->getAttribute('id')=~/(\d+)$/);
142    $node->setAttribute(id=>$prefix."p$n"); }
143 Tag('cnx:para',afterOpen=>\&number_para);
144 DefConstructor('\par',sub { $_[0]->maybeCloseElement('cnx:para'); },alias=>"\\par\n");
145 Tag('cnx:para', autoClose=>1, autoOpen=>1);
146 ⟨/ltxml⟩
```

cnote

```
147 ⟨*cls⟩
148 \srefaddidkey{note}
149 \addmetakey{note}{type}
150 \newenvironment{cnote}[1][]%
151 {\metasetkeys{note}{#1}\par\noindent\strut\hfill\begin{minipage}{10cm}{\bfseries\note@type}:~}%
152 {\end{minipage}\hfill\strut\par}
153 ⟨/cls⟩
154 ⟨*ltxml⟩
155 DefKeyVal('note','id','Semiverbatim');
156 DefKeyVal('note','type','Semiverbatim');
157 DefEnvironment('{cnote}OptionalKeyVals:note','<cnx:note %&KeyVals(#1)>#body</cnx:note>');
158 ⟨/ltxml⟩
```

4.3   Mathematics

cequation

```
159 ⟨*cls⟩
160 \srefaddidkey{equation}{id}
161 \newenvironment{cequation}[1][]%
162 {\metasetkeys{equation}{#1}\begin{displaymath}}
163 {\end{displaymath}}
164 ⟨/cls⟩
165 ⟨*ltxml⟩
166 DefKeyVal('equation','id','Semiverbatim');
167 DefEnvironment('{cequation} OptionalKeyVals:equation',
168       "<cnx:equation %&KeyVals(#1)>"
169             . "<ltx:Math mode='display'>"
170             . "<ltx:XMath>#body</ltx:XMath>"
171             . "</ltx:Math></cnx:equation>",
172       mode=>'display_math');
173 ⟨/ltxml⟩
```

4.4   Rich Text

In this section, we redefine some of LaTeX commands that have their counterparts
in CNXml.

quote

```
174 ⟨*cls⟩
175 \srefaddidkey{cquote}
176 \addmetakey{cquote}{type}
177 \addmetakey{cquote}{src}
178 \newenvironment{cquote}[1][]{%
179 \metasetkeys{cquote}{#1}\begin{center}\begin{minipage}{.8\textwidth}}{\end{minipage}\end{center
180 ⟨/cls⟩
181 ⟨*ltxml⟩
182 DefKeyVal('cquote','id','Semiverbatim');
183 DefKeyVal('cquote','type','Semiverbatim');
184 DefKeyVal('cquote','src','Semiverbatim');
185 DefEnvironment('{cquote} OptionalKeyVals:cquote',
186                "<cnx:quote %&KeyVals(#1)>#body</cnx:quote>");
187 ⟨/ltxml⟩
```

footnote

```
188 ⟨*ltxml⟩
189 DefConstructor('\footnote[]{}',"<cnx:note type='foot'>#2</cnx:note>");
190 ⟨/ltxml⟩
```

emph

```
191 ⟨*ltxml⟩
192 DefConstructor('\emph{}',"<cnx:emphasis>#1</cnx:emphasis>");
193 ⟨/ltxml⟩
```

displaymath, eqnarray   We redefine the abbreviate display math enviroment and the `eqnarray` and `eqnarray*` environments to use the CNXML equation tags, everything else stays the same.

