LaTeX for Beginners

Workbook

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Preface

This is an absolute beginners guide to writing documents in LaTeX using WinEdt 5.5. It assumes no prior knowledge of LaTeX, or any other computing language.

This workbook is designed to be used at the 'LaTeX for Beginners' student iSkills seminar, and also for self-paced study. Its aim is to introduce an absolute beginner to LaTeX and teach the basic commands, so that they can create a simple document and find out whether LaTeX will be useful to them.

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June, 2010

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Chapter 1

Introduction

1.1 What is LaTeX?

LaTeX (pronounced *lay-tek*) is a document preparation system for producing professional-looking documents, it is **not** a word processor. It is particularly suited to producing long, structured documents, and is very good at typesetting equations. It is available as free software for most operating systems.

LaTeX is based on TeX, a typesetting system designed by Donald Knuth in 1978 for high quality digital typesetting. TeX is a low-level language that computers can work with, but most people would find difficult to use; so LaTeX has been developed to make it easier. The current version of LaTeX is LaTeX2e.

If you are used to producing documents with Microsoft Word, you will find that LaTeX is a very different style of working. Microsoft Word is 'What You See Is What You Get' (WYSIWYG), this means that you see how the final document will look as you are typing. When working in this way you will probably make changes to the document's appearance (such as line spacing, headings, page breaks) as you type. With LaTeX you do not see how the final document will look while you are typing it — this allows you to concentrate on the content rather than appearance.

A LaTeX document is a plain text file with a .tex file extension. It can be typed in a simple text editor such as Notepad, but most people find it is easier to use a dedicated LaTeX editor. As you type you mark the document structure (title, chapters, subheadings, lists etc.) with tags. When the document is finished you compile it — this means converting it into another format. Several different output formats are available, but probably the most useful is Portable Document Format (PDF), which appears as it will be printed and can be transferred easily between computers.

1.2 Before You Start

The following conventions are used throughout this workbook:

- Actions for you to carry out are bulleted with an arrow ➲.
- `Text you type is written in this font`.
- Menu commands and button names are shown in **bold**.

Although the code in this workbook should work in any LaTeX editor, specific examples and screenshots refer to WinEdt 5.5.

Chapter 2

Document Structure

2.1 Essentials

➲ Start WinEdt.

If the **WinEdt Configuration Wizard** starts, click **OK** to close it.

➲ Open a new document.

➲ Right-click on the left margin and select **Show line numbers** (figure 2.1).

Line numbers will make it easier to compare your code with the screenshots and to find errors.

➲ Type the following:

```
\documentclass[a4paper,12pt]{article}

\begin{document}

A sentence of text.

\end{document}
```

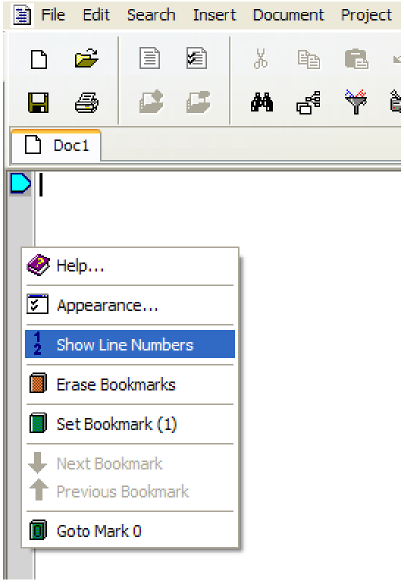


Figure 2.1: WinEdt screenshot showing the left margin context menu.

The `\documentclass` command must appear at the start of every LaTeX document. The text in the curly brackets specifies the document class. The **article** document class is suitable for shorter documents such as journal articles and short reports. Other document classes include **report** (for longer documents with chapters, e.g. PhD theses), **proc** (conference proceedings), **book** and **slides**. The text in the square brackets specifies options — in this case it sets the paper size to A4 and the main font size to 12pt.

The `\begin{document}` and `\end{document}` commands enclose the text and commands that make up your document. Anything typed before `\begin {document}` is known as the preamble, and will affect the whole document. Anything typed after `\end{document}` is ignored.

The empty lines aren't necessary[1], but they will make it easier to navigate between the different parts of the document as it gets longer.

➲ Click on the **Save** button.

➲ Create a new folder called **LaTeX course** in **My Documents**.

