

A Brief Introduction to L^AT_EX

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March 28, 2013

Abstract

In this paper, we try to give a brief overview of the capabilities of L^AT_EX.

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*Supported by GMA and I-Cubed

1 Introduction

L^AT_EX is a computer program for typesetting documents, created by D. E. Knuth.

2 Creating Graphics

2.1 Plotting Functions

There are many packages available for *creating* graphics, including TikZ, xypic, and pstricks. You should probably just pick one and stick with it. Tikz is the most capable, and has extensive examples online to help you learn.

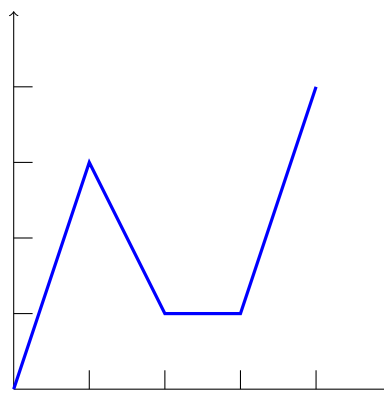


Figure 1: A Simple Tikz Drawing

Tikz is also a scripting language, allowing

you to use loops to simplify repetitive tasks.

If you include the package `pgfplots`, Tikz allows you to graph functions, as we saw in figure 2.1 on page 2.

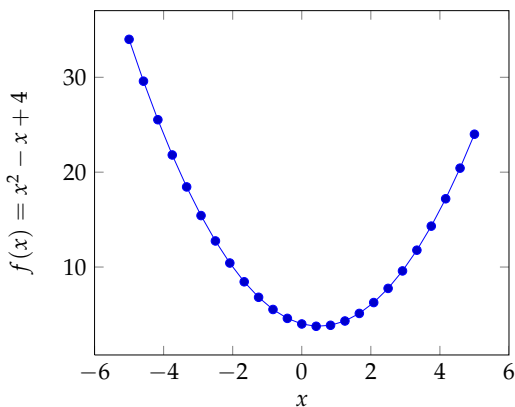


Figure 2: A graph with PGFplots

PGFplots allows 3d surfaces as well.

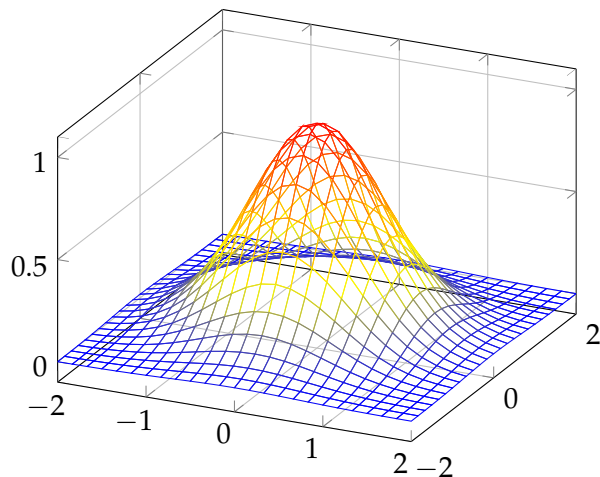


Figure 3: 3d mesh plot of $z = e^{-x^2 - y^2}$

More complicated diagrams and figures can be drawn, and there is a huge database¹ of ex-

¹<http://texample.net/tikz/examples/>

amples online.

2.2 More Interesting Drawings

Tikz supports a *wide* range of images. The easiest way to draw a complicated drawing is usually to separate it into ‘nodes’. Nodes can be given a wide variety of attributes, including shapes, labels, colors, etc. Figure 2.2 on page 2 shows a simple example.

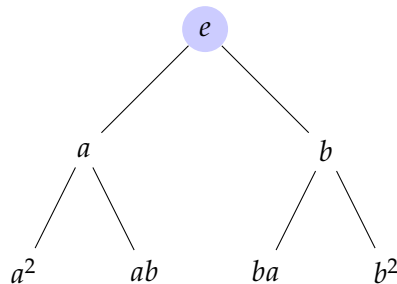


Figure 4: A simple tree

Figure 2.2 on page 3 shows a much more complicated example (stolen from Till Tantau²)

2.3 Using Other Software

LaTeX is not well suited to more intensive computation. However, Tikz/PGF provide lots of options for incorporating images from other systems (MATLAB, Sage, Maple, etc) into documents while still keeping the same style. Documentation and examples can be found here: <http://pgfplots.sourceforge.net/pgfplots.pdf>.

