Exercises in LaTeX

Session I: Basics

Note: Read and follow instructions carefully. If you see an error, it must be due to a mistake you made. Computers don't make mistakes.

1. Launch gedit (Applications → Accessories → Text Editor). Type the following text:

   ```
   \documentclass{article}
   \begin{document}
   This is my first \LaTeX\ document.
   \end{document}
   ```

   Save the file as, say, myfirstdoc.tex, in a directory (say, mydir). Now open a terminal. Change directory to where you have saved the file (type 'cd mydir' and press Enter). Give the command 'pdflatex myfirstdoc.tex' and press Enter. Now run the command 'evince myfirstdoc.pdf &' and see how the file appears.

2. Now prepare a document that contains the following paragraphs of text properly aligned:

   The geometry package
   Hideo UMEKI

   This package provides a flexible and complete user interface to page dimensions. You can specify them by using intuitive parameters to get your desired page layout. For example, if you want to set margins (the left, right, top and bottom margins) to 2cm from each edge of the paper, what you need is just \usepackage[margin=2cm]{geometry}.

   Did you get an error while compiling the document? Find out why you got an error and how you can avoid it. [Hint: Read the error message in the terminal.]

3. Now add the option `[a4paper,12pt]` after `documentclass` and before {`article`}. Add the command
   `\usepackage[hmargin=1in,vmargin=15mm]{geometry}`
   after the first line. Save the file, compile as before and see how the document has changed its appearance.

4. Did you align the title and the author's name at the centre? You could give a title to the document by including the command `\title{The geometry package}` in the preamble. To include the name of the author below the title, add the command `\author{Hideo UMEKI}` in the preamble. Also, add the command `\maketitle` immediately after the command `\begin{document}`. Now compile and see how the document looks. Do you think the title should be in bold font? Insert the command `\bf` within the curly brackets before the title. Do you see a date beneath the author's name? The date of compilation is automatically added. You could add a desired date using the command `\date{`$< date >$`}` in the preamble. Or you can get rid of the date being displayed by including the date command without any date value.

5. In the directory `mydir`, there is a file called image.jpg. Let us include this picture in the earlier document we created. To include the picture, you can use the command
   `\includegraphics{image.jpg}`

   Now compile the document and see. Does it give an error message?

You need to use another package to include graphics in your file. Now you add the command

```
\usepackage{graphicx}
```

in the preamble and compile again. How does the document look? Does the picture look too big for the page? You can scale it using an option in the includegraphics command. Insert `[scale=0.3]` after `includegraphics` and before the file name, thus: `\includegraphics[scale=0.3]{image.jpg}`. Now compile again and see how it looks. The `scale` option scales the width and height equally. You could scale them differently by specifying the `height` and `width` separated by a comma, as in the next exercise, or even just one of the values.

6. LaTeX will include the picture you inserted exactly at the point where you have given the command, whether there is space there or not. This is not the best way to do it, of course. You could permit LaTeX to place it at a location where there is space by making it a *float*. You do this by creating a float environment such as `figure`. You can do this by including the following commands:

```
\begin{figure}
\centering\includegraphics[width=4in,height=3in]{image.jpg}
\caption{A typical scene from Kerala}
\end{figure}
```

The `\centering` command, obviously, places the image horizontally centred on the page.

7. Let us now create a table. Here you can use a table environment to make it a float so that LaTeX can place it at a convenient location, just as you created a `figure` environment for the picture. Let us create the following table. Enter the following text:

```
\begin{table}
\caption{Planets in the Solar System}
\begin{tabular}{rlrp{1.5in}}
\hline\hline
{\bf No.} & {\bf Planet} & {\bf Mass} & {\bf Comments} \\
\hline
1. & Mercury & 0.06 & Hardly any atmosphere \\
2. & Venus   & 0.82 & Very hot and dense atmosphere \\
3. & Earth   & 1.00 & Atmosphere conducive for life \\
\hline\hline
\end{tabular}
\end{table}
```

Compile the document and see. Now change the value 1.5in to 5cm and compile. See how the table changes.

(*To learn more about creating a document with LaTeX, refer the* LaTeX Primer *provided as a pdf file.*)

Exercises in LaTeX
Session II: Lists and Boxes

1. We often use bulleted lists and numbered lists in our documents. Let us see how we can create them in LaTeX. Enter the following in your document and see how it looks:

```
 DNA molecules are made up essentially of four nucleotides, namely,
\begin{itemize}
\item Adinine,
\item Thymine,
\item Guanine, and
\item Cytosine.
\end{itemize}
```

2. We can create nested lists (ie. one list inside another). Try this:

```
 Computers can have different kinds of storage devices, such as,
\begin{itemize}
\item hard disk
\item ROM
\item Removable drives
    \begin{itemize}
    \item CDROM
    \item Flash memory (thumb drive)
    \end{itemize}
\end{itemize}
```

What do you get when you compile it? Notice that the nested lists use a different bullet?

