The external package: A package for including into a document separately compiled LaTeX*

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Abstract

The external package allows you to include into a document the result of compiling LaTeX code in a separate document that has its own preamble. This is useful when you want to use symbols from packages that you do not want to load into your main document. For example, your main document may use symbols from multiple packages that conflict or otherwise cannot be loaded together.

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1 Introduction

The `external` package allows you to include into a document the result of compiling LaTeX code in a separate document that has its own preamble. For example, you may want to use symbols from packages that cannot be loaded at the same time. By compiling them in separate documents and then including their compiled results in a master document, this allows you to use both symbols without conflicts.

This document serves as both the documentation and test suite for the `external` package.

1.1 Quick Start

Suppose you want to use the `\textbeta` symbol from the `textgreek` package, but you do do not want to load the `textgreek` package into your master document. (Maybe it is incompatible with some other package that you use or maybe LaTeX has run out of space for declaring new fonts.) You can render `\textbeta` using the `\external` → P. 6 command as in the following.

```
An atom undergoing
\external[preamble={\usepackage{textgreek}}]{\textbeta-decay}
can emit an electron.
```

An atom undergoing β-decay can emit an electron.

If you prefer, you can also use the environment `externalenv` → P. 6 as in the following.

```
An atom undergoing
\begin{externalenv}[preamble={\usepackage{textgreek}}]
\textbeta-decay
\end{externalenv}
~can emit an electron.
```

An atom undergoing β-decay can emit an electron.

The only difference between the command `\external` → P. 6 and the environment `externalenv` → P. 6 is that one is a command and the other is an environment.

If you want to format the LaTeX code as "display" math, use the `math=display` option as in the following example.

```
The solution to the two dimensional integral
\external[preamble={\usepackage{amsmath}}, math=display]
  {\iint xy\,dx\,dy}
involves $x^2$ and $y^2$.
```

The solution to the two dimensional integral

$$\iint xy\,dx\,dy$$

involves x^2 and y^2.

Note that even though these examples are compiled as separate LaTeX documents, they are automatically properly spaced relative to the surrounding text. In the resulting PDF, they even behave properly with regard to copy-and-paste.

For example, in the following, it is impossible to tell the difference between the "B" generated from `\external` → P. 6 and the one that is not.

```
ABC A\external{B}C
```

ABC ABC

However, there is a limitation to this when it comes to kerning and ligatures. For example, in the following, due to kerning "T" and "e" have a different amount of space between them when using `\external` → P. 6 and when not, and putting the second "f" in an `\external` → P. 6 command breaks up the "ffi" ligature.

```
Teffi T\external{e}f\external{f}i
```

Teffi Teffi

See Section 4 more details about options and Section 5 for common issues and their workarounds.

1.2 Notation

For debugging purposes, this documentation surrounds most examples with < and >, which are customized to render as ⎸ and ⎹. These are used as a gauge or registration mark. This makes it easy to see whether there is extra space to the left or right of a symbol and whether parts of the symbol extend below the baseline. The bottom of the bottom bar is at the baseline. The top of the top, middle and bottom bars are at the font size (10 points), where the top of an "M" would occur, and where the top of an "x" would occur, respectively. This is demonstrated in the following example.

1.3 Related Packages

There are a number of packages that provide similar functionality to that of `external`. The main distinguishing features of `external` is that it allows preambles to be specified for the externally compiled code and that it does exact sizing and spacing when the compiled code is included.

1.3.1 Externalization

A number of packages allow specified parts of a document to be "externalized" by compiling those parts as a separate LaTeX documents and then including the result in the master document. However, none of these allow those document parts to have a separate preamble.

`tikz` Contains the `external` library, which caches the results of compiling each `tikzpicture` in order to improve later compilation times. Has no support for those pictures having different preambles from the main document.

`pgfplots` Contains the `external` library as a counterpart to the `tikz external` library.

