Latex

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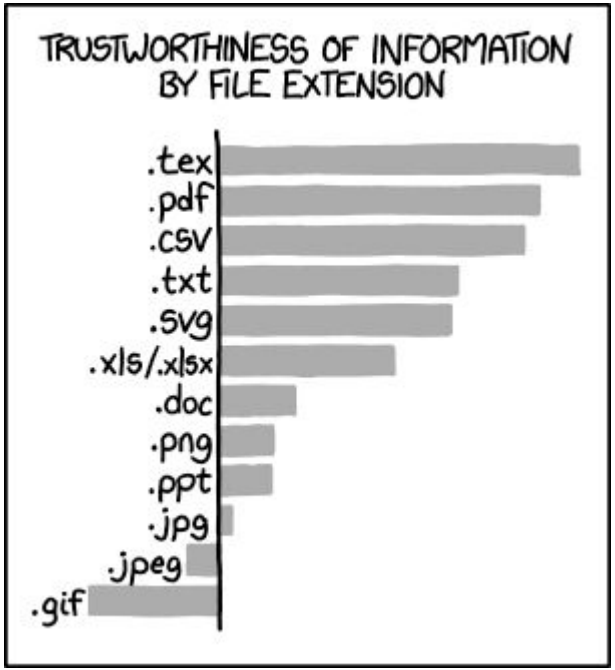
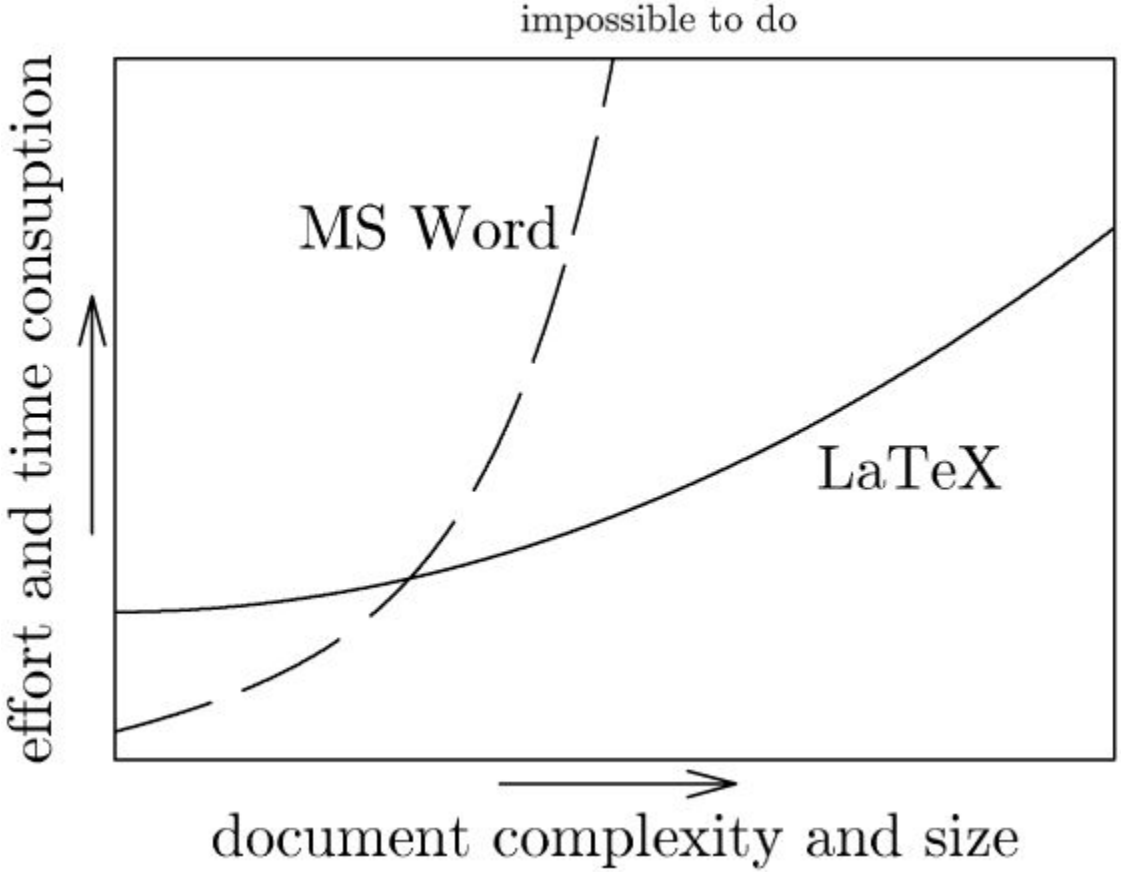


