

# **structview.sty: Structures and Views in $\text{\LaTeX}$ \***

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## **Abstract**

The **structview** 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).

This package supplies infrastructure for OMDoc structures and views: complex semantic relations between modules/theories.

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# 1 Introduction

Structures and views constitute ways of defining and relating theories in a theory graph that considerably extend the “object-oriented inheritance” constituted by the imports relation given by the `STEX module` package.

Structures are like imports, only that they allow to define new theories via inheritance with renaming. Views relate pre-existing theories and model conceptual refinements, framing, and implementation relations, again via a mapping between the languages defined by the source and target theories; we call these mappings **theory morphisms**.

For details about theory morphisms we refer to [RK13], but hope to make the underlying concepts clear with examples.

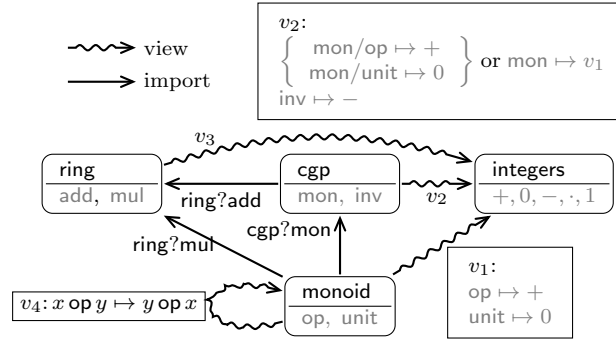


Figure 1: A Theory Graph with Structures and Views

## 2 The User Interface

The main contributions of the `modules` package are the `module` environment, which allows for lexical scoping of semantic macros with inheritance and the `\symdef` macro for declaration of semantic macros that underly the `module` scoping.

### 2.1 Package Options

`mh` The `mh` option turns on MathHub support.

### 2.2 Theory Morphisms

A theory morphism is a mapping between the languages of its source and target theory. This can be described mathematically using all the structures in the

<sup>1</sup>EDNOTE: explain the contribution of structures and views to theory graphs and synchronize with Figure 1.

gT<sub>E</sub>X distribution. However, in many situations, the language transformation of a morphism can be given in form of **assignments** that map symbols of the source theory to expressions of the target theory.

There are three kinds assignments:<sup>2</sup>

`\vassign` **symbol assignments** via `\vassign{⟨sym⟩}{⟨exp⟩}`, which maps a symbol  $\langle sym \rangle$  from source theory an expression  $\langle exp \rangle$  in the target theory.  
`\fassign` **function assignments** via `\fassign{⟨bvars⟩}{⟨pat⟩}{⟨exp⟩}`, is a variant which maps a function symbol  $\langle sym \rangle$  by mapping a pattern expression  $\langle pat \rangle$  ( $\langle sym \rangle$  applied to  $\langle bvars \rangle$ ) to an expression  $\langle exp \rangle$  in the target theory on bound variables  $\langle bvars \rangle$ .  
`\tassign` **term assignments** via `\tassign{⟨sym⟩}{⟨tname⟩}`, another special case, where the value is the symbol with name  $\langle tname \rangle$  in the target theory.

Figure 1 shows a concrete example<sup>3</sup>

The assignments above can be seen as abbreviations for a simple, formal definitions, which define a symbol of the source theory by an expression in the target theory.

## 2.3 Structures

`structure` Structures are specified by the `structure`<sup>1</sup> environment:

`\begin{structure}[⟨keys⟩]{⟨name⟩}{⟨sthy⟩}{⟨morph⟩}\end{structure}`

gives the structure the name  $\langle name \rangle$ , specifies the “source theory” via its identifier  $\langle sthy \rangle$ , and the morphism  $\langle morph \rangle$ . The `structure` environment takes the same keys as the `\importmodule` macro, which it generalizes. The morphism  $\langle morph \rangle$  in the body of the `structure` environment specifies the morphism (see 2.2 above). In a structure, we take the target theory to be the current theory.

## 2.4 Views

A view is a mapping between modules, such that all model assumptions (axioms) of the source module are satisfied in the target module.<sup>4</sup>

# 3 Limitations & Extensions

In this section we will discuss limitations and possible extensions of the `modules` package. Any contributions and extension ideas are welcome; please discuss ideas, requests, fixes, etc on the gT<sub>E</sub>X TRAC [[sTeX:online](#)].

<sup>2</sup>EdNOTE: MK: we need better macros here.

<sup>3</sup>EdNOTE: adapt when we fully understand this, and the implementation works.

<sup>1</sup>The old `\importmodulevia` environment is now deprecated.