`preview` Allows extracting certain environments from LaTeX sources as graphics. Intended for rendering "preview" versions of parts of a document and used as part of `preview-latex` and AUCTeX. Does not support custom preambles or exact sizing.

1.3.2 Miniature Documents

`minidocument` Provides the `minidocument` environment, which allows an entire miniature document to be embedded including a separate `\documentclass` and preamble. However, it assumes documents are entire pages and does not support exact spacing.

1.3.3 Ignoring Preambles

Several packages allow sub-documents to be included into a master document. These sub-documents are full fledged LaTeX documents that can be compiled on their own, but when they are included into the master document, either their preamble or specified parts are ignored. These packages are geared towards helping authors manage large documents that otherwise take a long time to compile (e.g., a book with each chapter as a sub-document). When compiling the master

document, these packages do not compile the sub-documents separately. Thus, they do not support separate preambles when compiling the master document.

`docmute` Redefines `\input` and `\include` to ignore everything between the initial `\documentclass` and `\begin{document}`.

`includex` Defines versions of `\include` that ignore certain parts of the included document. Not only can it ignore everything between `\documentclass` and `\begin{document}`, but it also allows ignoring anything outside specified environments. This package is currently unsupported.

`newclude` Adds various features to the LaTeX inclusion system. One of those features is the ability to ignore anything outside specified environments. This package is intended to subsume the features of `includex`, but these features are marked as in development.

1.3.4 Coping Preambles from Master Files

Another approach to including sub-documents that can be independently compiled is to have those sub-documents automatically copy the preamble in the master file. As with the packages in Section 1.3.3, these packages are geared towards helping authors manage large documents that otherwise take a long time to compile (e.g., a book with each chapter as a sub-document). When compiling the master document, these packages do not compile the sub-documents separately. Thus, they do not support separate preambles when compiling the master document.

`subfiles` Defines a document class for sub-documents that automatically copies the preamble of the master document when the sub-document is compiled, but when the master document is compiled, everything outside the `document` environment is ignored.

`childdoc` Defines commands to be put in sub-documents instead of the standard `\documentclass` and preamble. When the sub-document is separately compiled, this automatically copies the preamble of the master document, but when the master document is compiled, the commands used instead of the standard `\documentclass` and preamble are ignored.

1.3.5 Including Entire Pages

Some packages are designed to allow completely separate documents to be combined into one document. For example, combining multiple articles into a proceedings. Each document has its own preamble, but documents are included a whole page at a time.

`combine` Allows assembling a group of individual LaTeX documents into a single document. Also includes the `combinet` and `combnat` package to allow documents to share things like table of contents.

`subdocs` Allows combining documents where each sub-document is a complete, normal LaTeX document that is typeset separately. Shares the `.aux` files between documents so thing like the table of contents can be kept in common.

1.3.6 Listing Code and Displaying the Results

`tcolorbox`, `example`, `examplep`, `latexdemo`, and `showexpl` These packages all provide environments that display their content as source code next to the result of rendering that code. None of these involves separate compilation or allowing for specifying a separate preamble.

1.3.7 Minimal Page Layouts

`standalone` Provides the document class `standalone` that produces a page with minimal layout that is sized to fit its contents. Does not support automatic extraction of standalone documents, and has no support for exact sizing or including the results of compiling standalone document.

2 High-level Commands

2.1 `\external` and `externalenv`

The main commands of this package are `\external` and `externalenv`.

`\external[`⟨*options*⟩`]{`⟨*code*⟩`}`

Externally compiles the the LaTeX code in ⟨*code*⟩ and then includes the result. An examples of its usage is the following.

