



Introducing Document Preparation with L^AT_EX

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- Preparation of a document involves
 - Entering text
 - **Formatting text**
 - Display on a screen
 - Printing



- Preparation of a document involves
 - Entering text
 - **Formatting text**
 - Display on a screen
 - Printing
- T_EX (T_EX) is a typesetting system.
 - METAFONT – Font description language
 - A point on a glyph is found as the intersection of a line segment and a Bézier cubic curve
 - Computer modern typeface.
 - 62 parameters control the widths and heights of elements

Author of T_EX

Donald Knuth (1978), computer science professor at Stanford

- Math spacing carefully derived based on typesets in:
 - *Acta Mathematica*
 - *Indagationes Mathematicae*
 - Addison-Wesley's books



T_EX and L^AT_EX

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 - *Indagationes Mathematicae*
 - Addison-Wesley's books
- Line breaks
 - A *total-fit* line-breaking algorithm
 - Assigns *badness*. Minimizes SS of badness



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 - Assigns *badness*. Minimizes SS of badness
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 - Removes prefixes and suffixes
 - Will attempt to put a break between consonants in a pattern of the form vowel-consonant-consonant-vowel.



T_EX and L^AT_EX

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L^AT_EX is a set of macros for T_EX

Written by Leslie Lamport (1984), current release L^AT_EX2_ε



Pronunciation and Typesetting of \LaTeX

- no single agreed-upon pronunciation
- \TeX derives from the Greek $\tau\epsilon\chi\nu\eta$, which means “art, skill, craft”
- origin of the name suggests that “X” be pronounced like the “ch” in “technical”
- Options:
 - LAYtek
 - LAHtek
 - LahTEK

In \LaTeX , the symbol is a built-in \LaTeX command \LaTeX . In plain text, it should be spelled L-a-T-e-X.



Why L^AT_EX?

- It is a natural choice if you want to create beautiful output
- A structured system of typesetting. Spend time and effort on content not on layout
- Works across platforms
- Handles math well
- Table of contents, list of figures, bibliography etc.
- Cross-referencing features
- Stable processing engine
- Highly extensible
- Input is plain text
- Output can be anything
- Complete document preparation. Articles, presentations, posters, HTML.



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- **FREE & open source**



L^AT_EX vs. MS Word

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L^AT_EX

Editors

Automation

Prosper

Beamer

Posters

	L ^A T _E X	MS Word
WYSIWYG	×	✓
Platform independent	✓	×
Math	✓	✓
Citations & references	✓	×
Automated TOC, LoF	✓	×
Cross-references	✓	×
Style changes	✓	✓
Multimedia	✓	✓
Free	✓	×



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$$I_{mn}(\lambda) = I_0(\lambda) T_m^2(\lambda) \sum_{p=-\infty}^{\infty} \int_{r_m}^{r_m+w_m} dx \int_{r_m+pT}^{r_m+w_m+pT} \text{PSF}(x-x') dx'$$

$$I_{mn}(\lambda) = I_o(\lambda) T_m^2(\lambda) \sum_{p=-\infty}^{\infty} \int_{r_m}^{r_m+w_m} dx \int_{r_m+pT}^{r_m+w_m+pT} \text{PSF}(x-x') dx'$$



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MS Word Equation Editor

$$I_{mn}(\lambda) = I_o(\lambda) T_m^2(\lambda) \sum_{p=-\infty}^{\infty} \int_{r_m}^{r_m+w_m} dx \int_{r_m+pT}^{r_m+w_m+pT} \text{PSF}(x-x') dx'$$



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Microsoft Word window showing a document titled "cfaHolladay.doc". The document content is as follows:

(a) For the reconstruction of R:

$$\text{At } B: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} \sqrt{2} & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & \sqrt{2} \end{bmatrix}, \text{ at } G: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ \sqrt{2} & 0 & \sqrt{2} \end{bmatrix}, \text{ at } G: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} 0 & 0 & \sqrt{2} \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

(b) For the reconstruction of G:

$$\text{At } B: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} 0 & 1 & \sqrt{2} \\ 0 & 0 & 0 \\ \sqrt{2} & 1 & 0 \end{bmatrix}, \text{ at } R: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} 0 & 0 & \sqrt{2} \\ 1 & 0 & 0 \\ 0 & 1 & \sqrt{2} \end{bmatrix}, \text{ at } R: \frac{1}{(2+2\sqrt{2})} \begin{bmatrix} \sqrt{2} & 1 & 0 \\ 0 & 0 & 1 \\ \sqrt{2} & 0 & 0 \end{bmatrix}$$

