LaTeX tips

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The following is a compilation of Nick Higham's **Top Tips for New LaTeX Users**, Mark Trettin's **An essential guide to LaTeX 2ε usage**, and our own tips & suggestions. Complete beginners should first see basics on **LaTeX Wikibooks**.

If you do not know how type something in LaTeX, generally you should follow these steps

1. Consult **LaTeX Wikibooks**. Is there a standard solution to your problem?
2. Check one of the recommended references [1] or [2].
3. Google the solution (preferably use **LaTeX Stack Exchange**) and try to understand the solution using the sources mentioned above.

New paragraphs

In LaTeX a new paragraph is started by leaving a blank line or equivalently by `\par` command. Do not start a new paragraph by using `\\` (it merely terminates a line). Indeed, you should almost never type `\\`, except within environments such as `equation`, `tabular`, etc.

Hyphen, en dash, em dash

There are three important horizontal dash-like characters

- **hyphen** - typed as `-`

  Typically used between the elements of compound words, such as "hard-boiled egg", typed as "`hard-boiled egg`", or in names, such as "Antoine de Saint-Exupéry", typed as "`Antoine de Saint-Exup\'{e}ry`".

- **en dash** – typed as `--`

  Used to join names corresponding to different people in a phrase, such as "Navier–Stokes equations", typed as "`Navier--Stokes equations`", or in ranges, such as "Sections 3–7", typed as "`Sections 3--7`".

- **em dash** — typed as `---`

  Used to "set aside a phrase—like this—in a sentence", typed as "`set aside a phrase---like this---in a sentence`".

Inline math mode

Always type mathematics in math mode as `$...$` or `\(...\)` to produce "$y = f(x)$" instead of "y = f(x)", and "the dimension n" instead of "the dimension n". Punctuation should appear *outside* math mode, for inline math expressions, otherwise the spacing will be incorrect

- **correct:** `The variables $x$, $y$, and $z$ satisfy $x^2 + y^2 = z^2$.`
- **incorrect:** `The variables $x,$ $y,$ and $z$ satisfy $x^2 + y^2 = z^2.$`

Displayed math mode

Do not use `$$...$$` for separating math formulae from text as this command modifies vertical spacing within formulae and is difficult to parse. Instead, use `\[...\]` or better yet, opt for `\begin{equation*}...\end{equation*}` in case you are using the `amsmath` package. If needed, the displayed equation can then be converted into a numbered one simply by omitting the star from `equation*`.

For displayed equations, punctuation should appear as part of the display. All equations *must* be punctuated, as they are part of a sentence.

Text in displayed math mode

When a displayed equation contains text such as "subject to $x \geq 0$", instead of putting the text in `\mathrm` put the text in a `\text` command (requires `amsmath` package). Note that `\text` switches out of math mode, and this has the advantage of ensuring the correct spacing between words. For example

```
\begin{equation*}
  f(x) =
  \begin{cases}
    0 & \text{if $x = 0$,}
    \\
    \frac{1}{x} & \text{otherwise.}
  \end{cases}
\end{equation*}
```

is rendered as

$$f(x) = \begin{cases} 0 & \text{if } x = 0, \\ \frac{1}{x} & \text{otherwise.} \end{cases}$$

Math expressions

Ellipses (dots) are never explicitly typed as "...". Instead, they are typed as `\ldots` for baseline dots, as in `$x_1, x_2, \dots, x_n$` (giving $x_1, x_2, \dots, x_n$) or as `\cdots` for vertically centered dots, as in `$x_1 + x_2 + \cdots + x_n$` (giving $x_1 + x_2 + \cdots + x_n$). When using `amsmath` package the command `\dots` tries to automatically make the choice for you and switches between `\ldots` and `\cdots` depending on the following symbol.

If you are using angle brackets to denote an inner product use `\langle x, y \rangle` which renders as $\langle x, y \rangle$ instead of `< x, y >` which results in $< x, y >$.

For "much less than", type `\ll`, giving $\ll$, not `<<`, which gives $<<$. Similarly, "much greater than" is typed as `\gg`, giving $\gg$.