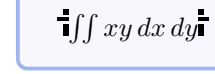
```
<\external[preamble={\usepackage{amsmath}}, math=inline]
   {\iint xy\,dx\,dy}>
```

$$\iint xy\,dx\,dy$$

`\begin{externalenv}[`⟨*options*⟩`]`
⟨*environment content*⟩
`\end{externalenv}`

The same as `\external`. The only difference is that `\external` is a command and `externalenv` is an environment. An example of its usage is the following.

```
<\begin{externalenv}[preamble={\usepackage{amsmath}}, math=inline]
   \iint xy\,dx\,dy
 \end{externalenv}>
```



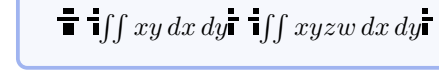
2.2 \newexternal and \newexternalenv

It is sometimes useful to define versions of the \external[→ P. 6] command and the externalenv[→ P. 6] environment that have default values for their options. These can be created with \newexternal and \newexternalenv. For example, you might want to define versions that load the amsmath package by default.

\newexternal[⟨*options*⟩]{⟨*command name*⟩}

With \newexternal, one can define a version of \external[→ P. 6] that has default values for its options.

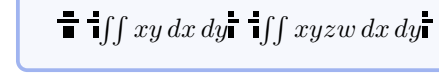
```
<\newexternal[preamble={\usepackage{amsmath}}, math=inline]{\ams}>
<\ams{\iint xy\,dx\,dy}>
<\ams[math=false]{$\iint xyzw\,dx\,dy$}>
```



\newexternalenv[⟨*options*⟩]{⟨*command name*⟩}

With \newexternalenv, one can define a version of externalenv[→ P. 6] that has default values for its options.

```
<\newexternalenv[preamble={\usepackage{amsmath}}, math=inline]{amsenv}>
<\begin{amsenv}\iint xy\,dx\,dy\end{amsenv}>
<\begin{amsenv}[math=false]$\iint xyzw\,dx\,dy$\end{amsenv}>
```



3 Low-level Commands

\ExternalWrite[⟨*options*⟩]{⟨*body*⟩}

\ExternalCompile[⟨*options*⟩]

\ExternalRead[⟨*options*⟩]

Both the \external[→ P. 6] command and the externalenv[→ P. 6] environment are broken up into three phases:

1. writing the intermediate LaTeX file,
2. compiling the intermediate LaTeX file, and
3. reading the file that results from that compilation (which is probably a PDF file).

These are handled with the commands \ExternalWrite, \ExternalCompile, and \ExternalRead, respectively. For example, instead of using the command \external → P. 6, you could explicitly call each of these as in the following.

```
<\ExternalWrite[file=external-external-separate,
                preamble={\usepackage{amsmath}}]
   {$\iint xy\,dx\,dy$}>
<\ExternalCompile[file=external-external-separate]>
<\ExternalRead[file=external-external-separate]>
```

$$\iint xy\,dx\,dy$$

Taking explicit control of these is particularly useful if you want to cache compilation results. See the \ExternalCode command for an example of this.

\ExternalCode{⟨*dim file*⟩}{⟨*preamble*⟩}{⟨*before savebox*⟩}{⟨*body*⟩}{⟨*before usebox*⟩}

This command expands to the code used in the intermediate LaTeX file. It is useful if you want to store the LaTeX code to be compiled in a separate file and reuse the compiled results between compilations of the master LaTeX file.

The ⟨*dim file*⟩ is the full filename of the dimension file to be generated. The ⟨*preamble*⟩, ⟨*before savebox*⟩, and ⟨*before usebox*⟩ are the same as the corresponding options in Section 4. The ⟨*body*⟩ is the LaTeX code to be compiled.

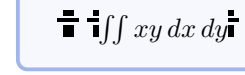
For example, you might write the following standalone file.

external-standalone-simple.tex

```
\RequirePackage{external.code}
\ExternalCode
  {external-standalone-simple.dim}
  {\documentclass{article}\usepackage{amsmath}}
  {}
  {$\iint xy\,dx\,dy$}
  {}
```

Then in your master file you can compile and read that standalone file with the following commands.

```
<\ExternalCompile[file=external-standalone-simple]>
<\ExternalRead[file=external-standalone-simple]>
```



Be careful if you rename a standalone file, as you will need to change the ⟨*dim file*⟩ argument to match. Otherwise, you will get an error along the lines of `In \ExternalRead, input dimension file does not exist`.