(c) For the reconstruction of B:

$$\text{At } R: \frac{1}{(1+\sqrt{2})} \begin{bmatrix} \sqrt{2} & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}, \text{ at } R: \frac{1}{(1+\sqrt{2})} \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & \sqrt{2} \end{bmatrix}$$

$$\text{at } G: \frac{1}{(1+\sqrt{2})} \begin{bmatrix} 0 & 0 & \sqrt{2} \\ 0 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, \text{ at } G: \frac{1}{(1+\sqrt{2})} \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ \sqrt{2} & 0 & 0 \end{bmatrix}$$

The status bar at the bottom shows: Page 5, Sec 1, 4/7, At 1.3", Ln 1, Col 1, REC TRK EXT OVR, English (U.S.)



Packages

	Back-end	Front-end
Windows	MikT _E X , T _E XLive	WinEdt, T _E XnicCenter
Mac	CMacT _E X, OzT _E X	T _E XShop iT _E XMac
Linux	teT _E X, T _E X Live	Kile

CoE Windows labs have:

- MikT_EX
- T_EXnicCenter



To install L^AT_EX on your PC you need:

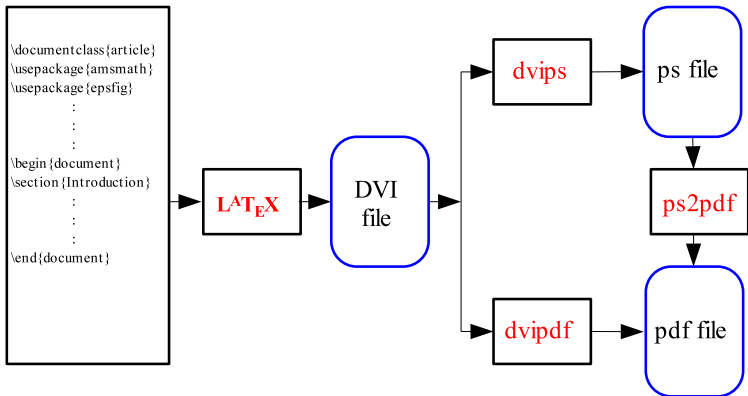
- **The back-end:** The base T_EX package
 - Windows
 - (MikT_EX). Available at [the MikT_EX](#) homepage
 - T_EXLive
 - Ghostscript, Ghostview, and GSview.
- **The front-end:** A L^AT_EX editor (WinEdt, T_EXnicCenter)
 - WinEdt: evaluation version. T_EXnicCenter: free
 - Available at [the WinEdt](#) homepage or at [Sourceforge.net](#)



The downside

There are certain “disadvantages”

- Somewhat steep learning curve
- Not interactive. Have to use pre-viewer before finalizing document
- Difficult to create your own document type



`pdflatex` is an alternative workflow that goes straight from the `*.tex` file to a PDF file.



Getting started

```
\documentclass{article}
```

```
\begin{document}
```

```
\section{Introduction}
```

The conditional probability of an event A assuming another event M , denoted by $P(A \setminus, |M)$, is by definition the ratio

```
\begin{align}P(A \setminus, |M) &= \frac{P(AM)}{P(M)} \\ \end{align}
```

```
\subsection{Bayes's theorem}
```

Bayes's theorem for probability densities is given by:

```
\begin{align}p(x|y) &= \frac{p(y|x)p(x)}{p(y)} \\ \end{align}
```

```
\end{document}
```



The screenshot shows a LaTeX Beamer presentation slide titled "1 Introduction". The slide content is as follows:

1 Introduction

The conditional probability of an event A assuming another event M , denoted by $P(A|M)$, is by definition the ratio

$$P(A|M) = \frac{P(AM)}{P(M)} \tag{1}$$

1.1 Bayes's theorem

Bayes's theorem for probability densities is given by:

$$p(x|y) = \frac{p(y|x)p(x)}{p(y)} \tag{2}$$

The screenshot also shows the window title "Yap - [seminarExample.dvi]", a menu bar with "File View Tools Window Help", a toolbar with navigation icons, and a status bar at the bottom indicating "I:/presentation/seminar 45.00,97.80pt Page: 1 (1st of 1)".



- \backslash is used to start \LaTeX commands
- $\%$ is used to start a comment
- $\&$, $\$$, $\#$, $-$, \wedge , $\{$ $\}$ and \sim are special characters
- Words are separated by one or more spaces.
- Paragraphs are separated by one or more blank lines.



