An Interactive Introduction to LaTeX

Part 1: The Basics

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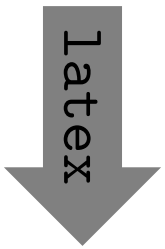
Why LaTeX?

- It makes beautiful documents
  - Especially mathematics
- It was created by scientists, for scientists
  - A large and active community
- It is powerful — you can extend it
  - Packages for papers, presentations, spreadsheets, ...

How does it work?

- You write your document in `plain text` with `commands` that describe its structure and meaning.
- The `latex` program processes your text and commands to produce a beautifully formatted document.

```
The rain in Spain falls \emph{mainly} on the plain.
```



The rain in Spain falls *mainly* on the plain.

More examples of commands and their output. . .

```
\begin{itemize}
\item Tea
\item Milk
\item Biscuits
\end{itemize}
```

- Tea
- Milk
- Biscuits

```
\begin{figure}
\includegraphics{gerbil}
\end{figure}
```

```
\begin{equation}
\alpha + \beta + 1
\end{equation}
```

$$\alpha + \beta + 1 \qquad (1)$$

Image license: CC0

Attitude adjustment

- Use commands to describe ‘what it is’, not ‘how it looks’.
- Focus on your content.
- Let LaTeX do its job.

Getting started

- A minimal LaTeX document:

```
\documentclass{article}
\begin{document}
Hello World! % your content goes here...
\end{document}
```

- Commands start with a *backslash* \ .
- Every document starts with a `\documentclass` command.
- The *argument* in curly braces { } tells LaTeX what kind of document we are creating: an `article`.
- A percent sign % starts a *comment* — LaTeX will ignore the rest of the line.

Getting started with **Overleaf**

- Overleaf is a website for writing documents in LaTeX.
- It 'compiles' your LaTeX automatically to show you the results.

Click here to open the example document in **Overleaf**

For best results, please use Google Chrome or a recent FireFox.

- As we go through the following slides, try out the examples by typing them into the example document on Overleaf.
- **No really, you should try them out as we go!**

Typesetting Text

- Type your text between `\begin{document}` and `\end{document}`.
- For the most part, you can just type your text normally.

```
Words are separated by one or more
spaces.

Paragraphs are separated by one
or more blank lines.
```

Words are separated by one or more spaces.

Paragraphs are separated by one or more blank lines.

- Space in the source file is collapsed in the output.

```
The   rain       in Spain
falls mainly on the plain.
```

The rain in Spain falls mainly on the plain.

Typesetting Text: Caveats

- Quotation marks are a bit tricky:
  use a backtick  on the left and an apostrophe  on the right.

`Single quotes: `text'.`	Single quotes: ‘text’.
`Double quotes: ``text''.`	Double quotes: “text”.

- Some common characters have special meanings in LaTeX:

   percent sign
   hash (pound / sharp) sign
   ampersand
   dollar sign

- If you just type these, you'll get an error. If you want one to appear in the output, you have to *escape* it by preceding it with a backslash.

`\$\%\&\#!`	$%&#!

Handling Errors

- LaTeX can get confused when it is trying to compile your document. If it does, it stops with an error, which you must fix before it will produce any output.
- For example, if you misspell `\emph` as `\meph`, LaTeX will stop with an "undefined control sequence" error, because "meph" is not one of the commands it knows.

Advice on Errors

1. Don't panic! Errors happen.
2. Fix them as soon as they arise — if what you just typed caused an error, you can start your debugging there.
3. If there are multiple errors, start with the first one — the cause may even be above it.

Typesetting Exercise 1

Typeset this in LaTeX: [1]

In March 2006, Congress raised that ceiling an additional $0.79 trillion to $8.97 trillion, which is approximately 68% of GDP. As of October 4, 2008, the "Emergency Economic Stabilization Act of 2008" raised the current debt ceiling to $11.3 trillion.

Click to open this exercise in **Overleaf**

- Hint: watch out for characters with special meanings!
- Once you've tried, click here to see my solution.

