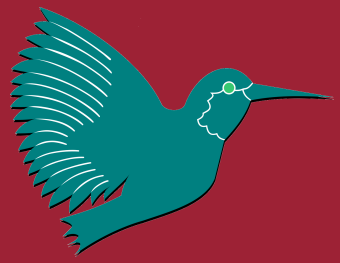

The LaTeX Project

A Brief Introduction

Christoforos Somarakis, PhD

November 14, 2022

Santa Clara University

School of Engineering

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Table of Contents I

Past & Present : Mother TeX

Volume 2 / **Seminumerical Algorithms**

THE ART OF COMPUTER PROGRAMMING

SECOND EDITION

Reading, Massachusetts
Menlo Park, California · London · Amsterdam · Don Mills, Ontario · Sydney

- *Late 70's*
  - ✓ Prof. D. Knuth did not like the looks of his book's new edition.
  - ✓ Quality was much worse than digitally printed books.
  - ✓ Digital printing: `1 - ink / 0 - no ink.`
  - ✓ Knuth envisioned a bridge between computer science and typesetting.

Past & Present : Mother TeX

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  - ✓ Quality was much worse than digitally printed books.
  - ✓ Digital printing: `1 - ink / 0 - no ink.`
  - ✓ Knuth envisioned a bridge between computer science and typesetting.
- *Early 80's*
  - ✓ Birth of TeX digital typographical system.

Past & Present : Mother TeX

Chapter 1 : The Name of the Game

TeX is derived from Greek words

$$\underbrace{\tau\epsilon\chi\nu}_{\tau\acute{\epsilon}\chi\nu\eta=\text{art}}\ o\lambda o\gamma\acute{\imath}\alpha = \text{technology}$$

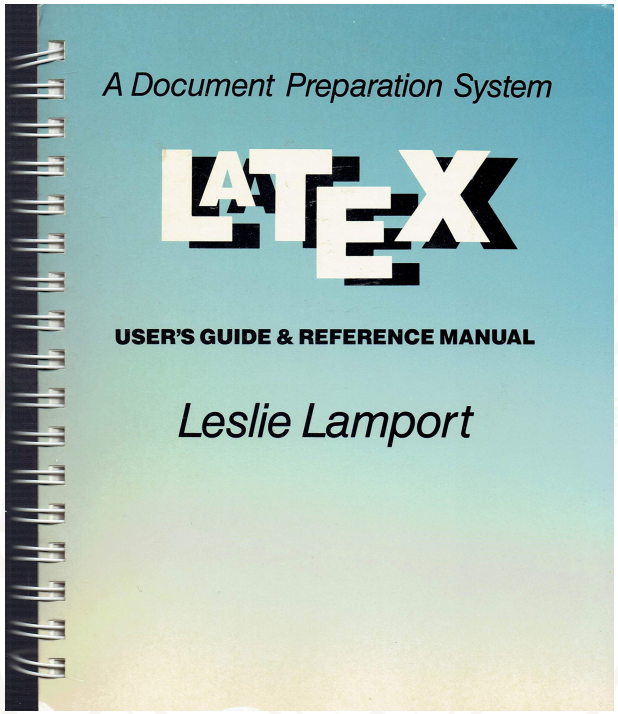
$\Rightarrow$ It is pronounced `/tech/` (and not `/tek/`).

Pronunciation and notation to differentiate from *TEX* (/teks/): the ***Text EXecutive*** processor developed by Honeywell Information Systems.

Evidently LaTeX is pronounced as `/LAH-tech/` or `/LAY-tech/`.

Past & Present : The LaTeX Project

- *Mid 80's*
  - ✓ L. Lamport developed macros based on TeX for his own use.
  - ✓ His effort evolved into a stand-alone package for general use.



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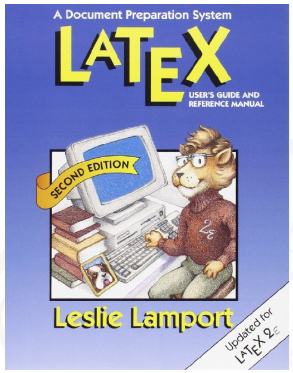
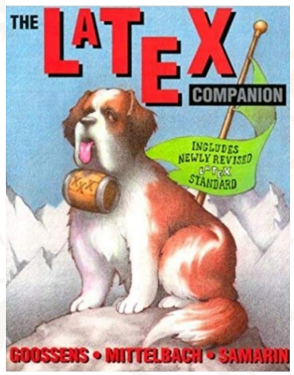


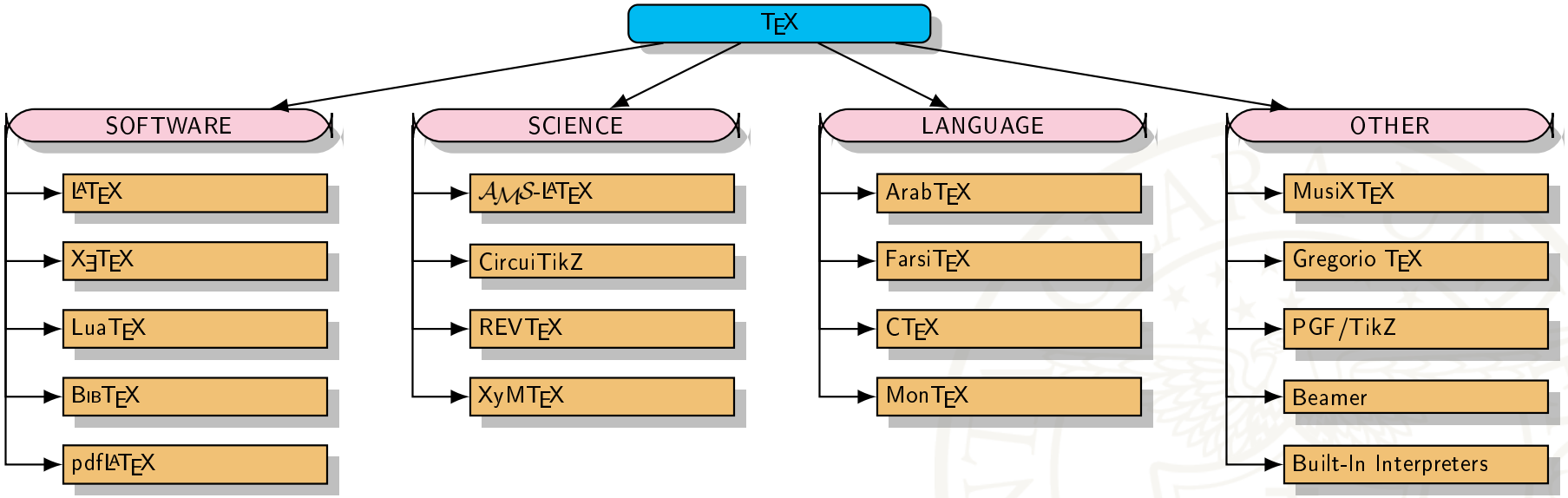
- *Late 80's*
  - ✓ LaTeX maintenance and development gets delegated to F. Mittelbach and the LaTeX 3 group.
  - ✓ The LaTeX project gets launched.

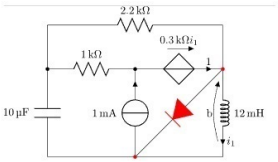


- *Mid 90's*
  - ✓ LaTeX 2_ε is released.
  - ✓ The `expl3` is released as package.

- Further reading : [1] and [2].

Past & Present : The Modern Realm





XETEX

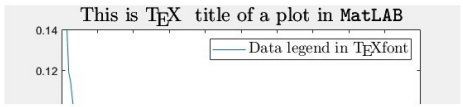
AMS-LATEX

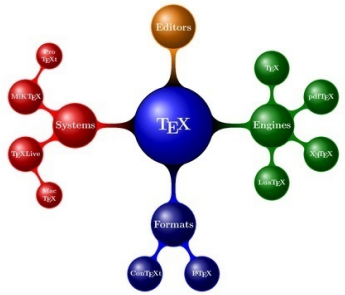
فارسی تک

PyLaTeX

TEX

latexify_py





LATTEmatica

Table of Contents I

What, How, Why : What is LaTeX?

1. A high-quality typesetting system.
2. Includes features designed for the production of technical and scientific documentation:
   - support for extremely complex mathematics, tables and technical content for the physical sciences;
   - facilities for footnotes, cross-referencing and management of bibliographies;
   - ease of producing complicated, document elements such as indexes, glossaries, table of contents, lists of figures;
   - highly customizable through thousands of add-on packages.
3. It is established as the standard for publication of scientific documents.
4. It expands to book writing...and for writing Gregorian Chants(!)
5. It is free (both main software + packages).