https://xkcd.com/1301/

Background

- Pronounced “lay-tech” or “lah-tech”
  - not lateks, as in gloves are made of latex
- LaTeX is a “Free” software system for document preparation
  - Provides high-quality typesetting
  - Authors can focus mostly on content/flow and not on aesthetics
  - Used to produce predominantly technical or scientific documents
    - Mathematical symbols, Equations, Footnotes, Tables, Figures, References, Table of contents, Bibliographies etc can be easily integrated



https://qph.cf2.quoracdn.net/main-qimg-7e3da016a0568d132ebea98a88654277

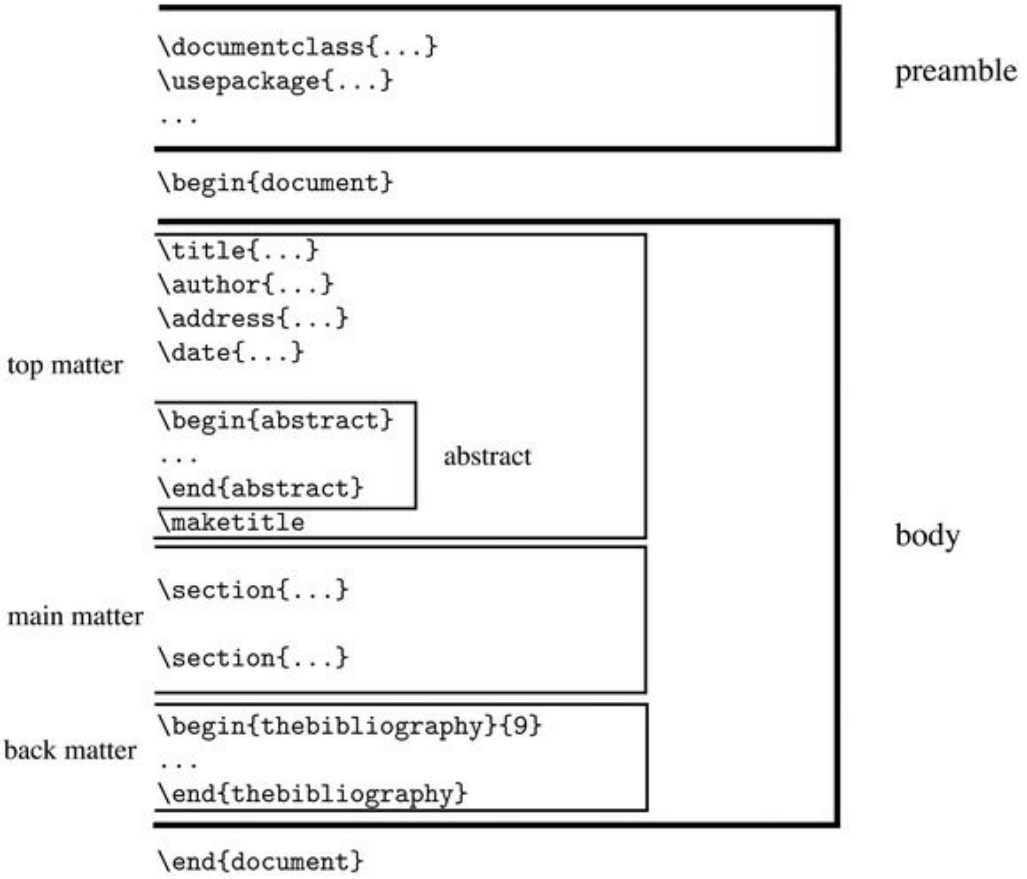
Files Used

- .tex: source document file (main file which you will edit)
- .cls: class file, loaded with \documentclass{...}
  - Mandatory, appears once in latex document, often very first command
  - Most common classes: article, report, letter, book, slides, beamer etc
  - E.g. article class provides commands for typesetting articles, such as \section, \tableofcontents, \author