[1] `http://en.wikipedia.org/wiki/Economy_of_the_United_States`

Typesetting Mathematics: Dollar Signs

- Why are dollar signs  special? We use them to mark mathematics in text.

```
% not so good:
Let a and b be distinct positive
integers, and let c = a - b + 1.

% much better:
Let $a$ and $b$ be distinct positive
integers, and let $c = a - b + 1$.
```

Let a and b be distinct positive integers, and let c = a - b + 1.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

- Always use dollar signs in pairs — one to begin the mathematics, and one to end it.
- LaTeX handles spacing automatically; it ignores your spaces.

```
Let $y=mx+b$ be \ldots

Let $y = m x + b$ be \ldots
```

Let $y = mx + b$ be ...

Let $y = mx + b$ be ...

Typesetting Mathematics: Notation

- Use caret ^ for superscripts and underscore _ for subscripts.

```
$y = c_2 x^2 + c_1 x + c_0$
```

$y = c_2 x^2 + c_1 x + c_0$

- Use curly braces { } to group superscripts and subscripts.

```
$F_n = F_n-1 + F_n-2$      % oops!

$F_n = F_{n-1} + F_{n-2}$ % ok!
```

$F_n = F_n - 1 + F_n - 2$

$F_n = F_{n-1} + F_{n-2}$

- There are commands for Greek letters and common notation.

```
$\mu = A e^{Q/RT}$

$\Omega = \sum_{k=1}^{n} \omega_k$
```

$\mu = A e^{Q/RT}$

$\Omega = \sum_{k=1}^{n} \omega_k$

Typesetting Mathematics: Displayed Equations

- If it's big and scary, *display* it on its own line using `\begin{equation}` and `\end{equation}`.

```
The roots of a quadratic equation
are given by
\begin{equation}
x = \frac{-b \pm \sqrt{b^2 - 4ac}}
         {2a}
\end{equation}
where $a$, $b$ and $c$ are \ldots
```

The roots of a quadratic equation are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (2)$$

where a, b and c are . . .

Caution: LaTeX mostly ignores your spaces in mathematics, but it can't handle blank lines in equations — don't put blank lines in your mathematics.

Interlude: Environments

- `equation` is an *environment* — a context.
- A command can produce different output in different contexts.

```
We can write
$ \Omega = \sum_{k=1}^{n} \omega_k $
in text, or we can write
\begin{equation}
  \Omega = \sum_{k=1}^{n} \omega_k
\end{equation}
to display it.
```

We can write $\Omega = \sum_{k=1}^{n} \omega_k$ in text, or we can write

$$\Omega = \sum_{k=1}^{n} \omega_k \tag{3}$$

to display it.

- Note how the Σ is bigger in the `equation` environment, and how the subscripts and superscripts change position, even though we used the same commands.

In fact, we could have written `$...$` as `\begin{math}...\end{math}`.

Interlude: Environments

- The `\begin` and `\end` commands are used to create many different environments.
- The `itemize` and `enumerate` environments generate lists.

```
\begin{itemize} % for bullet points
\item Biscuits
\item Tea
\end{itemize}

\begin{enumerate} % for numbers
\item Biscuits
\item Tea
\end{enumerate}
```

- Biscuits
- Tea

1. Biscuits
2. Tea

Interlude: Packages

- All of the commands and environments we've used so far are built into LaTeX.
- *Packages* are libraries of extra commands and environments. There are thousands of freely available packages.
- We have to load each of the packages we want to use with a `\usepackage` command in the *preamble*.
- Example: `amsmath` from the American Mathematical Society.

```
\documentclass{article}
\usepackage{amsmath} % preamble
\begin{document}
% now we can use commands from amsmath here...
\end{document}
```

Typesetting Mathematics: Examples with amsmath

- Use `equation*` ("equation-star") for unnumbered equations.

```
\begin{equation*}
  \Omega = \sum_{k=1}^{n} \omega_k
\end{equation*}
```

$$\Omega = \sum_{k=1}^{n} \omega_k$$

- LaTeX treats adjacent letters as variables multiplied together, which is not always what you want. amsmath defines commands for many common mathematical operators.

```
\begin{equation*} % bad!
 min_{x,y} (1-x)^2 + 100(y-x^2)^2
\end{equation*}
\begin{equation*} % good!
\min_{x,y}{(1-x)^2 + 100(y-x^2)^2}
\end{equation*}
```

