

LaTeX Level 3

Document Preparation

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Today's Programme

1. Some history and background
2. Environment - Live Ubuntu Linux
 - ▶ Exercise: getting to know the environment
3. Typesetting a simple document
 - ▶ Exercise: a first document
4. Basics: text, lists, tables, titles
 - ▶ Exercise: typesetting a text document
5. Mathematics: to infinity and beyond
 - ▶ Exercise: mathematics
6. Advanced: bibliography, cross references, figures
7. Resources and references



A brief history of T_EX

T_EX was designed by Donald Knuth in the late 1970s as a language for typesetting documents. The main characteristics are

- ▶ A markup language: embedded commands control the appearance of the output (like HTML).
- ▶ Free and freely available.
- ▶ Powerfully configurable: the language can be extended to your own specification.
- ▶ Stable for 20 years with a vast and supportive user community.



So what is L^AT_EX?

- ▶ Developed in the 1980s by Leslie Lamport.
- ▶ L^AT_EX works at a higher level than T_EX, making it easier to use.
- ▶ It has many powerful features including tools for creating tables of contents, bibliographies, cross-references and indexes.
- ▶ More widely used than T_EX and what we will be using today.



Why doesn't everybody use it?

- ▶ It works on an “edit, compile, view” cycle. There is no effective or universally available WYSIWYG interface. You write plain text files.
- ▶ Windows users are not used to including markup in documents.
- ▶ Many features such as colour and graphics are not standard and so need to be included explicitly.
- ▶ Extending the system using the macro language is difficult (but ultimately satisfying).

But

- ▶ There is a large and helpful community of T_EX users, particularly amongst mathematicians.



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How will we use L^AT_EX today?

- ▶ We will be using Ubuntu Linux Desktop today for the exercises. The CD runs a ‘live’ version of Linux which does not change the hard disk.
- ▶ This version of Ubuntu comes from OSS Watch, the Open Source advisory service based at OUCS.
- ▶ A good version of L^AT_EX is included on the CD.
- ▶ Familiarity with a Linux user interface is assumed.
- ▶ These exercises were prepared using the OSS Watch Live Ubuntu CD and a memory stick. I made frequent backups!

T_EX and L^AT_EX work equally well on Windows, Macintosh and many other operating systems.

L^AT_EX is available for Windows: the T_EXLive CD can be purchased from the OUCS shop or the software downloaded.



A simple L^AT_EX document

```
\documentclass[12pt,a4paper]{article} % Your input file must contain these two lines
\usepackage{color}
\usepackage{parskip}
\begin{document}
Words are separated by one or more spaces. Paragraphs
  separated by one or more blank lines. The output
is not affected by adding extra
spaces or extra blank lines to the input file.

Double quotes are typed like this: ``quoted text''.
Single quotes are typed like this: `single-quoted text`.

Emphasized text is typed like this: \emph{this is emphasized}.
Bold text is typed like this: \textbf{this is bold}.
Red text is typed like this: \textcolor{red}{this is red text}.

\subsection{A Warning or Two} % This command makes a subsection title.

If you get too much space after a mid-sentence
period---abbreviations like etc.\ are the common culprits)---then
type a backslash followed by
a space after the period, as in this sentence.

Remember, don't type the 10 special characters (such as dollar sign and
backslash) except as directed! The following seven are printed by
typing a backslash in front of them: \$ \% \& \# \_ \{ and \}.
The manual tells how to make other symbols.
\end{document}
```



Compiling and previewing a \LaTeX file

With a file called `test.tex`, either

compile the file using

```
latex test.tex
```

preview the file with

```
xdvi test.dvi &
```

turn it into PostScript

```
dvips -o test.ps
```

or using pdf\TeX

compile the file using

```
pdflatex test.tex
```

view it (and print if necessary)

```
acroread test.pdf
```



Exercise 1

Now do Exercise 1.

- ▶ If it is not already loaded, put the Ubuntu CD into the CD drive and restart the machine.
- ▶ Open a command tool window.
- ▶ Start the `emacs` editor using

```
emacs test.tex &
```
- ▶ Save the file and compile it.
- ▶ Preview it or fix errors.

Remember that \LaTeX files must end with `.tex`.



Some simple rules

- ▶ The characters

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

are special. Put a backslash (`\`) in front of them if you need the character to appear.

- ▶ Commands are words (usually) prefixed by `\`. Some commands have parameters which are surrounded by `{ }`.
- ▶ Some commands are environments of the form

```
\begin{xxx} ... \end{xxx}
```
- ▶ Anything after `%` is a comment and is ignored.



