A short introduction to LaTeX and it's importance

Damodar Rajbhandari

Out-reach Blogger at
www.physicslog.com

St. Xavier's College
Kathmandu, Nepal

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PHYSICS LOG

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Detail History

History back to Typography (eg: TeX) and Fonts:

A well-respected computer scientist Donald Knuth:

- Published "The Art of Computer Programming- Vol. 1"
- Typeset in metal-typesetting system.
- Publisher changed their printing technology into photo-typesetting.
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Issue:

- Letter wasn't position accurately.
- Some words are more darker than others.

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Issue:

- Letter wasn't position accurately.
- Some words are more darker than others.

In short, No quality control over the document.

Detail History

Inclined to think:

- During at Stanford, his community duty is to provide reading lists.
- Same time 1977, he got a gallery proof of the book "Artificial Intelligence" by Patrick Winston.

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  Trigger point:
- Prepared using the machine that was completely digital.
- It was typeset using pixels which encodes 0 and 1.
  Clue:
- High quality printing is the matter of computer program.
- He saw it as in the form of computer problems.

Detail History

Beginning of TeX:

- Created a digital typesetting system i.e. TeX
- Pronounce as: /'tɛx/ tekh or /'tɛk/ tek.
- Named from greek word $\tau\varepsilon\chi$ which means art as well as craft.
- In 1978, Shared his software within the Permissive software licence.
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Advantage:

- Gives extensive control of document layout.

Users using TeX:

- TeX users were growing and they extended the macros.

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Issue:

- Not easy to use !

Detail History

Invention of LaTeX:

- Date back to 1985, Leslie Lamport releases LaTeX to the modification of TeX.
- Aims to have a easy to use document preparation system.
- LaTeX = "Lamport's TeX"
- Pronounce as: /'la:tɛx/ LAH-tekh or /'leItɛk/ LAY-tek or /'la:tɛk/ LAH-tek
- Encloses with High Level Markup Language, which is syntactically distinguishable from the text.
- File extension: *.tex

Summary

TeX is all about formatting, for designers
&
LaTeX is all about content, for authors

Motivation

LaTeX is easy to learn.

Any questions so far?

Battle between "Word processor vs LaTeX"

Let's see, why some people started with word processor end up using LaTeX ?

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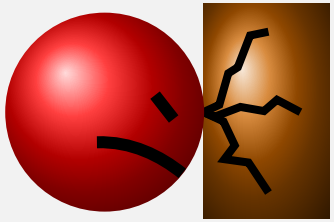

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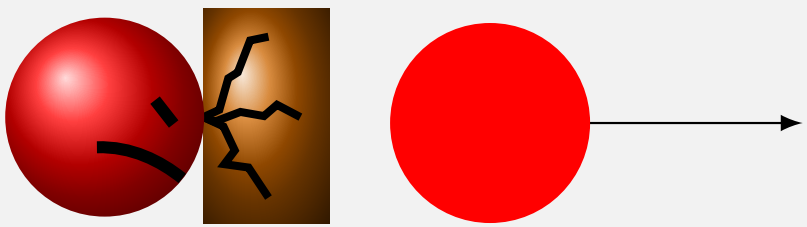

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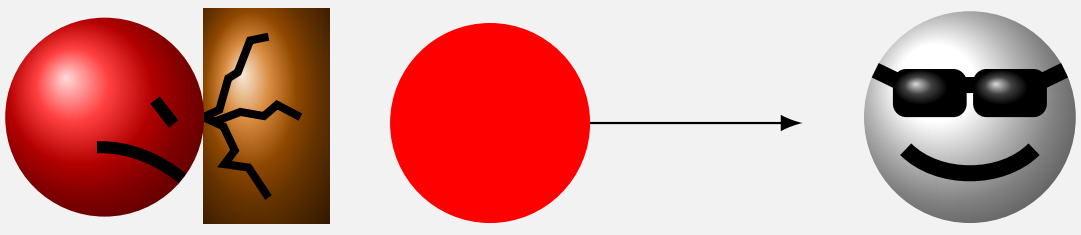

