

asypictureB — user-friendly integration of Asymptote into L^AT_EX*

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Abstract

The `asypictureB` package allows users to integrate Asymptote code for producing pictures into L^AT_EX source code using the shell-escape functionality. It is an alternative to the `asymptote` package that comes with Asymptote. The most important advantage of the `asypictureB` package is that it provides immediate access to Asymptote errors by repackaging them as L^AT_EX errors. It also allows limited use of TeX macros such as `\the\linewidth` inside Asymptote code.

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1 Introduction

The Asymptote programming language¹ is a powerful tool for the creation of diagrams, both two- and three-dimensional, that are compatible with \TeX documents. The programming language ships with a \LaTeX package called (appropriately but confusingly) `asymptote` that makes it easy to draw pictures by including Asymptote code in the \LaTeX source file. The `asymptote` package also allows the inclusion of interactive three-dimensional images in `pdf` files.²

Unfortunately, the author has encountered the several annoyances using the `asymptote` package.

1. When my Asymptote code contains errors that prevent it from compiling, I have found it extremely difficult to track down the offending line in the \TeX source file. This has been the single biggest annoyance and has led me to compose all but the simplest Asymptote images as separate `.asy` files, which are then included into the \TeX source once they do what I want.
2. The `asymptote` package does not support PNG files, although the Asymptote language does.
3. The `asymptote` package does have a mechanism in place so that when it is used with `latexmk`, Asymptote images that have not changed are not recompiled. Unfortunately, the mechanism for recognizing unchanged images is somewhat fragile: if a single image is inserted or deleted, then all subsequent images will have to be recompiled. In my experience, this can make a compilation last several minutes that would otherwise have lasted several seconds.
4. The `asymptote` package can rescale an Asymptote-produced image to a given width and/or a given height, but it cannot rescale the image by a given scaling factor.

The most important issue here is the first, which can to some extent be fixed using editor features; see, for instance, this explanation for `TeXnicCenter` (Windows only)³.

The `asypictureB` package is an alternative to the `asymptote` package that (optionally) uses `\write18` to call the Asymptote compiler directly from \LaTeX . The package provides some sort of fix for all the above issues:

1. Asymptote errors are repackaged as \LaTeX errors and reported immediately. At a minimum, users are shown the Asymptote error log and a line number that will allow them to locate the correct Asymptote picture within the \TeX source file.

Additionally, `asypictureB` is usually able to display the five lines of Asymptote code up to and including the first error. This is useful to locate the line of code on which the error occurs, since the line numbers in the Asymptote error log do not correspond to the line numbers in the \LaTeX source file.

¹<http://asymptote.sourceforge.net>

²The `asypictureB` package does not currently support this feature.

³http://www.artofproblemsolving.com/Wiki/index.php/Asymptote:_Advanced_Configuration#Showing_Asymptote_error_messages_in_TeXnicCenter

2. Any file type that is supported by both the Asymptote language and the `\includegraphics` command is supported by `asypictureB`. Assuming that the document is compiled using `pdflatex`, this includes the PNG, PDF, and (more or less) EPS file formats.
3. Users are permitted and strongly encouraged to specify a distinct name for each Asymptote image in the file. Distinctly named Asymptote images are not recompiled if their code has not changed since the last `latex` run.
4. Any option that works for the `\includegraphics` command can be given as an option to an `asypicture` environment.

There is one other feature worth mentioning: \LaTeX macros will be expanded inside Asymptote code if they are prefixed by `@` instead of `\`. This can be used as an incomplete substitute for the `inline` option of the `asymptote` package. It also provides a way to use macros in Asymptote code, which is not a feature that Asymptote supports otherwise.

Each of these features could stand significant improvements. However, since implementing them, the author has found himself much more willing to compose Asymptote code directly in a \TeX source file. This indicates to him that the package might prove useful to others, even in its current form. His hope is that the best ideas of this package would be copied and improved in the official `asymptote` package, allowing him to deprecate `asypictureB`.

2 Installation and running

First of all, the `asypictureB` package is mostly useless unless you have Asymptote installed on your system.

- For a MacOS system, this installation is automatic with a standard installation of MacTeX.
- For a Windows system, the official installation instructions are fairly good. As of this writing, the most recent version of the `setup.exe` file can be downloaded from <http://sourceforge.net/projects/asymptote/files/2.95/>.
- For a Unix-like system, a version of Asymptote is included in TeX Live, but there may be additional dependencies; see, for instance, <http://tex.stackexchange.com/a/155284/484>. You should also consult these two pages from the official documentation.

To use the `asypictureB` package, your `.tex` file should be run with shell-escape enabled:

```
pdflatex -shell-escape <filename>
```

[Note that `latex`, `lualatex`, etc. can be substituted for `pdflatex`, although you should make sure that the engine you use is compatible with whatever graphics formats your Asymptote pictures are compiled to.]

2.1 Running without shell escape

If you are unwilling to use shell-escape, `asypictureB` creates a script that makes it easy to execute the necessary commands afterwards. To use it, run the following four commands at the terminal. (The second command is optional; it allows you to inspect the script before running it.) For convenience, it is assumed that the name of the \LaTeX source file is `foo.tex`.

Windows:

```
pdflatex foo
type foo-asy_compile.txt
cmd < foo-asy_compile.txt
pdflatex foo
```

MacOS and Unix-like systems:

```
pdflatex foo
cat foo-asy_compile.sh
sh foo-asy_compile.sh
pdflatex foo
```

Instead of `pdflatex`, one may use `latex`, `lualatex`, Asymptote errors will be visible as \TeX errors on the second run of \LaTeX .