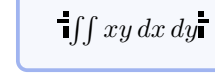
Also note that \ExternalCode is defined in the `external.code` package. This package is imported by the main `external` package, so you do not necessarily need to import it separately. However, `external.code` is designed be minimal and has no dependencies. Thus in the previous example, using `\RequirePackage{external.code}` instead of `\RequirePackage{external}` minimizes the compilation time. When there are a large number of standalone files, this difference can amount to a significant amount of time.

If you wanted to reuse compiled results between compilations of the master LaTeX file, you would want to manually run the following command.

```
pdflatex -shell-escape external-standalone-simple.tex
```

Then you would omit the call to `\ExternalCompile` → P. 7 and just call `\ExternalRead` → P. 7 as in the following.

```
<\ExternalRead[file=external-standalone-simple]>
```



4 Options

Options that are passed to commands are parsed using the `keyval` package. Their syntax is of the form:

$$\texttt{[}\langle key_1\rangle\texttt{=}\langle value_1\rangle\texttt{, }\langle key_2\rangle\texttt{=}\langle value_2\rangle\texttt{, }\cdots\texttt{, }\langle key_n\rangle\texttt{=}\langle value_n\rangle\texttt{]}$$

`\externalkeys{`⟨*options*⟩`}`

You can set the default value for any options with the `\externalkeys` command. For example, if want to default to use `mypdflatex` instead of `pdflatex` to compile LaTeX code, you could use the following command.

```
\externalkeys{latex=mylatex}
```

You can also specify this by passing the option when the `external` package is loaded as seen in the following example.

```
\usepackage[latex=mylatex]{external}
```

4.1 High-level Options

documentclass=⟨*class*⟩ (initially `article`)

This option specifies the document class to be used by the intermediate LaTeX file (by way of `\documentclass`) that is generated for each piece of externally compiled code. For example, the following uses the `proc` class, which (unlike `article`) contains the `\pagename` macro.

```
<\external[documentclass=proc]{\pagename}>
```

If the value of this key is blank, a `\documentclass` declaration is not added to the intermediate file. In this case, you will likely want to put a `\documentclass` declaration in the `preamble` option as in the following example. (Though this could be achieved with `documentclass=prog`, so doing it this way is gratuitous and solely for the sake of an example.)

```
<\external[documentclass={}, preamble={\documentclass{proc}}]
   {\pagename}>
```

documentclass/options=⟨*options*⟩ (initially empty)

This option specifies options to pass to the document class to be used by the LaTeX file that is generated for externally compiled code. For example, the following specifies passing the `12pt` option to `article`, which changes the default font to be 12 points tall.

```
<\external[documentclass/options={12pt}]{M}>
```

preamble=⟨*code*⟩ (initially empty)

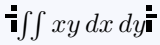
This options specifies LaTeX code to be put in the preamble of the intermediate LaTeX file that is generated for externally compiled code. For example, you might want to load packages as in the following.

```
<\external[preamble={\usepackage{amsmath}}]{$\iint xy\,dx\,dy$}>
```

`math`=⟨*false*, *inline*, *or* *display*⟩ (initially `false`)

This option controls whether the body of `\external`[→ P. 6] or `externalenv`[→ P. 6] is treated as math, and if so, whether it is inline math or display math. The following demonstrate each value possible for this option.

```
<\external[preamble={\usepackage{amsmath}}, math=false]
   {$\iint xy\,dx\,dy$}>
```



```
<\external[preamble={\usepackage{amsmath}}, math=inline]
   {\iint xy\,dx\,dy}>
```

```
<\external[preamble={\usepackage{amsmath}}, math=display]
   {\iint xy\,dx\,dy}>
```