➲ Name your document **Doc1** and save it as a **TeX** file in this folder.

[1] See section 3.5 on page 14 for information about how LaTeX deals with empty space in the .tex file.

It is a good idea to keep each of your LaTeX documents in a separate folder as the compiling process creates multiple files.

➲ Click on the **PDF TeXify** button .

A command prompt window will appear while your document is being converted to a PDF file. When this disappears Acrobat Reader will open and display your document. The PDF file is automatically saved in the same folder as the TEX file.

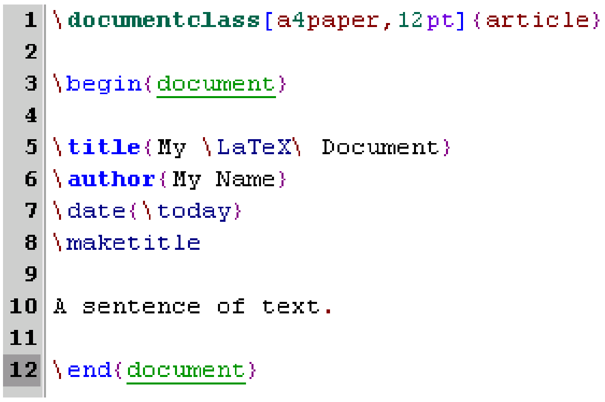
2.2 Creating a Title

The `\maketitle` command creates a title. You need to specify the title of the document. If the date is not specified today's date is used. Author is optional.

➲ Type the following directly after the `\begin{document}` command:

```
\title{My \LaTeX\ Document}
\author{My Name}
\date{\today}
\maketitle
```

Your document should now look like figure 2.2.



```
\documentclass[a4paper,12pt]{article}

\begin{document}

\title{My \LaTeX\ Document}
\author{My Name}
\date{\today}
\maketitle

A sentence of text.

\end{document}
```

Figure 2.2: WinEdt screenshot showing the maketitle command.

Notice that WinEdt uses colours to highlight different parts of your LaTeX code. Commands appear in blue. Look out for anything highlighted in red, as this is likely to be an error — either in spelling or code.

➲ Click on the **PDF TeXify** button and check the PDF.

Points to note:

- LaTeX is case sensitive so the `\LaTeX` command to produce the LaTeX logo must be typed exactly as above (capital L, T and X).
- Use a backslash (\) after the `\LaTeX` command to insert a space after the logo.
- `\today` is a command that inserts today's date. You can also type in a different date, for example `\date{June 2010}`.
- **Article** documents start the text immediately below the title on the same page. **Reports** put the title on a separate page (like this workbook).

2.3 Sections

You should divide your document into chapters (if needed), sections and subsections. The following sectioning commands are available for the **article** class:

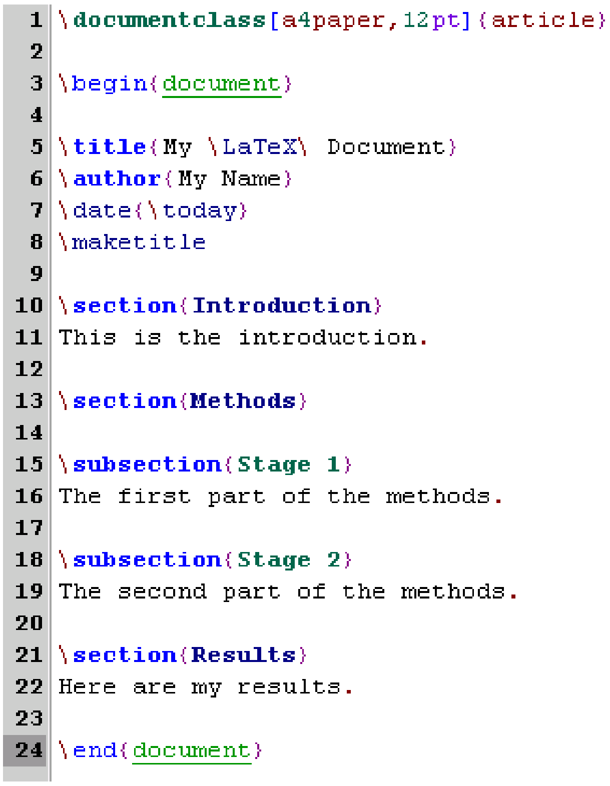
- `\section{...}`
- `\subsection{...}`
- `\subsubsection{...}`
- `\paragraph{...}`
- `\subparagraph{...}`

The title of the section replaces the dots between the curly brackets. With the **report** and **book** classes we also have `\chapter{...}`.