$$min_{x,y}(1-x)^2+100(y-x^2)^2$$

$$\min_{x,y}(1-x)^2+100(y-x^2)^2$$

- You can use `\operatorname` for others.

```
\begin{equation*}
\beta_i =
\frac{\operatorname{Cov}(R_i, R_m)}
     {\operatorname{Var}(R_m)}
\end{equation*}
```

$$\beta_i = \frac{\operatorname{Cov}(R_i, R_m)}{\operatorname{Var}(R_m)}$$

Typesetting Mathematics: Examples with amsmath

- Align a sequence of equations at the equals sign

$$\begin{aligned}(x+1)^3 &= (x+1)(x+1)(x+1)\\ &= (x+1)(x^2+2x+1)\\ &= x^3+3x^2+3x+1\end{aligned}$$

with the `align*` environment.

```
\begin{align*}
(x+1)^3 &= (x+1)(x+1)(x+1) \\
        &= (x+1)(x^2 + 2x + 1) \\
        &= x^3 + 3x^2 + 3x + 1
\end{align*}
```

- An ampersand `&` separates the left column (before the $=$) from the right column (after the $=$).
- A double backslash `\\` starts a new line.

Typesetting Exercise 2

Typeset this in LaTeX:

Let $X_1, X_2, \ldots, X_n$ be a sequence of independent and identically distributed random variables with $\mathrm{E}[X_i] = \mu$ and $\mathrm{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{1}{n} \sum_{i=1}^{n} X_i$$

denote their mean. Then as n approaches infinity, the random variables $\sqrt{n}(S_n - \mu)$ converge in distribution to a normal $N(0, \sigma^2)$.

Click to open this exercise in **Overleaf**

- Hint: the command for ∞ is `\infty`.
- Once you've tried, click here to see my solution.

End of Part 1

- Congrats! You've already learned how to ...
  - Typeset text in LaTeX.
  - Use lots of different commands.
  - Handle errors when they arise.
  - Typeset some beautiful mathematics.
  - Use several different environments.
  - Load packages.
- That's amazing!
- In Part 2, we'll see how to use LaTeX to write structured documents with sections, cross references, figures, tables and bibliographies. See you then!

An Interactive Introduction to LaTeX

Part 2: Structured Documents & More

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Outline

Structured Documents

- In Part 1, we learned about commands and environments for typesetting text and mathematics.
- Now, we'll learn about commands and environments for structuring documents.
- You can try out the new commands in Overleaf:

Click here to open the example document in **Overleaf**

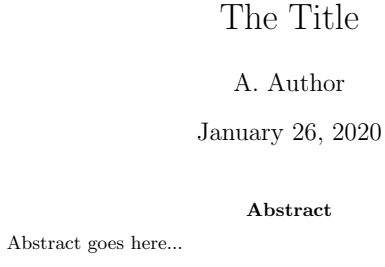
For best results, please use Google Chrome or a recent FireFox.

- Let's get started!

Title and Abstract

- Tell LaTeX the `\title` and `\author` names in the preamble.
- Then use `\maketitle` in the document to actually create the title.
- Use the `abstract` environment to make an abstract.

```
\documentclass{article}

\title{The Title}

\author{A. Author}

\date{\today}

\begin{document}
\maketitle

\begin{abstract}
Abstract goes here...
\end{abstract}

\end{document}
```



Sections

- Just use `\section` and `\subsection`.
- Can you guess what `\section*` and `\subsection*` do?

```
\documentclass{article}
\begin{document}

\section{Introduction}

The problem of \ldots

\section{Method}

We investigate \ldots

\subsection{Sample Preparation}

\subsection{Data Collection}

\section{Results}

\section{Conclusion}

\end{document}
```

1 Introduction

The problem of . . .

2 Method

We investigate . . .

2.1 Sample Preparation

2.2 Data Collection

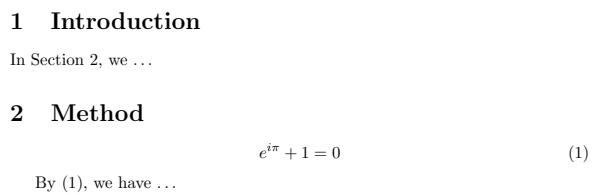
3 Results

4 Conclusion

Labels and Cross-References

- Use `\label` and `\ref` for automatic numbering.
- The `amsmath` package provides `\eqref` for referencing equations.

```
\documentclass{article}
\usepackage{amsmath} % for \eqref
\begin{document}

\section{Introduction}
\label{sec:intro}

In Section \ref{sec:method}, we \ldots

\section{Method}
\label{sec:method}

\begin{equation}
\label{eq:euler}
e^{i\pi} + 1 = 0
\end{equation}

By \eqref{eq:euler}, we have \ldots

\end{document}
```