Warning: This method is not entirely foolproof. In particular, if `pdflatex` is run twice in a row without running the `\filename-asy_compile` script in between, then Asymptote pictures which have been compiled at some point in the past, even if they have since been altered, will not be recompiled. Should this happen, you can force every `asypicture` to be recompiled by temporarily adding the `\RequireAsyRecompile` command before your first `asypicture`.

The safer method If you want to compile a \TeX source file from someone else (e.g., the internet), you may want neither to enable shell-escape nor to run a script generated by this file. A safer way to compile all Asymptote pictures generated by `asypictureB` (and for that matter by the `asymptote` package) is to run `asy -noV \filename-*.asy` after compiling `\filename.tex`. Once this is done, all the Asymptote files should be compiled, will be correctly imported upon a second run of `pdflatex` (or `latex`, ...). Re-running `asy` is not necessary until and unless any of the Asymptote pictures change. This method is “safe” in that you have greater control over which programs are actually being run.

This method will also work for your own files-in-progress, but is not recommended for two reasons:

- Asymptote errors will not be repackaged as \TeX errors, negating one of the main features of the `asypictureB` package.
- All Asymptote pictures will be recompiled, even if they have not changed since the last run. This can add considerably to the compile time.

2.2 Dependencies

As currently implemented, the `asypictureB` package requires the packages `fancyvrb` (tested with version 2.8), `graphicx` (tested with version 2005/11/14), `pgfkeys`, and `ifplatform` (tested with version 0.4). In fact, it depends on undocumented internals of the `fancyvrb` package, so later versions of this package could conceivably break it as well as earlier versions.

If shell-escape is not enabled, it also requires the `verbatimcopy` package, version 0.06 or later. Since `verbatimcopy` is not backwards compatible, earlier versions will, in fact, break `asypictureB`.

3 Usage

asypicture (*env.*) Code for Asymptote pictures should be placed within the **asypicture** environment, which takes one mandatory argument: a list of comma-separated expressions of the form $\langle key \rangle = \langle value \rangle$. It is strongly recommended that the key **name** always be used, since this will prevent the package from re-compiling pictures whose code has not changed. The time saving can be substantial if you have a document with a significant number of Asymptote pictures.

Keys other than **name** are passed onto an **\includegraphics** command from the **graphicx** package. The keys should be given in the following order:

1. Keys other than **scale** or **angle**.
2. The **scale** key (if it is used).
3. The **angle** key (if it is used).

The way the package is currently implemented, the **scale** and **angle** keys will effectively be evaluated last, regardless of the order in which they are given. However, this behavior is not ideal and may change in future versions of the package; the goal would be that keys should be evaluated in the order in which they are given. For the time being, giving keys in the order specified should ensure compatibility with future versions.

It is possible to expand macros within an **asypicture** environment by using an at symbol **@** in place of a backslash ****. For instance, the line

```
size(@the@linewidth, 0);
```

will be translated to something like

```
size(345.0pt, 0);
```

before being compiled by Asymptote.

asyheader (*env.*) Code within an **asyheader** environment is appended to the “header,” which is inserted at the beginning of every **.asy** file output by the **asypictureB** package. Initially, the header consists of the two lines

```
defaultpen(fontsize(@getfontsize pt));  
settings.prc = false;
```

Again, macros can be expanded inside an **asyheader** environment by prefixing them by **@** rather than ****. The macros are fully expanded when they are added to the header, not when they are written to a file. Thus, for instance, in a 10-point document, the first line of the header will always read

```
defaultpen(fontsize(10pt));
```

even if the font size is later changed to 12 points.

Note that any change to the header will require all subsequent **asypicture** environments to be recompiled. In a document with many Asymptote images, this could take a while.

\getfontsize The **\getfontsize** macro is an alias for **\f@size** that does not require

`\makeatletter`. It expands to the current font size (without the suffix `pt`).

`\asylistingfile` The `\asylistingfile` macro contains the filename of the Asymptote code for the most recent `asypicture`. It can be used with commands from e.g. `fancyvrb` or `listings` to display the Asymptote code for an image.

`\RequireAsyRecompile` By default, Asymptote images are compiled only if the Asymptote code has changed.

`\AsyCompileIfNecessary` The command `\RequireAsyRecompile` changes this setting to make all subsequent images recompile even if the code has not changed. (This can be useful, for instance, if you have just updated Asymptote.) The command `\AsyCompileIfNecessary` restores the default behavior for all subsequent Asymptote pictures.

3.1 Keys for `asypicture`

name If the key-value combination `name=<picturename>` appears in the mandatory argument to an `asypicture` environment, then the contents of that environment will be saved to the file

`<filename>-<picturename>.asy`

where `<filename>` is the name of the current `.tex` file (not including the `.tex` extension). The compiled Asymptote picture is saved to an image file such as `<filename>-<picturename>.eps`, `<filename>-<picturename>.pdf`, or `<filename>-<picturename>.png`.

Alphanumeric characters are allowed in the `name` key, as are the characters `-` (hyphen) and `_` (underscore). Other characters (including spaces, asterisks, etc.) should be avoided. The key may begin with any allowed character; however, names consisting of a single number with three or fewer digits are discouraged, since these may conflict with the `asymptote` package.

Although the `name` key is technically not required, it is strongly recommended that distinct names be given to all the different `asypicture` environments. This allows the `asypictureB` package to avoid recompiling pictures whose code has not changed—even if the pictures are reordered.

