$\LaTeX$-α

$\LaTeX$ Meets Wolfram

$\LaTeX$-α is a $\LaTeX$ package which incorporates the typesetting ease and control of $\LaTeX$ with the power of the Wolfram Language. The goal of **$\LaTeX$-α** is to provide the most complete, powerful and self-sufficient typesetting environment.

$\LaTeX$-α is a work in progress. Please keep checking back for updates by clicking the title.

```
\usepackage{latexalpha}
```

Calculations

$\LaTeX$-α allows for inline calculations, making scientific or mathematical document typesetting simpler and more streamlined. The examples below show that **$\LaTeX$-α** has the full capabilities of the Wolfram Language, and thus knows mathematical constants, can solve integrals and can differentiate symbolically.

A basic example:

```
$3+4=\calc{3+4}$
```

$$\overbrace{3+4}^{\text{Typed in }\LaTeX} \quad = \quad \overbrace{7}^{\text{Calculated by the Wolfram Cloud}}$$

Some more advanced examples:

```
$3\times4\sin\left(\frac{\pi}{4}\right)=$\calc{3*4 Sin[Pi/4]}$
```

$$3 \times 4 \sin\left(\frac{\pi}{4}\right) = 6\sqrt{2}$$

```
$\int_{10}^{35} e^{5x} dx=$\calc{Integrate [Exp[5*x], {x,10,35}]//N}$
```

$$\int_{10}^{35} e^{5x} dx = 2.00708 \times 10^{75}$$

```
$\frac{d}{dx}x^2\log(x)=\calc{D[x^2 Log[x], x]}$
```

$$\frac{d}{dx}x^2 \log(x) = x + 2x \log(x)$$

```
$\cos(\frac{\pi}{4})\approx
\sum_{n=0}^3 \frac{(-1)^n \left(\frac{\pi}{4}\right)^{2n} }{(2n)!}=
\calc{Total[Table[(-1)^n  (Pi/4)^(2 n)/((2 n)!), {n, 0, 3}]] // N}$
```

$$\cos(\frac{\pi}{4}) \approx \sum_{n=0}^{3} \frac{(-1)^n \left(\frac{\pi}{4}\right)^{2n}}{(2n)!} = 0.707103$$

Using the Greek Alphabet

The *calc* command is equipped with a special function to use greek characters, `Greek[ ]`.

```
\[(\lambda +4 )^3 (\lambda -1)=
\calc{Expand[ (Greek[Lambda] +4 )^3 (Greek[Lambda] -1)]}\]
```

$$(\lambda + 4)^3(\lambda - 1) = \lambda^4 + 11\lambda^3 + 36\lambda^2 + 16\lambda - 64$$

For capital greek letters, prepend "`Capital`". For example, `Greek[CapitalOmega]` becomes Ω .

Solving Equations

LaTeX-α allows for equations with multiple solutions to be solved within LaTeX documents with the command \\`solve`{`equation to be solved`}{`variable to be solved for`}. For example,

```
$\omega^2=1$ has solutions
\solve{Greek[Omega]^2==1}{Greek[Omega]}
```

$\omega^2 = 1$ has solutions

$$\omega = -1$$
$$\omega = 1$$

```
$3 K^2 - 4 K M y^2 + M^2 y^4 = 0$ has roots
\solve{3 K^2 - 4 K M y^2 + M^2 y^4 == 0}{y}
```

$3K^2 - 4KMy^2 + M^2y^4 = 0$ has roots

$$y = -\frac{\sqrt{K}}{\sqrt{M}}$$
$$y = \frac{\sqrt{K}}{\sqrt{M}}$$
$$y = -\frac{\sqrt{3}\sqrt{K}}{\sqrt{M}}$$
$$y = \frac{\sqrt{3}\sqrt{K}}{\sqrt{M}}$$

Some Useful Wolfram Language Functions

`N[ ]`

If you wrap your calculation in this function it will return a numerical value.
For example, e^2 would become 7.38906 .

`ScientificForm[Expression, Precision]`

This will give you a value in scientific notation. For example `ScientificForm[142342123342., 3]` will become 1.42×10^{11}.