Sectioning commands

The sectional units in an article are produced by the following commands:

- `\chapter{title}`
- `\section{title}`
- `\subsection{title}`
- `\subsubsection{title}`
- `\paragraph{title}`



List Environments

```
\begin{itemize}
\item enumerate: Numbered lists
\item itemize: Bulleted lists
\end{itemize}
```

- enumerate: Numbered lists
- itemize: Bulleted lists

```
\begin{enumerate}
\item enumerate: Numbered lists
\item itemize: Bulleted lists
\end{enumerate}
```

- 1 enumerate: Numbered lists
- 2 itemize: Bulleted lists



- **Inline math**

Inline math appears within a line and must appear enclosed in \$ signs. $x^2 = 2$

`\Rightarrow x = \pm \sqrt{2}`.

Inline math appears within a line and must appear enclosed in \$ signs. $x^2 = 2 \Rightarrow x = \pm\sqrt{2}$.

- **Equations**

```
\begin{align}
\mathcal{F}(\omega) &= \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt
\end{align}
```

$$\mathcal{F}(\omega) = \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt \quad (1)$$



More math

The Fibonacci numbers form a sequence defined recursively by:

```
\begin{align}
F(n) &= \begin{cases}
0, & \text{\mbox{if} } n=0; & \backslash\backslash \\
1, & \text{\mbox{if} } n=1; & \backslash\backslash \\
F(n-1) + F(n-2) & \text{\mbox{otherwise}}.
\end{cases} \\
&\end{cases} \\
\end{align}
```

The Fibonacci numbers form a sequence defined recursively by:

$$F(n) = \begin{cases} 0, & \text{if } n = 0; \\ 1, & \text{if } n = 1; \\ F(n-1) + F(n-2) & \text{otherwise.} \end{cases} \quad (3)$$



Customizing

```
\documentclass{article}
\newcommand{\parD}[2]{\frac{\partial #1}{\partial #2}}
\newcommand{\parDD}[2]{\frac{\partial^2 #1}{\partial #2^2}}
\begin{document}

\begin{align*}
\parD{y}{x} \left( \parD{y}{x} \right) = \parDD{y}{x}
\end{align*}
```

$$\frac{\partial}{\partial x} \left(\frac{\partial y}{\partial x} \right) = \frac{\partial^2 y}{\partial x^2}$$



Figures

```
\documentclass{article}
\usepackage{graphicx}

\begin{figure}[!h]
\centering
\includegraphics[width=5cm]{ginn_logo.pdf}
\caption{CoE logo}
\end{figure}
```



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Flow behind a cylinder - vorticity contours



The screenshot shows the TeXnicCenter interface with a menu bar (File, Edit, Search, View, Insert, Math, Format, Project, Build, Tools, Window, Help) and a toolbar. The main window displays the following LaTeX code:

```

\documentclass{beamer}

\usetheme{AUTheme}
\usefonttheme[onlymath]{serif}

\usepackage{amsmath, latexsym, color, graphicx, amssymb, here}
\usepackage{epsf, epsfig, pifont, tikz}
\usepackage{graphics, calrsfs}
\usepackage{tangocolors, times}
\usepackage{fancybox, calc}

\newcommand{\parD}[2]{\frac{\partial #1}{\partial #2}}
\newcommand{\parDE}[2]{\frac{\partial^2 #1}{\partial #2^2}}
\newcommand{\laplacian}{\Delta}
\renewcommand{\div}{\nabla\cdot}
\newcommand{\grad}{\nabla}
\newcommand{\divp}{\nabla^{\prime}\cdot}
\newcommand{\gradp}{\nabla^{\prime}}
\newcommand{\curl}{\nabla\times}
  
```

The status bar at the bottom indicates "Press F1 to get help", "Ln 1, Col 1", "UNDX", and "OVR READ UF".



Cross-referencing

Can cross-reference figures, tables, equations, sections using:

```
\label{name}, %\label{eq:wav}, \label{sec:wav}, \label{fig:wav}  
\ref{name}
```

For example

```
\begin{align}\label{eq:partial}  
    \parD{}{x} \left( \parD{y}{x} \right) = \parDD{y}{x}  
\end{align}  
Eq. \ref{eq:partial} describes \ldots
```

$$\frac{\partial}{\partial x} \left(\frac{\partial y}{\partial x} \right) = \frac{\partial^2 y}{\partial x^2} \quad (4)$$

Eq. 4 describes ...



