Hello World! A Quick Introduction to LaTeX

Mark H. Kim

February 5, 2012

This is a simple LaTeXdocument. It should be noted that LaTeXhandles spacing a little differently. For example, I have just started a new line here, but you won't see that in the output. Nor will you see this gigantic space. You have to hit enter twice to start a new paragraph.

By default, this results in creating a new line and some indentation. If you don't want to see the indent, you can use the `\noindent` command
like this. Make sure to insert a space after "noindent" (or any other command, for that matter). Why? `\noindent` is a command, but `\noindentlike` is not! If you don't want to start a new paragraph, you can force a linebreak using the \\ command
like this. I will hit enter every once in a while to make the source code more readable—in fact, I already have been doing that!

Let me explain the other commands I used above. `\texttt` turns the text between { and } into `typewriter font`. Other common font commands that make use of the curly brackets are *italics*, **boldface**, and underline. Some commands, like those for changing font sizes, do not use brackets. Instead, you type in the command and it is effective until it is interrupted by another command. For example: This is a really LARGE font but now it's only Large and now it's large and now it's normalsize and now it's small and now it's tiny.

What's with the dollar sign, then? There are two modes of input in LaTeX: the text mode (the one we're using now), and the math mode. The math mode is used to type in, well, math and other symbols. The dollar sign triggers the beginning and the end of the math mode, like this: $x + 1$. Compare that to x+1, which does not look as pretty. Some commands even produce an error if not used in math mode. For example, typing a superscript works like this: $x^2 + 4$. Try doing that without the dollars signs—you will get an error! This is why the backslashes were enclosed with dollars signs in the above paragraphs. Also, I had to type `\backslash` because the \ symbol is reserved for signifying LaTeXcommands. Some other common symbols like $, ^, and ~ also require special commands. The \^{} command is typed as such because \^ is really an accent mark, like this: L'Hôpital. Here are some names with common accent marks: Françoise Sagan, Antoine de Saint-Exupéry, Louise Glück, Roberto Bolaño.

There are two types of math modes: in-line mode and display mode. In-line mode is the one we've been using, like $\int_a^b f(x)\,dx$. Display mode is triggered by the `displaymath` environment or its shorthand \[\], and it displays a nice big equation in the center:

$$\int_a^b f(x)\,dx.$$

I prefer the shorthand

$$\int_a^b f(x)\,dx,$$

because it is easier to type. Some symbols are distinctly different in-line and displayed. Compare $\frac{1}{2}$, $\sum_{n=1}^{\infty} a_n$, $\lim_{x\to x_0} f(x)$, and

$$\frac{1}{2},\ \sum_{n=1}^{\infty} a_n,\ \lim_{x\to x_0} f(x).$$

Sometimes you want to have the "display mode" effect for in-line equations, in which case you should use the `\displaystyle` command. Voilà: $\displaystyle\frac{17}{25}$. Don't use it too often, though; it makes the output ugly if overused.

What if you would like to refer back to an old equation? In this case, you number the equation using the `equation` environment:

$$f(b) - f(a) = \int_a^b f'(x)\,dx. \tag{1}$$

And then you can say things like "We use equation (1) to compute the integral." The label-ref system creates a link to the equation with a *dynamic* reference mark, meaning the number in the `ref` part will change automatically if it changes in the `label` part. This is very useful in the editing process, as you don't have to change all the references manually. You can also use `\hyperref` to create a more elaborate link, like this: the Fundamental Theorem of Calculus. Don't worry about the boxes around the links; they won't show up on the printed version. The label-ref command can be used in a lot of other contexts as well. For example, we have the theorem environment here:

Theorem 1 (Fundamental theorem of calculus)**.** *If f is $\mathscr{C}^1$ on $[a,b]$, then f' is integrable on $[a,b]$ and*

$$f(b) - f(a) = \int_a^b f'(x)\,dx$$

holds.

And we refer to it here: Theorem 1. The text surrounded by the brackets in the theorem environment defines the name of the theorem as you can see above.

We also need multiple lines of equations from time to time. the `eqnarray` environment can be used here, in the following manner:

$$\begin{aligned} \|f(x) - f(y)\| &= \|f(x) - f_n(x) + f_n(x) - f_n(y) + f_n(y) - f(y)\| && (2)\\ &\leq \|f(x) - f_n(x)\| + \|f_n(x) - f_n(y)\| + \|f_n(y) - f(y)\| && (3)\\ &\leq \frac{\varepsilon}{3} + \frac{\varepsilon}{3} + \frac{\varepsilon}{3}. && (4) \end{aligned}$$

Here & signifies the beginning of a new column (`eqnarray` has three) and \\ introduces a line break, as always. If you don't want to see each line labeled, you introduce an asterisk in the environment:

$$\begin{aligned} \|f(x) - f(y)\| &= \|f(x) - f_n(x) + f_n(x) - f_n(y) + f_n(y) - f(y)\|\\ &\leq \|f(x) - f_n(x)\| + \|f_n(x) - f_n(y)\| + \|f_n(y) - f(y)\|\\ &\leq \frac{\varepsilon}{3} + \frac{\varepsilon}{3} + \frac{\varepsilon}{3}. \end{aligned}$$

This is the standard suppress-the-numbering command.

`eqnarray` is a type of *array*, which is synonymous to *table*. The generic text array is given by the `tabular` environment:

Hello	this is	a generic	LaTeXarray
containing	four	centered	columns.

The number of letters next to `tabular` defines the numbers of columns. Each letter specifies the alignment of the column: `l` for left, `c` for center, and `r` for right. If you would like to center the array itself, then the `center` environment should be used

Another	array
with more	words!

The generic array for the math mode is given by the `array` environment:

$$\begin{array}{cc} & a_0^{b_0} \\ a_1^{\sum c_n} & a_2 \times a_3 \end{array}$$

There are two particularly useful types of arrays for the math mode: matrices and piecewise functions. Compare the following matrices:

$$\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \end{array} \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{smallmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{smallmatrix}$$

Note that you don't have to define the number of columns for matrix environments. Piecewise functions are displayed using the `cases` environment, which produces a two-column array with a big curly bracket on the left:

$$f(x) = \begin{cases} e^{-x^2} & \text{if } x > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Note the use of \mbox{}, which creates a box of text mode within math mode. You can use \text{} if you wish.

Lastly, you might need to create a list or two from time to time. A unnumbered list is given by the `itemize` environment:

- Feed the kitty.
- Do the laundry.
- Procrastinate.

A numbered list is given by the `enumerate` environment:

1. Lather
2. Rinse
3. Repeat

The enumerate environment can be modified to adopt other numbering schemes. Here are some examples:

(1) Lather

(2) Rinse

(3) Repeat

(i) Lather

(ii) Rinse

(iii) Repeat

(a) Lather

(b) Rinse

(c) Repeat

A. Lather

B. Rinse

C. Repeat

I. Lather

II. Rinse

III. Repeat

This completes a quick introduction to LaTeX. See `http://mirrors.ctan.org/info/symbols/comprehensive/symbols-letter.pdf` for the comprehensive list of LaTeXsymbols. `http://detexify.kirelabs.org/classify.html` is very useful in looking up the symbols whose name you don't know.