Introduction to LaTeX

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1 Getting started

LaTeX is a computer typesetting system that is very suitable for producing scientific and mathematical documents of high typographical quality. It is also suitable for producing all sorts of other documents, from simple letters to complete books. The LaTeX program reads in text from a suitably prepared input file, and creates a 'DVI file' which encodes information on the fonts to be used and the positioning of the characters on the printed page. There are many programs available that can translate the 'DVI file' into page description languages such as 'PostScript' (*.ps) or 'Portable Document Format' (*.pdf).

Some books on LaTeX :

David F. Griffiths and Desmond J. Higham, **Learning LaTeX** . SIAM, Philadelphia, 1996, ISBN 0-89871-383-8

Helmut Kopka and Patrick W. Daly, **A Guide to LaTeX**. Addison-Wesley Professional, 2003, ISBN-10: 0321173856.

George Gratzer, **Math Into LaTeX** . Birkhauser, Boston, 2000, ISBN-10: 0817641319

Michel Goossens, Frank Mittelbach, Sebastian Rahtz, Denis Roegel and Herbert Voss, **The LaTeX Graphics Companion**. Addison-Wesley Professional, 2007, ISBN-10: 0321508920.

We will work with software called `Kile.`To get started:

- Login into computer.
- Go to `Applications`
- In the menu click `Terminal`
- In the window type `kile`
- Press `Enter`
- Go to `File`
- Click on `New`
- Choose `Empty document`

2 Basic LaTeX

2.1 A Typical LaTeX Input File

The input for LaTeX is a plain ASCII text file. You can create it with any text editor. It contains the text of the document, as well as the commands that tell LaTeX how to typeset the text. The document should always follow a structure:

- It starts by defining a class of document:

```
\documentclass [options] {class}
```

- Valid LaTeX document classes include: `article, report, letter, book, slides` and many more.
- All the standard classes (except slides) accept the following options for selecting the typeface size (10 pt is default): 10pt, 11pt, 12pt.

  All classes accept these options for selecting the paper size (default is letter): `a4paper, a5paper, b5paper, letterpaper, legalpaper, executivepaper`

  Miscellaneous options:

  - `landscape` – selects landscape format. Default is portrait.
  - `titlepage, notitlepage` – selects if there should be a separate title page.
  - `leqno` – equation number on left side of equations. Default is right side.
  - `fleqn` – displayed formulas flush left. Default is centred.
  - `openbib` – use "open" bibliography format.
  - `draft, final` – mark/do not mark overfull boxes with a rule. Default is final.
- *Default*- when option is not specified.
- If you specify more than one option, they must be separated by a comma.
- The preamble is everything from the start of the Latex source file until the `\begin{document}` command. It normally contains commands that affect the entire document.
- Additional packages are loaded by a

  ```
  \usepackage[options]{package}
  ```

  command. If you specify more than one package, they must be separated by a comma.
- There are numerous packages for LaTeX. The LaTeX packages Catalogue available on `http://texcatalogue.sarovar.org/`, `http://math.kangwon.ac.kr/ yhpark/tex/packages.html`, `ftp://ftp.pereslavl.ru/rented/lib/tex/texmf/doc/html/catalogue/alpha.html` and many other places.
- At the beginning of most documents there will be information about the document itself, such as the title and date, and also information about the authors, such as name, address, email etc.

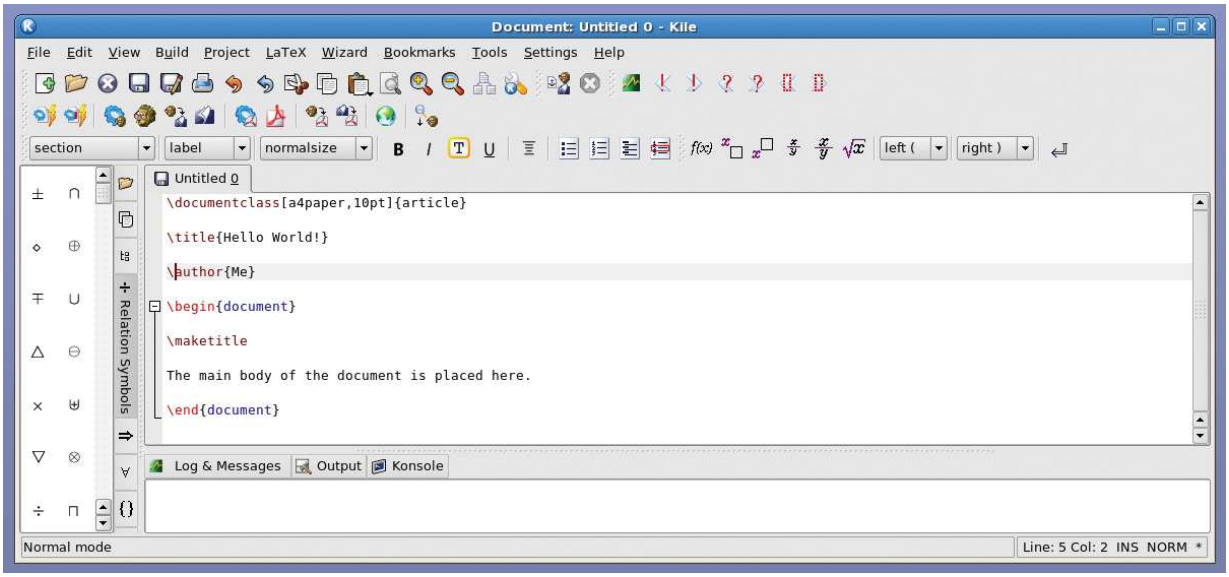
  ```
  \title{Hellow world!}
  \author{Me}
  ```

