LATEX Tutorial

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Abstract—In this tutorial, I will go over the basics of LATEX its importance, why one should learn it and other general usages of it. LATEX is a professional documentation tool that engineers use to write up research papers, mathematically heavy documents and more.

Index Terms—CMPE185, LATEX Tutorial, IEEEtran, journal, LATEX, paper, template.

1 Introduction

THIS is a simple tutorial for using LATEXThis program is extremely useful for engineers and programmers because of the capability it has compared to Notepad or Word. LATEX has many applications and can create clean papers whether it be research, mathematics, computer science or many other STEM related fields. It is used to provide information in a formal manner, which seamlessly integrates functions, paragraphs and figures into one.

1.1 Why Will This be Helpful?

This tutorial will be helpful because of the applications LATEX has in the industry. The tutorial is a simple guide to teach the fundamentals of LATEX so that you can have a general idea of how to use it as well.

1.2 Why Should You Learn LATEX

When interviewing with companies, talking to investors or any other person, they will want to see what you have done or accomplished. LATEX is one of the best ways to formally present your work(s) compared to other text editing software such as Microsoft Word. While Word can reach a level of professionalism, it has its limits.

2 Creating a .tex File

2.1 Environments

Environments mark the start and end of the LATEX document. Environments can be defined in many ways such as by accepting parameters, numbering them or just creating and defining a new one with any specifics about them. The way to show that an environment begins is using the labels

```
\begin {} and \end{}
```

Inside the brackets you can name your document to whatever you like.

2.2 Reserved Characters

There are reserved characters in LATEX . This subsection will cover the general uses of them. The reserved characters are:

```
# $ % ^ & _ ~ \ {}
```

One of the ways \ is used to show the beginning of a command. The main function of the \ is the start of any command. This could be the beginning of a document, dividing the document into sections, and more. With the start of any command come the arguments, which is where { and } come in. These take in arguments such as ”verbatim”, or when creating a new document, ”document”.

The next character is the %, which is for commenting. Another reserved character is the ˜, which creates a non-breaking space. What this means is that it creates a space that is unbreakable (cannot be shortened or expanded).

Lastly we have the \\. The function of this one is pretty simple, it just creates a new line Like so:

Hello
Bob.

2.3 Preamble

The Preamble in LATEX is a very important part of the document. When creating the document, you first need to choose the type of document you want to create. In this specific case we are using IEEE so out document class would be:

```
\documentclass{IEEEtran}
```

What this does is help create your document to follow the IEEE transaction format.

Another thing that should be included in the LATEX document is the command "usepackage" which allows you to import add-ons that can allow you to manipulate and create different styles of text. For example, in the syntax below:

```
\usepackage{pgfplots}
```

This allows for easy plotting and drawing data in the document. After having all these added, you can begin the document with

```
\begin {document}
```

and

```
\end{document}
```

2.4 Title and Heading Information

With all the syntax required for creating the document, now we need the the Title, Author and Date of the document. To create these we need:

```
\title \{insert title}

\author{Insert Author name}

\date{Insert date}
```

The last thing we need to do is add the:

```
\maketitle
```

What this does is it creates a page for the title elements (title, author, and date).

3 Sections

Sections in LATEX are another important part of writing a document. Sections allow for the document to be divided up into parts about specific areas that need to be covered. Those sections can have subsections, and the subsections can have sub-subsections, and so on. This can help go into details about different sections, and divides the report in an organized manner like this document you are reading. To create sections and subsections we have the following syntax:

```
\section {Insert Section title}
\subsection{Insert Subsection title}
```

4 Body Text and Paragraphs

Similar to other word processing software and tools, LATEX uses bodies and paragraphs to group things that are related together. This is done by using the tag:

```
\paragraph {insert title}
```

and

```
\subparagraph{insert title}
```

Using sub-paragraphs are similar to subsections in LATEX. They both act as a way to assist in organizing information such as giving an example to a concept introduced in a normal paragraph. The concept definition would be a paragraph, while the example could be a subparagraph to make understanding easier for anyone reading the paper.

5 Tables

In LATEXwe can create tables to display all sorts of information. In this section we will cover how to do that.

5.1 Table and Tabular

When making a table, there are 2 things to use: Table and Tabular. The function of table is to create the table itself and the function of tabular is to create the lines that divide the rows and columns. The syntax for Table and Tabular are below:

```
\begin{center}
    \begin{tabular}{c|c}
         &
         &
    \end{tabular}
\end{center}
```

What this is doing is that it creates a centered table, and the tabular creates a 2 entry columns. You can then put whatever values you want between the "&" symbols.

5.2 Table Characters and Symbols

There are special characters when it comes to making tables, and those characters are:

`{l, c, r}, | (vertical bar),`

`\hline, and \\`

Let's start with the { l, c, r } which are for alignment options. "l" aligns the column to the left, "c" is for the center, and "r" is for the right.

The vertical bar has a fairly straightforward usage, it just inserts a vertical bar between the values, but it needs to specified in the "tabular" section.

\hline is to create a horizontal line so that you can display rows on your table

Lastly, we have \\ which is to create a new line. This was mentioned earlier when \ was first introduced, but it has the same function here as well. It is used to create a new line.

5.3 Entering Content and Creating a Table

Now that we have all of the information needed to create a table, we will make a small simple table.

