

Introduction to \LaTeX for physicists

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Outline

- 1 Why \LaTeX ?
 - Introduction
 - The big idea
 - Advantages of using \LaTeX ?
 - Using \LaTeX ?
- 2 Examples
 - First attempts
 - Environments
 - Documentclass
 - Errors
- 3 Useful information
 - History
 - Tables
 - Internet resources

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Introduction

- This is an attempt to give you some information to get you started in using the L^AT_EX Document Preparation System.
- Further details can be obtained elsewhere, in particular from the main reference for L^AT_EX which is *The L^AT_EX User's guide and Reference Manual* by Leslie Lamport, and also from the internet resources shown at the end.
- This presentation will be available on my website.

The big idea of L^AT_EX

L^AT_EX is a “professional typesetting system”, and not a “botched together word processor”.

- Rather than encourage you to dictate exactly how your document should be laid out, L^AT_EX instructions allow you describe its *logical structure*.
- You concentrate on the logic of your document, L^AT_EX can concentrate on the typesetting

The big idea of L^AT_EX

There are a number of good reasons for concentrating on the logical structure rather than on the appearance of a document.

- It prevents you from making elementary typographical errors in the mistaken idea that they improve the aesthetics of a document. The primary function of document design is to make documents easier to read, not prettier.
- It is more flexible, since you only need to alter the definition of some particular type of structure and this will change the appearance of all appearances of that structure in a document.

The big idea of L^AT_EX

Logical design encourages better writing.

- A visual system makes it easier to create visual effects rather than a coherent structure.
- Logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.

Advantages of using \LaTeX :

- It produces beautiful results.
- It is free.
- It runs on every computer you could ever think of.
- It has been tried and tested for years.
- It typesets maths easily and cleanly.
- It's the majority-choice in the physics community.
- It emails around easily.

Advantages of using \LaTeX :

- The rest of the world uses it – and they all use effectively the same version. It is ‘backwards compatible’.
- You can submit your research papers to most journals electronically in \LaTeX .
- It is the best thing to do a thesis in – citations, references, and figures are all linked so that if you swap around two chapters, all the cross-references follow cleanly without you having to do anything more. It is the most logical way to write a thesis.
- Many more which I can't currently think of.

Disadvantages of using \LaTeX :

- None.

Well that's not quite true, there are some disadvantages which are basically:

- It's not WYSIWIG (What You See Is What You Get) and therefore...
- It takes a short while to get used to ...

but if you have more than half a brain, you have no serious alternative!

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Using L^AT_EX

- In order to use L^AT_EX you have to generate a file containing both the text that you wish to print and instructions to tell L^AT_EX how you want it to appear.
- You will normally create this file using your system's text editor.
- It is an ASCII file. Being an ASCII file means that it doesn't contain any control characters. Therefore the text editor that you choose to use should **not** be Microsoft Word or even WordPad. These absolutely stuff every file with every control character under the sun to control all their formatting. What is more, different versions of Microsoft Word appear to be incapable of speaking to each other reliably.

Using L^AT_EX

- The file can have any name but should end “.tex” to identify the file’s contents.
- L^AT_EX then creates a new file of typesetting commands; this has the same name as your file but the “.tex” ending is replaced by “.dvi”. This stands for ‘*device independent*’ and, as the name implies, this file can be used to create output on a range of printing devices. A dvi file is **not** an ASCII file and contains lots of control characters.
- The dvi file can be converted to PostScript (the language that laser printers talk) which is interestingly (yawn – are you still following?) also an ASCII language, so it’s easy to hack (for those wishing to try). This can also be converted to a pdf file.

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First attempt

What I am showing here is that
the input file looks rather like
the output. The stuff
gets
typed in in some sort of an order and the returns
go all over the place. But `\LaTeX` sorts them out.

this becomes:

What I am showing here is that the input file looks rather like the
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....sorts them out.

It's `{\bf only}` if I leave a `{\it blank}` line that `\LaTeX` starts a new paragraph. One other thing is that I would like to define a variable called `a` which is given by `$a=b^2+\sigma_i$` which I have now done.