1 Introduction

In Section 2, we …

2 Method

$$e^{i\pi} + 1 = 0 \quad (1)$$

By (1), we have …

Structured Documents Exercise

Typeset this short paper in LaTeX: [1]

Click to open the paper

Make your paper look like this one. Use `\ref` and `\eqref` to avoid explicitly writing section and equation numbers into the text.

Click to open this exercise in **Overleaf**

- Once you've tried, click here to see my solution.

[1] From `http://pdos.csail.mit.edu/scigen/`, a random paper generator.

Outline

Graphics

- Requires the `graphicx` package, which provides the `\includegraphics` command.
- Supported graphics formats include JPEG, PNG and PDF (usually).

```
\includegraphics[
  width=0.5\textwidth]{gerbil}

\includegraphics[
  width=0.3\textwidth,
  angle=270]{gerbil}
```

Image license: CC0

Interlude: Optional Arguments

- We use square brackets [ ] for optional arguments, instead of braces { }.
- `\includegraphics` accepts optional arguments that allow you to transform the image when it is included. For example, `width=0.3\textwidth` makes the image take up 30% of the width of the surrounding text (`\textwidth`).
- `\documentclass` accepts optional arguments, too. Example:

  ```
  \documentclass[12pt,twocolumn]{article}
  ```

  makes the text bigger (12pt) and puts it into two columns.
- Where do you find out about these? See the slides at the end of this presentation for links to more information.

Floats

- Allow LaTeX to decide where the figure will go (it can "float").
- You can also give the figure a caption, which can be referenced with `\ref`.

```
\documentclass{article}
\usepackage{graphicx}
\begin{document}

Figure \ref{fig:gerbil} shows \ldots

\begin{figure}
\centering
\includegraphics[%
  width=0.5\textwidth]{gerbil}
\caption{\label{fig:gerbil}Aww\ldots.}
\end{figure}

\end{document}
```

Figure 1: Aww....

Figure 1 shows ...

Image license: CC0

Tables

- Tables in LaTeX take some getting used to.
- Use the `tabular` environment from the `tabularx` package.
- The argument specifies column alignment — **l**eft, **r**ight, **r**ight.

```
\begin{tabular}{lrr}
Item   & Qty & Unit \$ \\
Widget & 1   & 199.99  \\
Gadget & 2   & 399.99  \\
Cable  & 3   & 19.99   \\
\end{tabular}
```

Item	Qty	Unit $
Widget	1	199.99
Gadget	2	399.99
Cable	3	19.99

- It also specifies vertical lines; use `\hline` for horizontal lines.

```
\begin{tabular}{|l|r|r|} \hline
Item   & Qty & Unit \$ \\\hline
Widget & 1   & 199.99  \\
Gadget & 2   & 399.99  \\
Cable  & 3   & 19.99   \\\hline
\end{tabular}
```

Item	Qty	Unit $
Widget	1	199.99
Gadget	2	399.99
Cable	3	19.99

- Use an ampersand [&] to separate columns and a double backslash [\] [\] to start a new row (like in the `align*` environment that we saw in part 1).

Outline

bibTeX 1

- Put your references in a `.bib` file in 'bibtex' database format:

```
@Article{Jacobson1999Towards,
  author = {Van Jacobson},
  title = {Towards the Analysis of Massive Multiplayer Online
           Role-Playing Games},
  journal = {Journal of Ubiquitous Information},
  Month = jun,
  Year = 1999,
  Volume = 6,
  Pages = {75--83}}

@InProceedings{Brooks1997Methodology,
  author = {Fredrick P. Brooks and John Kubiatowicz and
            Christos Papadimitriou},
  title = {A Methodology for the Study of the
           Location-Identity Split},
  booktitle = {Proceedings of OOPSLA},
  Month = jun,
  Year = 1997}
```

- Most reference managers can export to bibtex format.