➲ Replace "`A sentence of text.`" with the following:

```
\section{Introduction}
This is the introduction.

\section{Methods}

\subsection{Stage 1}
The first part of the methods.

\subsection{Stage 2}
The second part of the methods.

\section{Results}
Here are my results.
```

Your document should now look like figure 2.3.



```
\documentclass[a4paper,12pt]{article}

\begin{document}

\title{My \LaTeX\ Document}
\author{My Name}
\date{\today}
\maketitle

\section{Introduction}
This is the introduction.

\section{Methods}

\subsection{Stage 1}
The first part of the methods.

\subsection{Stage 2}
The second part of the methods.

\section{Results}
Here are my results.

\end{document}
```

Figure 2.3: WinEdt screenshot of document with sections.

➲ Click on the **PDF TeXify** button and check the PDF.

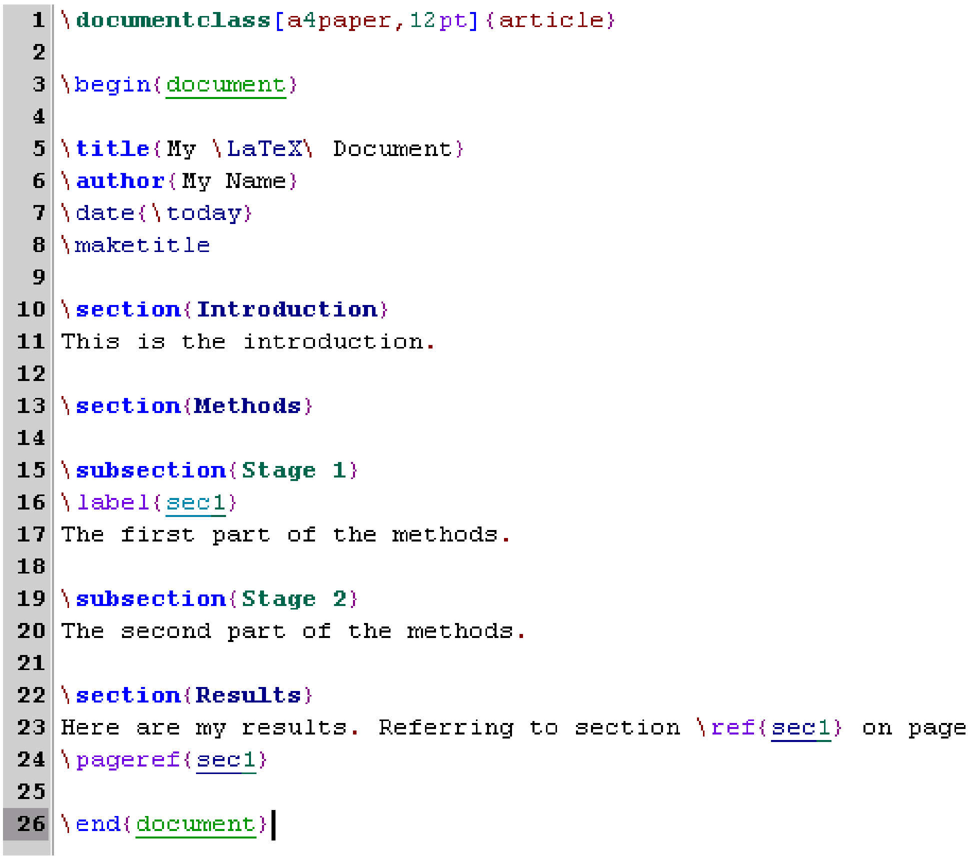
2.4 Labelling

You can label any of the sectioning commands so they can be referred to in other parts of the document. Label the section with `\label{labelname}`. Then type `\ref{labelname}` or `\pageref{labelname}`, when you want to refer to the section or page number of the label.

➲ Type `\label{sec1}` on a new line directly after `\subsection{Stage 1}`.

➲ Type `Referring to section \ref{sec1} on page \pageref{sec1}` in the **Results** section.