Graphics

the *graphic* command generates a graphic and saves it to your directory to be used later in your LaTeX document.

```
\graphic{Plot[ Tan[x], {x, 0, 2*Pi}]}{tan}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{tan.png}
\caption{Plot of $\tan(x)$ generated with the Wolfram API}
\end{figure}
```

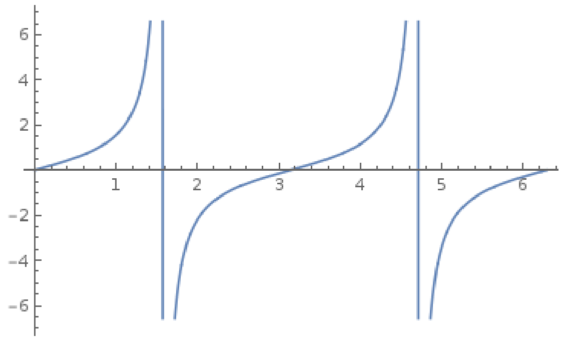

Figure 1: Plot of $\tan(x)$ generated with the Wolfram API

```
\graphic{ListPlot[ {1,2,2.5,2.9,3} ,PlotStyle->Red,Axes->False,Frame->True]}{plot}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{plot.png}
\caption{Some points plotted with the Wolfram API}
\end{figure}
```

Additionally, **LaTeX-**α supports error bars.

```
\graphic{ErrorListPlot[{{0.5,0.1},{1,0.1},{1.7,0.5},{2,0.1},{3,0.2}}]}{errorplot}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{errorplot.png}
\caption{Error Plot generated with the Wolfram API}
\end{figure}
```

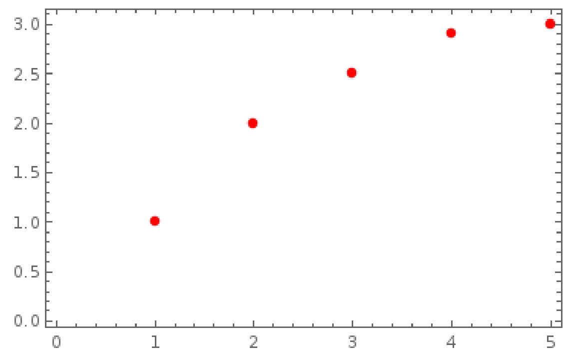

Figure 2: Some points plotted with the Wolfram API

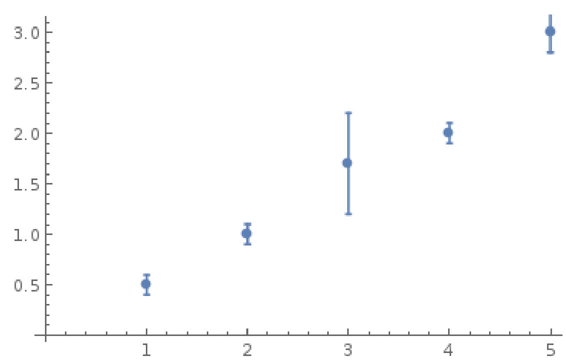

Figure 3: Error Plot generated with the Wolfram API

The \graphic command is (as the name would suggest) not restricted to scientific or mathematical plots.

```
\graphic{GeoGraphics[Frame->True]}{map}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{map.png}
\caption{A map}
\end{figure}
```

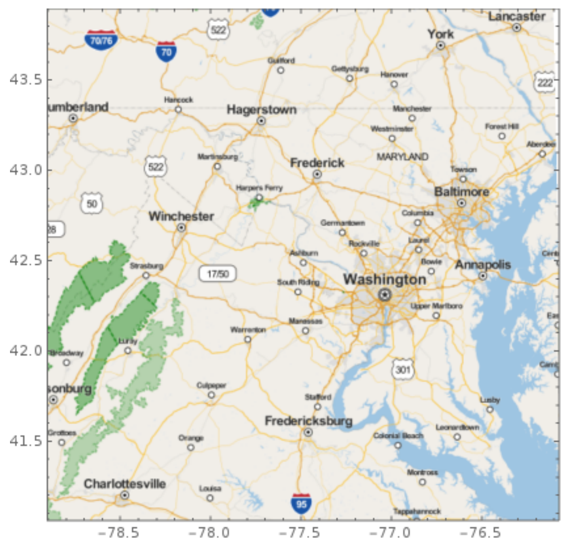

Figure 4: A map

Using Data Files

If you would like to make a plot using data stored in files on your computer, you can use **LATEX-α** 's $\backslash dataplotTXT$ command.