bibTeX 2

- Each entry in the `.bib` file has a *key* that you can use to reference it in the document. For example, `Jacobson1999Towards` is the key for this article:

```
@Article{Jacobson1999Towards,
  author = {Van Jacobson},
  ...
}
```

- It's a good idea to use a key based on the name, year and title.
- LaTeX can automatically format your in-text citations and generate a list of references; it knows most standard styles, and you can design your own.

bibTEX 3

- Use the `natbib` package[2] with `\citet` and `\citep`.
- Reference `\bibliography` at the end, and specify a `\bibliographystyle`.

```
\documentclass{article}
\usepackage{natbib}
\begin{document}

\citet{Brooks1997Methodology}
show that \ldots. Clearly,
all odd numbers are prime
\citep{Jacobson1999Towards}.

\bibliography{bib-example}
% if `bib-example' is the name of
% your bib file

\bibliographystyle{plainnat}
% try changing to abbrvnat

\end{document}
```

Brooks et al. [1997] show that .... Clearly, all odd numbers are pri
[Jacobson, 1999].

References

Fredrick P. Brooks, John Kubiatowicz, and Christos Papadimitriou. A meth
ology for the study of the location-identity split. In *Proceedings of OOPSI*
June 1997.

Van Jacobson. Towards the analysis of massive multiplayer online role-playi
games. *Journal of Ubiquitous Information*, 6:75–83, June 1999.

[2] There is a new package with more features named `biblatex` but most of the articles templates still use `natbib`.

Exercise: Putting it All Together

Add an image and a bibliography to the paper from the previous exercise.

1. Download these example files to your computer.

   Click to download example image

   Click to download example bib file

2. Upload them to Overleaf (use the project menu).

Outline

More Neat Things

- Add the `\tableofcontents` command to generate a table of contents from the `\section` commands.
- Change the `\documentclass` to

  `\documentclass{scrartcl}`

  or

  `\documentclass[12pt]{IEEEtran}`
- Define your own command for a complicated equation:

```
\newcommand{\rperf}{%
  \rho_{\text{perf}}}
$$
\rperf = {\bf c}'{\bf X} + \varepsilon
$$
```

$$\rho_{\text{perf}} = \mathbf{c}'\mathbf{X} + \varepsilon$$

More Neat Packages

- `beamer`: for presentations (like this one!)
- `todonotes`: comments and TODO management
- `tikz`: make amazing graphics
- `pgfplots`: create graphs in LaTeX
- `listings`: source code printer for LaTeX
- `spreadtab`: create spreadsheets in LaTeX
- `gchords`, `guitar`: guitar chords and tabulature
- `cwpuzzle`: crossword puzzles

See `https://www.overleaf.com/latex/examples` and `http://texample.net` for examples of (most of) these packages.

Installing LaTeX

- To run LaTeX on your own computer, you'll want to use a LaTeX *distribution*. A distribution includes a `latex` program and (typically) several thousand packages.
  - On Windows: MikTeX or TeXLive
  - On Linux: TeXLive
  - On Mac: MacTeX
- You'll also want a text editor with LaTeX support. See `http://en.wikipedia.org/wiki/Comparison_of_TeX_editors` for a list of (many) options.
- You'll also have to know more about how `latex` and its related tools work — see the resources on the next slide.

Online Resources

- The Overleaf Learn Wiki — hosts these slides, more tutorials and reference material
- The LaTeX Wikibook — excellent tutorials and reference material.
- TeX Stack Exchange — ask questions and get excellent answers incredibly quickly
- LaTeX Community — a large online forum
- Comprehensive TeX Archive Network (CTAN) — over four thousand packages plus documentation
- Google will usually get you to one of the above.

Thanks, and happy TEXing!

A quick guide to LaTeX

What is LaTeX?

LaTeX(usually pronounced "LAY teck," sometimes "LAH teck," and never "LAY tex") is a mathematics typesetting program that is the standard for most professional mathematics writing. It is based on the typesetting program TeX created by Donald Knuth of Stanford University (his first version appeared in 1978). Leslie Lamport was responsible for creating LaTeX a more user friendly version of TeX. A team of LaTeX programmers created the current version, LaTeX 2ε.