Your document should now look like figure 2.4.



```
\documentclass[a4paper,12pt]{article}

\begin{document}

\title{My \LaTeX\ Document}
\author{My Name}
\date{\today}
\maketitle

\section{Introduction}
This is the introduction.

\section{Methods}

\subsection{Stage 1}
\label{sec1}
The first part of the methods.

\subsection{Stage 2}
The second part of the methods.

\section{Results}
Here are my results. Referring to section \ref{sec1} on page
\pageref{sec1}

\end{document}
```

Figure 2.4: WinEdt screenshot of document with labels.

➲ Click on the **PDF TeXify** button and check the PDF.

2.5 Table of Contents

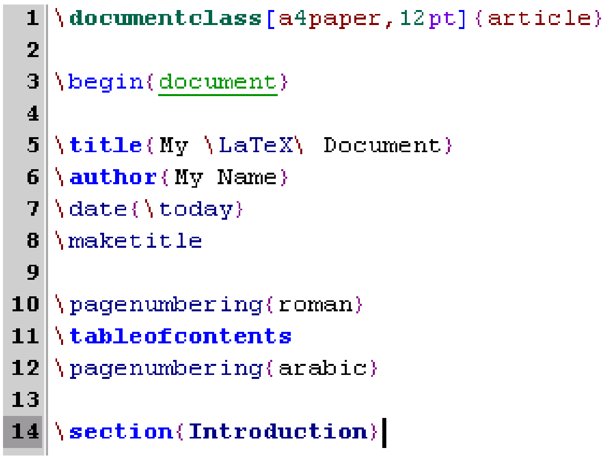
If you use sectioning commands it is very easy to generate a table of contents. Type `\tableofcontents` where you want the table of contents to appear in your document — often directly after the title page.

You may also want to change the page numbering so that roman numerals (i, ii, iii) are used for pages before the main document starts. This will also ensure that the main document starts on page 1. Page numbering can be switched between arabic and roman using `\pagenumbering{...}`.

➲ Type the following directly after `\maketitle`:

```
\pagenumbering{roman}
\tableofcontents
\pagenumbering{arabic}
```

The first 14 lines of code should now look like figure 2.5.



```
\documentclass[a4paper,12pt]{article}

\begin{document}

\title{My \LaTeX\ Document}
\author{My Name}
\date{\today}
\maketitle

\pagenumbering{roman}
\tableofcontents
\pagenumbering{arabic}

\section{Introduction}
```

Figure 2.5: WinEdt screenshot of document showing tableofcontents command.

➲ Click on the **PDF TeXify** button and check the PDF.

Chapter 3

Typesetting Text

3.1 Font Effects

There are LaTeX commands for a variety of font effects:

`\textit{words in italics}`	*words in italics*
`\textsl{words slanted}`	*words slanted*
`\textsc{words in smallcaps}`	WORDS IN SMALLCAPS
`\textbf{words in bold}`	**words in bold**
`\texttt{words in teletype}`	`words in teletype`
`\textsf{sans serif words}`	sans serif words
`\textrm{roman words}`	roman words
`\underline{underlined words}`	underlined words

WinEdt has shortcut buttons for *emphasize* (turns roman text into italic, and vice versa), **bold** and `teletype` (monospaced text). These save you from having to type the commands — simply highlight the text and click the button.

➲ Add some more text to your document and experiment with different text effects.

3.2 Coloured Text

To put coloured text in your document you need to use a **package**. There are many packages that can be used with LaTeX to enhance its functionality.

Packages are included in the **preamble** (i.e. before the `\begin{document}` command). Packages are activated using the `\usepackage[options]{package}` command, where `package` is the name of the package and `options` is an optional list of keywords that trigger special features in the package.

The basic colour names that `\usepackage{color}` knows about are black, red, green, blue, cyan, magenta, yellow and white:

> Red, green, blue, cyan, magenta, yellow and white.

The following code to produces coloured text:

```
{\color{colour_name}text}
```

Where `colour_name` is the name of the colour you want, and `text` is the text you want to be coloured.

- Type `\usepackage{color}` on the line before `\begin{document}`.
- Type `{\color{red}fire}` in your document.
- Click on the **PDF TeXify** button and check the PDF.

The word 'fire' should appear in red colour.

It is possible to add options that allow `\usepackage{color}` to understand more colour names, and even to define your own colours. It is also possible to change the background colour of text (as for white and yellow in the example above), but this is beyond the scope of this workbook. If you want more information about see the Colors chapter in the LaTeX Wikibook[1].

