LaTeX and Scientific Writing

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This document explains basics of Linux and scientific writing. It also serves as a template for the term project in PHYS201: Classical Mechanics at Koç University. More information is given in the source file in terms of comments, which are also essential to understand LaTeX, so read this document together with the actual PDF output. It is prepared in the REVTeX-4.2 style, which is used by the journals published by the American Physical Society, some of the most prestigious in the field (more specifically I use the PRL style). This style is optimal for peer-reviewed publications rather than term projects, but I wanted you to experience actual scientific writing, so keep the document this way. This introductory part that gives a short summary of a document is called the "abstract", and your project should have one as well.

BEGINNING LATEX

LaTeX (stylized as LaTeX) is a typesetting software commonly used by scientists to prepare manuscripts of various kinds, mainly peer-reviewed publications. You can use it for everyday purposes as well, it makes editing any document very easy once you learn the basics. We are interested in writing a scientific project in this document. LaTeX is pronounced as "leytek" in Turkish phonetics, the last letter is the Greek letter χ, not a capital x.

To start with, go to the LaTeX project website, download a LaTeX distribution for your operating system and install it. I have a MacOS system, and use MacTeX. Previously, I used MikTeX on Windows and TeX Live on Linux. Any of them (or some other up to date version) would do.

Now, the distribution has all the files that is required to prepare a document, but you may still need an editor to write the document. Some LaTeX distributions also come with an editor, some don't, and such editors may not be the best. I prefer TeXShop on Mac, and previously used TeXMaker on Linux, and WinEdt[1] on Windows. I don't claim that these are superior in some way, so make your own choice, but it is not a big deal as long as you don't dig up some obscure editor or distribution.

There are also some online platforms which can be very useful for collaborative writing as is usual in scientific publications. You may have a look at these if you are interested, but i advise to start with software on your own computer.

Once your software is in place, follow these steps:

- Open source.tex in your editor.
- LaTeX the file. LaTeX is a command that makes your source file into a readable document. For example, you do this by choosing the "LaTeX" command under the "Typeset" tab in TeXShop, your ediyor should have a similar tab. This step is all to do for a most basic LaTeX document, ours is not so basic
- From the same tab, execute the "BibTeX" command. This prepares your references as we detail below.
- Run the "LaTeX" command **twice** more.
- You should have the pdf version of this file generated in the folder. There are a bunch of other files as well, don't worry about them.

SOME EXAMPLES OF SCIENTIFIC WRITING

Symbols

I will just write some examples here, and you can see how it is done by looking at the source document. If you need to write any symbol or short equation, for example the greek letter χ, you put it between dollar signs in the source file: \$chi\$. This is true for short equations as well: $\vec{F} = -\vec{\nabla}U$. Of course you do not need to memorize all the special symbols, they are very very many, you look them up from the web at first, and you learn the ones commonly used after a while (this is easier than it sounds).

If you have a long or major equation, you do not use the dollar signs, but specific "environments" such as "equation" or "align". Here is a single equation

$$L = \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + \frac{e^2}{r} - \frac{e}{2c}Br^2\dot{\theta} \ , \tag{1}$$

and here is a few equations together

$$\begin{aligned} \ddot{x}_1 + \gamma\dot{x}_1 + \omega_0^2 x_1 - \beta^2 x_2 = 0 \\ \ddot{x}_2 + \gamma\dot{x}_2 + \omega_0^2 x_2 - \beta^2 x_1 = 0 \end{aligned} \tag{2}$$

[1] This one asks for donations after a while you use it, i remember uninstalling/installing it to stop the messages.

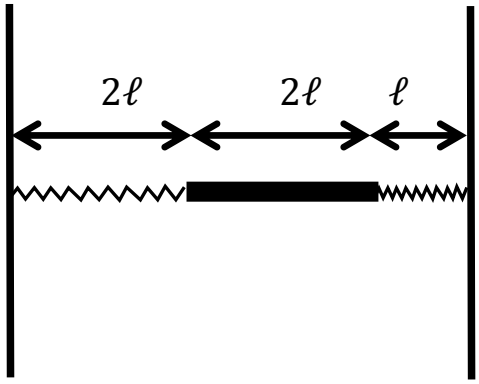

FIG. 1. This is the explanation of the figure, called a "caption".

If you label your equations (see source), then you can reference them as Eq. (**??**) or Eq. (**??**). Labelling is important, you should never refer to something with a number you write explicitly, since you always change places of equations, add new ones, or delete some. By using labels, there is no need to rewrite the equation number, you just look up its label (try erasing an equation, or adding another in between the ones above). Optionally, you can also put in-document links as in here, so that the reader can go to the relevant equation by clicking a number.

Figures

You can also easily add figures in LaTeX, such as Fig. **??**. Note that by default you do not pick where the figure ends up in the document, LaTeX takes care of it for you. If you want a specific place, there are ways to force your will, but i would avoid that at this introductory level.

Citations and References

Finally, a vital part of scientific publication is citing other publications, negligence in this regard is a grave offense, and you should make it a habit to cite what you write if it comes from a specific source. [2] There are various ways to arrange the references you cite, here i will show you how to use a .bib file using the command "BibTeX". There is a separate references.bib file in the same folder as the source.tex. This basically has the information about all the sources you want to cite. Then, you just call their name with the "cite" command. For example PHYS201 textbook is [**?**], or PHYS516 textbook is [**?**]. Here is a citation to a famous paper [**?**]. Of course, you do not cite documents like this, they come naturally in the text as in the following sentence:

"Einstein came up with the foundations of special relativity in 1905 [**?**]."

No one writes perfectly in the beginning, you learn the proper ways, and come up with your own style as you read and write more papers.

You can put more than one source into a single reference as in [**?** **?** **?**].

Acknowledgments: I thank my students who made this class fun to teach, and all my teachers who taught me the wonders of classical mechanics.

[2] Of course, you do not need to write the sources of common knowledge such as $F = ma$. Nevertheless, when in doubt, cite.