Math vs. text vs. functions

In properly typeset mathematics variables appear in italics (e.g., $f(x) = x^2 + 2x - 3$). The exception to this rule is predefined functions (e.g., $\sin(x)$). Thus it is important to **always** treat text, variables, and functions correctly. See the difference between x and x, -1 and -1, and $sin(x)$ and $\sin(x)$. There are two ways to present a mathematical expression—*inline* or as an *equation*.

Inline mathematical expressions

Inline expressions occur in the middle of a sentence. To produce an inline expression, place the math expression between dollar signs (`$`). For example, typing
`$90^{\circ}$ is the same as $\frac{\pi}{2}$ radians`
yields 90° is the same as $\frac{\pi}{2}$ radians.

Equations

Equations are mathematical expressions that are given their own line and are centered on the page. These are usually used for important equations that deserve to be showcased on their own line or for large equations that cannot fit inline. To produce an inline expression, place the mathematical expression between the symbols `\[` and `\]`. Typing
`\[x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\]` yields

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

Displaystyle

To get full-sized inline mathematical expressions use `\displaystyle`. Use this sparingly. Typing
`I want this $\displaystyle \sum_{n=1}^{\infty} \frac{1}{n}$, not this $\sum_{n=1}^{\infty} \frac{1}{n}$.` yields

I want this $\displaystyle \sum_{n=1}^{\infty} \frac{1}{n}$, not this $\sum_{n=1}^{\infty} \frac{1}{n}$.

Images

You can put images (pdf, png, jpg, or gif) in your document. They need to be in the same location as your .tex file when you compile the document. Omit `[width=.5in]` if you want the image to be full-sized.

```
\begin{figure}[ht]
\includegraphics[width=.5in]{imagename.jpg}
\caption{The (optional) caption goes here.}
\end{figure}
```

Text decorations

Your text can be *italics* (`\textit{italics}`), **boldface** (`\textbf{boldface}`), or <u>underlined</u> (`\underline{underlined}`).

Your math can contain boldface, $\mathbf{R}$ (`\mathbf{R}`), or blackboard bold, $\mathbb{R}$ (`\mathbb{R}`). You may want to used these to express the sets of real numbers ($\mathbb{R}$ or $\mathbf{R}$), integers ($\mathbb{Z}$ or $\mathbf{Z}$), rational numbers ($\mathbb{Q}$ or $\mathbf{Q}$), and natural numbers ($\mathbb{N}$ or $\mathbf{N}$).

To have text appear in a math expression use `\text`.
`(0,1]=\{x\in\mathbb{R}:x>0\text{ and }x\le 1\}` yields $(0,1] = \{x \in \mathbb{R} : x > 0 \text{ and } x \le 1\}$. (Without the `\text` command it treats "and" as three variables: $(0,1] = \{x \in \mathbb{R} : x > 0 and x \le 1\}$.)

Spaces and new lines

LaTeX ignores extra spaces and new lines. For example,

```
This   sentence will       look
fine after      it is     compiled.
```

This sentence will look fine after it is compiled.

Leave one full empty line between two paragraphs. Place `\\` at the end of a line to create a new line (but not create a new paragraph).

```
This
compiles


like\\
this.
```

This compiles
like
this.

Use `\noindent` to prevent a paragraph from indenting.

Comments

Use `%` to create a comment. Nothing on the line after the `%` will be typeset. `$f(x)=\sin(x)$ %this is the sine function` yields $f(x) = \sin(x)$

Delimiters

description	*command*	*output*
parentheses	`(x)`	(x)
brackets	`[x]`	[x]
curly braces	`\{x\}`	{x}

To make your delimiters large enough to fit the content, use them together with `\right` and `\left`. For example,
`\left\{\sin\left(\frac{1}{n}\right)\right\}_{n}^{\infty}` produces

$$\left\{\sin\left(\frac{1}{n}\right)\right\}_{n}^{\infty}.$$

Curly braces are non-printing characters that are used to gather text that has more than one character. Observe the differences between the four expressions `x^2`, `x^{2}`, `x^2t`, `x^{2t}` when typeset: x^2, x^{2}, x^2t, x^{2t}.

