L^AT_EX

Fundamentals

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Introduction

LaTeX is an advanced document production system especially designed to typeset mathematically based documents. LaTeX is effectively a programming language based on the TeX document production system which has been around for over 20 years.

How does it compare to, say, Microsoft Word? Well, LaTeX was designed from the ground up for document production. It can handle documents of arbitrary size and has many advanced features not avaliable in any other package. Its benefits include:

- Arbitrary document size

- Cross platform

- Basic documents are TEXT files

- Highly advanced macros

- Massive archive of avaliable add-ons and styles

- Ideal for documents with large amounts of mathematics, figures and tables

- Advanced referencing and citation capabilities

- Easy to use

- Produce press quality documents

- Used by journals and publishing houses around the world

- FREE

LaTeX provides you with complete control over how your document will look and can be compiled into almost any format: PDF; Postscript; HTML; GIF etc. There are free implementation of LaTeX on PC's, Mac's, Unix and almost all operating systems, all you need do is download one.

Once you have a version of LaTeX on your computer you are able to write documents in almost any editor: MS Word; Word Pad; Text editor; WinEDT; Emacs; VI; and even an email program if you want. With your document finished, you simply run it through the LaTeX engine and out pops your PDF or Postscript document, ready for publishing.

Compiling a document

As eluded to, a LaTeX document consists of text documents, which need to be compiled into a final document. You are free to write the document in any text editor and save the file as a text file, however most LaTeX implementations come with a reasonable editor. On the Mac's you should try TeXshop and on the PC's try WinEDT.

Once you create a LaTeX file (`filename.tex`) you need to compile it into the document format you want. Usually, your LaTeX implementation will have a "compile" or "build" or "LaTeX" button (on Unix systems, type the command `latex filename.tex`). Press this and it will compile your document. If there are errors, it will stop, tell you the line where the error is and allow you to correct it.

Running LaTeX will produce many files, the most important being the DVI file (`filename.dvi`). This is your document in a file for viewing on-screen. You can then convert the DVI file to a PostScript (`filename.ps`) or PDF (`filename.pdf`) document using `dvips` or `dvi2pdf`. You run these usually by pressing the appropriate button in your LaTeX program.

Once you have the the PostScript or PDF file you are free to print or view the file.

To produce high quality documents (for printing or screen viewing) consider the following:

- `latex filename.tex` will produce a DVI file for viewing on a screen

- `pslatex filename.tex` will produce a DVI file appropriate for printing or PDF

- `pdflatex filename.tex` will skip the DVI file and produce a PDF document

LaTeX has very advanced referencing, citations, tables of contents etc. To get these functioning correctly, you often have to compile your document 2 or 3 times. If the citations or references are not correct, run LaTeX again on your document.

A few basics

LaTeX consists of text with embedded commands which control how the text will appear on the printed page, a little like HTML. Consequently, there are special character which designate these embedded commands. The special characters are:

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

To include one of these special characters in your text, you need to precede it with a '`\`' as in `\#`, `\$`, `\%`, `\&`, `\_`, `\{` and `\}`. To include the characters `~`, `^` and `\` you need to use the `verbatim` environment or the `\verb` command to produce special characters in type writer style. These will be discussed later.

The `%` symbol is for comments — everything following it is ignored by the document processor.

Basic layout of a document

A LaTeX document is a text document with command and text throughout. All commands begin with a \. To start a document you need to choose a "class" which will define the underlying layout of the document. For example

```
\documentclass{book}
```

will provide the basic structure of a book and

```
\documentclass{article}
```

will provide the basic structure of a journal article. There are hundreds of possible document classes or styles which are generally available from the internet. You then need to define the document environment.

```
\documentclass{book}

  % Packages and other definitions go here...

\begin{document}

  Text goes here...

\end{document}
```

Different classes produce different behaviour for the commands \part, \chapter, \section, \subsection, \subsubsection and \tableofcontents