If the name `<picturename>` has been used before, a suffix will be appended to it: `__1` for the first repeat, `__2` for the second repeat, etc. Thus, if the same name (say `foo`) is used for several `asypictures`, then deleting the first of these will force all the others to recompile; but changing a picture of a different name will not affect any of the pictures named `foo`.

If no `name` key is given, the key-value combination `name=noname` is assumed. This default can be changed using the `\asyset` command: after the line

```
\asyset{name = foo}
```

nameless pictures will be called `foo` rather than `noname`.



Warning: If `asypictureB` determines that the contents of an `asypicture` environment named `<picturename>` have changed since the last run, it will delete all of the following files that exist:

`<filename>-<picturename>.eps`
`<filename>-<picturename>.pdf`
`<filename>-<picturename>.png`

3.2 Styles

`\asyset` Since `asypictureB` uses `pgfkeys` for keys, it is possible to create new keys, called “styles,” that set several other keys at once. For instance, the following line

```
\asyset{mysize/.style = {width=6cm, height=4cm}}
```

creates a new key called `mysize`. Any time in the document after this line, the command

```
\begin{asypicture}{name=picturename, mysize}
```

is exactly equivalent to the line

```
\begin{asypicture}{name=picturename, width=6cm, height=4cm}
```

This is precisely the same style mechanism that is used in TikZ; in fact, `\asyset{⟨keys⟩}` is equivalent to `\pgfkeys{/asy/.cd,⟨keys⟩}`, much as `\tikzset{⟨keys⟩}` is equivalent to `\pgfkeys{/tikz/.cd,⟨keys⟩}`.

The `\asyset` command may be used in the preamble or anywhere in the body of the document where macros are processed normally. It may not be used in the body of an `asypicture` or any other verbatim-like environment.

4 Examples

Here is a simple example:



```
\begin{asypicture}{name=sphere_image}
settings.outformat = "png";
settings.render = 16;
size(2.5cm,0);
import three;
draw(unitsphere, white);
\end{asypicture}
```

Here is an example that uses the user-defined macro `\asywidth` inside the Asymptote code to avoid duplicate code.

```
\noindent\def\asywidth{4cm}
\begin{asypicture}{name=triangle,width=\asywidth}
settings.outformat="pdf";
size(@asywidth,0);
draw((0,0) -- (1,0) -- (1,1) -- cycle);
dot((1,0), L=Label(
"\textbf{Bold} \textsc{Smallcaps}",
align=NE));
\end{asypicture}
\hfill
\begin{minipage}{\dimexpr\linewidth-\asywidth-15pt\relax}
\VerbatimInput[frame=leftline]{\asylistingfile}
\end{minipage}
```

The result:



```
defaultpen(fontsize(10 pt));
settings.prc = false;

settings.outformat="pdf";
size(4cm,0);
draw((0,0) -- (1,0) -- (1,1) -- cycle);
dot((1,0), L=Label(
    "\textbf{Bold} \textsc{Smallcaps}",
    align=NE));
```

The `\VerbatimInput` command is from the `fancyvrb` package. The first two lines of the Asymptote code listing come from the default `asyheader`. These, along with some extra whitespace, can be eliminated by playing with the `fancyvrb` options. More importantly for our purposes, changing the single line

```
\noindent\def\asywidth{4cm}
```

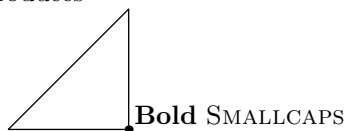
to

```
\noindent\def\asywidth{4.5cm}
```

will automatically affect both the width of the `asypicture` and the width of the `minipage`:

```
\noindent\def\asywidth{4.5cm}
\begin{asypicture}{name=triangle2,width=\asywidth}
    settings.outformat="pdf";
    size(@asywidth,0);
    draw((0,0) -- (1,0) -- (1,1) -- cycle);
    dot((1,0), L=Label(
        "\textbf{Bold} \textsc{Smallcaps}",
        align=NE));
\end{asypicture}
\hfill
\begin{minipage}{\dimexpr\linewidth-\asywidth-15pt\relax}
\VerbatimInput[frame=leftline,gobble=4,firstline=5]
    {\asylistingfile}
\end{minipage}
```

produces



```
settings.outformat="pdf";
size(4.5cm,0);
draw((0,0) -- (1,0) -- (1,1) -- cycle);
dot((1,0), L=Label(
    "\textbf{Bold} \textsc{Smallcaps}",
    align=NE));
```


5 Error handling

It has been stated several places in this document that `asypictureB` repackages Asymptote errors as `TeX` errors (and at least once that this feature, among others, could stand significant improvements). In this section is described exactly how these errors are repackaged, at least as of the current implementation. None of this is guaranteed to remain the same in future versions.

When `asypictureB` tells Asymptote to compile the file

`<filename>-<picturename>.asy,`

it reroutes all warning and error messages to the file

`<filename>-<picturename>_errors.txt.`

Once the Asymptote run is complete, it checks whether the error file has any lines of the form

`<filename>-<picturename>.asy:<number>.<stuff>`

If so, it throws a `LaTeX` package error and displays the contents of the error file, which include all the errors and warnings issued by Asymptote. Note that if some kind of `asy` error occurs that does not match this output form, `asypictureB` will not notice the error.

The `LaTeX` error message will give the line number of the `\end{asypicture}` command for the `asypicture` that caused the error, which is of limited use in isolating the error. More precise line numbers are given by the Asymptote error log; however, these line numbers are for the `asy` file rather than the `tex` file, and consequently not terribly helpful.