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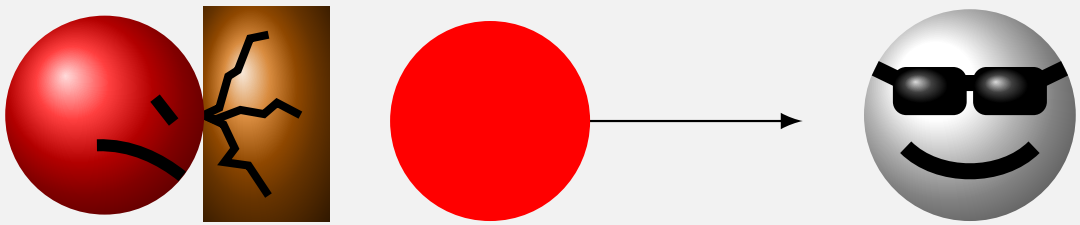

Reason?

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Stuffs	Office Word, 1983	LaTeX, 1985
Logo		
Handling Speed	Good for small docs	Good for large docs

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Logo		
Handling Speed	Good for small docs	Good for large docs
Layout quality	For general purpose it's okay!	Good for professional purpose
Good handling Table & Graphics	For Small number	For large number

Reason

Equations & Symbols	Time-consuming	Easy

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File Format	Binary	Plain-text

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File Format	Binary	Plain-text
Version Control System supports	No	Yes
Price	Proprietary Commercial Software	Free Software

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- It makes very simple to handle equations, figures, bibliography and index.

In short:

- High typographical quality of the document.
- LaTeX allows users to clearly separate the content from the format of the document.
- It gives user the opportunity to focus on "what" the creative part of your work, rather than "how" is it going to look when it get printed out.
- It makes very simple to handle equations, figures, bibliography and index.
- Programming kinda approach to putting the stuffs in the right place.

Lesson

When to use word processor? & When to use LaTeX?