```
194 ⟨*ltxml⟩
195 DefConstructor('\[',
196         "<cnx:equation id='#id'>"
197         . "<ltx:Math mode='display'>"
198         .   "<ltx:XMath>"
199         .    "#body"
200         .   "</ltx:XMath>"
201         . "</ltx:Math>"
202        ."</cnx:equation>",
203         beforeDigest=> sub{ $_[0]->beginMode('display_math'); },
204         captureBody=>1,
205         properties=> sub { RefStepID('equation') });
206 DefConstructor('\]'  ,"",beforeDigest=> sub{ $_[0]->endMode('display_math'); });
207 ⟨/ltxml⟩
```

displaymath   We redefine the abbreviate display math enviroment to use the CNXML equation tags, everything else stays the same.[10]

EdNote:10

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[10]EDNOTE: check LaTeX.ltxml frequently and try to keep in sync, it would be good, if the code in LaTeXML.ltxml could be modularized, so that the cnx/ltx namespace differences could be relegated to config options

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```
208 ⟨∗ltxml⟩
209 DefConstructor('\[',
210       "<cnx:equation id='#id'>"
211     . "<ltx:Math mode='display'>"
212     .   "<ltx:XMath>"
213     .     "#body"
214     .   "</ltx:XMath>"
215     . "</ltx:Math>"
216    ."</cnx:equation>",
217       beforeDigest=> sub{ $_[0]->beginMode('display_math'); },
218       captureBody=>1,
219       properties=> sub { RefStepID('equation') });
220 DefConstructor('\]'  ,"",beforeDigest=> sub{ $_[0]->endMode('display_math'); });
221
222 DefMacro('\eqnarray',     '\@@eqnarray\@start@alignment');
223 DefMacro('\endeqnarray', '\@finish@alignment\end@eqnarray');
224 DefMacro('\csname eqnarray*\endcsname',     '\@@eqnarray*\@start@alignment');
225 DefMacro('\csname endeqnarray*\endcsname', '\@finish@alignment\end@eqnarray');
226 DefConstructor('\@@eqnarray OptionalMatch:* AlignmentBody:\end@eqnarray',
227       sub {
228 my($document,$star,$body,%props)=@_;
229 $document->openElement('cnx:equation',refnum=>$props{refnum},id=>$props{id});
230 $document->openElement('ltx:Math',mode=>'display');
231 $document->openElement('ltx:XMath');
232 constructAlignment($document,$body,attributes=>{name=>'eqnarray'});
233 $document->closeElement('ltx:XMath');
234 $document->closeElement('ltx:Math');
235 $document->closeElement('cnx:equation'); },
236       mode=>'display_math',
237       beforeDigest=>sub { alignmentBindings('rcl'); },
238       properties=> sub { ($_[1] ? RefStepID('equation') : RefStepCounter('equation')); },
239       afterDigest=>sub {
240 $_[1]->setProperty(body=>$_[1]->getArg(2));},# So we get TeX
241       reversion=>'\begin{eqnarray#1}#2\end{eqnarray#1}');
242 ⟨/ltxml⟩
```

displaymath   We redefine the abbreviate display math envionment to use the CNXML equation
tags, everything else stays the same.[11]

```
243 ⟨∗cls⟩
244 \newcommand{\litem}[2][]{\item[#1]\label{#2}}
245 ⟨/cls⟩
246 ⟨∗ltxml⟩
247 Tag('cnx:item', autoClose=>1);
248 DefConstructor('\item[]',"<cnx:item>?#1(<cnx:name>#1</cnx:name>)");
249 DefConstructor('\litem[]{}',"<cnx:item id='#2'>?#1(<cnx:name>#1</cnx:name>)");
250 DefConstructor('\itemize@item[]',
```

---

[11]EDNOTE: check LaTeX.ltxml frequently and try to keep in sync, it would be good, if the code in
LaTeXML.ltxml could be modularized, so that the cnx/ltx namespace differences could be relegated
to config options

```
251        "<cnx:item id='#id'>?#1(<cnx:name>#1</cnx:name>)",
252        properties=>sub{ RefStepItemCounter(); });
253 DefConstructor('\enumerate@item[]',
254        "<cnx:item id='#id'>?#1(<cnx:name>#1</cnx:name>)",
255        properties=>sub{ RefStepItemCounter(); });
256 DefConstructor('\description@item[]',
257        "<cnx::item id='#id'>?#1(<cnx:name>#1</cnx:name>)",
258        properties=>sub{ RefStepItemCounter(); });
259 AssignValue(itemlevel=>0);
260 DefEnvironment('{itemize}',
261        "<cnx:list id='#id' type='itemize'>#body</cnx:list>",
262        properties=>sub { beginItemize('itemize'); });
263 DefEnvironment('{enumerate}',
264        "<cnx:list type='enumerate'  id='#id'>#body</cnx:list>",
265        properties=>sub { beginItemize('enumerate'); });
266 DefEnvironment('{description}',
267        "<cnx:list  type='description'  id='#id'>#body</cnx:list>",
268        properties=>sub { beginItemize('description'); });
269 ⟨/ltxml⟩
```

