



The L^AT_EX Project

A Brief Introduction

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School of Engineering

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- The L^AT_EX Project
- The Modern Realm



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- Why should I bother with L^AT_EX?

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Table of Contents I

1 Past & Present

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Past & Present : Mother T_EX



Volume 2 / Seminumerical Algorithms

● 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 T_EX



● Late 70's

- ✓ Prof. D. Knuth did not like the looks of his book's new edition.
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- ✓ Knuth envisioned a bridge between computer science and typesetting.

● Early 80's

- ✓ Birth of T_EX digital typographical system.

Past & Present : Mother T_EX

Chapter 1 : The Name of the Game

T_EX is derived from Greek words

$\tau\epsilon\chi\nu$ $o\lambda o\gamma i\alpha$ = technology
 $\tau\acute{e}\chi\nu\eta$ =art

⇒ It is pronounced /tech/ (and not /tek/).

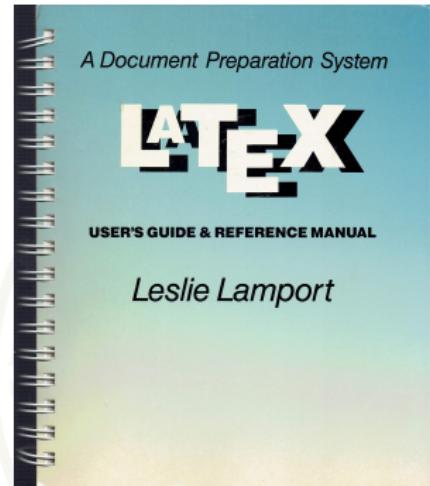
Pronunciation and notation to differentiate from *TEX* (/teks/): the *Text EXecutive* processor developed by Honeywell Information Systems.

Evidently L^AT_EX is pronounced as /LAH-tech/ or /LAY-tech/.

Past & Present : The L^AT_EX Project

● Mid 80's

- ✓ L. Lamport developed macros based on T_EX for his own use.
- ✓ His effort evolved into a stand-alone package for general use.



Past & Present : The L^AT_EX Project

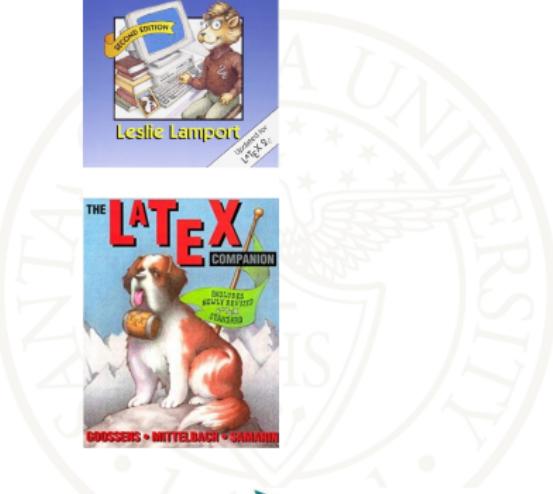
● Mid 80's

- ✓ L. Lamport developed macros based on T_EX for his own use.
- ✓ His effort evolved into a stand-alone package for general use.



● Late 80's

- ✓ L^AT_EX maintenance and development gets delegated to F. Mittelbach and the L^AT_EX 3 group.
- ✓ The L^AT_EX project gets launched.