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Now do some displayed equations

There are two types of equations. The equations that are in the text, like $E=mc^2$ like this, but also displayed equations which are written as

```
\begin{equation}
E=mc^2,
\end{equation}
```

and get a line to themselves.

Notice that the equation gets automatically numbered.

this becomes:

There are two types of equations. The equations that are in the text, like $E = mc^2$ like this, but also displayed equations which are written as

$$E = mc^2, \tag{1}$$

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Now have some fun

You probably noticed that superscripts go like a^2 and subscripts go like this a_i . Note that a^{23} works like that so if you want to raise something to the 23rd power you should use $a^{\{23\}}$. In other words you put the 23 in curly brackets.

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Consider the function

```
\begin{equation}
f(x) = \sum_{i=1}^N a_i^{j+k+l}.
\end{equation}
```

this becomes:

Consider the function

$$f(x) = \sum_{i=1}^N a_i^{j+k+l}. \quad (2)$$

Now have some fun

Consider the function

```
\begin{equation}
f(x) = \sum_{i=1}^N a_i^{j+k+1}.
\end{equation}
```

this becomes:

Consider the function

$$f(x) = \sum_{i=1}^N a_i^{j+k+1}. \quad (2)$$

Now have some fun

Consider the function

```
\begin{equation}
g(x) = \int_0^{\infty} e^{-y^2} \, dy,
\label{donkey}
\end{equation}
```

and I have labelled this equation which I can now refer to as `equation~\ref{donkey}`.

this becomes:

Consider the function

$$g(x) = \int_0^{\infty} e^{-y^2} dy, \tag{3}$$

and I have labelled this equation which I can now refer to as equation 3.

Now have some fun

Consider the function

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Itemize

There are a number of rather useful environments in L^AT_EX for producing particular effects. They all begin with a `begin` and end with an `end` and show which kind of environment they are.

Items in a list:

```
\begin{itemize}
\item Feed the cat
\item Hug a tree
\end{itemize}
```

this becomes:

Items in a list:

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Enumerate

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\begin{enumerate}  
\item Here is one.  
\item It's good for making lists.  
\item If you like numbered lists.  
\end{enumerate}
```

this becomes:

- 1 Here is one.
- 2 It's good for making lists.
- 3 If you like numbered lists.

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this becomes:

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Center

And also

```
\begin{center}
```

```
For making something {\bf centred}.
```

```
\end{center}
```

this becomes:

And also

For making something **centred**.

Note the US spelling!

Center

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```
\begin{center}
```

```
For making something {\bf centred}.
```

```
\end{center}
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this becomes:

And also

For making something **centred**.

Note the US spelling!

Quote

There is rather a nice effect you can use if

```
\begin{quote}
```

```
‘‘You would like to say something  
in poetry, maybe quoting something that somebody  
said to you that you thought was worth repeating.  
Oh why oh why am I typing this drivel?’’
```

```
\end{quote}
```

this becomes:

There is rather a nice effect you can use if

“You would like to say something in poetry, maybe quoting something that somebody said to you that you thought was worth repeating. Oh why oh why am I typing this drivel?”

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Eqnarray

Another useful trick is that of having a set of equations that line up, as in

```
\begin{eqnarray}
  f(x) & = & \sqrt{g(x)} \quad , \quad \backslash\backslash
  g(x) & = & e^{-h(x)} \quad , \quad \backslash\backslash
  h(x) & = & \alpha_{\nu} \xi_{\psi} (\eta_{\beta} ) .
\end{eqnarray}
```

this becomes:

Another useful trick is that of having a set of equations that line up, as in

$$f(x) = \sqrt{g(x)}, \tag{4}$$

$$g(x) = e^{-h(x)}, \tag{5}$$

$$h(x) = \alpha_{\nu} \xi_{\psi} (\eta_{\beta}). \tag{6}$$

Here note that you use the & characters to indicate what you want to line up.

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Here note that you use the & characters to indicate what you want to line up.

You actually do need some stuff at the beginning and end of your document to tell L^AT_EX what sort of a document this is. It might look like magic at the moment, but it does the job. A simple example is the following:

```
\documentclass[12pt]{report}  
\begin{document}  
A terribly simple document.  
\end{document}
```

The first-line says what size point you want in general, and that the document is a report. This controls the way that section headings and other things work.

This file produces a single page with the words:

A terribly simple document.

on it.

A much more exotic example is the following:

```
\documentclass[aps,prb,superscriptaddress,twocolumn,floatfix]{revtex4}
\usepackage{graphicx}
\usepackage[]{amsmath}
\begin{document}
\title{My paper}
\author{My name}
\affiliation{Clarendon Laboratory, University of Oxford, Parks Road, Oxford OX1 3PU, United Kingdom}
\begin{abstract}
This is my paper
\end{abstract}
\maketitle
A whole bunch of stuff. In this paper we refer to \cite{nernst}.
\begin{thebibliography}{**}
\bibitem{nernst}
M. S. Nam, A. Ardavan, S. J. Blundell and J. A. Schlueter,
Nature {\bf 449} 584, (2007).
\end{thebibliography}
\end{document}
```

which would be a starting point for writing a paper for *Physical Review* using the `revtex` macros. If this file were to be processed it would produce something looking just like a real paper. If you want to do this, as with *most* things in L^AT_EX, the easiest way to start is to edit someone else's document! Don't reinvent the wheel. See examples on arXiv.org

Class files

- L^AT_EX can input lots of different 'class files' for setting up documents to have various different standard formats.
- These typically have the extension `.sty` for document-styles (an older version) and `.cls` for document-classes. If you want to make your document look a particular way, then you will need to get the relevant class files.
- Some, like `article.cls` come with L^AT_EX. Others, like `revtex4.cls`, the *Physical Review* macros may need to be downloaded from a web site or taken from someone's computer. Please ask around!

Errors

- If you have written junk in your file, L^AT_EX may give you some error messages. It usually tells you which line the error is in. It also usually gives you some options, of which the best ones to use are either 'H' (give me some more help), or 'X' (quit and I'll go and edit my file and sort the problem out).
- It may take a while to get used to some of L^AT_EX's error messages – but after a bit of practice it will come naturally. It is usually a good idea to keep L^AT_EXing the document regularly as you write it.
- Typing in 200 pages and then expecting it to work first time is perhaps asking a bit much. Build it up slowly and check each new bit of text. Computers are so fast now that this is not really a problem.

Do it **twice!**

L^AT_EX needs to process your file twice. This is because on the first sweep it loads all your cross-references, and the second time it puts them all in properly. Therefore you need to L^AT_EX the document twice.

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A bit of history

- L^AT_EX was written 'on top of' a program called T_EX, which is harder to program in and is now not used as much, but you may come across it.
- L^AT_EX was for many years standardised on version 2.09. In 1993, a new version L^AT_EX2e appeared which is almost the same but uses `documentclass` rather than `documentstyle`. It is backwards compatible so the old files still work.
- In the future, L^AT_EX3 will appear. The idea is that the version number is tending asymptotically towards π . [NB this is not a joke!]