The BibT_EX package

- Create a bibliography database with a .bib extension:
e.g., bibdatabase.bib
- Include following two lines where you want the
bibliography to appear

```
\bibliographystyle{style} %% (plain, alpha, abbrv, unsrt)  
\bibliography{bibdatabase}
```

A BibT_EX entry looks like:

```
@article{lane87,  
  title = "Automatic multidimensional deconvolution",  
  author = "R. G. Lane and R. H. T. Bates",  
  JOURNAL = "Journal of the Optical Society of America",  
  YEAR = "1987",  
  VOLUME = "4",  
  NUMBER = "1",  
  PAGES = "180-188",  
  MONTH = "January"  
}
```




BibT_EX entry types

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@booklet

@conference

@incollection

@manual

@misc

@techreport

@proceedings

@inbook

@inproceedings

@mastersthesis

@phdthesis

@unpublished



- Use the

```
\cite{key}
```

command to include citations.

The authors in `\cite{key}` propose a new method to melt ice.

The authors in [1] propose a new method to melt ice.



Citations

- Use the

```
\cite{key}
```

command to include citations.

The authors in `\cite{key}` propose a new method to melt ice.

The authors in [1] propose a new method to melt ice.

- To include an entry that was not cited in the L^AT_EX document, add:

```
\nocite{key}
```



Citations

- Use the

```
\cite{key}
```

command to include citations.

The authors in `\cite{key}` propose a new method to melt ice.

The authors in [1] propose a new method to melt ice.

- To include an entry that was not cited in the L^AT_EX document, add:

```
\nocite{key}
```

- May also use

```
\nocite{*}
```



The screenshot shows the JabRef application window. The title bar reads "JabRef". The menu bar includes "File", "Edit", "View", "BibTeX", "Tools", "Web search", "Plugins", "Options", and "Help". The toolbar contains various icons for file operations and search. Below the toolbar, there are two tabs: "alljab.bib" and "extra2.bib", with "extra2.bib" selected. The main area displays a table of 33 bibliographic entries. The status bar at the bottom indicates "Status: Opened database 'M:\tex\extra2.bib' with 24 entries."

#	Entry...	Author	Title	Year	Journal	Owner	Timesta...	Bibteskey
1	Confer...	Adorf	HST Image Restoration--Status and Pro...	1991				adorf91
2	Confer...	Adorf	3rd ESO/ST-ECF Data Analysis Workshop	1991				adorf91b
3	Article	Aghdasi and Ward	Reduction of Boundary Artifacts in Imag...	1996	IP			aghdasi96
4	Article	Akaike	A New Look at the Statistical Model Ident...	1974	IEEE Tra...			akaike74
5	Article	Alecu et al.	The Gaussian Transform of Distribution...	2006	Signal Pr...	reevesj	2006.12...	Alecu2006
6	Confer...	Algazi et al.	Directional Interpolation of Images Base...					algazi91
7	Article	Allen	The relationship between variable selec...	1974	Techno...			allen74
8	Article	Aloimonos and Shulman	Learning early-vision computations	1989	Journal o...			aloimon...
9	Article	Alter-Gartenberg et al.	Compact Image Representation by Edg...	1994	CVGIP: G...			alter94
10	Article	Alter-Gartenberg et al.	Compact Image Representation by Edg...	1990	#JOSAa#			alter90
11	Article	Altes	The (F)ourier-(M)ellin transform and ma...	1978	Journal o...			altes78
12	Article	Ammar and Gragg	Superfast Solution of Real Positive Defi...	1988	SIAM Jou...			ammar88
13	Confer...	Analoui and Allebach	New Results on Reconstruction of Conti...					analoui92
14	Article	Anderssen and Bloomfield	A time series approach to numerical diff...	1974	Techno...			anders...
15	Book	Andrews and Hunt	Digital Image Restoration	1977				andrews...
16	Confer...	Angwin and Kaufman	Image Restoration Using a Reduced Or...					angwin88
17	Article	Appleby et al.	High-performance passive millimeter-w...	1993	#OE#			appleby93
18	Article	Arnold and others	Proton Magnetic Resonance Spectroscop...	1992	Annals of...			arnold92
19	Article	Astrom and Bates	Maximum Likelihood and Prediction Err...	1980	Automati...			astrom80
20	Confer...	Ayazifar and Lim	Pei-adaptive Model-based Interpolation ...					ayazifar92
21	Article	Ayers and Dainty	Iterative blind deconvolution method and...	1988	Optics L...			ayers88
22	Master...	Bakir	A filter design method for minimizing blu...	1998				bakir98
23	Article	Bakir and Reeves	A Filter Design Method for Minimizing Ri...	2000	#MI#			bakir99
24	Confer...	Bamberger	A Method for Image Interpolation Based ...	1992				bamberg...
25	Confer...	Bamberger et al.	An Instructional Image Database Packa...					bamberg...
26	Article	Banham and Katsaggelos	Digital image restoration	1997	IEEE Sig...			banham97
27	Article	Bao and Maudsley	Improved Reconstruction for MR Spectro...	2007	Medical I...	reevesj	2007.05...	Bao2007
28	Confer...	Barnwell and Mersereau	A Comparison of Some Subjective and ...	1977				barnwell...
29	Confer...	Bates and Davey	Towards making shift-and-add a versatil...	1987				bates87b
30	Confer...	Bates and Lane	Automatic deconvolution and phase retr...	1987				bates87
31	Article	Bates et al.	Self-Consistent Deconvolution. (I: T)heory	1976	Optik			bates76
32	Article	Beaudoin and Beauchemin	A new numerical Fourier transform in d...	2003	#SP#			beaudo...
33	Article	Beck et al.	Analysis of (SPECT) including scatter an...	1982	IEEE Tra...			beck82