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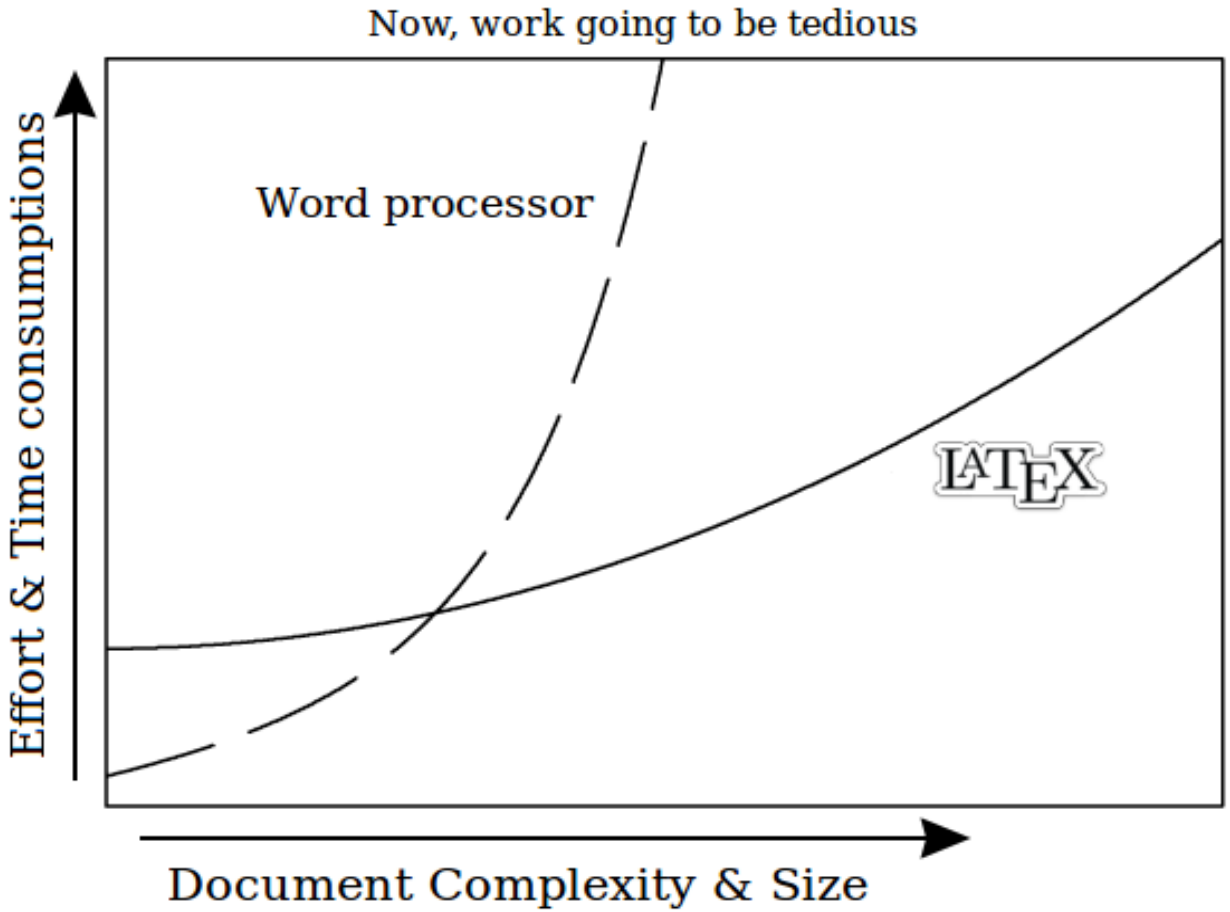
When to use word processor? & When to use LaTeX?



Motivation

LaTeX has more flexibility over your document and, powerful commands that makes your work easier and gives best results in least amount of time .

Any questions so far?

Setting up the LaTeX compiler and editor

For debian based Linux users:
With internet connection, just type the following commands one after another within the existing terminal:

- sudo apt-get install texlive-full
- sudo apt-get install texmaker

For Windows users:

- Click Download and install MiKTeX.
- Click Download and install Texmaker.

Understanding the *.tex document structure

```
\documentclass[Global parameter]{class.cls}
%[optional parameter]{calling design file}

%%%%%%%%%%%% Where we call necessary packages
% Preamble %        &
%%%%%%%%%%%% redefine commands
\usepackage{package_name}

\begin{document}
%%%%%%%%%%%%%%%%%%%
% Your contents! %
%%%%%%%%%%%%%%%%%%%

\end{document}
```

Understanding Document Type

- article : For short documents and journal articles. Commonly used!
- report : For longer documents and dissertations.
- book : Useful to write books
- letter : Useful to write letters
- beamer : For presentations

Knowing reserved characters

The following symbol characters have a special meaning:

Character	Funtion,	How to print it?
#	Macro parameter,	\#
$	Math mode,	\$
%	Comment,	\%
^	Superscript(in math mode),	\^{}
&	Seperate column entries in tables,	\&
_	Subscript(in $ $),	_
{}	Processing block,	\{\}
~	Use it whenever you want to leave a space which is unbreakable,	\~{}
\	Starting commands,	$\backslash$

Implementing our understanding using article.cls

```
\documentclass[a4paper, 12pt ]{article}

\usepackage[utf8]{inputenc} %Optional

\ title {CDT 1+1 D without preferred foliation}
\author{Damodar Rajbhandari}
\date{2017} %Skip date using \date{}

\begin{document}

\begin{titlepage}
\maketitle
\end{titlepage}
% Now, Start filling your contents!
\end{document}
```

Creating environment for specific use

```
...

\begin{document}
...
\begin{} %Fill environment in {}

%Created environment!

\end{}

\end{document}
```

Environments

Aligments:

- center
- flushleft
- flushright

Environments

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- flushright

Usefuls

- tabular*
- table*
- matrix*
- equation*
- minipage(small page within main page)
- verbatim(for inserting codes)
- itemize(helps to create item)
- figure*

* will be discussed it in more detail in the following section.

