

Using L^AT_EX for scientific writing

(part 1)

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T_EX and L^AT_EX

T_EX is a computer program created by Donald E. Knuth.

It is aimed at typesetting text and mathematical formulas.

T_EX is pronounced “Tech” with a “ch” as in the Scottish “Loch.”

L^AT_EX is a macro package which enables authors to typeset and print their work at the highest typographical quality, using a predefined, professional layout. L^AT_EX was originally written by Leslie Lamport.

It uses the T_EX formatter as its typesetting engine.

L^AT_EX is pronounced “Lay-tech” or “Lah-tech.”

No WYSIWYG

What You See Is What You Get

Advantages

- Several professional styles are available that make documents look “like printed”. Changing style requires changing one single line in the document, with consistency ensured.
- High-quality maths typesetting
- Only a few commands to define the structure of text,
no knowledge of typography or book design required.
- Complex scientific documents can be created automatically:
 - bibliography
 - index
 - cross-references
 - table of contents, lists of figures, tables etc.
 - ...
- Operating-system independent
- Long-term storage of documents: plain-text (ASCII) rather than binary
- Free software with source code available: errors are corrected rapidly

Disadvantages

- Learning curve
- Major changes in layout may require rewriting the style file
(blessing in disguise)
- One gets an eye for all the bad documents out there

Plan

- Document structure: sections, cross-references, lists, figures, tables
- Mathematics: symbols, formulas, theorems
- Bibliographic references (BibTeX)
- MakeIndex
- Incorporating graphics
- Creating graphics and diagrams in L^AT_EX
- Thesis, report, article and customised styles
- Presentations
- Anything else? e-mail me: roman@dcsl.bbk.ac.uk

Resources

Software CTAN www.tug.org,

win: MiKTeX 2.9 www.miktex.org

WinEdt 10.3 www.winedt.com

mac: MacTeX 2019 www.tug.org/mactex

win/mac: TeXstudio 2.12 texstudio.org

web: Overleaf / ShareLaTeX <https://www.overleaf.com/www.sharelatex.com>

Introduction <http://mirrors.ctan.org/info/lshort/english/lshort.pdf>

WikiBook <http://en.wikibooks.org/wiki/LaTeX>

Literature The L^AT_EX-companion (MITTELBACH *et al*, 2004)

Symbols Comprehensive symbol list from CTAN

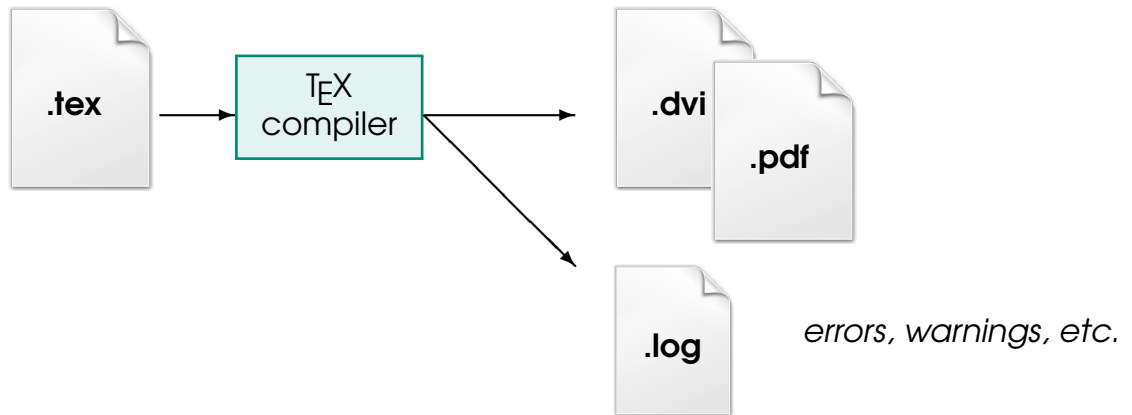
<http://tug.ctan.org/info/symbols/comprehensive/symbols-a4.pdf>

deTeXify: <http://detexify.kirelabs.org/classify.html>

Your first L^AT_EX document

```
\documentclass{article}  
\begin{document}  
My first \LaTeX{} document.  
\end{document}
```

How does L^AT_EX work?



Spaces

“Whitespace” characters such as blank or tab are treated uniformly as “space”. Several consecutive whitespace characters are treated as one space. Whitespace at the start of a line is generally ignored; a single linebreak is treated as whitespace.

An empty line between two lines of text defines the end of a paragraph. Several empty lines are treated the same as one empty line.

It does not matter whether you enter
one or several spaces after a word.

It does not matter whether you enter
one or several spaces after a word.

An empty line starts a new paragraph.

An empty line starts a new paragraph.