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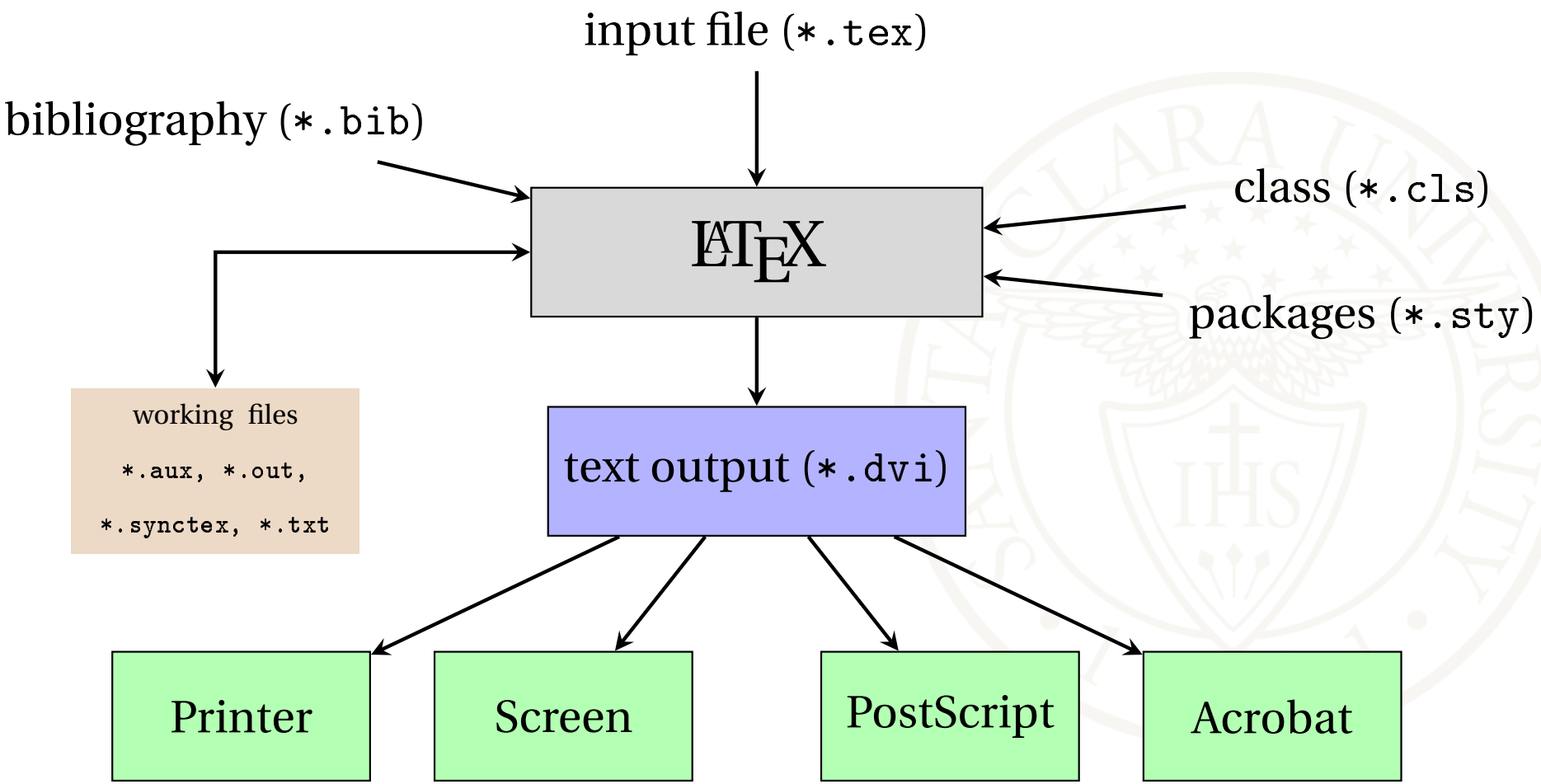
What, How, Why : How does LaTeX work ?



What, How, Why : How does LaTeX work ?

- Local Machine
  1. A TeX/ LaTeX typesetting distribution
     * MiKTeX (Windows)
     * TeX Live (Linux, UNIX-like systems)
     * MacTeX (TeX live for macOS)
  2. A LaTeX editor
     * Open source (TeX MAKER , TeX studio)
     * Freeware (LEd)
     * Proprietary/Shareware (Scientific WorkPlace, WinEdt)

- Cloud-based LaTeX editor

What, How, Why : Why should I bother about LaTeX?

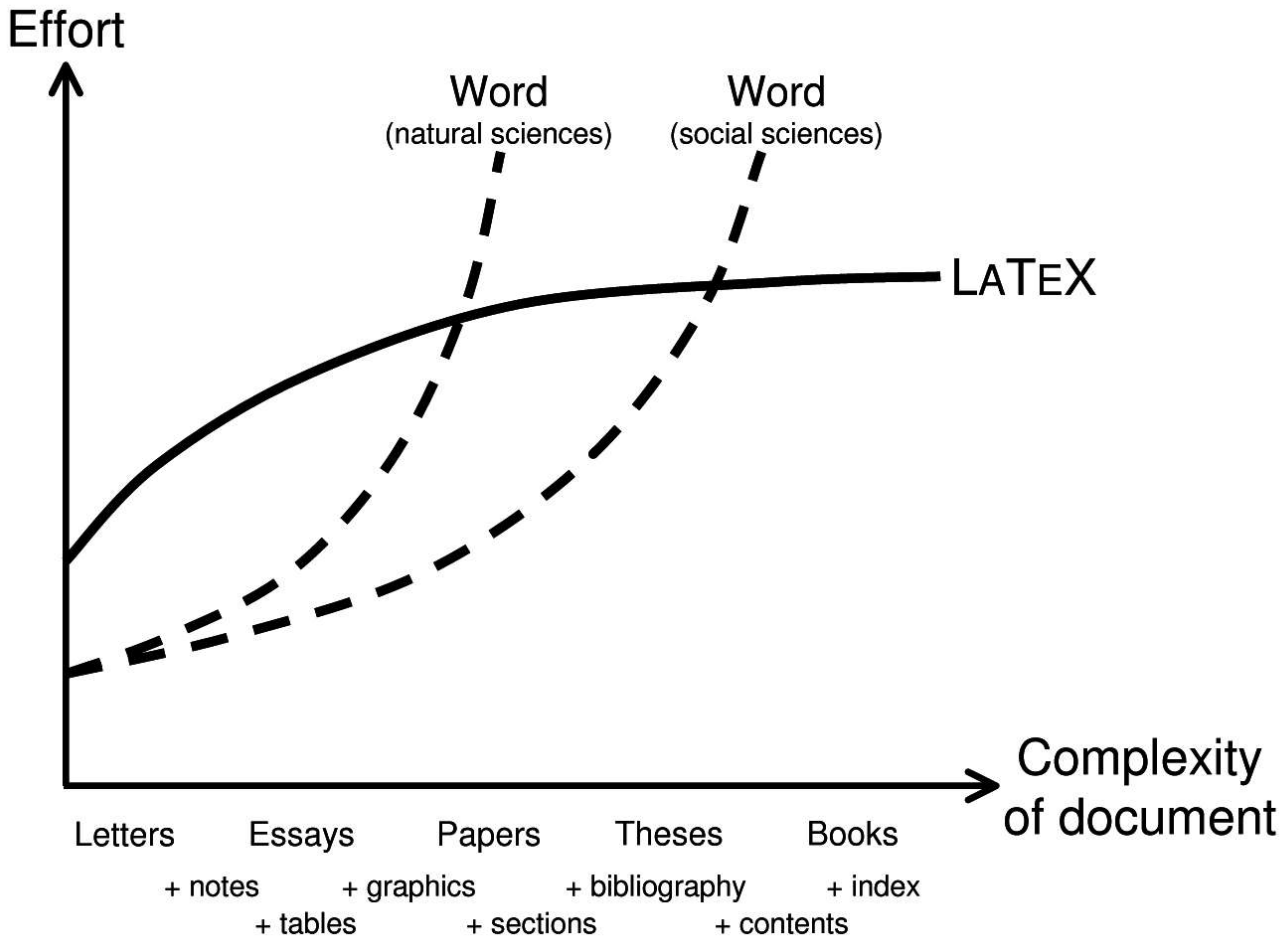
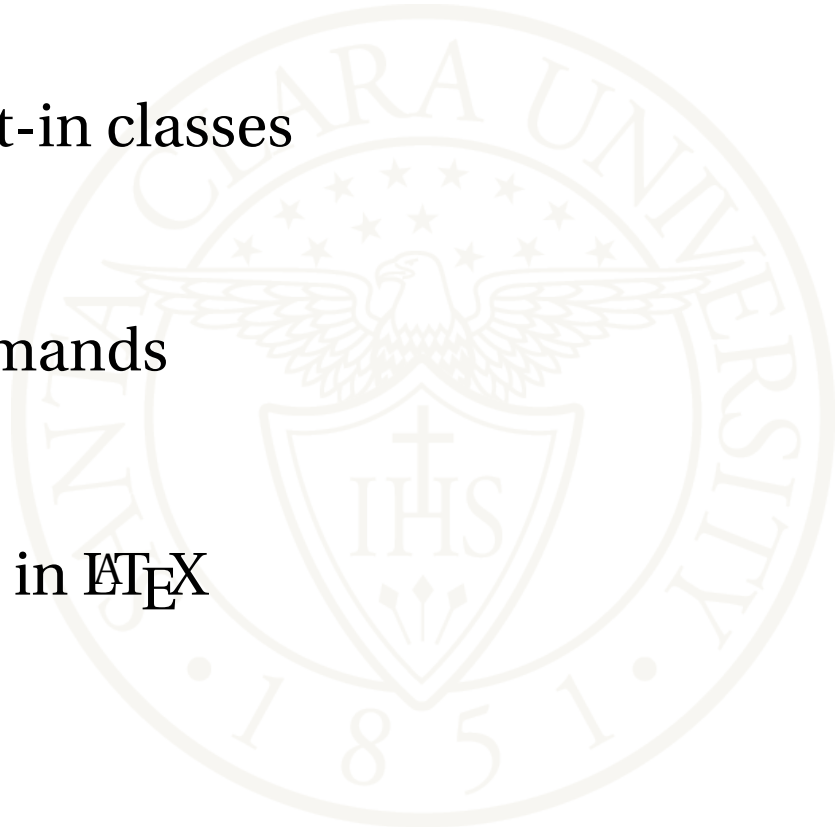


Image Credit [3].

What, How, Why : Why should I bother about LaTeX?

Because it is beautiful...

Table of Contents I



The Basics : Hello World!

tex

```
\documentclass{article}

\begin{document}

Hello \LaTeX World !

\end{document}
```

pdf

Hello LaTeX World !

The Basics : Hello World!

tex

```
\documentclass{article}

%compiler will ignore this.

\begin{document}
Hello \LaTeX World !
%comment here too
\end{document}
No % symbol necessary when
we are out of bounds.
==> In latex function/command
curly brackets {} stand for
required values, standard
brackets [] stand for
optional values.
```

pdf

Hello LaTeX World !

The Basics : Hello World!

tex

```
\documentclass{article}

%compiler will ignore this.


\begin{document}
Hello \LaTeX World !
%comment here too
\end{document}

No % symbol necessary when
we are out of bounds.
```

pdf

Hello LaTeX World !