Lists

You can produce ordered and unordered lists.

description	*command*	*output*

unordered list	`\begin{itemize}`
	`\item`
	`Thing 1`
	`\item`
	`Thing 2`
	`\end{itemize}`
		• Thing 1
		• Thing 2

ordered list	`\begin{enumerate}`
	`\item`
	`Thing 1`
	`\item`
	`Thing 2`
	`\end{enumerate}`
		1. Thing 1
		2. Thing 2

Symbols (in *math* mode)

The basics

description	*command*	*output*
addition	`+`	$+$
subtraction	`-`	$-$
plus or minus	`\pm`	$\pm$
multiplication (times)	`\times`	$\times$
multiplication (dot)	`\cdot`	$\cdot$
division symbol	`\div`	$\div$
division (slash)	`/`	$/$
circle plus	`\oplus`	$\oplus$
circle times	`\otimes`	$\otimes$
equal	`=`	$=$
not equal	`\ne`	$\neq$
less than	`<`	$<$
greater than	`>`	$>$
less than or equal to	`\le`	$\leq$
greater than or equal to	`\ge`	$\geq$
approximately equal to	`\approx`	$\approx$
infinity	`\infty`	∞
dots	`1,2,3,\ldots`	$1, 2, 3, \ldots$
dots	`1+2+3+\cdots`	$1 + 2 + 3 + \cdots$
fraction	`\frac{a}{b}`	$\frac{a}{b}$
square root	`\sqrt{x}`	$\sqrt{x}$
nth root	`\sqrt[n]{x}`	$\sqrt[n]{x}$
exponentiation	`a^b`	a^b
subscript	`a_b`	a_b
absolute value	`|x|`	$\|x\|$
natural log	`\ln(x)`	$\ln(x)$
logarithms	`\log_{a}b`	$\log_a b$
exponential function	`e^x=\exp(x)`	$e^x = \exp(x)$
degree	`\deg(f)`	$\deg(f)$

Functions

description	*command*	*output*
maps to	`\to`	$\to$
composition	`\circ`	$\circ$

piecewise function	`|x|=`
	`\begin{cases}`
	`x & x\ge 0\\`
	`-x & x<0`
	`\end{cases}`
		$\|x\| = \begin{cases} x & x \ge 0 \\ -x & x < 0 \end{cases}$

Greek and Hebrew letters

command	*output*	*command*	*output*
`\alpha`	α	`\tau`	τ
`\beta`	β	`\theta`	θ
`\chi`	χ	`\upsilon`	υ
`\delta`	δ	`\xi`	ξ
`\epsilon`	ϵ	`\zeta`	ζ
`\varepsilon`	ε	`\Delta`	Δ
`\eta`	η	`\Gamma`	Γ
`\gamma`	γ	`\Lambda`	Λ
`\iota`	ι	`\Omega`	Ω
`\kappa`	κ	`\Phi`	Φ
`\lambda`	λ	`\Pi`	Π
`\mu`	μ	`\Psi`	Ψ
`\nu`	ν	`\Sigma`	Σ
`\omega`	ω	`\Theta`	Θ
`\phi`	ϕ	`\Upsilon`	Υ
`\varphi`	φ	`\Xi`	Ξ
`\pi`	π	`\aleph`	$\aleph$
`\psi`	ψ	`\beth`	$\beth$
`\rho`	ρ	`\daleth`	$\daleth$
`\sigma`	σ	`\gimel`	$\gimel$

Set theory

description	*command*	*output*
set brackets	`\{1,2,3\}`	$\{1,2,3\}$
element of	`\in`	$\in$
not an element of	`\not\in`	$\notin$
subset of	`\subset`	$\subset$
subset of	`\subseteq`	$\subseteq$
not a subset of	`\not\subset`	$\not\subset$
contains	`\supset`	$\supset$
contains	`\supseteq`	$\supseteq$
union	`\cup`	$\cup$
intersection	`\cap`	$\cap$
big union	`\bigcup_{n=1}^{10}A_n`	$\bigcup_{n=1}^{10} A_n$
big intersection	`\bigcap_{n=1}^{10}A_n`	$\bigcap_{n=1}^{10} A_n$
empty set	`\emptyset`	$\emptyset$
power set	`\mathcal{P}`	$\mathcal{P}$
minimum	`\min`	$\min$
maximum	`\max`	$\max$
supremum	`\sup`	$\sup$
infimum	`\inf`	$\inf$
limit superior	`\limsup`	$\limsup$
limit inferior	`\liminf`	$\liminf$
closure	`\overline{A}`	$\overline{A}$

