An Example LaTeX Document

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This is an example of a LaTeX document, complete with theorems and headers and the like.

Contents

Golden Rule: Do not do anything manually if you can avoid it.

I have seen people manually add section numbers, manually bold theorems, manually create numbered lists, manually add spacing between every single paragraph…Do not do this. If you do not know how to do something, Google it! The site TeX.SE will frequently provide answers. Often, LaTeX can do it, and can do it better than you can.

The philosophy here is that what you see is what you mean. The source code shows you the logical structure of the document. Then the compiler converts that to a PDF.

1 Paragraphs

In LaTeX, paragraphs are caused when two line breaks are used. Single line breaks are ignored. Hence this entire block is one paragraph. This is useful because it means you can break text at convenient points, which makes your source code much more readable than if you had lines spanning hundreds of characters.

Now this is a new paragraph. If you want to start a new line without a new paragraph, use two backslashes like this:
Now the next words will be on a new line. **As a general rule, use this as infrequently as possible.**

You can **bold** or *italicize* text. Try to not do so repeatedly for mechanical tasks by, e.g. using theorem environments (see Section 4).

2 Math

Inline math is created with dollar signs, like $e^{i\pi} = -1$ or $\frac{1}{2} \cdot 2 = 1$.

Display math is created as follows:

$$\sum_{k=1}^{n} k^3 = \left(\sum_{k=1}^{n} k \right)^2.$$

This puts the math on a new line. Remember to properly add punctuation to the end of your sentences – display math is considered part of the sentence too!

Note that the use of `\left(` causes the parentheses to be the correct size. Without them, get something ugly like

$$\sum_{k=1}^{n} k^3 = (\sum_{k=1}^{n} k)^2.$$

2.1 Using alignment

Try this:

$$\prod_{k=1}^{4} (i - x_k)(i + x_k) = P(i) \cdot P(-i)$$
$$= (1 - b + d + i(c - a))(1 - b + d - i(c - a))$$
$$= (a - c)^2 + (b - d - 1)^2.$$

3 Shortcuts

In the beginning of the document we wrote

```
\newcommand{\half}{\frac{1}{2}}
\newcommand{\cbrt}[1]{\sqrt[3]{#1}}
```

Now we can use these shortcuts.

$$\frac{1}{2} + \frac{1}{2} = 1 \text{ and } \sqrt[3]{8} = 2.$$

4 Theorems and Proofs

Let us use the theorem environments we had in the beginning.

Definition. Let $\mathbb{R}$ denote the set of real numbers.

Notice how this makes the source code much more readable.

Theorem 1 (Vasc's Inequality)**.** *For any a, b, c we have the inequality*

$$\left(a^2 + b^2 + c^2\right)^2 \geq 3\left(a^3b + b^3c + c^3a\right).$$

For the proof of Theorem 1, we need the following lemma.

Lemma 2. *We have $(x + y + z)^2 \geq 3(xy + yz + zx)$ for any $x, y, z \in \mathbb{R}$.*

Proof. This can be rewritten as

$$\frac{1}{2}\left((x - y)^2 + (y - z)^2 + (z - x)^2\right) \geq 0$$

which is obvious. □

Proof of Theorem 1. In the lemma, put $x = a^2 - ab + bc$, $y = b^2 - bc + ca$, $z = c^2 - ca + ab$. □

Remark 1. In Theorem 1, equality holds if $a : b : c = \cos^2 \frac{2\pi}{7} : \cos^2 \frac{4\pi}{7} : \cos^2 \frac{6\pi}{7}$. This unusual equality case makes the theorem difficult to prove.

5 Referencing

The above examples are the simplest cases. You can get much fancier: check out the Wikibooks.

6 Numbered and Bulleted Lists

Here is a numbered list.

1. The environment name is "enumerate".

2. You can nest enumerates.
   a) Subitem
   b) Another subitem

$2\frac{1}{2}$. You can also customize any particular label.

3. But the labels continue onwards afterwards.

You can also create a bulleted list.

- The syntax is the same as "enumerate".

- However, we use "itemize" instead.

7 More Sources

This is just a modest example of some common usages. For more sources,

1. The excellent Wikibooks, `http://en.wikibooks.org/wiki/LaTeX`, provide a much more thorough, comprehensive treatise on using LaTeX.

2. Detexify, `http://detexify.kirelabs.org/classify.html`, can be useful for locating a particular symbol.

3. And finally, Google. Seriously. If you want to know how to do something, a quick Google search suffices 90% of the time.