Following are examples of a basic letter, book and article, three of the standard LaTeX classes.

```
\documentclass[a4paper,12pt]{letter}
\begin{document}
\address{Stuart Midgley \\ ANU}
\signature{Stuart Midgley}
\begin{letter}{Karren Visser \\ ANU}
\opening{Dear Karen}
    I really enjoyed the \LaTeX\ course.
\closing{Regards}
\end{letter}
\end{document}
```

```
\documentclass[a4paper,12pt]{book}
\makeindex
\begin{document}
\begin{titlepage}
\Large
\centering
    This is a book title page \\
\vspace{2cm}
   Which you have complete control over.
\end{titlepage}
\tableofcontents
\section{Introduction}
    This is the introduction
\section{Middle}
    Stuff goes here
\section{End}
    We finish up
\end{document}


\documentclass[a4paper,12pt,twocolumn]{article}
\begin{document}
\author{Stuart Midgley}
\title{Introduction to the \LaTeX\ article class}
\maketitle
\begin{abstract}
    This is an abstract of a demo paper with some extra
    text to show how the lines wrap and span multiple columns.
\end{abstract}
\subsection{Introduction}
    This is the intro.  All the text is in 2 columns which
    are automatically controlled by the \LaTeX\ system,
    without intervention by the author.
\subsection{Middle}
    More stuff goes here
\subsection{Conclusion}
    We finish up
\end{document}
```

As you can see, from the three examples, each class has its own particular commands and layout style.

Controlling margins and line spacing

LaTeX by default uses US Letter paper and sets a 1 inch left and top margin. To reset the margins to zero and then define your own margins, text width and text height use the following:

```
\setlength{\voffset}{-1in}          % Reset the top margin back to zero
\setlength{\hoffset}{-1in}          % Reset the left margin to zero
\setlength{\topmargin}{20mm}         % Top margin of 20mm
\setlength{\oddsidemargin}{20mm}     % Odd side left margin to 20mm
\setlength{\evensidemargin}{20mm}    % Even side left margin to 20mm
\setlength{\parskip}{5mm}            % Space between paragraphs to be 5mm
\setlength{\textheight}{25.7cm}      % Text height to be 25.7cm (an A4
                                     %    page is 25.7cm+2cm+2cm=29.7cm long)
\setlength{\textwidth}{17cm}         % Text width to be 17cm (an A4 page
                                     %    is 17cm+2cm+2cm=21cm wide)
```

In this example, all margins are 2cm. The units of length you can use are cm, mm, in, pt, pc, ex (height of the letter 'x') or em (width of the letter 'M').

Paragraphs, lines and spaces

LaTeX has the concept of a paragraph and line. To seperate paragraphs, leave a double blank line while to start a new line use a double backslash \\. For example:

<table>
<tr><td>

This is a new line embedded in text while this is not.

A double space makes a new paragraph that moves the text to the next line and indents the line a certain amount. All the spacings, margins and indents can be controlled by the advanced user.

</td><td>

```
This is a new line \\ embedded
in text while \\
this is not.

A double carriage return makes a new
paragraph that moves the text to the
next line and indents the line a
certain amount.  All the spacings,
margins and indents can be controlled
by the advanced user.
```

</td></tr>
</table>

LaTeX ignores all other carriage returns or line breaks and assumes that unbroken text forms one line. LaTeX also ignores multiple spaces. That is, 1 space " " is the same as 10 " " spaces. To force LaTeX to include these spaces, you need to precede them with a '\', eg \ \ \ \ \ \ \ \ \ \ produces 10 spaces   like so.

You can insert your own extra space of any size with the \hspace and \vspace commands.

some text	with a 1cm horizontal	```some text \hspace{1cm} with a```
space and		```1cm horizontal space and \\```
		```\vspace{1cm} \\```
		```a 1cm vertical space```

a 1cm vertical space

The amounts of "extra space" can be negative, like this: ABCDEF

Fonts and type style

LaTeX gains most of its font information from the class or style that you are using. Often, however, you may wish to change the font or type style while writing a document.

