

# An Idiosyncratic Guide to L<sup>A</sup>T<sub>E</sub>X

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## 1 Draft disclaimer

This document as you see it now is both incomplete and in need of fact-checking. It is currently published only because I think it is still somewhat more useful, to the cautious reader, than it not being published.

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## 2 Introduction

This is intended to serve as a quick-start tutorial for L<sup>A</sup>T<sub>E</sub>X, assuming you're somewhat familiar with HTML or markup in general, before drifting into miscellaneous notes.

I am *not* a L<sup>A</sup>T<sub>E</sub>X expert; this is purely compiled from my own “get this working” research. However, I hope it will be useful, despite all the other L<sup>A</sup>T<sub>E</sub>X tutorials already existant, as I have attempted to present a document that doesn't just give you simple examples but explains the core syntax to help you *understand* what you're doing, without a lengthy explanation of L<sup>A</sup>T<sub>E</sub>X concepts. [TODO: clarify this explanation.]

Please note that even though this is not a HTML document, it does contain hyperlinks.

## 3 Software

I currently use T<sub>E</sub>X Live installed though MacPorts, and TextMate for editing/preview.

## 4 Fundamentals

L<sup>A</sup>T<sub>E</sub>X originated as a macro package for T<sub>E</sub>X. As a consequence, the features of L<sup>A</sup>T<sub>E</sub>X are defined in terms of T<sub>E</sub>X, and there are some elements of T<sub>E</sub>X which are deprecated for ordinary use in L<sup>A</sup>T<sub>E</sub>X.

[TODO: talk about the antitypewriterness and imperativeness of L<sup>A</sup>T<sub>E</sub>X.]

## 5 Core syntax and semantics

### 5.1 Lexical structure

Much like HTML, runs of whitespace are presented as a single space. (Furthermore, L<sup>A</sup>T<sub>E</sub>X's model tends to treating space as a flexible gap between words rather than as an ordinary character, so as to well support justification.)

The following characters or sequences of characters are special.

Character	Purpose	Escaped
\	name a command	\textbackslash
\$	math mode	\\$
{	begin group [TODO: terminology]	\{
}	end group	\}
&	tab	\&
%	comment to end of line	\%
[	begin optional argument (only after a command)	{[}
]	end optional argument	{]}
#	macro argument	\#
^	math superscript	\textasciicircum or \^{}
_	math subscript	\_
~	non-breaking space	\textasciitilde or \~{}
--	en dash	-{}-
---	em dash	-{}-{}-

In addition to the given escapes, all of these can be escaped using the verbatim command, which is `\verb`, an arbitrary delimiter character, the text to be escaped, and the delimiter again (e.g. `\verb!&!;`); however, `\verb` has the additional effect of using a monospace font; it is best used for code rather than general or mathematical use of the above symbols.

### 5.2 Syntactic structure

It is useful to understand that T<sub>E</sub>X is an *imperative macro-substitution* system. It is usually not necessary to explicitly use the imperative nature, but it may be useful in debugging.

There are two forms of nested structure: *groups* and *environments*.

A group is delimited by `{...}`. Groups are most often used to surround arguments. Without a group, the *next single character* makes up the entire argument; thus the group effectively converts text into a single character. For example, in math mode, “`10^100`” produces “ $10^{100}$ ”, whereas “`10^{\100}`” produces “ $10^{100}$ ”. Omitting the braces is a useful shortcut, but can reduce clarity if used unwisely. Imperatively, a group has the effect of saving and restoring some state, such as font.

Environments are typically (but not necessarily) used for structure which spans many paragraphs. An environment is delimited by `\begin{name}... \end{name}`; thus it is very much like a HTML/SGML/XML element.

## 6 Commands

A command is a backslash followed by either a sequence of *letters* (note, not numbers or underscores) or a single non-letter. (For example, `\&` is a command which displays an ampersand, *not* an escaped ampersand. `\\` is a line break command, *not* an escaped backslash.)<sup>1</sup>

A command name is be separated from following letters by whitespace. This means that a command followed by text which should be a separate word must be separated by some other syntax: “`\textasciitilde foo`” produces “`~foo`” and “`\textasciitilde\ foo`” produces “`~ foo`”. If whitespace is not wanted, then use an empty group [**TODO: terminology**]: “`\textasciitilde{}foo`” produces “`~foo`”.

[**TODO: rewrite this**] Many commands take one or more required arguments; each one of these is usually a block but need not be. For example, `\frac12` is equivalent to `\frac{1}{2}`.

[**TODO: rewrite this**] Optional arguments are enclosed in [...]

[**TODO: more to go here**]

## 7 Document structure

A minimum L<sup>A</sup>T<sub>E</sub>X document is:

```
\documentclass{article}
\begin{document}
  Hello world.
\end{document}
```

Every L<sup>A</sup>T<sub>E</sub>X document must have a *document class* defined [**TODO: explain choice of document classes**], and contain its text in a *document* environment (which is analogous to HTML `<body>`). Everything preceding the *document* is the *preamble*, which is analogous to the HTML `<head>`.

The primary things which must be placed in the preamble are `\usepackage` commands.

## 8 Formatting and symbols

### 8.1 Quotes

T<sub>E</sub>X dates from a time when there were no curly quotes, or rather where the ``` and `'` ASCII characters were commonly used for paired quotes. Therefore, ``` and `'` should be paired and produce ‘single quotes’, whereas ```` and `''` produce “double quotes”. The ASCII double quote `"` is an error.