To allow the user to locate the line on which the actual error occurred, the `asypictureB` package attempts to parse the Asymptote error log and print out the five lines leading up to the error. More precisely, it does the following:

1. From the first line of the form

`<filename>-<picturename>.asy:<number>.<stuff>`

the `<number>` is extracted. Note that if no successful extraction occurs, there will be no `LaTeX` error.

2. Assuming `<number>` was extracted successfully, the lines of the `asy` file from the inclusive range `<number> - 5` to `<number>` are displayed as part of the `LaTeX` error message. These lines are usually identical and almost always similar to the lines in the actual `tex` file leading up to the error. In the author's experience, this is usually enough information to locate without difficulty the line on which the error occurred.⁴

Here's an example: Consider `LaTeX` file

⁴I.e., the line that caused Asymptote to choke. The usual rules of debugging apply: the line on which the compiler identified an error might have been correct if not for an earlier mistake that was syntactically correct.

```

1 \documentclass{article}
2 \usepackage{asyptureB}
3 \begin{document}
4 \def\asywidth{5cm}
5 \begin{asypture}{name=error_example}
6     // A comment
7     size(@asywidth, 0);
8     path l1 = (0,0) -- (1,1);
9     // Another comment
10    draw(box((0,0),(1,1)))
11    draw(l1, dotted);
12    draw(l2, dashed);
13 \end{asypture}
14 \end{document}

```

If this file is saved as `asyerrorexample.tex` and then compiled with the shell-escape option, the following error results:

```

! Package asyptureB Error:
draw(l1, dotted);
~
asyerrorexample-error_example.asy: 10.5: syntax error
error: could not load module 'asyerrorexample-error_example.asy'

```

```

6     size(5cm, 0);
7     path l1 = (0,0) -- (1,1);
8     // Another comment
9     draw(box((0,0),(1,1)))
10    draw(l1, dotted);
.

```

See the `asyptureB` package documentation for explanation.
Type `H <return>` for immediate help.
...

1.13 `\end{asypture}`

The \LaTeX error message first repeats the Asymptote error log, which explains that there was a syntax error. Next, the five lines leading up to the error are displayed. Looking at these five lines, one can determine that the difficulty was a comma omitted on line 9 of the Asymptote file. (It is diagnosed on line 10 because of how the compiler works.) Looking at the context, this corresponds to line 10 of the \LaTeX file.

Note that the macro `@asywidth` in the `asypture` code has been expanded to `5cm` in the error message.

6 Macros in `asyptures`

When the author first conceived of allowing macros in an `asypture` environment, the goal was to allow expressions like `size(@asywidth,0)`; where `\asywidth` was

a user-defined macro also used in the \LaTeX code to avoid hard-coding numbers. However, it was almost immediately apparent that this feature has more sophisticated uses, such as allowing user-defined syntax or even creating something similar to templates⁵.

6.1 Limitations

Before discussing the nifty features, let's discuss the fairly severe limitations they will have to work around.

No grouping symbols. If a macro takes a mandatory argument inside braces `{}`, then that macro cannot be used inside an `asypicture`.

Purely expandable macros only. Macros will be expanded, but not executed. In particular, macros that allow optional arguments will usually go horribly wrong.

One line only. As we will discuss, it is possible to use “unconventionally delimited” arguments. However, even in this case, a macro and all its arguments must fit on a single line.

Since the first two points all but forbid the use of macros with conventional arguments, it might be wondered whether macros in Asymptote code can be used for anything more interesting than storing user-defined lengths. They can.

6.2 Single-token arguments

[This is really more a fix than an example, but this seems as good a place as any to discuss it.]

Some macros, such as `\the`, take arguments that consist only of a single character or control sequence. For instance, `\the\textwidth` expands to something like `345.0pt`, whereas `\textwidth` by itself expands only to `\textwidth`. This can be significant if you want to produce an Asymptote picture that takes up a specified fraction of the text width.

6.3 Unconventionally delimited arguments

The \TeX primitive `\def` can be used to produce macros that are quite flexible about how they are delimited. For instance, the \TeX code

```
\def\draw#1;{\draw(#1);}
```

will take as its argument everything between the `\draw` command and the first subsequent semicolon. If this line showed up in \TeX code (preferably in the preamble), then subsequent `\asypicture` environments could include a line such as

```
@draw box((0,0), (1,1));
```

as an arguably more aesthetic alternative to the translation

⁵If you actually want to use templates in Asymptote code, the experimental *templated imports* feature of the language is probably a better choice than the macro techniques described in this section

```
draw( box((0,0), (1,1)));
```

A more advanced example is essentially a template for a sorting function⁶. Include the following code in the T_EX preamble:

```
\def\definesortfunction #1;{%
#1[] sort(#1[] a) {
  if (a.length <= 1) return a;
  static #1[] merge(#1[] b, #1[] c) {
    #1[] toreturn;
    int i = 0, j = 0;
    while (i < b.length && j < c.length) {
      if (!(c[j] < b[i])) { toreturn.push(b[i]); ++i; }
      else { toreturn.push(c[j]); ++j; }
    }
    while (i < b.length) {
      toreturn.push(b[i]);
      ++i;
    }
    while (j < c.length) {
      toreturn.push(c[j]);
      ++j;
    }
    return toreturn;
  }
  int halfway = floor(a.length / 2);
  #1[] b = sort(a[0:halfway]);
  #1[] c = sort(a[halfway:a.length]);

  return merge(b, c);
}}
```

Then within any `asypicture` environment, the line `@definesortfunction T;` can be used to define a function `T[] sort(T[])` that returns a sorted version of its argument, for any type `T` for which the less than operator `<` is defined. For instance, within an `asypicture`, the code

```
bool operator <(pair a, pair b) {
  return (a.x < b.x || (a.x == b.x && a.y < b.y));
}
```

```
@definesortfunction pair;
```

makes available a lexicographic sorting routine for ordered pairs of real numbers.