Useful commands

Here are the list of commands:

```
\textbf{bold} \textit{italic}
{\color{pick} text_here} %Changes the text color

\vspace{scale} %vertical spacing
               %for eg: scale = 1cm
\vspace*{scale} %for strictly follow this command!

\hspace{scale} %for horizontal spacing
\hspace*{scale}
```

Useful commands

```
\\ means line break
\noindent means no indentation in starting paragraph
\underline{text_here} gives underline to the text.

\textquotedblleft  creates double-quote left
\textquotedblright creates double-quote right

\chapter{}         creates chapter title
\section{}         creates heading
\section*{}        creates heading without labeling
\subsection{}      creates sub-heading
\subsubsection{}   creates sub-sub-heading
```

Useful commands

`\tableofcontents`	creates table of content
`\listoffigures`	list all the labelled figures.
`\listoftables`	list all the labelled tables.
`\newpage`	end up the page
`\pagenumbering{*}`	can change numbering style like arabic(1,2,...) to roman (I, II,...) by putting it instead of *

For maths commands, get it from the texmaker editor!

Any questions so far?

Importing images*

```
...
\usepackage{graphicx}
\graphicspath{{your_folder/}{../your_folder/}}
%put all the images in the "your_folder" and this folder
%is outside from the folder of your LaTeX file.
\begin{document}
...
\includegraphics[width = ?cm, height = ?cm]{?image}}

%if you like:
%[scale=?] %images in equal ratio in width & height
%[angle=?] %For eg: angle=45
\end{document}
```

*will not show in list of figures and cannot do cross-referencing!

Position specifier

Float* are used to contain contains things (i.e. tables and figures) that must be placed inside a single page.

```
Parameter                    Position
   h              [Place the float* here, i.e.
                  approximately at the same place
                  where command is defined]
   t              [Position at the top of the page]
   b              [Position at the bottom of the page]
   !              [Override the internal parameters
                  class file uses for determining
                  "good" float position]
   H              [Precisely place here, need float
                  package, equivalent to h!]
```

Exploration on inserting images

```
...
\begin{document}
\listoffigures
...
\begin{figure}[position specifier]

\includegraphics[width = ?cm, height = ?cm]{?image}}
\caption{?Will be shown in list of figures!}
\label{fig:?for cross-referencing}

\end{figure}
...\ref{fig:?for cross-referencing}
\end{document}
```

Some suggestions on graphics

- Use vector images(for eg. *.ps and *.pdf) rather than raster images(for eg. *.png) so that, the resolution is in good quality.

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  Vector images are created in drawing programs. This program uses points connected with curves or straight lines, like connect-the-dots. The advantage of using this images is that it is resolution independent.

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- Do not use spaces while naming the images.
- Choose file names that is specific and descriptive.

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  But, Raster or bitmapped images uses pixels to define images.
- Do not use spaces while naming the images.
- Choose file names that is specific and descriptive.
- Put all the images in one folder.

Any questions so far?

Understanding tables

Parameter	Meaning
l	left-justified column
c	centered column
r	right-justified column
|	vertical line
||	double vertical line
&	column separator
\\	start new row
\hline	horizontal line

Inserting table*

```
...
\begin{document}
...
\begin{tabular}{||c|c||}
\hline
Parameter & Meaning\\
\hline
l & left-justified\\
c & centered column\\
\hline
\end{tabular}

\end{document}
```

Output:

Parameter	Meaning
l	left-justified
c	centered column

*will not show in list of tables and cannot do cross-referencing!