- The text of your document is enclosed between two commands which identify the beginning and end of the actual document:

```
\begin{document}

\maketitle

The main body of the document is placed here.

\end{document}
```

- If you omit `\maketitle`, the titling will never be typeset
- A useful side-effect of marking the end of the document text is that you can store comments or temporary text underneath the `\end{document}` in the knowledge that LaTeX will never try to typeset them.

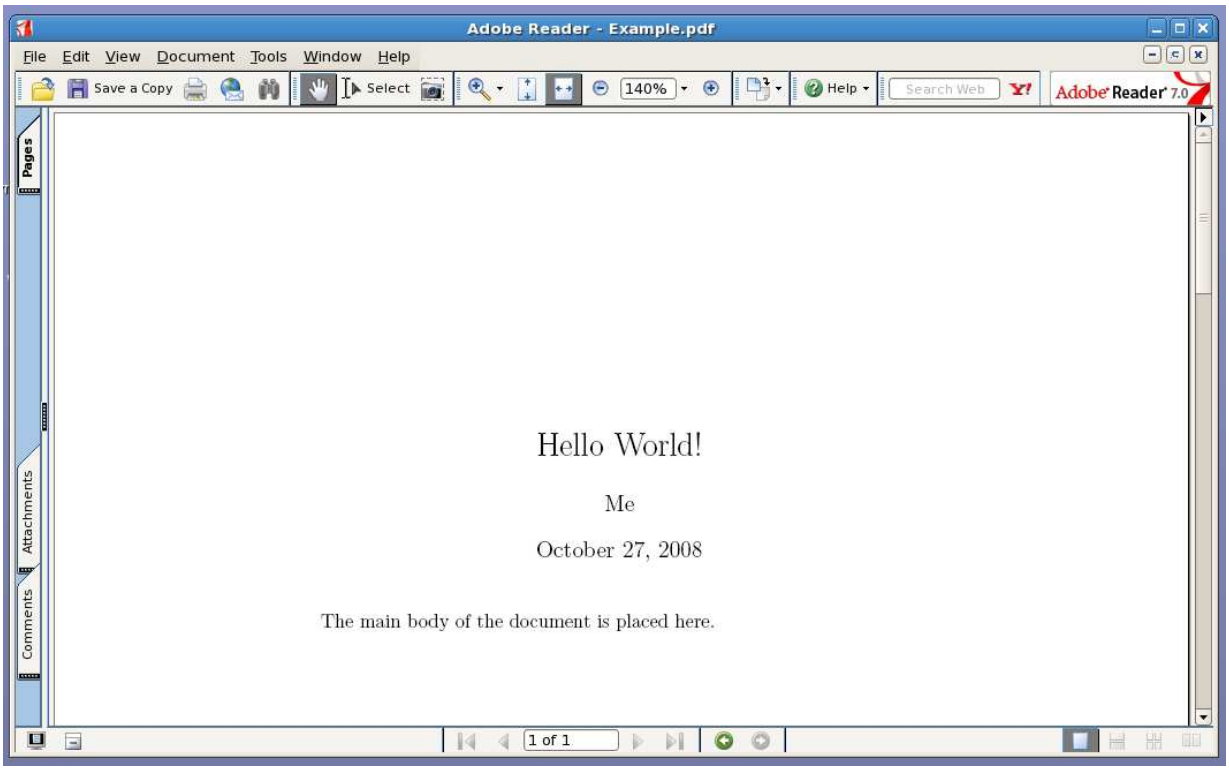
Your working window should look something like this:



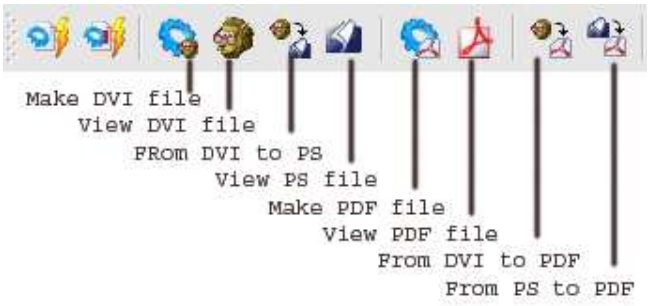
Then do following:

- Go to `File\Save As` and save your file as `example.tex`
- Go to `Build\Quick Build`
- You have got a `dvi` file, containing message 'The main body of the document is placed here.'
- For `pdf`, go to `Build\Convert\DVItoPDF`
- To view, click on the Adobe icon on the menu.

Which should give a `pdf` file:



Alternatively, You can use icons on the menu window:



2.2 Text in LaTeX

Most characters on the keyboard, such as letters and numbers, have their usual meaning and appear as they are typed in LaTeX document. However, a few rules apply:

1. 'Whitespace' characters, such as blank or tab, are treated uniformly as 'space' by LaTeX . Several consecutive whitespace characters are treated as one space. A 'newline' generated by an Enter key is thought of as a space.

2. An empty line- or any number of blank lines together- denotes the end of a paragraph. Several empty lines are treated the same as one empty line. A paragraph is automatically indented by LaTeX except when it is the first in the section. If you want to override this feature, insert `\noindent` command at the start of new paragraph.

3. The following characters have a special meaning in LaTeX:

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

When you want one of these characters to appear in the output, most of them can be generated by preceding the character with a backslash:

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

4. If a % sign is included in a line without being proceded by a backslash, the remainder of the line is ignored. This provides a mechanism for inserting comments into the LaTeX file.

2.3 Type Styles

One can control the shape, series, and family of the type. There are four shapes: upright, *italic*, *slanted*, and SMALL CAPS, and two series: medium, **boldface**, and three families: roman, sans serif, and `typewriter`.

This text was produced using the following lines:

```
One can control the shape, series, and family of the type.
There are four shapes: \textup{upright}, \textit{italic},
\textsl{slanted}, and \textsc{small caps}, and
two series: \textmd{medium}, \textbf{boldface},
and three families: \textrm{roman}, \textsf{sans serif},
and \texttt{typewriter}.
```

Note that text whose type is to be changed is enclosed in curly braces after the command. One can also combine features by staggered curly braces.

The declarations in the table below, can be used to change the type size selectively. These declarations, and the words to which they apply, are enclosed in curly braces to limit their scope. A space separates the command from the text.

Declaration	Typeset by LaTeX
`\tiny`	sample text
`\scriptsize`	sample text
`\footnotesize`	sample text
`\small`	sample text
`\normalsize`	sample text
`\large`	sample text
`\Large`	sample text
`\LARGE`	sample text
`\huge`	sample text
`\Huge`	sample text

Using the color package (which must be called in the Preamble), you can typeset LaTeX in any color. To add the color package in the Preamble, use the command: `\usepackage{color}`.

The color package makes a default color package available. The colors available are: red, green, and blue. To make a single word or phrase in color, use the command: `\textcolor{color}{words to be in color}`. For example, *text in red*, is obtained by `{\Huge\textit{\textcolor{red}{text in red}}}`.

2.4 Vertical and Horizontal Spacing

The `\\` command tells LaTeX to start a new line.
The vertical spacing between lines can be altered using the `\vspace` command. For example, the command

`\vspace{3.5cm}`

will leave a vertical space of 3.5cm. Horizontal spacing works in a similar way using the `\hspace` command. For example

```
Get out your rulers and measure these lengths.

\vspace{1.0cm}

Push right\hspace{1cm}one centimeter.
```

This results in:

Get out your rulers and measure these lengths.

Push right one centimeter.

Other units of length are `in` (inches), `em` (the width of the letter "M"), `ex` (the hight of the letter "x") and `pt` for points.

The `\newpage`command ends the current page.

2.5 Environments

Environments are portions of the document that we want LaTeX to treat differently from the main body. They are generally created by enclosing the text between the commands

`\begin{`*environment name*`}`
...
`\end{`*environment name*`}`.

Some of the common non-mathematical environments are list-making environments such as `itemize` and `enumerate`, text centering via `center`, and the two table-making environments `table` and `tabular`.

