

Basics of L^AT_EX: The de facto standard for publishing Mathematical Researches

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Introduction

- What is $\text{\LaTeX}$ (Quick History)
- The common question (Purpose)
- Example of a $\text{\LaTeX}$ output
- How it works

Introduction to various way to write $\text{\LaTeX}$

Getting Started

- Creating your first LaTeX document
- Section and Subsection
- Inserting lists
- Inserting images

Proper structuring of a $\text{\LaTeX}$ document

- Structure of a $\text{\LaTeX}$ document
- Using $\text{\LaTeX}$ Packages
- Inserting Mathematical equations
- Using $\text{\LaTeX}$ templates

Introduction

What is $\text{\LaTeX}$



- ▶ In 1978, Donald Knuths created $\text{\TeX}$ with the purpose of producing high-quality books (especially Scientific and Mathematics) with minimal effort.
- ▶ Then in 1980, Leslie Lamport needed to write $\text{\TeX}$ macros/shortcuts and thus from there $\text{\LaTeX}$ was born.
 - ▶ $\text{\LaTeX}$ uses $\text{\TeX}$ internally. $\text{\LaTeX}$ is essentially an expanded $\text{\TeX}$
- ▶ $\text{\TeX}$ and $\text{\LaTeX}$ are programming languages! In contrast to the competition (Microsoft Word / Pages / WPS Writer / LibreOffice Writer / Softmaker TextMaker) which are WYSIWYG (What you see is what you get) editors

Introduction

Purpose of learning $\text{\LaTeX}$ - Common Question



- Why should I go through the trouble of learning $\text{\LaTeX}$ if easier alternatives exist that produce a final document with similar quality?

Introduction

Purpose of learning $\text{\LaTeX}$ - Answers to the Common Question



- ▶ Why should I go through the trouble of learning $\text{\LaTeX}$ if easier alternatives exist that produce a final document with similar quality?
 - ▶ Quality and Complexity - If you are writing a short letter, or a school memo, then I can understand and say, YES it is not worth learning if we are writing simple documents
 - ▶ Academic Setting - If the text you need is highly complex, meaning it involves a lot of references, citations, figures, tables, cross-references and a bibliography, then it is highly worth it learning $\text{\LaTeX}$
 - ▶ Automatic Table of contents, figures and tables generation
 - ▶ Automatic Bibliography updating
 - ▶ Easier handling of sections and subsections
 - ▶ No need to worry about spacing as a proper template will take care of it for you

Introduction

Purpose of learning $\text{\LaTeX}$ - Beauty of $\text{\LaTeX}$



II. Least Action in Classical Mechanics.

1. The Concept of a Functional.

The mathematical concept of a functional will play a rather predominant role in what is to follow so that it seems advisable to begin at once by describing a few of the properties of functionals and the notation used in this paper in connection with them. No attempt is made at mathematical rigor.

To say F is a functional of the function $f(\sigma)$ means that F is a number whose value depends on the form of the function $f(\sigma)$ (where σ is just a parameter used to specify the form of $f(\sigma)$). Thus, $F = \int_{-\infty}^{\infty} f(\sigma)^2 d\sigma$ (1.1) is a functional of $f(\sigma)$ since it associates with every choice of the function $f(\sigma)$ a number, namely the integral. Also, the area under a curve is a functional of the function representing the curve, since to each such function a number, the area, is associated. The expected value of the energy in quantum mechanics is a functional of the wave function. Again, $F = g(0)$ (1.2) is a functional, which is especially simple because its value depends only on the value of the function $g(\sigma)$ at the one point $\sigma = 0$.

We shall write, if F is a functional of $f(\sigma)$, $F[f(\sigma)]$. A functional may have as its argument more than one function, or functions of more than one parameter, as,

$$F[x(t,s), y(t,s)] = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} X(t,s) Y(t,s) \sin w(t-s) dt ds.$$

A functional $F[f(\sigma)]$ may be looked upon as a function of an infinite number of variables, the variables being the value of the function $f(t)$ at each point σ . If the interval of the range of σ is divided up into a large number of points σ_i , and the value of the function at these points is $f(\sigma_i) = g_i$, say, then

8.