Special characters

`$ & % # _ { } ~ ^ \`

These characters can be used in your documents by adding a prefix backslash:

`\$ \& \% \# _ \{ \} \`

`$ & % # _ { }`

L^AT_EX commands

L^AT_EX commands are case sensitive and take one of the following two formats:

- start with a backslash `\` and then have a name consisting of letters only (e.g., `\LaTeX`)
Command names are terminated by a space, a number or any other 'non-letter'
- or consist of a backslash and exactly one non-letter character (e.g., `\$`)

L^AT_EX ignores whitespace after commands:

`\LaTeX document`

`LATEXdocument`

Some commands need a **parameter**

which has to be given between curly brackets `{ }` after the command name

Some commands support **optional parameters**

which are added after the command name in square brackets `[]`

You can `\textsl{lean}` on me!

You can *lean* on me!

Comments

When L^AT_EX encounters a % character while processing an input file, it ignores the rest of the present line, the linebreak, and all whitespace at the beginning of the next line

```
This is an % stupid
% Better: instructive <----
example: Supercal%
         ifragilist%
         icexpialidocious
```

This is an example: Supercalifragilisticexpialidocious

This can be used to write notes into the input file,
which will not show up in the printed version

The % character can also be used to split long input lines
where no whitespace or linebreaks are allowed

Document structure

```
\documentclass[options]{class}  
\usepackage{...}      (preamble)  
\begin{document}  
...  
\end{document}
```

Document classes

- `article` for articles in scientific journals, presentations, short reports, program documentation, invitations, etc.
- `report` for longer reports containing several chapters, small books, PhD theses, etc.
- `book` for real books
- ...

Document class options

- `10pt`, `11pt`, `12pt` sets the size of the main font in the document (10pt by default)
- `a4paper`, `letterpaper`, ... defines the paper size
- `twocolumn` typesets the document in two columns
- `twoside`, `oneside` specifies whether double or single sided output should be generated (The `article` and `report` classes are single sided and the `book` class is double sided by default.)
- ...

Page styles

`\pagestyle{style}`

- `plain` prints the page numbers on the bottom of the page,
in the middle of the footer (this is the default page style)
- `headings` prints the current chapter heading and the page number
in the header on each page, while the footer remains empty
- `empty` sets both the header and the footer to be empty

It is possible to change the page style of the current page with the command

`\thispagestyle{style}`

NB. You can create your own headers and footers (more in week 3).

Big documents

The following command is useful, in particular, when working with other people and version control systems because it reduces possible change conflicts in different parts of the document

`\input{filename}`

simply includes the contents of the file specified (does not start a new page)

The following two commands are useful when working on documents with several chapters (each chapter in a separate file, for example):

`\include{filename}`

inserts the contents of another file named *filename.tex*

(\LaTeX will start a new page before processing the material input from *filename.tex*)

`\includeonly{filename, filename, ...}`

after this command is executed in the preamble of the document, only `\include` commands for the filenames which are listed in the argument of the `\includeonly` command will be executed

Paragraphs

The most important text unit in L^AT_EX (and in typography) is the **paragraph**. We call it “text unit” because a paragraph is the typographical form which should reflect one coherent thought, or one idea.

— Often books are typeset with each line having the same length (**justified paragraphs**). L^AT_EX inserts the necessary linebreaks and spaces between words by optimising the contents of a whole paragraph. If necessary, it also **hyphenates** words that would not fit comfortably on a line. How the paragraphs are typeset depends on the document class. Normally the first line of a paragraph is **indented**, and there is no additional space between two paragraphs.

L^AT_EX always tries to produce the best linebreaks possible. If it cannot find a way to break the lines in a manner which meets its high standards, it lets one line stick out on the right of the paragraph. L^AT_EX then complains (“**overfull hbox**”) while processing the input file. This happens most often when L^AT_EX cannot find a suitable place to hyphenate a word. You can instruct L^AT_EX to lower its standards a little by giving the `\sloppy` command. It prevents such over-long lines by increasing the inter-word spacing even if the final output is not optimal. In this case a warning (“**underfull hbox**”) is given to the user. In most such cases the result doesn’t look very good. The command `\fussy` brings L^AT_EX back to its default behaviour.

Linebreaking and pagebreaking

`\\` or `\newline`

starts a new line without starting a new paragraph

`*`

additionally prohibits a pagebreak after the forced linebreak

`\newpage`

starts a new page

`\linebreak[n]`, `\nolinebreak[n]`, `\pagebreak[n]` and `\nopagebreak[n]` do what their names say. They enable the author to influence their actions with the optional argument *n*. It can be set to a number between 0 to 4. By setting *n* to a value below 4 you leave L^AT_EX the option of ignoring your command if the result would look very bad.

More special characters and symbols

quotation marks

`‘‘Please press the ‘x’ key.’’`

“Please press the ‘x’ key.”

hyphen

`daughter-in-law`

daughter-in-law

en-dash

`pages 13--67`

pages 13–67

em-dash

`yes---or no?`

yes—or no?

minus sign

`1 and -1`

1 and –1

ellipsis

`Not like this ...`

Not like this ...

`but like this: London, Rome, \ldots`

but like this: London, Rome, ...

Space between words

L^AT_EX inserts slightly more space at the end of a sentence, as this makes the text more readable. It assumes that sentences end with full stops, question marks or exclamation marks. If a full stop follows an uppercase letter, this is not taken as a sentence ending (full stops after uppercase letters normally occur in abbreviations).

