PHYS-4007/5007: Computational Physics

LaTeX Tutorial

Learning the LaTeX Mark-up Language

Log into your Linux account, open a terminal window, and change directory to your 'tex' subdirectory. Now open the web browser and go to the Samples of LaTeX Files Web Page on the course web page:

http://faculty.etsu.edu/lutter/courses/phys4007/texfiles/texfiles.htm

and download the 'latextutorial.tex' file to this directory. Following this, open this file in the emacs editor with

> emacs latextutorial.tex &

where the '>' symbol represents the Linux prompt (remember, don't type this symbol, it's only included above to indicate that this is a Linux command). Note that the ampersand symbol (&) puts the process in "background" mode so that you will get back the Linux command prompt to carry out additional commands.

Now go back to the terminal window and issue the command:

> latex latextutorial

– do not include the filename suffix ".tex" in this command. You will see a variety of output printed to the screen indicating any issues that the LaTeX compiler may have found. Following this, issue the Linux command:

> xdvi latextutorial &

and again, don't include the ".dvi" filename suffix. Click on the xdvi GUI and examine the document that was created.

1 Tables and Lists

This shows how one uses the \section command to make new sections. The following is an example of a scientific proposal cover page using the tabbing environment in LaTeX. Note the use of the \newpage command to force this table to appear on the following page.

PRINCIPAL INVESTIGATOR:	Type your name here
NAME AND ADDRESS OF THE ORGANIZATION:	East Tennessee State University Department of Physics and Astronomy Johnson City, TN 37614
SUBMISSION DATE:	19 September 2017
CLASS STATUS AND MAJOR:	Senior in Physics
MACHINE ARCHITECTURE:	Intel Core 2, 64-bit CPU
OPERATING SYSTEM:	Ubuntu Linux
PROGRAMMING LANGUAGE:	Fortran 77 and Python
GRANT OFFICIAL SIGNATURE:	Dr. Donald G. Luttermoser East Tennessee State University

The tabbing environment shouldn't be confused with the tabular environment. The following is an example of using the tabular environment.

Decimal Value	**Binary Value**	**Symbol**	**Name Description**
0	00000000	NUL	Null character
1	00000001	SOH	Start of Heading
2	00000010	STX	Start of Text

The LaTeX tutorial will discuss how to change the appearance of a table using this tabular environment a bit later.

One often needs to display lists. The following shows the use of the itemize environment (printed on the next page).

- High-dispersion spectra of the Mg II h and k resonance lines are a very sensitive diagnostic of temperature reversals in the atmospheres of stars due to their high opacity in relatively low-temperature regimes ($\sim$5000 Å).
- The Fe II multiplets are a major source of cooling in these types of stellar atmospheres (Judge & Neff 1990).
- The line strengths of the C II] UV0.01 multiplet are sensitive to the electron density of the emitting region (Stencel *et al.* 1981; Lennon *et al.* 1985).

At this point in this LaTeX tutorial, change this itemized lists from a "bulleted" list to a numeric list. To do this, change the word "itemize" in the \begin{itemize} and \end{itemize} commands to "enumerate" so that these commands read: \begin{enumerate} and \end{enumerate}. Recompile your LaTeX document to see how this itemized list changes in appearance.

2 Equations

One of the things that makes LaTeX so useful to physicists, astronomers, and mathematicians is its ability to create equations and formulae in papers in a relatively easy way. There are a variety of ways to display mathematics in papers which we will work on here. If you need to include an equation in the main body of a paragraph, then use the dollar sign as delimiters around the equation, $F = ma$. However, let's say that we want a little more space between the 'm' and the 'a' in this equation. We would then insert a small space with the \, marker, $F = m\,a$.

To make a numbered, center-justified equations, one uses the equation environment:

$$F_{\rm tot} = \sum_{i=1}^{N} F\left[t, r(t), v(t)\right] = ma = m\frac{dv(t)}{dt} = m\frac{d^2r(t)}{dt^2} \ . \tag{1}$$

If instead, we wanted an unnumbered center-justified equation, we would use the displaymath environment:

$$F_{\rm tot} = \sum_{i=1}^{N} F\left[t, r(t), v(t)\right] = ma = m\frac{dv(t)}{dt} = m\frac{d^2r(t)}{dt^2} \ .$$

If we need to display a set of equations that are numbered, we use the eqnarray environment:

$$v = \frac{dr(t)}{dt} = \dot{r} \qquad \text{(for velocity)} \tag{2}$$

$$a = \frac{dv(t)}{dt} = \frac{d^2r(t)}{dt^2} = \ddot{r} \qquad \text{(for acceleration),} \tag{3}$$

or if we would rather not have numbers associated with these equations, we would use the 'eqnarray$*$' environment:

$$\begin{aligned} v &= \frac{dr(t)}{dt} = \dot{r} \qquad \text{(for velocity)} \\ a &= \frac{dv(t)}{dt} = \frac{d^2r(t)}{dt^2} = \ddot{r} \qquad \text{(for acceleration),} \end{aligned}$$

Please note the use of the ampersand symbol (&) in the equation array environment to separate the left-hand side of the equation (typically with only one variable present), the center column containing the equal sign, and the right-hand side of the equation. LaTeX will make sure the center column with the equal signs line up in the same vertical column on the page.

