

# smultiling.sty: Multilinguality Support for $\text{\LaTeX}$

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## Abstract

The `smultiling` package is part of the  $\text{\LaTeX}$  collection, a version of  $\text{\TeX}/\text{\LaTeX}$  that allows to markup  $\text{\TeX}/\text{\LaTeX}$  documents semantically without leaving the document format, essentially turning  $\text{\TeX}/\text{\LaTeX}$  into a document format for mathematical knowledge management (MKM).

The `smultiling` package adds multilinguality support for  $\text{\LaTeX}$ , the idea is that multilingual modules in  $\text{\LaTeX}$  consist of a module signature together with multiple language bindings that inherit symbols from it, which also account for cross-language coordination.

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# 1 Introduction

We have been using  $\text{\TeX}$  as the encoding for the Semantic Multilingual Glossary of Mathematics (SMGloM; see [Gin+14]). The SMGloM data model has been taxing the representational capabilities of  $\text{\TeX}$  with respect to multilingual support and verbalization definitions; see [Koh14], which we assume as background reading for this note.

## 1.1 $\text{\TeX}$ Module Signatures

(monolingual)  $\text{\TeX}$  had the intuition that the symbol definitions (`\symdef` and `\symvariant`) are interspersed with the text and we generate  $\text{\TeX}$  module signatures (SMS `*.sms` files) from the  $\text{\TeX}$  files. The SMS duplicate “formal” information from the “narrative”  $\text{\TeX}$  files. In the SMGloM, we extend this idea by making the the SMS primary objects that contain the language-independent part of the formal structure conveyed by the  $\text{\TeX}$  documents and there may be multiple narrative “language bindings” that are translations of each other – and as we do not want to duplicate the formal parts, those are inherited from the SMS rather than written down in the language binding itself. So instead of the traditional monolingual markup in Figure 1, we we now advocate the divided style in Figure 2.

```
\begin{module}[id=foo]
\symdef{bar}{BAR}
\begin{definition}[for=bar]
  A \defiii{big}{array}{raster} ( $\bar{\phantom{x}}$ ) is a\ldots, it is much bigger
  than a \defiii[sar]{small}{array}{raster}.
\end{definition}
\end{module}
```

**Example 1:** A module with definition in monolingual  $\text{\TeX}$

We retain the old `module` environment as an intermediate stage. It is still useful for monolingual texts. Note that for files with a module, we still have to extract `*.sms` files. It is not completely clear yet, how to adapt the workflows. We clearly need a `lmh` or editor command that transfers an old-style module into a new-style signature/binding combo to prepare it for multilingual treatment.

## 2 The User Interface

The `smultiling` package accepts all options of the `babel.sty` and just passes them on to it. The options specify which languages can be used in the  $\text{\TeX}$  language bindings.

### 2.1 Multilingual Modules

`modsig` There the `modsig` environment works exactly like the old `module` environment,

```

\usepackage[english,ngerman]{multiling}
\begin{modsig}{foo}
\symdef{bar}{BAR}
\symi{sar}
\end{modsig}

\begin{modnl}[creators=miko,primary]{foo}{en}
\begin{definition}
  A \defiii[bar]{big}{array}{raster} ( $\bar{}$ ) is a\ldots, it is much bigger
  than a \defiii[sar]{small}{array}{raster}.
\end{definition}
\end{modnl}

\begin{modnl}[creators=miko]{foo}{de}
\begin{definition}
  Ein \defiii[bar]{gro"ses}{Feld}{Raster} ( $\bar{}$ ) ist ein\ldots, es
  ist viel gr"o"ser als ein \defiii[sar]{kleines}{Feld}{Raster}.
\end{definition}
\end{modnl}

```

**Example 2:** Multilingual  $\text{\TeX}$  for Figure 1.

only that the `id` attribute has moved into the required argument – anonymous module signatures do not make sense.

`modnl` The `modnl` environment takes two arguments the first is the name of the module signature it provides language bindings for and the second the ISO 639 language specifier of the content language. We add the `primary` key `modnl`, which can specify the primary language binding (the one the others translate from; and which serves as the reference in case of translation conflicts).<sup>1</sup>

`\symi` There is another difference in the multilingual encoding: All symbols are introduced in the module signature, either by a `\symdef` or the new `\symi` macro. `\symi{<name>}` takes a symbol name `<name>` as an argument and reserves that name. The variant `\symi*{<name>}` declares `<name>` to be a primary symbol; see [Koh14] for a discussion.  $\text{\TeX}$  provides variants `\symii` and `\symiii` – and their starred versions – for multi-part names.

