

# Day 02: Intro to L<sup>A</sup>T<sub>E</sub>X



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L<sup>A</sup>T<sub>E</sub>X101

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- ▶ **Adapted from** – <https://www.learnlatex.org/>.
  - ▶ Day 1 – [learnlatex.org](https://www.learnlatex.org/) lessons 1-6 (**Done!**)
  - ▶ Day 2 – [learnlatex.org](https://www.learnlatex.org/) lessons 7-12.
  - ▶ Day 3 – Specific templates (resume, presentations).
- ▶ **Slides Available** – <https://github.com/mdelrosa/latex-101>.
  - ▶ Template based on Clara Pavillet's Oxford Template
- ▶ **Slack back channel**
  - ▶ UC Davis Slack channel

Figures

Tables

Cross Referencing

Mathematics

Fonts + Spacing

Citations + References

# Figures

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Including images, resizing, positioning

The graphicx package provides the `\includegraphics` command.

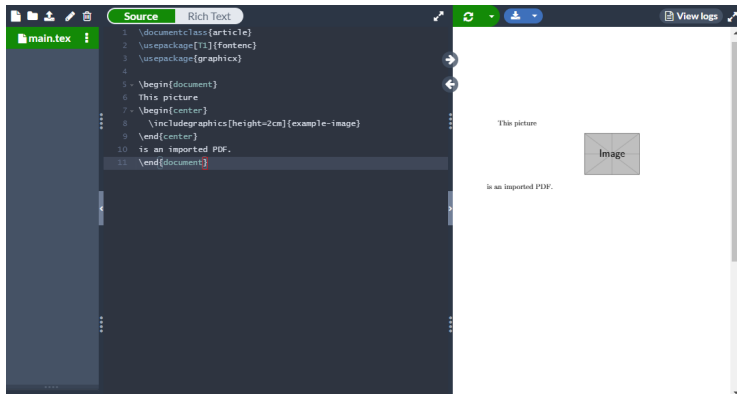


Figure 1: `example-image` is provided by default in most  $\text{\LaTeX}$  distributions.

- ▶ `\includegraphics` takes optional arguments for scaling
- ▶ Common commands: `\textheight`, `\textwidth`

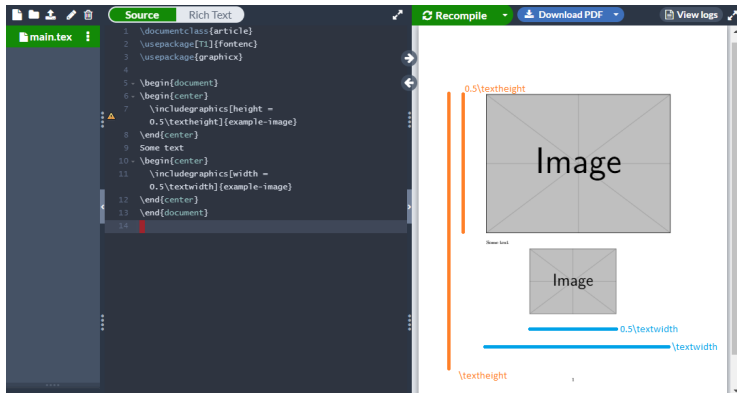


Figure 2: Optional arguments to change width and height of graphics.

`\includegraphics` takes optional arguments for clipping and rotating

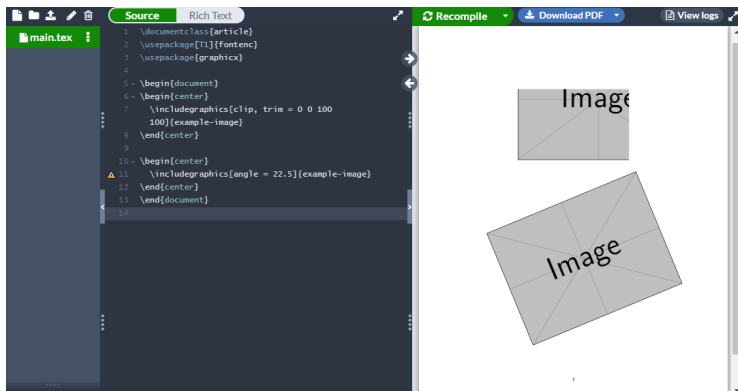


Figure 3: Optional arguments `clip`, `trim`, and `angle`.

Including images can lead to large gaps in text.

