Latex & Markdown

Introdução Engenharia Informática

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LaTeX & Markdown

Document Generation Paradigms i

1. **WYSIWYG (What You See Is What You Get)**
   - **Examples:** Microsoft Word, Google Docs, LibreOffice Writer.
   - **Concept:** The editing interface is a mirror of the final print output.
   - **Mechanism:** Direct manipulation. Formatting (bold, size, font) is applied directly to text characters.
   - **Pros:** Low barrier to entry; immediate visual feedback.
   - **Cons:** "What You See Is All You've Got."
     - Content is tightly coupled with presentation.
     - Moving a generic "Header" to a "Chapter Title" requires manual reformatting.
     - Complex documents (theses, books) often break formatting when moved between computers or versions.

Document Generation Paradigms ii

2. **WYSIWYM (What You See Is What You Mean)**
   - **Examples:** LaTeX, Markdown, HTML, AsciiDoc.
   - **Concept:** You edit the **semantic structure** (meaning), a compiler handles the **visual presentation**.
   - **Mechanism:** Separation of concerns.
     - *Source:* Plain text (`.tex`, `.md`) containing content and logical tags (e.g., `\section`, `# Heading`).
     - *Engine:* A compiler (e.g., `pdflatex`, `pandoc`) applies a specific style template to generate the output (PDF, HTML, EPUB).
   - **Pros:** Consistency, automation, superior typography.

The Value of Compiled Documents i

Why learn a complex syntax when Word exists?

A. Repository Usage (Git)

- **Text vs. Binary:** Word files (`.docx`) are zipped XML binaries. Version control systems (Git) treat them as "blobs." You cannot meaningfully diff them.
- **Line-by-Line Tracking:** In LaTeX/Markdown, you can track changes down to the specific character and see the commit history.
- **Branching:** Ideal for experimenting with a new chapter structure without breaking the main document.

The Value of Compiled Documents ii

B. Collaboration

- **No “File Locked” Issues:** Unlike opening a `.docx` on a network drive, multiple people can edit different text files in a project simultaneously.
- **Merging:** Git allows merging different text files automatically.
- **Modularity:** Large documents are split using `\input{chapter1.tex}`, keeping files small and manageable.

The Value of Compiled Documents iii

C. Migration & Templates

- **Abstraction:** In WYSIWYM, you tag text as “Title” or “Abstract”. You do not choose font size or margins manually.
- **Content Portability:**
  - *Scenario:* You write a thesis. Later, you want to publish a chapter as a conference paper.
  - *Action:* Change `\documentclass{thesis}` to `\documentclass{ieee-conf}`.
  - *Result:* The entire document is reformatted (fonts, columns, citations) instantly. No manual reformatting required.

LaTeX

Deep Dive: LaTeX i

LaTeX is the industry standard for scientific and technical communication. It is practically Turing-complete.

Document Structure

A LaTeX file (`.tex`) has two distinct parts:

1. **The Preamble:** Everything *before* `\begin{document}`.
   - Defines the "Class" (style).
   - Loads "Packages" (plugins for extra features like images, colors, links).
   - Sets global parameters (margins, meta-data).
2. **The Body:** The content environment inside `\begin{document} ... \end{document}`.

Deep Dive: LaTeX ii

Key Entities

- **Classes:**
  - `article`: Scientific papers, short reports.
  - `report`: Longer documents with chapters (theses).
  - `book`: Books with front/back matter support.
  - `beamer`: For creating presentation slides.
- **Environments:**
  - Blocks of logic defined by `\begin{name} ... \end{name}`.
  - *Examples:* `itemize` (lists), `equation` (math), `tabular` (tables), `center`.
- **Floats (Figures & Tables):**
  - LaTeX decides where to place images (`\begin{figure}`) for optimal reading flow.

Deep Dive: LaTeX iii

Usage & Compilation

- **CLI:** `pdflatex main.tex` (Single pass).
- **The 3-Pass Rule:** Often requires running 3 times to sync references (Pass 1: Collect labels; Pass 2: Assign numbers; Pass 3: Fix layout).
- **Automation:** `latexmk -pdf -pvc main.tex` (Watches for file changes, handles cross-references automatically).
- **Cloud: Overleaf**. A browser-based editor that manages the compiler installation for you.

Markdown

Deep Dive: Markdown i

Markdown is a lightweight markup language designed for readability.

Philosophy & Syntax

The goal is that the raw source file should be readable as plain text without looking like computer code.