## 2.2 Multilingual Definitions and Crossreferencing Terms

We do not need a new infrastructure for defining mathematical concepts, only the realization that symbols are language-independent. So we can use symbols for the coordination of corresponding verbalizations. As the example in Figure 2 already shows, we can just specify the symbol name in the optional argument of the `\defi` macro to establish that the language bindings provide different verbalizations of the same symbol.

For multilingual term references the situation is more complex: For single-word verbalizations we could use `\atrefi` for language bindings. Say we

<sup>1</sup>EdNOTE: @DG: This needs to be implemented in LaTeXML

have introduced a symbol `foo` in English by `\defi{foo}` and in German by `\defi[foo]{Foo}`. Then we can indeed reference it via `\trefi{foo}` and `\atrefi{Foo}{foo}`. But on the one hand this blurs the distinction between translation and “linguistic variants” and on the other hand does not scale to multi-word compounds as `bar` in Figure 2, which we would have to reference as `\atrefiii{gro"ses Feld Raster}{bar}`. To avoid this, the `smultiling` package provides the new macros `\mtrefi`, `\mtrefii`, and `\mtrefiii` for multilingual references. Using this, we can reference `bar` as `\mtrefiii[?bar]{gro"ses}{Feld}{Raster}`, where we use the (up to three) mandatory arguments to segment the lexical constituents.

The first argument is syntactically optional to keep the parallelity to `\*def*` `\*tref*` it specifies the symbol via its name  $\langle name \rangle$  and module name  $\langle mod \rangle$  in a MMT URI  $\langle mod \rangle ? \langle name \rangle$ . Note that MMT URIs can be relative:

1. `foo?bar` denotes the symbol `bar` from module `foo`
2. `foo` the module `foo` (the symbol name is induced from the remaining arguments of `\mtref*`)
3. `?bar` specifies symbol `bar` from the current module

Note that the number suffix `i/ii/iii` indicates the number of words in the actual language binding, not in the symbol name as in `\atref*`.

## 2.3 Multilingual Views

Views receive a similar treatment as modules in the `smultiling` package. A multilingual view consists of a view signature marked up with the `viewsig` environment. This takes three required arguments: a view name, the source module, and the target module. The optional first argument is for metadata (display, title, creators, and contributors) and load information (frompath, fromrepos, topath, and torepos).<sup>2</sup>

```
\begin{viewsig}[creators=miko,]{norm-metric}{metric-space}{norm}
  \vassign{base-set}{base-set}
  \vassign{metric}{\funcdot{x,y}{\norm{x-y}}}
\end{viewsig}
```

Views have language bindings just as modules do, in our case, we have

```
\begin{gviewnl}[creators=miko]{norm-metric}{en}{norm}{metric-space}
  \obligation{metric-space}{obl.norm-metric.en}
  \begin{assertion}[type=obligation,id=obl.norm-metric.en]
    $\defeq{d(x,y)}{\norm{x-y}}$ is a \trefii[metric-space]{distance}{function}
  \end{assertion}
  \begin{sproof}[for=obl.norm-metric.en]
    {we prove the three conditions for a distance function:}
    ...
  \end{sproof}
```

<sup>2</sup>EdNOTE: MK: that does not work yet, what we describe here is `mhviewig`; we need to refactor further.

`\end{gviewnl}`

### 3 Implementation

Technically, the `smultiling` package is essentially a wrapper around the `babel` package but allows specification of languages by their ISO 639 language codes.

#### 3.1 Class Options

To initialize the `smultiling` class, we pass on all options to `babel.cls` and record which languages are loaded by defining `\smul@⟨language⟩@loaded` macros.<sup>3</sup>