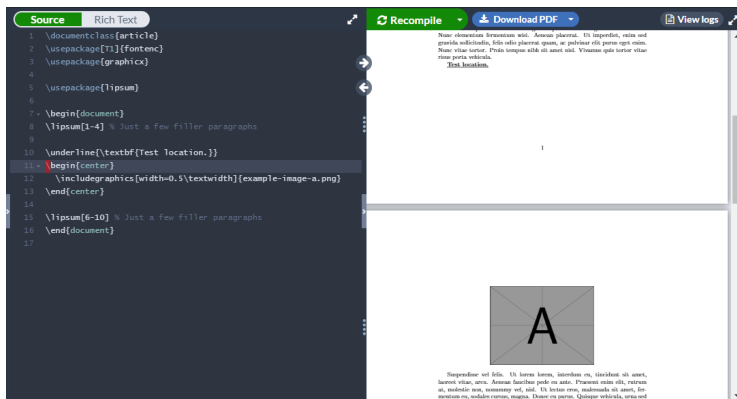


Figure 4: `\includegraphics` causing a gap on Page 1



Floats - an image environment (e.g., figure) that dynamically adjusts its position.

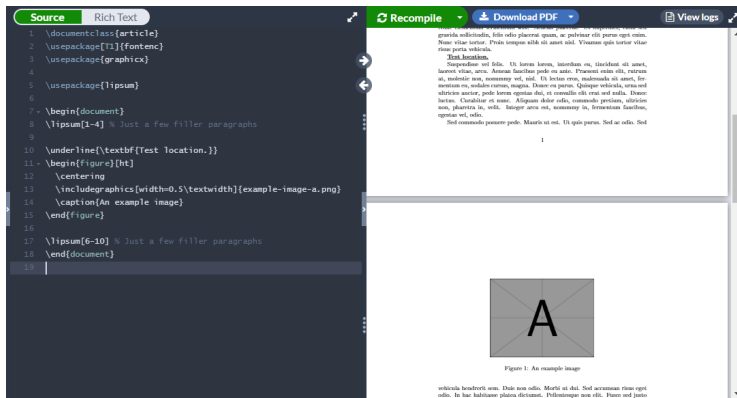


Figure 5: figure environment causes text to wrap properly

Optional arguments [h]ere, [t]op, [b]ottom, [p]age control float placement.



Figure 6: figure with [hb] optional argument placed on bottom of page

# Tables

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Building tables, aligning and merging cells

The array package provides commands for tables.

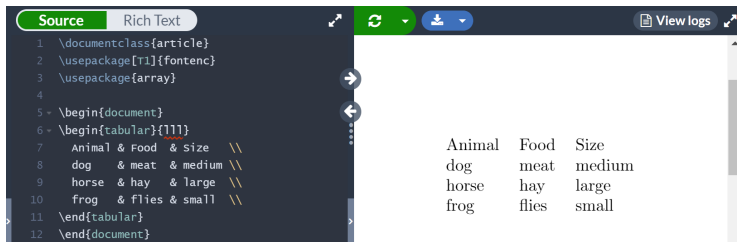


Figure 7: A tabular environment provided by array packages.

Argument to `tabular` changes alignment – `{l}` left, `{c}` center, `{r}` right.

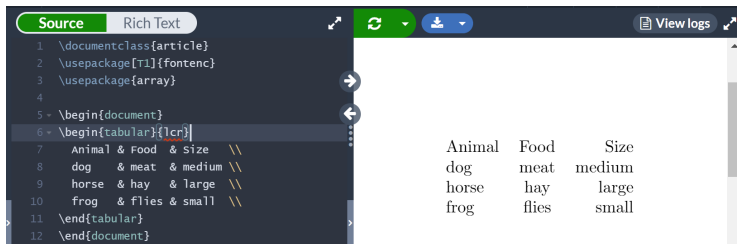


Figure 8: Same table with left, center, and right (`{lcr}`) column alignments.

(`{\lcr}`) columns will typeset into single row, even if they are wider than the page.

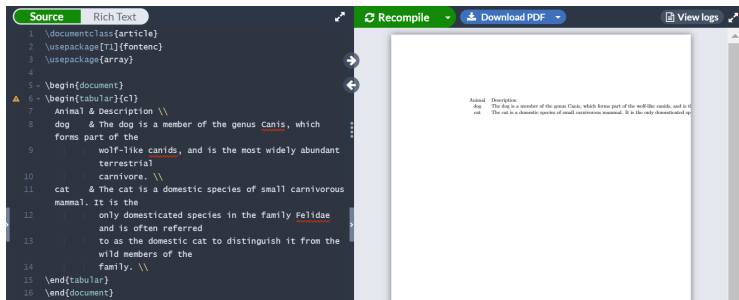


Figure 9: A runaway 1 column.

(`{p}`) columns are forced to a given width.