The Basics : documentclass

```
\documentclass[option1, option2]{class_name}
```

Examples of built-in classes

article for articles in scientific journals, presentations, short reports, program documentation, invitations, ...

proc a class for proceedings based on the article class.

minimal is as small as it can get. It only sets a page size and a base font. It is mainly used for debugging purposes.

report for longer reports containing several chapters, small books, thesis, ...

book for real books

slides for slides. The class uses big sans serif letters.

letter For writing letters.

beamer For writing presentations (like this one).

The Basics : documentclass

```
\documentclass[option1, option2]{class_name}
```

Examples of built-in options:

10pt, 11pt, 12pt - Sets the size of the main font in the document. If no option is specified, 10pt is assumed.

a4paper, letterpaper, etc... - Defines the paper size. The default size is letterpaper;

fleqn - Typesets displayed formulas left-aligned instead of centered.

leqno - Places the numbering of formulas on the left hand side instead of the right.

onecolumn, twocolumn - Instructs LaTeX to typeset the document in one column or two columns.

landscape - Changes the layout of the document to print in landscape mode.

Basic Templates : article

tex

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

\begin{document}

\lipsum[1]
\lipsum[2]
\lipsum[3]
\lipsum[4]

\end{document}
```

Lorem ipsum, or lipsum as it is sometimes known, is dummy text used in laying out print, graphic or web designs. The passage is attributed to an unknown typesetter in the 15th century who is thought to have scrambled parts of Cicero's De Finibus Bonorum et Malorum for use in a type specimen book.

pdf

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris. Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

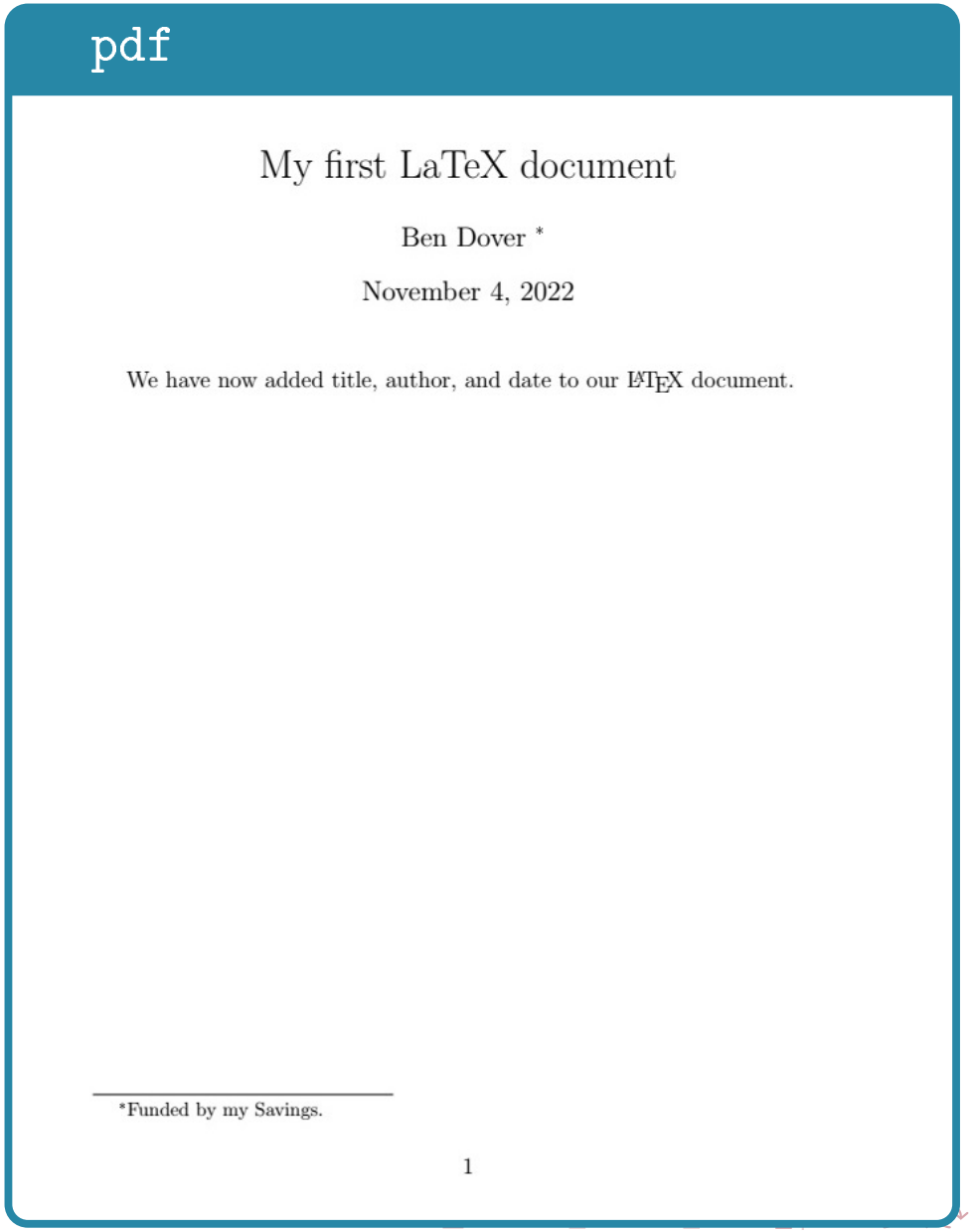
1

Basic Templates : article

tex

```
\documentclass[12pt, letterpaper]{article}
\title{My first LaTeX document}
\author{Ben Dover
            \thanks{Funded by my Savings.}}
\date{\today}


\begin{document}

\maketitle

We have now added title, author,
              and date to our \LaTeX{} document.
\end{document}

"\today" returns today's date updated in every
compile loop. For fixed date we can write
\date{11/15/2022}.
```

pdf


My first LaTeX document

Ben Dover *

November 4, 2022

We have now added title, author, and date to our LaTeX document.

*Funded by my Savings.

1

Basic Templates : article

tex

```
[...]
\begin{document}
\maketitle
We have now added title, author,
                and date to our \LaTeX{} document.
\section{Introduction}
We are writing an article; it consists of
sections. This is the first section. We named it
\textbf{Introduction}.

\subsection{Important Points} We can
highlight terms using \textit{italic style}, or
\textbf{boldface style}, or even
\underline{underline writing}\footnote{This
is a footnote.}.
\subsubsection{Critical sub-points}
This is very interesting. Read it.
\subsubsection{Critical sub-points}
Read this as well. It will pop-up in a Quiz.

\paragraph{Remarks} Paragraph under sub-section.

\section*{Section Two}
Article continues in this section (number ? ).
\end{document}

For sectioning without enumeration,  we add
 "*" (e.g. \section*{}, \subsection*{}, etc.)
```

pdf

My first LaTeX document

Ben Dover *

November 14, 2022

We have now added title, author, and date to our LaTeX document.

1 Introduction

We are writing an article; it consists of sections. This is the first section. We named it **Introduction**.

1.1 Important Points

We can highlight terms using *italic style*, or **boldface style**, or even underline writing[1].

1.1.1 Critical sub-points

This is very interesting. Read it.

1.1.2 Critical sub-points

Read this as well. It will pop-up in a Quiz.

Remarks Paragraph under sub-section.

Section Two

Article continues in this section (number ?).

*Funded by my Savings.
[1]This is a footnote.

1

Basic Templates : Document Sectioning

⇒ There are up to 7 levels of depth for defining sections:

```
-1 \part{part}

0 \chapter{chapter}

1 \section{section}

2 \subsection{subsection}

3 \subsubsection{subsubsection}

4 \paragraph{paragraph}

5 \subparagraph{subparagraph}
```


`\section` is the top-level document command in most documents.

In reports or books, this would be `\chapter` or `\part`.

Basic Templates : article

tex

```
\documentclass{article}
\title{My Awesome Title}
\author{Chris Somarakis
     \thanks{E-mail: csomarak@gmail.com}}
\date{\today}

\newcommand\shortlorem{Lorem ipsum dolor
sit amet, consectetur adipiscing elit,
sed do eiusmod tempor incididunt ut
labore et dolore magna aliqua.}

\begin{document}
\maketitle
\tableofcontents

\section{Introduction}
\shortlorem

\addcontentsline{toc}{section}
{Unnumbered Section}
%remove the command above to exclude unnumbered
%sections from table of contents

\section*{Unnumbered Section}
\shortlorem
\section{Second section}
\shortlorem
\end{document}
```

pdf

My Awesome Title

Chris Somarakis *

November 14, 2022

Contents

1 Introduction

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

Unnumbered Section

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

2 Second section

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

*E-mail: csomarak@gmail.com

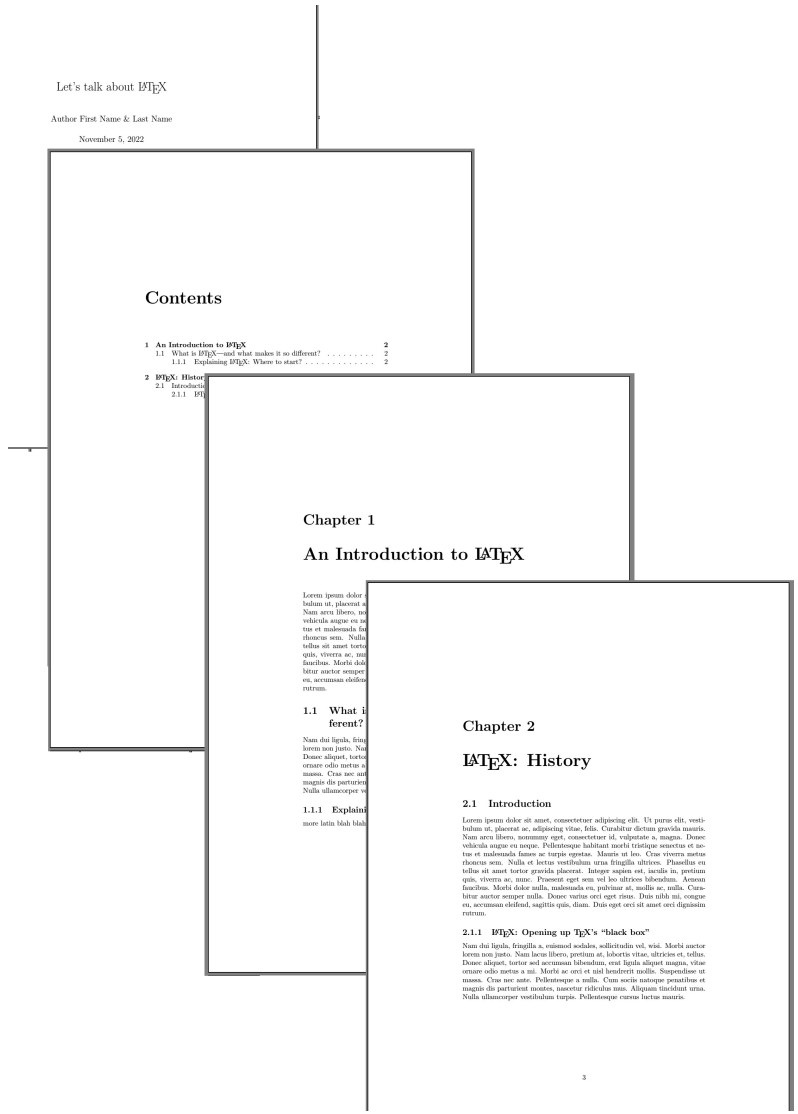
1

Basic Templates : book, report

tex