II. Least Action in Classical Mechanics

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Figure: Comparison between an original thesis paper and a transpiled output



Generating output via $\text{\LaTeX}$ is commonly done via this flow.

- ▶ First write $\text{\LaTeX}$ code from your editor of choice
- ▶ Run the $\text{\LaTeX}$ compiler to convert that $\text{\LaTeX}$ code to $\text{\TeX}$
- ▶ Run the $\text{\TeX}$ compiler to convert the $\text{\TeX}$ code to output of choice (PDF)

So this means when starting out with $\text{\LaTeX}$ you need to have the following tools:

1. Editor
2. $\text{\LaTeX}$ compiler (Note: $\text{\TeX}$ editor is normally bundled on $\text{\LaTeX}$ compilers)
3. PDF viewer (usually a web browser can also do this now, or if it is a dedicated $\text{\LaTeX}$ editor, it has one bundled too)

Installation

Orientation of my recommended editors



There are plenty of ways you can write $\text{\LaTeX}$ documents. There is a ton of $\text{\LaTeX}$ editor that produces the same output. However here are my top personal recommendations

1. TexMaker - Cross-platform standalone $\text{\LaTeX}$ editor.
<https://www.xm1math.net/texmaker/download.html>
2. TexStudio - Another cross-platform standalone $\text{\LaTeX}$ editor.
<https://www.texstudio.org/#download>
3. Overleaf - Web based $\text{\LaTeX}$ editor.
<https://www.overleaf.com/register>

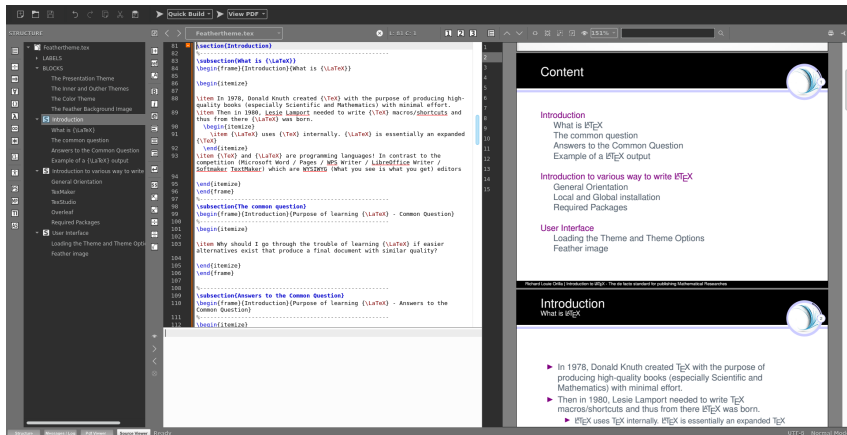
In our case, we will be using Overleaf as it provides us the following advantages.

- ▶ No need to setup $\text{\LaTeX}$ packages as it is already available on the fly
- ▶ Consumes less resources when using a normal $\text{\LaTeX}$ setup. Also ideal for non-powerful computers.

Only disadvantage is it un-useable when there is no internet.