- **Headers:** # for H1, ## for H2 (translates to <h1>, <h2>).
- **Lists:** – or * for bullets; 1. for numbered.
- **Formatting:** **Bold** (<b>), *Italic* (<i>), `Code`.
- **Links:** [Text](URL).
- **Images:** ![Alt Text](URL).

Deep Dive: Markdown ii

Flavors & Extensions

Markdown has evolved into several “Flavors”:

- **CommonMark:** The standardized specification.
- **GFM (GitHub Flavored Markdown):** Adds tables, task lists (`- [ ]`), and strikethrough.
- **Pandoc Markdown:** The most powerful version. Adds citations (`@author`), footnotes (`[^1]`), metadata blocks, and math support.

Deep Dive: Markdown iii

Usage (Pandoc)

Pandoc is the "Universal Converter". It reads Markdown and outputs almost anything.

- **Logic:** Markdown $\rightarrow$ Abstract Syntax Tree (AST) $\rightarrow$ Output Format.
- **Commands:**
  - `pandoc input.md -o output.pdf` (Uses LaTeX engine).
  - `pandoc input.md -o output.docx` (Generates Word).
  - `pandoc input.md -t beamer -o slides.pdf` (Generates LaTeX slides).

ToC

Table of Contents (ToC) i

LaTeX ToC

LaTeX generates a ToC automatically by scanning your Section tags (`\section`, `\subsection`).

- **The Command:** Simply place `\tableofcontents` where you want the list.
- **Compilation Mechanism:**
  1. *Run 1:* LaTeX writes all section titles and page numbers to a temporary `.toc` file.
  2. *Run 2:* LaTeX reads the `.toc` file and renders the list in the document.

Table of Contents (ToC) ii

- **Example:**

```
\begin{document}
  \maketitle
  \tableofcontents  % Auto-generates here
  \newpage
  \section{Introduction}
\end{document}
```

Table of Contents (ToC) iii

Markdown ToC

Standard Markdown does not have a strict ToC tag, but tools handle it differently:

1. **Pandoc:** Use the flag `--toc` in the command line. It scans headers (#, ##) to build it.
2. **Editors (VS Code/Typora):** Many support the macro `[TOC]`.
3. **Manual:** You write it as a list of links: `- [Introduction](#introduction)`.

Figures

Figures (LaTeX) i

The `graphicx` Package

LaTeX treats images as “floats”—it automatically decides the best position (top of page, bottom, etc.) to prevent awkward page breaks.

- **Prerequisite:** You must add `\usepackage{graphicx}` to your preamble.
- **Environment:** `\begin{figure}[placement]`.
  - *Placement options:* `h` (here), `t` (top), `b` (bottom), `!` (override constraints).

Figures (LaTeX) ii

- **Key Commands:**
  - `\includegraphics[options]{filename}`: The actual image insertion.
  - `\caption{ ... }`: Adds the description and numbering (e.g., “Figure 1: ...”).
  - `\label{ ... }`: Creates an anchor to reference it later (e.g., “See Figure \ref{...}”).

Figures (LaTeX) iii

LaTeX Code:

```latex
\begin{figure}[ht]
    \centering
    \includegraphics[width=0.5\textwidth]{results.png}
    \caption{Experimental Results}
    \label{fig:results}
\end{figure}
```

Figures (Markdown) i

Inline Images

Markdown syntax is concise (`![]()`) but typically places images **inline** (exactly where you type them) rather than floating them. Standard Markdown lacks native resizing, but extensions handle this.

1. Standard Syntax: `![Alt Text for Accessibility](path/to/image.png)`

2. With Resizing (HTML Fallback): Since Markdown supports raw HTML, this is the most compatible method for resizing. `<img src="image.png" width="300" />`

Figures (Markdown) ii

3. With Resizing (Pandoc Extension): If using Pandoc (standard for academic writing), you can use attributes.
`![Results](image.png){ width=50% }`

4. Adding Captions: In Pandoc, the "Alt Text" (text inside `[ ]`) automatically becomes the Figure Caption below the image when converting to PDF/LaTeX.

Tables

Tables i

LaTeX Tables (`tabular`)

LaTeX tables are precise but verbose. They use specific delimiters.

- **Environment:** `\begin{tabular}{cols}`
- **Column Spec:** `{l c r}` defines 3 columns (Left aligned, Centered, Right aligned).
- **Separators:** `&` separates cells; `\\` ends a row.
- **Lines:** `\hline` draws horizontal lines; `|` in column spec draws vertical lines.