Typefaces

`\rm` Roman
`\it` *Italic*
`\bf` **Boldface**
`\sl` *Slanted*
`\sf` Sans serif
`\sc` SMALL CAPS
`\tt` Typewriter

L^AT_EX environments

| | | |
|-------------|------------|-----------|
| abstract | figure | quote |
| array | flushleft | tabbing |
| center | flushright | table |
| description | itemize | tabular |
| displaymath | list | theorem |
| enumerate | math | titlepage |
| eqnarray | minipage | verbatim |
| equation | picture | verse |
| | quotation | |

Text-mode accents

| | | | | | |
|---|---------------------|---|---------------------|---|---------------------|
| ò | <code>\' {o}</code> | ō | <code>\={o}</code> | ô | <code>\t{oo}</code> |
| ó | <code>\' {o}</code> | ô | <code>\. {o}</code> | ø | <code>\c{o}</code> |
| ô | <code>\~ {o}</code> | ö | <code>\u{o}</code> | ø | <code>\d{o}</code> |
| ö | <code>\" {o}</code> | ö | <code>\v{o}</code> | ⓪ | <code>\b{o}</code> |
| õ | <code>\~ {o}</code> | ö | <code>\H{o}</code> | | |

National symbols

| | | | | | |
|---|------------------|---|------------------|---|------------------|
| œ | <code>\oe</code> | å | <code>\aa</code> | † | <code>\l</code> |
| Œ | <code>\OE</code> | Å | <code>\AA</code> | ‡ | <code>\L</code> |
| æ | <code>\ae</code> | ø | <code>\o</code> | ß | <code>\ss</code> |
| Æ | <code>\AE</code> | Ø | <code>\O</code> | | |

Miscellaneous symbols

† \dag
‡ \ddag

§ \S
¶ \P

© \copyright
£ \pounds

Math-mode accents

| | | | |
|-------------|------------------------|-------------|------------------------|
| \hat{a} | <code>\hat{a}</code> | \dot{a} | <code>\dot{a}</code> |
| \check{a} | <code>\check{a}</code> | \ddot{a} | <code>\ddot{a}</code> |
| \tilde{a} | <code>\tilde{a}</code> | \breve{a} | <code>\breve{a}</code> |
| \acute{a} | <code>\acute{a}</code> | \bar{a} | <code>\bar{a}</code> |
| \grave{a} | <code>\grave{a}</code> | \vec{a} | <code>\vec{a}</code> |

Greek letters (math mode)

| | | | |
|------------|-----------------------|------------|-----------------------|
| α | <code>\alpha</code> | ν | <code>\nu</code> |
| β | <code>\beta</code> | ξ | <code>\xi</code> |
| γ | <code>\gamma</code> | o | <code>o</code> |
| δ | <code>\delta</code> | π | <code>\pi</code> |
| ϵ | <code>\epsilon</code> | ρ | <code>\rho</code> |
| ζ | <code>\zeta</code> | σ | <code>\sigma</code> |
| η | <code>\eta</code> | τ | <code>\tau</code> |
| θ | <code>\theta</code> | υ | <code>\upsilon</code> |
| ι | <code>\iota</code> | ϕ | <code>\phi</code> |
| κ | <code>\kappa</code> | χ | <code>\chi</code> |
| λ | <code>\lambda</code> | ψ | <code>\psi</code> |
| μ | <code>\mu</code> | ω | <code>\omega</code> |

Greek letters (math mode)

| | | | |
|---------------|--------------------------|-------------|------------------------|
| ε | <code>\varepsilon</code> | ς | <code>\varsigma</code> |
| ϑ | <code>\vartheta</code> | φ | <code>\varphi</code> |
| ϱ | <code>\varrho</code> | | |
| Γ | <code>\Gamma</code> | Σ | <code>\Sigma</code> |
| Δ | <code>\Delta</code> | Υ | <code>\Upsilon</code> |
| Θ | <code>\Theta</code> | Φ | <code>\Phi</code> |
| Λ | <code>\Lambda</code> | Ψ | <code>\Psi</code> |
| Ξ | <code>\Xi</code> | Ω | <code>\Omega</code> |
| Π | <code>\Pi</code> | | |

Binary operations (math mode)

| | | | |
|-----------------|------------------------|------------------|-----------------------------|
| \pm | <code>\pm</code> | \cap | <code>\cap</code> |
| \mp | <code>\mp</code> | \cup | <code>\cup</code> |