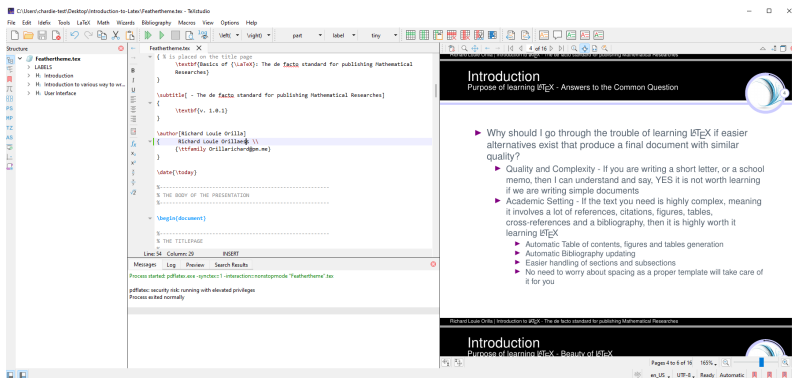
Installation

TexMaker



Installation

TexStudio



Installation

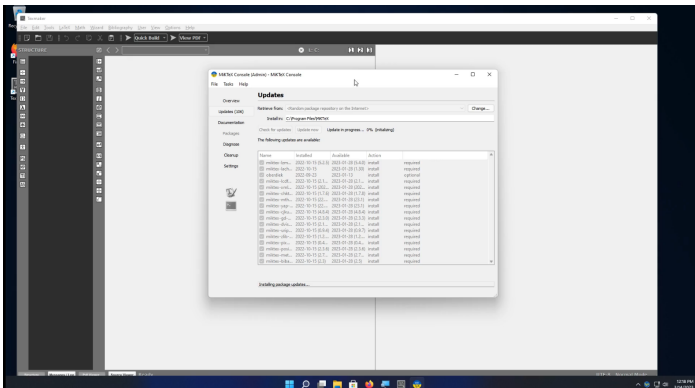
Overleaf



The screenshot displays the Overleaf web editor interface. The top navigation bar includes 'Menu', 'Upgrade', 'Introduction to LaTeX', 'Recompile', 'Review', 'Share', 'Submit', 'History', 'Layout', and 'Chat'. The left sidebar shows a file explorer with a tree view containing 'Feathergraphics', 'beamercolorthemeFeathe...', 'beamerinnerthemeFeathe...', 'beamerouterthemeFeathe...', 'beamerthemefeathersty', 'Feathertheme.nav', 'Feathertheme.pdf', 'Feathertheme.som', 'Feathertheme.tex', 'feynmann_mod.png', and 'feynmann_org.png'. Below this is a 'File outline' section with a 'Content' tab and a list of sections: 'Introduction', 'What is LaTeX', 'The common question', 'Answers to the Common...', 'Introduction', 'Example of a LaTeX ou...', 'Introduction', 'Introduction to various way...', 'Source files', and 'Installation'. The main editor area shows the source code of 'Feathertheme.tex' with line numbers 63 to 202. The code includes LaTeX commands for document structure, title page, and content. The right sidebar shows the rendered output of the document, titled 'Content'. It features a dark header with the 'Content' title and a circular logo. The main content area lists sections: 'Introduction' (What is LaTeX, The common question, Answers to the Common Question, Example of a LaTeX output), 'Introduction to various way to write LaTeX' (Source files, Local and Global installation, Required Packages), and 'User Interface' (Loading the Theme and Theme Options, Feather image). A footer note states: 'Richard Louie Orilla - Introduction to LaTeX - The de facto standard for publishing Mathematical Researches'. The bottom of the rendered output shows the 'Introduction' section with the text: 'What is LaTeX' and a paragraph starting with 'In 1978, Donald Knuth created TeX with the purpose of producing high-quality books (especially Scientific and Mathematics) with minimal effort.'

Installation

Setup video



Video: [Download here](#) -

<https://drive.proton.me/urls/SCAJ6DQZ7R#q1CcwwY78flk>



Your first $\text{\LaTeX}$ file

1. Click on Create New Project
2. Click on Blank Project
3. In the dialog box, name your New Project "My First Project"
4. Edit the `main.tex` with this content

```
1 \documentclass{article}
2 \begin{document}
3   Hello World!
4 \end{document}
```

Getting Started

Parts of the $\text{\LaTeX}$ code



**Command
name**

Option/Value

```
1 \documentclass{article}  
2 \begin{document}  
3   Hello World!  
4 \end{document}
```

1. $\text{\LaTeX}$ commands are composed with a command name and an optional option/value
2. Some commands have specific rules, like `begin` must have an `end`
3. One dead giveaway for commands is that it always starts with a `\`

Getting Started

Section and Subsection



```
1 \documentclass{article}
2 \begin{document}
3
4 \section{Section 1}
5 \subsection{Subsection 1}
6 This is a sample text inside section 1 subsection 1
7
8 \subsection{Subsection 2}
9 This is a sample text inside section 1 subsection 2
10
11 \section{Section 2}
12 \subsection{Subsection 1}
13 This is a sample text inside section 2 subsection 1
14
15 \subsection{Subsection 2}
16 This is a sample text inside section 2 subsection 2
17
18 \end{document}
```