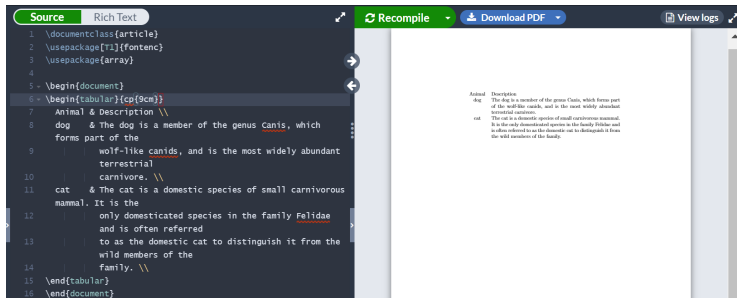
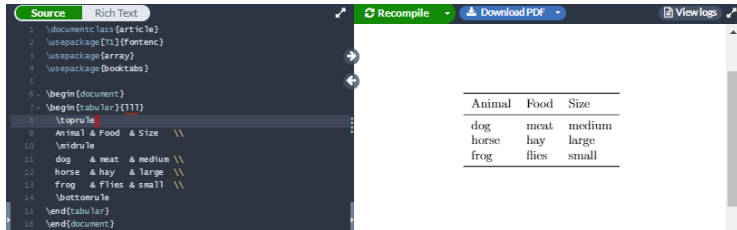


Figure 10: Same text in a `p` column with wrapped text.

Rules (lines) are enabled with the booktabs package.



The screenshot shows a LaTeX editor interface. On the left, the 'Source' tab is active, displaying the following LaTeX code:

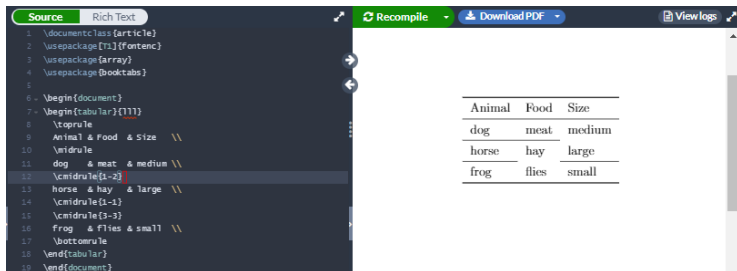
```
1 \documentclass{article}
2 \usepackage{t1]{fontenc}
3 \usepackage{array}
4 \usepackage{booktabs}
5
6 \begin{document}
7 \begin{tabular}{lll}
8 \toprule
9 Animal & Food & Size \\
10 \midrule
11 dog & meat & medium \\
12 horse & hay & large \\
13 frog & flies & small \\
14 \bottomrule
15 \end{tabular}
16 \end{document}
```

On the right, the 'Rich Text' tab shows the rendered output of the code, which is a table with three columns: Animal, Food, and Size. The table has horizontal rules at the top, between rows, and at the bottom.

Animal	Food	Size
dog	meat	medium
horse	hay	large
frog	flies	small



`\cmidrule` spans a subset of columns.

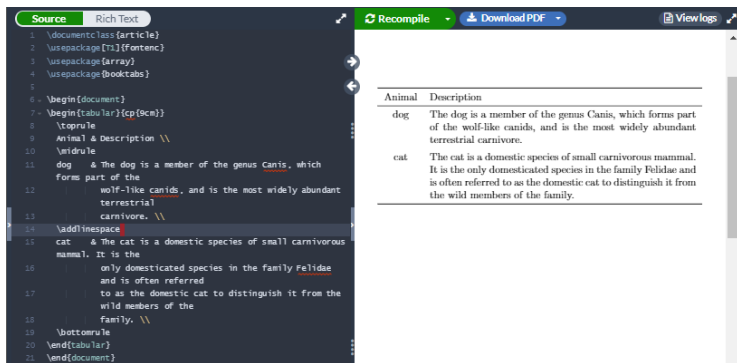


The screenshot shows a LaTeX editor interface with a source code editor on the left and a preview window on the right. The source code defines a table with three columns: Animal, Food, and Size. The table is created using the `\begin{tabular}{|l|l|l|}` command. The first row is the header: `Animal & Food & Size`. The subsequent rows are: `dog & meat & medium`, `horse & hay & large`, and `frog & flies & small`. The `\cmidrule{1-2}` command is used to draw a horizontal rule across the first two columns (Animal and Food) for the first three rows. The preview window shows the rendered table, which has a horizontal line under the first two columns of each row.

```
1 \documentclass{article}
2 \usepackage[T1]{fontenc}
3 \usepackage{array}
4 \usepackage{booktabs}
5
6 \begin{document}
7 \begin{tabular}{|l|l|l|}
8 \toprule
9 Animal & Food & Size \\
10 \midrule
11 dog & meat & medium \\
12 \cmidrule{1-2}
13 horse & hay & large \\
14 \cmidrule{1-1}
15 \cmidrule{3-3}
16 frog & flies & small \\
17 \bottomrule
18 \end{tabular}
19 \end{document}
```

Animal	Food	Size
dog	meat	medium
horse	hay	large
frog	flies	small

`\addlinespace` useful for more subtle separation.