Unfortunately, while this compiles correctly, the resulting Asymptote file has no line breaks in the entire definition of the sort function. If you want the Asymptote code (as opposed to just the `asypicture` code) to be readable, the following setup, proposed by Enrico Gregorio⁷, does the job:

⁶The algorithm here is a somewhat inefficient mergesort.

⁷<http://tex.stackexchange.com/a/160740/484>

```

\begingroup
\endlinechar='^^J \obeyspaces% end of lines are newlines
\gdef\definesortfunction #1;{% eat up the space following the macro
#1[] sort(#1[] a) {
  if (a.length <= 1) return a;
  static #1[] merge(#1[] b, #1[] c) {
    #1[] toreturn;
    int i = 0, j = 0;
    while (i < b.length && j < c.length) {
      if (!(c[j] < b[i])) { toreturn.push(b[i]); ++i; }
      else { toreturn.push(c[j]); ++j; }
    }
    while (i < b.length) {
      toreturn.push(b[i]);
      ++i;
    }
    while (j < c.length) {
      toreturn.push(c[j]);
      ++j;
    }
    return toreturn;
  }
  int halfway = floor(a.length / 2);
  #1[] b = sort(a[0:halfway]);
  #1[] c = sort(a[halfway:a.length]);

  return merge(b, c);
}% this % is necessary
}% this % is necessary
\endgroup% this % is necessary

```



Warning: If two commands use the same unconventional delimiter, then they cannot be nested. In particular, a command cannot appear inside its own argument. This is one of the reasons people usually delimit with grouping symbols, which is not an option here, short of using `@bgroup` and `@egroup` with copious occurrences of `@expandafter`.



Warning: The `\def` command is not expandable. Thus, the code defining the macros must be given *outside* `asypicture` environments, even when the macros are intended for use exclusively inside `asypictures`.

7 Missing features

The introduction of this documentation touted ways in which `asypictureB` improves on the behavior of the `asymptote` package. In this section, I clarify ways in which it falls short and describe how to compensate where possible. My hope is that these differences would narrow in both directions until only one package is necessary—preferably the official `asymptote` package.

Note that some of these “missing features” cannot be fixed without breaking backwards compatibility. This is largely why the package is named `asypictureB`, allowing room for a future, more powerful version named `asypicture`, in case the `asymptote` package does not step into the gap.

Tip: To retrieve the documentation for the `asymptote` L^AT_EX package, type `texdoc asy-latex` at the command line. To retrieve the documentation for the Asymptote programming language, type `texdoc asymptote`. To retrieve the documentation for `asypictureB`, type `texdoc asypictureB`.

No 3d interaction One of the most spectacular features of the `asymptote` package is the embedding of interactive three-dimensional images in PDF files. (Note that this requires the `inline` option when loading the package.) The `asypictureB` package currently has no such feature. In fact, the default header includes the line `settings.prc = false;` to prevent Asymptote from trying to produce an interactive (`prc`) image, since this might break things.

No inline option A second feature that is important, but less spectacular, is the `inline` option itself, which causes the Asymptote labels to be compiled (in L^AT_EX) with all the same packages loaded and macros defined as in the original document. For instance, font consistency between the Asymptote images and the larger document is ensured by this option. It comes with an important limitation—Asymptote cannot use size information about the labels when this option is in use.

The closest equivalent in the `asypictureB` package is the immediate expansion of macros introduced by the `@` symbol. This does not have the drawback of the `inline` option, and has many additional uses. However, it is less flexible inside labels (since, e.g., macros with arguments cannot be used this way), and does not ensure font consistency.

To compensate for this when using `asypictureB`, important packages and macro definitions should be echoed in the Asymptote header. Here is an example of code that could be placed in the preamble of a document to make the macro `\RR` (for \mathbb{R}) available in both the document text and the labels of its Asymptote pictures:

```
\usepackage{amssymb}
\newcommand{\RR}{\mathbb{R}}
\begin{asyheader}
usepackage("amssymb");
tex preamble("\newcommand{\RR}{\mathbb{R}}");
\end{asyheader}
```

The output format is not automatically set. When using `asymptote`, the output format is automatically set to either `eps` or `pdf` depending on what T_EX engine is being run (and which kind of graphics file it prefers). When using `asypictureB`, no such provision is made; if any format other than `eps` is desired, it must be selected by including the Asymptote code `settings.outformat="pdf";` (or `"png"`). This is by design, to allow the use of `png` files; but it can be a bit annoying at times. To set all Asymptote files to have `pdf` format, include the code


```
\begin{asyheader}
settings.outformat="pdf";
\end{asyheader}
```

in the preamble (or anywhere prior to the first `asypicture` environment).

Keys to asypicture are not conveyed to Asymptote In the `asymptote` package, keys like `width` and `height` are conveyed both to the implicit `\includegraphics` command and to Asymptote. In `asypictureB`, they are conveyed only to the `\includegraphics` command; font size and even resolution (for rasterized images) will be changed in the process of scaling the picture. Thus, the preferred method is to set the width, height, etc. through Asymptote’s `size` command.

