Introduction to LaTeX and GIT

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Abstract

LaTeXis a document preparation system for high-quality typesetting used for medium-to-large technical or scientific documents, however, it can be used for almost any form of publishing. It is technically not a word-processor, rather its main purpose is to make sure the appearance of the document is automatically taken care of without the supervision of the author.

LaTeX automatically makes your document beautiful and organized

1 LaTeX vs. Word processors

Using a word-processor (MS Word, LibreOffice, Pages etc.) only makes sense while writing short documents and get the output quickly. For larger documents with many cross-references, equations, figures and tables, LaTeX makes things easier and faster. Fig. 1 is a nice demonstration to show the complexity and effort necessary for writing documents using MS Word and LaTeX[1]. All journals provide LaTeX template for writing manuscripts in their specific formats. Since all the initial document set up is provided, writing manuscripts using LaTeX exceptionally easy and less time-consuming. Marquette university also have a LaTeX template for Ph.D. and MS thesis, available at: https://ctan.org/tex-archive/macros/latex/contrib/mugsthesis

LaTeX is well suited for writing complex documents with cross-references, equations, figures and tables efficiently.

2 Writing Equations using LaTeX

Managing equation in word processor is really challenging and time-consuming. Writing equations in LaTeX is exceptionally easy and intuitive. In LaTeX, equations are easy to create and edit. Both PowerPoint and Word now have equation editors that allow for LaTeX (see Fig. 2).

There are several methods for writing equation in LaTeX, i.e. inline, aligned, equation, gathered etc. The basic LaTeXmarkup for writing equations is shown in Fig. 3.

Equations can be written in line math such as $a^2 + b^2 = c^2$. One can also give equations their own space (Equation 1). The equations can be as complex as you want them to be ((Equation 2))

$$\gamma^2 + \theta^2 = \omega^2 \tag{1}$$

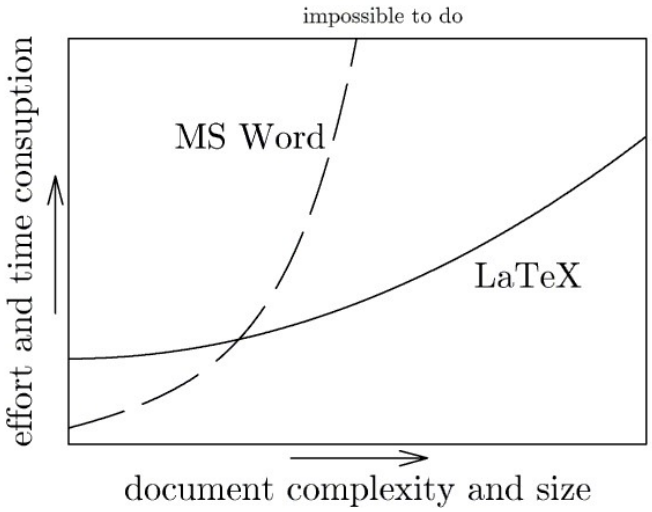

Figure 1: Word Processors vs. LaTeX

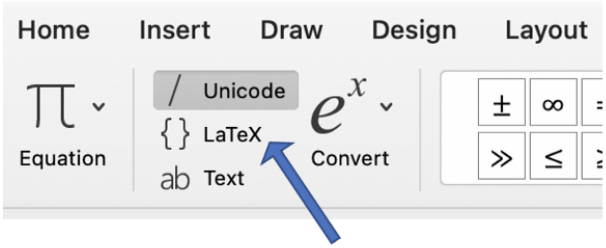

Figure 2: LaTeX style equation editor in PowerPoint

LaTeX markup...	...results in:
`A_\infty + \pi A_0`	$A_\infty + \pi A_0$
`\mathbf{A}_\mathbf{\infty} \mathbf{+} \mathbf{\pi} \mathbf{A}_ \mathbf{0}`	$\mathbf{A}_\mathbf{\infty} \mathbf{+} \mathbf{\pi} \mathbf{A}_ \mathbf{0}$
`\mathbf{A}_{\boldsymbol{\infty} } \boldsymbol{+} \boldsymbol{\pi} \mathbf{A}_{\boldsymbol{0} }`	$\mathbf{A}_{\boldsymbol{\infty} } \boldsymbol{+} \boldsymbol{\pi} \mathbf{A}_{\boldsymbol{0} }$
`2\alpha x^2yz+5`	$2\alpha x^2yz+5$
`\mathbf{2\alpha x^2yz+5}`	$\mathbf{2\alpha x^2yz+5}$