Calculus

description	*command*	*output*
derivative	`\frac{df}{dx}`	$\frac{df}{dx}$
derivative	`\f'`	f'
partial derivative	`\frac{\partial f}` `{\partial x}`	$\frac{\partial f}{\partial x}$
integral	`\int`	$\int$
double integral	`\iint`	$\iint$
triple integral	`\iiint`	$\iiint$
limits	`\lim_{x\to \infty}`	$\lim_{x\to\infty}$
summation	`\sum_{n=1}^{\infty}a_n`	$\sum_{n=1}^{\infty} a_n$
product	`\prod_{n=1}^{\infty}a_n`	$\prod_{n=1}^{\infty} a_n$

Logic

description	*command*	*output*
not	`\sim`	$\sim$
and	`\land`	$\land$
or	`\lor`	$\lor$
if...then	`\to`	$\to$
if and only if	`\leftrightarrow`	$\leftrightarrow$
logical equivalence	`\equiv`	$\equiv$
therefore	`\therefore`	$\therefore$
there exists	`\exists`	$\exists$
for all	`\forall`	$\forall$
implies	`\Rightarrow`	$\Rightarrow$
equivalent	`\Leftrightarrow`	$\Leftrightarrow$

Linear algebra

description	*command*	*output*
vector	`\vec{v}`	$\vec{v}$
vector	`\mathbf{v}`	$\mathbf{v}$
norm	`||\vec{v}||`	$\|\|\vec{v}\|\|$

matrix	`\left[`
	`\begin{array}{ccc}`
	`1 & 2 & 3 \\`
	`4 & 5 & 6\\`
	`7 & 8 & 0`
	`\end{array}`
	`\right]`
		$\left[\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6\\ 7 & 8 & 0 \end{array}\right]$

determinant	`\left|`
	`\begin{array}{ccc}`
	`1 & 2 & 3 \\`
	`4 & 5 & 6 \\`
	`7 & 8 & 0`
	`\end{array}`
	`\right|`
		$\left\|\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array}\right\|$

determinant	`\det(A)`	$\det(A)$
trace	`\operatorname{tr}(A)`	$\operatorname{tr}(A)$
dimension	`\dim(V)`	$\dim(V)$

Number theory

description	*command*	*output*
divides	`|`	$\|$
does not divide	`\not |`	$\nmid$
div	`\operatorname{div}`	div
mod	`\mod`	$\mod$
greatest common divisor	`\gcd`	$\gcd$
ceiling	`\lceil x \rceil`	$\lceil x \rceil$
floor	`\lfloor x \rfloor`	$\lfloor x \rfloor$

Geometry and trigonometry

description	*command*	*output*
angle	`\angle ABC`	$\angle ABC$
degree	`90^{\circ}`	90°
triangle	`\triangle ABC`	$\triangle ABC$
segment	`\overline{AB}`	$\overline{AB}$
sine	`\sin`	$\sin$
cosine	`\cos`	$\cos$
tangent	`\tan`	$\tan$
cotangent	`\cot`	$\cot$
secant	`\sec`	$\sec$
cosecant	`\csc`	$\csc$
inverse sine	`\arcsin`	$\arcsin$
inverse cosine	`\arccos`	$\arccos$
inverse tangent	`\arctan`	$\arctan$

Symbols (in *text* mode)

The followign symbols do **not** have to be surrounded by dollar signs.

description	*command*	*output*
dollar sign	`\$`	$
percent	`\%`	%
ampersand	`\&`	&
pound	`\#`	#
backslash	`\textbackslash`	\
left quote marks	` `` `	“
right quote marks	`''`	”
single left quote	`` ` ``	‘
single right quote	`'`	’
hyphen	`X-ray`	X-ray
en-dash	`pp. 5--15`	pp. 5–15
em-dash	`Yes---or no?`	Yes—or no?

Resources

Great symbol look-up site: Detexify
LaTeX Mathematical Symbols
The Comprehensive LaTeX Symbol List
The Not So Short Introduction to LaTeX 2ε
TUG: The TeX Users Group
CTAN: The Comprehensive TeX Archive Network

LaTeX for the Mac: MacTeX
LaTeX for the PC: TeXnicCenter and MiKTeX
LaTeX online: WriteLaTeX.

Dave Richeson, Dickinson College, http://divisbyzero.com/