`_` produces a space which will not be enlarged

`~` produces a space which will not be enlarged and

additionally prohibits a linebreak

(e.g. `~live football matches`)

e.g. live football matches

`\@` in front of a full stop says that this full stop terminates a sentence

(even if it follows an uppercase letter)

`\ldots\ on the NHS\@. Most\ldots`

... on the NHS. Most...

NB. The additional space after full stops can be disabled with the command

`\frenchspacing`

Sectioning

```
\section{Insect evolution and biology}  
\subsection{Five factors in a winning formula}  
\subsubsection{Flight}  
\paragraph{The origin of wings}  
\subparagraph{...}
```

1. Insect evolution and biology
1.1 Five factors in a winning formula
1.1.1. Flight
The origin of wings

The following can be used in the report and book classes:

```
\part{...}  
\chapter{...}
```

Document title

The **title** of the whole document is generated by issuing
`\maketitle`

The contents of the title have to be defined by the commands
`\title{...}`, `\author{...}` and optionally `\date{...}`
before calling `\maketitle`

In the argument of `\author`, you can supply several names separated by `\and`

Cross references

`\label{marker}` creates a label with the name *marker*

`\ref{marker}` prints the number of the section, subsection, figure, table, etc.
after which the corresponding `\label` command was issued

`\pageref{marker}` prints the page number of the page
where the `\label` command occurred

↓ 'label'

```
\section{Introduction}\label{sec:intro}
```

In this paper, we study the problem of\dots

```
\section{Preliminaries}\label{sec:prelims}
```

We consider structures of the form\dots

```
\section{Complexity of the Problem}
```

```
\label{sec:cmplx}
```

The structures introduces in

Section~\ref{sec:prelims} on

p.~\pageref{sec:prelims} enjoy\dots

1. Introduction

In this paper, we study the problem of
...

2. Preliminaries

We consider structures of the form...

3. Complexity of the Problem

The structures introduces in Section 2
on p. 4 enjoy...

Footnotes

`Footnotes\footnote{This is a footnote.}`
are often used by `\LaTeX{}` people.

Footnotes¹ are often used by \LaTeX people.

¹This is a footnote.

`Footnotes\footnote{\label{fn:latex}This is a footnote.}`
are often used by `\LaTeX{}` people
(one may also refer to footnote numbers: e.g., `\ref{fn:latex}`).

Footnotes¹ are often used by \LaTeX people (one may also refer to footnote numbers: e.g., 1).

¹This is a footnote.

NB: `\label` is placed inside the `\footnote` command
(but it can be placed either after `\section{...}` or inside those commands)

Lists

An example:

```
\begin{enumerate}
\item You can mix the list
environments to your taste:
\begin{itemize}
\item But it might start to
look silly.
\item[-] With a dash.
\end{itemize}
\item Therefore remember:
\begin{description}
\item[Stupid] things will not
become smart because they are
in a list.
\item[Smart] things, though, can be
presented beautifully in a list.
\end{description}
\end{enumerate}
```

An example:

1. You can mix the list environments to your taste:
 - But it might start to look silly.
 - With a dash.
2. Therefore remember:
Stupid things will not become smart because they are in a list.
Smart things, though, can be presented beautifully in a list.

Using L^AT_EX for scientific writing

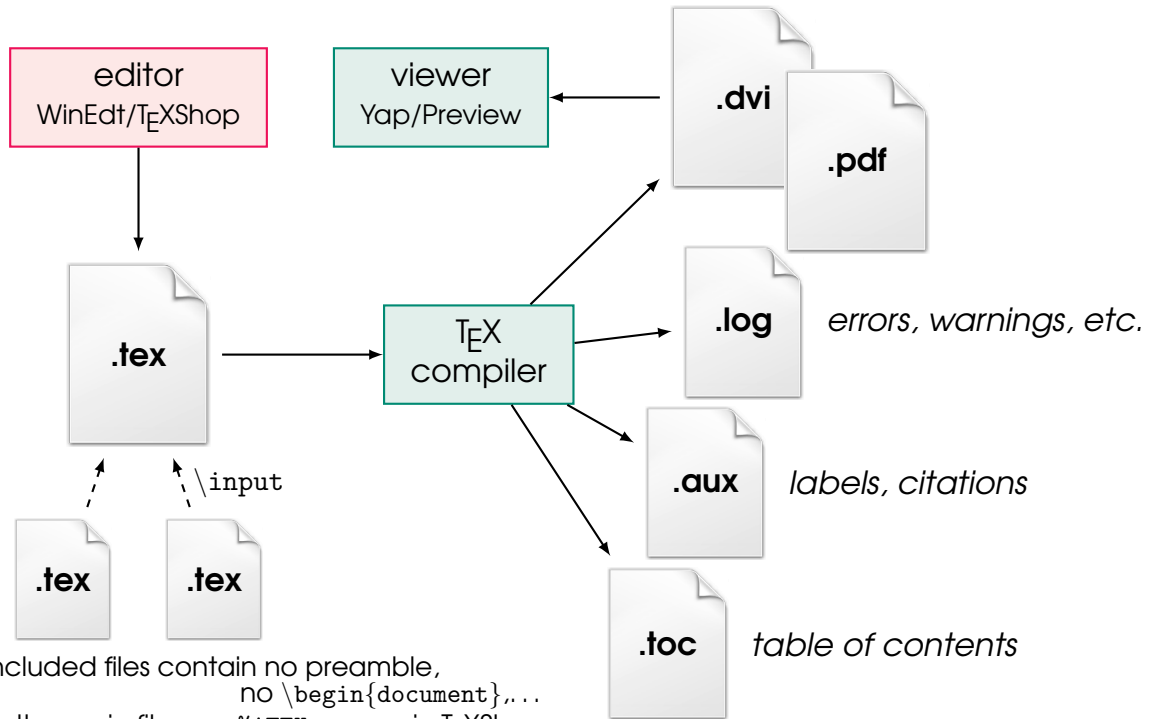
(part 2)