3. The bullets in the earlier list are the default used by LaTeX. Now suppose you want to use some other kind of bullet. Let us see how to do that. Try the following code:

```
 Unlike a word processor, \LaTeX\can automatically do things like
  {\renewcommand{\labelitemi}{$\triangleright$}
    \begin{itemize}
    \item cross references
    \item bibliographic citations
    \item equation numbering, etc.
    \end{itemize}
   }
```

The command `\labelitemi` defines the label for the first item. (Notice that the entire list, along with the command to change the bullet, are enclosed in braces {}. This is to confine the change to this list.) Similarly, you can define the labels for the second item using the command `\labelitemii`. Up to four levels are supported. Try creating a list with four levels and see what bullets you get for each level.

4. Let us now look at how to create a numbered list. Instead of `\begin{itemize}` try with `\begin{enumerate}` and see what happens. Make a list using `enumerate`. Of course, remember to end it with `\end{enumerate}`.

5. Let us try nested numbering. Try this code:

```
The three basic steps in producing a printed document using
\LaTeX\ are as follows:
     \begin{enumerate}
     \item \textsf{Prepare} a source file with the extension "tex"
     \item \textsf{Compile} it with \LaTeX\ to produce a "dvi" file
          \begin{enumerate}
          \item View the output using xdvi
          \item Edit the source if needed
          \item Recompile
          \end{enumerate}
     \item \textsf{Print} using a "dvi" driver (eg: \texttt {dvips})
     \end{enumerate}
```

   Incidentally, this is the original way of creating a LaTeX document. Notice what the command `\textsf` and `\texttt` did to the text. This is one way of introducing sans serif or `typrewriter` fonts in your text.

6. Let us see how we can make some changes in the numbering. Add `\usepackage{enumerate}` in the preamble. In the code given above for the previous exercise, add `[\hspace{5mm}Step 1.]` after the first `\begin{enumerate}` command and add `[i.]` after the second. (It is better to copy and paste the above code and create a second list with these changes. That will help you to see the changes clearly.) Now see how the same list has changed. The `\hspace` command is to indent the list from the left margin by the length given. Try using `a` or `A` instead of `i` and what happens.

7. We will now see a different kind of list, called *description*. This is often used to list things along with a description of the things. For instance, type the following in your document, compile it and see what you get:

```
\begin{description}
\item [Bhaskaracharya Pratishthana] A well-known institute in Pune
\item [SPACE] An NGO in Kerala promoting Free Software
\item [PLUG] The Pune GNU/Linux User Group
\end{description}
```

8. Remember that this environment does not create its own label. It gives a label only when we give one in square brackets. This makes it possible to create something like this:

```
\begin{description}
\item[\TeX] A typesetting program
\item[Emacs] A text editor and also
     \begin{description}
     \item a programming environment
     \item and a lot else besides
     \end{description}
\item[AbiWord] A word processor
\end{description}
```

After you check this out, give the following command before \begin{description} and see how the list changes:

```
\renewcommand{\descriptionlabel}[1]{\hspace{1cm}\textsf{#1}}
```

9. We would often want to put some text in a box. Let us see how we can do it in LaTeX. Try the following code:

   ```
   \framebox{I have been framed!}
   ```

10. Now try giving a long sentence or a paragraph within the framebox. (You can just copy and paste the above sentence several times.) How did the document turn out to be? In order to give a long sentence or a paragraph or even several paragraphs inside a box, you can use a `\parbox` command (literally, paragraph box) within the `\framebox` thus:

    ```
    \framebox{\parbox{4in}{If in the midst of the most serene day
    of summer, a thunderbolt were to fall from the clear blue vault
    of heaven, and rend the earth at the very feet of some careless
    traveller, he could not gaze at the smouldering chasm with half
    the astonishment and awe with which Sir Leicester beheld the
    Sovereign.}}
    ```

    If you don't want the frame to be seen, then simply use just the `\parbox` command alone. Note that `\parbox` requires a length given in braces. This is to specify the width of the box. (Remember to add or remove braces according to how you use the commands.)

11. You may sometimes want to show some LaTeX commands or programming code in your document. If you want to include LaTeX commands, they should not be seen as commands when you compile your document. For this, you can use the environment called `verbatim`. Like other environments, you begin and end verbatim with the `\begin` and `\end` commands. Whatever LaTeX code you write within will be shown in your document as text. The font will automatically change to typewriter font. You will see that this is ideal for printing the source code of programs also. Now try this. Place part of your LaTeX code within the verbatim environment. Be careful to see that the code that remains outside is consistent.

(*To find out more about lists and boxes, refer the* LaTeX Primer *provided as a pdf file.*)

Exercises in LaTeX
Session III: Mathematics

1. Let us create a simple equation in your document. Open your document in gedit and add the following:

```
The equation representing  a straight line in the Cartesian plane
is of the form $ax+by+c=0$, where $a$, $b$, $c$ are constants.
```

   Now compile the document and see what you get.

