An Introduction to LaTeX: Typesetting your Thesis or Research Paper

Part I: The Basics

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Doctoral School
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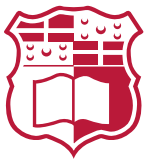
25th November, 2019



L-Università ta' Malta

Today's Plan

What is LaTeX?

- Pronounced lay-tek or lah-tek, NOT lay-teks!

TeX comes from the Greek word $\tau\acute{\varepsilon}\chi\nu\eta$, meaning skill/art/technique.

- A typesetting system: this means LaTeX worries about **typesetting**, so you shouldn't have to!

What is Typesetting?

Typesetting means worrying about what the document *looks* like. Any respectable publisher wants these things done right!

- Spacing and kerning between words/letters

AV Wa
No kerning
AV Wa
Kerning applied

- Ligatures

fi → fi
fl → fl
ct → ct

- Where titles are positioned, page numbering and ToC, etc.

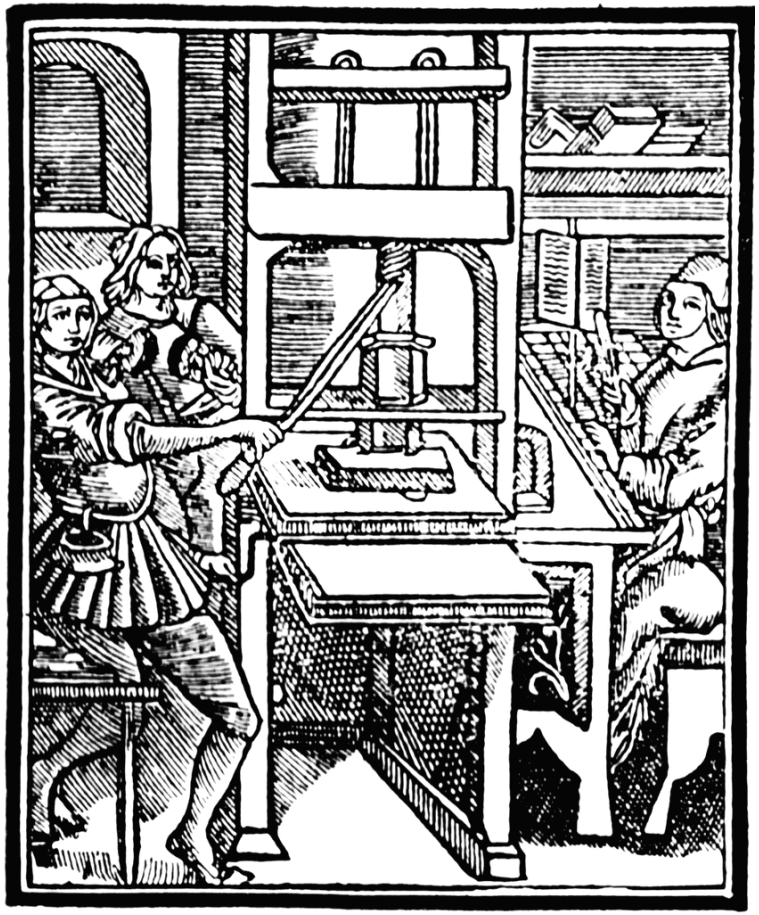


Figure: Gutenberg's press

TEXian Ontology

WYSWIG (read: wizy-wig), i.e., "what you see is what you get" editors, such as Libre Office Writer or Microsoft Word, are getting better at these things, but the typographical quality of the documents they produce is still inferior to LaTeX.

The *important* thing to understand though, is that LaTeX takes care of all this for you.

The philosophy:

> *LaTeX allows you to clearly separate the content from the format of your document. As a writer (scientist, researcher or not), this gives you the opportunity to focus on the "what", the creative part of your work, rather than the "how" is it going to look printed out in paper—that is LaTeX's job.*

Showcase

Here is a showcase of what people use LaTeX for:

On the Walks and Bipartite Double Coverings of Graphs with the same Main Eigenspace

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13th June, 2019

Abstract

The main eigenvalues of a graph G are those eigenvalues of the $(0,1)$-adjacency matrix $\mathbf{A}$ having a corresponding eigenvector not orthogonal to $\mathbf{j} = (1,\ldots,1)$. The CDC of a graph G is the direct product $G \times K_2$. The main eigenspace of $\mathbf{A}$ is generated by the principal main eigenvectors and is the same as the image of the walk matrix. A hierarchy of properties of pairs of graphs is established in view of their CDC's, walk matrices, main eigenvalues, eigenvectors and eigenspaces. We determine by algorithm that there are 32 pairs of non-isomorphic graphs on at most 8 vertices which have the same CDC.