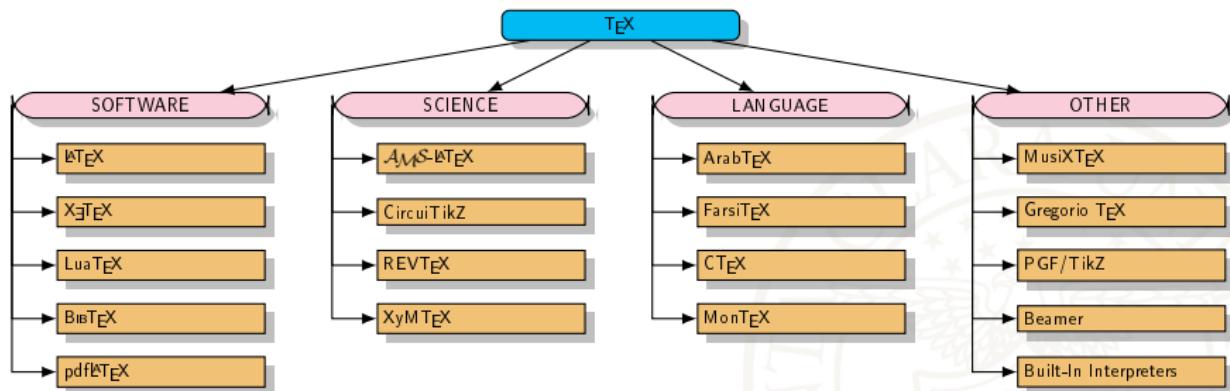
● Mid 90's

- ✓ L^AT_EX 2_E is released.
- ✓ The expl3 is released as package.

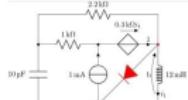
● Further reading : [1] and [2].



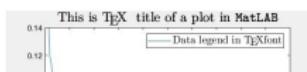
Past & Present : The Modern Realm

X_ET_EX

AMS-LATEX

فارسی^{تک}

PyLaTeX

TeX
latexify.py

گرگوری میندل
Gregor Mendel

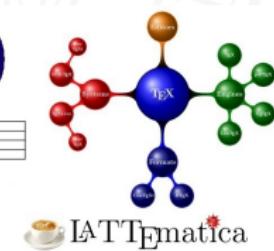


Table of Contents I

2 What, How, Why

- What is L^AT_EX?
- How does L^AT_EX work ?
- Why should I bother with L^AT_EX?



What, How, Why : What is L^AT_EX?

- 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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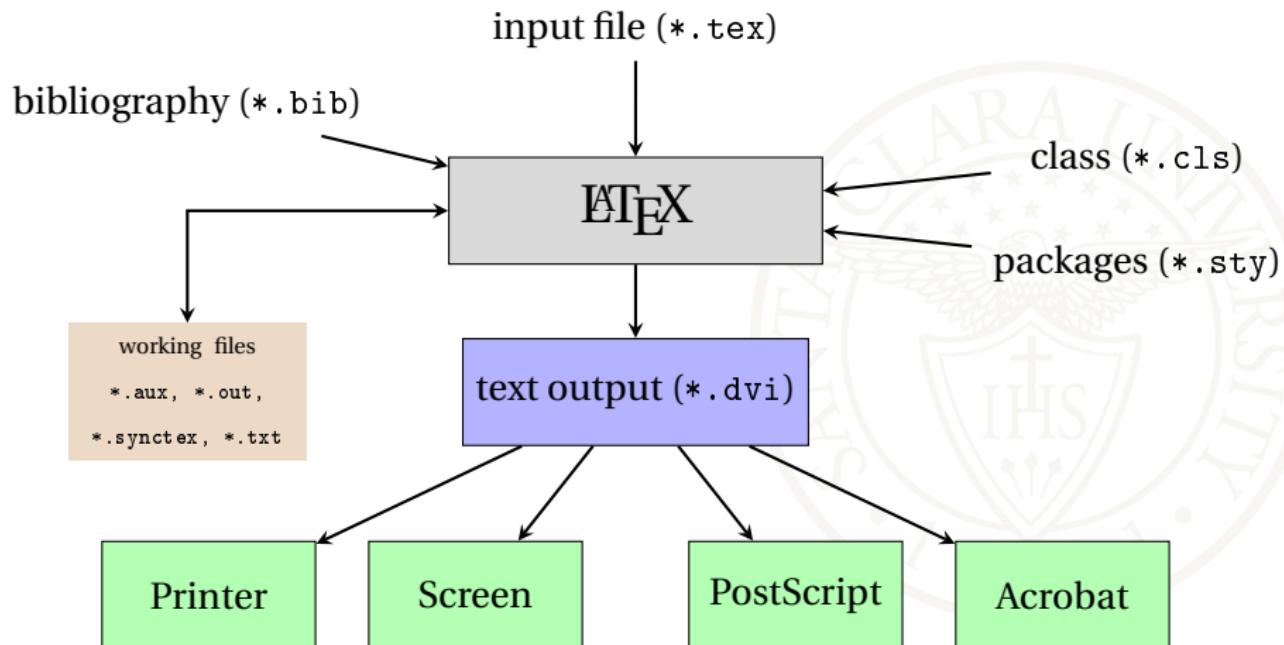
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What, How, Why : How does L^AT_EX work ?



