Researcher Development Unit: Introduction to Latex

Dr Morgiane Richard
Oana Matei, Florin Nedelea, Jaroslaw Dymiter

m.richard@abdn.ac.uk
Centre for Academic Development

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UNIVERSITY OF
ABERDEEN

Outline

What is LaTeX?

- LaTeX is a package based on the TeX programming language

- It is used to write documents (including presentations)

- You write a .tex file, which you compile to produce the output (.pdf or .dvi file)

- We will use Texworks to write and compile our .tex files

- Other available pieces of software are TexMaker, LyX (higher level)

Pros and Cons

- Steep learning curve, particularly for those who have no programming background

- You can not see immediately your output

- Editing the document is difficult for multi-author documents

However:

- Access to formatting commands helps keeping the formatting consistent throughout the document

- Large documents can be managed more easily

- Mathematics writing is very neat

- .pdf output is cross-platform and prints consistently

Preamble

A LaTeX document consists in **a preamble** and **a document environment**.

In the preamble, you indicate, in the following order:

1. the type of document you are writing: \documentclass[*options*]{*type of document*} (this is MANDATORY!);

2. packages needed for the document: \usepackage[*options*]{*name of package*} (will almost always be needed);

3. new or renewed commands (optionnal; not covered today).

Within the document environment, you write your text!

Document Classes

Most common document classes are:

- **article**

- **book** (for bigger documents)

- **letter**

- **beamer** (for presentations).

Classes may differ in their organisation (section numbering).

Document Classes

Common options are:

- Font size: 10pt, 11pt, 12pt;

- Paper size: a4paper usually;

- Number of columns: onecolumn, twocolumn;

- Landscape printout: landscape.

You do not have to put options. If you put several options, you must add them all between the square brackets and separate them by commas.

\documentclass[12pt, a4paper]{article}

Packages

There are VERY MANY packages, but here are a few you are likely to need:

- amsmath: for writing maths;

- graphicx: for importing graphics;

- xcolor: for writing in color;

- fancyhdr (for thesis in particular): for managing headers and footers.

Packages

There are all included in the same way:

\usepackage[*options*]{*name of package*}.

\usepackage{amsmath}

A couple of tips:

An easy way to alter default margins: \usepackage[scale=*number*]{ geometry }where **scale** will be a number between 0 and 1.

To stop the default indentation of paragraph: \usepackage{parskip}

Documentation on these packages (including available options) is available on the CTAN website. The order in which you include packages may be important (order as above is best).

Document Environment

The document environment is created as follows:

\begin{document}

blablabla

\end{document} - this should be the last line of your file!

In fact, all environments are created in a similar fashion.

Creating a LaTeX Document

To create a new LaTeX file:

- Go the the folder 'All Disciplines\Mathematical Sciences';

- Open Texworks and choose 'File - New';

- Saving your work on your H-drive or memory stick is best;

- Whenever you make changes to your .tex file, re-run the file by clicking the green arrow at the top-left;

- You may want to change the font, line number and syntax colouring in TexWorks (under Format menu).

Creating a LaTeX Documents

It is best to locate your .tex file in a folder: LaTeX produces many intermediate files during compilation. These files contain various types of information, used for referencing in particular.

Compilation errors will usually be explained in the bottom window. alongside the error line.

To add the line number in the .tex file: Format - Line Numbers.

To add colouring to the .tex file: Format - Syntax Coloring - LaTeX.

Exercise

Exercise 1:

Create a small LaTeX document. You will create a .tex file which should look like this:

\documentclass[12pt]{article}

\usepackage{amsmath}

\begin{document}

Hello World!

\end{document}

To generate a .pdf file, you need to click the green arrow in order to compile the .tex file.

Text Formatting

Some useful formatting commands:

- *Italic*: \textit{*your text*};

- **Bold**: \textbf{*your text*};

- changing the color :

  \textcolor{*name of the colour*} {*your text*};

  (defaut colour names are: white, black, red, green, blue, yellow, magenta, cyan)

- To force a new line: \\;

- To start a new paragraph: skip a line in the code;

- To alter the linespacing \linespread{*some factor*}

Text Formatting

The itemize environment allows you to create a list (like this one):

\begin{itemize}

\item *your first bullet point*;

\item *your second bullet point*;

\end{itemize}

The enumerate environment works in the same way and creates a numbered list.

Creating a Title

To write the title of your documents, you need the following lines of code:

\title{*your title*}

\date{*the date*}

\author{*your name and any other*}

\maketitle

Sections

To start a section (or subsection):

\section (or \subsection){*your section title*}.

The numbering is done automatically.

If you do not want your sections to be numbered, use the starred version: \section*{*your section title*}.

You can generate a table of content automatically with the command (usually just below the \begin{document} command):

\tableofcontents

Exercise

Exercise 2:

Modify your .tex file by adding a title, sections, and using different formatting to your text to produce an output similar to **Example2.pdf**.

