Introduction to LATEX

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Introduction to $\[\] ET_EX$

Alex Milbrand

Graduate Student Seminar

September 8, 2017

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History

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- TEX created by Donald E. Knuth, released in 1978
- LATEX created by Leslie Lamport, released in 1985
- After version 3 of TEX, the version number asymptotically approaches π with each new update
 - The current version number of T_EX, as of January 12, 2014, is 3.14159265

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 $\mathsf{MikT}_{E\!X}$ is a T_EX/LATEX distributor needed to compile files within other programs.

 $T_{E}\!X$ works is an editor that comes preloaded with MikT_{E}\!X, but is very basic and not suggested for beginners.

Share ATEX (sharelatex.com) is an online editor with pdf viewer. No downloaded software is needed. All files are saved online.

 $T_{E}X studio \ and \ T_{E}X maker \ are \ common \ T_{E}X/ \ \ \ \ T_{E}X editors \ used.$ Both require MikT_EX to be installed *before* downloading.

TEXmaker Screenshot



TEXstudio Screenshot



Setting Up Your Document (Preamble)

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Start off with telling $\[MTEX]$ what type of document you are making: $\[class] \{class\}$

Class Types:

- PDF Documents: \documentclass{article}
- Beamer Presentations: \documentclass{beamer}Posters
 - \documentclass{baposter}
 - \documentclass{tikzposter}
 - \documentclass{beamer} in conjunction with
 \usepackage{beamerposter}

Packages are "add-ons" that have extra tools not already equipped in $Package [options] \{package name\}$

Writing Your Document

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After your preamble, the code for your document will entirely be nested within:

 $\verb|begin{document}|$

 $\verb|end{document}|$

Comments (text that will not show up in document) are added by putting a % before the comment. This can be used in-line with shown text or on its own line.

Since some characters are used for commands/codes, the following characters need a " $\$ " before the symbol:

To get "\", type \textbackslash .

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New Paragraphs: \\or \newline starts a new line of text, but treats the text as if it was part of the previous paragraph. Double-enter will start a new paragraph.

New Pages: $\[AT_EX\]$ will automatically switch to a new page after text/pictures/etc have filled up a page. Inserting \newpage in your code will force the following text to be on the next page.

White Space: A specific amount of vertical white space can be added using \vspace{size} where the size can be given in most measurements: 0.5cm, 1in, etc. A similar command is used for horizontal space: \hspace{size}.

Basic Example

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Code

```
\documentclass{article}
```

```
3 * \begin{document}
4 This is a basic example of what an
article document would look like.
5 \vspace{1cm}\\
```

```
6 General sentences and words do not
require special commands. %This text
will not appear in the pdf
```

\end{document}

PDF

This is a basic example of what an article document would look like.

General sentences and words do not require special commands.

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Include \usepackage[options]{package name} in your
preamble.

AMS Packages

- amsmath: substitutes to the eqnarray envionment; insert plain test inside equation with \text{blah}; easy to create matrices
- amsthm: adds environment for theorem-like structures
- amssymb (which includes amsfonts): adds binary relation/operation symbols like ..., × , and ⊞; adds blackboard bold letters like ℝ, ℤ, and ℚ

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geometry Package

- Can specify the size/type of paper you want to use, such as legal, letter (default), A0, etc.
- Control the margins individually or all at once
- Control the size of the text area, including any headers or footers
- Specify the orientation of the paper; landscape or portrait (default)

Example Paper Sizes



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hyperref Package

- Include URL's with \url{link} or "hidden" links with \href{link}{description}
- Can create "mailto" links for email addresses
- Can link within the document with
 \hyperlink{label}{link caption} and
 \hypertarget{label}{target caption} like this!
 - Useful for table of contents, indices, and references

polynom Package

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- Will compute and display any or all steps for polynomial long division (can even show synthetic division steps)
 - Can display Euclidean algorithm for polynomials
 - Can display the factorization of a polynomial

For example, \polyfactorize{2X^3+X^2-7X+3} will output $2\left(X - \frac{1}{2}\right)\left(X + \frac{1}{2} + \frac{\sqrt{13}}{2}\right)\left(X + \frac{1}{2} - \frac{\sqrt{13}}{2}\right)$.

Does not support functions (like $\sin x$) or roots and exponents (other than integers). See documentation on package for details.

algorithm2e Package

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Creates environments for writing and displaying algorithmsCan change keywords or typography of keywords

Example Code

\begin{algorithm]{H]
 \KwData{this text}
 \KwResult{how to write algorithm with \LaTeX2e }
 initialization\;
 \While{not at end of this document}{
 read current\;
 \eIf{understand}{
 go to next section\;
 current section becomes this one\;
 }{
 go back to the beginning of current section\;
 }
 }
 \caption{How to write algorithms}
 \end{algorithm}

Example Output

Data: this text
Result: how to write algorithm with LATEX2e
initialization;
while not at end of this document do
read current;
if understand then
go to next section;
current section becomes this one;
else
go back to the beginning of current section;
end
end
Algorithm 1: How to write algorithms

Math Environments

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You can type mathematical equations/expressions in much the same way as you would into google or wolframalpha. For example, $x^2+y^2=z^2$ would yield $x^2 + y^2 = z^2$.

