

# L<sup>A</sup>T<sub>E</sub>X

A computer system for typesetting documents

Typewriter → designer → typesetter → printer

Text (content) → design and implementation →  
what we see and read

L<sup>A</sup>T<sub>E</sub>X is a document ‘design’ language and can  
be compared to a (high level) computer  
programming language

Similar idea to HTML (just much more  
powerful than HTML)

L<sup>A</sup>T<sub>E</sub>X is built on T<sub>E</sub>X which is a typesetting  
language (low level) comparable to C as a  
programming language

To use L<sup>A</sup>T<sub>E</sub>X one creates a “text” file which  
contains text + design (and some typesetting)  
instructions

One then *compiles* this file to obtain the  
formatted version which can be sent to a  
printer

L<sup>A</sup>T<sub>E</sub>X/T<sub>E</sub>X is available for just about any computer system

It is *the method* of document preparation for scientists especially those wanting to display mathematics

It is a standard for giving to journals

Electronic preprint archives on the Net usually recommend L<sup>A</sup>T<sub>E</sub>X/T<sub>E</sub>X

L<sup>A</sup>T<sub>E</sub>X frees you from worrying too much about formatting as it is a high level formatting language based on *logical design*

All you need worry about is content (mostly).

L<sup>A</sup>T<sub>E</sub>X vs T<sub>E</sub>X = broad design vs nuts-and-bolts (high vs low)

WYSIWYG apps rely on *visual design* vs L<sup>A</sup>T<sub>E</sub>X's *logical design*

*Example 1:* say you want to add some poetry to your document. In  $\text{\LaTeX}$  there is a `verse` environment that lets you tell  $\text{\LaTeX}$  that the text inside some part of your document is poetry and  $\text{\LaTeX}$  will then indent it (etc) so it stands out correctly.

$\Rightarrow$  automatic formatting

*Example 2:* say you want to use an inner product in your document, as in  $(A, B)$  you can write a macro (i.e. a definition)

`\ip`

that gives you  $(A, B)$  whenever you type it. This allows you to change  $(A, B)$  to  $(\phi, \Gamma)$  or even  $[\phi, \Gamma]$  whenever you want throughout your document.

$\Rightarrow$  Easy to make global changes

*Example 3:* ligatures — the letters  $f$  and  $l$  put together  $fl$  not like  $g$  and  $c$  which become  $gc$

$\Rightarrow$  fancy typesetting built-in

## **More advantages:**

Mathematical typesetting (especially good when adding  $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\text{L}\text{T}\text{E}\text{X}$  packages)

A single font designed by Knuth

Automatic indexes and tables of contents, footnote numbering etc etc

Bibliographic database with  $\text{BIB}\text{T}\text{E}\text{X}$  and automatic cross-referencing

Small text file to transport (not binary) = long lifetime and device independent

It's free!

Lots of add-ons: there is more than 3GB worth of stuff in the CTAN

Department standard = lots of expertise

In the end you should use the *right tool for the job*. Thesis and journal articles in mathematics are highly structured documents with lots of sections and subsections, cross references, mathematics and citations. All this means that using L<sup>A</sup>T<sub>E</sub>X is the way-to-go!

Macromedia Freehand for Macintosh or xfig for Unix/X11 are good also for producing single “vector” drawings, as many mathematical subjects call for, and can output to encapsulated postscript (for inclusion in L<sup>A</sup>T<sub>E</sub>X documents).

L<sup>A</sup>T<sub>E</sub>X has some basic “vector” drawing capabilities builtin.