The next set of commands and environments are largely presentational, so we just skip them.

```
270 ⟨∗ltxml⟩
271 DefEnvironment('{center}','#body');
272 DefEnvironment('{minipage}{}','#body');
273 DefEnvironment('{small}','#body');
274 DefEnvironment('{footnotesize}','#body');
275 DefEnvironment('{tiny}','#body');
276 DefEnvironment('{scriptsize}','#body');
277 ⟨/ltxml⟩

278 ⟨∗ltxml⟩
279 DefConstructor('\ref Semiverbatim', "<cnx:cnxn target='#1'>&LookupValue('LABEL@#1')</cnx:cnxn>"
280 ⟨/ltxml⟩
```

4.5   Statements

cexample
```
281 ⟨∗cls⟩
282 \srefaddidkey{example}
283 \addmetakey{example}{name}
284 \newenvironment{cexample}[1][]{\metasetkeys{example}{#1}
285 {\ifx\example@name\@empty\else\noindent\bfseries{\example@name}\fi}}
286 {}
287 ⟨/cls⟩
288 ⟨∗ltxml⟩
289 DefKeyVal('example','id','Semiverbatim');
290 DefEnvironment('{cexample}OptionalKeyVals:example',
291                "<cnx:example %&KeyVals(#1)>#body</cnx:example>");
292 ⟨/ltxml⟩
```

15

cexercise   The `cexercise`, `cproblem` and `csolution` environments are very simple to set
up for LATEX. For the LATEXML side, we simplify matters considerably for the
moment by restricting the possibilities we have on the CNXML side: We as-
sume that the content is just one `<cnx:para>` element for the `<cnx:problem>` and
EdNote:12   `<cnx:solution>` elements.[12]

```
293 ⟨∗cls⟩
294 \newcounter{cexercise}
295 \srefaddidkey{cexercise}
296 \addmetakey{cexercise}{name}
297 \newenvironment{cexercise}[1][]{\metasetkeys{cexercise}{#1}
298 {\ifx\cexercise@name\@empty\else\stepcounter{cexercise}\noindent\bfseries{\cexercise@name~\arab
299 {}
300 \srefaddidkey{cproblem}
301 \newenvironment{cproblem}[1][]{\metasetkeys{cproblem}{#1}}{}{}
302 \srefaddidkey{csolution}
303 \newenvironment{csolution}[1][]{\metasetkeys{csolution}{#1}}{\par\noindent\bfseries{Solution}}{
304 ⟨/cls⟩
305 ⟨∗ltxml⟩
306 DefKeyVal('cexercise','id','Semiverbatim');
307 DefKeyVal('cexercise','name','Semiverbatim');
308 DefEnvironment('{cexercise}OptionalKeyVals:exercise',
309        "<cnx:exercise ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')()>"
310        . "#body"
311        . "</cnx:exercise>");
312 DefKeyVal('cproblem','id','Semiverbatim');
313 DefKeyVal('cproblem','name','Semiverbatim');
314 DefEnvironment('{cproblem}OptionalKeyVals:cproblem',
315        "<cnx:problem ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')()>"
316     . "?&defined(&KeyVal(#1,'name'))(<cnx:name>&KeyVal(#1,'name')</cnx:name>\n)()"
317        . "#body"
318        . "</cnx:problem>");
319 DefKeyVal('csolution','id','Semiverbatim');
320 DefKeyVal('csolution','name','Semiverbatim');
321 DefEnvironment('{csolution}OptionalKeyVals:cproblem',
322        "<cnx:solution ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')()>"
323     . "?&defined(&KeyVal(#1,'name'))(<cnx:name>&KeyVal(#1,'name')</cnx:name>\n)()"
324        . "#body"
325        . "</cnx:solution>");
326 ⟨/ltxml⟩
```

crule

```
327 ⟨∗cls⟩
328 \srefaddidkey{rule}
329 \addmetakey{rule}{name}
330 \addmetakey{rule}{type}
331 \newenvironment{crule}[1][]{\metasetkeys{rule}{#1}%
332 {\noindent\bfseries{\rule@type:}\ifx\rule@name\@empty\else~(\rule@name)\fi}}%
```