If the thought of writing your document this way appalls you, see section 13.

Also note that `'` will appear as a right curly quote even in verbatim sections; if you’re trying to accurately present source code, see section 15.17.

---

<sup>1</sup>In package implementations, `@` is often temporarily redefined into a letter so that it can be used to define commands which are inaccessible from “ordinary” source. This is done and undone using the commands `\makeatletter` and `\makeatother`.

## 8.2 Lines and paragraphs

Paragraphs (as in HTML `<p>`) are denoted by text being *separated by a blank line, or by the equivalent `\par` command (usually only in macros)*.

*Specific line breaks which are not paragraph separations* (as in HTML `<br>`) are denoted by `\\` (which is also used for new rows of tables and mathematical expressions).

This is a paragraph.

This is another paragraph \\  
whose text has been split into two lines.

## 8.3 Centering

[TODO: center, `\centering`]

## 8.4 Periods, dashes, and whitespace

[TODO: more to go here]

“TeX assumes a period ends a sentence unless it follows an uppercase letter.” (Lamport p. 14)

So, put a `\_` (where `_` means “space”) in a sentence like `Smith et al.\ say that ...`. And, if an uppercase letter ends a sentence, do a `\@` before the period: In the class, I gave Bob a `C\@`.

– <http://www.ece.ucdavis.edu/~jowens/commonerrors.html>

## 8.5 Text styles

[TODO: `texttt` etc.]

# 9 Large structures

[TODO: more subsections]

## 9.1 The document title

[TODO: Title data and `\maketitle`]

[TODO: Customizing title formatting]

## 9.2 Lists

[TODO: List types: `enumerate`, `itemize`, and `description`]

## 9.3 Labels and references

[TODO: more to go here]

## 9.4 Footnotes

Writing a footnote is usually simple: put `\footnote{Text of footnote goes here.}` at the place where you wish the footnote number to appear.

There are some situations in which this will not work, such as inside a math environment [TODO: **confirm this**]. In this case, you can instead define the mark and text separately. Put `\footnotemark` where you wish the number to appear, and then put `\footnotetext{...}` somewhere in the text after it, but before any other footnote. [TODO: **confirm that it’s after and not before.**]

## 9.5 Tables

[TODO: more to go here]

## 9.6 Quotations and monospace

The quote environment is precisely analogous to HTML `<blockquote>`.

The `verbatim` environment is analogous to HTML `<pre>`, except that it disables L<sup>A</sup>T<sub>E</sub>X interpretation of the contents; it is thus like the nonstandard `<xmp>` element. Within a paragraph, `\verb!...!` serves the same function (see 5.1 for syntax). Monospace font without changing text interpretation is provided by `\texttt{...}` (note the 3 “t”s). There is no analogue to the distinction between `<code>` and `<tt>`.

[TODO: Old note: `\ttstyle (check) is like ;code;`]

## 9.7 Page and column breaks

[TODO: `\pagebreak \columnbreak`]

## 10 Layout model

[TODO: more to go here]

kpreid: What is vtop?

`|Zz|`: it creates a vertical box, by stacking a set of horizontal boxes, and the resulting vertical box `|Zz|`:

unlike `\vbox`, which does the same but the final box has its baseline coincident with the last `hbox` `|Zz|`:

you also have `\vcenter`, which has the final baseline at the center of the resulting vertical box, but i

Paragraphs can be put in the margin using `\marginpar{bla bla}`. <http://www.f.kth.se/~ante/latex.php>

`\rlap{foo}` outputs `foo`, then backs up the width of `foo`. Example aligned linear system:

```
\begin{align*}
x_1 + 2x_2 + 3x_3 &= b_1 \\
5x_1 - \rlap{\phantom{1}x_2}\phantom{1x_2} + \phantom{0x_3} &= b_2 \\
7x_1 + 3x_2 + 5x_3 &= b_3
\end{align*}
```

Better way to do a linear system (this goes inside a `math env`):

```
\begin{alignedat}{3}
x_1 &+ {}&2x_2 &+ {}&3x_3 &= b_1 \\
5x_1 &- {}&x_2 &+ {}& &= b_2 \\
7x_1 &+ {}&3x_2 &+ {}&5x_3 &= b_3
\end{alignedat}
```

## 11 Packages

[TODO: more to go here]

## 12 Defining commands

[TODO: rewrite this text] `\providecommand` defines a command if it does not exist. `\newcommand` defines a command, requiring that it does not exist. `\renewcommand` overwrites an existing command. This is used to (a) change the behavior of a package, or (b) uniformly change the appearance of some notation you use while still using the standard name.

[TODO: defining environments]

[TODO: `\let`]

## 13 Unicode

L<sup>A</sup>T<sub>E</sub>X assumes ASCII input by default. To permit using UTF-8 input, add to the preamble

`\usepackage[utf8]{inputenc}`

This enables interpreting the input as UTF-8; however, rendering Unicode characters is a separate issue. By default, a small set of Unicode characters is understood; others will be reported as errors. I do not know what the exact set is.

It is possible to extend the understood Unicode characters using the `\DeclareUnicodeCharacter` command. Here is a list of the declarations, primarily for mathematics, which I have found useful at some point.