## History

Donald Knuth announced the first version of  $\text{T}_{\text{E}}\text{X}$  in 1978

The standard version of  $\text{T}_{\text{E}}\text{X}$  came out in 1983

Leslie Lamport started distributing  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}2.09$  in 1985

The current  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X} 2_{\epsilon}$  was distributed in 1994 (backward compatible with  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}2.09$  mostly)

Development is continuing in the  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}3$  project

Compare time-span between major changes in Word or Wordperfect etc

Must be close to a copy of the L<sup>A</sup>T<sub>E</sub>X book by Leslie Lamport — one of the best computer manuals

‘The L<sup>A</sup>T<sub>E</sub>X Companion’ by Goossens *et al.* and ‘The L<sup>A</sup>T<sub>E</sub>X Graphics Companion’ by Goossens *et al.* (different *et al.* )

Loads of documentation locally comes with the te<sub>L</sub>E<sub>X</sub> distribution which is installed on digican. This documentation can be accessed easily from

[www.it.ms.unimelb.edu.au/tex/index.html](http://www.it.ms.unimelb.edu.au/tex/index.html)

Useful web sites:

- [www.latex-project.org/](http://www.latex-project.org/)
- [www.ctan.org](http://www.ctan.org) or rather <http://mirror.aarnet.edu.au/CTAN/help/Catalogue/catalogue.html>
- [www.tex.ac.uk](http://www.tex.ac.uk) and [www.tug.org](http://www.tug.org)

**What do I do?** I will describe the unix/X11 usage. Can use this or TeXshop on a OS X Mac.

Open a good text editor (eg: xemacs)

Write your L<sup>A</sup>T<sub>E</sub>X code which consists of your text and commands

Save your file as myfirst.tex

Type `latex myfirst.tex` to compile your document

More than a single space is ignored. A blank line implies a new paragraph

If there is an error L<sup>A</sup>T<sub>E</sub>X will tell you usually which line it is on — fix it and then recompile.

If you have referred to equations or sections of your document you must compile a second time.

If you use B<sup>I</sup>B<sub>T</sub><sub>E</sub>X also compile the file using B<sup>I</sup>B<sub>T</sub><sub>E</sub>X after the first ‘latex-ing’ and then compile twice more.

So usual scenario is

```
Euler@digican> xemacs myfirst.tex
```

then do some typing :-) and save it

```
Euler@digican> latex myfirst.tex
```

```
Euler@digican> bibtex myfirst
```

```
Euler@digican> latex myfirst.tex
```

```
Euler@digican> latex myfirst.tex
```

Don't worry the compilation is *fast*...

The command `latex` generates `myfirst.aux`, `myfirst.log` and most importantly the `myfirst.dvi`, the 'device independent' file.

One can preview the output on the screen using

```
Euler@digican> xdvi myfirst.dvi
```

One can produce a postscript file for printing

```
Euler@digican> dvips myfirst.dvi -o
```

and print as usual

```
Euler@digican> lpr -Pmlwb myfirst.ps
```

## Basic structure of a $\text{\LaTeX}$ document

```
\documentclass{the type of document}
```

the rest of the preamble, which is setting up the document, eg macros such as  $\text{\ip}$  double-spacing, adding extension packages etc.

```
\begin{document}
```

A structured document

```
\end{document}
```

## Three types of L<sup>A</sup>T<sub>E</sub>X structure

1. The pair

```
\begin{some formatting environment}
```

```
\end{some formatting environment}
```

Example:

```
\begin{equation}
```

```
xn + yn = zn
```

```
\end{equation}
```

gives

$$x^n + y^n = z^n \quad (1)$$

2. The formatting command

```
\do-this{to this input}
```

Example:

```
\textbf{to this input} makes the text
```

contained with boldface such as

**to this input**

3. The command

```
\just-do-this-now
```

Examples

`\pounds` gives us the pound symbol £

`{1st-text \large 2nd-text}` makes the  
2nd-text larger, as in

1st-text 2nd-text

Hence there are some *special* characters in  
`LATEX`

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

Sometimes formatting commands take multiple  
arguments inside more than one set of `{}` or  
parameters inside `[]`

examples

```
\documentclass[11pt,a4paper]{article}
```

```
\newcommand{\ip}{[\phi, \Gamma]}
```