- .sty: style or packages, loaded with \usepackage{...}
  - Packages are optional and many may be loaded
  - Often prior to the beginning of the document
  - Provide things on top of the class
  - E.g. graphicx package helps include images with graphical effects
- .bib: BibTeX Bibliographical Database file, a specially formatted text file that lists references

Format

https://media.springernature.com/lw685/springer-static/
_5_En_8_Fig1_HTML.gif



Simple Example

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

\title{My first LaTeX document}
\author{Hubert Farnsworth\thanks{Funded by the Overleaf team.}}
\date{August 2022}

\begin{document}
\maketitle
We have now added a title, author and date to our first \LaTeX{} document!
% This line here is a comment. It will not be typeset in the document.
\end{document}
```

Text Formatting

- Bold: bold text in LaTeX is typeset using the \textbf{...} command.
- Italics: italicised text is produced using the \textit{...} command.
- Underline: to underline text use the \underline{...} command.
- Example:
  - Some of the \textbf{greatest} discoveries in \underline{science} were made by \textbf{\textit{accident}}
- \emph{argument}: depends on the context
  - Inside normal text, the emphasized text is italicized
  - Reversed if used inside an italicized text

Images, Captions, Labels, References

```
\documentclass{article}
\usepackage{graphicx}
\graphicspath{{images/}}

\begin{document}

\begin{figure}[h]
    \centering
    \includegraphics[width=0.75\textwidth]{mesh}
    \caption{A nice plot.}
    \label{fig:mesh1}
\end{figure}

As you can see in figure \ref{fig:mesh1}, the function grows near the origin. This example is on page
\pageref{fig:mesh1}.
\end{document}
```

Lists

```
\documentclass{article}
\begin{document}

\begin{itemize}
  \item The individual entries are indicated with a black dot, a so-called bullet.
  \item The text in the entries may be of any length.
\end{itemize}

\begin{enumerate}
  \item This is the first entry in our list.
  \item The list numbers increase with each entry we add.
\end{enumerate}

\end{document}
```

Math

- Two writing modes for typesetting mathematics:
  - inline math mode: formulas inline i.e. part of a paragraph
  - display math mode: write expressions not part of a text or paragraph
    - typeset on separate lines

```
\documentclass[12pt, letterpaper]{article}
\begin{document}
In physics, the mass-energy equivalence is stated
by the equation $E=mc^2$, discovered in 1905 by Albert Einstein.
\end{document}
```

Equations typeset in display mode can be numbered or unnumbered, as in the following example:

```
\documentclass[12pt, letterpaper]{article}
\begin{document}
The mass-energy equivalence is described by the famous equation
\[ E=mc^2 \] discovered in 1905 by Albert Einstein.

In natural units ($c = 1$), the formula expresses the identity
\begin{equation}
E=mc^2
\end{equation}
\end{document}
```

Complex Math

\documentclass{article}

\begin{document}

Subscripts in math mode are written as a_b and superscripts are written as a^b. These can be combined and nested to write expressions such as

\[T^{i_1 i_2 \dots i_p}_{j_1 j_2 \dots j_q} = T(x^{i_1},\dots,x^{i_p},e_{j_1},\dots,e_{j_q}) \]

We write integrals using $\int$ and fractions using $\frac{a}{b}$. Limits are placed on integrals using superscripts and subscripts:

\[\int_0^1 \frac{dx}{e^x} = \frac{e-1}{e} \]

Lower case Greek letters are written as ω δ etc. while upper case Greek letters are written as Ω Δ.

Mathematical operators are prefixed with a backslash as $\sin(\beta)$, $\cos(\alpha)$, $\log(x)$ etc.

\end{document}

Sections

- \section{section}
- \subsection{subsection}
- \subsubsection{subsubsection}

Tables