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How does L^AT_EX work?



NB: the included files contain no preamble,
no `\begin{document}`,...
to specify the main file, use `%!TEX root = in TEXShop`
Set Main File in menu in WinEdt

Table of Contents

The sectioning commands

`\part{...}` only in the report/book class
`\chapter{...}` only in the report/book class
`\section{...}`
`\subsection{...}`
`\subsubsection{...}`
`\paragraph{...}`
`\subparagraph{...}`

not only typeset their argument in big/bold/etc. letters,
but also write the title and the current page number to the .toc file.

Use then `\tableofcontents` to produce the ToC.

(it simply reads the contents of the .toc file!)

Accents and Special Characters

H\^otel, na\"i ve, \'el\'eve,\\
sm\o rrebr\o d, !'Se\~norita!,\\
Sch\"onbrunner Schlo\ss{} Stra\ss e

Hôtel, naïve, élève,
smørrebrød, ¡Señorita!,
Schönbrunner Schloß Straße

Ó	\’o	ó	\’o	Ô	\^o	Õ	\~o
Ȫ	\=o	Ȫ	\.o	Ö	\"o	Ȫ	\c c
Ǿ	\u o	Ǿ	\v o	Ǿ	\H o	Ȫ	\b o
Ȫ	\d o	ȪȪ	\t oo	o is <u>any</u> character			
œ	\oe	Œ	\OE	œ	\ae	Æ	\AE
å	\aa	Å	\AA	ø	\o	Ø	\O
†	\l	‡	\L	ı	\i	ı	\j
ı	!‘	ı	?‘				

Tables

`\begin{tabular}[pos]{spec}...\end{tabular}`

pos: vertical position of the table relative to the baseline of the surrounding text
(*t*, *b* or *c* to align the table at the top, bottom or centre)

column specification:

l for left-aligned, *r* for right-aligned and *c* for centred text;

p{width} for a column containing justified text with line breaks (paragraph)
(If the text in a column is too wide for the page, L^AT_EX won't automatically wrap it.)

column separator:

| for a vertical line or an arbitrary column separator in @{...}

horizontal line: `\hline` or `\cline{j-i}`, where *j* and *i* are the column numbers the line should extend over

```
\begin{tabular}{|r|l|}\hline
7C0 & hexadecimal \\
3700 & octal \\ \cline{2-2}
11111000000 & binary \\ \hline
1984 & decimal \\ \hline
\end{tabular}
```

7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

Tables (cont.)

```
\begin{tabular}{|p{5.7cm}|}\hline
Welcome to Boxy's paragraph.
We sincerely hope you'll
all enjoy the show.\\ \hline
\end{tabular}
```

Welcome to Boxy's paragraph.
We sincerely hope you'll all enjoy the show.

NB: standard units are `mm`, `cm`, `in`,

`pt` (1pt = 1/72.27 in = 0.351mm), `ex` (height of x), `em` (width of M)

```
\begin{tabular}{c r @{.} l}
Pi expression & & \\
\multicolumn{2}{c}{Value} \\ \hline
$\pi$ & 3.1416 & \\
$\pi^{\pi}$ & 36.46 & \\
$(\pi^{\pi})^{\pi}$ & 80662.7 & \\
\end{tabular}
```

Pi expression	Value
π	3.1416
π^{π}	36.46
$(\pi^{\pi})^{\pi}$	80662.7

```
\begin{tabular}{|c|}\hline
\hrule{1pt}{4ex}Pitprop \ldots\\ \hline
\hrule{0pt}{4ex}Strut\\ \hline
\end{tabular}
```

Pitprop ...
Strut

NB: see also `\renewcommand{\arraystretch}{1.5}` `\renewcommand{\tabcolsep}{0.2cm}`

Floating Figures and Tables

```
\begin{figure}[placement specifier]\end{figure}
```

```
\begin{table}[placement specifier]\end{table}
```

placement specifier (default [tbp]):

- h 'here' at the very place in the text where it occurred (useful for small floats)
- t at the top of a page
- b at the bottom of a page
- p on a special page containing only floats
- ! without considering most of the internal parameters,
which could stop this float from being placed.