In normal text mode:

Roman	```\textrm{Roman}```
Italic	```\textit{Italic}```
Bold	```\textbf{Bold}```
Slant	```\textsl{Slant}```
CAPS	```\textsc{Caps}```
Type	```\texttt{Type}```
Sans Serif	```\textsf{Sans Serif}```

In math mode:

Roman	```Roman```
Italic	```Italic```
Bold	```$\mathbf{Bold}$```
Type	```$\mathtt{Type}$```
SansSerif	```$\mathsf{Sans Serif}$```
$\mathcal{CALLIGRAPHY}$	```$\mathcal{CALLIGRAPHY}$```

To change type size:

Tiny	```{\tiny Tiny}```
Script	```{\scriptsize Script}```
Foot note	```{\footnotesize Foot note}```
Small	```{\small Small}```
Normal	```{\normalsize Normal}```
Large	```{\large Large}```
Larger	```{\Large Larger}```
LARGER	```{\LARGE LARGER}```
Huge	```{\huge Huge}```
Huger	```{\Huge Huger}```

These are the standard fonts and fontsizes. However countless other fonts can be specially installed, and in LaTeX it is easy to achieve text of arbitrary size (as well as text that is raised, lowered, stretched, rotated, reflected, coloured...)

Environments and inline

A common feature of LaTeX is the environment. Environments are started with \begin{...} and finished with \end{...}. The environment then applies to everything between the begin and end statements. Examples of environments are

Itemised list:

- item 1

- item 2

```
\begin{itemize}
\item item 1
\item item 2
\end{itemize}
```

Enumerated list:

1. item 1

2. item 2

```
\begin{enumerate}
\item item 1
\item item 2
\end{enumerate}
```

Verbatim:

```
    preformatted text works
as        a type writer
which

is

different to normal text
```

```
\begin{verbatim}

    preformatted text works
as        a type writer
which

is

different to normal text

\end{verbatim}
```

Equation:

$$x^{2} + 1 = y \tag{1}$$

```
\begin{equation}
x^{2}+1=y
\end{equation}
```

Centered text:

This text is
centered

```
\begin{center}
This text is\\
centered
\end{center}
```

Often it is desirable to have the environment inline with text. This is achieved usually with a command and the text in braces:

an equation $x^2 + 1 = y$ in line

```
an equation $x^{2}+1=y$ in line
```

and verbatim `text` `inline` is a little different

```
and verbatim \verb+text    inline+
is a little different
```

you can **do bold** text and *italic* with different SIZES which can be added easily.

```
you can \textbf{do bold} text and
\textit{italic} with different
{\Large sizes} {\tiny which can be}
added easily.
```

Special characters and equations

LaTeX is strongest at special characters and equations. There are 3 different equation environments: inline equation; equation environment; and equation array (for multi-line equations)

An inline equation: $f(x) = \frac{1}{\alpha} \sum_{n=1}^{100} x^n$

```
An inline equation:
$f(x)=\frac{1}{\alpha}
 \sum_{n=1}^{100} x^{n}$
```

Equation environment:

$$f(x) = \frac{1}{\alpha} \sum_{n=1}^{100} x^n \qquad (2)$$

```
\begin{equation}
f(x)=\frac{1}{\alpha}
\sum_{n=1}^{100} x^{n}
\end{equation}
```

Equation array environment:

$$
\begin{eqnarray}
f(x) & = & \frac{1}{\alpha} \sum_{n=1}^{100} x^n \qquad (3) \\
 & = & \alpha^{-1} \sum_{n=1}^{100} \left(x^2 \right)^{\frac{n}{2}} \qquad (4)
\end{eqnarray}
$$

```
\begin{eqnarray}
f(x) & = & \frac{1}{\alpha}
\sum_{n=1}^{100} x^{n} \\
 & = & \alpha^{-1} \sum_{n=1}^{100}
\left( x^{2} \right)^{\frac{n}{2}}
\end{eqnarray}
```

There are also a large number of symbols available. In the math environment:

$\alpha\ \beta\ \pi$

```
$\alpha$ $\beta$ $\pi$
```

$\pm\ \times\ \uplus$

```
$\pm$ $\times$ $\uplus$
```

$\leq\ \ll\ \succeq$

```
$\leq$ $\ll$ $\succeq$
```

$\leftarrow\ \Longleftrightarrow\ \notin$

```
$\leftarrow$ $\Longleftrightarrow$ $\notin$
```

$\aleph\ \nabla\ \infty$

```
$\aleph$ $\nabla$ $\infty$
```

In regular text mode:

ò ä o͡o i̱	`\'{o} \"{a} \t{oo} \b{i}`
œ ł ß	`\oe \l \ss`
† § ©	`\dag \S \copyright`

LATEX also has smart quotes "". To use the smart quotes, you need to enter a double ' followed by a double '

    The "smart quotes" look nice   `The ''smart quotes'' look nice`

For a complete description of symbols see "LATEX A Document Preparation System" by Leslie Lamport.