Figure 3: LaTeX style equation markup example

$$\mathcal{L}_{\mathcal{T}}(\vec{\lambda}) = \sum_{\mathbf{x},\mathbf{s}\in\mathcal{T}} \log P(\mathbf{x}|\mathbf{S}) - \sum_{i=1}^{m} \frac{\lambda_i^2}{2\sigma^2} \tag{2}$$

You can be really creative with how you want to present your equation sets (3 and 4)

$$\begin{aligned} x &= y & w &= z & a &= b + c \\ 2x &= -y & 3w &= \frac{1}{2}z & a &= b \\ -4 + 5x &= 2 + y & w + 2 &= -1 + w & ab &= cb \end{aligned} \tag{3}$$

$$\begin{aligned} f(x_1, x_2, x_3) =& f_0 m_0 \vee f_1 m_1 \vee f_3 m_3 \vee \\ & \vee f_4 m_4 \vee f_5 m_5 \vee f_6 m_6 \vee f_7 m_7 \\ =& 0 m_0 \vee 1 m_1 \vee 0 m_3 \vee \\ & \vee 1 m_4 \vee 0 m_5 \vee 0 m_6 \vee 1 m_7 \end{aligned} \tag{4}$$

LaTeX provides the fastest way to write complex mathematical equation with symbols, subscripts and superscripts

3 Building Tables with LaTeX

Building tables using LaTeXis done using the "Tabular" environment. If the table becomes large and complex, it gets tricky to manage. I usually use a website: `https://www.tablesgenerator.com/latex_tables` which is an excellent tool for generating LaTeX code for large and complex tables. For demonstration, Table 1 is generated using the abovementioned website as shown in Fig. 4.

Table 1: A Sample Table

11	12	13	Merged
21	22	23	Column
31	32	33	

4 Citation Management in LaTeX

LaTeX citation management is effortless. All the citations can be kept in a separate file (in this case "refs.bib") in bibtex format. Every time, a citation is required, we just write \cite{key used in .bib file}. For example, Mukut et. al. [2] or Claydon et al. [3]. All the citations used in the document will be summarized at the end of the document.