3.3 Font Sizes

There are LaTeX commands for a range of font sizes:

[1] `http://en.wikibooks.org/wiki/LaTeX/Colors`

`{\tiny tiny words}`	tiny words
`{\scriptsize scriptsize words}`	scriptsize words
`{\footnotesize footnotesize words}`	footnotesize words
`{\small small words}`	small words
`{\normalsize normalsize words}`	normalsize words
`{\large large words}`	large words
`{\Large Large words}`	Large words
`{\LARGE LARGE words}`	LARGE words
`{\huge huge words}`	huge words

➲ Experiment with different font sizes in your document.

3.4 Lists

LaTeX supports two types of lists: **enumerate** produces numbered lists, while **itemize** is for bulleted lists. Each list item is defined by `\item`. Lists can be nested to produce sub-lists.

➲ Type the following to produce a numbered list with a bulleted sub-list:

```
\begin{enumerate}
\item First thing
\item Second thing
\begin{itemize}
\item A sub-thing
\item Another sub-thing
\end{itemize}
\item Third thing
\end{enumerate}
```

➲ Save the document and convert to a PDF.

The list should look like this:

1. First thing
2. Second thing
    - A sub-thing

    - Another sub-thing

3. Third thing

It is easy to change the bullet symbol using square brackets after the `\item`, for example, `\item[-]` will give a dash as the bullet. You can even use words as bullets, for example, `\item[One}`.

The following code:

```
\begin{itemize}
\item[-] First thing
\item[+] Second thing
\begin{itemize}
\item[Fish] A sub-thing
\item[Plants] Another sub-thing
\end{itemize}
\item[Q] Third thing
\end{itemize}
```

Produces:

- - First thing
- + Second thing
    - Fish A sub-thing
    - Plants Another sub-thing
- Q Third thing

3.5 Comments & Spacing

Comments are created using %. When LaTeX encounters a % character while processing a .tex file, it ignores the rest of the line (until the [**Return**] key has been pressed to start a new line — not to be confused with line wrapping in your editor). This can be used to write notes in the input file which will not show up in the printed version.

The following code:

```
It is a truth universally acknowledged% Note comic irony
in the very first sentence
, that a single man in possession of a good fortune, must
be in want of a wife.
```

Produces:

> It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife.

Multiple consecutive spaces in LaTeX are treated as a single space. Several empty lines are treated as one empty line. The main function of an empty line in LaTeX is to start a new paragraph. Two backslashes (\\) can also be used to start a new paragraph. In general, LaTeX ignores blank lines and other empty space in the .tex file.

➲ Experiment with putting comments and blank lines in to your document.

If you want to add blank space into your document use the `\vspace{...}` command. This will add blank vertical space of a height specified in typographical points (pt). For example, `\vspace{12pt}` will add space equivalent to the height of a 12pt font.

3.6 Special Characters

The following symbols are reserved characters which have a special meaning in LaTeX:

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

All of these apart from the backslash \ can be inserted as characters in your document by adding a prefix backslash:

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

Note that you need to type a pair of curly brackets `{}` after the hat `^` and tilde `~`, otherwise these will appear as accents over the following character. For example, “`\^ e`” produces “ê”.

The above code will produce:

$ %   ˆ   &   _   {   }   ˜

The backslash character \ can not be entered by adding a prefix backslash, \\, as this is used for line breaking. Use the `\textbackslash` command instead.

➲ Type code to produce the following sentence in your document:

> Item #1A\642 costs $8 & is sold at a ˜10% profit.

Ask the tutor, or check the .tex file of this workbook, if you need help.

Chapter 4

Tables

The `tabular` command is used to typeset tables. By default, LaTeX tables are drawn without horizontal and vertical lines — you need to specify if you want lines drawn. LaTeX determines the width of the columns automatically.

This code starts a table:

```
\begin{tabular}{...}
```

Where the dots between the curly brackets are replaced by code defining the columns:

- `l` for a column of left-aligned text (letter l, not number 1).
- `r` for a column of right-aligned text.
- `c` for a column of centre-aligned text.
- `|` for a vertical line.

For example, `{lll}` will produce 3 columns of left-aligned text with no vertical lines, while `{|l|l|r|}` will produce 3 columns — the first 2 are left-aligned, the third is right-aligned, and there are vertical lines around each column.

The table data follows the `\begin` command:

- `&` is placed between columns.
- `\\` is placed at the end of a row (to start a new one).

