# LaTeX Example Document

## 1 Math Formatting

LaTeX has three different input modes: normal input mode, inline math mode, and full math mode. Normal input mode is what you'll type most of your text in. Inline math mode allows you to write mathematics and equations in your paragraphs; full math mode will place all of your text on its own line. Here is an example of an equation in inline mode: $\sum_{i=1}^{\infty} \left(\frac{x}{i}\right)^2$. Here is the same equation in full math mode:

$$\sum_{i=1}^{\infty} \left(\frac{x}{i}\right)^2$$

Note that the same symbols will work in both modes, but may be displayed slightly differently.

### 1.1 Symbols

The following is a list of useful math symbols to know in LaTeX:

- Subscripts and superscripts: $x^2, y_0, 2^{n+1}, a_{i+1,n}, 2^{2^{2^n}}$

- Fractions: $\frac{x}{y}, 2/3$

- Square roots: $\sqrt{16}, \sqrt[4]{x}$

- Floor/ceiling: $\lfloor 4.5 \rfloor, \lceil -9.7 \rceil$

- Lots of random symbols: $<, >, \geq, \leq, \neq, \in, \subset, \subseteq, \cap, \cup, \vee, \wedge, \equiv, \sim, \forall, \exists, |, \pm$

- Arrows: $\leftarrow, \Leftarrow, \rightarrow, \Rightarrow, \leftrightarrow, \Leftrightarrow$

- Greek letters: $\epsilon, \iota, \pi, \phi, \varphi, \theta, \Lambda, \Omega, \Psi$

- Sets: $\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}$

- Special numbers: $\infty, \mathrm{e}, \mathrm{i}$

- Binomial coefficients and others: $\binom{a}{b}, \binom{n}{n-k}, \begin{bmatrix} a \\ b \end{bmatrix}, \begin{Bmatrix} a \\ b \end{Bmatrix}$

### 1.2 Other Useful Tricks

You already saw an example of formatting summations, so here's another example of product notation (fun exercise: assume $a, b, c..., z$ are constant. What does the following product equal?):

$$\prod_{X=a,b,c,...} (x - X)$$

You can do an integral the same way:

$$\int_{-\infty}^{\infty} \mathrm{e}^{-x^2} dx = \sqrt{\pi}$$

Arrays and matrices are challenging in LaTeX. Here's how you do them:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \cdot \begin{pmatrix} e & f \\ g & h \end{pmatrix} = \begin{pmatrix} ae + bg & af + bh \\ ce + dg & cf + dh \end{pmatrix}$$

There are two other really useful typesetting tricks that use similar syntax to the array syntax. The first is piecewise functions:

$$f(x) = \begin{cases} \frac{\sin x}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$$

The other useful way you can use the array syntax is to line up a sequence of equations or inequalities:

$$
\begin{align}
x^2 + 5x + 6 &= x^2 + 2x + 3x + 6 \tag{1} \\
&= x(x + 2) + 3(x + 2) \tag{2} \\
&= (x + 3)(x + 2) \tag{3}
\end{align}
$$

If you're trying to write a formal theorem and a proof, you can do so in the following way (note that you must define the theorem in your document header, much like you would define a new command):

**Theorem 1** (Fermat). *Let $n > 2$ be an integer. There are no positive integers $a, b, c$ that satisfy the following equation:*

$$a^n + b^n = c^n$$

*Proof.* This is trivial! Go do something hard, like prove $P = NP$. ∎

## 2 Other Formatting

Normal input mode lets you type regular text, and LaTeX will break this up into pages and paragraphs for you. In general, white space doesn't matter in LaTeX. The one exception to the rule is paragraph breaks, which are delimited by a blank line.

Here's the start of another paragraph. You can also force line breaks:
Here's the start of a new line.

You can write emphasized text in a number of different ways: *like this*, **like this**, <u>like this</u>, or LIKE THIS.

There are a number of formatting environments defined in normal mode that will let you typeset things however you want. You can do things like write numbered lists:

1. Take CS173

2. ???

3. Profit!

Here's how to create a table:

| Name | HW 1 | HW 2 | Average |
|---|---|---|---|
| John | 67 | 43 | 55 |
| Jane | 72 | 65 | 68.5 |
| **Total:** | 139 | 108 | 123.5 |

LaTeX supports a rich cross-referencing and citation management system. You can reference any numbered element in your document, including sections, figures, equations, or pages. For example, see section 1, eq. 2, or theorem 1.

# 3   Where to find stuff

LaTeX has a quite steep learning curve, but once you know it, you'll never want to use anything else. So how do you get to know it really well? Here's a list of some resources:

- Google

- The Not-So-Short Introduction to LaTeX $2_\varepsilon$: `http://fmwww.bc.edu/GStat/docs/latex2e.pdf`. This will be your best friend for a long time. Read through the whole thing.

- The Comprehensive LaTeX Symbol List: `http://www.tex.ac.uk/tex-archive/info/symbols/comprehensive/symbols-a4.pdf`. This 141-page document lists just about every possible symbol you could ever want to typeset. Don't get lost!

- LaTeX: A Document Preparation System (2nd ed.), by Leslie Lamport. This book is definitely a good investment; it was written by the creator of LaTeX, and provides a lot of discussion of the ins and outs of the system. ISBN: 978-0201529838

- The LaTeX Companion, by Michel Goossens, Frank Mittelbach, and Alexander Samarin. Another really useful reference, and is a much more substantial reference than the above book. ISBN: 978-0201541991