Resources

The ideal reference book for getting started with LATEX:

> LATEX A Document Preparation System 2nd Edition
> Leslie Lamport
> Addison Wesley 1994

The definitive guide to all things LATEX:

> The LATEX Companion
> Goossens Mittelbach Samarin
> Addison Wesley 1994

Large online resources with class files, fonts and distributions:

> `http://www.ctan.org`

The notes for the Graduate Information Literacy Program give a much more in-depth introduction to LATEX:

> `http://wwwmaths.anu.edu.au/~chrisw/LaTeX/`

Exercises

Try to recreate the letter and article attached to the back of this manual yourself. They will help you understand the above material. The source files are available from the course website, `http://wwwmaths.anu.edu.au/~chrisw/LaTeX/`.

Joe Bloggs
Building 555
ANU   ACTON   0200

March 28, 2004

Jane Nobody
Building 556
ANU   ACTON   0200

Dear Jane

RE: ILP LaTeX course

I am writing regarding the ILP Latex course. I attended the course on March 28, 2004 and found it very useful. Unfortunately, I did not have time to attend the "Beyond Basics" course and would like to know if the course material is available.

I realise that attendance at the course is vital to my understanding of LaTeX, however I have lectures on all course dates. If you could please forward me the course material, I am sure I can undertake the course in my own time.

On another note, writing letters, articles and books with LaTeX is very easy.

Regards

Joe Bloggs

Introduction to the LaTeX article class

Stuart Midgley Chris Wetherell

March 28, 2004

Abstract

This is a demonstration article written by Stuart Midgley (and tinkered with a little by Chris Wetherell) for the Information Literacy Program (ILP). This article is broken into three parts. The first will guide the beginner LaTeX user through basic equations, layout and other useful information.

The second section will introduce the LaTeX user to very simple LaTeX concepts such as font sizes and other rather useful features. While the third section will pull the whole document together.

1 Introduction

LaTeX is a powerful document production system used by scientists and writers the world over. Its beautiful typeset equations are the envy of all other word processors and typesetting programs.

For example, consider the interaction between two charged particles,

$$\vec{F} = \frac{q_1 q_2}{4\pi\epsilon_0 r^3}\vec{r} \qquad (1)$$

where $\vec{r}$ is the position vector between the two particles. This equation can be expanded to give the force on n particles quite easily

$$\vec{F}_j = \sum_{i=1}^{n}\left(\frac{q_j q_i}{4\pi\epsilon_0 r_{ij}^3}\vec{r}_{ij}\right) \qquad (2)$$

You can even enter a multi line equation

$$\phi_{n+1}(\eta) = 2x\phi_n(\eta) + \phi_{n-1}(\eta) \qquad (3)$$
$$\phi_1(\eta) = \eta \qquad (4)$$
$$\phi_0(\eta) = 1 \qquad (5)$$

or and inline equation $\phi_{n+1}(\eta) = 2x\phi_n(\eta) + \phi_{n-1}(\eta)$ which is exciting.

Of course you may want to use specific symbols † ‡ § ¶ œ ò ô ǒ ôo o just to make the document look a bit snazzy.

Its also worth noting how well LaTeX jusifies your document. It always looks good.

2 Middle

More importantly, you may want to *highlight* some of your text with nice "quotes" and **a bigger bolder font** all of which LaTeX supports. Of course, LaTeX doesn't help with the grammar or spelling. Your text editor needs to handle that.

Another important feature of LaTeX is the class file. The class file specifies everything about a document and ensures a consistent look and feel to your document all the time. It has often been said, that no document looks as good as a LaTeX document. The fonts always look good, the document just looks professional. Notice also the automatic hyphenation.

3 Conclusion

Not much to put here, except that a document written in LaTeX is very portable. You should be able to email your text file to anyone in the world and they can recreate your document perfectly, regardless of platform. Also, since the document is just a text file it is nice and small.