---

[12]EDNOTE: relax this when we have automated the generation of cnx:para elements

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```
333 {}
334 ⟨/cls⟩
335 ⟨∗ltxml⟩
336 DefKeyVal('rule','id','Semiverbatim');
337 DefKeyVal('rule','name','Semiverbatim');
338 DefKeyVal('rule','type','Semiverbatim');
339 DefEnvironment('{crule}OptionalKeyVals:rule',
340                "<cnx:rule ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')() type='&KeyVal(#1
341      . "?&defined(&KeyVal(#1,'name'))(<cnx:name>&KeyVal(#1,'name')</cnx:name>\n)()"
342      . "\n#body\n"
343      . "</cnx:rule>\n");
344 ⟨/ltxml⟩
```

statement

```
345 ⟨∗cls⟩
346 \srefaddidkey{statement}
347 \newenvironment{statement}[1][]{\metasetkeys{statement}{#1}}{}
348 ⟨/cls⟩
349 ⟨∗ltxml⟩
350 DefKeyVal('statement','id','Semiverbatim');
351 DefEnvironment('{statement} OptionalKeyVals:statement','<cnx:statement %&KeyVals(#1)>#body</cnx
352 ⟨/ltxml⟩
```

proof

```
353 ⟨∗cls⟩
354 \srefaddidkey{proof}
355 \newenvironment{proof}[1][]{\metasetkeys{proof}{#1}}{}
356 ⟨/cls⟩
357 ⟨∗ltxml⟩
358 DefKeyVal('proof','id','Semiverbatim');
359 DefEnvironment('{proof}OptionalKeyVals:proof','<cnx:proof %&KeyVals(#1)>#body</cnx:proof>');
360 ⟨/ltxml⟩
```

definition

```
361 ⟨∗cls⟩
362 \srefaddidkey{definition}
363 \addmetakey{definition}{term}
364 \addmetakey{definition}{seealso}
365 \newenvironment{definition}[1][]{\metasetkeys{definition}{#1}{\noindent\bfseries{Definition:}}}
366 ⟨/cls⟩
367 ⟨∗ltxml⟩
368 DefKeyVal('definition','id','Semiverbatim');
369 DefKeyVal('definition','term','Semiverbatim');
370 DefKeyVal('definition','seealso','Semiverbatim');
371 DefEnvironment('{definition}OptionalKeyVals:definition',
372                "<cnx:definition ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')()>\n"
373      . "?&defined(&KeyVal(#1,'term'))(<cnx:term>&KeyVal(#1,'term')</cnx:term>\n)()"
374      . "\n#body\n"
375      . "?&defined(&KeyVal(#1,'seealso'))(<cnx:seealso><cnx:term>&KeyVal(#1,'term')</cnx:term></
```

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```
376        . "</cnx:definition>\n");
377 ⟨/ltxml⟩
```

cmeaning

```
378 ⟨*cls⟩
379 \srefaddidkey{meaning}
380 \newenvironment{cmeaning}[1][]{\metasetkeys{meaning}{#1}}{}
381 ⟨/cls⟩
382 ⟨*ltxml⟩
383 DefKeyVal('meaning','id','Semiverbatim');
384 DefEnvironment('{cmeaning}OptionalKeyVals:meaning','<cnx:meaning %&KeyVals(#1)>#body</cnx:meani
385 ⟨/ltxml⟩
```