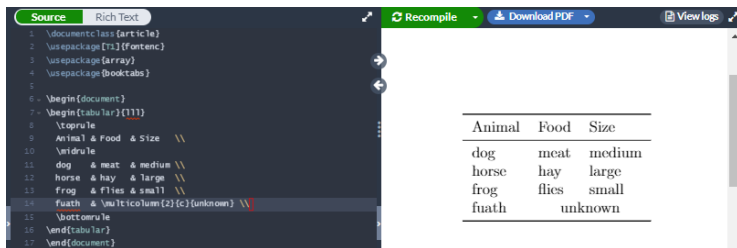
The screenshot shows a LaTeX editor interface with a 'Source' tab selected. The source code on the left defines a table with two columns: 'Animal' and 'Description'. The code uses `\begin{tabular}`, `\toprule`, `\midrule`, `\bottomrule`, and `\addlinespace` to format the table. The rendered output on the right shows a table with two rows: 'dog' and 'cat'. The 'dog' row has a description that is split across three lines. The 'cat' row has a description that is split across four lines. The `\addlinespace` command is used to add extra vertical space between the rows of the table.

```
1 \documentclass{article}
2 \usepackage[T1]{fontenc}
3 \usepackage{array}
4 \usepackage{booktabs}
5
6 \begin{document}
7 \begin{tabular}{cp{9cm}}
8 \toprule
9 Animal & Description \\
10 \midrule
11 dog & The dog is a member of the genus Canis, which
12 form part of the
13 wolf-like canids, and is the most widely abundant
14 terrestrial
15 carnivore. \\
16 \addlinespace
17 cat & The cat is a domestic species of small carnivorous
18 mammal. It is the
19 only domesticated species in the family Felidae
20 and is often referred
21 to as the domestic cat to distinguish it from the
22 wild members of the
23 family. \\
24 \bottomrule
25 \end{tabular}
26 \end{document}
```

Animal	Description
dog	The dog is a member of the genus <u>Canis</u> , which form part of the wolf-like <u>canids</u> , and is the most widely abundant terrestrial carnivore.
cat	The cat is a domestic species of small carnivorous mammal. It is the only domesticated species in the family <u>Felidae</u> and is often referred to as the domestic cat to distinguish it from the wild members of the family.

`\multicolumn` creates cells spanning multiple columns. Arguments include:

1. Number of columns cell spans
2. Alignment of cell
3. Contents of cell



The screenshot shows a LaTeX editor interface. On the left, the 'Source' tab is active, displaying the following LaTeX code:

```
1 \documentclass{article}
2 \usepackage[T1]{fontenc}
3 \usepackage{array}
4 \usepackage{booktabs}
5
6 \begin{document}
7 \begin{tabular}{lll}
8 \toprule
9 Animal & Food & Size \\
10 \midrule
11 dog & meat & medium \\
12 horse & hay & large \\
13 frog & flies & small \\
14 fuath & \multicolumn{2}{c}{unknown} \\
15 \bottomrule
16 \end{tabular}
17 \end{document}
```

On the right, the rendered output is shown. It is a table with three columns: Animal, Food, and Size. The table has a top rule, a middle rule, and a bottom rule. The last row, 'fuath', has its 'Food' and 'Size' cells merged into a single cell containing 'unknown'.

Animal	Food	Size
dog	meat	medium
horse	hay	large
frog	flies	small
fuath	unknown	

multirow package exists, but you can just use blank cells!

```
1 \documentclass{article}
2 \usepackage[T1]{fontenc}
3 \usepackage{array}
4 \usepackage{booktabs}
5
6 \begin{document}
7 \begin{tabular}{lll}
8 \toprule
9 Group & Animal & Size \\
10 \midrule
11 herbivore & horse & large \\
12 & deer & medium \\
13 & rabbit & small \\
14 \addlinespace
15 carnivore & dog & medium \\
16 & cat & small \\
17 & lion & large \\
18 \addlinespace
19 omnivore & crow & small \\
20 & bear & large \\
21 & pig & medium \\
22 \bottomrule
23 \end{tabular}
24 \end{document}
```

Group	Animal	Size
herbivore	horse	large
	deer	medium
	rabbit	small
carnivore	dog	medium
	cat	small
	lion	large
omnivore	crow	small
	bear	large
	pig	medium

Useful utility for table creation:

<https://www.tablesgenerator.com/>.

Default table style

	A	B	C	D	E
1					
2	Tell				
3					
4					

Generate

Copy to clipboard

Result (click "Generate" to refresh)

```

1 % Please add the following required packages to your document preamble:
2 % \usepackage{multirow}
3 \begin{table}[]
4 \begin{tabular}{|l|l|l|l|l|}
5 \hline
6 & & & & \\
7 \multirow{3}{*}{Tell} & & & & \\
8 & & & & \\
9 & & & & \\
10 \end{tabular}
11 \end{table}

```

Figure 11: Generate code for table based on WYSIWYG editor.

# Cross Referencing

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Smart references for figures, tables, sections, etc.