The `langfiles` option specifies that for a module `⟨mod⟩`, the module signature file has the name `⟨mod⟩.tex` and the language bindings of language with the ISO 639 language specifier `⟨lang⟩` have the file name `⟨mod⟩.⟨lang⟩.tex`.<sup>4</sup>

```

1 ⟨*sty⟩
2 \newif\if@langfiles\@langfilesfalse
3 \DeclareOption{langfiles}{\@langfilestrue}
4 \DeclareOption*{\PassOptionsToPackage{\CurrentOption}{babel}}
5 \@namedef{smul@\CurrentOption @loaded}{yes}
6 \ProcessOptions
7 ⟨/sty⟩
8 ⟨*ltxml⟩
9 # -*- CPERL -*-
10 package LaTeXML::Package::Pool;
11 use strict;
12 use LaTeXML::Package;
13 DeclareOption('langfiles',sub {AssignValue('smultiling_langfiles',1,'global');});
14 DeclareOption(undef,sub {PassOptions('babel','sty',ToString(Digest(T_CS('\CurrentOption')))); });
15 ProcessOptions();
16 ⟨/ltxml⟩

    We load babel.sty

17 ⟨*sty⟩
18 \RequirePackage{etoolbox}
19 \RequirePackage{babel}
20 \RequirePackage{modules}
21 ⟨/sty⟩
22 ⟨*ltxml⟩
23 RequirePackage('babel');
24 RequirePackage('modules');
25 ⟨/ltxml⟩

```

#### 3.2 Handling Languages

`\smul@select@language` This macro selects one of the registered languages by its language code by setting the internal `\smul@lang` macro to the argument and then runs the actual selection

<sup>3</sup>EDNOTE: @DG: We also want to do that in  $\LaTeX$ ML

<sup>4</sup>EDNOTE: implement other schemes, e.g. the onefile scheme.

code in `\smul@select@lang`. This internal code register is only initialized there, the code is generated by the `\smul@register@language` macro below.

```

26 <*sty>
27 \newcommand\smul@select@lang{}
28 \newcommand\smul@select@language[1]{\def\smul@lang{#1}\smul@select@lang}

\smul@register@language \smul@register@language{<lang>}{<babel>} registers the babel language name
<babel> with its ISO 639 language code <lang> by extending the \smul@select@language
macro.

29 \newcommand\smul@register@language[2]%
30 {\@ifundefined{smul@#1@loaded}{\appto\smul@select@lang%
31 {\expandafter\ifstrequal\expandafter\smul@lang{#1}{\selectlanguage{#2}}{}}}}
32 </sty>
33 <!txml>
34 DefConstructor(' \smul@register@language{}{}', '');
35 </txml>

```

Now we register a couple of languages for which we have `babel` support. Maybe we have to extend this list with others. But then we have to extend the mechanisms.

```

36 <!txml>RawTeX('
37 <*sty | !txml>
38 \smul@register@language{af}{afrikaans}
39 \smul@register@language{de}{ngerman}
40 \smul@register@language{fr}{french}
41 \smul@register@language{he}{hebrew}
42 \smul@register@language{hu}{hungarian}
43 \smul@register@language{id}{indonesian}
44 \smul@register@language{ms}{malay}
45 \smul@register@language{nn}{nynorsk}
46 \smul@register@language{pt}{portuguese}
47 \smul@register@language{ru}{russian}
48 \smul@register@language{uk}{ukrainian}
49 \smul@register@language{en}{english}
50 \smul@register@language{es}{spanish}
51 \smul@register@language{sq}{albanian}
52 \smul@register@language{bg}{bulgarian}
53 \smul@register@language{ca}{catalan}
54 \smul@register@language{hr}{croatian}
55 \smul@register@language{cs}{czech}
56 \smul@register@language{da}{danish}
57 \smul@register@language{nl}{dutch}
58 \smul@register@language{eo}{esperanto}
59 \smul@register@language{et}{estonian}
60 \smul@register@language{fi}{finnish}
61 \smul@register@language{ka}{georgian}
62 \smul@register@language{el}{greek}
63 \smul@register@language{is}{icelandic}
64 \smul@register@language{it}{italian}
65 \smul@register@language{la}{latin}

```

```

66 \smul@register@language{no}{norsk}
67 \smul@register@language{pl}{polish}
68 \smul@register@language{sr}{serbian}
69 \smul@register@language{sk}{slovak}
70 \smul@register@language{sl}{slovenian}
71 \smul@register@language{sv}{swedish}
72 \smul@register@language{th}{thai}
73 \smul@register@language{tr}{turkish}
74 \smul@register@language{vi}{vietnamese}
75 \smul@register@language{cy}{welsh}
76 \smul@register@language{hi}{hindi}