Note that `math=display`, as seen in the following example, is equivalent to the incantation `\[\external{$\displaystyle...$}\]`.

```
<\[\external[preamble={\usepackage{amsmath}}]
     {$\displaystyle\iint xy\,dx\,dy$}\]>
```

`margin/top`=⟨*length*⟩ (initially `1in`)

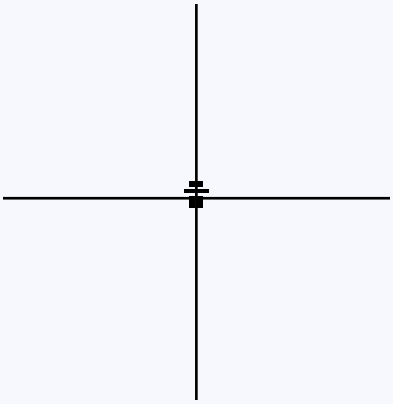
`margin/bottom`=⟨*length*⟩ (initially `1in`)

`margin/left`=⟨*length*⟩ (initially `1in`)

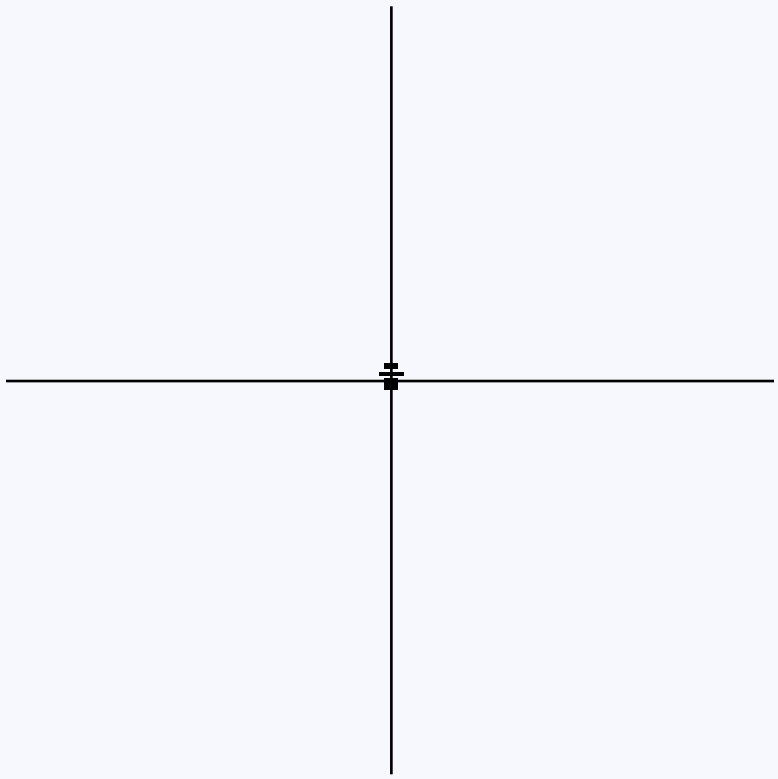
`margin/right`=⟨*length*⟩ (initially `1in`)

These options specify the margin to place around the LaTeX code being compiled externally. This is useful if the LaTeX code being compiled externally draws outside its bounding box. If there is not enough margin to contain the drawn portions, the result may be clipped. For example, compare the two following examples. The 2-inch rules are clipped when the default (1-inch) margins are used but are not clipped when 3-inch margins are used.

```
\vspace{2in}
\hspace{2in}
<\begin{externalenv}
   \rlap{\rule[3pt]{2in}{1pt}}%
   \llap{\rule[3pt]{2in}{1pt}}%
   \smash{\rule[-2in]{1pt}{4in}}%
 \end{externalenv}>
\vspace{2in}
```



```
\vspace{2in}
\hspace{2in}
<\begin{externalenv}[margin/top=3in, margin/bottom=3in,
                     margin/left=3in, margin/right=3in]
   \rlap{\rule[3pt]{2in}{1pt}}%
   \llap{\rule[3pt]{2in}{1pt}}%
   \smash{\rule[-2in]{1pt}{4in}}%
 \end{externalenv}>
\vspace{2.2in}
```