Exploration on inserting tables

```
\begin{document}
\listoftables
\begin{table}[position specifier]
\begin{tabular}{||c|c||}
\hline
Parameter & Meaning\\
\hline
l & left-justified\\ %Not forgot to add \\ at the end
c & centered column\\
\hline
\end{tabular}
\caption{?Will be shown in list of tables!}
\label{table:?for cross-referencing}
\end{table}
... \ref{table:?for cross-referencing}
```

Any questions so far?

Creating Matrix

```
...
\usepackage{amsmath}
\begin{document}
...
$\begin{matrix}
a & b \\
c & d
\end{matrix}$
...
$
\begin{pmatrix}
a & b \\
c & d
\end{pmatrix}$
...
```

```
$\begin{bmatrix}
a & b \\
c & d
\end{bmatrix}
\quad
\begin{vmatrix}
a & b \\
c & d
\end{vmatrix}
\quad
\begin{Vmatrix}
a & b \\
c & d
\end{Vmatrix}
$ ...
```

contd.

Output:

$$\begin{matrix} a & b \\ c & d \end{matrix}$$

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

Any questions so far?

Inserting equation

```
...
\usepackage{amsmath} %important package

\begin{document}
...
\begin{equation} \label{eq:eg}

S = \frac{1}{8\pi G}\int d^{4}\times\sqrt{\det(g_{\mu\nu})}\
    left(\Lambda-\frac{1}{2}R\right)

\end{equation}
Equation \ref{eq:eg} is known as Einstein-Hilbert Action
    with no matter coupling.
% To do cross-referencing, we have used \ref{} command.
...
```

contd.

Output:

$$S = \frac{1}{8\pi G} \int d^4x \sqrt{\det(g_{\mu\nu})} \left(\Lambda - \frac{1}{2} R \right) \tag{1}$$

Equation 1 is known as Einstein-Hilbert Action with no matter coupling.

Exploration on inserting equation

```
...
\usepackage{amsmath} %mandatory package
\begin{document}
...
\begin{align}

S &= \frac{1}{8\pi G}\int d^{4}\times\sqrt{\det(g_{\mu\nu})}\
    left(\Lambda-\frac{1}{2}R\right) \\
%Useful character is &
&\ Leftrightarrow  \frac{1}{8\pi G}\sum_{j\epsilon T}\left( \
    Lambda\frac{\sqrt{5}}{4}a^{2}n_{j}(T)-\delta_{j}\right)

\end{align}
...
\end{document}
```

contd.

Output:

$$S = \frac{1}{8\pi G}\int d^4x\sqrt{\det(g_{\mu\nu})}\left(\Lambda - \frac{1}{2}R\right) \tag{2}$$

$$\Leftrightarrow \frac{1}{8\pi G}\sum_{j\epsilon T}\left(\Lambda\frac{\sqrt{5}}{4}a^2 n_j(T) - \delta_j\right) \tag{3}$$

contd.

```
...
\begin{align}
S &= \frac{1}{8\pi G}\int d^{4}\times\sqrt{\det(g_{\mu\nu})}\
    left(\Lambda-\frac{1}{2}R\right) \nonumber \\
%Useful command: \nonumber
&\ Leftrightarrow  \frac{1}{8\pi G}\sum_{j\epsilon T}\left( \
    Lambda\frac{\sqrt{5}}{4}a^{2}n_{j}(T)-\delta_{j}\right) \
    label{eg2}
%Useful command: \label{}
\end{align}
Thus, we have converted Einstein-Hilbert action in smooth
     manifold with no matter coupling into Regge action
    in discretized triangulated manifold (i.e. equation \
    ref{eg2}).
...
```

contd.