```

### 3.3 Signatures

**modsig** The `modsig` environment is just a layer over the `module` environment. We also redefine macros that may occur in module signatures so that they do not create markup.

```

77 \newenvironment{modsig}[2] [] {%
78 \def\@test{#1}\ifx\@test\@empty\begin{module}[id=#2]\else\begin{module}[id=#2,#1]\fi}
79 {\end{module}}

```

**viewsig** The `viewsig` environment is just a layer over the `view` environment with the keys suitably adapted.

```

80 \newenvironment{viewsig}[4] [] {\def\@test{#1}\ifx\@test\@empty%
81 \begin{view}[id=#2,ext=tex]{#3}{#4}\else\begin{view}[id=#2,#1,ext=tex]{#3}{#4}\fi}
82 {\end{view}}

```

**mhviewsig** The `mhviewsig` environment is just a layer over the `mhview` environment with the keys suitably adapted.

```

83 \newenvironment{mhviewsig}[4] [] {\def\@test{#1}\ifx\@test\@empty%
84 \begin{mhview}[id=#2,ext=tex]{#3}{#4}\else\begin{mhview}[id=#2,#1,ext=tex]{#3}{#4}\fi}
85 {\end{mhview}}
86 \<sty | ltxml>
87 \<ltxml>');

```

**\@sym\*** has a starred form for primary symbols.

```

88 \<sty>
89 \newcommand\symi{\@ifstar\@symi@star\@symi}
90 \newcommand\@symi[1]{\if@importing\else Symbol: \textsf{#1}\fi}
91 \newcommand\@symi@star[1]{\if@importing\else Primary Symbol: \textsf{#1}\fi}
92 \newcommand\symii{\@ifstar\@symii@star\@symii}
93 \newcommand\@symii[2]{\if@importing\else Symbol: \textsf{#1-#2}\fi}
94 \newcommand\@symii@star[2]{\if@importing\else Primary Symbol: \textsf{#1-#2}\fi}
95 \newcommand\symiii{\@ifstar\@symiii@star\@symiii}
96 \newcommand\@symiii[3]{\if@importing\else Symbol: \textsf{#1-#2-#3}\fi}
97 \newcommand\@symiii@star[3]{\if@importing\else Primary Symbol: \textsf{#1-#2-#3}\fi}
98 \</sty>
99 \<ltxml>
100 DefConstructor('\symi OptionalMatch:* {}',

```



```

101      "<omdoc:symbol ?#1(role='primary')(role='secondary') name='#2'/>");
102 DefConstructor('\symii OptionalMatch:* {} {}',
103      "<omdoc:symbol ?#1(role='primary')(role='secondary') name='#2-#3'/>");
104 DefConstructor('\symiii OptionalMatch:* {} {} {}',
105      "<omdoc:symbol ?#1(role='primary')(role='secondary') name='#2-#3-#4'/>");
106 </ltxml>

```

### 3.4 Language Bindings

modnl:\*

```

107 <*sty>
108 \addmetakey{modnl}{load}
109 \addmetakey*{modnl}{title}
110 \addmetakey*{modnl}{creators}
111 \addmetakey*{modnl}{contributors}
112 \addmetakey{primary}{contributors}[yes]
113 </sty>
114 <*ltxml>
115 DefKeyVal('modnl','title','Semiverbatim');
116 DefKeyVal('modnl','load','Semiverbatim');
117 DefKeyVal('modnl','creators','Semiverbatim');
118 DefKeyVal('modnl','contributors','Semiverbatim');
119 DefKeyVal('modnl','primary','Semiverbatim');
120 </ltxml>

```

modnl The modnl environment is just a layer over the module environment and the \importmodule macro with the keys and language suitably adapted.

```

121 <*sty>
122 \newenvironment{modnl}[3][[]{\metasetkeys{modnl}{#1}%
123 \smul@select@language{#3}%
124 \def\@test{#1}\ifx\@test\@empty\begin{module}[id=#2.#3]\else\begin{module}[id=#2.#3,#1]\fi%
125 \if@langfiles\importmodule[load=#2,ext=tex]{#2}\else
126 \ifx\modnl@load\@empty\importmodule{#2}\else\importmodule[ext=tex,load=\modnl@load]{#2}\fi%
127 \fi}
128 {\end{module}}
129 </sty>
130 <*ltxml>
131 DefEnvironment('{modnl} OptionalKeyVals:modnl {}{}',
132      '?#excluded()(<omdoc:theory '
133      . 'xml:id="#2.#3">'
134      . '?&defined(&GetKeyVal(#1,"creators"))(<dc:creator>&GetKeyVal(#1,"creators")</dc:cr
135      . '?&defined(&GetKeyVal(#1,"title"))(<dc:title>&GetKeyVal(#1,"title")</dc:title>())'
136      . '?&defined(&GetKeyVal(#1,"contributors"))(<dc:contributor>&GetKeyVal(#1,"contribut
137      . '<omdoc:imports from=?&GetKeyVal(#1,"load")(&canonical_omdoc_path(&GetKeyVal(#1,"
138      . '#body'
139      . '</omdoc:theory>)',
140      afterDigestBegin=>sub {
141      my ($stomach, $whatsit) = @_;