5	26	3	64	300
1	2	3	4	3
3	3	456	4	4

For the table above, the syntax to create it is below. It's a fairly simple table, but it

```
\begin{center}
  \begin{tabular}{|l||c||c||c||r|}
    \hline
      5 & 26 & 3 & 64 & 300  \\ \hline
      1 & 2 & 3 & 4 & 3  \\ \hline
      3 & 3 & 456 & 4 & 4  \\ \hline
    \end{tabular}
\end{center}
```

6 Figures

Figures in LaTeX are very useful, and display valuable information for the reader.

6.1 Infographics

Using infographics to represent information emphasizes the point and makes the information that you are presenting more understandable as well. Infographics can be inserted using the command:

```
\includegraphics[graphic keys]
{file-name}
```

The "graphics keys" argument of the command takes in scaling measures such as width, height and a scale factor. The other argument is the file name, which is just the image that is being passed in. For the file argument to work, the image must be in the same directory as the .tex file so that it can reference it.

6.2 Titration Plot Example

Below is an example of using infographics. Below is the graph, and below the graph is the code to create the graph. The data is from the .pdf file provided. The data shows the pH levels grow steadily over time, however there is a spike that makes it increase rapidly and returns back to a steady increase rate.

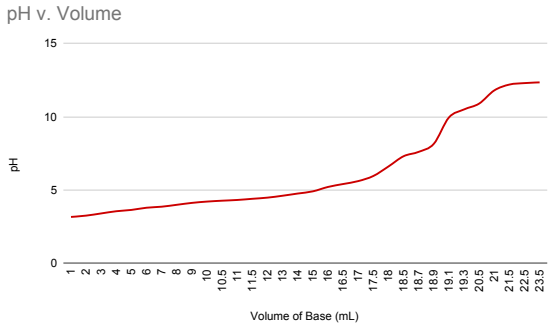

Fig. 1. Titration Plot Example

```
\begin{figure}
  \centering
   \includegraphics[width=3in]
   {pHvVolume.pdf}
   \caption{Titration Plot Example}
   \label{fig:plot}
\end{figure}
```

7 Mathematical Formulas

You can add formulas and math terminology in LaTeX, which is a common use for the software. Math terminology in LaTeX properly formats the equations in a clean manner.

7.1 Equation environments: In-Line vs. Display

In LaTeXthere are two ways to present mathematical formulas in a document: in-line and display. In-line means that the formula is in the line of the body of text, it doesn't need to make a new line for it to be inserted. It can be added and the sentence can continue on directly after that. Display means that we create a new line to show the function or formula. This is better when the formula is large and needs more space such that it is clearer for the reader of the document.

An example of in-line is the following.

The Pythagorean theorem is $a^2 + b^2 = c^2$.
As you can see the formula did not leave the text area, it stayed "in-line".

The next example is an example of display: Let's take an expression such as:

$$\sum_{i=1}^{10} t_i \tag{1}$$

This is display mode. As you can see the amount of space required is more so having in-line here would not be as ideal when presenting this summation.
The syntax to implement both of these is below:

In-Line:

```
$a^2 + b^2 = c^2$
```

Display:

```
\begin{equation}
\sum_{i=1}^{10} t_i
\end{equation}
```

7.2 Symbols

There are many symbols that can be used in LaTeXsuch as the basics:

```
+, -, *, ^, /, (), and []
```

Of course, there are greek letters that can be used as well which can be implemented as:

```
$\alpha$, $\beta$, $\gamma$ ...
```

And their alternative capital forms can be used by just capitalizing the word when using them. An example of using them (alpha, beta and Gamma): α, β, Γ

7.3 Fractions

Fractions in LaTeXis fairly simple. If we use:

```
$\frac{numerator}{denominator}$
```

And replace "numerator" and "denominator" with values or variables (n and m for this example), we will get: $\frac{n}{m}$ You can input whatever functions into the numerator and denominator to create any type of fraction you want.

7.4 Superscripts and Subscripts

Lastly we have superscripts and subscripts, which are also fairly easy to use. T use them all you need to do is:

```
^ : superscript
_ : subscript
```

This is what allows us to use and make formulas such as: $a^2 + b^2 = c^2$

8 How To: References

8.1 Bibliography

At the end of any document, we have to provide a list of references used to the reader. The way this is done is using:

```
\begin{bibliography}
\end{bibliography}
```

These commands are for labeling what will go in the bibliography, and will be used in the bibliography section towards the end of the document.

8.2 Label, Reference, Cite

Labels can come in handy because they are essentially a name you can provide to a marker such that, that object can be referenced later. The next thing is referring to an object. We can refer to an object using the code below. Lastly we have cite, which means that we can cite a source using the name from the Bibliography page. However, if not done properly, the citation will not work properly, so you have to be accurate while doing this. All the syntax for using these commands is below:
Label:

```
\label{object name}
```

Reference:

```
\ref{object name}
```

Cite:

```
\cite{name in Bibliography}
```

9 How To: Acknowledgements

Acknowledgements are for acknowledging the other parties involved in your paper. For example someone can list their friend, colleague, professor or even a company in the acknowledgements section. The way acknowledgements are done are:

```
\section*{Acknowledgement}
```

This allows us to list our acknowledgments without any numbering system, which is what the * does. Again, just like the Bibliography, there will be a separate section for my own personal acknowledgements towards the end of the document.

10 Conclusion

LaTeX is a super beneficial tool to pickup and learn. It gives people more freedom when creating and writing papers. LaTeX gives a professional aesthetic in the documents, something that other word processors cannot do such as Microsoft Word.

Acknowledgements

I would like to thank the internet for being a super resourceful guide on a lot of LaTeX syntax that I did not know how to do as well as Professor Moulds for the template.

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