You may want to save you .tex file under a different name.

Remember that whenever you make alterations to your .tex file you need to compile it (click the green arrow).

To make comments, you can start a line with the command:

%

Inserting Figures

To insert a figure saved as an image file, you need to use the following command:

\includegraphics[*some attributes*]{*name of the file*}

This requires to include the graphicx package.

Some of the common attributes are:

- width and height:

  \includegraphics[width=3cm, height=4cm]{*file name*}

  the length can be in cm, mm, pt;

- scale: \includegraphics[scale=0.5]{ };

- angle: \includegraphics[angle=90]{ }

Image files can be .eps, .jpg, .png or .pdf.

Inserting Figures

However, inserting figures in this way has very limited flexibility....

Include the command within a 'figure' environment:

\begin{figure}[*placement spec*]

\includegraphics[width=. . .]{figure.eps}

\end{figure}

If you want the figure to be centered, add the command \centering before the includegraphics command.

\begin{figure}[*placement spec*]

\centering

\includegraphics[width=. . .]{figure.eps}

\end{figure}

Inserting Figures

The placement specifiers are:

Specifier	Effect
t	places the float at the top of the page
b	places the float at the bottom of the page
p	places the float on a special float page
h	places the float at the point where the source code appears (or approximately)
!	overrides internal LaTeX rules for good positioning of floats
H	places the float precisely at this point (requires the 'float' package). This is useful in multicolumn documents.

Exercise

Exercise 3:

Insert a figure to your LaTeX document. You can use the figures in the Figures folder or choose one of your own.

Note: if your .tex file and your figure are not in the same folder, you must indicate the path to the figure in the includegraphics command:

\includegraphics[width=8cm]{Figures/figure1.jpg}

Inserting Tables

To create a table, you need the tabular environment:

\begin{tabular} {*column spec*}

First row: first item & *second item* & ... \\

Second row: first item & *second item* & ... \\

etc ...

\end{tabular}

There must be as many column specifiers as there are columns in the table, all added within the same pair of curly brackets.

Inserting Tables

Specifier	Effect
l	creates a left-justified column
c	creates a centered column
r	creates a right-justified column
p{some width}	creates a column of specified width with text aligned at the top

Inserting Tables

Again, things become a lot more flexible if you embed your table in a float environment, i.e. a table environment in this case:

\begin{table}[*placement spec*]

\begin{tabular} {*column spec*}

etc ...

\end{tabular}

\end{table}

Exercises

Exercise 4:

Insert a table to your LaTeX document.

You can add horizontal lines with the command \hline and vertical lines with the | character between column specifiers.

Captions

You can include a caption in a float with the command

\caption[*short*]{*long*},

where *short* appears in the list of figures (or tables) and *long* appears beside the float in the document.

The *short* option is optional.

The list of figures and list of tables can be generated automatically with the commands (usually just below the \begin{document} command):

\listoffigures

\listoftables

Labels

It is also possible to create labels to reference floats. Referencing is done as following in LaTeX:

Insert: \label{*marker*} in the float, where *marker* is a marker (name) you are giving your float. The best is to insert the command in the caption command or after.

In the text, you call the float number in this way: 'Figure $\sim$\ref{*marker*} ...'. The $\sim$ sign creates a space before the reference number.

In fact, you may reference any numbered object within your document (float, section, equation ...)

Exercise

Exercise 5:

Add a caption to your table.

Add a label to your table and try referencing to it in your text.

Writing Mathematics

LaTeX is most useful to write mathematical text.

The mathematics command can be used within a math environment, which may be either inline (within the normal text) or displayed (starting a new paragraph).

inline math	displayed math
\begin{math}...\end{math}	\begin{displaymath}... \end{displaymath}
\(...\)	\[...\]
$...$	$$...$$ (to avoid)

Writing Mathematics

To get numbered equations in displayed mode, use the 'equation' environment:

\begin{equation}...\end{equation}.

Maths Symbols

There are VERY MANY symbols available in the math environment, and there is a Comprehensive List of LaTeX Symbols.

Here are a few common ones:

- Greek letters:

  lowercase greek symbols are written $\name$ and uppercase $\Name$

  Example: μ, Φ

- Subscript and upperscript:

  $\_symbol$ and $\^symbol$

  If your symbol has more than one character you need to include them in curly brackets.

  Example: 10^3, C_6^{14}

Maths Symbols

- Square root: $\sqrt{number}$

  Example: $\sqrt{49}$

- fractions: $\frac{top\ number}{bottom\ number}$

  or $\dfrac{top\ number}{bottom\ number}$

  Example: $\dfrac{6}{13}$

- Integration $\int$ ($\int$)

- Sum (sigma symbol) $\sum$ ($\sum$)

- Trigonometric functions: $\cos$, $\sin$, $\tan$, $\cotan$

Exercise

Exercise 6:

Try writing the first equation appearing in **Example5.pdf**.