Tables ii

LaTeX Code:

```
\begin{table}[h]
  \centering
  \begin{tabular}{|l|c|r|}
    \hline
    \textbf{Item} & \textbf{Qty} & \textbf{Price} \\
    \hline
    Apples & 5 & \$1.00 \\
    Oranges & 10 & \$2.50 \\
    \hline
  \end{tabular}
  \caption{Grocery List}
\end{table}
```

Tables iii

Markdown Tables

Markdown uses “ASCII Art” style pipes. It is simpler and easier to read in raw code, but less flexible (no merged cells or complex alignment).

Markdown Code:

```
| Item     | Qty | Price |
|:---------|:---:|------:|  <-- Alignment (Left,
| Apples   | 5   | $1.00 |  Center, Right)
| Oranges  | 10  | $2.50 |
```

Bibliography

Bibliography Management i

LaTeX (BibTeX / BibLaTeX)

Citations are stored in a separate plain text database file (`.bib`).

1. The Database (`refs.bib`):

```
@article{einstein1905,
    author = "Albert Einstein",
    title = "On the Electrodynamics of Moving Bodies",
    year = "1905"
}
```

Bibliography Management ii

2. The Document:

```
As stated by \cite{einstein1905}, relativity is
complex.

\bibliographystyle{plain}
\bibliography{refs}
```

Bibliography Management iii

Markdown (Pandoc Citeproc)

Pandoc can read BibTeX files and process citations in Markdown.

The Syntax:

```
As stated by [@einstein1905], relativity is complex.
```

The Command: `pandoc doc.md --bibliography=refs.bib --citeproc -o doc.pdf`

Biography Generation i

In academic papers (especially IEEE), “Biographies” are formatted blocks at the end of a paper containing the author’s photo and a short bio.

LaTeX (IEEEtran Class)

The `IEEEtran` class provides a specific environment for this. It handles wrapping the text around the photo automatically and styling the name in bold capital letters.

Biography Generation ii

LaTeX Code:

```
% Requires \documentclass{IEEEtran}

\begin{IEEEbiography}[{\includegraphics[width=1in,clip,
received the B.S. degree in aerospace engineering ...
He is currently a Professor at X University.
His research interests include LaTeX and Typography.
\end{IEEEbiography}
```

Biography Generation iii

Markdown

Markdown does not have a native “Biography” semantic tag. You create it manually using Headers and Images, or HTML if rendering to web.

Markdown Code:

```
## Author Biography

![John Doe](photo.jpg){ width=100px align=left }

**John Doe** received the B.S. degree in
aerospace engineering ...
He is currently a Professor at X University.
```

Mathematical Equations

Mathematical Equations i

One of the primary reasons to use WYSIWYM is the superior rendering of mathematics.

LaTeX Math

LaTeX has two modes:

1. **Inline Mode:** For math inside a sentence. Surrounded by $.
   - *Syntax:* `Let $x$ be a variable.`
2. **Display Mode:** For centered, standalone equations.
   - *Syntax:* `\[ E = mc^2 \]` or `\begin{equation} ... \end{equation}`.

Mathematical Equations ii

Common Commands:

- **Fractions:** `\frac{numerator}{denominator}`
- **Greek:** `\alpha`, `\beta`, `\Omega`
- **Summation/Integrals:** `\sum_{i=0}^{n}`, `\int_{0}^{\infty}`
- **Sub/Superscripts:** `x_i`, `x^2`

Mathematical Equations iii

Markdown Math

Most Markdown engines (GitHub, Pandoc, Obsidian, Jupyter) use **MathJax** or **KaTeX** to render LaTeX syntax inside Markdown.

- **Syntax:** It generally uses the exact same `$` delimiters as LaTeX.
  - Inline: `$E=mc^2$`
  - Block: `$$E=mc^2$$`

Comparison Example (Quadratic Formula): Both LaTeX and Markdown use: `x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}`

Further Resources

Further Resources i

LaTeX

- **Overleaf Learn:** https://www.overleaf.com/learn (The best beginner-friendly documentation).
- **CTAN (Comprehensive TeX Archive Network):** https://ctan.org/ (The central repository for all LaTeX packages).
- **Detexify:** https://detexify.kirelabs.org/classify.html (Draw a symbol to find its LaTeX command).

Further Resources ii

Markdown & Pandoc

- **Markdown Guide:** https://www.markdownguide.org/ (Comprehensive tutorial on syntax and flavors).
- **Pandoc Documentation:** https://pandoc.org/ (The manual for the universal converter).
- **GitHub Flavored Markdown Spec:** https://github.github.com/gfm/

Further Resources iii

Tools

- **Editors:** VS Code (with LaTeX Workshop & Markdown All in One).
- **Reference Management:** Jabref (Works directly with BibTeX).