`\caption{caption text}` caption for the float
(a running number and the string "Figure" or "Table" will be added by L^AT_EX)

`\listoffigures` and `\listoftables` are similar to `\tableofcontents` (.lof and .lot)

Figure~\ref{white} is an example of Pop-Art.

```
\begin{figure}[!hbtbp]  
\fboxsep=0mm\framebox[5mm]{\rule{0pt}{5mm}}  
\caption{Five by Five in Millimetres.}  
\label{white}  
\end{figure}
```

Figure 1 is an example of Pop-Art.



Figure 1. Five by Five in Millimetres.

Formulas in L^AT_EX

There two ways of typesetting a mathematical formula:

- in-line within a paragraph (text style) `$...$`
- or the paragraph can be broken to typeset it separately
(display style) `\[...\]`

Add `a` squared and `b` squared to get
`c` squared. Or, using a more mathematical
approach: `$a^2 + b^2 = c^2$`. Or, using
even more mathematical approach
`\[`
`a^2 + b^2 = c^2`
`\]`

Add *a* squared and *b* squared to get
c squared. Or, using a more mathe-
matical approach: $a^2 + b^2 = c^2$. Or,
using even mathematical approach
$$a^2 + b^2 = c^2$$

NB: most of what follows relies on the `amsmath` package (`\usepackage{amsmath}`)

Equation numbers

`\label{label}` and `\eqref{label}` work with equation numbers

`\tag{name}` allows one to change equation number to *name*

`equation*` is the same as `equation` but without numbering

(similar for other equation environments)

```
Einstein says
\begin{equation}
E = mc^2 \label{clever}
\end{equation}
He didn't say
\begin{equation}
1 + 1 = 3 \tag{dumb}
\end{equation}
This is a reference to
\eqref{clever}.
Again, Einstein says
\begin{equation*}
E = mc^2
\end{equation*}
```

Einstein says

$$E = mc^2 \quad (1)$$

He didn't say

$$1 + 1 = 3 \quad (\text{dumb})$$

This is a reference to (1). Again, Einstein says

$$E = mc^2$$

Subscripts and Superscripts

`$p^3_{ij} \quad m_{\text{Knuth}}$`
`$a^{x+y} \neq a^{x+y} \quad e^{x^2} \neq e^{x^2}$`

$$p_{ij}^3 \quad m_{\text{Knuth}} \quad a^x + y \neq a^{x+y} \quad e^{x^2} \neq e^{x^2}$$

`$f(x) = x^2 \quad f'(x) = 2x$`
`$\hat{XY} \quad \widehat{XY} \quad \bar{x}_0 \quad \bar{x}_0$`

$$f(x) = x^2 \quad f'(x) = 2x \quad f''(x) = 2 \quad \hat{XY} \quad \widehat{XY} \quad \bar{x}_0 \quad \bar{x}_0$$

`$\vec{a} \quad \vec{AB} \quad \overrightarrow{AB} \quad \overleftarrow{BA}$`

$$\vec{a} \quad \vec{AB} \quad \overrightarrow{AB} \quad \overleftarrow{BA}$$

`$\Psi = v_1 \cdot v_2 \cdot \ldots$`
`$n! = 1 \cdot 2 \cdot \ldots (n-1) \cdot n$`

$$\Psi = v_1 \cdot v_2 \cdot \ldots \quad n! = 1 \cdot 2 \cdot \ldots (n-1) \cdot n$$

Fractions

In **display style**:

```
\[3/8 \quad \frac{3}{8}
\quad \tfrac{3}{8} \]
```

$$3/8 \quad \frac{3}{8} \quad \tfrac{3}{8}$$

In **text style**:

```
$1\frac{1}{2}$~hours \quad
$1\dfrac{1}{2}$~hours
```

$$1\frac{1}{2} \text{ hours} \quad 1\dfrac{1}{2} \text{ hours}$$

```
\[\sqrt[3]{\frac{x^2}{k+1}}\quad
x^{\frac{2}{k+1}}\quad
\frac{\partial^2 f}{\partial x^2} \]
```

$$\sqrt[3]{\frac{x^2}{k+1}} \quad x^{\frac{2}{k+1}} \quad \frac{\partial^2 f}{\partial x^2}$$

binomial coefficients

```
Pascal's rule is
\begin{equation*}
\binom{n}{k} = \binom{n-1}{k}
+ \binom{n-1}{k-1}
\end{equation*}
```

Pascal's rule is

$$\binom{n}{k} = \binom{n-1}{k} + \binom{n-1}{k-1}$$

`\stackrel{#1}{#2}` puts the symbol given in 1 in superscript-like size over 2,
which is set in its usual position

```
$f_n(x) \stackrel{*}{\approx} 1$
```

$$f_n(x) \overset{*}{\approx} 1$$

Integrals, Sums and Products

In **display style**:

`\[\sum_{i=1}^n \quad \prod \epsilon`
`\quad \int_0^{\frac{\pi}{2}}\]`

$$\sum_{i=1}^n \quad \prod_{\epsilon} \quad \int_0^{\frac{\pi}{2}}$$

In **text style**:

`$_\sum_{i=1}^n \quad \prod \epsilon$`
`\quad $_\int_0^{\frac{\pi}{2}}$`

$$\sum_{i=1}^n \quad \prod_{\epsilon} \quad \int_0^{\frac{\pi}{2}}$$

NB: `\textstyle` and `\displaystyle` change font sizes and
the location of sub/superscripts

NB: use `\limits` and `\nolimits` to change the location of sub/superscripts

`$_\sum\limits_{i=1}^n$`

$$\sum_{i=1}^n$$

`$_\underbrace{\overbrace{(a+b+c)}^6}_{\text{meaning of life}}^9$`
`\cdot \overbrace{(d+e+f)}^9$`
`_\text{meaning of life} = 42$`

$$\underbrace{\overbrace{(a+b+c)}^6 \cdot \overbrace{(d+e+f)}^9}_{\text{meaning of life}} = 42$$

Functions

```

 $\backslash$ arccos  $\backslash$ cos  $\backslash$ csc  $\backslash$ exp  $\backslash$ ker  $\backslash$ limsup$
 $\backslash$ arcsin  $\backslash$ cosh  $\backslash$ deg  $\backslash$ gcd  $\backslash$ lg  $\backslash$ ln$
 $\backslash$ arctan  $\backslash$ cot  $\backslash$ det  $\backslash$ hom  $\backslash$ lim  $\backslash$ log$
 $\backslash$ arg  $\backslash$ coth  $\backslash$ dim  $\backslash$ inf  $\backslash$ liminf  $\backslash$ max$
 $\backslash$ sinh  $\backslash$ sup  $\backslash$ tan  $\backslash$ tanh  $\backslash$ min  $\backslash$ Pr$
 $\backslash$ sec  $\backslash$ sin$

```

```

arccos cos csc exp ker lim sup
arcsin cosh deg gcd lg ln
arctan cot det hom lim log
arg coth dim inf lim inf max
sinh sup tan tanh min Pr
sec sin

```

```

 $\backslash$ [ $\backslash$ lim_ $\{x \rightarrow 0\}$ 
 $\backslash$ frac $\{\sin x\}{x=1}$ \]

```

$$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$$

\backslash DeclareMathOperator allows one to define new functions

(works only in the preamble):

```

 $\backslash$ DeclareMathOperator $\{\argh\}{argh}$ 
 $\backslash$ DeclareMathOperator $\ast\{\nut\}{Nut}$ 
 $\backslash$ [ $3\argh = 2\nut_{x=1}$ \]

```

$$3 \argh = 2 \text{Nut}_{x=1}$$

Delimiters

L^AT_EX provides all sorts of symbols delimiters:

 $(\lfloor \cdot \rfloor, \lceil \cdot \rceil)$

([{ | [< | ||

$$\{a,b,c\} \neq \{a,b,c\}$$
$$a, b, c \neq \{a, b, c\}$$

NB: If you put `\left` in front of an opening delimiter and `\right` in front of a closing delimiter, L^AT_EX will automatically determine the correct size of the delimiter.

Every `\left` must be closed with a corresponding `\right`.

(use the invisible `\right.` if needed)

$$\frac{1}{(1-x^2)^3} \quad \text{quad} \quad \frac{1}{(1-x^2)^3}$$

$$1 + \left(\frac{1}{1 - x^2} \right)^3 \quad \ddagger_-)$$

Specifying delimiter size by hand:

$$\begin{aligned} & \$\Big((x+1)(x-1)\Big)^{\sim\{2\}}\$ \\ & \$\big(\ \Big(\ \bigg(\ \Bigg(\ \quad \\ & \big\}\ \Big\}\ \bigg\}\ \Bigg\}\ \quad \\ & \big\|\ \Big\|\ \bigg\|\ \Bigg\|\ \quad \\ & \big\Downarrow\ \Big\Downarrow \\ & \bigg\Downarrow\ \Bigg\Downarrow\$ \end{aligned}$$

$$\left((x+1)(x-1)\right)^2$$

Multiple equations

```
\begin{align*}f(x) &= (a+b)(a-b)\\&= a^2-ab+ba-b^2\\ \end{align*}
```

$$\begin{aligned}f(x) &= (a+b)(a-b) \\ &= a^2 - ab + ba - b^2\end{aligned}$$

```
\begin{align}f(x) &= 3x^5 + x^4 + 2x^3 \\ &\quad \nonumber \\ &\quad + 9x^2 + 12x + 23 \\ &= g(x) - h(x) \\ \end{align}
```

$$\begin{aligned}f(x) &= 3x^5 + x^4 + 2x^3 \\ &\quad + 9x^2 + 12x + 23 \quad (2) \\ &= g(x) - h(x) \quad (3)\end{aligned}$$

other equation environments: `flalign`, `gather`, `multline` and `split`

NB: `align*`, `flalign*`, `gather*` and `multline*`

produce equations without numbers

Arrays and Matrices

```
\begin{equation*}
\mathbf{X} = \left(
\begin{array}{ccc}
x_1 & x_2 & \ldots \\
x_3 & x_4 & \ldots \\
\vdots & \vdots & \ddots
\end{array}
\right)
\end{equation*}
```

$$\mathbf{X} = \begin{pmatrix} x_1 & x_2 & \dots \\ x_3 & x_4 & \dots \\ \vdots & \vdots & \ddots \end{pmatrix}$$

delimiters:

`matrix (none), pmatrix (, bmatrix [, Bmatrix {, vmatrix | and Vmatrix ||`
the maximum number of columns is 10

```
\begin{equation*}
\begin{matrix}
1 & 2 \\
3 & 4
\end{matrix}
\quad
\begin{bmatrix}
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9
\end{bmatrix}
\end{equation*}
```

$$\begin{matrix} 1 & 2 \\ 3 & 4 \end{matrix} \quad \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

Font Size

In math mode, the font size is set with the following four commands:

```
\displaystyle (123),  
\textstyle (123),  
\scriptstyle (123),  
\scriptscriptstyle (123)
```

```
\begin{equation*}  
R = \frac{\displaystyle{\sum_{i=1}^n (x_i - \bar{x})  
(y_i - \bar{y})}}{\displaystyle{\left[  
\sum_{i=1}^n (x_i - \bar{x})^2  
\sum_{i=1}^n (y_i - \bar{y})^2  
\right]^{1/2}}}}  
\end{equation*}
```

$$R = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\left[\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2 \right]^{1/2}}$$

LaTeX Maths in HTML

<http://www.mathjax.org>

```
<html>
<head>
<script type="text/javascript"
  src="http://cdn.mathjax.org/mathjax/latest/
      MathJax.js?config=TeX-AMS-MML_HTMLorMML"></script>
<script type="text/javascript">
MathJax.Hub.Config({
  tex2jax: {
    inlineMath: [['$','$'], ['\\(','\\)']],
    processEscapes: true
  }
});
</script>
</head>
<html>
<p>a query is <em>uniquely foldable</em> if it contains no atom
 $S(t,t')$  in  $q$  such that there are  $R, T \leq_{\mathcal{T}} S$  with
 $R \nleqq_{\mathcal{T}} T$  and
 $\models \exists R \neg \sqsubseteq \exists T \neg$ 
</p>
</html>
```

Bibliography: Fast Way

`\bibitem[label]{marker}` creates an entry in the `thebibliography` environment

The *marker* is then used to cite the book, article or paper within the document:

`\cite{marker}`

```
Partl~\cite{pa} has  
proposed that \ldots  
\begin{thebibliography}{99}  
\bibitem{pa} H.~Partl:  
\emph{German \TeX},  
TUGboat Volume~9, Issue~1 (1988)  
\end{thebibliography}
```

Partl (1) has proposed that ...

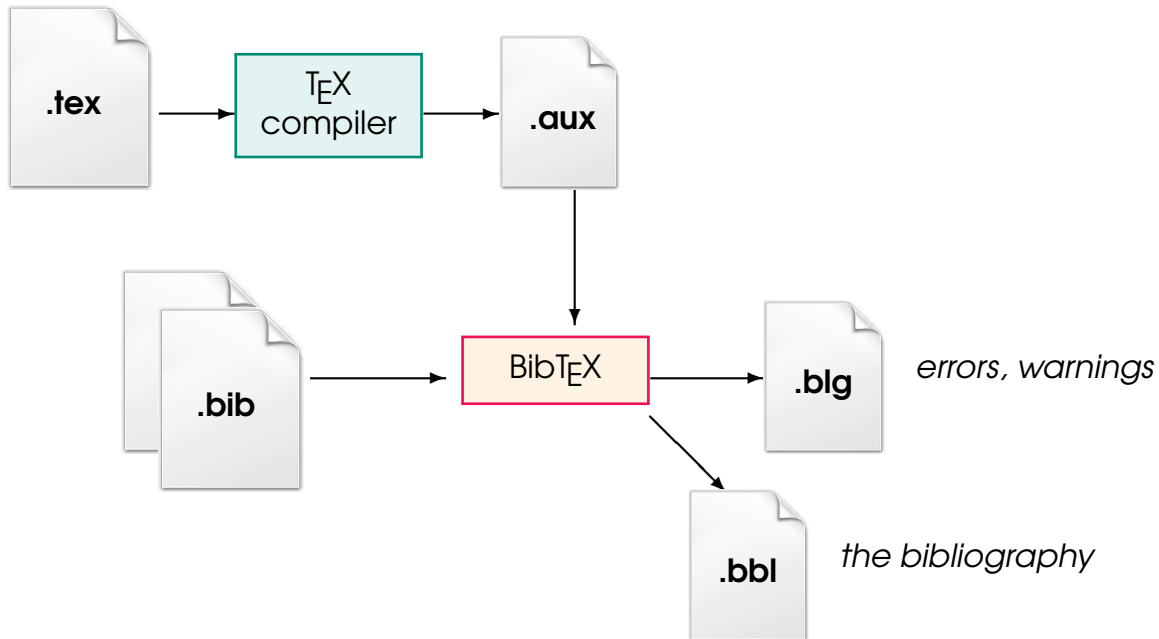
References

- (1) H. Partl: *German T_EX*, TUGboat
Volume 9, Issue 1 (1988)

The entries get enumerated automatically (if the `label` option is not used)

The parameter after the `\begin{thebibliography}` defines
how much space to reserve for the number of labels (99)

Bibliography: Bib_TE_X Way



Bibliography: Bib_TE_X Way

Bib_TE_X is a file format and a program designed to work with L^AT_EX. The file format stores bibliographical information like author name, journal title, date, etc.