Some points to consider

1. Sections and subsections, unlike `\begin`, it does not require to have a partner such as `\end`
2. They work in such a way that it acts as a separator of that particular line of the $\text{\LaTeX}$ document
3. There are several commands that act like this such as `\item` from `enumerate` and `itemize`



1. To insert a list with numbers, you use the `\begin{enumerate}` command
2. Then on the next subsequent lines, you add items in the list with the use of the `\item` command
3. Note: Since you use `\begin`, then you must also use `\end` after you list down every item inside an enumerated list.

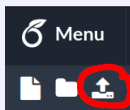
```
1 \documentclass{article}
2 \begin{document}
3   \begin{enumerate}
4     \item Item 1
5     \item Item 2
6   \end{enumerate}
7 \end{document}
```



1. On the other hand if you want to use a list with bullets instead of numbers, you use the `\begin{itemize}` command
2. Then on the next subsequent lines, you add items in the list with the use of the `\item` command
3. Note: Since you use `\begin`, then you must also use `\end` after you list down every item inside an itemized list.

```
1 \documentclass{article}
2 \begin{document}
3   \begin{itemize}
4     \item Item 1
5     \item Item 2
6   \end{itemize}
7 \end{document}
```

1. To insert an image, we must first import the package `graphicx` `\usepackage{graphicx}` command
2. We insert these import statements after `\documentclass{article}` but before `\begin{document}`
3. Ofcourse before we can proceed we must first download an image and upload it to Overleaf. In our case we will use an eagle image hosted in my website
4. After downloading the image, upload it to Overleaf by pressing the upload button, it is the icon with an arrow pointing up, located at the upper left side of the app, just below the Menu button





1. To make our lives easier, we will tell Overleaf to download the image for us, so on the dialog page, click From External URL
2. Input `https://www.richardorilla.website/images/eagle.png` in the URL to fetch the file from field
3. Then press create

Add Files ×

- New File
- Upload
- From Another Project
- From External URL**
- From Mendeley
- From Zotero

URL to fetch the file from

`https://www.richardorilla.website/images/eagle.png`

File Name In This Project

`eagle.png`

Cancel **Create**



1. Now that we have uploaded the image, we will now apply the following code

```
1 \documentclass{article}
2 \usepackage{graphicx}
3 \begin{document}
4   \includegraphics[scale=1]{eagle.png}
5 \end{document}
```

Proper structuring of a $\text{\LaTeX}$ document

Proper Structure of a $\text{\LaTeX}$ document



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1. All $\text{\LaTeX}$ documents must have a defined `\documentclass` and must have a `\begin` and `\end{document}`
2. Imported packages using the `\usepackage` command must be inserted after the `\documentclass` and before the `\begin{document}`. This is called a preamble
3. Anything else must be inside the document command

```
1 \documentclass{class}
2 ... your preamble goes here ...
3 \begin{document}
4 ... your text goes here ...
5 \end{document}
```

Getting Started

Proper Structure of a $\text{\LaTeX}$ document



```
1 \documentclass{article}
2 \usepackage{graphicx}
3
4 \begin{document}
5   \includegraphics[scale=0.5]{eagle.png}
6   \section{Birds}
7   Birds are a group of warm-blooded vertebrates constituting the class Aves
8   \subsection{Paleognathae}
9   The Paleognathae, or "old jaws", are one of the two superorders recognized within
10  the taxonomic class Aves and consist of the ratites and tinamous.
11  \subsubsection{Struthioniformes}
12  This is a subsection inside a subsection!
13  \subsection{Neognathae}
14  Nearly all living birds belong to the superorder Neognathae or "new jaws".
15
16  \section{2nd Section}
17  \subsection{Subsection 1}
18  This is a sample text inside section 2 subsection 1. This contains an enumerated list
19  \begin{enumerate}
20    \item Number 1
21    \item Number 2
22  \end{enumerate}
23
24  \subsection{Subsection 2}
25  This is a sample text inside section 2 subsection 2. This contains an itemized list
26  \begin{itemize}
27    \item Number 1
28    \item Number 2
29  \end{itemize}
30
31 \end{document}
```