²<http://www.ctan.org/author/tantau>



Figure 5: A nice tree drawn with Tikz

3 Formatting

3.1 Fonts

Since L^AT_EX uses font families instead of individual fonts, it can be difficult to change a single font. However, many families have been made into packages³. The program XeLaTeX will build L^AT_EX packages out of fonts currently installed on your computer, but this doesn't always work well.

3.2 Tables and Arrays

Tables (which are called arrays in math mode) are simple and easy to create. For example:

Vegetables	Celery	Potato	Onion
Fruit	Banana	Grape	Pineapple

Figure 6: Categorizing food

³<http://www.tug.dk/FontCatalogue/>

And

$$\mathcal{M} = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$$

3.3 Definitions, Theorems, etc.

With the `amsthm` package, you can create new 'theorem' environments like so:

Definition 1. Let $n, k \in \mathbb{Z}$ with $0 \leq k \leq n$. Define the binomial coefficient $\binom{n}{k}$ by

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

Theorem 1. For all $n \in \mathbb{Z}^+$ and all $x \in \mathbb{R}$, the following expansion holds

$$(x+1)^n = \sum_{k=0}^n \binom{n}{k} x^k.$$

Theorem 1 is known as the *Binomial Theorem*.

3.4 Complicated Equations

Equations that span multiple lines can be formatted easily with the `align` environment. If you don't want it numbered, use `align*` instead. Note that the `align` environment already defaults to math mode, so you don't need to put in dollar signs.

Theorem 2 (Series Expansion).

$$\frac{x}{1-3x+2x^2} = \sum_{n \geq 0} (2^n - 1)x^n.$$

Proof.

$$\begin{aligned} \frac{x}{1-3x+2x^2} &= \frac{x}{(1-x)(1-2x)} & (1) \\ &= \frac{1}{1-2x} - \frac{1}{1-x} & (2) \\ &= \sum_{n \geq 0} 2^n x^n - \sum_{n \geq 0} x^n & (3) \\ &= \sum_{n \geq 0} (2^n - 1)x^n. & (4) \end{aligned}$$

Line 2 follows from partial fraction decomposition. \square

3.5 Headers and Footers

Just use the `fancyhdr` package, it's easy. See the preamble of this article for an example.

4 Presentations

4.1 Slideshows

Use `\documentclass{beamer}`. Slides are specified with `\begin{frame} ... \end{frame}`.

The `\pause` command makes information show up incrementally.

The `\begin{block}{blocktitle} ... \end{block}` allows you to put information in containers called blocks, which help you to organize a presentation.

4.2 Posters

Beamer can also be used to make posters, using the `block` environment to organize information. Many examples can be found online.

5 Reference Management

There are two main options when creating a bibliography. The first is to style the bibliography yourself, include it at the end, and let L^AT_EX handle citations throughout the document. The other is to use BibTeX, a different (but closely related) program to style your bibliography from the basic data, then let L^AT_EX handle the rest.

5.1 Without BibTeX

Use the `thebibliography` environment at the end of the document to enter bibliography elements. Then you can just use `\cite{name}` to cite an entry.

5.2 With BibTeX

The first method is simpler, but requires you to do more work. The second is more complicated at first, but makes it extremely easy to change styles. We'll use the BibTeX method here. Here's an example citation [EucBC]. And here's another [Wil95].

The default styles can be found here: http://en.wikibooks.org/wiki/LaTeX/Bibliography_Management#Bibliography_styles. Many journals and conferences will provide their own bibliography style file (`.bst`) for use in publications. New styles can be automatically generated using `makebst` tool, but this can get *very* complicated.

Note that, by default, reference entries are only generated if they are cited in the document somewhere. If you want a reference to show up regardless of whether it is cited, use the `\nocite{name}` command. Using `\nocite{*}` will make all references defined in the `.bib` file appear in the document.

References

- [EucBC] Euclid. On the infinitude of primes.
Alex. J. Math., 1(1):1–5, 300BC.
- [Wil95] Andrew Wiles. Modular elliptic curves and Fermat’s last theorem.
Ann. of Math. (2), 141(3):443–551, 1995.