```

```

142 my $keyval = $whatsit->getArg(1);
143 my $signature = ToString($whatsit->getArg(2));
144 my $language = ToString($whatsit->getArg(3));
145 if ($keyval) {
146     # If we're not given load, AND the langfiles option is in effect,
147     # default to #2
148     if ((! $keyval->getValue('load')) && (LookupValue('smultiling_langfiles')))) {
149         $keyval->setValue('load',$signature); }
150     # Always load a TeX file
151     $keyval->setValue('ext','tex');
152     $keyval->setValue('id',"$signature.$language"); }
153 module_afterDigestBegin(@_);
154 importmoduleI(@_);
155 return; },
156 afterDigest =>\&module_afterDigest );
157 </ltxml>%$

```

mhmodnl:\*

```

158 <*sty>
159 \addmetakey{mhmodnl}{repos}
160 \addmetakey{mhmodnl}{path}
161 \addmetakey*{mhmodnl}{title}
162 \addmetakey*{mhmodnl}{creators}
163 \addmetakey*{mhmodnl}{contributors}
164 \addmetakey{primary}{contributors}[yes]
165 </sty>
166 <*ltxml>
167 DefKeyVal('mhmodnl','title','Semiverbatim');
168 DefKeyVal('mhmodnl','repos','Semiverbatim');
169 DefKeyVal('mhmodnl','path','Semiverbatim');
170 DefKeyVal('mhmodnl','creators','Semiverbatim');
171 DefKeyVal('mhmodnl','contributors','Semiverbatim');
172 DefKeyVal('mhmodnl','primary','Semiverbatim');
173 </ltxml>

```

mhmodnl The mhmodnl environment is just a layer over the module environment and the \importmhmodule macro with the keys and language suitably adapted.

```

174 <*sty>
175 \newenvironment{mhmodnl}[3][\metasetkeys{mhmodnl}{#1}%
176 \smul@select@language{#3}%
177 \def\@test{#1}\ifx\@test\@empty\begin{module}[id=#2.#3]\else\begin{module}[id=#2.#3,#1]\fi%
178 \edef\@repos{\ifx\mhmodnl@repos\@empty\mh@currentrepos\else\mhmodnl@repos}
179 \if@langfiles\importmhmodule[repos=\@repos,load=#2,ext=tex]{#2}\else
180 \ifx\mhmodnl@load\@empty\importmodule{#2}\else\importmodule[ext=tex,load=\mhmodnl@load]{#2}\fi%
181 \fi}
182 {\end{module}}
183 </sty>
184 <*ltxml>
185 DefEnvironment('mhmodnl OptionalKeyVals:mhmodnl {}{}',
186               '?#excluded()(<omdoc:theory '

```

```

187 . 'xml:id="#2.#3" >'
188 . '?&defined(&GetKeyVal(#1,"creators"))(<dc:creator>&GetKeyVal(#1,"creators")</dc:cr
189 . '?&defined(&GetKeyVal(#1,"title"))(<dc:title>&GetKeyVal(#1,"title")</dc:title>())'
190 . '?&defined(&GetKeyVal(#1,"contributors"))(<dc:contributor>&GetKeyVal(#1,"contribut
191 . '<omdoc:imports from="?&GetKeyVal(#1,"load")(&canonical_omdoc_path(&GetKeyVal(#1,"
192 . '#body'
193 . '</omdoc:theory>)',
194 afterDigestBegin=>sub {
195   my ($stomach, $whatsit) = @_;
196   my $keyval = $whatsit->getArg(1);
197   my $signature = ToString($whatsit->getArg(2));
198   my $language = ToString($whatsit->getArg(3));
199   my $repos = ToString(GetKeyVal($keyval,'torepos'));
200   my $current_repos = LookupValue('current_repos');
201   if (!$repos) { $repos = $current_repos; }
202   my $defpaths = LookupValue('defpath');
203   my $load_path = ($$defpaths{MathHub}).$repos.'/source/'. $signature;
204
205   if ($keyval) {
206     # If we're not given load, AND the langfiles option is in effect,
207     # default to #2
208     if ((! $keyval->getValue('path')) && (LookupValue('smultiling_langfiles')) {
209       $keyval->setValue('load',$load_path); }
210     # Always load a TeX file
211     $keyval->setValue('ext','tex');
212     $keyval->setValue('id'," $signature.$language"); }
213   module_afterDigestBegin(@_);
214   importmoduleI(@_);
215   return; },
216 afterDigest=>sub {
217   module_afterDigest(@_); });
218 </ltxml>%$