What, How, Why : How does L^AT_EX work ?

● Local Machine

① A T_EX/ L^AT_EX typesetting distribution

- * MiK_T_EX (Windows)
- * T_EX Live (Linux, UNIX-like systems)
- * MacT_EX (T_EX live for macOS)



② A L^AT_EX editor

- * Open source (TeX MAKER , TeX studio)
- * Freeware (LEd)
- * Proprietary/Shareware (Scientific WorkPlace, WinEdt)

● Cloud-based L^AT_EX editor



What, How, Why : Why should I bother about L^AT_EX?

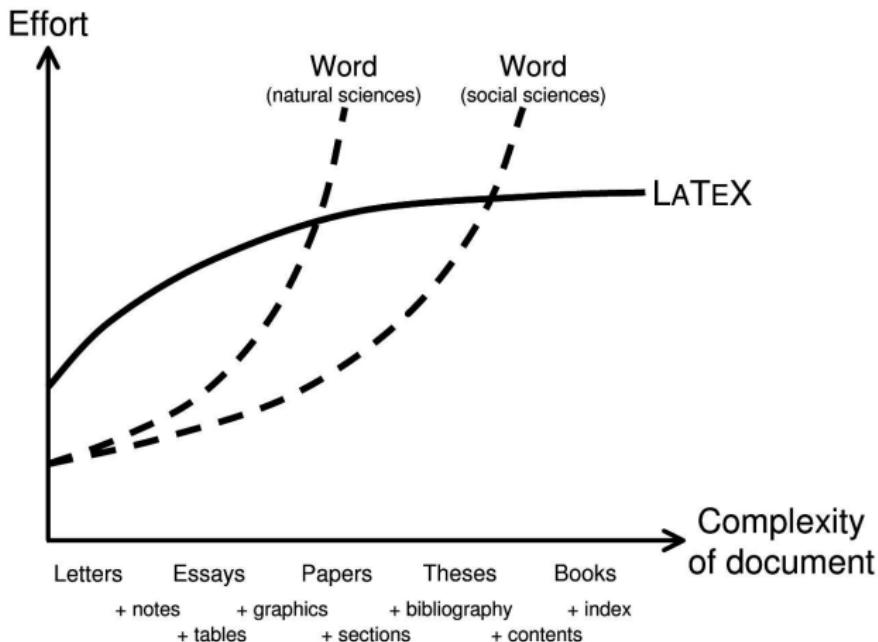


Image Credit [3].

What, How, Why : Why should I bother about L^AT_EX?

Because it is beautiful...



Table of Contents I

3 The Basics

- Hello World !
- The article, book, report built-in classes
- Font Types & Sizes
- Packages & User Defined Commands
- List & Tables
- Extra : Handling Large Projects in L^AT_EX

The Basics : Hello World!

tex

```
\documentclass{article}\begin{document}Hello \LaTeX{} World !\end{document}
```

pdf

Hello L^AT_EX 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 L^AT_EX 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 L^AT_EX 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 L^AT_EX 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, consectetur 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 ultricies. Phasellus en 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 ac, 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 ut, lobortis vitac, 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 tur-

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 L^AT_EX document.

*Funded by my Savings.

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 L^AT_EX document

Ben Dover *

November 14, 2022

We have now added title, author, and date to our L^AT_EX 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 writing¹.

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.

¹This is a footnote.

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	1
	Unnumbered Section	1
2	Second section	1

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

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

Let's talk about \LaTeX{}

Author First Name & Last Name

November 1, 2022

Contents

1 An Introduction to \LaTeX{}	1
1.1 What is \LaTeX{} and what makes it so different?	1
1.2 \LaTeX{}: History	2
1.3 \LaTeX{}: Opening up \TeX{}'s “black box”	3

Chapter 1

An Introduction to \LaTeX{}

Latin ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy enim accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy.