```
\begin{center}
\begin{tabular}{c c c}
 cell1 & cell2 & cell3 \\
 cell4 & cell5 & cell6 \\
 cell7 & cell8 & cell9
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{|c|c|c|}
 \hline
 cell1 & cell2 & cell3 \\
 cell4 & cell5 & cell6 \\
 cell7 & cell8 & cell9 \\
 \hline
\end{tabular}
\end{center}
```

References

- \bibitem (not recommended)

%%%%%%%%%% Example 1%%%%%%%%%%%%%%%%%%%%%%%%%%
\begin{thebibliography}{100} % 100 is a random guess of the total number of
%references
\bibitem{Boney96} Boney, L., Tewfik, A.H., and Hamdy, K.N., ``Digital
Watermarks for Audio Signals," \emph{Proceedings of the Third IEEE
International Conference on Multimedia}, pp. 473-480, June 1996.
\bibitem{MG} Goossens, M., Mittelbach, F., Samarin, \emph{A LaTeX
Companion}, Addison-Wesley, Reading, MA, 1994.
\bibitem{HK} Kopka, H., Daly P.W., \emph{A Guide to LaTeX},
Addison-Wesley, Reading, MA, 1999.
\bibitem{Pan} Pan, D., ``A Tutorial on MPEG/Audio Compression," \emph{IEEE
Multimedia}, Vol.2, pp.60-74, Summer 1998.
\end{thebibliography}
%%%%%%%%%% end %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

- Tough to accurately format each \bibitem based on the reference style you're asked to use
  - Should the year come immediately after the authors, or at the end of the entry?
  - Given names first, or last names first?
  - For different manuscripts or documents that use different reference styles you'll need to rewrite the \bibitem for each reference.

Bibtex

Maintain a bibliography database file (e.g. sample.bib) which contains format-independent information about our references

```
@book{texbook,
  author = {Donald E. Knuth},
  year = {1986},
  title = {The {\TeX} Book},
  publisher = {Addison-Wesley Professional}
}

