

structview.sty: Structures and Views in \LaTeX^*

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Abstract

The **structview** package is part of the \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.

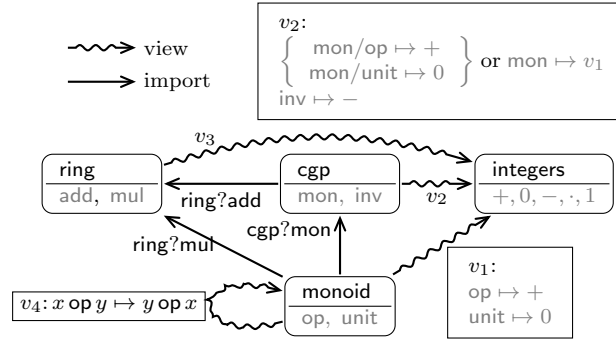


Figure 1: A Theory Graph with Structures and Views

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

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

LaTeX 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:²

\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 example³

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 `sstructure`¹ environment:

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

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. For marking up views the **structview** package supplies the **view** environment; see Figure 2 for the LaTeX markup of view v_1 from Figure 1. The **view** environment takes one optional key/value argument followed by two mandatory ones: the names of the source and target modules. The **view** environment takes the following keys: **id** for a name, **title** and **display** for visual presentation, **loadfrom**, **loadto**, and **ext**⁴ for specifying the source files that supply the source and target modules, **creators**, **contributors**, **src cite** for document metadata, and **type**⁵.

²EdNOTE: MK: we need better macros here.

³EdNOTE: adapt when we fully understand this, and the implementation works.

¹The old `importmodulevia` environment is now deprecated.

⁴EdNOTE: MK: we probably need `toext` and `fromext` here, but this never came up yet.

⁵EdNOTE: ????

```

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

```

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

```

\begin{view}{monoid}{integers}
\vassign{magbase}{base}
\fassign{a,b}{\magmaop{a}b}{\inttimes{a,b}}
\tassign{monunit}{\intzero}
\begin{assertion}
The Integers with addition form a monoid in the obvious way.
\end{assertion}
\end{view}

```

Example 2: A view from monoids to integers

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 `sTeX` TRAC [[sTeX:online](#)].

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 \langle*package\rangle
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 `LATeXML`, we also initialize the package inclusions.

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

4.2 Theory Morphisms by Assignments

EdN:6

```
\*assign 6
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

`sstructure` 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{sstructure}[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 }%
```

⁶EdNOTE: probably get rid of the optional argument

`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 {sstructure} instead!}%
21 \begin{sstructure}[#1]{missing}{#2}}
22 {\end{sstructure}}

```

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}{loadfrom}
27 \addmetakey{view}{loadto}
28 \addmetakey{view}{creators}
29 \addmetakey{view}{contributors}
30 \addmetakey{view}{srccite}
31 \addmetakey{view}{type}
32 \addmetakey[sms]{view}{fromext}
33 \addmetakey[sms]{view}{toext}

```

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

```

34 \newcounter{view}[section]
35 \newrobustcmd\view@heading[4]{%
36   \if@importing%
37   \else%
38     \stepcounter{view}%
39     \edef\@display{#3}\edef\@title{#4}%
40     \noindent%
41     \ifx\@display\st@flow%
42     \else%
43       {\textbf{View} {\thesecion.\theview} from \textsf{#1} to \textsf{#2}}%
44       \sref@label{id{View \thesecion.\theview}}%
45       \ifx\@title\@empty%
46         \quad%
47       \else%
48         \quad(\@title)%
49       \fi%
50       \par\noindent%
51     \fi%
52     \ignorespaces%
53   \fi%
54 }%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.

```

55 \newenvironment{view}[3] []{% keys, from, to

```

```

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

```

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

```

65 \newenvironment{@view}[2]{%from, to
66 \@importmodule[\view@loadfrom]{#1}{\view@ext}%
67 \@importmodule[\view@loadto]{#2}{\view@ext}%
68 \csxdef{views@\view@id @from}{#1}%
69 \csxdef{views@\view@id @to}{#2}%
70 \csxdef{views@\view@id @loadfrom}{\view@loadfrom}%
71 \csxdef{views@\view@id @loadto}{\view@loadto}%
72 }{}%

```

viewsketch The viewsketch environment is deprecated, we give an error

```

73 \newenvironment{viewsketch}[3][]{%
74 {\PackageError{structview}%
75 {The {viewsketch} environment is deprecated}{use the {view} instead!}%
76 \begin{view}[#1]{#2}{#3}}
77 {\end{view}}

```

EdN:7 **\obligation** The \obligation element does not do anything yet on the latexml side.⁷

```

78 \newrobustcmd\obligation[3][]{%
79 \if@importing%
80 \else Axiom #2 is proven by \sref{#3}%
81 \fi%
82 }%
83 \</package>

```

⁷EdNOTE: document above