I may well be missing some standard way to obtain definitions like these; if so, let me know!

```

\DeclareUnicodeCharacter{00AC}{\ifmmode \lnot \else \textlnot \fi} % override
\DeclareUnicodeCharacter{00B0}{\ifmmode ^{\circ} \else \textdegree \fi} % override
\DeclareUnicodeCharacter{00B1}{\ensuremath{\pm}}
\DeclareUnicodeCharacter{00B5}{\mu}
\DeclareUnicodeCharacter{00B7}{\ifmmode \cdot \else \textperiodcentered \fi} % override
\DeclareUnicodeCharacter{00D7}{\ifmmode \times \else \texttimes \fi} % override
\DeclareUnicodeCharacter{00F7}{\ifmmode \div \else \textdiv \fi} % override
\DeclareUnicodeCharacter{0393}{\ensuremath{\Gamma}}
\DeclareUnicodeCharacter{0394}{\ensuremath{\Delta}}
\DeclareUnicodeCharacter{0398}{\ensuremath{\Theta}}
\DeclareUnicodeCharacter{03A3}{\ensuremath{\Sigma}}
\DeclareUnicodeCharacter{03A9}{\ensuremath{\Omega}}
\DeclareUnicodeCharacter{03B1}{\ensuremath{\alpha}}
\DeclareUnicodeCharacter{03B2}{\ensuremath{\beta}}
\DeclareUnicodeCharacter{03B3}{\ensuremath{\gamma}}
\DeclareUnicodeCharacter{03B4}{\ensuremath{\delta}}
\DeclareUnicodeCharacter{03B5}{\ensuremath{\epsilon}}
\DeclareUnicodeCharacter{03B8}{\ensuremath{\theta}}
\DeclareUnicodeCharacter{03BB}{\ensuremath{\lambda}}
\DeclareUnicodeCharacter{03C0}{\ensuremath{\pi}}
\DeclareUnicodeCharacter{03C1}{\ensuremath{\rho}}
\DeclareUnicodeCharacter{03C3}{\ensuremath{\sigma}}
\DeclareUnicodeCharacter{03C6}{\ensuremath{\phi}}
\DeclareUnicodeCharacter{03C9}{\ensuremath{\omega}}
\DeclareUnicodeCharacter{2080}{\ensuremath{_0}}
\DeclareUnicodeCharacter{2081}{\ensuremath{_1}}
\DeclareUnicodeCharacter{2082}{\ensuremath{_2}}
\DeclareUnicodeCharacter{2083}{\ensuremath{_3}}
\DeclareUnicodeCharacter{2084}{\ensuremath{_4}}
\DeclareUnicodeCharacter{2085}{\ensuremath{_5}}
\DeclareUnicodeCharacter{2086}{\ensuremath{_6}}
\DeclareUnicodeCharacter{2087}{\ensuremath{_7}}
\DeclareUnicodeCharacter{2088}{\ensuremath{_8}}
\DeclareUnicodeCharacter{2089}{\ensuremath{_9}}
\DeclareUnicodeCharacter{208A}{\ensuremath{+_}}
\DeclareUnicodeCharacter{208B}{\ensuremath{-_}}
\DeclareUnicodeCharacter{208C}{\ensuremath{=_}}
\DeclareUnicodeCharacter{208D}{\ensuremath{_(}}
\DeclareUnicodeCharacter{208E}{\ensuremath{_)}}
\DeclareUnicodeCharacter{2190}{\ifmmode \leftarrow \else \textleftarrow \fi} % override
\DeclareUnicodeCharacter{2191}{\ifmmode \uparrow \else \textuparrow \fi} % override
\DeclareUnicodeCharacter{2192}{\ifmmode \rightarrow \else \textrightarrow \fi} % override
\DeclareUnicodeCharacter{2193}{\ifmmode \downarrow \else \textdownarrow \fi} % override
\DeclareUnicodeCharacter{21D0}{\ensuremath{\Leftarrow}}
\DeclareUnicodeCharacter{21D2}{\ensuremath{\Rrightarrow}}
\DeclareUnicodeCharacter{21D4}{\ensuremath{\Leftrightarrow}}
\DeclareUnicodeCharacter{2200}{\ensuremath{\forall}}
\DeclareUnicodeCharacter{2203}{\ensuremath{\exists}}
\DeclareUnicodeCharacter{2205}{\ensuremath{\varnothing}}
\DeclareUnicodeCharacter{2206}{\ensuremath{\Delta}}
\DeclareUnicodeCharacter{2208}{\ensuremath{\in}}
\DeclareUnicodeCharacter{2209}{\ensuremath{\notin}}
\DeclareUnicodeCharacter{220F}{\ensuremath{\prod}}
\DeclareUnicodeCharacter{2211}{\ensuremath{\sum}}
\DeclareUnicodeCharacter{2212}{\ensuremath{-}}
\DeclareUnicodeCharacter{2213}{\ensuremath{\mp}}
\DeclareUnicodeCharacter{221D}{\ensuremath{\propto}}
\DeclareUnicodeCharacter{221E}{\ensuremath{\infty}}
\DeclareUnicodeCharacter{2229}{\ensuremath{\cap}}
\DeclareUnicodeCharacter{222A}{\ensuremath{\cup}}

```

```

\DeclareUnicodeCharacter{2248}{\ensuremath{\approx}}
\DeclareUnicodeCharacter{2260}{\ensuremath{\neq}}
\DeclareUnicodeCharacter{2261}{\ensuremath{\equiv}}
\DeclareUnicodeCharacter{2264}{\ensuremath{\leq}}
\DeclareUnicodeCharacter{2265}{\ensuremath{\geq}}
\DeclareUnicodeCharacter{2282}{\ensuremath{\subset}}
\DeclareUnicodeCharacter{2283}{\ensuremath{\superset}}
\DeclareUnicodeCharacter{FB00}{ff}
\DeclareUnicodeCharacter{FB01}{fi}
\DeclareUnicodeCharacter{FB02}{fl}
\DeclareUnicodeCharacter{FB03}{ffi}
\DeclareUnicodeCharacter{FB04}{ffl}

```

Note that the ones marked “override” are supported, but not in math mode; my redefinitions make them work in both text and math mode.

