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An Introduction to LaTeX

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March 11, 2016

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When should you *not* use LaTeX?

A Closer Look at TEXample.tex

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The main parts of a `tex` file are:

- The `documentclass` declaration
- The rest of the *preamble*
- The body of the document, everything between `\begin{document}` and `\end{document}`

The documentclass

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\documentclass[option1,option2,...]{class}
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Every document starts with a `documentclass` declaration, which tells LaTeX what kind of document to create when it compiles your `tex` file.

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- Other common classes: *report*, *book*, *letter*, and *beamer*
- There are also lots of *options* you can specify:

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- There are also lots of *options* you can specify:

10pt, 11pt, etc.	Font size (10pt is default)
a4paper, letterpaper,...	Defines the size of your paper
twoside, oneside	Double- or single-sided output

The Preamble

The preamble is everything between the `documentclass` declaration and `\begin`{*`document`*}.

This is where you would specify which `packages` your document will be using, along with any *`options`* for those packages, and any other options or information that isn't necessarily a part of the document's content.

We'll talk more about packages later, but other things that go in the preamble:

- Setting lengths of spaces before/after paragraphs, line height, etc.
- Specifying author/title/date, etc. (important if you will be making a title page)

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You can organize your document using `\section`{ }, `\subsection`{ }, and, in the case of the *report* or *book* document classes, `\chapter`{ }. Your PDF output will include these sections as bookmarks.

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Try typing in `latex texample.tex`.

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Try typing in `latex texample.tex`.

Okay, now try `pdflatex texample.tex`.

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But...

- Using a text editor helps you learn commands and processes by heart
- I just find text editors to be a lot easier on the eyes

Packages

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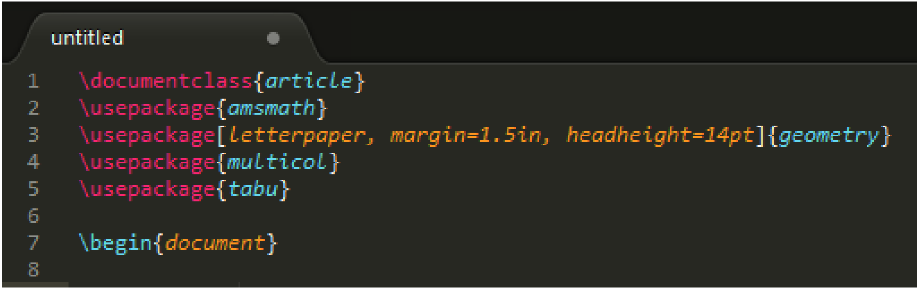

```latex
\documentclass{article}
\usepackage{amsmath}
\usepackage[letterpaper, margin=1.5in, headheight=14pt]{geometry}
\usepackage{multicol}
\usepackage{tabu}

\begin{document}

```

Anatomy of a Package Call

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Why use this over the options in the documentclass declaration?

Where do Packages Come From?

Anyone who wants to can make a package, so there are a lot of them out there. It wouldn't be feasible for LaTeX to install *all* of them right off the bat. Instead, it installs some core packages and downloads and installs any others that are called on the spot.

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They can be manually installed, too:

- Windows: Start → MikTeX → Maintenance → MikTeX Package Manager
- Mac: This is actually pretty hard! We can talk about it if need be

Useful Packages

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How do you know what packages to use for what?

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LaTeX documents are fully-justified by default, but you can change the text alignment by surrounding it with (for example) `\begin{center}` and `\end{center}` to center it. You can use `flushleft` and `flushright` to left and right justify, respectively.

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Environments: The other class of options are called *environments*. They have the general structure of

```
\begin{environment}
affected text
\end{environment}
```

Environments usually set larger blocks of text apart from the normal flow of the document.

Some Notes on Sizing and Spacing

As mentioned above, you set the base text size in the `documentclass` declaration. All of the decisions about spacing and sizing that LaTeX makes are based off of that (default is *10pt*).

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Other lengths you can set are things like `\parindent`, the indentation on each paragraph, or `\abovedisplayskip` and `\belowdisplayskip` for the space above and below the display math environment.

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Two other useful commands are `\quad` and `\qquad`, which insert horizontal space of length 1em and 2em, respectively.

Math Mode

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Let’s have a look at `jmasm_template.tex` and its corresponding output.

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Technically using $$ is frowned upon (it's TEX, not LATEX), but practically speaking it is fine.