@book{latex:companion,
  author = {Frank Mittelbach and Michel Gossens
            and Johannes Braams and David Carlisle
            and Chris Rowley},
  year = {2004},
  title = {The {\LaTeX} Companion},
  publisher = {Addison-Wesley Professional},
  edition = {2}
}
```

\bibliographystyle{plain} % We choose the "plain" reference style
\bibliography{sample} % Entries are in the sample.bib file

This is processed with the following sequence of commands, assuming our LATEX document is in a file named sample.tex (and that we are using pdflatex):

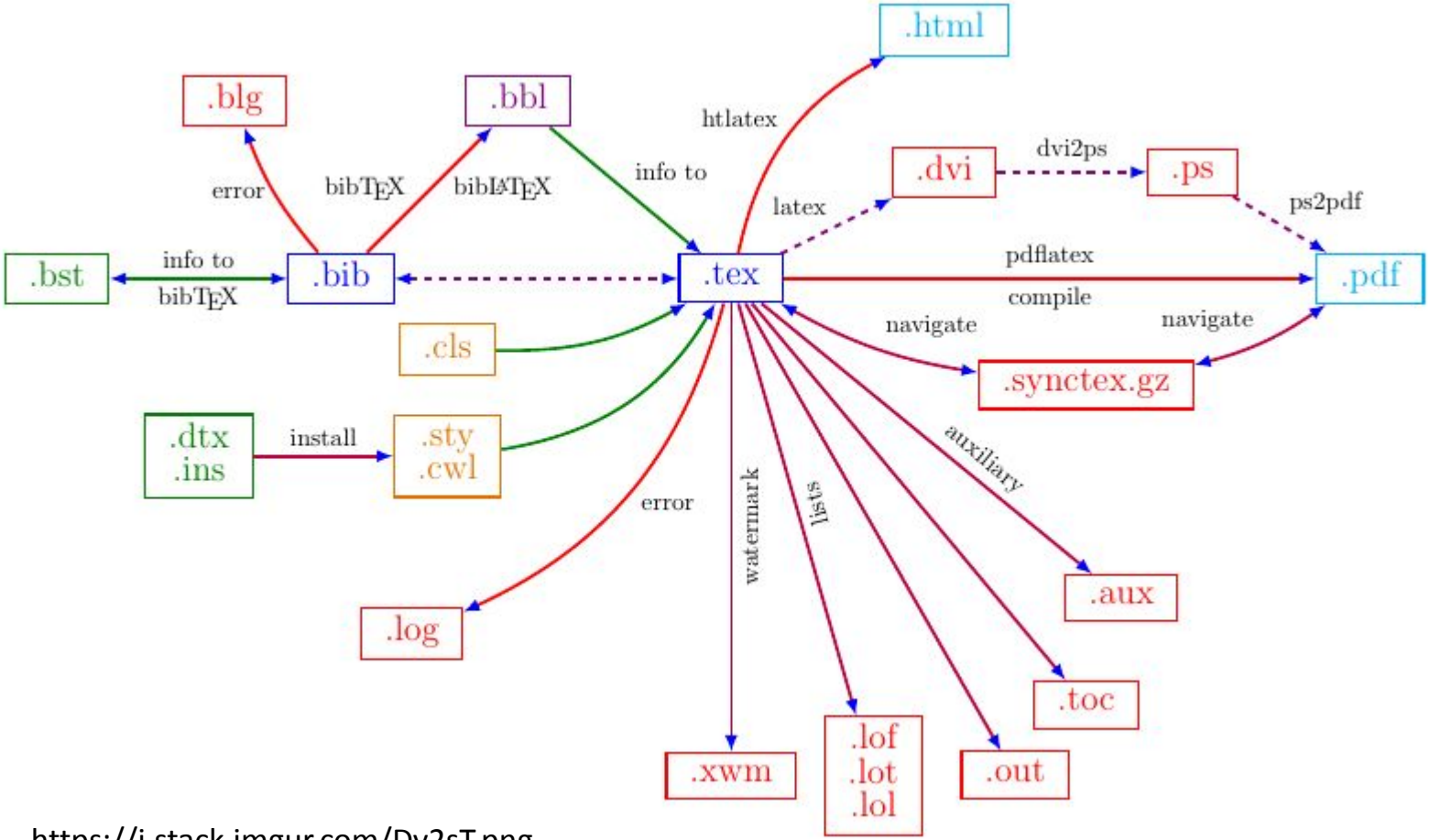
pdflatex sample
bibtex sample
pdflatex sample
pdflatex sample

Why 4 runs?

- First pdflatex run: pdflatex sees \bibliographystyle{...} and a \bibliography{...}
  - Doesn't know what \cite{...} commands are about
  - In output PDF, all the \cite{...} commands are simply rendered as [?] and no reference list appears
  - pdflatex writes information about the bibliography style and .bib file, as well as all occurrences of \cite{...}, to the file sample.aux
- Bibtex sample now looks at sample.aux
  - Notes the .bib file indicated by \bibliography{...}
  - Looks up all the entries with keys that match the \cite{...} commands used in the .tex file
  - Uses the style specified with \bibliographystyle{...} to format the cited entries, and writes a formatted thebibliography list into the file sample.bbl
  - no changes are made to the output PDF

Why 4 runs?

- pdflatex run again: sees sample.bbl file
  - inserts the contents of sample.bbl i.e. the \begin{thebibliography}....\end{thebibliography} into the LATEX source, where \bibliography{...} is
  - reference list appears in the output PDF formatted according to the chosen \bibliographystyle{...}, but the in-text citations are still [?]
- pdflatex run again: \cite{...} commands are replaced with the corresponding numerical labels in the output PDF!



https://i.stack.imgur.com/Dy2sT.png

Common mistakes

- “end” doesn’t follow “begin”
- $ doesn’t follow $
- Using commands from packages not defined in the preamble
- Forgetting to escape i.e. “\”s.
- Forgetting bibliography{filename}
  - bibtex file is saved in the same location where the sample tex file is saved.
- Forgetting end{document}

References

- https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes (brief)
- https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex
- https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes (in-depth)
- https://www.andrew.cmu.edu/course/15-251/misc/LaTex%20Primer.pdf
- https://www.overleaf.com/learn/latex/Errors (errors)