Also note that given these definitions, U+03A3 GREEK CAPITAL LETTER SIGMA is typeset as a capital sigma  $\Sigma$ , whereas U+2211 N-ARY SUMMATION is typeset as a summation sign  $\sum$ , and similarly for capital pi and product symbols. Mac users should note that the standard option-shift-W and option-shift-P keystrokes produce the sum and product symbols, not Greek letters. Furthermore, the letter definitions, which use math mode, are probably not suitable for actually presenting Greek text, which I know nothing about.

## 14 Mathematics

[TODO: more to go here]

the AMS Short Math Guide and amsmath user’s guide.

`\left` and `\right`

`\not` to negate a following symbol

`\DeclareMathOperator`

[TODO: Column defs in matrices: <http://texblog.net/latex-archive/maths/amsmath-matrix/>]

`\operatorname{...}` displays the parameter as a textual operator name (like `\sin`, `\cos`, etc.). `\mathrel{...}`

does the same for a relational operator (like `\leq`), and `\mathbin{...}` for a “regular” binary operator like `+`.

`\operatornamewithlimits \mid = \mathrel |`

[TODO: more to go here]

The subtle way to get right-aligned labels using extra alignment tabs.

`\text` vs. `\mathrm`

If you need to write your own variation depending on the math style, use

```
\mathchoice{display result}{inline text result}{superscript}{double superscript}
```

## 15 Useful packages

Most of these packages are distributed with T<sub>E</sub>X Live. Each package name is linked to its page on CTAN (if present) providing further information, documentation, and download.

[TODO: more to go here] other packages

### 15.1 array

Some guides to tabular formatting mention m and b column types which don’t work by default. This package enables/provides them. [TODO: more to go here]

### 15.2 amsmath

### 15.3 amssymb

### 15.4 changepage

[TODO: more to go here] “Change the page layout in the middle of a document”

## 15.5 dcolumn

[**TODO: more to go here**]Provides tabular columns aligned on decimal points.

## 15.6 fancyvrb

## 15.7 fullpage

[**TODO: more to go here**]Use normal-ish page margins rather than the narrow ones  $\LaTeX$  defaults to.

## 15.8 geometry

[**TODO: more to go here**]Easily customize page margins. Can allegedly be used on a per-page basis but I have an old version.

## 15.9 graphicx

## 15.10 inputenc

See section 13.

## 15.11 kbordermatrix

Not part of CTAN or  $\TeX$  Live.

The `kbordermatrix` package by Kim C. Border provides matrices with cells outside the matrix for row and column labels.

## 15.12 longtable

[**TODO: more to go here**]Tables which can break across pages.

## 15.13 multicol

## 15.14 multirow

## 15.15 rotating

## 15.16 textcomp

Provides better versions of many symbols. Is implicitly used by `upquote`.

## 15.17 upquote

$\LaTeX$  tends to assume that certain ASCII-isms such as the straight quote are abominations not to be tolerated. This can have the unfortunate consequence of making your source code's strings look 'like this'. Using the `upquote` package will fix this, resulting in 'this' instead inside of "verbatim" (but not `texttt`).

## 15.18 verbatim

[**TODO: more to go here**]Provides `\verbatiminput`.

## 15.19 wrapfig

```
\begin{wrapfigure}{r}{0.3\textwidth}
  \includegraphics[width=0.3\textwidth]{circuits}
\caption{Some caption.}
\label{somelabel}
\end{wrapfigure}
```

Note - if the `wrapfig` is taller than the page text (there is white space at the bottom of the page) then

## 16 Useful definitions

[TODO: explain]

```
\newcommand{\unit}[1]{\ensuremath{\, \mathrm{#1}}}  
\newcommand{\abs}[1]{\left\lvert\right\lvert#1\right\rvert}
```

```
\newcommand{\mat}[1]{\begin{bmatrix} #1 \end{bmatrix}}  
\newcommand{\augmat}[2]{\left[\begin{array}{*{#1}c|*{10}c}#2\end{array}\right]}  
\newcommand{\detmat}[1]{\abs{\begin{matrix} #1 \end{matrix}}}  
\newcommand{\avec}[1]{\renewcommand{\}{, } \left\langle #1 \right\rangle}
```

```
\newcommand{\valigntop}[1]{\hskip0pt \vtop{\hbox{} \vspace{-1em}\hbox{#1}}} % makes a box's top align with
```

```
\newcommand{\itemtag}[1]{\tag*{\llap{#1}\hspace{5pt}}}
```

## 17 Reference material

[TODO: amsshort, amsmath, lshort, comprehensive symbols list]