- ▶ \label commands assign ID to the most recent numbered element.
- ▶ \ref commands display number corresponding to label with same ID.

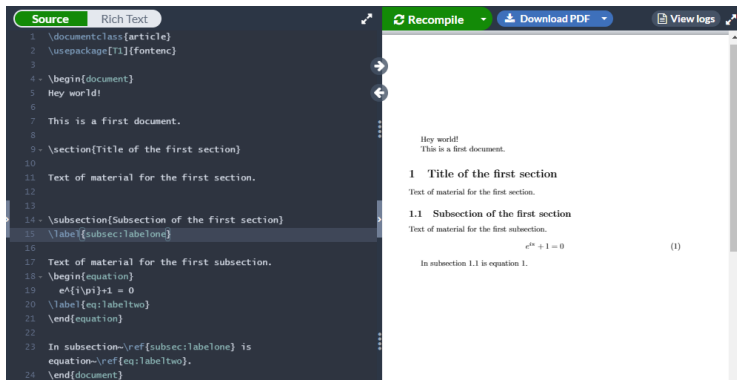


Figure 12: \label and ref commands used to number section and equation environments.

`\label` and `\ref` accept any text as arguments.

Good to name labels after corresponding elements, for example:

- ▶ `\label{eq:...}` for equations
- ▶ `\label{sec:...}` for sections
- ▶ `\label{tab:...}` for tables



# Mathematics

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Inline vs. display equations

L<sup>A</sup>T<sub>E</sub>X's biggest feature: *math mode*. Two categories of math mode equations:

1. **Inline:** Does not break paragraph. Denoted by  $\dots$  or  $\backslash(\dots\backslash)$ .
2. **Display:** Breaks paragraph, centers equation. Denoted by  $\backslash[\dots\backslash]$ , `equation` environment, or `align` environment.

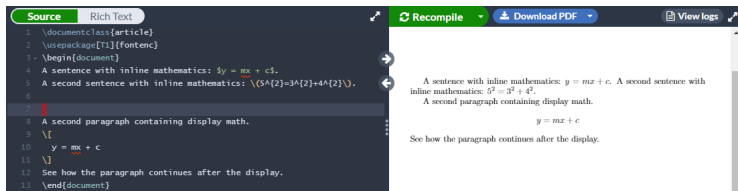


Figure 13: Example.

Customary to write *all* math symbols in math mode. For example,

- ▶  $2$  and  $-2$  (using inline math mode)
- ▶ 2 and -2 (without inline math mode)

Be careful about plaintext copied from other files that include:

- ▶ \$ (interpreted as math mode delimiter!)
- ▶ \_ (subscript symbol)

Common mathematical constructs:

- ▶ Subscripts (`_`) and superscripts (`^`). Pay attention to curly braces (`{}`)!
- ▶ Specialist symbols (`\sin`, `\log`, `\theta`, so many more!)

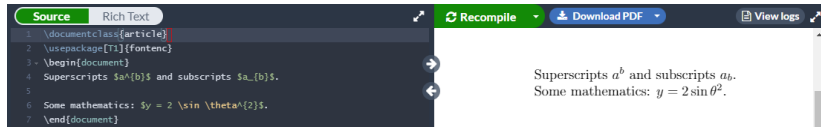


Figure 14: Examples of mathematical symbols.

Display math environments are treated as part of a paragraph. Cannot end a paragraph (i.e., no newline within display environment).

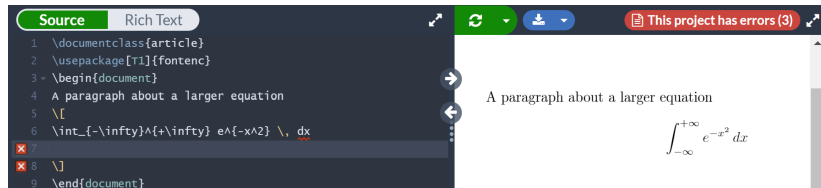


Figure 15: Error arising from blank line in display math environment.

Whitespace delimited by specific control characters (e.g., `\,`).

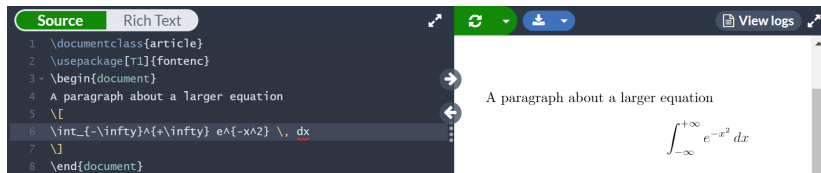


Figure 16: Whitespace in math environment requires control characters!

Numbered equation environments enable cross-referencing.