4.6   Conexxions

cnxn

```
386 ⟨*cls⟩
387 \addmetakey{cnxn}{document}
388 \addmetakey{cnxn}{target}
389 \addmetakey{cnxn}{strength}
390 \newcommand{\cnxn}[2][]%  keys, link text
391 {\metasetkeys{cnxn}{#1}{\underline{#2}}\footnote{{\ttfamily\@ifx\cnxn@document\@empty\cnxn@docu
392 \newcommand\@makefntext[1]{\parindent 1em\noindent\hb@xt@1.8em{\hss\@makefnmark}#1}
393 ⟨/cls⟩
394 ⟨*ltxml⟩
395 DefKeyVal('cnxn','document','Semiverbatim');
396 DefKeyVal('cnxn','target','Semiverbatim');
397 DefKeyVal('cnxn','strength','Semiverbatim');
398 DefConstructor('\cnxn OptionalKeyVals:cnxn {}','<cnx:cnxn %&KeyVals(#1)>#1</cnx:cnxn>');
399 ⟨/ltxml⟩
```

link

```
400 ⟨*cls⟩
401 \addmetakey{link}{src}
402 \newcommand{\link}[2][]{\metasetkeys{link}{#1}\underline{#2}}
403 ⟨/cls⟩
404 ⟨*ltxml⟩
405 DefKeyVal('link','src','Semiverbatim');
406 DefConstructor('\link OptionalKeyVals:link {}','<cnx:link %&KeyVals(#1)>#2</cnx:link>');
407 ⟨/ltxml⟩
```

cfigure   The cfigure only gives us one of the possible instances of the `<figure>` ele-

ment[13].[14] In LaTeX, we just pipe the size information through to includegraphics,
in LaTeXML, we construct the CNXML structure[15]

```
408 ⟨*cls⟩
```

---

[13]EDNOTE: extend that
[14]EDNOTE: do more about required and optional keys in arguments.
[15]EDNOTE: what do we do with the graphicx information about size,... CSS?

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```
409 \srefaddidkey{cfigure}
410 \addmetakey{cfigure}{type}
411 \addmetakey{cfigure}{caption}
412 \newcounter{figure}
413 \newcommand{\cfigure}[3][]{% cnx_keys, graphicx_keys, path
414 \begin{center}%
415 \includegraphics[#2]{#3}%
416 \metasetkeys{cfigure}{#1}\sref@target%
417 \ifx\cfigure@caption\@empty\else
418 \par\noindent Figure\refstepcounter{figure} {\arabic{figure}}: \cfigure@caption%
419 \protected@edef\@currentlabel{\arabic{figure}}%
420 \sref@label@id{Figure \thefigure}\fi
421 \end{center}}
422 ⟨/cls⟩
423 ⟨*ltxml⟩
424 DefKeyVal('cfigure','id','Semiverbatim');
425 DefKeyVal('cfigure','name','Semiverbatim');
426 DefKeyVal('cfigure','type','Semiverbatim');
427 DefKeyVal('cfigure','caption','Semiverbatim');
428 DefConstructor('\cfigure OptionalKeyVals:cfigure Semiverbatim Semiverbatim',
429           "<cnx:figure ?&defined(&KeyVal(#1,'id'))(id='&KeyVal(#1,'id')')()>"
430       . "?&defined(&KeyVal(#1,'name'))(<cnx:name>&KeyVal(#1,'name')</cnx:name>\n)()"
431         . "<cnx:media type='&KeyVal(#1,'type')' src='#3'/>"
432       . "?&defined(&KeyVal(#1,'caption'))(<cnx:caption>&KeyVal(#1,'caption')</cnx:caption>\
433        . "</cnx:figure>");
434 ⟨/ltxml⟩
```

ccite

```
435 ⟨*cls⟩
436 \addmetakey{ccite}{src}
437 \newcommand{\ccite}[2][]{\metasetkeys{ccite}{#1}\emph{#2}}
438 ⟨/cls⟩
439 ⟨*ltxml⟩
440 DefKeyVal('ccite','src','Semiverbatim');
441 DefConstructor('\ccite OptionalKeyVals:ccite {}','<cnx:cite %&KeyVals(#1)>#2</cnx:cite>');
442 ⟨/ltxml⟩
```

term