- `\hline` inserts a horizontal line.
- `\cline{1-2}` inserts a partial horizontal line between column 1 and column 2.

The command `\end{tabular}` finishes the table.

Examples of tabular code and the resulting tables:

```
\begin{tabular}{|l|l|}
Apples & Green \\
Strawberries & Red \\
Oranges & Orange \\
\end{tabular}
```

Apples	Green
Strawberries	Red
Oranges	Orange

```
\begin{tabular}{rc}
Apples & Green \\
\hline
Strawberries & Red \\
\cline{1-1}
Oranges & Orange \\
\end{tabular}
```

Apples	Green
Strawberries	Red
Oranges	Orange

```
\begin{tabular}{|r|l|}
\hline
8 & here's \\
\cline{2-2}
86 & stuff \\
\hline \hline
2008 & now \\
\hline
\end{tabular}
```

8	here's
86	stuff
2008	now

4.1 Practical

➲ Write code to produce the following tables:

Item	Quantity	Price ($)
Nails	500	0.34
Wooden boards	100	4.00
Bricks	240	11.50

	Year		
City	2006	2007	2008
London	45789	46551	51298
Berlin	34549	32543	29870
Paris	49835	51009	51970

Ask the tutor, or look at the .tex file of this workbook, if you need help.

Chapter 5

Figures

This chapter describes how to insert an image in to your LaTeX document, which requires the `graphicx` package. Images should be PDF, PNG, JPEG or GIF files. The following code will insert an image called myimage:

```
\begin{figure}[h]
\centering
\includegraphics[width=1\textwidth]{myimage}
\caption{Here is my image}
\label{image-myimage}
\end{figure}
```

`[h]` is the placement specifier. `h` means put the figure approximately here (if it will fit). Other options are `t` (at the top of the page), `b` (at the bottom of the page) and `p` (on a separate page for figures). You can also add `!`, which overrides the rule LaTeX uses for choosing where to put the figure, and makes it more likely it will put it where you want (even if it doesn't look so good).

`\centering` centres the image on the page, if not used images are left-aligned by default. It's a good idea to use this as the figure captions are centred.

`includegraphics{...}` is the command that actually puts the image in your document. The image file should be saved in the same folder as the TeX file.

`[width=1\textwidth]` is an optional command that specifies the width of the picture - in this case the same width as the text. The width could also be given in centimeters (cm). You could also use `[scale=0.5]` which scales the image by the desired factor, in this case reducing by half.

`\caption{...}` defines a caption for the figure. If this is used LaTeX will add "Figure" and a number before the caption. If you use captions, you can use `\listoffigures` to create a table of figures in a similar way to the table of contents (section 2.5, page 9).

`\label{...}` creates a label to allow you to refer to the table or figure in your text (section 2.4, page 8).

5.1 Practical

- ➲ Add `\usepackage{graphicx}` in the preamble of your document (before the `\begin{document}` command).
- ➲ Find the 'Water lillies' JPEG image in **My Documents** > **My Pictures** > **Sample Pictures** and save a copy to your **LaTeX course** folder in **My Documents**.
- ➲ Rename the file to 'Waterlilies' (LaTeX cannot process spaces in file names).
- ➲ Type the following text at the point where you want your image inserted:

```
\begin{figure}[h!]
\centering
\includegraphics[width=1\textwidth]{Waterlilies}
\caption{My test image}
\end{figure}
```

- ➲ Click on the **PDF TeXify** button and check the PDF.

Chapter 6

Equations

One of the main reasons for writing documents in LaTeX is because it is really good at typesetting equations. Equations are written in 'math mode'.

6.1 Inserting Equations

You can enter math mode with an opening and closing dollar sign `$` (or use `\(...\)`). This can be used to write mathematical symbols within a sentence — for example, typing `$1+2=3$` produces $1 + 2 = 3$.

If you want a "displayed" equation on its own line use `\[...\]`. For a numbered displayed equation, use `\begin{equation}...\end{equation}`.

For example, `\[1+2=3\]` produces:

$$1 + 2 = 3$$

and `\begin{equation}1+2=3\end{equation}` produces:

$$1 + 2 = 3 \tag{6.1}$$

Use `\begin{eqnarray*}...\end{eqnarray*}` to write equation arrays for a series of equations/inequalities. This code produces an unnumbered array — removing the star `*` produces an array with individually numbered equations.