Avoid the `\over` command for typing fractions as it is difficult to parse and clashes with the `amsmath` package. Instead, use `\frac{}{}` in displayed math mode.

Defining macros

Always use `\newcommand{\<name>}{...}` for defining new macros. Never use `\def\<name>{...}`. The main problem with `\def` is that no check is done on whether there already exists another macro of the same name. So a macro defined earlier may be overwritten without any error warning. Macros may be re-defined using `\renewcommand{\<name>}{...}`.

Functions and operators

Mathematical functions should be typeset in roman font. This is done automatically for the many standard mathematical functions that LaTeX supports, such as `\sin`, `\exp`, `\max`, etc. If the function you need is not built into LaTeX, such as a `\diag` operator, create your own by the general `\newcommand{\diag}{\operatorname{diag}}` or, when using the `amsmath` package, by `\DeclareMathOperator{\diag}{diag}`. Do not use `\newcommand{\diag}{\mathrm{diag}}` for defining operators as it renders the function name incorrectly.

Parentheses, brackets, braces, ...

When enclosing a math formula inside some delimiters (parentheses, brackets, braces, etc.) a good start is to always use the `\left` and `\right` commands with the appropriate delimiter. These commands change the delimiters' size dynamically depending on the content. For example

```
\begin{equation*}
  \sum_{k=0}^n a q^k = a \left( \frac{1 - q^{n + 1}}{1 - q} \right).
\end{equation*}
```

yields

$$\sum_{k=0}^{n} aq^k = a\left(\frac{1-q^{n+1}}{1-q}\right).$$

When the automatic scaling is too drastic, advanced users might want to tweak some cases manually using the commands, such as `\big`, `\Big`, etc. instead of `\left` and `\right`.

Centering floats

A frequently seen mistake is to use `\begin{center}...\end{center}` inside environments such as figure, table, minipage, etc. However, `center` can cause additional vertical space around the float. To properly center floats, use `\centering` command, such as in this example

```
\begin{figure}[ht]
  \centering
  \includegraphics{imagefile}
  \caption{Some caption.}
  \label{fig:figure}
\end{figure}
```

Overfull hbox

The `overfull hbox` warning means that a line of your document is too long to fit within the horizontal space on the page, and LaTeX couldn't find a good way to break it apart. If it is difficult to spot, `\documentclass[draft]{...}` will help you to locate the exact place where the text is hanging out past the margin.

Labeling and referencing

In LaTeX sections, formulae, floats, etc. are marked using the `\label` command and referenced using the `\ref` command. However, when using the `amsmath` package one usually references *equations* using the `\eqref` command which adds parentheses around the reference number.

It is common practice among LaTeX users to add a few letters to the label to describe *what* you are referencing. For example use `\label{sec:some-section}` to denote sections, `\label{fig:some-figure}` to denote figures, `\label{eq:some-equation}` to denote equations, etc.

Note that in floats (figures, tables, etc.) the `\label` command comes *after* the `\caption` command otherwise you will get a reference to the (sub)section where float is declared instead of a reference to the float itself.

Splitting and aligning equations

When your equation is too long to be fitted on a single line, use `multline` environment from the `amsmath` package instead of `equation` and split the equation at a suitable place using `\\`. For example

```
\begin{multline}
  \label{eq:multline-equation}
  \sum_{i=1}^{30} x_i
  =
  x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14} + x_{15}
  \\
  + x_{16} + x_{17} + x_{18} + x_{19} + x_{20} + x_{21} + x_{22} + x_{23} + x_{24} + x_{25} + x_{26} + x_{27} +
        x_{28} + x_{29} + x_{30}.
\end{multline}
```

yields

$$\sum_{i=1}^{30} x_i = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + x_{16} + x_{17} + x_{18} + x_{19} + x_{20} + x_{21} + x_{22} + x_{23} + x_{24} + x_{25} + x_{26} + x_{27} + x_{28} + x_{29} + x_{30}. \quad (1)$$