Output:

$$S = \frac{1}{8\pi G}\int d^4x\sqrt{\det(g_{\mu\nu})}\left(\Lambda - \frac{1}{2}R\right)$$
$$\Leftrightarrow \frac{1}{8\pi G}\sum_{j\epsilon T}\left(\Lambda\frac{\sqrt{5}}{4}a^2 n_j(T) - \delta_j\right) \quad (4)$$

Thus, we have converted Einstein-Hilbert action in smooth manifold with no matter coupling into Regge action in discretized triangulated manifold (i.e. equation 4).

Any questions so far?

Bibliography: Bibtex

We'll create bibliography using Bibtex rather than thebibliography environment(if you like, click how!). Here are the following steps:

- Create a new file in the texmaker.
- Click Bibliography menu Then, Bibtex.
- Choose which type of document you want to cite. For eg: "Article in Journal".
- Then, you will see like:

contd.

```
@Article{*, % this line * means label for citation.
author = {*},
title = {*},
journal = {*},
year = {*},
OPTkey = {*},   % OPT means optional
OPTvolume = {*}, %if you want to put volume then,
                 %remove OPT and make it volume = {*}
OPTnumber = {*}, %if you donot need these just remove it.
OPTpages = {*},
OPTmonth = {*}, %never forget "comma"
OPTnote = {*},
OPTannote = {*}
}
```

contd.

- Fill the information as:

```
@Article{cdt,
author = {Joshua H. Cooperman and Jonah M. Miller},
        %if there are more than two authors then,
        %add by putting "and" one after another.
title = {A first look at transition amplitude in (2+1)-
    dimensional causal dynamical triangulation},
journal= {Classical and Quantum Gravity},
volume= {31},
pages= {035012},
year= {2014}
}
```

Removed which are not used!

contd.

- Save it as ?bibfile.bib and should be within the same folder of your document's tex file.

```
\begin{document}
...\cite{cdt} %Creates citation!
...\citep{cdt} %creates citation with parenthesis!
...\citep{cdt,cdt} %creates multiple citation using comma

%if you want to put footnote then, use this command:
% \footnote{your_text_here!}

\ bibliographystyle {apa}
%choose another instead of apa, if you like!
\ bibliography {?bibfile}
\end{document}
```

contd.

- Now, compile it by clicking:

1. PDFLaTeX
2. BibTeX
3. PDFLaTeX
4. PDFLaTeX (this one is for sure!)

- Check the pdf.

Any questions so far?

How to install extra packages

Error: "class file" or "package file" not found.
Means: Package needs to be installed.
Steps:

[1] For linux users*:

- First, you need to have texlive-full installed.
- Know which file is missing by seeing in Message/Log of Texmaker.
- Open the terminal.
- Type: cd /usr/share/texlive/texmf-dist/tex/latex
- Make a directory to make your files organize as by typing: sudo mkdir ?package_dir
- Download & extract the package from Comprehensive TeX Archive Network(CTAN) or any resources.

contd.

- Copy the file, by typing:
  sudo cp /home/?username/Downloads/?package/?.sty ./?package_dir
  Don't copy *.bst. The bst file will go in the /bibtex/bst directory. And, it should be known that other files(i.e. *.tex, *.pdf, *.dvi) are likely documentation for the package.
- Update the filename database using the texhash command by typing: sudo texhash
  Messages about texhash updating, then done.

contd.

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- Update the filename database using the texhash command by typing: sudo texhash
  Messages about texhash updating, then done.

  Motivation: I just wanted to teach you some commands in linux terminal.

contd.

[*] Simplest way:

- Know which package is missing from the Message/Log of Texmaker.
- Download the required package and extract it.
- Put the ?.sty file inside the folder where your document source code ?.tex is in!
- Click Quick build in the texmaker!
- It will automatically install that package in the texlive package directory.
  I haven't yet got issue[1] while following this step!

[1] If you find issue then, shot me an email at `dphysicslog@gmail.com` and we will together solve that problem.

contd.