Keywords: Eigenvalues, walks, walk matrix, main eigenspace, canonical (bipartite) double covering, TF-isomorphism.

1 Introduction

A graph of order n is a pair of sets $G = (\mathcal{V}, \mathcal{E})$ where $\mathcal{V} = \{1,\ldots,n\}$ is called the set of vertices, and $\mathcal{E} \subseteq \{\{u,v\} : u,v \in \mathcal{V} \text{ and } u \neq v\}$ is called the set of edges. (We consider graphs which are simple; that is, graphs which are undirected, without multiple edges or loops.) A k-walk in a graph G is a k-tuple $(u_0,u_1,\ldots,u_k) \in \mathcal{V}^{k+1}$ such that $\{u_{i-1},u_i\} \in \mathcal{E}$ for all $1 \leqslant i \leqslant k$.

The adjacency matrix of a graph G, denoted by $\mathbf{A}(G)$, or simply $\mathbf{A}$ where the context is clear, is the symmetric $n \times n$ matrix (a_{ij}), where $a_{ij} = 1$ if $\{i,j\} \in \mathcal{E}$, and $a_{ij} = 0$ otherwise. We use terminology for a graph G and its adjacency matrix $\mathbf{A}$ interchangeably, since the graph G is determined, up to relabelling of the vertices, by $\mathbf{A}$. For example, the eigenvalues and eigenvectors of a graph G are respectively those of the matrix $\mathbf{A}$. The spectrum $\mathrm{spec}(G)$ of a graph G is the multiset consisting of the s distinct eigenvalues

1

Figure: Research papers

Showcase

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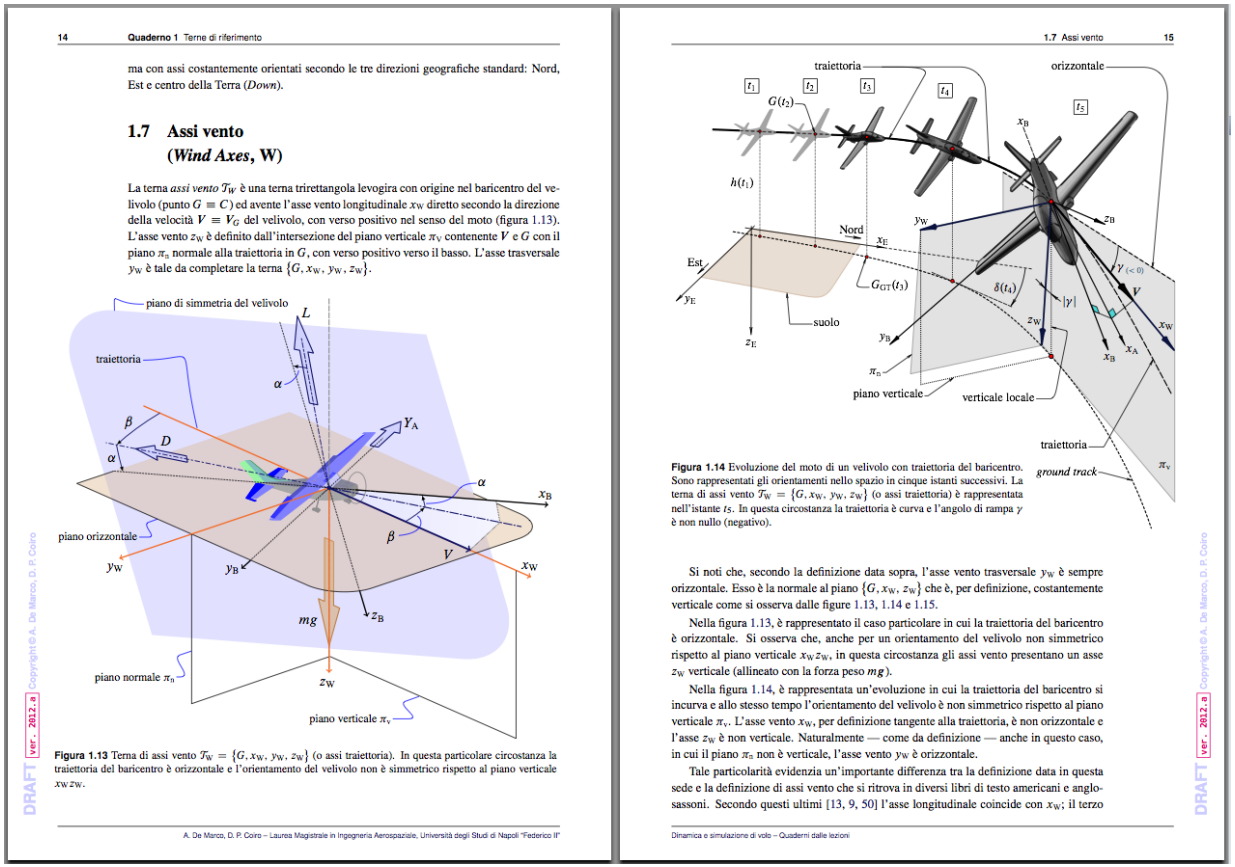