1.1 What is \LaTeX{}?

Latin ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy enim accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy.

Latin ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy enim accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy.

Chapter 2

\LaTeX{}: History

2.1 Introduction

Latin ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy enim accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy.

2.1.1 \LaTeX{}: Opening up \TeX{}'s “black box”

Latin ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy enim accusamus et iusto odio dignissim qui blandit praesent luptatum zzril delenit diam, nonumy.

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.

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	<i>Sample Text 0123</i>
slanted	\textsl{Sample Text 0123}	\slshape	<i>Sample Text 0123</i>
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 \textcolor{brown}{\texttt{\url{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}
\begin{tabular}{|c c|} \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 L^AT_EX 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.

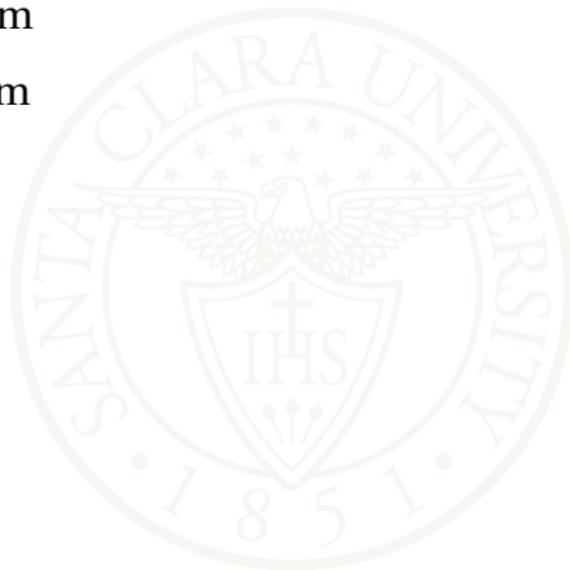
References

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

Table of Contents I

4 Bibliography in L^AT_EX

- The bibT_EX management system
- The natbib management system



Bibliography management in L^AT_EX.

- ✓ It is possible to include references using either of L^AT_EX's major bibliography management programs.
 - ✓ The basic file that includes bibliography information is a file with extension *.bib.
-
- I. bibL^AT_EX: external program that process bibliography information and act (roughly) as the interface between .bib file and L^AT_EX document.
 - II. bibL^AT_EX, natbib : LaTeX packages that format citations and bibliographies.

The .bib file. Acceptable Structures

```
@article{einstein,
    author = "Albert Einstein",
    title = "{Zur Elektrodynamik bewegter K\"orper}. ({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{knotnuthwebsite,
    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
```

```
1 @article{einstein,
2   author = "Albert Einstein",
3   title = "((Der Elektrodynamik bewegter K(\o)rper). ((German))",
4   journal = "Annalen der Physik",
5   volume = "17",
6   number = "10",
7   pages = "891-921",
8   year = "1905",
9   DOI = "https://doi.org/10.1002/andp.19053221004",
10  keywords = "physics"
11 }
12
13
14 @book{dirac,
15   title=(The Principles of Quantum Mechanics),
16   author=(Paul Adrien Maurice Dirac),
17   isbn=(9780198520115),
18   series=(International series of monographs on physics),
19   year=(1930),
20   publisher=(Clarendon Press),
21   keywords = (physics)
22 }
23
24 @online{knotnuthwebsite,
25   author = "Donald Knuth",
26   title = "Stanford Computers and Typesetting",
27   url = "http://www-cs-faculty.stanford.edu/~uno/ahoc.html",
28   addendum = "(accessed: 01.09.2016)",
29   keywords = "latex,knuth"
30 }
31
32
33 @inbook{knotnuth,
34   author = "Donald E. Knuth",
35   title = "Fundamental Algorithms",
36   publisher = "Addison-Wesley",
37   year = "1973",
38   chapter = "1.2",
39   keywords = "knuth,programming"
40 }
41
42 @article{ctan,
43   author = "George D. Greenwade",
44   title = "The Comprehensive (T)ex (A)rchive (N)etwork ((CTAN))",
45   year = "1993",
46   journal = "TUGboat",
47   volume = "14",
48   number = "3",
49   pages = "342-351",
50   keywords = "latex"
51 }
52
53
54 @book{latekcompanion,
55   author = "Michel Goossens and Frank Mittelbach and Alexander Samarin",
56   title = "The \LaTeX{} Companion",
57   year = "1993",
58   publisher = "Addison-Wesley",
59   address = "Redding, Massachusetts",
60   keywords = "latex"
61 }
62
```