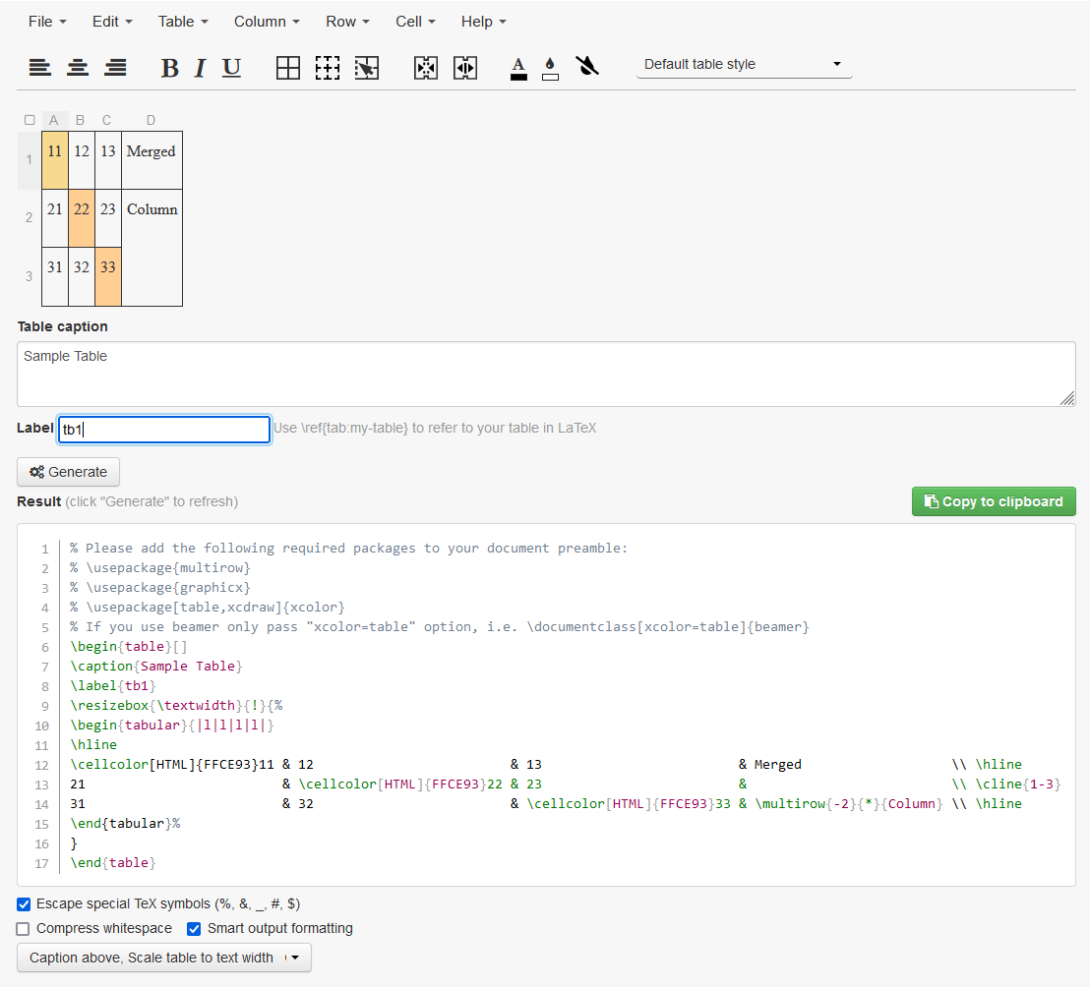

Figure 4: Demo of LaTeX table generation

5 List of Contents, Figures and Tables

Creating list of Contents, Figures and Table is really easy in LaTeX

Contents

List of Figures

List of Tables

6 How can we use LaTeX

LaTeX is an open-source tool which is freely available in all platforms. You can use any one of the following:

1. For Windows: `MiKTeX, proTeXt or Tex Live`
2. For Linux: `Tex Live`
3. For MacOS: `MacTex`
4. From Online: `Papeeria, Overleaf, ShareLaTex, Datazar, and LaTeX base`

I personally use the offline version of LaTeX alongside with a text editor called VSCode

7 A Short Introduction to `GIT`

`GIT` is a version control system (VCS) for tracking changes in a project. This is a widely used tool for managing large-scale programs like Linux kernel, but it can also be used for smaller scale projects like your own programming projects, homework, assignments, papers, or thesis. `GIT` is freely available in all platform. There are several online platforms which let you maintain a cloud repository for better collaboration and safety (`GitHub, GitLab etc.`). `GitHub` is the most popular of them all.

7.1 `GIT` Workflow I Use for LaTeX

1. Set up the working directory as a `GIT` repository (enable version control)
2. Make a cloud version of the repository using your favorite `GIT` server, i.e. `GitLab`, `GitHub` etc.
3. Maintain separate branches for the master version, and any collaboration.
4. Work on my computer on my specific branch and when done use the following command:

```
git add <any new files that has been created>
git commit -a -m <specific message for the new updates>
    ==> This will update the current state of the branch
git checkout <The main/master branch>
    ==> go to the main/master branch
git merge <the branch I am working in>
    ==> update the main/master branch with my edits
git push
    ==> This will sync the cloud repository in GitHub or GitLab
```

5. My collaborator will do the following:

```
git pull
    ==> get the updates from the cloud repository
git merge <his/her working branch>
    ==> sync the main/master branch to their working branch

Edit/review the project, add comments, etc.

git add <any new files that has been created>
git commit -a -m <specific message for the new updates>
    ==> This will update the edits in their local repository
git checkout <The main/master branch>
    ==> go to the main/master branch
git merge <the branch the collaborator is working in>
    ==> update the main/master branch with the collaborator's
edits
git push
    ==> This will sync the cloud repository in GitHub or GitLab
```

6. go back and forth between 4 and 5 until the final version is ready.

References

[1] Contrasting Microsoft Word and LaTeX, April 2020. [Online; accessed 15. Sep. 2022].

[2] Khaled Mosharraf Mukut, Somesh Roy, and Eirini Goudeli. Molecular arrangement and fringe identification and analysis from molecular dynamics (MAFIA-MD): A tool for analyzing the molecular structures formed during reactive molecular dynamics simulation of hydrocarbons. *Comput. Phys. Commun.*, 276:108325, July 2022.

[3] I. Claydon, M. Gieles, and A. Zocchi. The properties of energetically unbound stars in stellar clusters. MNRAS, 466:3937–3950, May 2017.