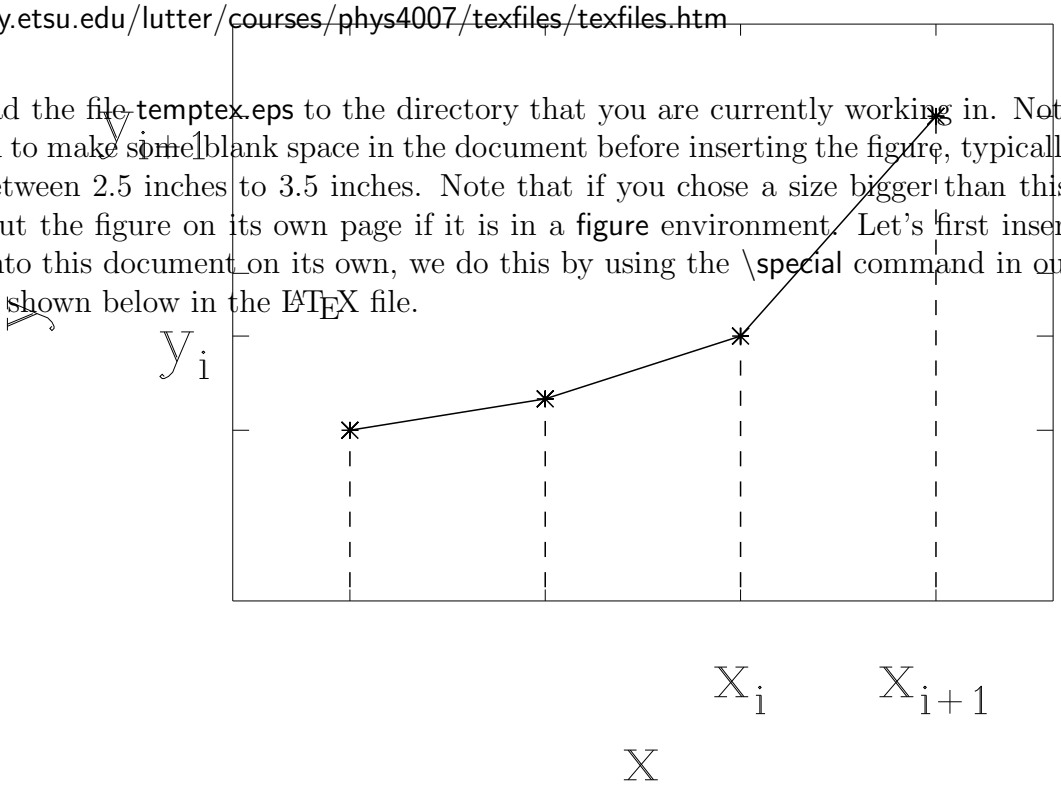
3 Including Figures

Figures can be included in the LaTeX mark-up language as well. We can either have a figure by itself or in a figure environment with a figure number and a caption. LaTeX in Unix is designed to have figure files as encapsulated postscript files. As such, we will focus on using these types of figure files.

First, go to the following page on the course web page,

http://faculty.etsu.edu/lutter/courses/phys4007/texfiles/texfiles.htm

and download the file temptex.eps to the directory that you are currently working in. Note that we need to make some blank space in the document before inserting the figure, typically anywhere between 2.5 inches to 3.5 inches. Note that if you chose a size bigger than this, LaTeX will put the figure on its own page if it is in a figure environment. Let's first insert this figure into this document on its own, we do this by using the \special command in our LaTeX file as shown below in the LaTeX file.



We see that this figure is a little too big and that it is not centered in the space that we have allowed for it. To correct this, let's first scale the figure down to 80% of its current size by setting hscale and vscale from 100 to 80. We see that it is still too big for the area we set. We could increase our vertical space allowed for the figure, or shrink the figure down to 70%. Go ahead and shrink this figure now in both the vertical and horizontal directions.