[2] For Windows users:

- Click *Windows key* and search *miktex package manager*.
- Open it and search the package you want!
  Need internet connection!
- Install it!

[2] FNDB means File Name Database

contd.

[2] For Windows users:

- Click *Windows key* and search *miktex package manager*.
- Open it and search the package you want!
  Need internet connection!
- Install it!
  But, if you have package downloaded then, follow the below steps:

[2] FNDB means File Name Database

contd.

[2] For Windows users:

- Click *Windows key* and search *miktex package manager*.
- Open it and search the package you want!
  Need internet connection!
- Install it!
  But, if you have package downloaded then, follow the below steps:
- Copy the package file and paste to the path Local disk C → Program Files → MiKTeX 2.9 → tex → latex → ?package_dir (create a folder)→ paste it here!
- Then, click *Windows key* and search *miktex settings(Admin)*.
- Open it and click *Refresh FNDB*[2] then, click *OK*.

[2] FNDB means File Name Database

Any questions so far?

List of useful packages*

- comment (helps to create multiline comment)*
- float (puts graphics in desired position)*
- imakeidx (Creates index)*
- nomencl (Creates list of abbreviations)*
- geometry (helps to modify the layout)
- hyperref (use to create hyperlink)
- fancyhdr (use to design header and footer)
- mathptmx (for Times New Roman)

* will be discussed it in more detail in the following section.

Package: comment

```
...
\usepackage{comment}
\begin{document}
...
\begin{comment}

Fill your comments!
For multi-line comments.

\end{comment}
\end{document}
```

Package: float

```
...
\begin{document}
\listoffigures
...
\begin{figure}[H]

\includegraphics[width = ?cm, height = ?cm]{?image}}
\caption{?Will be shown in list of figures!}
\label{fig:?for cross-referencing}

\end{figure}
...
\ref{fig:?for cross-referencing}
\end{document}
```

See wrapfig package for better handling the images.

Package: imakeidx

```
...
\usepackage{imakeidx}
\makeindex
\begin{document}

...\index{Quantum Gravity} Quantum Gravity...

\appendix
... %Creating any chapter refers to appendices

\ bibliographystyle {stylename}
\ bibliography {bibfile}

\printindex
\end{document}
```

Package: nomencl

```
\usepackage{nomencl}
\makenomenclature
\renewcommand{\nomname}{List of Abbrevations}
\begin{document}
...
\printnomenclature
%put the above command where you want to see list of
    abbrevations.
\newpage
...
CDT \nomenclature{CDT}{Causal Dynamical Triangulation} is
     one of the candidate of \nomenclature{QG}{Quantum
    Gravity} Quantum Gravity.
...
\end{document}
```

Understanding minor errors like:

- vbox message
- hbox message
- Missing $ inserted.
- ?package.file_extension (for eg: damodar.sty) file not found.

References

Here are the list of resources where i learned alot of things on LaTeX.

- ShareLaTeX
- TeX Stack Exchange
- Overleaf
- Wikibooks

Special thanks

I would to express my deep gratitude to my on-going cdt's supervisor Jonah Maxwell Miller for always inspiring me to do interesting things.

Special page

Dedication

To

My Late Father

who is in heaven

Special page

On a personal note, I would like to thank to my parents especially to my Uncle and Aunt, whose continued love, encouragement, best wishes, support, and belief in my abilities have made it possible for me to go from very mediocre student to a good standing student.

Foremost, thanks to Dipika and Swastika for being a part of my life. Without their emotional support upto now, i might never succeed to stand at this position.

Final words!!!

Assignment

Keep this presentation file[3] as a guide!
Create an empty LaTeX document and implement all the stuffs that you have learned today!

THANK YOU FOR YOUR KIND PATIENCE

[3] This presentation file is prepared using beamer LaTeX class. Find a copy of source code at `https://github.com/damicristi/latex` and presentation file at `https://physicslog.com/about-author`