| \setminus | <code>\setminus</code> | \uplus | <code>\uplus</code> |
| \cdot | <code>\cdot</code> | \sqcap | <code>\sqcap</code> |
| \times | <code>\times</code> | \sqcup | <code>\sqcup</code> |
| $*$ | <code>\ast</code> | \triangleleft | <code>\triangleleft</code> |
| \star | <code>\star</code> | \triangleright | <code>\triangleright</code> |
| \diamond | <code>\diamond</code> | \wr | <code>\wr</code> |
| \circ | <code>\circ</code> | \bigcirc | <code>\bigcirc</code> |
| \bullet | <code>\bullet</code> | \triangleup | <code>\triangleup</code> |
| \div | <code>\div</code> | ∇ | <code>\nabla</code> |
| \triangleleft | <code>\lhd</code> | \triangleright | <code>\rhd</code> |
| \vee | <code>\vee</code> | \odot | <code>\odot</code> |
| \wedge | <code>\wedge</code> | \dagger | <code>\dagger</code> |
| \oplus | <code>\oplus</code> | \ddagger | <code>\ddagger</code> |
| \ominus | <code>\ominus</code> | \amalg | <code>\amalg</code> |
| \otimes | <code>\otimes</code> | \triangleleft | <code>\unlhd</code> |
| \oslash | <code>\oslash</code> | \triangleright | <code>\unrhd</code> |

Relational symbols (math mode)

| | | | |
|---------------|--------------------------|---------------|--------------------------|
| \leq | <code>\leq</code> | \geq | <code>\geq</code> |
| \prec | <code>\prec</code> | \succ | <code>\succ</code> |
| \preceq | <code>\preceq</code> | \succeq | <code>\succeq</code> |
| \ll | <code>\ll</code> | \gg | <code>\gg</code> |
| \subset | <code>\subset</code> | \supset | <code>\supset</code> |
| \subseteq | <code>\subseteq</code> | \supseteq | <code>\supseteq</code> |
| \sqsubset | <code>\sqsubset</code> | \sqsupset | <code>\sqsupset</code> |
| \sqsubseteq | <code>\sqsubseteq</code> | \sqsupseteq | <code>\sqsupseteq</code> |
| \in | <code>\in</code> | \ni | <code>\ni</code> |
| \vdash | <code>\vdash</code> | \dashv | <code>\dashv</code> |
| \smile | <code>\smile</code> | \mid | <code>\mid</code> |
| \frown | <code>\frown</code> | \parallel | <code>\parallel</code> |
| \neq | <code>\neq</code> | \perp | <code>\perp</code> |
| \equiv | <code>\equiv</code> | \cong | <code>\cong</code> |
| \sim | <code>\sim</code> | \bowtie | <code>\bowtie</code> |
| \simeq | <code>\simeq</code> | \propto | <code>\propto</code> |
| \asymp | <code>\asymp</code> | \models | <code>\models</code> |
| \approx | <code>\approx</code> | \doteq | <code>\doteq</code> |
| | | \Join | <code>\Join</code> |

Variable-size symbols (math mode)

| | | | | | |
|-----------|-----------|----------------------|-----------|--------------|-------------------------|
| Σ | \sum | <code>\sum</code> | \cap | \bigcap | <code>\bigcap</code> |
| \prod | \prod | <code>\prod</code> | \cup | \bigcup | <code>\bigcup</code> |
| \coprod | \coprod | <code>\coprod</code> | \sqcup | \bigsqcup | <code>\bigsqcup</code> |
| \int | \int | <code>\int</code> | \vee | \bigvee | <code>\bigvee</code> |
| \oint | \oint | <code>\oint</code> | \wedge | \bigwedge | <code>\bigwedge</code> |
| \odot | \odot | <code>\odot</code> | \otimes | \bigotimes | <code>\bigotimes</code> |
| \oplus | \oplus | <code>\oplus</code> | \uplus | \biguplus | <code>\biguplus</code> |

Delimiters

| | | | |
|---|--------------|---|--------------|
| (| (|) |) |
| [| [|] |] |
| { | \{ | } | \} |
| ⌊ | \lfloor | ⌋ | \rfloor |
| ⌈ | \lceil | ⌋ | \rceil |
| ⟨ | \langle | ⟩ | \rangle |
| / | / | \ | \backslash |
| | \vert | | \Vert |
| ↑ | \uparrow | ↑ | \Uparrow |