# More detail of the structure of a L<sup>A</sup>T<sub>E</sub>X document

## The preamble

```
% lines beginning with % are comments
%%%%%%%%% what kind of document are we writing %%%%%%%%%%
\documentclass[11pt,a4paper]{article}

%%%%%%%%% inclusion of latex 2e packages or extensions %
\usepackage{graphicx,amsmath,amsfonts,amsthm}

%%%%%%%%%% setting up or modifying the page %%%%%%%%%%%
% this is a low level command (unusual LaTeX syntax)
\textheight=24cm

% To change the spacing edit here!
\renewcommand{\baselinestretch}{1.3}

% AMS latex command for changing equation numbering
% inside sections
\numberwithin{equation}{section}

%%%%%%%%%% ***** Macros ***** %%%%%%%%%%

\newcommand{\mymacro}{\hat{\varphi}^{(n)}}
\newcommand{\ip}{[\phi,\Gamma]}

% this defines a theorem environment,
% numbered by section, called thm
\newtheorem{thm}{Theorem}[section]
```

## Document classes

The standard document classes, which are styles of document, are

- `article`
- `report`
- `book`
- `letter`
- `slides`

Theses in the department can be written under `report` or `book`

but other classes have written like various specific `thesis` and alternative `letter` classes.

This talk was written with the `seminar` class included in the standard `teTeX` distribution on `digican`

A more sophisticated talk environment uses `prosper`

## The contents: after the preamble

### Firstly: The title page or section

```
\begin{document}

\title{My new manuscript}
\author{A. L. Owczarek \\  

        Department of Mathematics and Statistics,\\  

        The University of Melbourne,\\  

        Victoria 3010, Australia.}

\date{
\begin{center}
\today
\end{center}
}

\maketitle

\begin{abstract}
This is interesting article about knots and  $G\{o\}$ del.

\end{abstract}
```

## The main contents

```
%*****  
\section{Introduction}
```

```
%*****
```

Here we explain why everyone that has gone before is so insignificant compared to the intellectual leap this article is about to unveil. We need to have a second sentence.

```
%*****  
\section{The methods} \label{methods}
```

```
%*****
```

Similarly, staircase polygons with staircase holes were also investigated. Topologically, the objects look like the cross section of a slab of Emmenthaler cheese or foam rubber. There is a boundary polygon, containing disjoint polygons which don't touch the boundary. It was shown that, with a finite number of holes, the connective constant is unchanged for any finite number of holes.

## contents continued

```
%*****  
\section{Results}
```

```
%*****
```

We are just so clever for thinking like this  
in section \ref{methods}.

In an earlier  
paper

\cite{guttman1998} the problem of  
\emph{punctured polygons}  
was studied.

```
%*****  
\section*{Acknowledgements}
```

```
%*****
```

I would like to thank my family and the members of  
the Academy of Motion Pictures.

**To add a reference list all one needs to add is**

```
%% References
```

```
\bibliography{my-bibliographic-database}  
\bibliographystyle{unsrt}
```

This tells  $\text{\LaTeX}$  that you keep a bibliographic database called

`my-bibliographic-database.bib`.

$\text{\LaTeX}$  searches for all citations you made: eg `\cite{guttman1998}` by looking up the ‘keys’ eg. `guttman1998` in your `.bib` file

$\text{\LaTeX}$  creates a file called `my myfirst.bbl` with the actual bibliography for `myfirst.tex` (and a log file `myfirst.blg`)