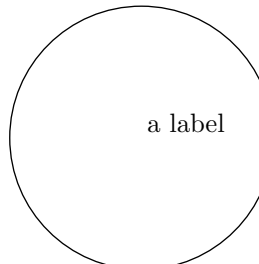
Bad (font size distorted):

```
\begin{asypicture}{name=bad_width,
width=3.5cm}
settings.outformat="pdf";
draw(unitcircle);
label("a label", position=(0,0), align=NE);
\end{asypicture}
```



Good:

```
\begin{asypicture}{name=good_width, width=3.5cm}
size(3.5cm,0);
settings.outformat="pdf";
draw(unitcircle);
label("a label", position=(0,0), align=NE);
\end{asypicture}
```



Note that in the “good” example, the key `width=3.5cm` is necessary only if you want to make sure the included image has *precisely* the specified width, and probably not even then.

No spaces in file names The `asymptote` package takes measures to accomodate peculiar file names—in particular, file names that include spaces. The `asypictureB` package does not.

No directory specification The `asymptote` package allows the user to specify a directory in which to store the Asymptote code and images. The `asypictureB` package does not currently have this feature, although there is a patch by user202729 that will hopefully be included in the next version. Note that neither package respects the `-output-directory` commandline option.

Suboptimal interaction with latexmk By design, the `asypictureB` package allows the image format to be specified by the Asymptote code; it does not care whether a `png` or `pdf` file is produced. Unfortunately, `latexmk` relies on being

able to identify the generated image file from the T_EX log file. Thus, if you use `asypictureB` with `latexmk`, it will rerun Asymptote every time for `asypictures` that produce a file format other than the one expected by `latexmk`. Since `asypictureB` and `latexmk` are two different solutions to the same problem, I expect most users will choose one or the other. But for those who want to use them together, hopefully there will be a better solution in the future.

8 Acknowledgements

The current `asypictureB` package incorporates bug fixes and improvements by user202729 (<https://tex.stackexchange.com/users/250119>) and cfr (<https://tex.stackexchange.com/users/39222>). For more details, see the commit history on github.

9 Implementation

```

1 \NeedsTeXFormat{LaTeX2e}
2 \ProvidesPackage{asypictureB}
3   [2025/01/04 v0.4 user-friendly integration of Asymptote into LaTeX]
4
5 \RequirePackage{fancyvrb}
6 \RequirePackage{graphicx}
7 \RequirePackage{pgfkeys}
8
9 \makeatletter
10
11 \def\asy@OutFile{\FV@OutFile}
12
13 \RequirePackage{ifplatform}
14
```

Define the `\shell@execute` command. If shell escape is enabled, the command executes its contents in the shell. Otherwise, the command is written to a script for the user to execute.

```

15 \ifshellescape
16   \def\ASYPIC@shell{18}
17   \newcommand{\shell@execute}{\immediate\write\ASYPIC@shell}
18 \else
19   \newwrite\ASYPIC@shell
20   \ifwindows
21     \openout\ASYPIC@shell=\jobname-compile_asy.txt\relax
22   \else
23     \openout\ASYPIC@shell=\jobname-compile_asy.sh\relax
24   \fi
25   \newcommand{\shell@execute}[1]{\{%
26     \edef\temp{#1}%
27     \write\expandafter\ASYPIC@shell\expandafter{\temp}%
28   }}
29 \fi
30
```

Define the `\copyfile` command, which should work regardless of whether shell escape is enabled. (If shell escape is enabled, it is more efficient.)


```

31 \ifshellescape
32   \newcommand{\copyfile}[2]{%
33     \ifwindows%
34       \immediate\write18{copy #1 #2 /y}%
35     \else%
36       \immediate\write18{cp #1 #2}%
37     \fi%
38   }
39 \else
40   \RequirePackage{verbatimcopy}
41   \newcommand{\copyfile}[2]{%
42     \OldVerbatimCopy{#1}{#2}%
43   }
44 \fi
45

```

Define the `\deletefile` command. Unlike `\copyfile`, this command will have no immediate effect if shell escape is not enabled, instead writing a line to the script. (If shell escape *is* enabled, of course the command will immediately delete the file.)

```

46 \newcommand{\deletefile}[1]{%
47   \ifwindows%
48     \shell@execute{del #1}%
49   \else%
50     \shell@execute{rm #1}%
51   \fi%
52 }
53

```

Set up the key-value system for `asypictureB` using `pgfkeys`.

```

54 \newcommand{\asyset}[1]{\pgfkeys{/asy}{#1}}
55 \newcommand{\@asyerrorfilename}{\@asypicturename_errors.txt}
56 \newcounter{@asy@linenumber}
57
58 \asyset{name/.initial=noname, name/.value required}%
59
60 \asyset{graphic options/.code={}}
61 \asyset{set graphic option/.style={graphic options/.append code=#1}}

```

Unrecognized keys should be passed to the `\includegraphics` command using `\setkeys`.

```

62 \asyset{.unknown/.code = %
63   {%
64     \edef\unknownkey{\pgfkeyscurrentname}%
65     \asyset{set graphic option/.expand once = {%
66       \expandafter\setkeys\expandafter{%
67         \expandafter G\expandafter i\expandafter n\expandafter%
68         }\expandafter{\unknownkey=#1}%
69       }}%
70     }%
71 }

```

However, scale and angle must be dealt with separately.