| ↓ | \downarrow | ↓ | \Downarrow |
| ↕ | \updownarrow | ↕ | \Updownarrow |

“Log-like” functions (math mode)

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

Compare $\sin^2x + \cos^2x = 1$ with $\sin^2x + \cos^2x = 1$.

produces: Compare $\sin^2x + \cos^2x = 1$ with $\sin^2x + \cos^2x = 1$.

Arrow symbols (math mode)

| | | | |
|----------------------|---------------------------------|-----------------------|----------------------------------|
| \leftarrow | <code>\leftarrow</code> | \longleftarrow | <code>\longleftarrow</code> |
| \Lleftarrow | <code>\Lleftarrow</code> | \Longleftarrow | <code>\Longleftarrow</code> |
| \rightarrow | <code>\rightarrow</code> | \longrightarrow | <code>\longrightarrow</code> |
| \Rightarrow | <code>\Rightarrow</code> | \Longrightarrow | <code>\Longrightarrow</code> |
| \leftrightarrow | <code>\leftrightarrow</code> | \longleftrightarrow | <code>\longleftrightarrow</code> |
| \Leftrightarrow | <code>\Leftrightarrow</code> | \Longleftrightarrow | <code>\Longleftrightarrow</code> |
| \mapsto | <code>\mapsto</code> | \longmapsto | <code>\longmapsto</code> |
| \hookrightarrow | <code>\hookrightarrow</code> | \hookleftarrow | <code>\hookleftarrow</code> |
| \lleftarrow | <code>\lleftarrow</code> | \rightharpoonup | <code>\rightharpoonup</code> |
| \rrightarrow | <code>\rrightarrow</code> | \rightharpoonown | <code>\rightharpoonown</code> |
| \rightleftharpoons | <code>\rightleftharpoons</code> | \leadsto | <code>\leadsto</code> |
| \uparrow | <code>\uparrow</code> | \Updownarrow | <code>\Updownarrow</code> |
| \Uparrow | <code>\Uparrow</code> | \nearrow | <code>\nearrow</code> |
| \downarrow | <code>\downarrow</code> | \searrow | <code>\searrow</code> |
| \Downarrow | <code>\Downarrow</code> | \swarrow | <code>\swarrow</code> |
| \updownarrow | <code>\updownarrow</code> | \nwarrow | <code>\nwarrow</code> |

Misc. symbols (math mode)

| | | | |
|------------|-----------------------|-------------------|---------------------------|
| \aleph | <code>\aleph</code> | $'$ | <code>\prime</code> |
| \hbar | <code>\hbar</code> | \emptyset | <code>\emptyset</code> |
| \imath | <code>\imath</code> | ∇ | <code>\nabla</code> |
| \jmath | <code>\jmath</code> | \surd | <code>\surd</code> |
| ℓ | <code>\ell</code> | \top | <code>\top</code> |
| \wp | <code>\wp</code> | \perp | <code>\bot</code> |
| \Re | <code>\Re</code> | \parallel | <code>\parallel</code> |
| \Im | <code>\Im</code> | \sphericalangle | <code>\angle</code> |
| ∂ | <code>\partial</code> | \triangle | <code>\triangle</code> |
| ∞ | <code>\infty</code> | \backslash | <code>\backslash</code> |
| \square | <code>\Box</code> | \diamond | <code>\Diamond</code> |
| \forall | <code>\forall</code> | \sharp | <code>\sharp</code> |
| \exists | <code>\exists</code> | \clubsuit | <code>\clubsuit</code> |
| \neg | <code>\neg</code> | \diamond | <code>\diamondsuit</code> |
| \flat | <code>\flat</code> | \heartsuit | <code>\heartsuit</code> |
| \natural | <code>\natural</code> | \spadesuit | <code>\spadesuit</code> |
| \mho | <code>\mho</code> | | |

Internet resources

And finally...

`http://www.latex-project.org/`

`http://en.wikibooks.org/wiki/LaTeX`

For **Linux** users, install the tetex package (should already be installed). On the **Mac**, use X11 and see:

`http://www.icg.port.ac.uk/~edmonde/mac.html`

For the **PC**, the most popular implementation seems to be

`http://www.miktex.org/`