4.2 Low-level Options

`before`=⟨*code*⟩ (initially `\stepcounter{external@number}`)

This option specifies LaTeX code to run before the rest of the code in an `\external`→P. 6 command or `externalenv`→P. 6 environment. This is particularly useful for incrementing any counters used in the `file`→P. 16 option. The following is an example of this in action.

```
\newcounter{foo}%
\thefoo
<\external[file=external-external-before,
           before={\stepcounter{foo}}]{}>%
\thefoo
```


`before compile`=⟨*code*⟩ (initially empty)

With an `\external`[→ P. 6] command or `externalenv`[→ P. 6] environment, this option specifies LaTeX code to run after writing the file for the externally complied code but before compiling the externally compiled code. The following is an example of this in action.

```
\newcounter{baz}%
\thebaz
<\external[file=external-external-before-compile,
           before compile={\stepcounter{baz}}]{}>%
\thebaz
```


`before read`=⟨*code*⟩ (initially empty)

In an `\external`[→ P. 6] command or `externalenv`[→ P. 6] environment, this option specifies LaTeX code to run after compiling the externally compiled code but before reading the file output by the externally compiled code. The following is an example of this in action.

```
\newcounter{quux}%
\thequux
<\external[file=external-external-before-read,
           before read={\stepcounter{quux}}]{}>%
\thequux
```


`after`=⟨*code*⟩ (initially empty)

This option specifies LaTeX code to run after the rest of the code in an `\external`[→ P. 6] command or `externalenv`[→ P. 6] environment. The following is an example of this in action.

```
\newcounter{bar}%
\thebar
<\external[file=external-external-after,
           after={\stepcounter{bar}}]{}>%
\thebar
```

`before savebox`=⟨*code*⟩ (initially empty)

This option specifies code to be put before the `\savebox` that is used in the intermediate LaTeX file that is generated for externally compiled code. This option corresponds to the ⟨*before savebox*⟩ argument of `\ExternalCode` → P. 8.

This option is rarely needed.

The following example demonstrates the use of this option, though since the definition of `\p` could be put in the preamble, putting it in `before savebox` is gratuitous and solely for the sake of an example.

```
<\external[before savebox={\newcommand{\p}[1]{(##1)}}]{\p{x}}>
```

`before usebox`=⟨*code*⟩ (initially empty)

This option specifies code to be put before the `\usebox` that is used in the intermediate LaTeX file that is generated for externally compiled code. This option corresponds to the ⟨*before usebox*⟩ argument of `\ExternalCode` → P. 8.

This option is rarely needed.

The following example demonstrates the use of this option, though since there are other ways to accomplish this effect, using `before usebox` is gratuitous and solely for the sake of an example. Note that we have to set the margins to small or zero lengths to prevent them from overlapping the rest of the page.

```
<\external[preamble={\usepackage{xcolor}},
           before usebox={\pagecolor{gray!50}},
           margin/top=1pt, margin/bottom=1pt,
           margin/left=0pt, margin/right=0pt]
   {ABC}>
```

`latex`=⟨*program name*⟩ (initially empty)

This option specifies the program to use to compile the intermediate LaTeX file that is generated for each bit of externally compiled code.

Blank means to autodetect between `pdflatex`, `xelatex`, or `lualatex` to match whatever the master document is being compiled with.

For example, if you wanted to force certain code to run under `pdflatex`, you could do the following.

```
<\external[latex=pdflatex]{\pdfescapehex{ABC}}>
```

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`latex/options`=⟨*code*⟩ (initially `-halt-on-error -interaction=batchmode`)

This option specifies what command-line options to pass to LaTeX when compiling the intermediate LaTeX file that is generated for externally compiled code.