The bibtex bibliography management 1/2

tex

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

This document is an example of plain
\textrm{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 /texbook are declared.
```

pdf

Bibliography management: plain bibtex

November 13, 2022

This document is an example of plain bib\TeX{} bibliography 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 bib\TeX{} bibliography management. Three items are cited: *The \LaTeX{} Companion* book [2], the Einstein journal paper [1], and the Donald Knuth's website [3]. The L^AT_EX related items are [2, 3].

L^AT_EX [?] 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}

\titl{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 L^AT_EX Companion* book Goossens et al. [1993], the Einstein journal paper Einstein [1905], and the Donald Knuth's website Knuth. The L^AT_EX 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 L^AT_EX 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 L^AT_EX Companion* book [2], the Einstein journal paper [1], and the Donald Knuth's website [3]. The L^AT_EX 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 L^AT_EX 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

5 Figures



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 , ...]...`, L^AT_EX will
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

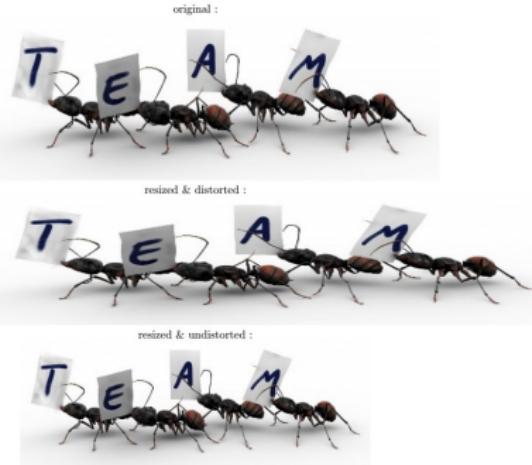


Figures : Synopsis of \includegraphics syntax

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, consectetur 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.

sim 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. Suspendedisse 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 its placement,
- ✓ L^AT_EX 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} \texttt{BEGIN}} \lipsum[1]
    {\color{red} \texttt{END}}
\begin{figure}[t]
\includegraphics[width=1in]{antteam}
\caption{This is the first figure}
\end{figure}
{\color{green} \texttt{BEGIN}}
\lipsum[2] {\color{orange} \texttt{END}}
\begin{figure}[b]
\includegraphics[width=iin,angle=-45]{antteam}
\caption{This is the second figure}
\end{figure}
{\color{cyan} \texttt{END}}
\lipsum[3] {\color{brown} \texttt{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



has habuisse platea dictum. Integer tempore consueta usque. Eiusmod facilis, Non elementum fermentum sis. Aenean pleviat. Ut impedit, satis sed gravius sollicitud. Id est odio pleviat quan, ac pleviat est parie eget estra. Nunc vites tortor. Proin tempore nulli sit ann, sed. Vivisse quis tortor vites. Non vites tortor. Curabitur ante. Volutabam lectus nibh at lectus. Sed hic, portio quis, vivere ac, sene. Praesent ept son vel obitrua tberuan. Aenean facilis. Morbi dolor rilla, molestada en, pulvriar st, nolle se, iolla. Cumdati varice sequitur nulla. Donec varius omni eget risus. Duis nibh mi, omni egestas, nunc. Donec ante. Donec ante. Donec ante. Donec ante. Donec ante. diglossia rutrum. **END BEGIN** Nam dol ligula, fringilla a, estmodi sodic. sedicitibus vel, sis. Morbi auctor lorem non just. Nam laevis libet, peftiam at, lobetis vita, ultricies et, tellus. Donec aliquip, torter sed accutus tberuan. Donec ante. Donec ante. Donec ante. Morbi dolor rilla, molestada en, pulvriar st, nolle se, iolla. Sed curvus mala. Suspedisse at massa. Cive nec est. Pelletope a, nilla. Cum sois natoe, perfrinot et magna da parturient meone, nascetur ridiculus mus. Aliquem tincidunt uras. Nulla ulmocper vestibulum turpi. Pelletope a, nilla. **END BEGIN** Nam dol ligula, fringilla a, estmodi sodic. Donec felis est, congue con, voluptat at, tiscridat tristis, ibens. Vivisse vivere fermentum id. Donec nonmny pelletope nata. Phasmida alitinge sepper est. Proin fermentum natus ne quan. Sed diam, turpis, pede. Hac, portio quis, vivere ac, sene. Praesent ept son vel obitrua tberuan. Non elekted convequt lorem. Sed hebetis nulla vites nra. Pelletope tberuan parie vel magis. Integer nra estra. Praesent euismod nra et parus. Donec ante. Donec ante. Donec ante. Donec ante. Donec ante. Donec ante. Non elupitate metus ne min. Vestibulum pelletope felis en massa. **END** Quisque ullamcorper placent ipsum. Cive nibh. Morbi vel justo vites itinatit utrices. Leem ipsum dol sit amet, connectetur adipiscing est.



