The latexalpha2 package*

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2019/03/02

1 Introduction

latexalpha2 is a LaTeX package that allows you to embed and execute your Wolfram Language (Mathematica) source codes in a LaTeX document. When the document is compiled, the computation results will be inserted into the compiled file. For example,

```
$$ \wolfram{LaplaceTransform[t^4 Sin[t],t,s]} $$
```

gives the Laplace transform of $t^4 \sin t$ and generates

$$\frac{24\left(5s^4-10s^2+1\right)}{\left(s^2+1\right)^5}.$$

It is also quite easy to generate plots or animations with this package. Moreover, all the embedded codes can be executed either locally or on the cloud.
The main features of the package are somewhat similar to `SageTeX`[1], but here we use Wolfram Language (Mathematica) instead of Sage.
If you have any questions or comments, you are welcome to raise issues or pull requests through the Github repository for this package[2]. For now, latexalpha2 only supports Unix-like systems.
This package is *not* endorsed by or affiliated with Wolfram Research, Inc. in any way.

2 Installation

The Wolfram Language codes are executed using the WolframScript interpreter[3]. So please make sure that WolframScript is appropriately installed before using

*This document corresponds to latexalpha v1.0, date 2019/03/02.
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[1] `https://ctan.org/pkg/sagetex`
[2] `https://github.com/stevenliuyi/latex-alpha2`
[3] `https://www.wolfram.com/wolframscript`

latexalpha2. If you'd like to run your codes on cloud, please authenticate first:

```
wolframscript -authenticate
```

When compiling your document, LaTeX must be invoked with the `-shell-escape` flag in order to run WolframScript. Currently, this package is only tested with pdfLaTeX. After put `\usepackage{latexalpha2}` in the preamable of your document, you can compile it as:

```
pdflatex -shell-escape filename.tex
```

3 Usage

3.1 Package options

When importing the package as `\usepackage[`⟨*option*⟩`]{latexalpha2}` in your document, there are two pairs of options available. The first pair is `local` (default) and `cloud`. As the names suggest, it controls whether the computations are performed locally (via locally installed Mathematica) or on the cloud (via Wolfram Cloud). The second pair is `cache` (default) and `nocache`, which controls whether or not the computation results are cached. Cached results will not be computed again when you compile the document next time if the corresponding Wolfram Language code and output format are not changed.

3.2 Macros

`\wolfram` `\wolfram[`⟨*format*⟩`]{`⟨*code*⟩`}` takes any Wolfram Language code, executes it and insert the result into the document. The options for format are `tex` (default), `wolfram` and `text`. For example,

```
$$ \wolfram{Series[Exp[x],{x,0,5}]} $$
```

generates a power series expansion for e^x about $x = 0$ to 5th order, and the result is

$$1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120} + O\left(x^6\right).$$

`\wolframgraphics` `\wolframgraphics[`⟨*format*⟩`]{`⟨*code*⟩`}{`⟨*filename*⟩`}` generates a plot from Wolfram Language code and saves the image in the current folder. The file format options are `pdf` (default), `png` and `jpg`. For example, the 3D plot shown in figure 1 is generated by

```
\begin{figure}
  \wolframgraphics{Plot3D[Sin[x]Cos[y],{x,-2Pi,2Pi},{y,-2Pi,2Pi}]}{example}
  \includegraphics{example.pdf}
  \caption{Plot of $f(x,y)=\sin(x)\cos(y)$}
```

```
\centering
\end{figure}
```