For centered text or any other object:

```
Text on line 1
\begin{center}
  Centered text on line 2
\end{center}
```

which produces

Text on line 1

Centered text on line 2

The `itemize` version produces "bullets".

```
\begin{itemize}
\item One
\item Two
\item Three
\end{itemize}
```

will turn into

- One
- Two
- Three

Numbered lists are produced with `enumerate`.

```
\begin{enumerate}
\item One
\item Two
\item Three
\end{enumerate}
```

will turn into

1. One
2. Two
3. Three

List can be nested:

```
\begin{enumerate}
\item One
   \begin{enumerate}
     \item One
     \begin{enumerate}
        \item One
        \item Two
        \item Three
     \end{enumerate}
     \item Two
     \item Three
  \end{enumerate}
\item Two
\item Three
\end{enumerate}
```

will turn into

1. One
   (a) One
      i. One
      ii. Two
      iii. Three
   (b) Two
   (c) Three
2. Two
3. Three

3 More Basics

3.1 Document Structure

All LaTeX files will begin with the command

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

This command tells that the document is an article and the type size for the text is 12 points. The `article` can be replaced by `report`, `book`, `slides`, or `letter`. If you're writing a thesis or a final year project report, you should use `report` etc.

As an alternative to the standard classes built into LaTeX you can use any available class that has been appropriately defined in a file with a `cls` extension. For example,

```
\documentclass{amsart}
```

is used by The American Mathematical Society for journals and book series.
To use this command, you can save `amsart.cls` in the directory of your input file.

3.2 Titles for Documents

A title page can be generated automatically by specifying the title, authors, affiliations, and date. For example, the title page of this document was generated using the commands

```
\begin{document}
\title{\textbf{Introduction to \LaTeX}}
\author{Renata Retkute \\ Department of Mathematics}
\date{\today}
\maketitle
```

Command `maketitle` tells LaTeX to format the title page, using the information supplied by the `\title` , `\author` , and `\date` commands. If there is more then one author, their names should be separated by `\and` . It is possible to add footnotes, for example, to recognise financial support, using the `\thanks{....}` command after author name. One could also give a specific date such as `\date{05/11/2007}`. The command `\today` automatically puts in the date the document was produced. If the `\date` command is omitted, then the current date is generated; to suppress the date use `\date{}` with an empty argument.
A table of contents can automatically included by using the `\tableofcontents` command, including

it after `\maketitle`.LaTeX stores the information that needs to produce the table of contents in a file with `toc` extension. Each time you run `tex` file, the information in `toc` file is updated. The analogous commands `\listoftables` and `\listoffigures` work in the same way, producing files with extensions `lot` and `lof` , respectively.

3.3 Sectioning Commands

We can regard LaTeX documents as organized hierarchically into units such as words, sentences, paragraphs and *sections*. The command

```
\section{Introduction}
```

creates a section whose heading is `Introduction`. Each time it encounters the `\section` command, LaTeX starts a new section. The section number is generated automatically. With the `report` class, `\chapter` is also available. We may also give the unit a *key*, for example, `intro`, by using

```
\section{Introduction}\label{intro}
```

We can refer to that section later in the document using the `\ref` command

```
It was shown in Section \ref{intro} that ....
```

The commands `subsection` and `subsubsection` subdivide the document even further and work in the same way as `\section`.

There are also alternative forms if we want to avoid the numbering:

```
\section*{...},  \subsection*{...},   \subsubsection*{...}
```

3.4 Bibliography

A bibliography can be created with the `thebibliography` environment. This is similar to the list-making environment discussed before. The command `\bibitem,` whose argument is enclosed in curly braces, precedes each entry. The argument specifies the key by which the entry can be cited, anywhere in the document, using the `\cite` command. You need yo compile LaTeX file twice, for citation to appear in the text.

A bibliography is, for example, created by using

```
\begin{thebibliography}{99}
  \bibitem{1a} Author1, Title1, Year1.
  \bibitem{1b} Author2, Title2, Year2.
\end{thebibliography}
```

You should place the environment `\thebibliogrphy` at the end of your document but before `\end{document}` . The second argument `"{9}"` gives LaTeX an upper limit on the number of the items appearing in the bibliography list. If the number of entries was between 100 and 999 then we would use `\begin{thebibliography}{999}` .

You can now cite both books in the text. For example

```
The two books are \cite{1a,1b}.
```

Will give

The two books are [1, 2].

References
[1] Autho1, Title1, Year1.
[2] Author2, Title2, Year2

4 Producing Mathematical Formulae using LaTeX

4.1 Mathematics Mode

There are few different ways to typeset mathematical formulas into LaTeX .
In order to obtain a mathematical formula using LaTeX, one must enter mathematics mode before the formula and leave it afterwards. Mathematical formulae can occur either embedded in text or else displayed between lines of text. When a formula occurs within the text of a paragraph one should place a $ sign before and after the formula, in order to enter and leave mathematics mode. Thus a sentence like

```
 Let $f$ be the function defined by $f(x) = 3x + 7$, and let
$a$ be a positive real number.
```

will give

Let f be the function defined by $f(x) = 3x+7$, and let a be a positive real number.