```
\documentclass{report}
\title{Let's talk about \LaTeX }
\author{Author First Name \& Last Name}
\date{\today}
\usepackage{lipsum}

\begin{document}
\maketitle
\tableofcontents

\chapter{An Introduction to \LaTeX}
\lipsum[1]
\section{What is \LaTeX -and what makes
                          it so different?}
\lipsum[2]

\subsection{Explaining \LaTeX: Where to start?}
more latin blah blah

\chapter{\LaTeX: History}
\section{Introduction}
\lipsum[1]

\subsection{\LaTeX: Opening up
    \TeX's "black box"}
\lipsum[2]

\end{document}
```

pdf



Basic Templates : book, report

tex

```
\documentclass[letter,12pt]{report}
\usepackage{titlesec}
\usepackage{lipsum}
\titleformat
{\chapter} % command
[display] % shape
{\bfseries\Large\itshape} % format
{Story No. \ \thechapter} % label
{0.5ex} % sep
{    \rule{\textwidth}{1pt}
    \vspace{1ex}
    \centering
} % before-code
[ \vspace{-1.5ex}%
\rule{\textwidth}{0.3pt}
] % after-code
%
\titleformat{\section}[wrap]
{\normalfont\bfseries}
{\thesection.}{0.5em}{}
\titlespacing{\section}{12pc}{1.5ex plus .1ex
                              minus .2ex}{1pc}
\begin{document}
\chapter{Let's begin}
\section{First Attempt}
\lipsum[1]
\section{Second attempt}
\lipsum[2]
\end{document}
```

pdf

Story No. 1

Let's begin

1.1. First Attempt Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

1.2. Second attempt Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

1

Font Types & Sizes

tex

```
\documentclass{article}
\begin{document}
This is a simple example, {\tiny this will show
different font sizes} and also \textsc{different
font styles}.

\vspace{1cm}

In this example the {\huge huge font size} is
set and the {\footnotesize Foot note size also}.
There's a fairly large set of font sizes.

\vspace{1cm}

In this example, a command and a switch are used.
\texttt{A command is used to change the style of
a sentence}.

\sffamily
A switch changes the style from this point to the
end of the document unless another switch is used.
\rmfamily

\vspace{3cm}
Part of this text is written \textsl{in different
font style} to highlight it.
\end{document}
```

pdf

This is a simple example, this will show different font sizes and also DIFFERENT FONT STYLES.

In this example the huge font size is set and the Foot note size also. There's a fairly large set of font sizes.

In this example, a command and a switch are used. `A command is used to change the style of a sentence.`
A switch changes the style from this point to the end of the document unless another switch is used.

Part of this text is written *in different font style* to highlight it.

Font Types & Sizes

Command	Output
\tiny	Lorem ipsum
\scriptsize	Lorem ipsum
\footnotesize	Lorem ipsum
\small	Lorem ipsum
\normalsize	Lorem ipsum
\large	Lorem ipsum
\Large	Lorem ipsum
\LARGE	Lorem ipsum
\huge	Lorem ipsum
\Huge	Lorem ipsum

Font Types & Sizes

typeface = family	command	switch command	output
serif (roman)	`\textrm{Sample Text 0123}`	`\rmfamily`	Sample Text 0123
sans serif	`\textsf{Sample Text 0123}`	`\sffamily`	Sample Text 0123
typewriter (monospace)	`\texttt{Sample Text 0123}`	`\ttfamily`	Sample Text 0123

Font styles

style	command	switch command	output
medium	`\textmd{Sample Text 0123}`	`\mdseries`	Sample Text 0123
bold	`\textbf{Sample Text 0123}`	`\bfseries`	**Sample Text 0123**
upright	`\textup{Sample Text 0123}`	`\upshape`	Sample Text 0123
italic	`\textit{Sample Text 0123}`	`\itshape`	*Sample Text 0123*
slanted	`\textsl{Sample Text 0123}`	`\slshape`	*Sample Text 0123*
small caps	`\textsc{Sample Text 0123}`	`\scshape`	Sample Text 0123

Font Types & Sizes

tex

```
\documentclass{article}
\begin{document}
This is a simple example, {\tiny this will show
different font sizes} and also \textsc{different
font styles}.

\vspace{1cm}

In this example the {\huge huge font size} is
set and the {\footnotesize Foot note size also}.
There's a fairly large set of font sizes.

\vspace{1cm}

In this example, a command and a switch are used.
\texttt{A command is used to change the style of
a sentence}.

\sffamily
A switch changes the style from this point to the
end of the document unless another switch is used.
\rmfamily

\vspace{3cm}
Part of this text is written \textsl{in different
font style} to highlight it.
\end{document}
```

pdf

This is a simple example, this will show different font sizes and also DIFFERENT FONT STYLES.

In this example the huge font size is set and the Foot note size also. There's a fairly large set of font sizes.

In this example, a command and a switch are used. `A command is used to change the style of a sentence.`
A switch changes the style from this point to the end of the document unless another switch is used.

Part of this text is written *in different font style* to highlight it.

Packages & User-Defined Commands

tex

```
\documentclass[letter,12pt]{article}
\usepackage{hyperref}
\usepackage{xcolor}
\newcommand{\RC}{\color{red}}%Color commands
\newcommand{\BC}{\color{blue}}
\newcommand{\chris}[1]{{\color{brown} #1}}
\documentclass[letter,12pt]{article}
\usepackage{hyperref}
\hypersetup{
    colorlinks=true,
    urlcolor=cyan,
    }
\begin{document}
{\BC \section*{The \texttt{xcolor} package}}
\subsection{ Introduction}
{\RC The package provides driver-independent
access to several kinds of color tints, shades,
tones, and mixes } \textcolor{brown}{ of
arbitrary colors.} Every package typically comes
with a user's manual. For more info on
\texttt{xcolor} we refer to \href{https://ctan.
org/pkg/xcolor?lang=en}{CTAN (click)}.
\chris{This is my personal comment in brown.}
\end{document}
```

pdf

The xcolor package

0.1 Introduction

The package provides driver-independent access to several kinds of color tints, shades, tones, and mixes of arbitrary colors. The package starts from the basic facilities of the color package, and provides easy Every package typically comes with a user's manual. For more information on xcolor package we refer to CTAN (click).

This is my personal comment in brown.

Lists and Tables

tex

```
\documentclass{article}
\usepackage{bbding}
\begin{document}
Bullet point or enumerated lists and tables
\begin{itemize}
\item item 1
\item item 2
\item item 3
\end{itemize}
\begin{enumerate}
\item enumerated list item 1
\item enumerated list item 1
\end{enumerate}
\begin{itemize}
\item[\Checkmark] item 1
\item[\Checkmark] item 2
\item[\Checkmark] item 3
\end{itemize}
\centering
\begin{tabular}{||l c r ||}
 \hline
 LeftAligned  & Centered & RightAligned \\ [0.5ex]
 \hline\hline
 1 & 3 & 5  \\
 \hline
 2 & 4 & 6  \\
 \hline
\end{tabular}
\end{document}
```

pdf

Bullet point or enumerated lists and tables

- item 1
- item 2
- item 3

1. enumerated list item 1
2. enumerated list item 1

✓ item 1

✓ item 2

✓ item 3

LeftAligned	Centered	RightAligned
1	3	5
2	4	6

Large Projects : Inserting a LaTeX file into another.

tex

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

\input{preamble}%globally defined packages,
commands, definitions, etc

\title{Title}

\setlength {\marginparwidth }{2cm}
\begin{document}

    \maketitle
%below these are all separate .tex files
    \input{abstract}
    \input{introduction}
    \input{problem}
    \input{solution}
    \input{conclusion}
    \section*{References}
    \bibliographystyle{plain}
    \bibliography{nozzleDesign}
\end{document}
```

pdf

Title

November 14, 2022

Abstract

This is where the abstract goes.

1 Introduction

This is where the introduction goes.

2 Problem Setup

This is my problem setup. [1]

3 Solution

This is where I will solve the problem.