Document classes

The `\documentclass{class}` markup includes:

- `article` for short documents and articles for publication.
- `report` for longer technical documents.
- `book` for book publication.
- `letter` for personal letters and includes addresses, date and signature.

There are many others.



Class options

The standard classes can be modified by options. Options appear in square brackets [...] after the `\documentclass` command.

`a4paper` makes the page size suitable for A4 paper.

`11pt` prints the document using eleven-point type rather than the default of ten-point type; option `12pt` uses twelve point type. A point is a typesetting measurement and is 1/72 of an inch.

`twoside` formats `article` and `report` documents for two-sided printing. This is the default for `book` style.

`twocolumn` produces two columns on each page.

so `\documentclass[a4paper,12pt]{article}` would use the article style and produce output formatted for A4 paper and 12pt type.



Frequently used packages

`times` Sets the default font to Times Roman.

`color` Allows coloured text and backgrounds.

`graphicx` Loads the macros for including external graphics (or picture) files.

`hyperref` Turns cross-references into hyperlinks in PDF documents.

`amsmath` Additional mathematical symbols from the American Mathematical Society.

`parskip` Leave a blank line between paragraphs.

`fancyhdr` Allows for complex headers and footers.



Titles

Titles are easy to include in documents and tables of contents automatically generated from section and subsection headings.

```
\title{Your title}
\author{Your name}
\date{A date}
\maketitle
\tableofcontents
```

This will make a title page and a table of contents.



Section headings

```
\section{Top-level heading}
\subsection{2nd-level heading}
\subsubsection{3rd-level heading}
\paragraph{4th-level heading}
\subparagraph{5th-level heading}
```

Sections will be formatted and numbered automatically.



Lists

- | | |
|------------------------|---|
| 1. Frogs | <code>\begin{enumerate}</code> |
| 2. Toads | <code>\item Frogs</code> |
| 2.1 Lesser spotted | <code>\item Toads</code> |
| 2.2 Warty | <code>\begin{enumerate}</code> |
| ▶ Look before you leap | <code>\item Lesser spotted</code> |
| ▶ Then go for it | <code>\item Warty</code> |
| ▶ Enjoy the trip | <code>\end{enumerate}</code> |
| | <code>\end{enumerate}</code> |
| | <code>\begin{itemize}</code> |
| | <code>\item Look before you leap</code> |
| | <code>\item Then go for it</code> |
| | <code>\item Enjoy the trip</code> |
| | <code>\end{itemize}</code> |



Footnotes

Both frogs^a and toads^b are found where I live.

^awhich hop
^bwhich crawl

Both frogs
`\footnote{which hop}`
and toads
`\footnote{which crawl}`
are found
where I live.



Quotes

A quotation often used in examples is

Now is the time for all good men to come to the aid of the party.

A quotation often used in examples is

```
\begin{quote}
Now is the time for all good men to
come to the aid of the party.
\end{quote}
```



Formatting characters

Command	or	Effect
<code>\textrm{...}</code>	<code>{\rmfamily...}</code>	Text is roman family
<code>\textsf{...}</code>	<code>{\sffamily...}</code>	Text is sans serif family
<code>\texttt{...}</code>	<code>{\ttfamily.}</code>	Text is typewriter family
<code>\textmd{...}</code>	<code>{\mdseries...}</code>	Text is medium series
<code>\textbf{...}</code>	<code>{\bfseries...}</code>	Text is bold series
<code>\textup{...}</code>	<code>{\upshape...}</code>	Text is upright shape
<code>\textit{...}</code>	<code>{\itshape...}</code>	Text is <i>italic</i> shape
<code>\textsl{...}</code>	<code>{\slshape...}</code>	Text is <i>slanted</i> shape
<code>\textsc{...}</code>	<code>{\scshape...}</code>	Text is SMALL CAPS shape
<code>\emph{...}</code>	<code>{\em...}</code>	Text is <i>emphasized</i> font.
<code>\textnormal{}</code>	<code>{\normalfont...}</code>	Text is default font



The *tabular* environment

1. The table is enclosed by `\begin{tabular}{XXX}` and `\end{tabular}`
2. Each X represents the alignment of column — either l (left), r (right) or c (centre).
3. An exact width can be set using `p{lin}`.
4. Otherwise the width of the column is set automatically.
5. Cells on a row are separated by `&`.
6. Put `\\` between each row.