Math Commands

Some common math symbols:

`\alpha`, `\beta`, etc.	α, β, etc.	`x^{2}, y_{1}, a^{b}_{c}`	x^2, y_1, a^b_c
`\Gamma`, `\Delta`, etc.	Γ, Δ, etc.	`\frac{x}{y}`	$\frac{x}{y}$
`\ldots`, `\cdots`	$\ldots, \cdots$	`\sqrt[x]{y}`	$\sqrt[x]{y}$
`\ddots`, `\vdots`	$\ddots, \vdots$	`\sum_{i=1}^{n}`	$\sum_{i=1}^n$
`\leq`, `\geq`	$\leq, \geq$	`\int_{0}^{\infty}`	$\int_0^\infty$
`\bigcap`, `\bigcup`	$\bigcap, \bigcup$	`\prod_{n=1}^{N}`	$\prod_{n=1}^N$
`\exists`, `\forall`	$\exists, \forall$	`\in`	$\in$
`\times`, `\div`, `\pm`	$\times, \div, \pm$	`\cdot`, `\bullet`, `\circ`	$\cdot, \bullet, \circ$
`\sin`, `\cot`, etc.	$\sin, \cot$, etc.	`\lim_{x \to \infty}`	$\lim_{x\to\infty}$

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`\ldots`, `\cdots`	$\ldots, \cdots$	`\sqrt[x]{y}`	$\sqrt[x]{y}$
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`\exists`, `\forall`	$\exists, \forall$	`\in`	$\in$
`\times`, `\div`, `\pm`	$\times, \div, \pm$	`\cdot`, `\bullet`, `\circ`	$\cdot, \bullet, \circ$
`\sin`, `\cot`, etc.	$\sin, \cot$, etc.	`\lim_{x \to \infty}`	$\lim_{x\to\infty}$

You can combine all of these to make pretty much anything!

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And in display mode:

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Math Commands

A quick note, there is a package you can use to get slanted fractions:

```
\usepackage{xfrac}
```

With *xfrac*, you can use the `\sfrac` command to make slanted fractions:

`$ \sfrac{150}{29} $` ${}^{150}\!/_{29}$

`$$ \sfrac{150}{29} $$` ${}^{150}\!/_{29}$

It's useful for saving space, but I wouldn't try putting any math symbols that take up too much space in there.

Notes on Escaping Characters and Delimiters

Because some characters are used as part of commands in LaTeX, we need to be careful about using them both in and out of math mode.

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Watch out for: `& % $ # _ { } ~ ^ \`.

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For the others, you can just put a \ in front of them, e.g. `\&` will give you &.

Quotation marks are also done differently, with `‘‘text’’` giving you “text” and `‘text’` giving you ‘text’ (those are supposed to be grave accent marks).

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In Math Mode:
Parenthesis ( ), brackets [ ], and absolute value $||$ can be done with the keyboard. You still need to be careful of braces $\{\}$ as above. You can get the norm $\|x\|$ with `\|` (i.e. `\|x\|`).

Your delimeters can scale, though!

Scaling Delimeters

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...we have to use `\left\{` and `\right\}`, i.e.

```
$$ \left\{\frac{1}{a_n}\right\}_{n=1}^{\infty} $$
```

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Other Display Math Environments

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The asterisks suppress numbering, and we could've used them on *equation*, too.

Tables

It is best to start out by just looking at an example of a table:

```
\begin{tabular}{|r|cl|}
(1,1) & (1,2) & (1,3) \\
\hline
(2,1) & (2,2) & (2,3)
\end{tabular}
```

(1,1)	(1,2)	(1,3)
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{r|cl|} tells LaTeX several things:

- The number of letters determines the number of columns (three)
- The letters themselves determine the text alignment in each column (r for right, c for center, l for left)
- Vertical lines (|) determine where vertical borders are inserted into the table

Ampersands (&) separate cells, `\hline` inserts a horizontal border, and \\ends a row.

Arrays

You can enter inline math mode inside individual table cells (display mode is not advised):

```
\begin{tabular}{|c|c|}
$\frac{1}{2}$ & $a \to \infty$ \\
Math and & Text \\
\end{tabular}
```

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You can also include an entire table in math mode using the *array* environment instead of *tabular*. If you wanted to include plain text, you would just use the `\text{}` command.

```
$$ \begin{array}{|c|c|}
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\end{array} $$
```

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Matrices and Vectors

Matrices and vectors work pretty similarly to Tables, but they have their own special environments. There are different environments depending on the delimeters you want around your matrix. The two most common are *pmatrix* (for parenthesis) and *bmatrix* (for square brackets). If you don't want any delimeters at all, you can just use *matrix*.

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$$\begin{bmatrix} 1 & 2 & 3 \\ \frac{1}{2} & f(x) & \infty \end{bmatrix}$$

You *can* use matrices in inline math mode, but that doesn't mean you should. If it's in the middle $\mathbf{A} = \begin{pmatrix} a_{1,1} & a_{1,2} \\ a_{2,1} & a_{2,2} \end{pmatrix}$ of a paragraph it's going to mess your spacing up a bit.

Lists

There are two list environments, *itemize* and *enumerate*.

Both use the same general structure:

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LaTeX will automatically make a sublist if you nest an *itemize* or *enumerate* environment within another list environment:

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1. Item one

   1.1 Subitem one

   1.2 Subitem two

2. Item two

The graphicx package

If you want to include images in your document, *graphicx* is the way to do it. When exporting to a PDF using `pdflatex`, supported files are JPG, PNG, PDF, and EPS (using the *epstopdf* package).

The command to include an image using *graphicx* looks like this:

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By default, LaTeX just looks for images in whichever folder your `tex` file is in, but you can specify a specific path in the preamble for LaTeX to use when looking for images:

```
\graphicspath{{images/}}
```

Online LaTeX Editors

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This also seems like a great time to talk about commenting!

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