4 Summary and Conclusion

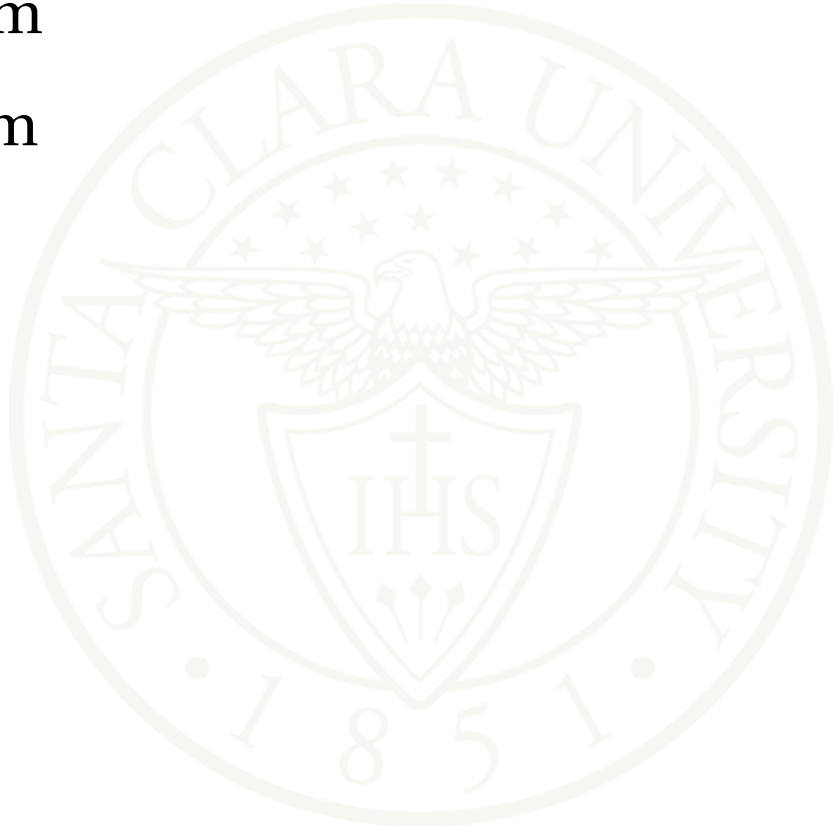
This is the conclusion.

References

[1] J. U. Brackbill, D. B. Kothe, and C. Zemach. A continuum method for modeling surface tension. *J. Comput. Phys.*, 100:335–354, 1992.

1

Table of Contents I



Bibliography management in LaTeX.

- ✓ It is possible to include references using either of LaTeX's major bibliography management programs.
- ✓ The basic file that includes bibliography information is a file with extension `*.bib`.

I. bibTeX: external program that process bibliography information and act (roughly) as the interface between `.bib` file and LaTeX document.

II. bibLaTeX, natbib : LaTeX packages that format citations and bibliographies.

The .bib file. Acceptable Structures

```
@article{einstein,
  author =       "Albert Einstein",
  title =        "{Zur Elektrodynamik bewegter K{\"o}rper}. ({German})
                 [{On} the electrodynamics of moving bodies]",
  journal =      "Annalen der Physik",
  volume =       "322",
  number =       "10",
  pages =        "891--921",
  year =         "1905",
  DOI =          "http://dx.doi.org/10.1002/andp.19053221004",
  keywords =     "physics"
}

@book{dirac,
  title={The Principles of Quantum Mechanics},
  author={Paul Adrien Maurice Dirac},
  isbn={9780198520115},
  series={International series of monographs on physics},
  year={1981},
  publisher={Clarendon Press},
  keywords = {physics}
}

@online{knuthwebsite,
    author    = "Donald Knuth",
    title     = "Knuth: Computers and Typesetting",
    url       = "http://www-cs-faculty.stanford.edu/~uno/abcde.html",
    addendum = "(accessed: 01.09.2016)",
    keywords  = "latex,knuth"
}
```

The .bib file. Acceptable Structures

```
@inbook{knuth-fa,
   author = "Donald E. Knuth",
   title = "Fundamental Algorithms",
   publisher = "Addison-Wesley",
   year = "1973",
   chapter = "1.2",
   keywords  = "knuth,programming"
}

@article{ctan,
    author  = "George D. Greenwade",
    title   = "The {C}omprehensive {T}ex {A}rchive {N}etwork ({CTAN})",
    year    = "1993",
    journal = "TUGBoat",
    volume  = "14",
    number  = "3",
    pages   = "342--351",
    keywords  = "latex"
}
```

The .bib file. Acceptable Structures

```
@book{latexcompanion,
    author    = "Michel Goossens and Frank Mittelbach and Alexander Samarin",
    title     = "The \LaTeX\ Companion",
    year      = "1993",
    publisher = "Addison-Wesley",
    address   = "Reading, Massachusetts",
    keywords  = "latex"
}

@book{knuth-acp,
   author = "Donald E. Knuth",
   publisher = "Addison-Wesley",
   title = "The Art of Computer Programming",
   series = "Four volumes",
   year = "1968",
   note = "Seven volumes planned",
   keywords  = "knuth,programming"
}
```

For more information on bibstyles and syntax :

`https://en.wikipedia.org/wiki/BibTeX`

(one of multiple sources available).

Example of .bib file

refs.bib

refs.bib

```
@article{einstein,
  author =       "Albert Einstein",
  title =        "{Zur Elektrodynamik bewegter K{\"o}rper}. ({German})
                 [{On} the electrodynamics of moving bodies]",
  journal =      "Annalen der Physik",
  volume =       "322",
  number =       "10",
  pages =        "891--921",
  year =         "1905",
  DOI =          "http://dx.doi.org/10.1002/andp.19053221004",
  keywords =     "physics"
}

@book{dirac,
  title={The Principles of Quantum Mechanics},
  author={Paul Adrien Maurice Dirac},
  isbn={9780198520115},
  series={International series of monographs on physics},
  year={1981},
  publisher={Clarendon Press},
  keywords = {physics}
}

@online{knuthwebsite,
    author    = "Donald Knuth",
    title     = "Knuth: Computers and Typesetting",
    url       = "http://www-cs-faculty.stanford.edu/~uno/abcde.html",
    addendum = "(accessed: 01.09.2016)",
    keywords  = "latex,knuth"
}


@inbook{knuth-fa,
   author = "Donald E. Knuth",
   title = "Fundamental Algorithms",
   publisher = "Addison-Wesley",
   year = "1973",
   chapter = "1.2",
   keywords  = "knuth,programming"
}

@article{ctan,
    author  = "George D. Greenwade",
    title   = "The {C}omprehensive {T}ex {A}rchive {N}etwork ({CTAN})",
    year    = "1993",
    journal = "TUGBoat",
    volume  = "14",
    number  = "3",
    pages   = "342--351",
    keywords  = "latex"
}


@book{latexcompanion,
    author    = "Michel Goossens and Frank Mittelbach and Alexander Samarin",
    title     = "The \LaTeX\ Companion",
    year      = "1993",
    publisher = "Addison-Wesley",
    address   = "Reading, Massachusetts",
    keywords  = "latex"
}
```

The bibtex bibliography management 1/2

tex

```
\documentclass{article}
\title{Bibliography management: plain
\texttt{bibtex}}
\begin{document}
\maketitle

This document is an example of plain
bib\TeX bibliography
management. Three items are cited:
\textit{The \LaTeX\ Companion} book
\cite{latexcompanion}, the Einstein
journal paper \cite{einstein}, and the
Donald Knuth's website \cite{knuthwebsite}.
The \LaTeX\ related items are
\cite{latexcompanion,knuthwebsite}.
\LaTeX{} \cite{lamport94} is a set of
macros built atop \TeX{} \cite{texbook}.
\medskip
\begin{thebibliography}{9}
\bibitem{texbook} Donald E. Knuth (1986)
\emph{The \TeX{} Book},  Addison-Wesley
Professional.

\bibitem{lamport94}
Leslie Lamport (1994) \emph{\LaTeX: a document
preparation system}, Addison Wesley,
Massachusetts, 2nd ed.\end{thebibliography}
\end{document}
%only entries of latex2e /textbook are declared.
```

pdf

Bibliography management: plain **bibtex**

November 13, 2022

This document is an example of plain bibTEXbibliography management. Three items are cited: *The LATEX Companion* book [?], the Einstein journal paper [?], and the Donald Knuth's website [?]. The LATEX related items are [?, ?].

LATEX [2] is a set of macros built atop TEX [1].

References

[1] Donald E. Knuth (1986) *The TEX Book*, Addison-Wesley Professional.

[2] Leslie Lamport (1994) *LATEX: a document preparation system*, Addison Wesley, Massachusetts, 2nd ed.

The bibtex bibliography management 2/2

tex

```
\documentclass{article}
\title{Bibliography management: plain
\texttt{bibtex}}
\begin{document}
\maketitle

This document is an example of plain
bib\TeX bibliography
management. Three items are cited:
\textit{The \LaTeX\ Companion} book
\cite{latexcompanion}, the Einstein
journal paper \cite{einstein}, and the
Donald Knuth's website \cite{knuthwebsite}.
The \LaTeX\ related items are
\cite{latexcompanion,knuthwebsite}.

\LaTeX{} \cite{lamport94} is a set of
macros built atop \TeX{} \cite{texbook}.
\medskip

\bibliography{refs}
\bibliographystyle{plain}

\end{document}

%no entries of latex2e /tex-book were
found in bib file.
```

pdf

Bibliography management: plain **bibtex**

November 13, 2022

This document is an example of plain bibTEXbibliography management. Three items are cited: *The LATEX Companion* book [2], the Einstein journal paper [1], and the Donald Knuth's website [3]. The LATEX related items are [2, 3].

LATEX [?] is a set of macros built atop TEX [?].

References

[1] Albert Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905.

[2] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The LATEX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[3] Donald Knuth. Knuth: Computers and typesetting.

The natbib package 1/2

tex

```
\documentclass{article}
\usepackage{natbib}
\bibliographystyle{abbrvnat}

\title{Bibliography management:
 \texttt{natbib} package}

\begin{document}

\maketitle

This document is an example of \texttt{natbib}
package using in bibliography management. Three
items are cited: \textit{The \LaTeX\ Companion}
 book \cite{latexcompanion}, the Einstein
 journal paper \citet{einstein}, and the Donald
 Knuth's website \cite{knuthwebsite}. The
 \LaTeX\ related items are
 \cite{latexcompanion,knuthwebsite}.

\medskip

\bibliography{refs}

\end{document}
```

pdf

Bibliography management: **natbib** package

November 13, 2022

This document is an example of **natbib** package using in bibliography management. Three items are cited: *The LaTeX Companion* book Goossens et al. [1993], the Einstein journal paper Einstein [1905], and the Donald Knuth's website Knuth. The LaTeX related items are Goossens et al. [1993], Knuth.