In particular, note that even mathematical expressions consisting of a single character, like f and a in the example above, are placed within $ signs. This is to ensure that they are set in italic type, as is customary in mathematical typesetting.

In order to obtain an mathematical formula or equation which is displayed on a line by itself, one places `\[` before and `\]`after the formula. Then expression

```
If $f(x) = 3x + 7$ and $g(x) = x + 4$ then
\[ f(x) + g(x) = 4x + 11 \]
and
\[ f(x)g(x) = 3x^2 + 19x +28. \]
```

will produce:

If $f(x) = 3x + 7$ and $g(x) = x + 4$ then

$$f(x) + g(x) = 4x + 11$$

and

$$f(x)g(x) = 3x^2 + 19x + 28.$$

4.2 Equation Environments

In order to get a numbered expression, we must use the `equation` environment, which is contained in `\begin{equation}....\end{equation}`. If we include a labeling command, as in `\label{eqn1}`, we can refer to the equation by its key `\ref{eqn1}` rather than its number. If equations with more than one line have to be displayed, then a more elaborate environment is to be used. This is provided by `\begin{eqnarray}....\end{eqnarray}`.

```
If $f(x) = 3x + 7$ and $g(x) = x + 4$ then
\begin{eqnarray}
f(x) + g(x) &  = & 4x + 11, \label{eqn1} \\
f(x)g(x) & = & 3x^2 + 19x +28. \label{eqn2}
\end{eqnarray}
Equations (\ref{eqn1})-(\ref{eqn2}) ...
```

which yields:

If $f(x) = 3x + 7$ and $g(x) = x + 4$ then

$$\begin{aligned} f(x) + g(x) &= 4x + 11, && (1)\\ f(x)g(x) &= 3x^2 + 19x + 28. && (2) \end{aligned}$$

Equations (1)-(2) ...

If you don't like to have all equations numbered, you can use the `\begin{eqnarray*}.....\end{eqnarray*}` environment. A `\\` indicates that a new line starts, while `&=&` makes sure that everything is centered about the equality sign `=`.

If your expression is too long, to fit on a single line then you must use `eqnarray`and broke expression across a line. Typically, the point at which the expression is broken must be chosen by trial and error after previewing the output. To avoid multiple numeration of the same formula, use command `\nonumber`.

4.3 Characters in Mathematics Mode

All the characters on the keyboard have their standard meaning in mathematics mode, with the exception of the characters

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

Letters are set in italic type. In mathematics mode the character `'` has a special meaning: typing `$u'+v''$` produces $u' + v''$.

There are various control sequences for producing underlining, overlining and various accents in mathematics mode. The following table lists these control sequences, applying them to the letter a:

$\hat{a}$	`\hat{a}`	$\acute{a}$	`\acute{a}`	$\bar{a}$	`\bar{a}`	$\dot{a}$	`\dot{a}`	$\breve{a}$	`\breve{a}`
$\check{a}$	`\check{a}`	$\grave{a}$	`\grave{a}`	$\vec{a}$	`\vec{a}`	$\ddot{a}$	`\ddot{a}`	$\tilde{a}$	`\tilde{a}`

Spaces and single carriage returns in the input file between letters and other symbols do not have any effect on the typesetting of mathematical formulae, since LaTeX determines spacing within formulae by its own internal rules.

A backslash can be obtained in mathematics mode by typing `\backslash`.

Subscripts and superscripts are obtained using the special characters `_` and `^` respectively. Thus the identity

$$ds^2 = dx_1^2 + dx_2^2 + dx_3^2 - c^2 dt^2$$

is obtained by typing

```
\[ ds^2 = dx_1^2 + dx_2^2 + dx_3^2 - c^2 dt^2 \]
```

It can also be obtained by typing

```
\[ ds^2 = dx^2_1 + dx^2_2 + dx^2_3 - c^2 dt^2 \]
```

since, when a superscript is to appear above a subscript, it is immaterial whether the superscript or subscript is the first to be specified.

Where more than one character occurs in a superscript or subscript, the characters involved should be enclosed in braces. For example, the polynomial $x^{17} - 1$ is obtained by typing `$x^{17}-1$`.

Subscripts and superscripts are treated differently when they are attached to integral, summation, or product symbols or to max, min, inf, or sup.

```
\[
 S_N=\sum_{j=1}^N a_j
\]

\[
 \int_{x=0}^\infty e^{-x^2} dx
\]
```

will give

$$S_N = \sum_{j=1}^{N} a_j$$

$$\int_{x=0}^{\infty} e^{-x^2} dx$$

For fraction formating command `\frac`is used and always followed by two expressions that are enclosed in curly braces (the numerator and denominator). For example,

```
\[
  x=\frac{1+y}{1+2z^2}
\]
```

will produce

$$x = \frac{1+y}{1+2z^2}$$

In LaTeX , an n^{th} root is produced using `\sqrt[n]{expression}`.