Activity

Create a $\text{\LaTeX}$ document that has the following:

1. Your name (no family name, can be nickname only)
2. A little information about yourself (Do not over-share)
 - 2.1 Your favorite "something" (Can be a show or a genre)
 - 2.2 Something interesting that you know off / Can be based on your favorite "something"
3. Write something about your impressions with $\text{\LaTeX}$
4. You need to apply the following
 - 4.1 Section and Subsections
 - 4.2 Lists (Both enumerated and listed)
 - 4.3 Images

Note: To add emphasis to a particular words and paragraphs, you can use `\textbf{Bold Text}`, `\textit{Italicize Text}` and `\underline{Underline Text}`



1. $\text{\LaTeX}$ packages are premade $\text{\LaTeX}$ documents that aims to extend the existing functionalities that $\text{\LaTeX}$ already offers.
2. This can be done by utilizing the `\usepackage` command
3. Recall that we use the `\usepackage` command in our code earlier to insert an image, specifically the `\usepackage{graphicx}` command
4. Packages are not preinstalled by default as they are not part of the built-in functionality that $\text{\LaTeX}$ provides however for Overleaf, all packages at <https://www.ctan.org/pkg/> are already predownloaded, while on MikTeX, it is downloaded on demand after building the PDF for the first time after the `\usepackage` has been inserted

Proper structuring of a $\text{\LaTeX}$ document

Inserting Mathematical equations



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1. $\text{\LaTeX}$ has extensive support for mathematical font types
2. However we will also use an external $\text{\LaTeX}$ package, we will use `amsmath`
3. Mathematical equations are wrapped with the commands `\[` and `\]` (Math mode) or `\(` and `\)` (Inline)
4. For example, the pythagorean theorem $x^n + y^n = z^n$ is written as `\[ x^n+y^n=z^n\ ]`
5. I recommend testing your equations on this <https://latex.codecogs.com/eqneditor/editor.php> page

```
1 \documentclass{article}
2 \usepackage{amsmath}
3
4 \begin{document}
5
6 This is display math mode
7 \[ \text{Result} = p + \sum_{i=0}^n f(x) \]
8
9 Here is way of applying summation equation but is written differently.
10 In this setup, we use inline : Result \(\displaystyle p + \sum_{i=0}^n f(x)\)
11
12 \hfill
13
14 If you want the limits to be written exactly as what it looks like in display math mode, then we
15 use this setup instead: Result \(\displaystyle p + \sum\limits_{i=0}^n f(x)\)
16 \end{document}
```

Proper structuring of a $\text{\LaTeX}$ document

Using $\text{\LaTeX}$ templates



1. $\text{\LaTeX}$ templates are predefined projects purposely made empty on section parts to be filled out for future use
2. Despite $\text{\LaTeX}$ being tedious as experienced first hand, templates and packages are the reason why $\text{\LaTeX}$ is very well alive and being used in the industry even today
3. Overleaf has a huge section of templates to choose from which you can find here <https://www.overleaf.com/latex/templates>
4. For those planning to use the offline version of $\text{\LaTeX}$, You can select a template at Overleaf, create a new document using this template (by pressing the Open as Template button) and then downloading the project

Thoughts and Conclusions

An abstract graphic on the right side of the slide. It features a large, semi-transparent sphere in the center, with several flowing, ribbon-like lines in shades of blue and white curving around it. The lines have a sense of motion, as if they are being swept or blown by a breeze. The overall effect is dynamic and artistic.

An abstract graphic consisting of several flowing, curved lines in shades of light blue and white, resembling a stylized wave or a dynamic swoosh. The lines are layered and have a soft, ethereal quality, with some small white dots scattered along their paths. The graphic is positioned on the right side of the slide, partially framing the text.

Thank you for listening, if you have any other questions you can reach me out at richard.orilla@protonmail.com