References

A. Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905. doi: http://dx.doi.org/10.1002/andp.19053221004.

M. Goossens, F. Mittelbach, and A. Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

D. Knuth. Knuth: Computers and typesetting. URL `http://www-cs-faculty.stanford.edu/ uno/abcde.html`.

The natbib package 2/2

tex

```
\documentclass{article}
\usepackage[square,numbers]{natbib}
\bibliographystyle{abbrvnat}

\title{Bibliography management:
 \texttt{natbib} package}

\begin{document}

\maketitle

This document is an example of \texttt{natbib}
package using in bibliography management. Three
items are cited: \textit{The \LaTeX\ Companion}
 book \cite{latexcompanion}, the Einstein
 journal paper \citet{einstein}, and the Donald
 Knuth's website \cite{knuthwebsite}. The
 \LaTeX\ related items are
 \cite{latexcompanion,knuthwebsite}.

\medskip

\bibliography{refs}

\end{document}
```

pdf

Bibliography management: **natbib** package

November 13, 2022

This document is an example of **natbib** package using in bibliography management. Three items are cited: *The LaTeX Companion* book [2], the Einstein journal paper Einstein [1], and the Donald Knuth's website [3]. The LaTeX related items are [2, 3].

References

[1] A. Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905. doi: http://dx.doi.org/10.1002/andp.19053221004.

[2] M. Goossens, F. Mittelbach, and A. Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[3] D. Knuth. Knuth: Computers and typesetting. URL `http://www-cs-faculty.stanford.edu/ uno/abcde.html`.

Table of Contents I

Figures

tex

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

\begin{document}

Some text before figure.

\begin{figure}[h]
    \centering
    \includegraphics[width=0.5\textwidth]
     {antteam.jpg}
    \caption{Teamwork ! }
    \label{fig: ants}
\end{figure}
As you can see in Figure \ref{fig: ants}, there
are four ants. Note that the option
\{\texttt{width=0.5 $\backslash$ textwidth}\}
sets the width size of figure equal to 50\%
of the width of test.
\end{document}
```

pdf

Some text before figure.

Figure 1: Teamwork !

As you can see in Figure 1, there are four ants. Note that the option {`width=0.5 \ textwidth`} sets the width size of figure equal to 50% of the width of test.

Figures : Synopsis of `\includegraphics` syntax

Includes a graphics file.

`\includegraphics[options]{filename}`

(some) examples of `options`

- `width` : bounding box is this `width`. Example: `[width=1in]`.
- `height`: bounding box is this `height`.
- `keepaspectratio` : If set to true, or just specified as here `\includegraphics[...,keepaspectratio,...]...`, LaTeXwill adjust graphic dimensions as much as possible but without distortion.
- `scale` : Factor by which to scale the graphic. Example : `[scale=0.7]`. This number may be any value; a number between 0 and 1 will shrink the graphic and a negative number will reflect it.

Figures : Synopsis of \includegraphics syntax

tex

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

\begin{document}


\begin{center}
  \includegraphics[angle=90,width=1in]{antteam}
  \hspace{1in}
  \includegraphics[width=1in,angle=-45]{antteam}
  \hspace{1in}
  \includegraphics[scale=0.3]{antteam}
\end{center}
\end{document}
```

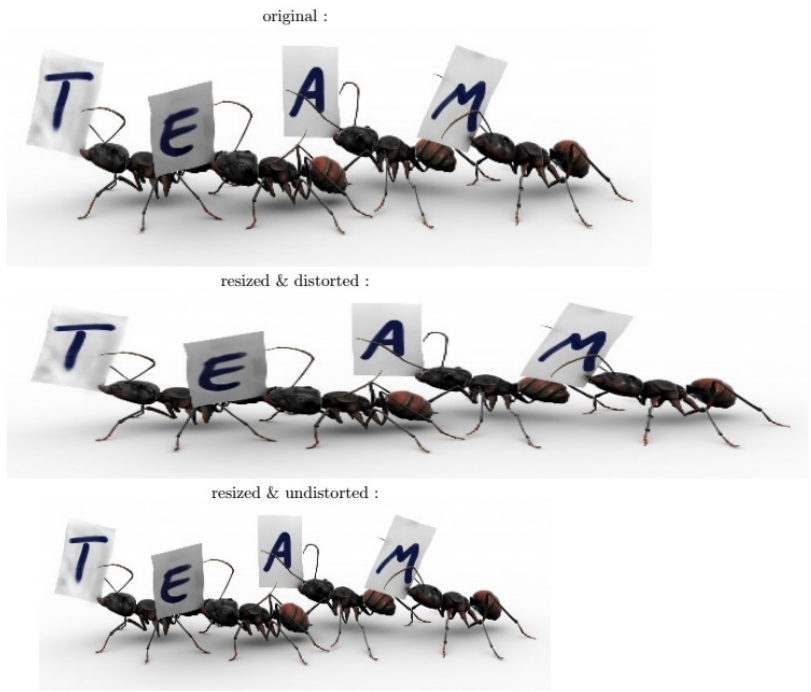
pdf

Figures : Synopsis of \includegraphics syntax

tex

```
\documentclass{article}
\usepackage{graphicx}
\graphicspath{{images/}}
\begin{document}
\begin{center}
original :
  \includegraphics[scale=1]
  {"antteam rescaled image.jpg"}
   \hspace{1in}
   resized \& distorted :
    \includegraphics[width=17cm, height=4cm]
    {"antteam rescaled image.jpg"}
       \hspace{1in}
          resized \& undistorted :
    \includegraphics[width=20cm, height=4cm,
    keepaspectratio]{"antteam rescaled image.jpg"}
\end{center}
\end{document}
```

pdf



Figures within text

tex

```
\documentclass{article}
\usepackage{graphicx,lipsum,xcolor}
\graphicspath{{images/}}

\begin{document}
  {\color{blue} BEGIN} \lipsum[1]
  {\color{red} END}
  \includegraphics[width=1in]{antteam}
  {\color{green} BEGIN}
  \lipsum[2]  {\color{orange} END}
  \includegraphics[width=1in,angle=-45]{antteam}
  {\color{cyan} END}
  \lipsum[3] {\color{brown} END}
  \includegraphics[scale=0.2]{antteam}
\end{document}
```

pdf

BEGIN Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. END  BEGIN Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris. END  END Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. END 

The `figure` environment

- ✓ The combination of text and images may not look as expected.
- ✓ To change this we need to introduce a new environment: `figure`.
- ✓ The `figure` environment is used to display pictures as floating elements within the document.
- ✓ This means you include the picture inside the figure environment and you don't have to worry about it's placement,
- ✓ LaTeX will position it in a such way that it fits the flow of the document.
- ✓ Extra features such as `label` and `caption` enhance practicality, readability.

The figure environment

tex

```
\documentclass{article}
\usepackage{graphicx,lipsum,xcolor}
\graphicspath{{images/}}

\begin{document}
  {\color{blue} BEGIN} \lipsum[1]
  {\color{red} END}
\begin{figure}[t]
 \includegraphics[width=1in]{antteam}
 \caption{This is the first figure}
\end{figure}
  {\color{green} BEGIN}
  \lipsum[2]  {\color{orange} END}
\begin{figure}[b]
  \includegraphics[width=1in,angle=-45]{antteam}
  \caption{This is the second figure}
\end{figure}
  {\color{cyan} END}
  \lipsum[3] {\color{brown} END}
  \lipsum[4] \lipsum[5]  \lipsum[6]
\lipsum[7]\begin{figure} \centering
  \includegraphics[scale=0.2]{antteam}
\end{figure}
\lipsum[8]
\end{document}
```

pdf

Figure 1: This is the first figure

BEGIN Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. END BEGIN Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris. END END Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. END Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In

Figure 2: This is the second figure

hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula. Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer. Suspendisse vel felis. Ut lorem lorem, interdum eu, tincidunt sit amet, laoreet vitae, arcu. Aenean faucibus pede eu ante. Praesent enim elit, rutrum at, molestie non, nonummy vel, nisl. Ut lectus eros, malesuada sit amet, fermentum eu, sodales cursus, magna. Donec eu purus. Quisque vehicula, urna sed ultricies auctor, pede lorem egestas dui, et convallis elit erat sed nulla. Donec luctus. Curabitur et nunc. Aliquam dolor odio, commodo pretium, ultricies non, pharetra in, velit. Integer arcu est, nonummy in, fermentum faucibus, egestas vel, odio. Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetuer at, consectetuer sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

The figure environment

```
\begin{figure}[options]
\includegraphics[width=8cm]{someplotfilename}
\centering %to center graphic within the figure environment
\end{figure}
```

options	action
h	Place the float (approx.) here
t	Position at the top of the page
b	Position at the bottom of the page
p	Put on a special page
!	Override internal parameters

If we want to place figure *exactly* in code location we can combine options `h` and `!` as:

```
\begin{figure}[h!]...
```

Digression : The table environment

tex

```
\documentclass{article}
\begin{document}
Using the \texttt{table} environment we can
create tables with caption and label indexing
for reference.
\begin{table}[h!]
\centering
\centering
\begin{tabular}{||l c r ||}
 \hline
 LeftAligned  & Centered & RightAligned \\ [0.5ex]
 \hline\hline
 1 & 3 & 5  \\
 \hline
 2 & 4 & 6  \\
 \hline
\end{tabular}
\caption{Table to test captions \& labels.}
\label{table:1}
\end{table}

To refer Table \ref{table:1} we write:
%
begin{verbatim}
 \ref{table:1}.
end{verbatim}
The options of the  \texttt{table} environment
are similar to \texttt{figure} environment.
\end{document}
```

pdf

Using the table environment we can create tables with caption and label indexing for reference.

LeftAligned	Centered	RightAligned
1	3	5
2	4	6

Table 1: Table to test captions & labels.

To refer Table 1 we write:

\ref{table:1}.

The options of the table environment are similar to figure environment.