Greek letters are produced in mathematics mode by preceding the name of the letter by a backslash. Thus to obtain the formula $A = \pi r^2$ one types `$A= \pi r^2 $` .

For a list of Greek letters and selected mathematical symbols, see Appendix B.

In math mode, the spaces in your source file are completely ignored by LaTeX , but you can use commands for horizontal spacing to improve appearance of the formulae. In the table below, the distance between the vertical bars indicate the amount of space, created in each case:

`||` gives	||
`|\,|` gives	||
`|\;|` gives	||
`|\quad|` gives	| |
`|\qquad|` gives	| |
`|\hspace{.5in}|` gives	| |
`|\hspace{6em}|` gives	| |

Text can be embedded in displayed equations (in LaTeX) by using `\mbox{embedded text}`. For example, one obtains

$$f(m) = 0 \text{ for all } m \in M$$

by typing

```
\[  f(m) = 0 \mbox{ for all } m \in M \]
```

Note the blank spaces before and after the words 'for all' in the above example. Had we typed

```
\[  f(m) = 0 \mbox{for all} m \in M \]
```

we would have obtained

$$f(m) = 0\text{for all}m \in M$$

Matrices and other arrays are produced in LaTeX using the `array` environment. Each row of the array must contain the same number of entries, separated by `&`. All rows except the last are terminated with `\\`.

Matrices are formed from arrays, which are enclosed within auto-sized braces, such as `\left(` and `\right)`.

```
\[ \left( \begin{array}{ccc}
a & b & c \\
d & e & f \\
g & h & i \end{array} \right)\]
```

gives

$$\left(\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right)$$

We can use the array environment to produce formulae such as

$$|x| = \begin{cases} x, & x \geq 0; \\ -x, & x < 0. \end{cases}$$

by typing

```
\[ |x| = \left\{ \begin{array}{ll}
     x, & x \geq 0 ;\\
    -x, & x < 0.
   \end{array} \right \]
```

The large brace is produced using `\left\{`. However this requires a corresponding `\right` delimiter to match it. We therefore use the *null delimiter* `\right` instead of `\right}`.

5 Tables

There are two environments related to tables. The first, called `tabular`, produces the table and second, `table`, is used to give the table a caption and a possible key for cross-referencing.
The `tabular` environment has the form:

```
\begin{tabular}{format}
....
\end{tabular}
```

where format tells how many columns there are to be and whether they should be left justified, (l), centered, (c), or right justified, (r).

```
\begin{tabular}{lcr}
Name & Function & Range\\
\hline
Sine & $\sin  x$ & $[-1, 1]$\\
Gaussian & $\exp -x^2$ & $(0, 1]$\\
Unity & 1 & $[1]$\\
\end{tabular}
```

gives

Name	Function	Range
Sine	$\sin x$	$[-1, 1]$
Gaussian	$\exp -x^2$	$(0, 1]$
Unity	1	$[1]$

Notes:

1. `{lcr}` says left-justify the first column, centre the second and right-justify the third.
2. `&` separates the columns, `\\` ends the lines.
3. `\hline` puts a horizontal line right across the table.

4. To get vertical lines right down the table, change `{lcr}` into `{|l|c|r|}`.
5. Table is left justified on the page, to centre the whole table, enclose the `tabular` environment within `\begin{center}`... `\end{center}`.

Next, we place the table in the `table` environment and give it a caption and a key. By designing a key after the caption with `\label{mytable}` we can refer to this table anywhere in the document by `\ref{mytable}` at which point the table number will be automatically inserted, for example, talking about Table 1, below:

```
\begin{table}[h]
 \begin{center}
  \begin{tabular}{lcr}
   Name & Function & Range\\
   \hline
   Sine & $\sin  x$ & $[-1, 1]$\\
   Gaussian & $\exp -x^2$ & $(0, 1]$\\
   Unity & 1 & $[1]$
  \end{tabular}
  \caption{Table with a caption and a key}\label{tab:1}
 \end{center}
\end{table}
```

gives

Name	Function	Range
Sine	$\sin x$	$[-1, 1]$
Gaussian	$\exp -x^2$	$(0, 1]$
Unity	1	$[1]$

Table 1: Table with a caption and a key

An optional argument `[h]` tells LaTeX that you wish the table to appear here (where it has been typed in); other options are `[t]` for top of the page, `[b]` for the bottom of page, and `[p]` which puts table on the separate page. It is possible to include more then one location specifier; `\begin{table}[thb]` tells LaTeX that our preferences are `t`, `h`, and `b`, in that order. To make the caption appear above the table instead of below, place the caption `\caption` command immediately after the `\begin{table}` command.