Figure 2: This is the second figure

1

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.

`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] \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 telus sit amet tortor gravida placerat. Integer sapien est, lacinulis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu ea, pulvinar at, mollis ac, nulla. Curabitur auuctor 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 auuctor 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 lucius 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 blandii ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eni purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eni massa. Vestibulum pellentesque felis eni.



Figure 1: This is the first figure



Figure 2: This is the second figure

flag 3 Quisque ullamcorper placerat ipsum. Cras nibi. 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 enim. 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 fauci 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.

Table of Contents I

6 Mathematical Expressions in L^AT_EX



Mathematical expressions in L^AT_EX

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
\textrm{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

L^AT_EX 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

$$(a + b)^2 = a^2 + 2ab + b^2 \quad (1)$$

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

- $\$ \dots \$$
- $\backslash(\dots \backslash)$
- $\begin{math} \dots \end{math}$

Example : It is well known that $1 + 1 = 2$ hold true.

② Display math

- $\$\$ \dots \$\$$
- $\backslash[\dots \backslash]$
- $\begin{displaymath} \dots \end{displaymath}$
- $\begin{equation} \dots \end{equation}$

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 L^AT_EX

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

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

\pm \sqrt{-1} = \pm i$ A tagged equation
\begin{equation}\label{eq: euler} \tag{Euler}

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

\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

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

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 $x = \frac{\pi}{2}$:

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

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. \square

Mathematical expressions in L^AT_EX

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\cdot \sin\bigg(
\frac{\pi}{2}\bigg) = i \text{ \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 \text{ \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

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

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

Theorem 1. *Reality can meet Imagination.*

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

Mathematical expressions in L^AT_EX

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 \dots \\
a_{n+1} &=& a_n + a_{n-1}, \quad \forall n \geq 2
\end{eqnarray}
```

```
$$\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\dots}}}}}}} \rightarrow 2 $$
```

```
\begin{equation}
\int_{-\infty}^{+\infty} e^{-x^2} dx = \sqrt{\pi}
\end{equation}
```

[....]