Figures: The wrapfigure environment

tex

```
\documentclass{article}
\usepackage{graphicx,lipsum,wrapfig}
\graphicspath{{images/}}

\begin{document}
 \lipsum[1]  \emph{flag 1}
\begin{wrapfigure}{r}{0.55\textwidth}
 \includegraphics[width=0.25
 \textwidth]{antteam}
 \centering
 \caption{This is the first figure}
\end{wrapfigure}
\lipsum[2]  \emph{\textbf{flag 2}}
\lipsum[3]

%the line above was left intentionally
%empty, otherwise it would mess up the
%position of the second figure, try it.
  \begin{wrapfigure}{l}{0.25\textwidth}
  \includegraphics[width=0.25\textwidth,
  angle=-45]{antteam}
  \caption{This is the second figure}
\end{wrapfigure}
  \textit{\textbf{flag 3}} \lipsum[4]
  \emph{\underline{flag 4}} \lipsum[5]
\end{document}
```

pdf

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. *flag 1* Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet

Figure 1: This is the first figure

magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris. ***flag 2*** Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Figure 2: This is the second figure

flag 3 Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula. *flag 4* Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor.

1

Table of Contents I

Mathematical expressions in LaTeX

tex

```
\documentclass[12pt, letterpaper]{article}
\usepackage{amsmath}
\begin{document}
\LaTeX{} supports different representation of
mathematical expressions and several math
related packages. In line equations, such as
$(a+b)^2=a^2+2ab+b^2$ are those presented inline
with the text. Another form is with the
\texttt{equation} environment
\begin{equation}
(a+b)^2=a^2+2ab+b^2
\end{equation}
If we don't want to use indexes we can use
the bracket $\backslash$[ .... $\backslash$]:
\[
(a+b)^2=a^2+2ab+b^2
\]
\end{document}
```

pdf

LaTeX supports different representation of mathematical expressions and several math related packages. In line equations, such as $(a+b)^2=a^2+2ab+b^2$ are those presented inline with the text. Another form is with the `equation` environment

$$(a+b)^2=a^2+2ab+b^2 \tag{1}$$

If we don't want to use indexes we can use the bracket \[.... \]:

$$(a+b)^2=a^2+2ab+b^2$$

Scripting can be a matter of taste.

Equivalence of math modes

1. Inline math
   - `$ ... $`
   - `\( ... \)`
   - `\begin{math}...\end{math}`

   Example : It is well known that $1 + 1 = 2$ hold true.
2. Display math
   - `$$ ... $$`
   - `\[ ... \]`
   - `\begin{displaymath} ... \end{displaymath}`
   - `\begin{equation} ... \end{equation}`

   Example : It is well known that

$$1 + 1 = 2$$

   hold true.

Basic math-related packages

* amsmath provides miscellaneous enhancements for improving the information structure and printed output of documents containing mathematical formulas. Some of the features provided by this package are:
  1. The \ DeclareMathOperator command defines "operator name" commands analogous to \ sin () $= \sin()$ and \ lim $= \lim$.
  2. math structure commands and indexing commands e.g., eqnarray, tag, eqref, text, etc...
* amsthm helps to define theorem-like structures.
* amssymb provides an extended symbol collection.

Mathematical expressions in LaTeX

tex

```
\documentclass[12pt, letterpaper]{article}
\usepackage{amsmath,amssymb,amsthm}
\newtheorem{lem}{Lemma}
\newtheorem{thm}{Theorem}
\begin{document}
We write a text with mathematical formulae
and thoughts. We use either inline equations
$x^2+1=0$ or equations in display math mode
$$x^2+1=0 ~ \Leftrightarrow ~  x =
\pm \sqrt{-1} = \pm i$$ A tagged equation
\begin{equation}\label{eq: euler} \tag{Euler}
e^{ix}=\cos(x) + i\,\sin(x)\,~~~
\forall\, x \, \in\,  \mathbb R
\end{equation} where $i^2=-1$, can be
referred to as Equation  \eqref{eq: euler}.
\begin{thm}\label{thm: result}
Reality can meet Imagination.
\end{thm}
[...]
```

pdf

We write a text with mathematical formulae and thoughts. We use either inline equations $x^2+1=0$ or equations in display math mode

$$x^2+1=0 \;\Leftrightarrow\; x=\pm\sqrt{-1}=\pm i$$

A tagged equation

$$e^{ix}=\cos(x)+i\,\sin(x) \quad \forall\, x \in \mathbb{R} \tag{Euler}$$

where $i^2=-1$, can be referred to as Equation (Euler).

Theorem 1. *Reality can meet Imagination.*

Proof of Theorem 1. From (Euler), we have for $x=\frac{\pi}{2}$:

$$e^{i\frac{\pi}{2}}=\cos\left(\frac{\pi}{2}\right)+i\,\sin\left(\frac{\pi}{2}\right)=i \tag{1}$$

if we uplift both sides of Eq. (1) to the power of i, we have $e^{i^2\frac{\pi}{2}}=i^i \;\Leftrightarrow$

$$e^{-\frac{\pi}{2}}=i^i.$$

Last equation shows a real number to be equal to an imaginary number. □

Mathematical expressions in LaTeX

tex

```
[....]
\begin{proof}[Proof of Theorem
\ref{thm: result}]
From \eqref{eq: euler}, we have for
$x=\frac{\pi}{2}$:
\begin{equation}\label{eq: 3}
e^{i\frac{\pi}{2}} = \cos\bigg(
\frac{\pi}{2}\bigg) + i\, \sin \bigg(
 \frac{\pi}{2}\bigg) = i \end{equation} if we
 uplift both sides of Eq. \eqref{eq: 3}
 to the power of $i$, we have \( e^{i^2
  \frac{\pi}{2}} = i^i ~~\Leftrightarrow  \)
{\Huge \[  e^{-\frac{\pi}{2}} = i^i .  \] }
Last equation shows a real number to be equal
 to an imaginary number.
\end{proof}
\end{document}
```

pdf

We write a text with mathematical formulae and thoughts. We use either inline equations $x^2+1=0$ or equations in display math mode

$$x^2+1=0 \;\Leftrightarrow\; x=\pm\sqrt{-1}=\pm i$$

A tagged equation

$$e^{ix}=\cos(x)+i\,\sin(x) \quad \forall\, x\in\mathbb{R} \tag{Euler}$$

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Theorem 1. *Reality can meet Imagination.*

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Last equation shows a real number to be equal to an imaginary number. □

Mathematical expressions in LaTeX

tex

```
\documentclass[12pt, letterpaper]{article}
\usepackage{amsmath,amssymb,amsthm}
\newtheorem{lem}{Lemma}
\newtheorem{thm}{Theorem}
\begin{document}

Examples of Equations

\begin{eqnarray}
a_1&=&1 \\
a_2&=&1 \\
a_3&=&2 \cdots  \\
a_{n+1}&=&a_{n}+a_{n-1},~~~~\forall\, n\geq 2
\end{eqnarray}

$$\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+
\sqrt{2+\sqrt{2+\cdots}}}}}}} \rightarrow 2 $$

\begin{equation}
\int_{-\infty}^{+\infty} e^{-x^2} \, dx =

\sqrt{\pi}
\end{equation}


[....]
```

pdf

Examples of Equations

$$\begin{aligned} a_1 &= 1 && (1)\\ a_2 &= 1 && (2)\\ a_3 &= 2\cdots && (3)\\ a_{n+1} &= a_n + a_{n-1}, \quad \forall\, n \geq 2 && (4) \end{aligned}$$

$$\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\cdots}}}}}}} \rightarrow 2$$

$$\int_{-\infty}^{+\infty} e^{-x^2}\, dx = \sqrt{\pi} \qquad (5)$$

Matrix with brackets $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ or with parentheses $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$

$$\sum_{n=1}^{\infty} \frac{1}{n^\alpha} = \begin{cases} \zeta(\alpha) \in \mathbb{R}, & \text{if} \quad \alpha > 1 \\ \infty, & \text{if} \quad \alpha = 1 \end{cases}$$

Where $\zeta(\alpha)$ is the Riemann function. The function can be written as a converging summation or integral:

$$\zeta(\alpha) = \sum_{n=1}^{\infty} \frac{1}{n^\alpha} = \frac{1}{\Gamma(\alpha)} \lim_{t\to\infty} \int_0^t \frac{x^{\alpha-1}}{e^x - 1}\, dx$$

and $\Gamma(\cdot)$ is the Gamma function, defined as

$$\Gamma(\alpha) = \int_0^{\infty} e^{-x} x^{\alpha-1}\, dx.$$

Mathematical expressions in LaTeX

tex

```
[....]
\begin{equation*} \text{Matrix with brackets}
\begin{bmatrix}
1 & 2 \\ 3 & 4
\end{bmatrix} \text{or with parentheses}
\begin{pmatrix}
1 & 2 \\ 3 & 4
\end{pmatrix}
\end{equation*}
$$ \sum_{n=1}^\infty \frac{1}{n^\alpha} =
\begin{cases}
\zeta(\alpha) \in \mathbb R ,~~~  & \text{if}
~~~\alpha >1 \\ \infty ,~~~ & \text{if}~~~
\alpha =1 \end{cases}  $$
Where $\zeta(\alpha)$ is the Riemann function.
The function can be written as a converging
summation or integral: $$\zeta(\alpha)=
\sum_{n=1}^{\infty}\frac{1}{n^{\alpha}} =
 \frac{1}{\Gamma(\alpha)}\lim_{t\rightarrow\infty}
 \int_{0}^t \frac{x^{\alpha-1}}{e^{x}-1}\,dx $$
 and $\Gamma(\cdot)$ is the Gamma function,
 defined  as $$\Gamma(\alpha)=
 \int_{0}^{\infty}e^{-x}  x^{\alpha-1}\,dx.$$
\end{document}
```

pdf

Examples of Equations

$$\begin{aligned} a_1 &= 1 && (1)\\ a_2 &= 1 && (2)\\ a_3 &= 2\cdots && (3)\\ a_{n+1} &= a_n + a_{n-1}, \quad \forall\, n \geq 2 && (4) \end{aligned}$$

$$\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\cdots}}}}}}} \to 2$$

$$\int_{-\infty}^{+\infty} e^{-x^2}\,dx = \sqrt{\pi} \qquad (5)$$

Matrix with brackets $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ or with parentheses $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$

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and $\Gamma(\cdot)$ is the Gamma function, defined as

$$\Gamma(\alpha) = \int_0^{\infty} e^{-x} x^{\alpha-1}\,dx.$$

Mathematical expressions in LaTeX

tex

```
\documentclass[12pt, letterpaper]{article}
\usepackage{amsmath,amssymb,amsthm}
\newtheorem{lem}{Lemma}
\newtheorem{thm}{Theorem}
\begin{document}

Examples of Equations (cont'd)

%%
Linear system in matrix form:
 $$\begin{pmatrix}
            3  & -10 & 2 \\
            -1 &   7 & 4 \\
            5  &   0 & 1
        \end{pmatrix}
        \begin{pmatrix}
            x\\ y\\ z
        \end{pmatrix}
        =
        \begin{pmatrix}
           3x-10y+2z \\
           -x+7y+4z \\
           5x+z
        \end{pmatrix}$$


   [....]