```
443 ⟨*cls⟩
444 \newcommand{\term}[1]{{\bfseries\underline{#1}}}
445 ⟨/cls⟩
446 ⟨*ltxml⟩
447 DefConstructor('\term[]{}',"<cnx:term>#2</cnx:term>");
448 ⟨/ltxml⟩
```

4.7 Metadata

metadata

```
449 ⟨*cls⟩
```

```
450 \addmetakey{metadata}{version}
451 \addmetakey{metadata}{created}
452 \addmetakey{metadata}{revised}
453 \newsavebox{\metadatabox}
454 \newenvironment{metadata}[1][]%
455 {\noindent\hfill\begin{lrbox}{\metadatabox}
456 \begin{minipage}{.8\textwidth}%
457 {\Large\bfseries CNX Module: \cnx@name\hfill\strut}\\[2ex]}%
458 {\end{minipage}\end{lrbox}\fbox{\usebox\metadatabox}\hfill}
459 % \newenvironment{metadata}[1][]%
460 % {\noindent\strut\hfill\begin{lrbox}{\metadatabox}\begin{minipage}{10cm}%
461 % {\strut\hfill\Large\bfseries CNX Module: \cnx@name\hfill\strut}\\[2ex]}%
462 % {\end{minipage}\end{lrbox}\fbox{\usebox\metadatabox}\hfill\strut\\[3ex]}
463 ⟨/cls⟩
464 ⟨*ltxml⟩
465 DefKeyVal('metadata','version','Semiverbatim');
466 DefKeyVal('metadata','created','Semiverbatim');
467 DefKeyVal('metadata','revised','Semiverbatim');
468 DefEnvironment('{metadata}OptionalKeyVals:metadata',
469     "<cnx:metadata>\n"
470   . "<md:version>&KeyVal('#1','version')</md:version>\n"
471   . "<md:created>&KeyVal('#1','created')</md:created>\n"
472   . "<md:revised>&KeyVal('#1','revised')</md:revised>\n"
473   . "#body\n"
474   . "</cnx:metadata>");
475 ⟨/ltxml⟩
```

authorlist

```
476 ⟨*cls⟩
477 \newenvironment{authorlist}{{\bfseries{Authors}:~}}{\\[1ex]}
478 ⟨/cls⟩
479 ⟨*ltxml⟩
480 DefEnvironment('{authorlist}',"<md:authorlist>#body</md:authorlist>");
481 ⟨/ltxml⟩
```

maintainerlist

```
482 ⟨*cls⟩
483 \newenvironment{maintainerlist}{{\bfseries{Maintainers}:~}}{\\[1ex]}
484 ⟨/cls⟩
485 ⟨*ltxml⟩
486 DefEnvironment('{maintainerlist}',"<md:maintainerlist>#body</md:maintainerlist>");
487 ⟨/ltxml⟩
```

cnxauthor

```
488 ⟨*cls⟩
489 \srefaddidkey{auth}
490 \addmetakey{auth}{honorific}
491 \addmetakey{auth}{firstname}
492 \addmetakey{auth}{other}
```

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```
493 ⟨cls⟩ \addmetakey{auth}{surname}
494 ⟨cls⟩ \addmetakey{auth}{lineage}
495 ⟨cls⟩ \addmetakey{auth}{email}
496 ⟨cls⟩ \newcommand{\cnxauthor}[1][]{\metasetkeys{auth}{#1}\auth@first~\auth@sur,}
497 ⟨/cls⟩
498 ⟨*ltxml⟩
499 DefKeyVal('auth','id','Semiverbatim');
500 DefKeyVal('auth','firstname','Semiverbatim');
501 DefKeyVal('auth','surname','Semiverbatim');
502 DefKeyVal('auth','email','Semiverbatim');
503 DefConstructor('\cnxauthor OptionalKeyVals:auth',
504     "<md:author id='&KeyVal('#1','id')'>\n"
505   . "?&defined(&KeyVal(#1,'honorific'))(<md:honorific>&KeyVal('#1','honorific')</md:honorifi
506   . "?&defined(&KeyVal(#1,'firstname'))(<md:firstname>&KeyVal('#1','firstname')</md:firstnam
507   . "?&defined(&KeyVal(#1,'other'))(<md:other>&KeyVal('#1','other')</md:other>\n)()"
508   . "?&defined(&KeyVal(#1,'surname'))(<md:surname>&KeyVal('#1','surname')</md:surname>\n)()"
509        . "?&defined(&KeyVal(#1,'lineage'))(<md:lineage>&KeyVal('#1','lineage')</md:lineag
510        . "?&defined(&KeyVal(#1,'email'))(<md:email>&KeyVal('#1','email')</md:email>\n)()"
511   . "</md:author>\n");
512 ⟨/ltxml⟩
```