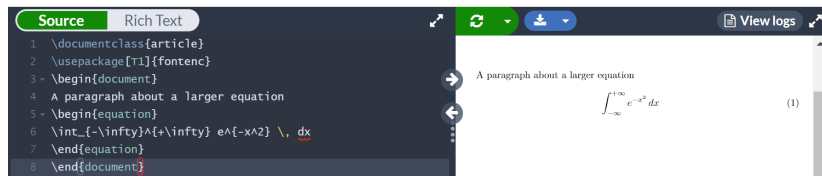


Figure 17: Same math in equation environment

To suppress numbers, add asterisk (\*)

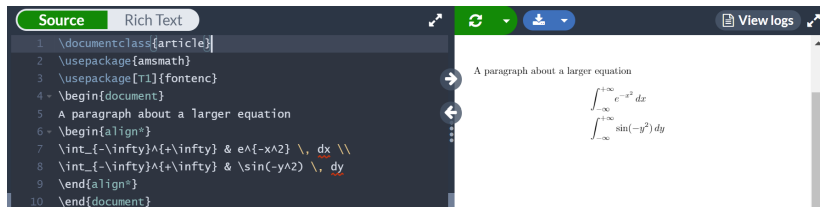


Figure 18: align environment with number suppressed.



align environments also enable cross-referencing plus control of line alignment.

- ▶ `\\`: Force a newline
- ▶ `&` : Location to align between two lines

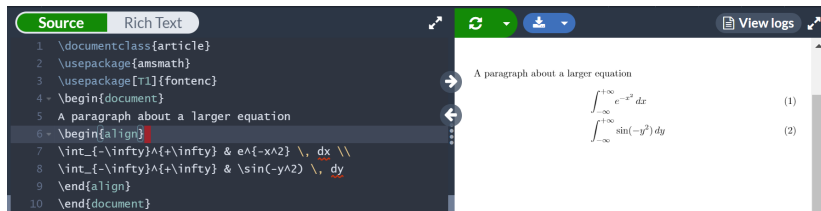


Figure 19: Two lines in align environment

align environments also enable cross-referencing plus control of line alignment.

- ▶ `\\`: Force a newline
- ▶ `&` : Location to align between two lines

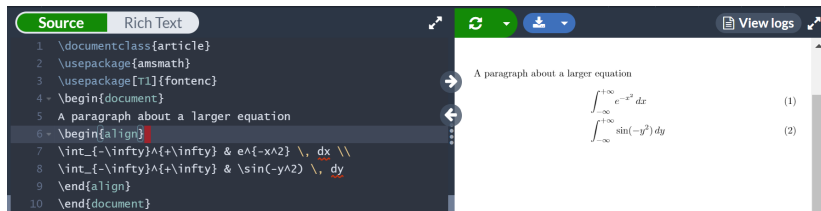


Figure 20: Two lines in align environment

To suppress number in align or equation, add an asterisk (i.e., align\*, equation\*)



Figure 21: align without number.

`amsmath` provides three matrix environments:

1. `matrix` – Matrix with no brackets
2. `pmatrix` – Matrix with parentheses
3. `bmatrix` – Matrix with square brackets

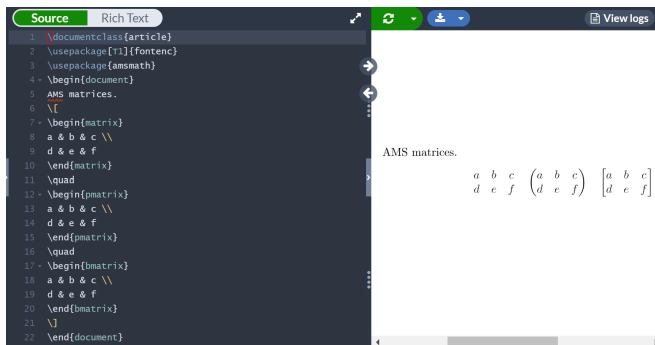



Figure 22: Different matrices with different delimiters.

Math fonts can convey specific meaning. Available math fonts are:

Name	Command	Example
Roman	<code>\mathrm</code>	$\mathbf{R}$
Italic	<code>\mathit</code>	$\mathit{R}$
Boldface	<code>\mathbf</code>	$\mathbf{R}$
Sans serif	<code>\mathsf</code>	$\mathbf{R}$
Monospaced/typewriter	<code>\mathtt</code>	$\mathbf{R}$
Double-struck/blackboard bold	<code>\mathbb</code>	$\mathbb{R}$

To use plain font in a math environment:

- ▶ `\text` to match outer font.
- ▶ `\mathrm` roman font (regardless of outer font).



The screenshot shows a LaTeX editor interface with a 'Source' tab selected. The source code is as follows:

```
1 \documentclass{article}
2 \usepackage[T1]{fontenc}
3 \usepackage{amsmath}
4 \begin{document}
5
6  $\text{bad use } size \neq \mathit{size} \neq \mathrm{size}$ 
7
8  $\textit{\text{bad use } size \neq \mathit{size} \neq \mathrm{size}}$ 
9
10 \end{document}
```

To the right of the code editor, the rendered output is displayed. It shows two lines of text, each preceded by a dollar sign (\$). The first line is the result of the first  $...$  command, and the second line is the result of the second  $...$  command. Both lines show the text 'bad use size ≠ size ≠ size' where 'size' is in a normal font and '≠' is in a math font.