Matrices

There are several environments to write matrices:

- \begin{matrix} .... \end{matrix} creates a matrix with no delimiter;

- \begin{pmatrix} .... \end{pmatrix} creates a matrix within brackets;

- \begin{Bmatrix} .... \end{Bmatrix} creates a matrix within curly brackets.

Matrices

These environments require a displayed maths environment. The layout is similar to a table environment:

\[\begin{pmatrix}

first row: first element & *second element* & etc... \\

second row: first element & *second element* & etc... \\

⋮

\end{pmatrix} \]

The commands \vdots: ⋮ \dots: . . . and \ddots: ⋱ may be useful.

Exercise

Exercise 7:

Try writing matrices as in **Example5.pdf**.

Systems of Equations

For writing systems of equations, or a series of equations, you can use the align environment.

If you want none of the equations to be numbered, you can use the starred version: \begin{align*} ... \end{align*}, and if some of the equations should not be numbered, then add the command \nonumber at the end of the corresponding line.

Each line of equation is ended by a double back-slash (\\) and equations will be align at the position of the commercial-and (&)

\begin{align}

y &= $x^2 - 2x + 1$ \\

& = $(x - 1)^2$ \nonumber

\end{align}

Exercises

Exercise 8:

Try writing a system of equations as in **Example5.pdf**.

Spaces in Maths Environment

There are usually no space in the maths environment, and to force one you can use either of the following commands:

command	effect
\quad	space equal to font size
\,	space equal to 3/18 of a quad
\:	space equal to 4/18 of a quad
\;	space equal to 5/18 of a quad

To insert some text within the mathematics environment, you can use the command \text{*your text*}.

Bibliography

The most straightfoward way to make a bibliography in latex is to create an embedded bibliography with the bibliography environment which you insert just before the \end{document} (if this is were you want it to appear).

Each item is created with the command \bibitem{*marker*} and in the text, you can refer to the particular item with the command \cite{*marker*}. This produces a numbered citation style.

\begin{thebibliography} {*num*}

\bibitem{*marker*} *Author, Title, ed., ... , Year.*

\end{thebibliography}

num is a numerical key which is usually 9 or 99 (indicates the order of magnitude of the number of items in the bibliography).

Using BibTex

Another way to create a bibliography is to use BibTex, which requires that references are stored in a .bib file.

This file may be generated from some bibliography softwares (EndNote, RefWorks): items are written in a very particular synthax.

At the end of the document, you should write the following commands:

\bibliography{*your bib file name*}: this indicates the name of your .bib file

\bibliographystyle{*some style*} somewhere before the \bibliography command: this indicates the formatting style for the reference list.

Many journals will provide their bibliography style and Latex provide a few default as well ('plain' for instance).

Using BibTex

Many more bibliography styles are available if you include the natbib package: discuss with your supervisor which is appropriate.

\usepackage{natbib}

natbib also allows for different citation styles (i.e author-date):

- \citet{nameXX} to produce a citation as Author (Year)

- \citep{nameXX} to produce a citation as (Author, date)

Using BibTex

When using a .bib file to store your bibliography, you need to:

- compile the .tex file ('PDFLaTeX' compilation)

- then compile the .bib file ('BibTeX' compilation)

- then compile the .tex file a second time.

You will need to do all this whenever you are modifying your .bib file and/or your references in the text. This allows for all bibliographic items and references to be refreshed.

Splitting Your .tex File

For big documents such as a thesis, it may be handy to break the document on different .tex files, e.g. write each chapter on a particular .tex file.

In this case, you can write a top-level document which will contain the preamble and the document environment, and use the \include command:

\documentclass[*options*]{*your class*}

your packages

\begin{document}

\include{*your chapter file name*}

\end{document}

Include versus Input

The command \include{*file name*} cannot be nested and forces a new page before and after the document. You can use the \includeonly command in the preamble to compile part of your document only.

If you want to nest files, or if you do not wish you .tex file to start on a new page, use \input{*file name*}.

Either command will keep consistent numbering.

Only the top-level document contains the preamble. In the subsequent documents, you must start your text directly, e.g.:

\section{First Chapter}

This is my first chapter.

LATEX in Everyday Life

- For writing research papers: some journals provide a LATEX template and instructions (and you mostly have to fill in the blanks!)

- To write presentations, you can use the Beamer package

Softwares and Readings

There are many freely available LaTeX editors: TexMaker, TeXStudio, LyX.

A good place to start is the beginners' page of TUG.

The LaTeX Wikibook is an excellent resource for information on LaTeX.

The CTAN website has information on most (if not all) LaTeX packages.

There are also many forums of questions and answers about LaTeX, for instance, the Tex Stack Exchange.