## 18 The source of this document

```
% Kevin Reid's guide to LaTeX
```

```
%
```

```
% If you were hoping for a formatted document and got this instead, use the specific URL
```

```
% <https://switchb.org/kpreid/topics/latex.pdf>.
```

```
\documentclass{article}  
\usepackage[utf8]{inputenc}  
\usepackage{verbatim,upquote,multicol,datetime}  
\usepackage{tocloft} % provides \cftpagenumbersoff  
\usepackage{hyperref}
```

```
\usepackage[paperheight=140in,paperwidth=8.5in,inner=0.4in,outer=3in,marginparwidth=2.7in,vmargin=0.8in]{geometry}  
\usepackage[hmargin=1in,vmargin=0.8in]{geometry}
```

```
\newcommand{\packname}[1]{\href{http://tug.ctan.org/cgi-bin/ctanPackageInformation.py?id=#1}{\texttt{#1}}}  
\newcommand{\envname}[1]{\texttt{#1}}  
\newcommand{\cmdname}[1]{\textbackslash\texttt{#1}} % TODO: find how to make a tt backslash  
\newcommand{\packsubsection}[1]{\subsection[\texttt{#1}]{\packname{#1}}\label{#1}}  
\newcommand{\helem}[1]{\texttt{<#1>}}  
\newenvironment{inlinetable}{\begin{center}}{\end{center}}  
\newcommand{\XXX}[1][more to go here]{\textbf{[TODO: #1]}}
```

```
\title{An Idiosyncratic Guide to \LaTeX}  
\author{\href{https://switchb.org/kpreid}{Kevin Reid}}  
\date{Last modified: \input{moddate} \ \ Last rebuild: \the\year-\twodigit\month-\twodigit\day}
```

```
\setlength{\cftsubsecnumwidth}{2.8em}  
\cftpagenumbersoff{section}  
\cftpagenumbersoff{subsection}  
\cftpagenumbersoff{subsubsection}
```

```
\begin{document}
```

```
\maketitle
```

```
\section{Draft disclaimer}
```

This document as you see it now is both incomplete and in need of fact-checking. It is currently published only because I think

```
\vspace{2em}\hrule % XXX get these spacing tweaks more cleanly  
\begin{multicols}{2}  
\tableofcontents  
\end{multicols}
```

```
\hrule\vspace{1em}
```

```
\section{Introduction}
```

This is intended to serve as a quick-start tutorial for `\LaTeX`, assuming you're somewhat familiar with HTML or markup in general.

I am `\emph{not}` a `\LaTeX` expert; this is purely compiled from my own "get this working" research. However, I hope it will be useful.

Please note that even though this is not a HTML document, it does contain hyperlinks. Furthermore, the page size has been set to A4.

```
\section{Software}
```

I currently use `\href{http://tug.org/texlive/}{\TeX} Live` installed through `\href{http://www.macports.org/}{MacPorts}`, and `\href{http://www.tug.org/texlive/}{\TeX} Live` installed through `\href{http://www.tug.org/texlive/}{\TeX} Live`.

```
\section{Fundamentals}
```

`\LaTeX` originated as a macro package for `\TeX`. As a consequence, the features of `\LaTeX` are defined in terms of `\TeX`, and `\TeX` is the base.

XXX[talk about the antitypewriterness and imperativeness of `\LaTeX`.]

```
\section{Core syntax and semantics}
```

```
\subsection{Lexical structure}
```

Much like HTML, runs of whitespace are presented as a single space. (Furthermore, `\LaTeX`'s model tends to treating space as a single character.)

The following characters or sequences of characters are special.

```
\begin{inlinetable}
```

```
\begin{tabular}{cp{15em}c} % TODO: Make this relative to the text width
```

```
Character & Purpose & Escaped \\
```

```
\hline
```

```
\textbackslash
```

```
& name a command
```

```
& \verb!\textbackslash! \\
```

```
\$ & math mode & \verb!\$! \\
```

```
\{ & begin group XXX[terminology] & \verb!\{! \\
```

```
\} & end group
```

```
& \verb!\}! \\
```

```
\& & tab
```

```
& \verb!\&! \\
```

```
\% & comment to end of line
```

```
& \verb!\%! \\
```

```
{[] & begin optional argument (only after a command)
```

```
& \verb!{}! \\
```

```
{[]} & end optional argument
```

```
& \verb!{}! \\
```

```
\# & macro argument
```

```
& \verb!\#! \\
```

```
\textasciicircum
```

```
& math superscript
```

```
& \verb!\textasciicircum! or \verb!\^{}! \\
```

```
\_ & math subscript
```

```
& \verb!\_! \\
```

```
\textasciitilde
```

```
& non-breaking space
```

```
& \verb!\textasciitilde! or \verb!\~{}! \\
```

```
-{}- & en dash
```

```
& \verb!-{}-! \\
```

```
-{}-{}- & em dash
```

```
& \verb!-{}-{}-! \\
```

```
\end{tabular}
```

```
\end{inlinetable}
```

```
\label{explainverb}
```

In addition to the given escapes, all of these can be escaped using the verbatim command, which is `\verb!\verb!`, an arbitrary delimiter.

```
\subsection{Syntactic structure}
```

It is useful to understand that `\TeX` is an `\emph{imperative macro-substitution}` system. It is usually not necessary to explicitly escape characters.

There are two forms of nested structure: `\emph{groups}` and `\emph{environments}`.

A group is delimited by `\verb!{...}!`. Groups are most often used to surround arguments. Without a group, the `\emph{next single character}` is taken.

Environments are typically (but not necessarily) used for structure which spans many paragraphs. An environment is delimited by `\begin{...}... \end{...}`.

```
\section{Commands}
```

A command is a backslash followed by either a sequence of `\emph{letters}` (note, not numbers or underscores) or a single non-letter character.

A command name is separated from following letters by whitespace. This means that a command followed by text which should be treated as a command is `\code{...}`.