Two main math environments: inline mode and display mode.

Inline Mode

Allows the user to put equations/expressions within a paragraph/sentence, as in the first paragraph above.

- **\$** math **\$**
- $\blacksquare \ (math \)$

\begin{math}...math...\end{math}

Math Environments

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Display Mode

Equations/expressions written in display mode will be centered and in their own line of text. These can be numbered or unnumbered, based on your code.

- For unnumbered:
 - **\$** \$\$ math \$\$
 - $\blacksquare \ \ [math \ \]$
 - \begin{displaymath}...math...\end{displaymath}
- For numbered:
 - \begin{equation}...math...\end{equation}

Note: the amsmath package adds slight variations to these math evironments

It's All Greek to Me!

Standard Letters

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Spell out the name of the letter (after a backslash). Capitalizing the name will give you an uppercase Greek letter.

- $\delta,$ delta for $\delta,$
- **S**\gamma\$ for γ , \$\Gamma\$ for Γ
- There are no "capital letters" where you would write the standard latin letter. eq. use A for a capital alpha

Variants

Some lowercase letters have different forms to choose from.

- **\$\phi\$** yields ϕ and **\$\varphi\$** yields φ
- Standard: ϵ , θ , κ , ϕ , π , ρ , σ
- Variant: ε , ϑ , \varkappa , φ , ϖ , ϱ , ς

Fractions, Exponents, and Functions

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Fractions can be inputted using $\frac{num}{denom}$ (or $\frac{num}{denom}$ for large fractions inline math mode). $\frac{1}{2}$ gives $\frac{1}{2}$ and $\frac{1}{2}$ gives $\frac{1}{2}$

Exponents

Fractions

Exponents are added with $\hat{}$ or $\{exponent\}$ (in math mode). So x^abc results in x^abc but x^{abc} results in x^{abc} . Subscripts are used the same way with _ instead of $\hat{}$

Functions

Use $\sin x$ intead of $\sin x$. Results in $\sin x$ and $\sin x$, respectively. The same applies for other functions, such as logarithms, trigonometric, min/max, etc.

Operators and Relations

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Basic

Operators:

\$\times\$, \$\otimes\$, \$\oplus\$, \$\cup\$, \$\cap\$ ×, ⊗, ⊕, ∪, ∩

Relations:

\$\subset\$, \$\subseteq\$, \$\neq\$, \$\cong\$, \$\sim\$

$$\Box$$
 \subset , \subseteq , \neq , \cong , \sim

It is normally pretty easy to look up the code for any symbol you don't know.

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Symbols wit	h Upper/	Lower	Limits

Code	Inline	Display
$\lim_{x\to x} f(x)$	$\lim_{x\to\infty}f(x)$	$\lim_{x\to\infty}f(x)$
$\sum_{n=1}^{50}2n$	$\sum_{n=1}^{50} 2n$	$\sum_{n=1}^{50} 2n$
$\left int_{a}^{b}f(x)dx \right $	$\int_{a}^{b} f(x) dx$	$\int_{a}^{b} f(x) dx$

Similar coding is done for union ($\langle cup \rangle$, intersection ($\langle cap \rangle$, products ($\langle prod \rangle$, etc.

There are ways to make the inline-mode limits actually go above and below your symbols, though it does mess with the spacing of your paragraph lines.

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Func	rti∩nc
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While in a math mode, you do not want functions/operations (like trig functions) in the italics font normally outputted by math modes. Ex:

BAD	GOOD
sinx + cosx	$\sin x + \cos x$

Most functions/operations that act like this have a basic code:

$\sin x$	$\log x$	$\label{ln x}$	\mbox{max} A	$\det A$	\gcd A
sin x	log x	ln x	max A	det A	$\operatorname{gcd} A$

Parenthesis and Brackets

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Most bracket types can just be typed out in math mode with the standard keyboard key. So (2x-3)|x+1| is coded (2x-3)|x+1|.

Self-Scaling Brackets

\$($frac{1}{2}$)\$\$

If you are enclosing larger equations/expressions, you will want your brackets to scale appropriately. You can indicate this by putting \left and \right before the symbol:

 $(\frac{1}{2})$

 $\left(\frac{1}{2}\right)$

 $\ (\frac{1}{2}\)$

You can use \lbrace for { , \langle for \langle , etc.

Aligning Equations



Inserting Images from Files

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Package needed: graphicx

T_EX will automatically look for pictures in the same folder that your .tex file is saved, though you can indicate which folder(s) to look in by indicating in your preamble. Insert an image by coding:

 $\label{eq:linear} \$

You can change both the width and height to get a precise image size. Changing only width (height) will automatically scale the height (width) to match the aspect ratio of the image.