Presentations

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<http://prosper.sourceforge.net/>

- Prosper
- Needs the following packages:
 - prosper
 - seminar
 - pstricks

<http://latex-beamer.sourceforge.net/>

- Beamer
- Needs the following packages:
 - latex-beamer
 - xcolor
 - pgm



Beamer documents

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Posters

- Uses the `frame` environment. A slide is defined within

```
%\begin{frame}
```

```
Slide body
```

```
%\end{frame}
```

- Preserves document structure
- Very customizable
- Allows for overlays



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- Uses the `frame` environment. A slide is defined within

```
%\begin{frame}
```

```
Slide body
```

```
%\end{frame}
```

- Preserves document structure
- Very customizable
- Allows for overlays
- Auto-generation of ToCs and ToFs
- Beamer tour: <http://latex-beamer.sourceforge.net/beamerexample1.pdf>.



- The a0poster.cls class file can be used to create upto A0 size posters.
- It offers the following capabilities
 - Allows for paper sizes A0, A1, A2, A3, & A4
 - Allows font sizes from 12pt–107pt
 - Scales formulas and math symbols
 - The package also creates a postscript header file for `dvips` to ensure that the poster will be printed in the right size.



The header of a L^AT_EX poster document looks like:

```
\documentclass[options]{a0poster}  
\usepackage{graphicx,pstricks,...}  
\begin{document}
```

The following options are available:

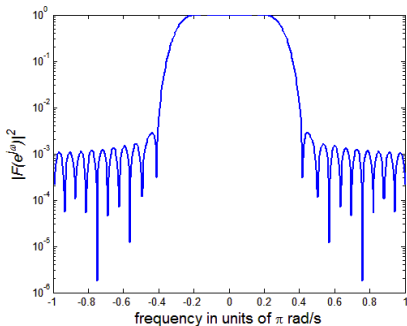
<i>landscape</i>	landscape format
<i>portrait</i>	portrait format
<i>a0b</i>	“DIN A0 big”
<i>a0</i>	DIN A0
<i>a1</i>	DIN A1
<i>a2</i>	DIN A2
<i>a3</i>	DIN A3
<i>posterdraft</i>	reduces the postscript output to DIN A4 size.
<i>final</i>	makes postscript output in original size

- LyX is a T_EX based WYSIWYM editor
- Available for multiple platforms
- Offers a GUI with menus
- Supports BibT_EX
- Has WYSIWYG table and math editors
- Uses T_EX rules for indents, spacing, and hyphenation



L^AT_EX in plotting tools

- MATLAB supports L^AT_EX
 - Figure labels and other text can be parsed by a L^AT_EX interpreter
 - The `latex` command translates MATLAB matrices into L^AT_EX arrays
 - Can publish a formatted m-file, including L^AT_EX constructs, as a L^AT_EX document





L^AT_EX in plotting tools

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- PGFPLOTS is a drawing package for L^AT_EX based on PGF/Tikz
- text-based specification of plots
- can actually calculate and evaluate figures



- The Graduate School maintains AU thesis and dissertation style files
- AU allows L^AT_EX for theses. Formatting restrictions have been relaxed. Color and multimedia as well as hyper-references are possible in PDF files.
- We have a rather inactive `tex-users` mailing list.



Summary

- L^AT_EX is a programming language, not an application
- An abundance of L^AT_EX utilities are available for different platforms
- All L^AT_EX components and packages are free and easily available
- It can be used to generate various document types
- Style files for Auburn University theses are available