<sup>4</sup>EdNOTE: Document and make Examples

```

\begin{module}[id=ring]
\symdef{rbase}{R}
\symdef{rtimes}[2]{\infix\cdot{#1}{#2}}
\symdef{rone}{1}
\begin{structure}{mul}{monoid}
\tassign{magbase}{rbase}
\fassign{a,b}{\magmaop{a}b}{\rtimes{a}b}
\tassign{monunit}{rone}
\end{structure}
\symdef{rplus}[2]{\infix+{#1}{#2}}
\symdef{rminus}[1]{\infix-{#1}{#2}}
\begin{structure}{add}{cgroup}
\fassign{a,b}{\magmaop{a}b}{\rplus{a}b}
\tassign{monunit}{rzero}
\tassign{cginvOp}{\rminus}
\end{structure}
...
\end{module}

```

**Example 1:** A Module for Rings with inheritance from monoids and commutative groups

## 4 The Implementation

### 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). The options we are not using, we pass on to the `sref` package we require next.

```

1 <*package>
2 \newif\if@structview@mh@\@structview@mh@false
3 \DeclareOption{mh}{\@structview@mh@true}
4 \PassOptionsToPackage{\CurrentOption}{modules}
5 \DeclareOption*{\PassOptionsToPackage{\CurrentOption}{modules}}
6 \ProcessOptions

```

The next measure is to ensure that the `sref` and `xcomment` packages are loaded (in the right version). For L<sup>A</sup>T<sub>E</sub>X<sub>M</sub>L, we also initialize the package inclusions.

```

7 \if@structview@mh@\RequirePackage{structview-mh}\fi
8 \RequirePackage{modules}

```

### 4.2 Theory Morphisms by Assignments

5

\\*assign

---

<sup>5</sup>EDNOTE: probably get rid of the optional argument

```

9 \newrobustcmd\vassign[3] []{\ifmod@show\ensuremath{#2\mapsto #3}, \fi}%
10 \newrobustcmd\fassign[4] []{\ifmod@show \ensuremath{#3(#2)\mapsto #4}, \fi}%
11 \newrobustcmd\tassign[3] []{\ifmod@show \ensuremath{#2\mapsto} #3, \fi}%

```

### 4.3 Structures

**structure** The `structure` environment just calls `\importmodule`, but to get around the group, we first define a local macro `\@@doit`, which does that and can be called with an `\aftergroup` to escape the environment grouping introduced by `structure`.

```

12 \newenvironment{structure}[3] []{%
13   \gdef\@@doit{\importmodule[#1]{#3}}%
14   \ifmod@show\par\noindent importing module #3 via \@@doit\fi%
15 }{%
16   \aftergroup\@@doit\ifmod@show end import\fi%
17 }%

```

**importmodulevia** This is now deprecated, we give an error, but punt to `structure`.

```

18 \newenvironment{importmodulevia}[2] []%
19 {\PackageError{structview}%
20  {The {importmodulevia} environment is deprecated}{use the {structure} instead!}%
21  \begin{structure}[#1]{missing}{#2}}
22 {\end{structure}}

```

### 4.4 Views

We first prepare the ground by defining the keys for the `view` environment.

```

23 \srefaddidkey{view}
24 \addmetakey*{view}{title}
25 \addmetakey{view}{display}
26 \addmetakey{view}{from}
27 \addmetakey{view}{to}
28 \addmetakey{view}{creators}
29 \addmetakey{view}{contributors}
30 \addmetakey{view}{srccite}
31 \addmetakey{view}{type}
32 \addmetakey[sms]{view}{ext}

```

**\view@heading** Then we make a convenience macro for the view heading. This can be customized.

```

33 \newcounter{view}[section]
34 \newrobustcmd\view@heading[4]{%
35   \if@importing%
36     \else%
37       \stepcounter{view}%
38       \edef\@display{#3}\edef\@title{#4}%
39       \noindent%
40       \ifx\@display\st@flow%
41         \else%

```

```

42      {\textbf{View} {\thesection.\theview} from \textsf{#1} to \textsf{#2}}}%
43      \sref@label{id{View \thesection.\theview}}%
44      \ifx\@title\@empty%
45          \quad%
46      \else%
47          \quad(\@title)%
48      \fi%
49      \par\noindent%
50      \fi%
51      \ignorespaces%
52  \fi%
53 }%ifmod@show

```

**view** The `view` environment relies on the `@view` environment (used also in the `STEX` module signatures) for module bookkeeping and adds presentation (a heading and a box) if the `showmods` option is set.

```

54 \newenvironment{view}[3][]{%
55   \metasetkeys{view}{#1}%
56   \sref@target%
57   \begin{@view}{#2}{#3}%
58   \view@heading{#2}{#3}{\view@display}{\view@title}%
59 }{%
60   \end{@view}%
61   \ignorespaces%
62 }%
63 \ifmod@show\surroundwithmdframed{view}\fi%

```

**@view** The `@view` does the actual bookkeeping at the module level.

```

64 \newenvironment{@view}[2]{%from, to
65   \@importmodule[\view@from]{#1}{\view@ext}%
66   \@importmodule[\view@to]{#2}{\view@ext}%
67 }{}%

```

**viewsketch** The `viewsketch` environment behaves like `view`, but only has text contents.

```

68 \newenvironment{viewsketch}[3][]{%
69   \metasetkeys{view}{#1}%
70   \sref@target%
71   \begin{@view}{#2}{#3}%
72   \view@heading{#2}{#3}{\view@display}{\view@title}%
73 }{%
74   \end{@view}%
75 }%
76 \ifmod@show\surroundwithmdframed{viewsketch}\fi%

```

EdN:6      **\obligation** The `\obligation` element does not do anything yet on the latexml side.<sup>6</sup>

```

77 \newrobustcmd\obligation[3][]{%
78   \if@importing%

```

---

<sup>6</sup>EdNOTE: document above

```
79 \else Axiom #2 is proven by \sref{#3}%  
80 \fi%  
81 }%  
82 \end{package}
```