Important note: using this implementation, scale and angle will always be the next-to-last, respectively the last, keys executed, no matter in what order the keys are given. Thus, it is impossible to rotate an `asypicture` and then set the width or height using these keys. However, this functionality can be provided within the

Asymptote code.

```

72 \def\asy@scale{1}
73 \asyset{scale/.style={set graphic option = {\def\asy@scale{#1}}},
74     scale/.value required}
75 \newcommand{\asy@angle}{0}
76 \asyset{angle/.style = {set graphic option = {\def\asy@angle{#1}}},
77     angle/.value required}
78
79 \newcommand{\getfontsize}{\f@size}
80
81 \newif\ifasyfilechanged
82 \newif\ifASYPIC@flush
83 \newif\if@asyrepeat
84 \newread\@asyreadold
85 \newread\@asyreadnew
86 \edef\@tempasyfile{\jobname-temp}
87
88 \newcommand{\RequireAsyRecompile}{\ASYPIC@flushtrue}
89 \newcommand{\AsyCompileIfNecessary}{\ASYPIC@flushfalse}
90 \AsyCompileIfNecessary
91
92 \newcommand\clearasyheader{\def\ASYPIC@header{}}
93
94 \def\ASYPIC@header{}
95
96 \def\asyheader{\FV@Environment}{asyheader}}
97
98 \def\FVB@asyheader{%
99     \@bsphack
100     \begingroup
101     \FV@UseKeyValues
102     \FV@DefineWhiteSpace
103     \def\FV@Space{\space}%
104     \FV@DefineTabOut
105     \def\FV@ProcessLine##1{\g@addto@macro\ASYPIC@header{##1^^J}}%
106     \let\FV@FontScanPrep\relax
107     %% DG/SR modification begin - May. 18, 1998
108     %% (to avoid problems with ligatures)
109     \let\@noligs\relax
110     %% DG/SR modification end
111     \FV@Scan}%
112
113 \def\FVE@asyheader{\endgroup\@esphack}
114
115 \DefineVerbatimEnvironment{asyheader}{asyheader}%
116     {codes={\catcode'\@0},tabsize=4}

Set up the default asyheader:
117 \begin{asyheader}
118 defaultpen(fontsize(\getfontsize pt));
119 settings.prc = false;
120 \end{asyheader}

Now, define the asypicture environment using fancyvrb internals:
121 \def\asypicture{\FV@Environment}{asypicture}}

```

122

Define the `\ASYPIC%recordname` command. As an example, `\ASYPIC@recordname@foo` in the file `bar.tex` would set `\asylistingfile` to `bar-foo.asy` the first time it is called. A second call to `\ASYPIC@recordname{foo}` would set `\asylistingfile` to `bar-foo__1.asy`, a third to `bar-foo__2.asy`, and so on. The next number to use is stored in the macro `\ASYPIC@name@foo`. (Note that this is a macro, not a counter.)

```

123 \newcommand{\ASYPIC@recordname}[1]{%
124   \edef\tempmacroname{\ASYPIC@name@#1}%
125   \ifcsname\tempmacroname\endcsname%% if \ASYPIC@name@... is defined
126     \edef\oldnum{\csname\tempmacroname\endcsname}%
127     \edef\@asypicturename%
128       {\jobname-#1__\oldnum}%
129     \expandafter\xdef\csname\tempmacroname\endcsname%
130       {\the\numexpr\oldnum+1\relax}%
131     \edef\ASYPIC@current@num{\csname\tempmacroname\endcsname}%
132   \else%% This is the first time this name is being used.
133     \edef\@asypicturename%
134       {\jobname-#1}%
135     \expandafter\gdef\csname\tempmacroname\endcsname{1}%
136   \fi%
137   \xdef\asylistingfile{\@asypicturename.asy}
138 }
139
```

Most of the following definition is copied verbatim from the definition of the `VerbatimOut` environment in `fancyvrb.dtx`. I don't actually understand what a lot of it does.

```

140
141 \def\FVB@asypicture#1{%
142   \@bsphack
143   \asyset{graphic options/.code={}}%
144   \asyset{#1, name/.get = \currentname}%
145   \ASYPIC@recordname{\currentname}%
146   \begingroup
147     \FV@UseKeyValues
148     \FV@DefineWhiteSpace
149     \def\FV@Space{\space}%
150     \FV@DefineTabOut
151     \def\FV@ProcessLine{\immediate\write\asy@OutFile}%
152     \immediate\openout\asy@OutFile\@tempasyfile.asy\relax
153     \immediate\write\asy@OutFile{\ASYPIC@header^^J}
154     \let\FV@FontScanPrep\relax
155     %% DG/SR modification begin - May. 18, 1998
156     %% (to avoid problems with ligatures)
157     \let\@noligs\relax
158     %% DG/SR modification end
159     \FV@Scan}
160
161 \newcommand{\ASYPICcomparefiles}[2]{
162   \IfFileExists{\@asypicturename.asy}%
163     {\openin\@asyreadold=#1.asy\relax%
164      \openin\@asyreadnew=#2.asy\relax%
165      \asyfilechangedfalse%