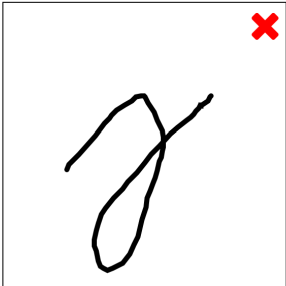
Figure 23: Plain font in math environment.

So many math symbols! If you're lost, detexify  
(<http://detexify.kirelabs.org/classify.html>) can help.

**Detexify**

classify

symbols



$\gamma$ 

Score: 0.167844022366746  
`\usepackage{ mathrsfs }`  
`\mathscr{V}`  
mathmode

$\gamma$ 

Score: 0.18726617170142607  
`\gamma`  
mathmode

$\gamma$ 

Score: 0.20065749412174066  
`\usepackage{ upgreek }`  
`\upgamma`  
mathmode

Figure 24: Returned matches for a hand-drawn gamma ( $\gamma$ ) symbol.

# Fonts + Spacing

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Paragraph spacing, newlines, explicit spacing/formatting



Behavior for new paragraphs:

- ▶ Default: indents, no blank line between paragraphs
- ▶ `parskip`: no indents, blank line between paragraphs



Figure 25: New paragraph behavior using `parskip`.

- ▶ For default text, newlines between paragraphs should be automatically added by including ‘blank lines’
- ▶ In certain environments, need `\\` to force newlines
  - ▶ End of `table` rows
  - ▶ Inside of `center` environments
  - ▶ Inside of `verse` environments (poetry)

For more fine-tuned whitespace:

- ▶ `\,` – thin space (text mode)
- ▶ `\.`, `\:`, `\;` – different sized spaces (math mode)
- ▶ `\hspace`, `\vspace` – explicit horizontal, vertical space

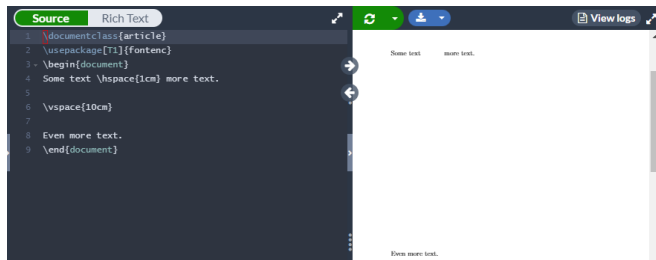


Figure 26: Examples of `\hspace`, `\vspace`.

For short pieces of text, the following formatting commands are available:

Name	Command	Example
Roman	<code>\textrm</code>	Format
Italic	<code>\textit</code>	<i>Format</i>
Boldface	<code>\textbf</code>	<b>Format</b>
Sans serif	<code>\textsf</code>	<b>Format</b>
Monospaced	<code>\texttt</code>	Format
Small caps	<code>\textsc</code>	FORMAT

- ▶ Group = anything in curly braces (`{}`). Use with large blocks of text.
- ▶ `\itshape` and `\bfseries` used to make groups italic and bold face, respectively.

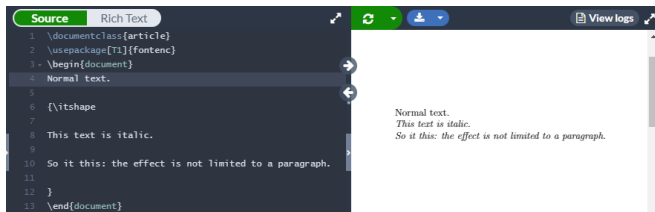


Figure 27: Example of `\itshape` used with a group.

- ▶ Relative font size within a group – `\huge`, `\large`, `\normalsize`, `\small`, `\footnotesize`, `\tiny`.
- ▶ `\par` – end of paragraph

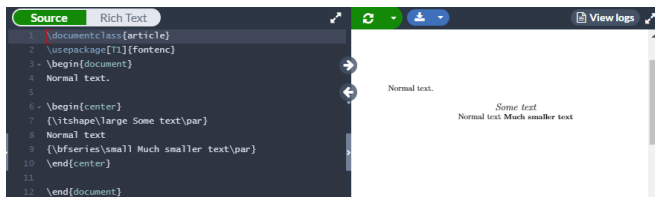


Figure 28: Example of `\large`, `\small` commands used with groups.