For example —

```
\begin{eqnarray*}
```

```
  a & = & b + c \\
    & = & y - z
\end{eqnarray*}
```

Produces:

$$\begin{aligned} a &= b+c \\ &= y-z \end{aligned}$$

6.2 Mathematical Symbols

Although some basic mathematical symbols (+ - = ! / ( ) [ ] :) can be accessed directly from the keyboard, most must be inserted using a command.

This section is a very brief introduction to using LaTeX to produce mathematical symbols — the Mathematics chapter in the LaTeX Wikibook is an excellent tutorial on mathematical symbol commands, which you should refer to if you want to learn more. If you want to find the command for a specific symbol try Detexify[1], which can recognise hand drawn symbols.

6.2.1 Powers & Indices

Powers are inserted using the hat ^ symbol. For example, `$n^2$` produces n^2.

Indices are inserted using an underscore `_`. For example, `$2_a$` produces 2_a.

If the power or index includes more than one character, group them using curly brackets `{...}`, e.g. `$b_{a-2}$` produces b_{a-2}.

6.2.2 Fractions

Fractions are inserted using `\frac{numerator}{denominator}`.

`\[\frac{a}{3}\]` produces:

$$\frac{a}{3}$$

[1] `http://detexify.kirelabs.org`

Fractions can be nested —

`\[\frac{y}{\frac{3}{x}+b}\]` produces:

$$\frac{y}{\frac{3}{x}+b}$$

6.2.3 Roots

Square root symbols are inserted using `\sqrt{...}` where `...` is replaced by the square root content. If a magnitude is required it can be added using optional square brackets `[...]`.

`\[\sqrt{y^2}\]` produces:

$$\sqrt{y^2}$$

`\[\sqrt[x]{y^2}\]` produces:

$$\sqrt[x]{y^2}$$

6.2.4 Sums & Integrals

The command `\sum` inserts a sum symbol; `\int` inserts an integral. For both functions, the upper limit is specified by a hat ^ and the lower by an underscore _.

`\[\sum_{x=1}^5 y^z\]` produces:

$$\sum_{x=1}^5 y^z$$

`\[\int_a^b f(x)\]` produces:

$$\int_a^b f(x)$$

6.2.5 Greek letters

Greek letters can be typed in math mode using the name of the letter preceded by a backslash \. Many Greek capital letters are used in the Latin alphabet — for those that are different capitalise the first letter of the name to produce a capital Greek letter.

For example —

`$\alpha$` = α
`$\beta$` = β
`$\delta, \Delta$` = δ, Δ
`$\theta, \Theta$` = θ, Θ
`$\mu$` = μ
`$\pi, \Pi$` = π, Π
`$\sigma, \Sigma$` = σ, Σ
`$\phi, \Phi$` = ϕ, Φ
`$\psi, \Psi$` = ψ, Ψ
`$\omega, \Omega$` = ω, Ω

6.3 Practical

- Write code to produce the following equations:

$$e = mc^2 \tag{6.1}$$

$$\pi = \frac{c}{d} \tag{6.2}$$

$$\frac{d}{dx}e^x = e^x \tag{6.3}$$

$$\frac{d}{dx}\int_0^\infty f(s)ds = f(x) \tag{6.4}$$

$$f(x) = \sum_i = 0^\infty \frac{f^{(i)}(0)}{i!}x^i \tag{6.5}$$

$$x = \sqrt{\frac{x_i}{z}y} \tag{6.6}$$

Ask the tutor, or look at the .tex file of this workbook, if you need help.

Chapter 7

Further Reading

LaTeX Project
`http://www.latex-project.org/`
Official website - has links to documentation, information about installing LaTeX on your own computer, and information about where to look for help.

The Not So Short Introduction to LaTeX2e
`http://ctan.tug.org/tex-archive/info/lshort/english/lshort.pdf`
A good tutorial for beginners.

LaTeX Wikibook
`http://en.wikibooks.org/wiki/LaTeX/`
Comprehensive and clearly written, although still a work in progress. A downloadable PDF is also available.

Comparison of TeX Editors on Wikipedia
`http://en.wikipedia.org/wiki/Comparison_of_TeX_editors`
Information to help you to choose which LaTeX editor to install on your own computer.

TeXnicCenter
`http://texniccenter.org/`
One of the best free LaTeX editors.