A table

<i>Vegetables</i>		<i>Planting time</i>
Beans	Broad	November
	French	May
Beetroot		March
Carrots		March
Courgettes		June
Tomatoes	Beef	May (outdoors)
	Cherry	April (under glass)



The table source

```
\begin{tabular}{|l|l|l|} \hline
\multicolumn{2}{|c|}{\emph{Vegetables}}
& \emph{Planting time} \\ \hline
Beans & Broad & November \\ \cline{2-3}
& French & May \\ \hline
\multicolumn{2}{|l|} {Beetroot} & March \\ \hline
\multicolumn{2}{|l|} {Carrots} & March \\ \hline
\multicolumn{2}{|l|} {Courgettes} & June \\ \hline
Tomatoes & Beef & May (outdoors) \\ \cline{2-3}
& Cherry & April (under glass) \\ \hline
\end{tabular}
```



Exercise 2

Now do the set of Exercises in Section 2.



Inline or Display math?

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$$

```
\(\lim_{n \to \infty}
\sum_{k=1}^n \frac{1}{k^2}
= \frac{\pi^2}{6}\)
```

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$$

```
\[
\lim_{n \to \infty}
\sum_{k=1}^n \frac{1}{k^2}
= \frac{\pi^2}{6}
\]
```



Equations

Numbered Equations

$$g(E) = \frac{(E)}{+} (I) I E \frac{!}{E^2} \quad (1)$$

```
\begin{equation}
g(E) = \frac{(E)}{+}
+ (I) I {E}
\frac{!}{E^2}
\end{equation}
```



Simple maths

Superscript: a^2

Superscript: `a^2`

Subscript: a_2

Subscript: `a_2`

Root: $\sqrt{56}$

Root: `$$\sqrt{56}$$`

Fraction: $\frac{123}{x}$

Fraction: `$$\frac{123}{x}$$`



More maths

$$a + b = c + d = xy = w/z \quad \vec{x} \cdot \vec{y} = 0 \text{ if and only if } \vec{x} \perp \vec{y}$$

$$\frac{\partial}{\partial y} fxy = 0 \quad y^4 = 2x + z_3 \quad z = 3\sqrt{\sqrt{y^2} = 3y^5 + 5}$$

```
\(a+b=c+d=xy=w/z\)
\(\vec{x}\cdot\vec{y}=0 \mbox{ if and only if }
\vec{x}\perp\vec{y}\)
\(\frac{\partial}{\partial y}fxy=0\)
\ (y^4=2x+z_3\)
\ (z=3\sqrt{\sqrt{y^2}=3y^5+5}\)
```



Sorting out spacing

$$\iint_D g(x, y) dx dy$$

instead of

$$\int \int_D g(x, y) dx dy$$

```
\begin{displaymath}
\int\!\!\!\!\int_D g(x, y)
\ , \ \mathrm{d} x\ , \ \mathrm{d} y
\end{displaymath}
```

instead of

```
\begin{displaymath}
\int\int_D g(x, y) \ \mathrm{d}
x \ \mathrm{d} y
\end{displaymath}
```

◀ ▶ ↻ 🔍

Arrays

$$\mathbf{X} = \begin{pmatrix} x_{11} & x_{12} & \dots \\ x_{21} & x_{22} & \dots \\ \vdots & \vdots & \ddots \end{pmatrix}$$

```
\begin{displaymath}
\mathbf{X} =
\left(
\begin{array}{ccc}
x_{11} & x_{12} & \ldots \\
x_{21} & x_{22} & \ldots \\
\vdots & \vdots & \ddots
\end{array}
\right)
\end{displaymath}
```

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Another array

$$y = \begin{cases} a & \text{if } d > c \\ b+x & \text{today} \\ l & \text{and every day} \end{cases}$$

```
\begin{displaymath}
y = \left\{
\begin{array}{ll}
a & \text{if } d > c \\
b+x & \text{today} \\
l & \text{and every day}
\end{array}
\right.
\end{displaymath}
```

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Grouping in an array

$$\left(\frac{1}{3} \mid \frac{2}{4} \right)$$

```
\begin{displaymath}
\left(
\begin{array}{c|c}
1 & 2 \\
\hline
3 & 4
\end{array}
\right)
\end{displaymath}
```

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Exercise 3

Now do the exercises in Section 3.

These are all based on typesetting mathematics. If you will not be needing \LaTeX for mathematical typesetting then experiment further with some techniques explained in Chapter 2 of *The Not So Short Introduction to \LaTeX 2 ϵ* .