Note that if you change this, you will almost certainly want to include the `-halt-on-error` and `-interaction=batchmode` options in whatever you change it to.

For example, the `ifplatform` package needs the `-shell-escape` option in order to give precise platform information. This can be specified as in the following.

```
<\external[preamble={\usepackage{ifplatform}}]
   {\platformname}>
<\external[preamble={\usepackage{ifplatform}},
           latex/options={-shell-escape -halt-on-error
                          -interaction=batchmode}]
   {\platformname}>
```

*NIX Linux

Note that if this document was compiled on Windows, then the two calls to `\external` → P. 6 in this example will produce the same results as each other, but on any other platform they will be different.

`file`=⟨*file basename*⟩(initially `\jobname-external-\arabic{external@number}`)

This option specifies the basename of the intermediate files that are generated for externally compiled code.

For example, the following uses `external-external-file` as the basename.

```
<\external[file=external-external-file,
           preamble={\usepackage{amsmath}}]
   {$\iint xy\,dx\,dy$}>
```

$\iint xy\,dx\,dy$

Be careful not to use the same filename for two different pieces of externally compiled code as that can lead to unexpected results.

`file/tex`=⟨*extension*⟩ (initially `.tex`)

`file/dim`=⟨*extension*⟩ (initially `.dim`)

`file/out`=⟨*extension*⟩ (initially `.pdf`)

These options specify the extensions to use for the intermediate LaTeX, dimension, and compiled files, respectively.

These options are rarely needed.

An example of using them is the following.

```
\DeclareGraphicsRule{.mypdf}{pdf}{.mypdf}{}%
<\external[
   file/tex=.mytex, file/dim=.mydim, file/out=.mypdf,
   file=external-external-extension,
   before read={\ShellEscape{mv external-external-extension.pdf
                                external-external-extension.mypdf}}]
   {ABC}>
```

`includegraphics/options`=⟨*key-value sequence*⟩ (initially empty)

This option specifies options to be passed to the `\includegraphics` command that is used to read into the master document the result of compiling the LaTeX code that is compiled separately. For example, the following uses `angle` to rotate the image read by `\includegraphics`.

```
<\external[includegraphics/options={angle=45}]{M}>
```

`debug`=⟨*true or false*⟩ (initially `false`)

Whether to print tracing information to standard out. This is helpful in determining exactly what part of a command failed.

For example, consider the following call to `\external` → P. 6.

```
<\external[preamble={\usepackage{amsmath}}]{$\iint xy\,dx\,dy$}>
```

When the `debug` option is `true`, lines like the following will be printed to the standard output.

```
**** Begin \ExternalWrite on {external-external-21}
       with {$\iint xy\,dx\,dy$}
**** End \ExternalWrite on {external-external-21}
**** Begin \ExternalCompile on {external-external-21}
**** End \ExternalCompile on {external-external-21}
**** Begin \ExternalRead on {external-external-21}
**** End \ExternalRead on {external-external-21}
```

5 Issues and Workarounds

5.1 Document Not Updating

A common issue is when changing the LaTeX code to be externally compiled (e.g., the ⟨*body*⟩ of a `\external`→P. 6), but those changes are not reflected in the master document after re-compiling the master document. The cause of this is that `external` has no way to detect whether compiling the intermediate LaTeX file succeeded or failed. A failure can happen for example if the LaTeX code to be externally compiled contains an error that causes the compilation of the intermediate LaTeX file to fail. If compilation of the intermediate LaTeX file fails, the dimension file and the resulting compiled, PDF file from previous compilation will not be overwritten.

To fix this, delete the PDF and dimension files. Then failure of the compilation of the intermediate LaTeX file will cause a file-not-found error when the PDF and dimension file are read. You can then fix the error in the LaTeX code to be externally compiled and use this file-not-found error to let you know when you have fixed that LaTeX code.