Now we will reposition this figure so that it is centered in the space that we made for it. First we need to shift it downward — as such, change voffset from 0 to -30 (where these numbers have units of 'points,' note that there are 72 points per inch on the document). This picture is now vertically centered, now we must center it horizontally. As can be seen,

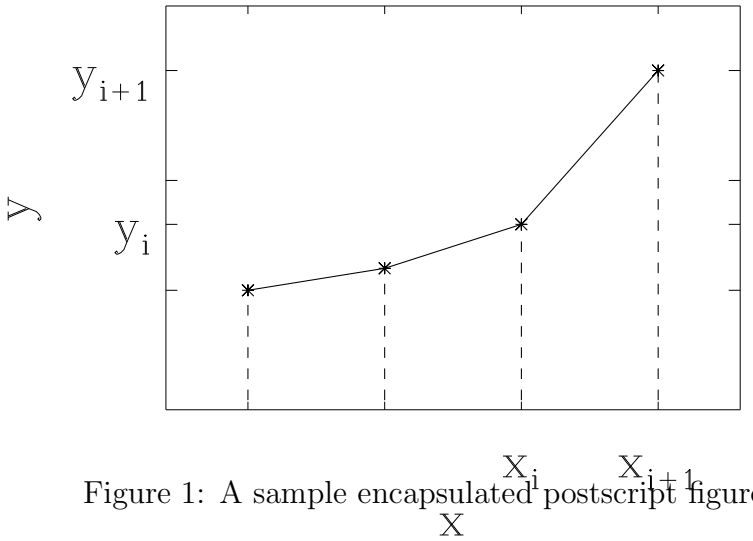


Figure 1: A sample encapsulated postscript figure.

we need to shift this picture a bit to the right — as such, change hoffset from 0 to 30. At this point, the figure is well placed for the space we have allowed for it.

Next, we will place this figure in a figure environment. At first, we will use the same settings as we did for the figure on the previous page. The first thing we note is that LaTeX has placed this figure at the top of this page. Note that we prefer to have this figure show up after this paragraph. We can force LaTeX to place it at this location by issuing a '[h]' keyword after the \begin{figure} command.

At this point we see that the x-axis label falls below the figure caption. Since we have enough room to move the figure up using the voffset keyword, go ahead and change -30 to 0 and recompile your LaTeX file. We now see that the x-axis label is above the figure caption, however we don't have quite enough space between the last paragraph and the top of the figure. As such, we will increase the size of the vertical space from 2.8 inches to 3.0 inches in the figure environment. At this point, I think we are satisfied with the placement of this figure in the floating figure environment.

4 The Table Environment

We will next work with the table environment. Let's use the table we printed on page 2 and insert it in the table environment as shown below.

Decimal Value	Binary Value	Symbol	Name Description
0	00000000	NUL	Null character
1	00000001	SOH	Start of Heading
2	00000010	STX	Start of Text

Now before the \begin{tabular}{rccl} line, insert the line \begin{table}, and after the \end{tabular}, insert the line \end{table} and recompile your code.

We now see that this table has move to the top of this page. Since we don't want the table to appear before the position of where it is at in the LaTeX file, insert '[h]' keyword after the \begin{table} command.

At this point, we want to center this table on the page. To center this table, insert the line \begin{center} after the \begin{table}[h] line and enter \end{center} after the \end{tabular} line (and before the \end{table} line) and recompile the code using the 'latex latextutorial' command at the Linux prompt. Click on the xdvi GUI to see how this has changed your document.

We next want to add some vertical lines in this table to separate each column with a line and completely enclose the table in a box. To do this, input the '|' character in the \begin{tabular} line so that it reads:

\begin{tabular}{|r|c|c|l|}

then insert an \hline command just before the \end{tabular} line. Recompile and look at the output in the xdvi GUI.

Finally, let's include a caption for this table. In scientific journals, table captions typically come at the top of a table. After the \begin{center} line, insert the following line:

\caption{Portion of the ASCII Set of Symbols}

Recompile and examine the resulting dvi file. When all is said and done, the data table should appear as follows:

Table 1: Portion of the ASCII Set of Symbols

Decimal Value	**Binary Value**	**Symbol**	**Name Description**
0	00000000	NUL	Null character
1	00000001	SOH	Start of Heading
2	00000010	STX	Start of Text

5 Special Fonts

At this point, go ahead and try different things with this LaTeX program, for instance, making some of the text boldface with the \textbf{ } environment or italics with the \textit{ } environment. Note that there is also a sans-serif font. The command for this is \textsf{ }. Go through this LaTeX document and change some of the phrases and/or sentences to each of these 3 fonts.