```

```

166         \@asyrepeattrue%
167     \loop%
168         \ifeof\@asyreadold%
169             \@asyrepeatfalse%
170             \ifeof\@asyreadnew%
171             \else%
172                 \asyfilechangedtrue%
173             \fi%
174         \else%
175             \ifeof\@asyreadnew%
176                 \@asyrepeatfalse%
177                 \asyfilechangedtrue%
178             \else% Not at the end of either file in this case
179                 \readline\@asyreadold to \oldfileline%
180                 \readline\@asyreadnew to \newfileline%
181                 \ifx\oldfileline\newfileline%
182                     \@asyrepeattrue%
183                 \else
184                     \asyfilechangedtrue%
185                     \@asyrepeatfalse%
186                 \fi%
187             \fi%
188         \fi%
189     \if@asyrepeat
190     \repeat%
191     \closein\@asyreadold%
192     \closein\@asyreadnew%
193 }%
194 {\asyfilechangedtrue}%
195 \IfFileExists{#1.pdf}{-}{%
196     \IfFileExists{#1.png}{-}{%
197         \IfFileExists{#1.eps}{-}{%
198             \asyfilechangedtrue%
199         }%
200     }%
201 }%
202 }
203
204 \def\ASYPIC@runasy{%
205     \message{Attempting to run asy on \@asypicturename.asy^^J}%
206     \shell@execute{asy -noV \@asypicturename.asy 2> \@asyerrorfilename}%
207     \openin\@asyreadold=\@asyerrorfilename\relax%
208     \ifeof\@asyreadold%
209         \closein\@asyreadold% Error log does not exist.
210     \else%
211         \def\@asyerrormessage{^^J}%
212         %Create command to process line of log file to figure
213         %out the Asymptote file line number:
214         \edef\@asy@temp{%
215             \def\noexpand\@asy@processerrorline####1\detokenize\expandafter{%
216                 \@asypicturename.asy:%
217             }%
218         }%
219         \@asy@temp##2.##3:\relax{%

```

```

220         \xdef\@asy@errorlinenumber{\numexpr##2\relax}}%
221 %
222 \gdef\@asy@errorlinenumber{-5}%
223 {%
224     \endlinechar=-1%
225     \loop\unless\ifeof\@asyreadold%
226         \readline\@asyreadold to \@asyerrorcurrentline%
227         \ifnum\@asy@errorlinenumber=-5%
228             {\expandafter\expandafter\expandafter%
229              \@asy@processerrorline\expandafter%
230              % Suffix provides default of -5:
231              \@asyerrorcurrentline\detokenize\expandafter%
232              {\@asypicturename.asy:} -5.1:\relax%
233             }%
234         \fi%
235         \expandafter\g@addto@macro\expandafter\@asyerrormessage%
236         \expandafter{\@asyerrorcurrentline^^J}%
237     \repeat%
238 }%
239 \closein\@asyreadold%
240 \ifnum\@asy@errorlinenumber=-5% No error
241 \else%
242     \openin\@asyreadold\@asypicturename.asy\relax%
243     \edef\numlinesout{5}
244     \setcounter{@asy@linenumber}{\numlinesout}
245     \loop\ifnum\value{@asy@linenumber}<\@asy@errorlinenumber%
246         \readline\@asyreadold to \temp%
247         \stepcounter{@asy@linenumber}%
248     \repeat%
249     %
250     \addtocounter{@asy@linenumber}{-\numlinesout}%
251     %
252     {%
253         \endlinechar='^^J%
254         \loop\ifnum\value{@asy@linenumber}<\@asy@errorlinenumber%
255             \stepcounter{@asy@linenumber}%
256             \edef\temp/{\arabic{@asy@linenumber}}}%
257             \expandafter\g@addto@macro\expandafter%
258             \@asyerrormessage\expandafter{\temp/ }%
259             \readline\@asyreadold to \@asytempmessage%
260             \expandafter\g@addto@macro\expandafter%
261             \@asyerrormessage\expandafter{\@asytempmessage}%
262         \repeat%
263     }%
264     \closein\@asyreadold%
265     \PackageError{asypictureB}{\@asyerrormessage}{%
266         The Asymptote run described above
267         gave a non-empty error log. I have^^J%
268         reproduced the error log and attempted
269         to print the five lines leading^^J%
270         up to the error. Press enter or return
271         to continue, and then fix your^^J%
272         Asymptote code when this run is done.
273     }%

```

```

274      \fi%
275      \fi%
276 }
277
278 \def\FVE@asypicture{\immediate\closeout\asy@OutFile\endgroup%
279   \@esphack%
280   \ifASYPIC@flush%
281     \asyfilechangedtrue%
282   \else%
283     \ASYPICcomparefiles{\@asypicturename}{\@tempasyfile}%
284   \fi%
285   \ifasyfilechanged%
286     \IfFileExists{\@asypicturename.png}%
287       {\deletefile{\@asypicturename.png}}{}%
288     \IfFileExists{\@asypicturename.pdf}%
289       {\deletefile{\@asypicturename.pdf}}{}%
290     \IfFileExists{\@asypicturename.eps}%
291       {\deletefile{\@asypicturename.eps}}{}%
292     \copyfile{\@tempasyfile.asy}{\@asypicturename.asy}%
293     \ASYPIC@runasy%
294   \fi%
295   \asyset{graphic options}%
296   % Avoid giving "file does not exist" errors.
297   \chardef\previousinteractionmode=\interactionmode%
298   \batchmode%
299   \includegraphics[scale=\asy@scale,angle=\asy@angle]%
300     {\@asypicturename}%
301   \interactionmode=\previousinteractionmode%
302 }
303
304 \DefineVerbatimEnvironment{asypicture}{asypicture}%
305   {codes={\catcode'\@=0},tabsize=4}
306
307 %\AtEndDocument{\deletefile{\@tempasyfile.asy}}
308 \ifshellescape\else
309   \AtEndDocument{\closeout\ASYPIC@shell}
310 \fi
311
312
313 \makeatother

```

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	27, 34, 36, 151, 153				
X					
\xdef	129, 137, 220				