XXX[rewrite this]

Many commands take one or more required arguments; each one of these is usually a {} block but need not be. For example, \verb!

```
\XXX[rewrite this]
Optional arguments are enclosed in [...]
```

```
\XXX
```

```
\section{Document structure}
```

A minimum \LaTeX{} document is:

```
\begin{verbatim}
\documentclass{article}
\begin{document}
  Hello world.
\end{document}
\end{verbatim}
```

Every \LaTeX{} document must have a \emph{document class} defined \XXX[explain choice of document classes], and contain its text

The primary things which must be placed in the preamble are \verb!\usepackage! commands.

```
\section{Formatting and symbols}
```

```
\subsection{Quotes}
```

\TeX{} dates from a time when there were no curly quotes, or rather where the \verb!`! and \verb!'! ASCII characters were common

If the thought of writing your document this way appalls you, see section \ref{unicode}.

Also note that \verb!'! will appear as a right curly quote even in verbatim sections; if you're trying to accurately present sou

```
\subsection{Lines and paragraphs}
```

Paragraphs (as in HTML \helem{p}) are denoted by text being \em{separated} by a blank line, or by the equivalent \verb!\par! com

Specific line breaks which are \em{not} paragraph separations (as in HTML \helem{br}) are denoted by \verb!\\! (which is also us

```
\begin{verbatim}
This is a paragraph.
```

```
This is another paragraph \\
whose text has been split into two lines.
\end{verbatim}
```

```
\subsection{Centering}
```

```
\XXX[ \envname{center}, \cmdname{centering}]
```

```
\subsection{Periods, dashes, and whitespace}
```

```
\XXX
```

```
\begin{quote}
\TeX assumes a period ends a sentence unless it follows an uppercase letter." (Lamport p. 14) So, put a \verb!\_! (where \verb!_
\end{quote} -- \url{http://www.ece.ucdavis.edu/~jowens/commonerrors.html}
```

```
\subsection{Text styles}
```

```
\XXX[ texttt etc.]
```

```
\section{Large structures} % TODO: better name for this
```

```
\XXX[ more subsections]
```

```
\subsection{The document title}
```

```
\XXX[ Title data and \cmdname{maketitle}]
```

```
\XXX[Customizing title formatting]
```

```

\subsection{Lists}

\XXX[List types: enumerate, itemize, and description]

\subsection{Labels and references}

\XXX

\subsection{Footnotes}

Writing a footnote is usually simple: put \verb!\footnote{Text of footnote goes here.}! at the place where you wish the footnote.

There are some situations in which this will not work, such as inside a math environment \XXX[confirm this]. In this case, you can use \footnotemark.

\subsection{Tables}

\XXX

\subsection{Quotations and monospace}

The \envname{quote} environment is precisely analogous to HTML \helem{blockquote}.

The \envname{verbatim} environment is analogous to HTML \helem{pre}, except that it disables \LaTeX{} interpretation of the content.

\XXX[ Old note: \cmdname{ttstyle} (check) is like <code>]

\subsection{Page and column breaks}

\XXX[\cmdname{pagebreak} \cmdname{columnbreak}]

\section{Layout model}

\XXX
\begin{verbatim}
kpreid: What is vtop?
|Zz|: it creates a vertical box, by stacking a set of horizontal boxes, and the resulting vertical box has its baseline coincident with the top of the first box.
|Zz|:
unlike \vbox, which does the same but the final box has its baseline coincident with the last hbox
|Zz|:
you also have \vcenter, which has the final baseline at the center of the resulting vertical box, but it is only allowed in math mode.

Paragraphs can be put in the margin using \marginpar{bla bla}. http://www.f.kth.se/~ante/latex.php

\rlap{foo} outputs foo, then backs up the width of foo. Example aligned linear system:
\begin{align*}
x_1 + 2x_2 + 3x_3 &= b_1 \\
5x_1 - \rlap{\phantom{1}x_2}\phantom{1x_2 + 0x_3} &= b_2 \\
7x_1 + 3x_2 + 5x_3 &= b_3
\end{align*}
Better way to do a linear system (this goes inside a math env):
\begin{alignedat}{3}
x_1 &+ {}&2x_2 &+ {}&3x_3 &= b_1 \\
5x_1 &- {}&x_2 &+ {}& &= b_2 \\
7x_1 &+ {}&3x_2 &+ {}&5x_3 &= b_3
\end{alignedat}
\end{verbatim}

\section{Packages}

\XXX

\section{Defining commands}

\XXX[ rewrite this text]
\verb!\providecommand! defines a command if it does not exist.
\verb!\newcommand! defines a command, requiring that it does not exist.
\verb!\renewcommand! overwrites an existing command. This is used to (a) change the behavior of a package, or (b) uniformly change the behavior of a package.

\XXX[defining environments]

```

```
\XXX[\cmdname{let}]
```

```
\section{Unicode}  
\label{unicode}
```

```
\LaTeX{} assumes ASCII input by default. To permit using UTF-8 input, add to the preamble  
\begin{quote}  
\begin{verbatim}  
\usepackage[utf8]{inputenc}  
\end{verbatim}  
\end{quote}
```

This enables interpreting the input as UTF-8; however, rendering Unicode characters is a separate issue. By default, a small set

It is possible to extend the understood Unicode characters using the `\DeclareUnicodeCharacter!` command. Here is a list of