```

EdN:5

**viewn1** The **viewn1** environment is just a layer over the **viewsketch** environment with the keys and language suitably adapted.<sup>5</sup>

```

219 <ltxml>RawTeX('
220 <*sty | ltxml>
221 \newenvironment{viewn1}[5][\def@test{#1}\ifx@test@empty%
222 \begin{viewsketch}[id=#2.#3,ext=tex]{#4}{#5}\else%
223 \begin{viewsketch}[id=#2.#3,#1,ext=tex]{#4}{#5}\fi%
224 \smul@select@language{#3}}
225 {\end{viewsketch}}

```

EdN:6

**mhviewn1** The **mhviewn1** environment is just a layer over the **mhviewsketch** environment with the keys and language suitably adapted.<sup>6</sup>

<sup>5</sup>EDNOTE: MK: we have to do something about the if@langfiles situation here. But this is non-trivial, since we do not know the current path, to which we could append `.<lang>!`

<sup>6</sup>EDNOTE: MK: we have to do something about the if@langfiles situation here. But this is non-trivial, since we do not know the current path, to which we could append `.<lang>!`

```

226 \newenvironment{mhviewnl}[5][\def\@test{#1}\ifx\@test\@empty%
227 \begin{mhviewsketch}[id=#2.#3,ext=tex]{#4}{#5}\else%
228 \begin{mhviewsketch}[id=#2.#3,#1,ext=tex]{#4}{#5}\fi%
229 \smul@select@language{#3}}
230 {\end{mhviewsketch}}
231 \</sty | ltxml>
232 \ltxml');

```

### 3.5 Multilingual Statements and Terms

**\mtref\*** we first first define an auxiliary conditional `\@instring` that checks if `?` is in the first argument. `\mtrefi` uses it, if there is one, it just calls `\termref`, otherwise it calls `\@mtrefi`, which assembles the `\termref` after splitting at the `?`.

```

233 \ltxmlRawTeX('
234 \*sty | ltxml>
235 \def\@instring#1#2{TT\fi\begin{group}\edef\x{\end{group}\noexpand\in@{#1}{#2}}\x\ifin@}
236 \newcommand\mtrefi[2][\if\@instring{?}{#1}\@mtref #1\relax{#2}\else\termref[cd=#1]{#2}\fi}
237 \def\@mtref#1?#2\relax{\termref[cd=#1,name=#2]}
238 \newcommand\mtrefii[3][\mtrefi[#1]{#2 #3}]
239 \newcommand\mtrefiii[4][\mtrefi[#1]{#2 #3 #4}]
240 \</sty | ltxml>
241 \ltxml');

```

### 3.6 Finale

Finally, we need to terminate the file with a success mark for perl.

```

242 \ltxml>1;

```

## References

- [Gin+14] Deyan Ginev et al. “The SMGLoM Project and System”. 2014. URL: <http://kwarc.info/kohlhase/submit/cicm14-smglom-system.pdf>.
- [Koh14] Michael Kohlhase. “A Data Model and Encoding for a Semantic, Multilingual Glossary of Mathematics”. In: *Intelligent Computer Mathematics*. Conferences on Intelligent Computer Mathematics. (Coimbra, Portugal, July 7–11, 2014). Ed. by Stephan Watt et al. Lecture Notes in Computer Science. accepted. Springer, 2014. URL: <http://kwarc.info/kohlhase/submit/cicm14-smglom-datamd1.pdf>. Forthcoming.