# Citations + References

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.bib files,

Reference Databases (aka, bibliography files, .bib files) –

- ▶ Contain bibliography entries/references (e.g., book, article, etc.)
- ▶ Each entry contains multiple *fields*.
- ▶ author field: contains all authors separated by **and** (important!).

```
1 @article{oetiker1995not,  
2   title={The {N}ot so {S}hort {I}ntroduction to {LATEX}2 $\varepsilon$ },  
3   author={Oetiker, Tobias and Partl, Hubert and Hyna, Irene and Schlegl, Elisabeth},  
4   journal={Electronic document available at http://www.tex.ac.uk/tex-archive/info/  
lshort},  
5   year={1995},  
6   publisher={Citeseer}  
7 }
```

Figure 29: Example .bib entry.

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T. Oetiker, H. Partl, I. Hyna, and E. Schlegl, “The Not so Short Introduction to LATEX2 $\varepsilon$ ,” *Electronic document available at <http://www.tex.ac.uk/tex-archive/info/lshort>*, 1995



Behind the scenes, three steps:

1. Compile document; creates list of cited references in document (not always everything in the database!).
2. Run a program (BibTeX or Biber); takes cited references, matches them to database entries, puts them in order.
3. Compile document again; resolves citations in document.

**Note:** Overleaf will abstract out this process. Only need to hit “Compile.”

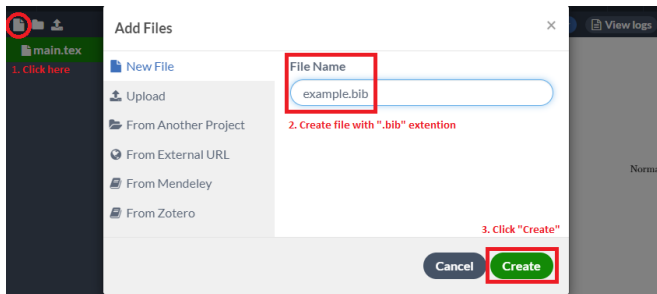


Figure 30: Creating a new .bib file in Overleaf.

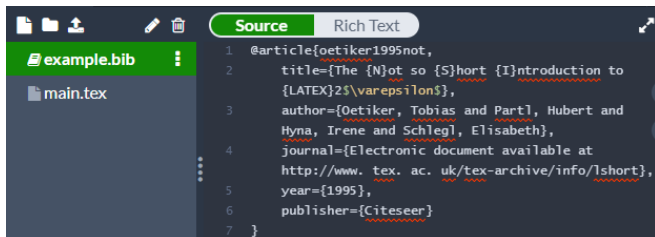


Figure 31: `.bib` file with a single entry.

- ▶ Using natbib package (BibTeX-based)
- ▶ Parenthetical citation (`\citep`) vs. Textual citation (`\citet`)

The image shows a LaTeX document using the `natbib` package. The document content includes several examples of citations: a parenthetical citation, a textual citation, a citation with optional page arguments, a citation with optional text, and a group citation. The references section lists the sources for these citations, including a book by Stefan Kottwitz and a paper by Tobias Oetiker et al.

```

1
2 \documentclass{article}
3 \usepackage[T1]{fontenc}
4 \usepackage{natbib}
5
6 \begin{document}
7
8 A parenthetical citation \citep{oetiker1995not}. A
   textual citation \citet{oetiker1995not}.
9
10 A citation with optional page arguments
   \citep[p.~42]{oetiker1995not}.
11
12 A citation with optional text
   \citep[See]{pp.~42-50}{oetiker1995not}.
13
14 A group citation \citep{oetiker1995not,
   kottwitz2011latex}.
15
16 \bibliographystyle{plainnat}
17 \bibliography{example}
18 \end{document}

```

A parenthetical citation [Oetiker et al., 1995]. A textual citation Oetiker et al. [1995].  
 A citation with optional page arguments [Oetiker et al., 1995, p. 42].  
 A citation with optional text [See Oetiker et al., 1995, pp. 42-50].  
 A group citation [Oetiker et al., 1995, Kottwitz, 2011].

**References**

Stefan Kottwitz. *LaTeX beginner's guide*. Packt Publishing Ltd, 2011.

Tobias Oetiker, Hubert Partl, Irene Hyna, and Elisabeth Schlegl. The Not so Short Introduction to L<sup>A</sup>T<sub>E</sub>X2<sub>ε</sub>. Electronic document available at <http://www.tex.ac.uk/tex-archive/info/short>, 1995.

Figure 32: Textual vs. parenthetical citations using natbib.

- ▶ Finished: Lessons 1-6 (Day 01) and 7-12 (Day 02) from [learnlatex.org](http://learnlatex.org)
- ▶ Lessons 13 to 16 – can ask questions re: these on the Slack channel! ([#latex101](#))
- ▶ Next time: Resume/CV templates, Beamer, Inkscape



T. Oetiker, H. Partl, I. Hyna, and E. Schlegl, “The Not so Short Introduction to LATEX2 $\epsilon$ ,” *Electronic document available at <http://www.tex.ac.uk/tex-archive/info/lshort>*, 1995.