I may well be missing some standard way to obtain definitions like these; if so, let me know!

```
{\footnotesize  
\begin{verbatim}  
\DeclareUnicodeCharacter{00AC}{\ifmmode \lnot \else \textlnot \fi} % override  
\DeclareUnicodeCharacter{00B0}{\ifmmode ~{\circ} \else \textdegree \fi} % override  
\DeclareUnicodeCharacter{00B1}{\ensuremath{\pm}}  
\DeclareUnicodeCharacter{00B5}{\mu}  
\DeclareUnicodeCharacter{00B7}{\ifmmode \cdot \else \textperiodcentered \fi} % override  
\DeclareUnicodeCharacter{00D7}{\ifmmode \times \else \texttimes \fi} % override  
\DeclareUnicodeCharacter{00F7}{\ifmmode \div \else \textdiv \fi} % override  
\DeclareUnicodeCharacter{0393}{\ensuremath{\Gamma}}  
\DeclareUnicodeCharacter{0394}{\ensuremath{\Delta}}  
\DeclareUnicodeCharacter{0398}{\ensuremath{\Theta}}  
\DeclareUnicodeCharacter{03A3}{\ensuremath{\Sigma}}  
\DeclareUnicodeCharacter{03A9}{\ensuremath{\Omega}}  
\DeclareUnicodeCharacter{03B1}{\ensuremath{\alpha}}  
\DeclareUnicodeCharacter{03B2}{\ensuremath{\beta}}  
\DeclareUnicodeCharacter{03B3}{\ensuremath{\gamma}}  
\DeclareUnicodeCharacter{03B4}{\ensuremath{\delta}}  
\DeclareUnicodeCharacter{03B5}{\ensuremath{\epsilon}}  
\DeclareUnicodeCharacter{03B8}{\ensuremath{\theta}}  
\DeclareUnicodeCharacter{03BB}{\ensuremath{\lambda}}  
\DeclareUnicodeCharacter{03C0}{\ensuremath{\pi}}  
\DeclareUnicodeCharacter{03C1}{\ensuremath{\rho}}  
\DeclareUnicodeCharacter{03C3}{\ensuremath{\sigma}}  
\DeclareUnicodeCharacter{03C6}{\ensuremath{\phi}}  
\DeclareUnicodeCharacter{03C9}{\ensuremath{\omega}}  
\DeclareUnicodeCharacter{2080}{\ensuremath{_{0}}}  
\DeclareUnicodeCharacter{2081}{\ensuremath{_{1}}}  
\DeclareUnicodeCharacter{2082}{\ensuremath{_{2}}}  
\DeclareUnicodeCharacter{2083}{\ensuremath{_{3}}}  
\DeclareUnicodeCharacter{2084}{\ensuremath{_{4}}}  
\DeclareUnicodeCharacter{2085}{\ensuremath{_{5}}}  
\DeclareUnicodeCharacter{2086}{\ensuremath{_{6}}}  
\DeclareUnicodeCharacter{2087}{\ensuremath{_{7}}}  
\DeclareUnicodeCharacter{2088}{\ensuremath{_{8}}}  
\DeclareUnicodeCharacter{2089}{\ensuremath{_{9}}}  
\DeclareUnicodeCharacter{208A}{\ensuremath{_{+}}}  
\DeclareUnicodeCharacter{208B}{\ensuremath{_{-}}}  
\DeclareUnicodeCharacter{208C}{\ensuremath{_{=}}}  
\DeclareUnicodeCharacter{208D}{\ensuremath{_{(}}}  
\DeclareUnicodeCharacter{208E}{\ensuremath{_{)}}}  
\DeclareUnicodeCharacter{2190}{\ifmmode \leftarrow \else \textleftarrow \fi} % override  
\DeclareUnicodeCharacter{2191}{\ifmmode \uparrow \else \textuparrow \fi} % override  
\DeclareUnicodeCharacter{2192}{\ifmmode \rightarrow \else \textrightarrow \fi} % override  
\DeclareUnicodeCharacter{2193}{\ifmmode \downarrow \else \textdownarrow \fi} % override  
\DeclareUnicodeCharacter{21D0}{\ensuremath{\Leftarrow}}  
\DeclareUnicodeCharacter{21D2}{\ensuremath{\Rightarrow}}  
\DeclareUnicodeCharacter{21D4}{\ensuremath{\Leftrightarrow}}  
\DeclareUnicodeCharacter{2200}{\ensuremath{\forall}}  
\DeclareUnicodeCharacter{2203}{\ensuremath{\exists}}  
\DeclareUnicodeCharacter{2205}{\ensuremath{\varnothing}}  
\DeclareUnicodeCharacter{2206}{\ensuremath{\Delta}}  
\DeclareUnicodeCharacter{2208}{\ensuremath{\in}}
```

```

\DeclareUnicodeCharacter{2209}{\ensuremath{\notin}}
\DeclareUnicodeCharacter{220F}{\ensuremath{\prod}}
\DeclareUnicodeCharacter{2211}{\ensuremath{\sum}}
\DeclareUnicodeCharacter{2212}{\ensuremath{-}}
\DeclareUnicodeCharacter{2213}{\ensuremath{\mp}}
\DeclareUnicodeCharacter{221D}{\ensuremath{\propto}}
\DeclareUnicodeCharacter{221E}{\ensuremath{\infty}}
\DeclareUnicodeCharacter{2229}{\ensuremath{\cap}}
\DeclareUnicodeCharacter{222A}{\ensuremath{\cup}}
\DeclareUnicodeCharacter{2248}{\ensuremath{\approx}}
\DeclareUnicodeCharacter{2260}{\ensuremath{\neq}}
\DeclareUnicodeCharacter{2261}{\ensuremath{\equiv}}
\DeclareUnicodeCharacter{2264}{\ensuremath{\leq}}
\DeclareUnicodeCharacter{2265}{\ensuremath{\geq}}
\DeclareUnicodeCharacter{2282}{\ensuremath{\subset}}
\DeclareUnicodeCharacter{2283}{\ensuremath{\supset}}
\DeclareUnicodeCharacter{FB00}{ff}
\DeclareUnicodeCharacter{FB01}{fi}
\DeclareUnicodeCharacter{FB02}{fl}
\DeclareUnicodeCharacter{FB03}{ffi}
\DeclareUnicodeCharacter{FB04}{ffl}
\end{verbatim}
}