Cross-references

```
\section{Introduction}\label{intro}
Here is the introduction.
\section{A section heading}
We can refer to section \ref{intro}
which is on page \pageref{intro}.
```

A `\label` can follow sections, figures tables, equations and so on. The numbering is sorted out automatically. When there are cross-references, the `latex` command must be run twice to get them sorted out.



Figures

```
\begin{figure}
\vspace{3cm}
\caption{This is photograph}
\end{figure}
\begin{table}
...
\caption{This is a table}
\end{table}
```

- ▶ Figures and tables are numbered automatically.
- ▶ Just as `\tableofcontents` will list your sections and subsections at the beginning of the document, `\listoffigures` and `\listoftables` will list the figures and tables with their captions.



Including graphics

```
\begin{figure}
\begin{center}
\includegraphics[angle=90,
width=0.5\textwidth]{test}
\end{center}
\end{figure}
```

The format of the graphics files you include depends on whether the final printer-ready output is produced via `dvips` or `pdflatex`.

- `dvips` Use EPS (Encapsulated PostScript) files.
- `pdflatex` Use JPEG, PDF and PNG format.



Options for `graphicx` package

`width=xx` scale graphic to the width specified.
`height=xx` scale graphic to the height specified.
`angle=nn` rotate graphic counterclockwise.
`scale=nn` scale graphic.



Components of BibTeX

test.tex

```
\documentclass{article}
\begin{document}
\bibliographystyle{plain}
In \cite{homer} we see that
\bibliography{myrefs}
\end{document}
```

myrefs.bib

```
@author{homer,
  author="Homer Simpson",
  title="My Favorite Donuts",
  journal="Comparative Confectionary",
  year="2006",
  volume="18",
  pages="9-55"}
```



Running BibTeX

```
latex test # writes test.aux
bibtex test # writes test.aux
latex test # writes test.aux
latex test # writes test.aux
```

\LaTeX and BibTeX communicate using the `.aux` file. \LaTeX tells BibTeX what it wants done and BibTeX writes a `.bbl` file which \LaTeX reads the next time it is run.



Exercise 4

Now do the exercises in Section 4.



Books

1. Leslie Lamport: *L^AT_EX, A document preparation system*, 2nd edition, Addison-Wesley, (Reading, Massachusetts, 1994)
2. Michel Goossens, Frank Mittelbach and Alexander Samarin: *The L^AT_EX Companion*, Addison-Wesley, (Reading, Massachusetts, 1994)
3. Michel Goossens, Frank Mittelbach and Sebastian Rahtz: *The L^AT_EX Graphics Companion*, Addison-Wesley, (Reading, Massachusetts, 1997)

More books

1. Michel Goossens, Sebastian Rahtz et al.: *The L^AT_EX Web Companion*, Addison-Wesley, (Reading, Massachusetts, 1999)
2. Helmut Kopka and Patrick Daly: *A Guide to L^AT_EX*, Addison Wesley, 3rd Edition 1999
3. Donald E. Knuth: *The T_EX book*, Addison Wesley, (Reading, Massachusetts, 1986)

Distributions

- ▶ T_EXLive (CD and DVD, from OUCS shop) for Linux, Unix, Mac, Windows.
- ▶ teT_EX (most Linux distributions), for Linux/Unix. Now no longer supported.
- ▶ MikT_EX (web download), for Windows.
- ▶ Textures (commercial) for Macintosh and MacT_EX which is free.
- ▶ VT_EX and Y&Y T_EX (commercial) for Windows

Shells and frontends

- ▶ WinEdt (commercial) for Windows.
- ▶ Emacs (on the T_EXLive CD) for Linux and Windows.
- ▶ Winshell and T_EXnicCenter (on the T_EXLive CD).
- ▶ Lyx (free) for Linux/Unix and Windows.
- ▶ Aquamacs (free), an emacs-like editor for Macs.
- ▶ Scientific Word (commercial but site licensed) for Windows

Other resources

- ▶ The T_EXLive CD from OUCS shop (see <http://www.tug.org/texlive>) has T_EX setups for Windows, Unix and Linux
- ▶ The Comprehensive T_EX Archive Network (CTAN) has all free T_EX packages. See <http://www.ctan.org>
- ▶ The T_EX Users Group, <http://www.tug.org/>, has links to all the T_EX distributions and projects

Other things you can do with L^AT_EX

- ▶ Do Japanese or Hebrew
- ▶ Typeset music or chess boards
- ▶ Make pictures
- ▶ Convert to HTML
- ▶ Typeset XML directory
- ▶ Produce bus timetables