maintainer

```
513 ⟨*cls⟩
514 \newcommand{\maintainer}[1][]{\metasetkeys{auth}{#1}\auth@first~\auth@sur,}
515 ⟨/cls⟩
516 ⟨*ltxml⟩
517 DefConstructor('\maintainer OptionalKeyVals:auth',
518     "<md:maintainer id='&KeyVal('#1','id')'>\n"
519   . "?&defined(&KeyVal(#1,'honorific'))(<md:honorific>&KeyVal('#1','honorific')</md:honorifi
520   . "?&defined(&KeyVal(#1,'firstname'))(<md:firstname>&KeyVal('#1','firstname')</md:firstnam
521   . "?&defined(&KeyVal(#1,'other'))(<md:other>&KeyVal('#1','other')</md:other>\n)()"
522   . "?&defined(&KeyVal(#1,'surname'))(<md:surname>&KeyVal('#1','surname')</md:surname>\n)()"
523        . "?&defined(&KeyVal(#1,'lineage'))(<md:lineage>&KeyVal('#1','lineage')</md:lineag
524        . "?&defined(&KeyVal(#1,'email'))(<md:email>&KeyVal('#1','email')</md:email>\n)()"
525   . "</md:maintainer>\n");
526 ⟨/ltxml⟩
```

keywordlist

```
527 ⟨*cls⟩
528 \newenvironment{keywordlist}{\bfseries{Keywords}:~}{\\[1ex]}
529 ⟨/cls⟩
530 ⟨*ltxml⟩
531 DefEnvironment('{keywordlist}',"<md:keywordlist>\n#body\n</md:keywordlist>");
532 ⟨/ltxml⟩
```

keyword

```
533 ⟨*cls⟩
534 \newcommand{\keyword}[1]{#1,}
535 ⟨/cls⟩
```

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```
536 ⟨*ltxml⟩
537 DefConstructor('\keyword {}',"<md:keyword>#1</md:keyword>");
538 ⟨/ltxml⟩
```

cnxabstract

```
539 ⟨*cls⟩
540 \newenvironment{cnxabstract}%
541 {\par\noindent\strut\hfill\begin{minipage}{10cm}{\bfseries{Abstract}:~}}%
542 {\end{minipage}\hfill}
543 ⟨/cls⟩
544 ⟨*ltxml⟩
545 DefEnvironment('{cnxabstract} OptionalKeyVals:cnxabstract',
546        "<md:abstract>\n#body\n</md:abstract>\n");
547 1;
548 ⟨/ltxml⟩
```

Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

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References

[Koh10a] Michael Kohlhase. `metakeys.sty:` *A generic framework for extensible Metadata in LATEX*. Self-documenting LATEX package. Comprehensive TEX Archive Network (CTAN), 2010. URL: `http://www.ctan.org/tex-archive/macros/latex/contrib/stex/metakeys/metakeys.pdf`.

[Koh10b] Michael Kohlhase. `sref.sty:` *Semantic Crossreferencing in LATEX*. Self-documenting LATEX package. Comprehensive TEX Archive Network (CTAN), 2010. URL: `http://www.ctan.org/tex-archive/macros/latex/contrib/stex/sref/sref.pdf`.

[Ste]   *Semantic Markup for LATEX*. Project Homepage. URL: `http://trac.kwarc.info/sTeX/` (visited on 02/22/2011).