```

Note that the ones marked `\override` are supported, but not in math mode; my redefinitions make them work in both text and math

Also note that given these definitions, U+03A3 GREEK CAPITAL LETTER SIGMA is typeset as a capital sigma  $\Sigma$ , whereas U+2211

```
\section{Mathematics}
```

```
\XXX
```

```
\href{ftp://ftp.ams.org/pub/tex/doc/amsmath/short-math-guide.pdf}{the AMS Short Math Guide} and \href{ftp://ftp.ams.org/pub/tex/}
```

```
\verb!\left and \right!
```

```
\verb!\not! to negate a following symbol
```

```
\verb!\DeclareMathOperator!
```

```
\XXX[Column defs in matrices: http://texblog.net/latex-archive/maths/amsmath-matrix/]
```

```
\verb!\operatorname{...}! displays the parameter as a textual operator name (like sin, cos, etc.). \verb!\mathrel{...}! does the
```

```
\verb!\operatornamewithlimits!
```

```
\verb!\mid! = \verb!\mathrel !!
```

```
\XXX
```

```
\begin{verbatim}
```

The subtle way to get right-aligned labels using extra alignment tabs.

```
\text vs. \mathrm
```

If you need to write your own variation depending on the math style, use

```
\mathchoice{display result}{inline text result}{superscript}{double superscript}
```

```
\end{verbatim}
```

```
\section{Useful packages}
```

Most of these packages are distributed with  $\TeX$  Live. Each package name is linked to its page on CTAN (if present) providing

```
\XXX other packages
```

```
\packsubsection{array}
```

Some guides to tabular formatting mention m and b column types which don't work by default. This package enables/provides them.

```
\packsubsection{amsmath}
```

```
\packsubsection{amssymb}
```

```
\packsubsection{changepage}
```

```

\XXX \Change the page layout in the middle of a document"

\packsubsection{dcolumn}

\XXX Provides tabular columns aligned on decimal points.

\packsubsection{fancyvrb}

\packsubsection{fullpage}

\XXX Use normal-ish page margins rather than the narrow ones \LaTeX{} defaults to.

\packsubsection{geometry}

\XXX Easily customize page margins. Can allegedly be used on a per-page basis but I have an old version.

\packsubsection{graphicx}

% skipping ifpdf

\packsubsection{inputenc}

See section \ref{unicode}.

\subsection{kbordermatrix}
\label{kbordermatrix}

Not part of CTAN or \TeX{} Live.

The \href{http://www.hss.caltech.edu/~kcb/TeX/}{\texttt{kbordermatrix}} package by Kim C. Border provides matrices with cells on

\packsubsection{longtable}

\XXX Tables which can break across pages.

\packsubsection{multicol}

\packsubsection{multirow}

\packsubsection{rotating}

\packsubsection{textcomp}

Provides better versions of many symbols. Is implicitly used by \packname{upquote}.

\packsubsection{upquote}

\LaTeX{} tends to assume that certain ASCII-isms such as the straight quote are abominations not to be tolerated. This can have

%2010-09-08 I hear from Sam Peyson at COSI that vaucanson-g is a package for laying out finite state diagrams. But that's too sp

\packsubsection{verbatim}

\XXX Provides \verb!\verbatiminput!.

\packsubsection{wrapfig}

\begin{verbatim}
\begin{wrapfigure}{r}{0.3\textwidth}
  \includegraphics[width=0.3\textwidth]{circuits}
\caption{Some caption.}
\label{somelabel}
\end{wrapfigure}
Note - if the wrapfig is taller than the page text (there is white space at the bottom of the page) then its text-clearing will
\end{verbatim}

\section{Useful definitions}

\XXX[explain]

\begin{verbatim}

```

```

\newcommand{\unit}[1]{\ensuremath{\, \mathrm{#1}}}
\newcommand{\abs}[1]{\left\lvert#1\right\rvert}

\newcommand{\mat}[1]{\begin{bmatrix} #1 \end{bmatrix}}
\newcommand{\augmat}[2]{\left[\begin{array}{*{#1}c|*{10}c}#2\end{array}\right]}
\newcommand{\detmat}[1]{\abs{\begin{matrix} #1 \end{matrix}}}
\newcommand{\avec}[1]{\renewcommand{\,}{, } \left\langle#1 \right\rangle}

\newcommand{\valigntop}[1]{\hskip0pt \vtop{\hbox{}}\vspace{-1em}\hbox{#1}} % makes a box's top align with the top of the text line

\newcommand{\itemtag}[1]{\tag*{\llap{#1}\hspace{5pt}}}% requires leqno
\end{verbatim}

\section{Reference material}

\XXX[amsshort, amsmath, lshort, comprehensive symbols list]

\section{The source of this document}
{\footnotesize\verbatiminput{\jobname.tex}}

\end{document}

```