2. Now make a small change like the following and see what it gives:

```
The equation representing  a straight line in the Cartesian plane
is of the form $$ax+by+c=0$$, where $a$, $b$, $c$ are constants.
```

3. Now let us try something a bit more complicated. Add the following text in your document and compile it:

```
Fermat conjectured that there was no integral solution for the
equation $$x^n + y^n = z^n $$ when $n > 2$.
```

   Do you get something like this?

   Fermat conjectured that there was no integral solution for the equation
   $$x^n + y^n = z^n$$
   when $n > 2$.

4. How do we write the following?

   The sum of the squares of the first n natural numbers is
   $$S_n^2 = \frac{n(n+1)(2n+1)}{6}$$

   Add the following text to your document:

```
The sum of the squares of the first $n$ natural numbers is
$$ S_n^2 = \frac{n(n+1)(2n+1)}{6} $$
```

5. Now let us write the following and compile and see what it gives:

```
$$ \sum_{n=1}^\infty\frac{1}{n^2} = \frac{\pi^2}{6} $$
```

   You should get something like this:
   $$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

6. Let us see how to write definite integrals. Type the following exactly as it is in your document and guess what you should get when you compile it.

```
{\int_0^\infty\frac{\sin x}{x}dx=\frac{\pi}{2}}
```

   What did you get? Is it a familiar equation?

7. We will now write the following:

Thus, $\lim_{x\to\infty}\int_0^x \frac{\sin x}{x}dx = \frac{\pi}{2}$ and so, by definition,

$$\int_0^\infty \frac{\sin x}{x}dx = \frac{\pi}{2}$$

The source for this is as follows:

```
Thus,
$\mathrm{\lim\limits_{x\to\infty}\int_0^{x}\frac{\sin x}{x}dx
      =\frac{\pi}{2}}$
and so, by definition,
\begin{equation*}
 \mathrm{\int_0^\infty\frac{\sin x}{x}dx=\frac{\pi}{2}}
\end{equation*}
```

But this will give an error on compilation. This happens because the `equation*` environment is available only if you use the package amsmath. So, in the preamble, add the comand `\usepackage{amsmath}` and compile again.

8. We have seen how to write sum. Let us now see how to write product. Add the following source code to your document and compile it. See what you get. Could you guess the result?

```
$$ p_k(x)=\prod_{\substack{i=1\\i\ne k}}^n
\left(\frac{x-t_i}{t_k-t_i}\right) $$
```

9. We will now try to write a differential equation. Enter the source code given below:

```
$$ \frac{\mathrm d^2 u}{\mathrm d x^2} + \omega^2 u = 0 $$
```

Did you get the following on compilation?

$$\frac{\mathrm{d}^2 u}{\mathrm{d}x^2} + \omega^2 u = 0$$

We have to use the command `\mathrm` to ensure that the 'd' is typeset in straight roman font and not in italics. If you need to type several differential equations, it may be helpful to define a command, say `\diff`, for this purpose. This can be done by giving the command `\newcommand{\diff}{\mathrm d}` in the preamble.

10. We can write partial differential equations as follows:

```
$$\frac{\partial u}{\partial t}+t\frac{\partial u}{\partial x}=0$$
```

to get something like

$$\frac{\partial u}{\partial t} + t\frac{\partial u}{\partial x} = 0$$

and like this: `$$ \nabla^2\phi = 0 $$` to get:

$$\nabla^2\phi = 0$$

11. Now let us see how to create a report in LaTeX. Create a file containing the following:

```
\documentclass[a4paper,12pt]{report}
\usepackage[margin=1in]{geometry}
\usepackage{graphicx}
\title{\bf This is a dummy report}
\author{My name \\ My institute}

\begin{document}
\maketitle
\tableofcontents
\chapter*{Acknowledgements}
I thank everyone.

\chapter{Introduction}
\section{How it started}

Table below shows some useless data.
\begin{table}
\centering\begin{tabular}{rlp{35mm}}
\hline\hline
{\bf No.} & {\bf This} & {\bf That}\\
\hline
1. & something & something else \\
2. & something & something else \\
3. & something & something else \\
\hline\hline
\end{tabular}
\end{table}

\section{A New Section}
\subsection{This is a sub section}
blah blah blah

\chapter{The Work}
This chapter that describes the work that should have been done.

The figure  \ref{myfigure} below shows something.
\begin{figure}
\includegraphics[scale=0.5]{myfigure.jpg}
\caption{This is a figure}
\label{myfigure}
\end{figure}

\section{Another Section}
And life goes on and on ........

\end{document}
```

(*To understand more about creating mathematical expressions using LaTeX, refer* LaTeX Primer.)