The program incorporates files stored in a Bib_TE_X file (.bib) into L^AT_EX documents.

A Bib_TE_X database is essentially a plain text file containing bibliography entries:

```
@article{Gettys90,  
  author = {Jim Gettys and Phil Karlton and Scott McGregor},  
  title = {The {X} Window System, Version 11},  
  journal = {Software Practice and Experience},  
  volume = {20},  
  number = {S2},  
  year = {1990}  
}
```

`\bibliographystyle{plain}` sets the style of the bibliography

plain labels have numerical identifiers (e.g. [1]);

unsrt entries are numbered based on when they are cited,

not alphabetically by author;

alpha labels are based on the publication year and author(s) name;

abbrv names and journal titles are abbreviated.

`\bibliography{bibfile}` makes the bibliography,

where the Bib_TE_X database is *bibfile.bib*

Running BibTeX

The steps are:

1. Run \LaTeX on your `.tex` file — this will generate the `.aux` file that BibTeX needs to find the citations.
2. Run BibTeX on your `.tex` file — this can usually be done from your \LaTeX front-end. If not, use the command line.
3. Run \LaTeX on your `.tex` file — this will create the bibliography section in the document, but will not insert the correct numbering
4. Run \LaTeX on your `.tex` file one more time — this step finishes everything; the references section will be created and all of the citations will be properly numbered.

NB: TeXShop for Mac OS includes an AppleScript that will execute these four steps automatically

NB: MikTeX includes the **TeXify** command that performs all the required steps

Structure of BibTeX files

article An article from a journal or magazine

required fields: author, title, journal, year

optional fields: volume, number, pages, month, note

book A book with an specified publisher

required: author or editor, title, publisher, year

optional: volume or number, series, address, edition, month, note

booklet A work that is printed and bound,
but without a named publisher or sponsoring institution

required: title

optional: author, howpublished, address, month, year, note

inbook A part of a book, e.g., a chapter, section

required: author or editor, title, chapter and/or pages, publisher, year

optional: volume or number, series, type, address, edition, month, note

incollection A part of a book having its own title

required: author, title, booktitle, publisher, year

optional: editor, volume / number, series, type, chapter, pages,
address, edition, month, note

inproceedings An article in a conference proceedings

required: author, title, booktitle, year

optional: editor, volume / number, series, pages, address, month,
organization, publisher, note

Structure of BibTeX files (cont.)

manual Technical documentation

required field: title

optional fields: author, organization, address, edition, month, year, note

masterthesis A master's thesis

required: author, title, school, year

optional: type, address, month, note

phdthesis A PhD thesis

required: author, title, school, year

optional: type, address, month, note

proceedings Conference proceedings

required: title, year

optional: editor, volume / number, series, address, publisher, note month, organization

techreport A report published by a school or other institution

required: author, title, institution, year

optional: type, number, address, month, note

unpublished A document having an author and title, but not formally published

required: author, title, note

optional: month, year

misc Use this type when nothing else fits

required: none

optional: author, title, howpublished, month, year, note

Names in BibTeX

Multiple authors are separated with **and**.

You should type an author's complete name and
let the bibliography style decide what to abbreviate

Most names can be entered in the obvious way:

John Paul Jones Jones, John Paul
Ludwig von Beethoven von Beethoven, Ludwig

Each name consists of four parts: **First**, **von**, **Last** and **Jr**;
each part consists of a (possibly empty) list of name-tokens
tokens in the von part begin with lower-case letters
the Jr part is preceded by a comma

For example, the first name of Miguel Lopez Fernandez is "Miguel" and the last name is "Lopez Fernandez". If you typed Miguel Lopez Fernandez, BibTeX would think "Lopez" were a First-part token, so a comma should be used: Lopez Fernandez, Miguel

Another example: Charles Louis Xavier Joseph de la Vallee Poussin
This name has four tokens in the First part, two in the von, and two in the Last.

NB: If you want BibTeX to consider something a single token, enclose it in braces:

{Barnes and Noble, Inc.}

Import / Export of BibTeX Files

- JabRef (<http://www.jabref.org>): a reference manager tool for BibTeX
(import from/export to various formats, including Medline/Pubmed, Endnote)
- Mendeley: see <http://blog.mendeley.com/tag/bibtex/>

a more realistic scenario:

- keep the references in .bib files
- use BibTeX to extract and format cited entries (creates .bb1 file)
- for the final version, replace the `\bibliography` command by
the contents of the generated .bb1 file
- edit the items in the `thebibliography` environment