## my-bibliographic-database.bib

```
@article{guttman1998,  
author="A. J. Guttmann and A. L. Owczarek and X. G. Viennot",  
title="Vicious walkers and Young tableaux: Without walls",  
journal="J. Phys. A.",  
volume=31,  
year=1998,  
pages="8123--8135"  
}  
  
@book{hughes1995a-a,  
author="B. D. Hughes",  
title="Random Walks and Random Environments, Vol. 1. Random walks",  
publisher="Clarendon Press",  
address="Oxford",  
year=1995  
}  
  
@article{guttman1984a-a,  
author="A. J. Guttmann and N. Wormald",  
journal="J. Phys. A.",  
volume=17,  
year=1984,  
pages="L271"  
}  
  
@article{owczarek1987a-a,  
author="A. L. Owczarek and R. J. Baxter",  
journal="J. Phys. A",  
volume=20,  
year=1987,  
pages="5263--5271"  
}  
  
@article{owczarek1989a-a,  
author="A. L. Owczarek and R. J. Baxter",  
journal="J. Phys. A",  
volume=22,  
year=1989,  
pages="1141--1165"  
}
```

The file `myfirst.bbl` is created in the style `unsrt` which also determines the formatting of the citations in the bulk of the text.

There have been lots of journal styles written — look in CTAN. I use `aip` for my papers which is from the American Institute of Physics.

### `myfirst.bbl`

```
\begin{thebibliography}{1}

\bibitem{guttman1998}
A.~J. Guttmann, A.~L. Owczarek, and X.~G. Viennot.
\newblock Vicious walkers and young tableaux: Without walls.
\newblock {\em J. Phys. A.}, 31:8123--8135, 1998.

\end{thebibliography}
```

## Inclusion of Encapsulated postscript figures

Use `graphics` or `graphicx` packages by putting `\usepackage{graphicx}` in the preamble then put

```
\begin{figure}[ht]
\begin{center}
\includegraphics[width=12cm]{picture.eps}
\caption{\textit{A caption explaining the figure.}}
\label{myfig1}
\end{center}
\end{figure}
```

close to where you first cite the figure with  
as in `figure~\ref{myfig1}`

## Other useful packages

The  $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\text{\LaTeX}$  packages `amsmath`, `amsthm` etc are all useful for the best presentation of maths

`latexsym` for some further symbols

The package `pstricks` is popular for making lots of postscript figure manipulations and creations

I find `rotating` good for rotating tables

If you need to you can use  $\text{\LaTeX}$  to write music or Feynman diagrams (both have packages!).

**Equations** There are two major types of equation:

1. ‘Displayed’ equations
2. ‘In-line’ equations

There are several environments for producing displayed equations some with numbering, some without, some for multiline equations and some for single lines.

For single line equations with numbering use

```
\begin{equation}
\sum_{k=0}^{\infty}
\left( \frac{\Gamma(z_k)}{\Phi(z_k)} + 1 \right)
= \oint d\theta \: e^{2\pi i \theta}
\end{equation}
```

$$\sum_{k=0}^{\infty} \left( \frac{\Gamma(z_k)}{\Phi(z_k)} + 1 \right) = \oint d\theta e^{2\pi i \theta} \quad (2)$$

Now note how the same equation looks displayed in-line ‘encased’ by \$ and \$

We have  $\sum_{k=0}^{\infty} \left( \frac{\Gamma(z_k)}{\Phi(z_k)} + 1 \right) = \oint d\theta e^{2\pi i \theta}$ .

Usually only smaller equations like  $\Gamma(z_i) = 1/2$  would be displayed inline.

We have  $\sum_{k=0}^{\infty} (\Gamma(z_k)/\Phi(z_k) + 1) = \oint d\theta e^{2\pi i \theta}$ .  
 Usually only smaller equations like  $\Gamma(z_i) = 1/2$  would be displayed inline.

L<sup>A</sup>T<sub>E</sub>X may change the way you look at typeset documents forever.

At the very least it will help get you through your honours or postgrad degree in maths.

These slides, links and some other material can be found at

`http://ms.unimelb.edu.au/~aleks/latex-talk.html`

Try modifying some of these or create your own with the L<sup>A</sup>T<sub>E</sub>X book nearby.

Enjoy producing beautifully typeset documents — Impress your friends and family ;-)