pdf

Examples of Equations

$$a_1 = 1 \tag{1}$$

$$a_2 = 1 \tag{2}$$

$$a_3 = 2 \dots \tag{3}$$

$$a_{n+1} = a_n + a_{n-1}, \quad \forall n \geq 2 \tag{4}$$

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

$$\int_{-\infty}^{+\infty} e^{-x^2} dx = \sqrt{\pi} \tag{5}$$

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

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

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

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

Mathematical expressions in L^AT_EX

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*}
$$ \sum_{n=1}^{\infty} \frac{1}{n^\alpha} = 
\begin{cases} \zeta(\alpha) \in \mathbb{R}, & \alpha > 1 \\ \infty, & \text{otherwise} \end{cases}
\alpha = 1 \end{cases} $$
Where  $\zeta(\alpha)$  is the Riemann function.
The function can be written as a converging
summation or integral:  $\zeta(\alpha) = \lim_{t \rightarrow \infty} \int_0^t e^{-x} x^{\alpha-1} dx$ 
and  $\Gamma(\alpha)$  is the Gamma function,
defined as  $\Gamma(\alpha) = \int_0^\infty e^{-x} x^{\alpha-1} dx$ .
\end{document}
```

pdf

Examples of Equations

$$a_1 = 1 \quad (1)$$

$$a_2 = 1 \quad (2)$$

$$a_3 = 2 \dots \quad (3)$$

$$a_{n+1} = a_n + a_{n-1}, \quad \forall n \geq 2 \quad (4)$$

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

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

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

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

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

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

Mathematical expressions in L^AT_EX

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:

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

Augmented matrix

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

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 L^AT_EX

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{aligned*}
& \frac{d}{dx}(x \sin(x^2)) = x \frac{d}{dx}(\sin(x^2)) + \sin(x^2) \frac{d}{dx}(x) \\
& + \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*}
```

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:

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

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:

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

Math in L^AT_EX- 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 `amstheorem` package ([clickable link](#))
- ✓ References [4, 5, 6].
- ✓ Multiple online material and books available for free.

Table of Contents I

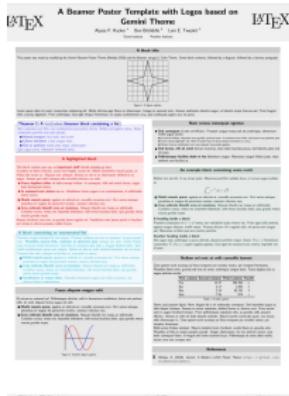
7 Additional / Advanced Topics

- Troubleshooting / Frequent Errors
- Take-Home Points
- Resources



Further/Advanced Topics

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



About the Beamer class in presentation making
A short story

A. B. Arthur¹ J. Doe²

¹Faculty of Physics

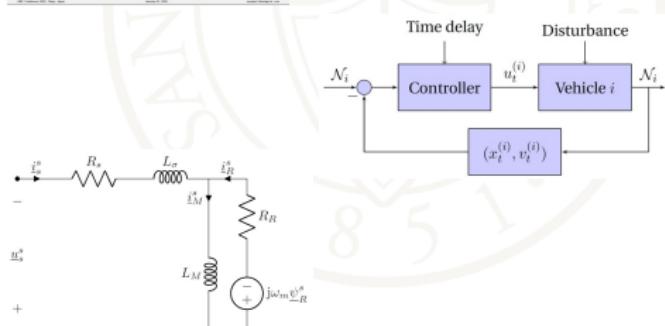
Very Famous University

²Faculty of Mathematics

Very Famous University

Very Large Conference, November 2022

Author: Arthur (2013) About Beamer — L^AT_EX 2021 — 3 / 20



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 than cloud based compilers.
- ⑤ If errors persist, a cleaning-up of T_EX 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

- ✓ T_EX and L^AT_EX 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)
- ✓ L^AT_EX Tutorial (clickable link)
- ✓ <https://tex.stackexchange.com/> for continuous learning and connection with the T_EX community.
- ✓ This presentation can be found at: www.csomarakis.com

Thank You ! Questions ?

csomarak@gmail.com

References

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Quo vadis L^AT_EX (3) Team—A look back and at the upcoming years
TUGboat, Volume 41 (2020), No. 2 201
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-  Lode, C.
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2019 Clemens Lode Verlag
-  Goossens, M., Mittelbach, F., Samarin, A.
The L^AT_EX Companion
1994 Addison-Wesley
-  Mittelbach, F., Goossens, M., Braams, J., Carlisle, D., Rowley, C., Fuller, J.
The L^AT_EX Companion, Ver. 2
2005 Addison-Wesley
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2017 Addison-Wesley