The file *data.txt* contains a list of numbers generated using the Wolfram Language. It's contents are shown here for reference:

```
{{1, 4.23012}, {2, 5.21578}, {3, 9.69427}, {4, 16.79}, {5, 16.6168},
{6, 27.1912}, {7, 8.96403}, {8, 19.9478}, {9, 27.887}, {10, 14.6491},
{11, 30.6462}, {12, 12.2211}, {13, 44.8838}, {14, 30.3541}, {15, 38.5018},
{16, 44.3764}, {17, 63.9962}, {18, 87.8068}, {19, 69.8112}, {20, 46.7955}}
```

```
\dataplotTXT{data.txt}{ListLinePlot}{dataplot}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{dataplot.png}
\caption{Plot of random dataset stored in a separate file}
\end{figure}
```

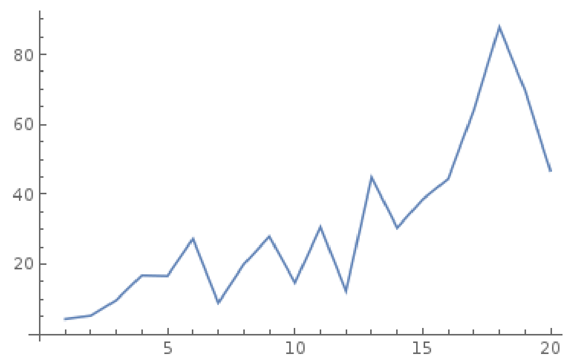

Figure 5: Plot of random dataset stored in a separate file

dataplotTXT takes an optional fourth argument in which you can specify plot options.

```
\dataplotTXT{data.txt}{ListLinePlot}{dataplotstyled}{Frame -> True, Axes -> False,
PlotStyle -> (Red, Thick, Dotted),
FrameLabel -> (Style['x-axis Label', 12, FontFamily -> Arial],
Style['y-axis Label', 12, FontFamily -> Arial])}

\begin{figure}[h!]
\centering
\includegraphics[width=0.6\textwidth]{dataplotstyled.png}
\caption{Styled plot of random dataset stored in a separate file}
\end{figure}
```

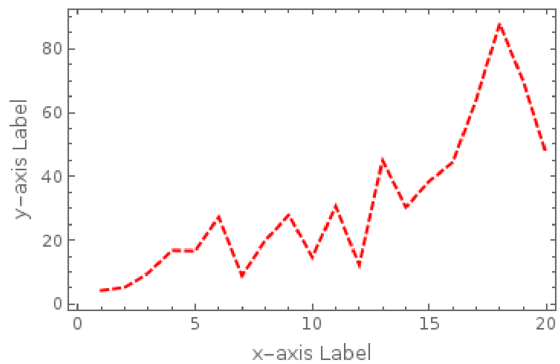

Figure 6: Styled plot of random dataset stored in a separate file

A couple notes on syntax: In the plot specifications, you'll notice that single quotation marks, ('), have been used as a string delimiter rather than double, ("). This is necessary. Additionally, lists have been specified by regular parentheses rather than the usual Wolfram style of curved ({ }) parentheses.

Tips for Graphics

- Once a graphic has been generated and saved to your computer, it is best to comment out the `\graphic` line to reduce compile time. Be careful, however, that if you are doing this, you are not reusing names for graphics.
- If you wish to show multiple functions or datasets in one graphic, the Wolfram function `Show[ ]` allows for this. For example, `Show[Plot[x,{x,0,1}],ListPlot[`*data*`]]` will plot the line $y = x$ overtop the dataset *data*.

Wolfram Alpha

Additionally, **$\LaTeX$-α** can take Wolfram Alpha input and insert the results into your document.

```
The biggest city in Canada is $\WolframAlpha{ biggest city in Canada }$.
```

The biggest city in Canada is Toronto.

```
The Empire State Building is
$\WolframAlpha{ how tall is the empire state building}$ tall.
```

The Empire State Building is 1250 Feet tall.

$\LaTeX$-α was built as a project for HackPrinceton 2014.
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