\end{document}
```

pdf

Examples of Equations (cont'd)
Linear system in matrix form:

$$\begin{pmatrix} 3 & -10 & 2 \\ -1 & 7 & 4 \\ 5 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3x - 10y + 2z \\ -x + 7y + 4z \\ 5x + z \end{pmatrix}$$

Linear system in equations form:

$$\begin{array}{rrrrcl} 3x_1 & -2x_2 & +x_3 & -x_4 & = & 7 \\ -x_1 & & -5x_3 & +2x_4 & = & 2 \\ & x_2 & +2x_3 & & = & 0 \\ 2x_1 & +3x_2 & & -5x_4 & = & -1 \end{array}$$

Augmented matrix

$$\left(\begin{array}{cccc|c} 3 & -2 & 1 & -1 & 7 \\ -1 & 0 & -5 & 2 & 2 \\ 0 & 1 & 2 & 0 & 0 \\ -2 & 3 & 0 & -5 & -1 \end{array}\right)$$

Product/Chain rule:

$$\begin{aligned} \frac{d}{dx}(x\sin(x^2)) &= x\frac{d}{dx}(\sin(x^2)) + \sin(x^2)\frac{d}{dx}(x) \\ &= x\cos(x^2)\frac{d}{dx}(x^2) + \sin(x^2) \\ &= x\cos(x^2)2x + \sin(x^2) \\ &= 2x^2\cos(x^2) + \sin(x^2) \end{aligned}$$

Mathematical expressions in LaTeX

tex

```
[....]

Linear system in equations form:

$$\begin{matrix}
3x_1 & -2x_2 &  +x_3 &  -x_4 & = & 7\\
 -x_1 &       & -5x_3 & +2x_4 & = & 2\\
  &   x_2 & +2x_3 &       & = & 0\\
 2x_1 & +3x_2 &       & -5x_4 & = & -1
\end{matrix}$$
Augmented matrix

 $$\left( \begin{array}{cccc|c}
 3 & -2 &  1 & -1 &  7\\
-1 &  0 & -5 &  2 &  2\\
 0 &  1 &  2 &  0 &  0\\
-2 &  3 &  0 & -5 & -1
 \end{array} \right)$$

 Product/Chain rule:
\begin{align*}
\frac{d}{dx}(x\sin(x^2))&=x\frac{d}{dx}(\sin(x^2))
+ \sin(x^2)\frac{d}{dx}(x) \\
&= x\cos(x^2)\frac{d}{dx}(x^2) + \sin(x^2)\\
 &= x\cos(x^2)2x + \sin(x^2)\\
&= 2x^2\cos(x^2) + \sin(x^2)
\end{align*}
\end{document}
```

pdf

Examples of Equations (cont'd)
Linear system in matrix form:

$$\begin{pmatrix} 3 & -10 & 2 \\ -1 & 7 & 4 \\ 5 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3x - 10y + 2z \\ -x + 7y + 4z \\ 5x + z \end{pmatrix}$$

Linear system in equations form:

$$\begin{matrix} 3x_1 & -2x_2 & +x_3 & -x_4 & = & 7 \\ -x_1 & & -5x_3 & +2x_4 & = & 2 \\ & x_2 & +2x_3 & & = & 0 \\ 2x_1 & +3x_2 & & -5x_4 & = & -1 \end{matrix}$$

Augmented matrix

$$\left(\begin{array}{cccc|c} 3 & -2 & 1 & -1 & 7 \\ -1 & 0 & -5 & 2 & 2 \\ 0 & 1 & 2 & 0 & 0 \\ -2 & 3 & 0 & -5 & -1 \end{array} \right)$$

Product/Chain rule:

$$\begin{aligned} \frac{d}{dx}(x\sin(x^2)) &= x\frac{d}{dx}(\sin(x^2)) + \sin(x^2)\frac{d}{dx}(x) \\ &= x\cos(x^2)\frac{d}{dx}(x^2) + \sin(x^2) \\ &= x\cos(x^2)2x + \sin(x^2) \\ &= 2x^2\cos(x^2) + \sin(x^2) \end{aligned}$$

Math in LaTeX- Further Reading

- ✓ List of Greek Letters & Symbols (clickable link)
- ✓ CTAN `amsmath` package (clickable link)
- ✓ Tutorial of the `amssymb` package (clickable link)
- ✓ Tutorial of the AMS `amsthm` package (clickable link)
- ✓ References [4, 5, 6].
- ✓ Multiple online material and books available for free.

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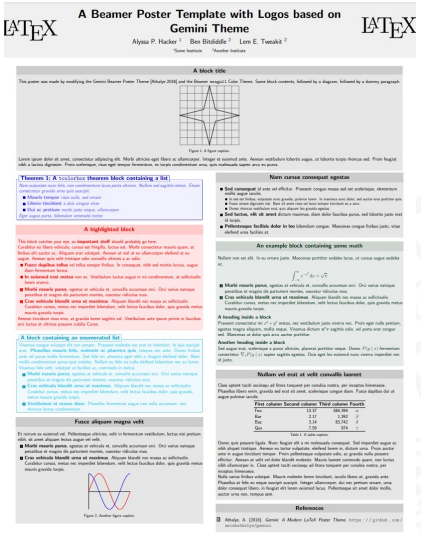
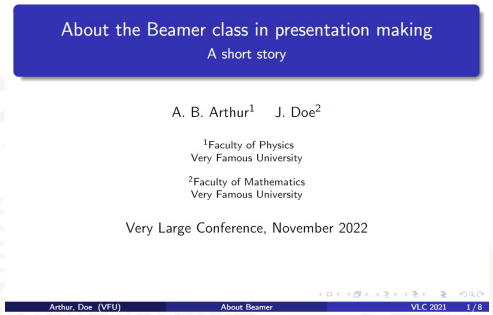
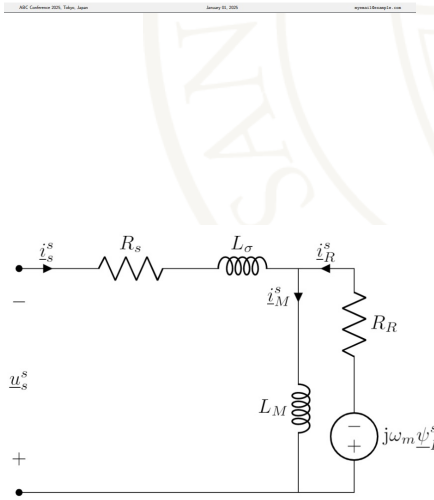
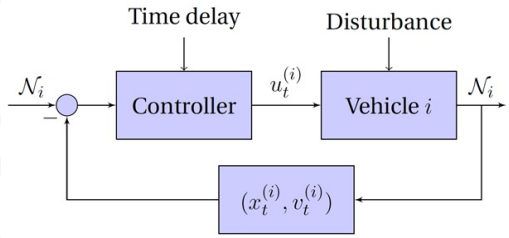
Further/Advanced Topics

- ✓ Beamer (a LaTeX- based environment for slide-deck presentations (like the present one)
- ✓ Conference Posters
- ✓ Graphics in LaTeX: The `picture` and `TikZ` environments.
- ✓ The `CircuiTikz` package
- ✓ Typesetting exams in LaTeX
- ✓ Formal letters, Resumes and other templates.
- ✓ Create your own document class.
- ✓ Create your own packages.
- ✓ IguanaTeX in MS-PowerPoint (not advanced....try it !)









Troubleshooting / Frequent Errors

1. Not all packages are compatible with each other.
2. Often times, you make a mistake when creating a document. You will notice the log file reporting a problem.
3. There are some common mistakes:
   - “begin" not followed by “end"
   - Using commands from packages not defined in the preamble.
   - Do not generate files that are already open somewhere else (e.g. pdf file already open in other reader).
   - Missing number of left/right curly brackets after right/left curly brackets (encapsulation mismatch).
   - Don’t forget \’s.
   - $ doesn’t follow $
4. PC compilers tend to “complain" more cloud based compilers.
5. If errors persist, a cleaning-up of TeX generated files could help.

Take-Home Points

- ✓ The purpose of this presentation is to introduce a software system for academic/scientific, but most of all a *beautiful* typesetting.
- ✓ At the end of the day, this is a standalone software language, with all strings attached.
- ✓ Most significant transitioning involved is this from WYSIWYG processors to software-oriented typesetting.
- ✓ After learning the basics, we will all develop our skillset within the language and evolve with it, to the level of our needs/interests.

Resources

- ✓ TeX and LaTeX related resources [6, 5, 4].
- ✓ CTAN The Comprehensive TeX Archive Network `https://ctan.org/`, and every pdf user's manual of packages.
- ✓ OverLeaf: `https://www.overleaf.com/` (start from here)
- ✓ LaTeX Tutorial (clickable link)
- ✓ `https://tex.stackexchange.com/` for continuous learning and connection with the TeX community.
- ✓ This presentation can be found at: www.csomarakis.com

Thank You !
Questions ?

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