To align several numbered equations vertically at points marked with `&` use `align` environment from the `amsmath` package. For example

```
\begin{align}
  \label{eq:align-1}
  a & = 3 r^2 + \sin \varphi,
  \\
  \label{eq:align-2}
  b & = 2 \ln r - \cos \varphi.
\end{align}
```

is rendered as

$$a = 3r^2 + \sin\varphi, \tag{2}$$
$$b = 2\ln r - \cos\varphi. \tag{3}$$

For aligning several expression while numbering the whole formula as a unit, use `split` environment from the `amsmath` package inside the `equation` environment. For example

```
\begin{equation}
  \label{eq:split}
  \begin{split}
    a & = \left( r + 1 \right)^2
    \\
      & = r^2 + 2 r + 1.
  \end{split}
\end{equation}
```

gives

$$\begin{aligned} a &= \left(r + 1\right)^2 \\ &= r^2 + 2r + 1. \end{aligned} \tag{4}$$

Avoid using the standard LaTeX environment `eqnarray` as it does not produce as good results as the `amsmath` environments, nor is it as versatile.

Note that the environments `multline` and `align` also have their unnumbered equivalents `multline*` and `align*`.

The environment `align*` allows for multiple columns of equations using multiple & symbols. A good explanation of the environment's behaviour is not easy to find, so we include it here. Two equivalent points of view are possible

1. The odd &s in line represent the points of alignment, the even &s split the content.
2. All &s separate line into columns. Odd columns are right-aligned, even columns are left-aligned.

For example

```
\begin{align*}
  \text{ right }| & \text{ left } & \text{ right }| & \text{ left } & \text{ right }| & \text{ left } \ldots
  \\
  | & & | & & | & \ldots
\end{align*}
```

will produce

$$\begin{aligned} \text{right} \mid \text{left} \\ \mid \end{aligned} \qquad \begin{aligned} \text{right} \mid \text{left} \\ \mid \end{aligned} \qquad \begin{aligned} \text{right} \mid \text{left } \ldots \\ \mid \ldots \end{aligned}$$

This section provides just a basic overview of equation splitting and aligning. See **LaTeX Wikibooks** for a nice list of the various kinds of equation and align environments.

Subequations environment

The `subequations` environment from the `amsmath` package provides a convenient way to number equations in a group with a subordinate numbering scheme. For example

```
\begin{subequations}
  \label{eq:subequations}
  \begin{align}
    \label{eq:subequation-1}
    a &= 3 r^2 + \sin \varphi,
    \\
    \label{eq:subequation-2}
    b &= 2 \ln r - \cos \varphi.
  \end{align}
\end{subequations}
```

is rendered as

$$a = 3r^2 + \sin\varphi, \tag{5a}$$
$$b = 2\ln r - \cos\varphi. \tag{5b}$$

Note that the labels read (5a) and (5b) instead of (5) and (6).

Making comments in the pdf file

When collaborating with several people, or just working on a bigger project on your own, it may be useful to make some to-do notes that are easily recognizable in the compiled pdf file. The easiest thing to do is to color, underline or cross-out desired words with the help of the `color` or `ulem` packages. However, for a more systematic approach of writing your to-do notes, opt for the `todonotes` package and its `\todo` command.

For example

```
``One can easily prove \todo{How?} that the set of all prime numbers is infinite.
The set of prime numbers is an example of a \emph{countable} infinite set.
On the other hand, the set of real numbers is an example of an \emph{uncountable} infinite set.''
```

renders as

"One can easily prove that the set of all prime numbers is infinite. The set of prime numbers is an example of a *countable* infinite set. On the other hand, the set of real numbers is an example of an *uncountable* infinite set."

How?

The main advantage of the `todonotes` package is that the notes are more visible and easily removable by using the option `\documentclass[final]{...}`. Also, at any point in the document a list of all the inserted to-do items can be listed with the `\listoftodos` command.

For more details on the usage of `todonotes`, see the documentation of the package at **CTAN**.

References

[1] Donald E. Knuth. *The TeXbook.* Addison-Wesley Professional, 1986.

[2] Leslie Lamport. *Latex: A Document Preparation System.* Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA, 1986.