6 Figures

You may want to display pictures, such as function plots or digitilized photographs, that have been generated with some other computer packages. This can usually be done with the `\includegraphics` command. In this case, the `epsfig` package must be loaded with the dvips option; that is:

```
\usepackage{epsfig}
```

must appear in the preamble.

Where you want a file with image called `'figure.eps'` to appear, use the `\includegraphics` command, possibly with scaling or rotation options, e.g.,

```
\includegraphics{figure.eps}
\includegraphics[width=60mm]{figure.eps}
\includegraphics[height=60mm]{figure.eps}
\includegraphics[scale=0.75]{figure.eps}
\includegraphics[angle=45,width=52mm]{figure.eps}
```

The following defines `figure` environment:

```
\begin{figure}[htbp]
\begin{center}
\includegraphics[width=0.75\textwidth,height=0.15\textheight]{figure.eps}
\caption{A simple figure.}
\label{fig1}
\end{center}
\end{figure}
```

The options [htbp] stand for 'here', 'top of current page', bottom of current page' and 'on a separate page' respectively. LaTeX will try to do the first one first; if it can't, it will try the second and so on.

With the above code, this is what you get:

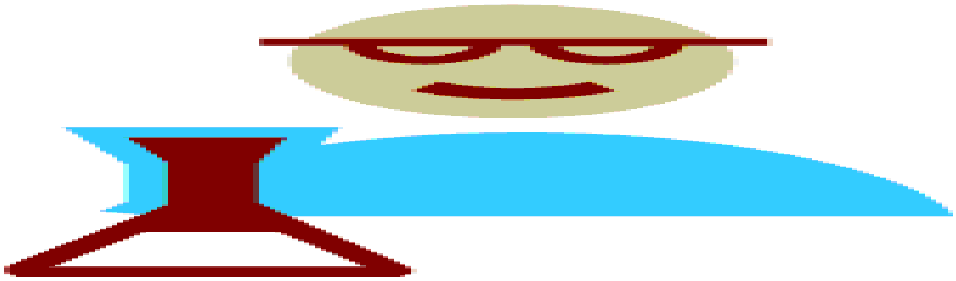
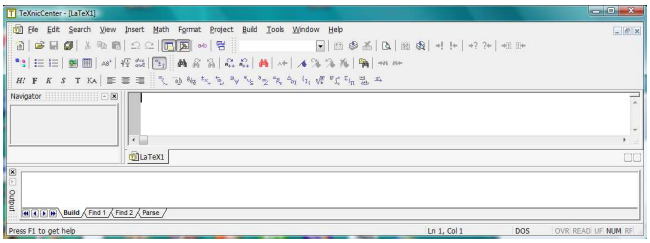


Figure 1: A simple figure.

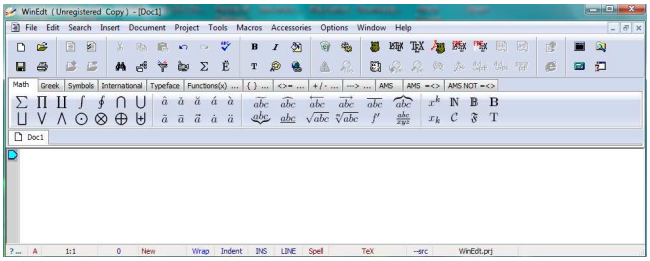
The End

That's about it; good luck!

If you would like to install free LaTeX related software on your home PC or laptop, I would recommend `proTeXt`, which aims to be an easy-to-install distribution for Windows, based on `MiKTeX`, and most important- is free. After downloading, it guides the installation via a short `pdf` document, which provides clickable links to install the various components, along with explanations. Download available at http://www.tug.org/protext/.



Another alternative is WinEdt, which involves a more complicated instalation procedure and the software is a shareware- licence for students costs 30$: `http://www.winedt.com/`.



7 Exercises

1. Make a small report in LaTeX.
   - Define your own title and author name.
   - Make some text boldface, and change the font size of some text.
   - Make a table of contents.
2. Using `\itemize` environment, make your shopping list.
3. Make following table:

n	$n!$
1	1
2	2
3	6
4	24
5	120
6	720
7	5040
8	40320
9	362880
10	3628800

4. Typeset following formulas:

   (a)
   $$\frac{1}{1+\frac{1}{2+\frac{1}{3+x}}}+\frac{1}{1+\frac{1}{2+\frac{1}{3+x}}}$$

   (b)
   $$\begin{aligned} e^x &\approx 1+x+x^2/2!+ \\ &\quad +x^3/3!+x^4/4!+ \\ &\quad +x^5/5! \end{aligned}$$

