First Steps in LaTeX

B. Piette

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1 Introduction

The aim of the LaTeXpractical is to get you familiar with the LaTeX basics which you will need during this term but also in later years. Aside from this problem sheet, you have also been given a `model_sheet.pdf` which you will have to clone. The file `fig1.pdf` is a file that you will insert in the document.

2 Getting Started

To write a LaTeXdocument, you must start a LaTeX editor such as **TeXworks** or **Tex Studio** and open a new document. The best and simpler option is probably to use the cloud solution `www.overleaf.com`.

2.1 Overleaf

You can start overleaf from a University computer as an AppHub application or by opening `www.overleaf.com` in any web browser. You should login using your University credentials.

To get started,

- Select `New Project` and then `Blank Project`.
- Upload the file `fig1.pdf` in Overleaf (you will need it later).

3 The Preamble

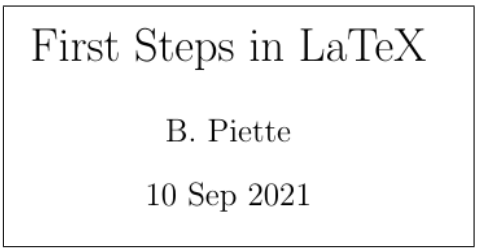
The first step in creating a word document is to write a preamble to tell LaTeX which type of document we want to write. One can create, reports, letters, articles or even book. For this session we will write an article.

Create a new latex document and enter the following text:

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

\author{B. Piette}
\date{10 Sep 2021}
\title{First Steps in \LaTeX}

\begin{document}
\maketitle

\end{document}
\vspace{5mm}
```

You should obviously replace the name with yours and update the date.

Once you have done so, save the file and *compile* the LaTeX document (the green arrow on the menu bar). The compiled file should then be shown in a separate window and look like the following:



This is just the title of the article. Notice the command `\maketitle` just below `\begin{document}` : this is what creates the title from the data defined above.

From now on any text we write will be inserted between `\maketitle` and `\end{document}` .

4 Plain text

Next we would like to type some plain text but also start a new section. A section is simply started with the command `\section{THE SECTION TITLE}` . Insert that command with the same title as on the model `pdf` file. Then add the first line of plain text. (Ignore the `[1]` for now as we will deal with it later).

You can then recompile the document and the following should appear below the title:

> **1 Plain text**
>
> Plain text is easy, we just enter it the way would normally.

5 Plain text with maths

We can also insert mathematical expressions inside some text. For example $\sqrt{a+b}$ is simply obtained using `$\sqrt{a+b}$` while a^2 is obtained using `$a^2$` .

Before we do this, we also create a sub section. This can be done with `\subsection{THE SUBSECTION TITLE}` .

Use this to clone what is on the model `pdf` file and recompile the document. The following should be added below the first section:

> **1.1 Maths in plain text**
>
> We can also include some maths in plain text, like this: $d = \sqrt{x^2 + y^2}$.

Notice that the section have been automatically numbered.

6 Equations

We will now typeset some equations on separate lines. This allows for larger expression to be written.

The equation

$$a = b \tag{1}$$

is obtained simply with the following commands:

```
1 \begin{equation}
2   a = b
3   \label{eq:aequalsb}
4 \end{equation}
```

The keywords \begin{equation} and \end{equation} start and end an equation. (Do not include $ inside such equations!) The equation is automatically given a number and, thanks to using the \label{eq:aequalsb} command, which has given it a name, we can refer to its number, (1), using (\ref{eq:aequalsb}) . You will notice that you will have to compile the document twice before the equation number is correctly inserted. If we insert other equations above this one later, the number will be automatically updated (try to do this in word!!).

To clone the equation on the model file, you also need to know the following:

- A fraction is simply obtained using \frac{NUMERATOR}{DENOMINATOR}
- Greeks letters are given by \LETTER_NAME , so α is obtained from \alpha . Note that this only works in mathematical expressions.
- A subscript is obtained using the underscore character so x_i is obtained using x_i (again, this only works in mathematical expressions).

You are now ready to clone the first equation from the model sheet and this should add the following to your document:

2 Equations

Larger equations are usually put on separated lines

$$M\frac{d^2x}{dt^2} = k(x_0 - x) - \Gamma\frac{dx}{dt}, \tag{1}$$

where equation (1) is nothing but Newton's equation for a damped oscillator.

To be able to typeset the second equation you only need to know that the symbol for partial derivative, ∂ is simply \partial . Remember to use a label for your equation so that you can refer to it as well.

We can also used partial differential operators

$$\frac{\partial\phi}{\partial t} = K\frac{\partial^2 x}{\partial x^2}. \tag{2}$$

Equation (2) is called the diffusion equation.

Notice that the first sentence is indented. This is because we have inserted a blank line before that sentence, hence starting a new paragraph.

Sometimes it is useful to align equations, usually around the equal sign. There are different ways to do this but the simplest one is as follows:

- Replace the keyword `equation` by `eqnarray` in the `\begin{equation}` and `\end{equation}` .
- Instead of `=` use `&=&` on both lines
- End of the first line with `\nonumber \\` where `\nonumber` tells LaTeX not to number the first line of the equation and the double `\` specifies where the line ends.

You can align any number of lines and you can have expression on both sides of the equal sign is you wish to.

When using special functions like the trigonometric function, one should typeset using a Roman font rather than a slanted one.. This is done by preceding the name of the function with a backslash. So $\sin(\theta)$ is obtained using `\sin(\theta)` .

You can now clone the 3 equation from the model sheet and add the following to your document:

We can also allign 2 or more equations on their equal signs:

$$\begin{aligned}(\sin(\theta)+\cos(\theta))^2 &= \sin^2(\theta)+\cos^2(\theta))+2\sin(\theta)+\cos(\theta)\\ &= 1+2\sin(\theta)\cos(\theta) \qquad (3)\end{aligned}$$

7 Figures

Figures are quite easy to to obtain. First of all, make sure that the file `fig1.pdf` is in the same folder as your LaTeX document, or, if you are using overleaf , that you have uploaded `fig1.pdf`.

Figures are inserted in the LaTeXdocument as followes:

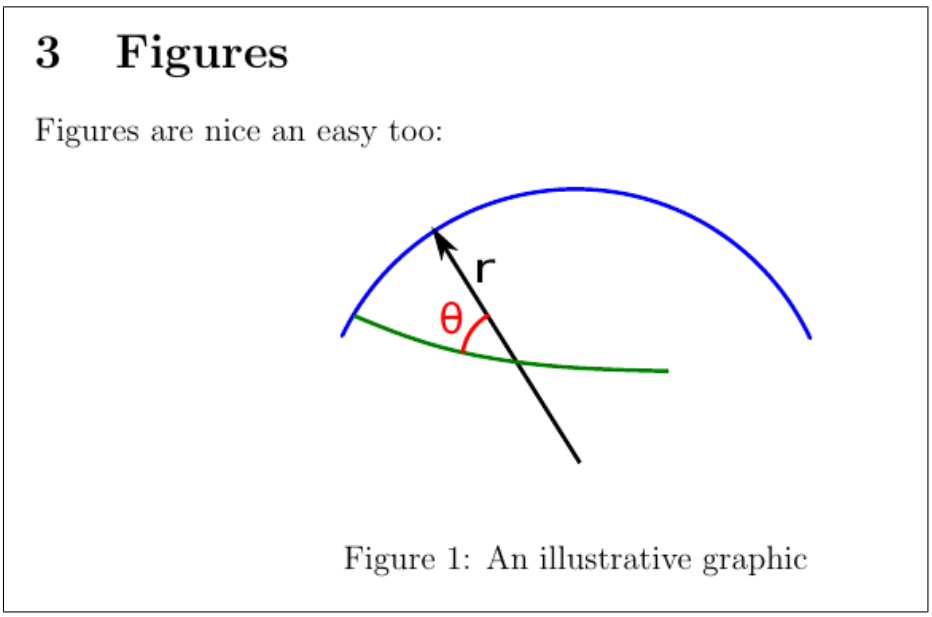
```
\begin{figure}[h!]
  \begin{center}
    \includegraphics[width=SIZE]{FILENAME}
  \end{center}
  \caption{YOUR CAPTION}
\end{figure}
```

where:

- `SIZE` is the size you want the figure to be on the document. It can be specified in `mm` or `cm` . Use `60mm` to clone the model sheet.

- `FILENAME` is the name of the file, `fig1.pdf` as this is the file we have provided. If must be in the same folder as the LaTeXdocument but a path can be specified if it is not.
- `[h!]` next to `\begin{figure}` tells LaTeX that you want the figure to be where you have placed it in your LaTeX file. It is usually what we want, but LaTeX often move it elsewhere, often at the very end of the document.

You should now easily continue editing your document and add the following to it:



8 Tables

Tables are a bit fiddly to do.

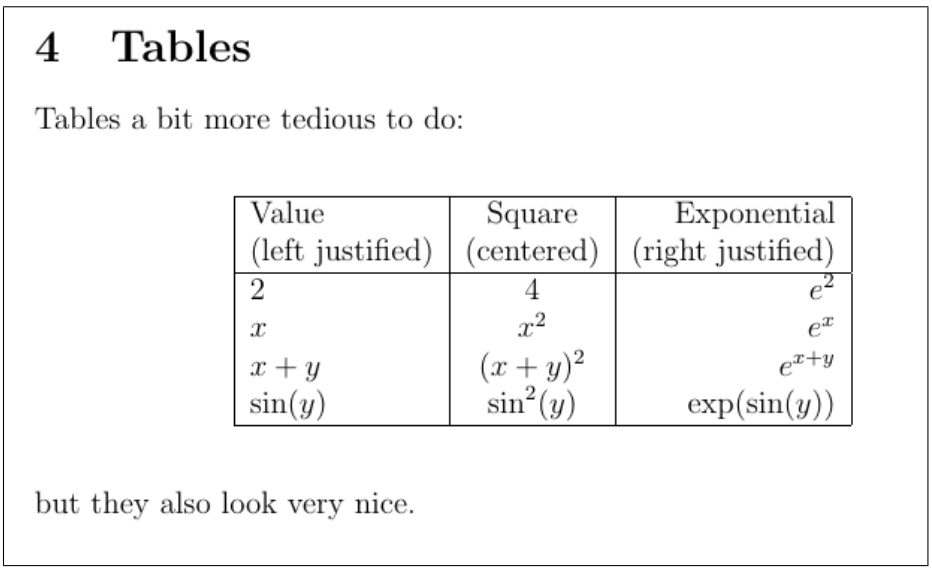
HEADER1	HEADER2
VAL11	VAL12
VAL21	VAL22

The table above was obtained with the following code:

```
\begin{center}
\begin{tabular}{|l|r|}
\hline
  HEADER1 & HEADER2 \\
\hline
  VAL11 & VAL12 \\
  VAL21 & VAL22 \\
\hline
\end{tabular}
\end{center}
```

Notice that `{|l|r|}` specifies the number of columns (2 in this example as well as how the columns are justified `l` for left justified, `c` for centred, `r` for right justified. The vertical bars specifies where the vertical bars between column will be, if any. `\hline` draws horizontal lines.

With this knowledge you can now clone the table from the model sheet:



4 Tables

Tables a bit more tedious to do:

Value (left justified)	Square (centered)	Exponential (right justified)
2	4	e^2
x	x^2	e^x
$x+y$	$(x+y)^2$	e^{x+y}
$\sin(y)$	$\sin^2(y)$	$\exp(\sin(y))$

but they also look very nice.

9 References

The first line of the text reads `Plain text is easy [1]` where the `[1]` stands for a citation. To add this, add the following after the word `easy`:

```
\cite{Lamport1994}
```

Then add the following lines just before the line `\end{document}`:

```
1 \begin{thebibliography}{99}
2
3 \bibitem{Lamport1994}
4 Leslie Lamport
5 {\it LaTeX: A Document Preparation System}
6 (1994) Addison-Wesley
7
8 \end{thebibliography}
```

Notice that you can add as many `\bibitem` entries below line 6 should you have more than one.

10 Conclusions

You have done very well if you have managed to get this far. We would like to add that figures, tables as well as sections can all be given labels as and be referred to by name rather than numbers, exactly like the equations. This make editing a document much much simpler as it saves you to track how the numbers of different items are changing as you add or remove from your document.

One can do much more in LaTeX that what we have described here. To find out how to typeset specific objects or expressions, simply do a google search.