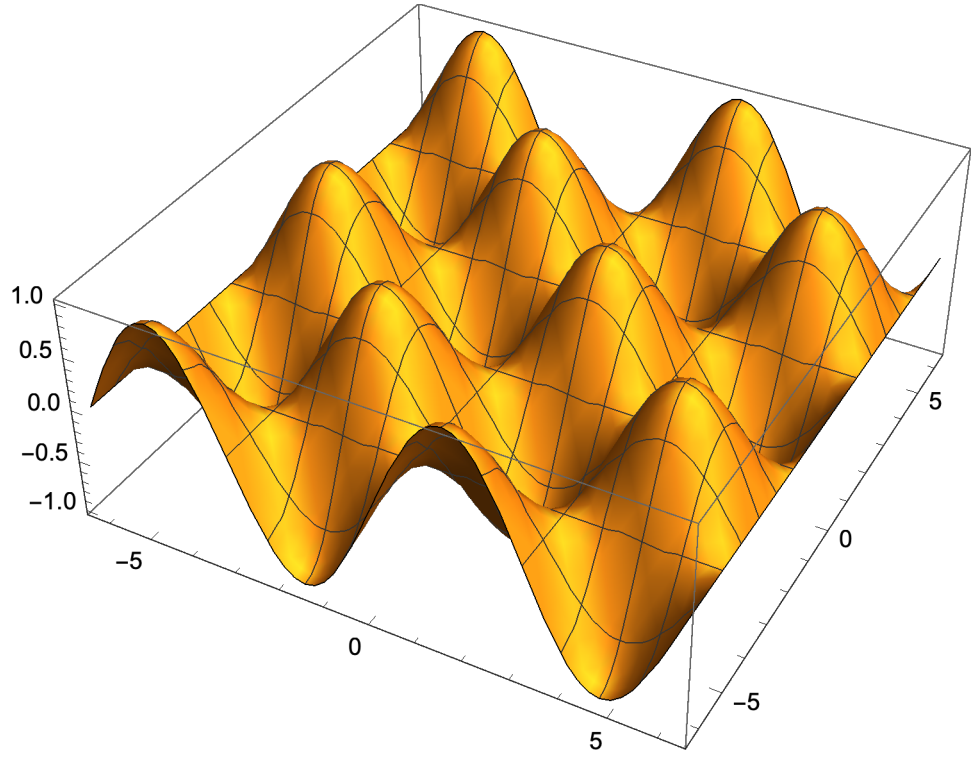

Figure 1: Plot of $f(x, y) = \sin(x)\cos(y)$

`\wolframalpha` `\wolframalpha[⟨format⟩]{⟨query⟩}` sends a query to Wolfram|Alpha and put the result into the document. The options for format are `tex` (default), `wolfram`, `wolfram2` and `text`. The options `wolfram` and `wolfram2` correspond to the pure standard Wolfram Language result and the result generated by free-form input, respectively. In the Wolfram Language documutation[4], the former corresponds to the `WolframResult` format, and the latter corresponds to the `Result` format. The default option `tex` uses the `WolframResult` format and converts the result into the TEX form. Besides, the option `text` generates plain text which is the result of the `ShortAnswer` format. As an example,

```
The population of Shanghai is $\wolframalpha{Shanghai population}$, which
is $\wolframalpha{ratio of Shanghai population and NYC population}$ times the
population of New York City.
```

[4] `https://reference.wolfram.com/language/ref/WolframAlpha.html`

generates "The population of Shanghai is 2.415×10^7people, which is 2.814 times the population of New York City."

`\wolframsolve` `\wolframsolve{⟨equation⟩}{⟨variable⟩}` solves an equation and display the corresponding results. For example,

```
\wolframsolve{a x^2+b x+c==0}{x}
```

produces

$$x = \frac{-\sqrt{b^2-4ac}-b}{2a}$$
$$x = \frac{\sqrt{b^2-4ac}-b}{2a}$$

`\wolframdsolve` `\wolframdsolve{⟨equation⟩}{⟨dependent variable⟩}{⟨independent variable⟩}` is similar to `\wolframsolve`, but it solves an differential equation. For example,

```
\wolframdsolve{y'[x]+y[x]==a Sin[x]}{y[x]}{x}
```

produces

$$y(x) = \frac{1}{2}a(\sin(x) - \cos(x)) + c_1 e^{-x}$$

`\wolframtex` `\wolframtex{⟨format⟩}{⟨code⟩}` takes TEX code instead of Wolfram Language code, and performs some simple calculations. The options for format are the same as `\wolfram`, i.e. `tex` (default), `wolfram` and `text`. For example, the result of

```
$$ \wolframtex{\int_a^b\sin(x)\,dx} $$
```

is

$$\cos(a) - \cos(b).$$

`\wolframanimation` `\wolframanimation{⟨code⟩}{⟨foldername⟩}` is similar to `\wolframgraphics`, but it converts any Wolfram Language animation object into a sequence of images, instead of a single image. The images are saved in a subfolder of current folder, named as ⟨*foldername*⟩. You can then use `\animategraphics` from the `animate` package[5] to generate animation. Note that PDF files with animations can only be viewed in a small number of PDF readers, which includes Acrobat Reader. Please refer to the documentation for the `animate` package for more information.

[5] `https://ctan.org/pkg/animate`

3.3 Notes

If you want to input backslashs in your Wolfram Language codes, you could use `\backslash`. For example, use `\backslash[Alpha]` instead of `\[Alpha]` to represent the Greek letter α.

4 Acknowledgement

This package is heavily inspired by `LaTeX-Alpha`[6]. Acutally, that is where the name of this package comes from. Unfortunately, `LaTeX-Alpha` has been down for a while. The objective of this package is to replace `LaTeX-Alpha`, as well as to provide various new features.

[6] `https://github.com/Akollek/LaTeX-Alpha`