   (c)
   $$\begin{vmatrix} F''_{xx} & F''_{xy} & F'_x \\ F''_{yx} & F''_{yy} & F'_y \\ F'_x & F'_y & 0 \end{vmatrix} = 0$$

(d)

$$\sqrt[3]{q+\sqrt{q^2-p^3}}+\sqrt[3]{q-\sqrt{q^2-p^3}}$$

(e)

$$\int_{x^2+y^2\leq R^2} f(x,y)\,dx\,dy = \int_{\theta=0}^{2\pi}\int_{r=0}^{R} f(r\cos\theta, r\sin\theta) r\,dr\,d\theta.$$

A More complex LaTeX file

Here is an example of a more complex LaTeX input file:

```
\documentclass[12pt]{article}
  \usepackage[...]{...}
  \newcommand{...}{...}
  \newtheorem{...}{...}
  \makeindex
\begin{document}
  \titel{...}
  \author{...}
  \date{...}
  \maketitle
  \tableofcontest
  \begin{abstract}
     . . .
  \end{abstract}
  \section{Section one}\label{sec:1}
     . . .
  \appendix
  \section{Appendix one}{\label{app:1}
     . . .
  \begin{thebibliography}
    \bibitem{...}
       . . .
  \end{thebibliohraphy}
  \printindex
\end{document}
```

B Mathematical Symbols

Greek letters:

α	\alpha	θ	\theta	o	o	τ	\tau
β	\beta	ϑ	\vartheta	π	\pi	υ	\upsilon
γ	\gamma	γ	\gamma	ϖ	\varpi	ϕ	\phi
δ	\delta	κ	\kappa	ρ	\rho	φ	\varphi
ϵ	\epsilon	λ	\lambda	ϱ	\varrho	χ	\chi
ε	\varepsilon	μ	\mu	σ	\sigma	ψ	\sigma
ζ	\zeta	ν	\nu	ς	\varsigma	ω	\omega
η	\eta	ξ	\xi				
Γ	\Gamma	Λ	\Lambda	Σ	\Sigma	Ψ	\Psi
Δ	\Delta	Ξ	\Xi	Υ	\Upsilon	Ω	\Omega
Θ	\Theta	Π	\Pi	Φ	\Phi		

Mathematical symbols:

$\sum$	\sum	$\bigcap$	\bigcap	$\bigodot$	\bigodot	$\prod$	\prod
$\bigcup$	\bigcup	$\bigotimes$	\bigotimes	$\coprod$	\coprod	$\bigsqcup$	\bigsqcup
$\bigoplus$	\bigoplus	$\int$	\int	$\bigvee$	\bigvee	$\biguplus$	\biguplus
$\oint$	\oint	$\bigwedge$	\bigwedge				
$\pm$	\pm	$\cap$	\cap	$\diamond$	\diamond	$\oplus$	\oplus
$\mp$	\mp	$\cup$	\cup	$\bigtriangleup$	\bigtriangleup	$\ominus$	\ominus
$\times$	\times	$\uplus$	\uplus	$\bigtriangledown$	\bigtriangledown	$\otimes$	\otimes
$\div$	\div	$\sqcap$	\sqcap	$\triangleleft$	\triangleleft	$\oslash$	\oslash
$*$	\ast	$\sqcup$	\sqcup	$\triangleright$	\triangleright	$\odot$	\odot
$\star$	\star	$\vee$	\vee	$\bigcirc$	\bigcirc	$\circ$	\circ
$\wedge$	\wedge	$\dagger$	\dagger	$\setminus$	\setminus	$\ddagger$	\ddagger
$\cdot$	\cdot	$\wr$	\wr	$\amalg$	\amalg		
$\leq$	\leq	$\geq$	\geq	$\equiv$	\equiv	$\models$	\models
$\prec$	\prec	$\succ$	\succ	$\sim$	\sim	$\perp$	\perp
$\preceq$	\preceq	$\succeq$	\succeq	$\simeq$	\simeq	$\mid$	\mid
$\ll$	\ll	$\gg$	\gg	$\asymp$	\asymp	$\parallel$	\parallel
$\subset$	\subset	$\supset$	\supset	$\approx$	\supset	$\bowtie$	\bowtie
$\subseteq$	\subseteq	$\supseteq$	\supseteq	$\cong$	\cong	$\neq$	\neq
$\smile$	\smile	$\sqsubseteq$	\sqsubseteq	$\sqsupseteq$	\sqsupseteq	$\doteq$	\doteq
$\frown$	\frown	$\in$	\in	$\ni$	\ni	$\propto$	\propto
$\vdash$	\vdash	$\dashv$	\dashv	$<$	<	$>$	>
$\ldots$	\ldots	$\cdots$	\cdots	∂	\partial	∞	\infty