Inserting Images from Files

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Original:



Change width and height:



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Change only height:



Plotting Graphs within T_EX

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Package needed: pgfplots

\begin{tikzpicture} \begin{axis}[scale=0.55, xmin=-4, xmax=4, ymin=-5, ymax=15, axis lines=center, xlabel=\$x\$, ylabel={\$f(x)\$},] \addplot [domain=-4:4,samples=200,] {x^2-4}; \end{taxis} \end{tikzpicture}



Plotting Graphs within T_EX

Introduction to LATEX Alex Milbrand sin(r)\begin{tikzpicture} \begin{axis}[scale=0.6,hide axis, colormap/jet] \addplot3[mesh,samples=50,domain= -8:8,]{sin(deg(sqrt(x^2+y^2))) /sqrt(x^2+y^2)}; \addlegendentry{\$\frac{sin(r)}{r}\$} Pictures and Graphs \end{axis} \end{tikzpicture}

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Diagrams

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Package needed: tikz-cd

Example: Fundamental Homomorphism Theorem

```
\begin{tikzcd}
G\arrow{r}{f}\arrow[swap]
{d}{\varphi} & H\\
G/K\arrow[swap]{ur}{h}
\end{tikzcd}
```



BibTEX

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BibT_EX works seamlessly with T_EX to help manage a bibliography and cite your sources within your document.

You will need to create a separate .bib file that your T_EX document will reference. This .bib file should be saved in the same folder as your .tex file.

Within your TEX code, there is no extra package needed. However, if you are using a table of contents and want to include "References" in your table of contents, be sure to have \usepackage[nottoc]{tocbibind} in your preamble.

BibTEX - .bib File

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To create a .bib file, simply open a new document in whatever program you are using for T_EX and save the file as a .bib file. In the .bib file, you will only have entries based on your references.

@entrytype{name, info separated by commas}

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Example: @book{dummitfoote, author="David S. Dummit and Richard M. Foote, title="Abstract Algebra",

> edition="3", year="2003", publisher="Wiley"}

BibTEX - Entry Types and Fields

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Common Entry Types

- article
- book
- unpublished
- inbook : just a section, chapter, or part of a book
- misc : good for websites

Common Fields Used

- author
- booktitle
- title
- edition
- journal
- volume
- year
- url
- chapter

$BibT_EX - .tex File$

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Citing in document

Once you've named an entry in your .bib file, to place its reference number within your document, simply put \cite{name} where you are making the reference.

In .tex file

When you are ready to output your reference list, specify the style you would like it in and the .bib file name: \bibliographystyle{style} \bibliography{file}

BibTEX - Example

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@article(einstein, author="Albert Einstein", tittle="fluz: Elektrodynamik bewegter K(\"o)per). (Germani)(Coh Heelterodynamics of moving bodies]", journal="article", outmac="article", outmac="article", pages="891-921", vgar="3057", Diol="http://dx.doi.org/10.1002/andp.19053221004"]

@book[latexcompanion, author="Michel Goossens and Frank Mittelbach and Alexander Samarin", tttle="The LaTeA\ Companion", year="1993", publisher="Addison-Wesley", address="feeding, Massachusetts")

@misc{knuthwebsite, author="Donald Knuth", title="Knuth: Computers and Typesetting", url="http://www-csfaculty.stanford.edu/\"{]uno/abcde.html"} \documentclass[a4paper,10pt]{article} \usepackage[utf8]{inputenc} \usepackage[nottoc]{tocbibind}

\title{Bibliography management: BibTeX} \author{Share\LaTeX} \begin{document} \maketitle \tableofcontents \medskip \section{First Section} This document is an example of BibTeX using in bibliography management. Three items are cited: \textit{The \LaTeX\ Companion} book \cite{latexcompanion}, the Einstein journal paper \cite{einstein}, and the Donald Knuth's website \cite{knuthwebsite}. The \LaTeX\ related items are \cite{latexcompanion,knuthwebsite}. \medskip \bibliographystyle{plain} \bibliography{sample} \end{document}

Bibliography management: BibTeX

ShareWTgX

September 5, 2017

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1 First Section

This document is an example of BibTeX using in bibliography management. Three items are cited: The BT_2K Companion book [2], the Einstein journal paper [1], and the Donald Knuth's website [3]. The BT_2K related items are [2, 3].

References

- Albert Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodics]. Annalen der Physik, 322(10):891–921, 1905.
- [2] Michel Goossens, Frank Mittelbach, and Alexander Samarin. The BT_EX Companion. Addison-Wesley, Reading, Massachusetts, 1993.

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[3] Donald Knuth. Knuth: Computers and typesetting.

Just for Fun

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You can also manually place "coffee stains" on your documents with the coffee package!

Lorum ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Suliam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Done uliamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nun lectus placerat pede. Vivanus nunc nunc, molestie ut, ultricies vel, sempe un, velit. Ut portitior. Praesent in sapien. Lorem ipsum dolor sit amet, consecteuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut mens. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ane holobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus telus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut portitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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- Downloads: miktex, texstudio, texmaker,texworks
- \blacksquare The Not So Short Introduction to $\ensuremath{{\mbox{E}}} T_{\ensuremath{{\mbox{E}}} X}$
- sharelatex.com/learn
- T_EX for gmail
- MathIM: can use "faugrad" chatroom
- TEX StackExchange
- The Great, Big List of LaTEX Symbols
- http://detexify.kirelabs.org/classify.html

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