5.2 Hash Symbols and Command Arguments

The use of hashes symbols that one would use when referencing a command argument (e.g., `#1`) can lead to problems. For example, the following would lead to an error.

```
<\external[preamble={\newcommand{\p}[1]{(#1)}}]{\p{x}}>
```

The solution to this is to use double hashes (for example, `##1` instead of `#1`) as demonstrated in the following.

```
<\external[preamble={\newcommand{\p}[1]{(##1)}}]{\p{x}}>
```

```
<\begin{externalenv}[preamble={\newcommand{\p}[1]{(##1)}}]
   \p{x}
 \end{externalenv}>
```

This even applies in the body of an `\external`→P. 6 or `externalenv`→P. 6 as seen in the following.

```
<\external{\newcommand{\p}[1]{(##1)}\p{x}}>
```

```
<\begin{externalenv}
   \newcommand{\p}[1]{(##1)}%
   \p{x}
 \end{externalenv}>
```

This also applies to standalone files as seen in the following.

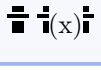
external-standalone-hash.tex

```
\RequirePackage{external.code}
\ExternalCode
  {external-standalone-hash.dim}
  {\documentclass{article}\newcommand{\p}[1]{(##1)}}
  {}
  {\p{x}}
  {}
```

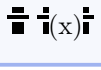
```
<\ExternalCompile[file=external-standalone-hash]>
<\ExternalRead[file=external-standalone-hash]>
```

Finally, `\newexternal`→P. 7 and `\newexternalenv`→P. 7 require *four* hashes due to an extra level of indirection occurring in them as demonstrated in the following examples.

```
<\newexternal[preamble={\newcommand{\p}[1]{(####1)}}]{\paren}>
<\paren{\p{x}}>
```

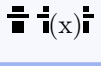


```
<\newexternalenv[preamble={\newcommand{\p}[1]{(####1)}}]{paren}>
<\begin{paren}\p{x}\end{paren}>
```

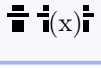


However, in their bodies this does not apply and only two hashes should be used as demonstrated in the following.

```
<\newexternal{\paren}>
<\paren{\newcommand{\parens}[1]{(##1)}\parens{x}}>
```



```
<\newexternalenv{paren}>
<\begin{paren}
   \newcommand{\parens}[1]{(##1)}%
   \parens{x}
 \end{paren}>
```



5.3 Category Codes

Some commands change the category codes of many characters. These pose a problem for use with commands from this `external` package as the arguments to commands are parsed before those category codes have changed. The way to work around this is to use the `\scantokens` macro to cause parts of those arguments to be re-parsed.

For example, the `\DeclareFontShape` macro redefines category codes for characters used in its argument. Thus to use it one must insert a call to `\scantokens` as in the following.

```
<\external[preamble={
            \usepackage{pifont}
            \DeclareFontFamily{U}{msa}{}
            \scantokens{
              \DeclareFontShape
                {U}{msa}{m}{n}
                {<-6>msam5<6-8>msam7<8->msam10}{}\relax}}]
   {\Pisymbol{msa}{15}}>
```

The \relax before the end of the argument to \scantokens ensures that \scantokens does not insert an extra space at the end. See https://tex.stackexchange.com/questions/117906/use-of-everyeof-and-endlinechar-with-scantokens for details.

This trick also works when using a standalone file as in the following.

external-standalone-catcode.tex

```
\RequirePackage{external.code}
\ExternalCode
  {external-standalone-catcode.dim}
  {\documentclass{article}
   \usepackage{pifont}
   \DeclareFontFamily{U}{msa}{}
   \scantokens{
     \DeclareFontShape
       {U}{msa}{m}{n}
       {<-6>msam5<6-8>msam7<8->msam10}{}\relax}}
  {}
  {\Pisymbol{msa}{15}}
  {}
```

```
<\ExternalCompile[file=external-standalone-catcode]>
<\ExternalRead[file=external-standalone-catcode]>
```

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