14 Quaderno 1 Terne di riferimento

ma con assi costantemente orientati secondo le tre direzioni geografiche standard: Nord, Est e centro della Terra (*Down*).

1.7 Assi vento (*Wind Axes*, W)

La terna *assi vento* $\mathcal{T}_W$ è una terna trirettangola levogira con origine nel baricentro del velivolo (punto $G \equiv C$) ed avente l'asse vento longitudinale x_W diretto secondo la direzione della velocità $V \equiv V_G$ del velivolo, con verso positivo nel senso del moto (figura 1.13). L'asse vento z_W è definito dall'intersezione del piano verticale π_V contenente V e G con il piano π_n normale alla traiettoria in G, con verso positivo verso il basso. L'asse trasversale y_W è tale da completare la terna $\{G, x_W, y_W, z_W\}$.

Figura 1.13 Terna di assi vento $\mathcal{T}_W = \{G, x_W, y_W, z_W\}$ (o assi traiettoria). In questa particolare circostanza la traiettoria del baricentro è orizzontale e l'orientamento del velivolo non è simmetrico rispetto al piano verticale $x_W z_W$.

Figura 1.14 Evoluzione del moto di un velivolo con traiettoria del baricentro. Sono rappresentati gli orientamenti nello spazio in cinque istanti successivi. La terna di assi vento $\mathcal{T}_W = \{G, x_W, y_W, z_W\}$ (o assi traiettoria) è rappresentata nell'istante t_5. In questa circostanza la traiettoria è curva e l'angolo di rampa γ è non nullo (negativo).

Si noti che, secondo la definizione data sopra, l'asse vento trasversale y_W è sempre orizzontale. Esso è la normale al piano $\{G, x_W, z_W\}$ che è, per definizione, costantemente verticale come si osserva dalle figure 1.13, 1.14 e 1.15.

Nella figura 1.13, è rappresentato il caso particolare in cui la traiettoria del baricentro è orizzontale. Si osserva che, anche per un orientamento del velivolo non simmetrico rispetto al piano verticale $x_W z_W$, in questa circostanza gli assi vento presentano un asse z_W verticale (allineato con la forza peso mg).

Nella figura 1.14, è rappresentata un'evoluzione in cui la traiettoria del baricentro si incurva e allo stesso tempo l'orientamento del velivolo è non simmetrico rispetto al piano verticale π_v. L'asse vento x_W, per definizione tangente alla traiettoria, è non orizzontale e l'asse z_W è non verticale. Naturalmente — come da definizione — anche in questo caso, in cui il piano π_n non è verticale, l'asse vento y_W è orizzontale.

Tale particolarità evidenzia un'importante differenza tra la definizione data in questa sede e la definizione di assi vento che si ritrova in diversi libri di testo americani e anglosassoni. Secondo questi ultimi [13, 9, 50] l'asse longitudinale coincide con x_W; il terzo

Figure: Notes and textbooks

Showcase

Here is a showcase of what people use LaTeX for:

Address
Viale Fulvio Testi, 62
20126, Milano, Italy

Tel & Skype
+39 329 7216527
neoben86

Mail
carmine.benedetto@gmail.com
carmine@carminebenedetto.net

Web & Git
carminebenedetto.net
bitbucket.org/neoben
github.com/neoben

Programming

OS Preference
GNU/Linux ★★★★★
Unix ★★★★☆
MacOS ★★☆☆☆
Windows ★☆☆☆☆

Personal Skills

CarmineBenedetto
Computer Engineer

Experience

02/13 - Now **Software Engineer** — Fluidmesh Networks SRL, Milano, Italy
Design and development of algorithms, solutions and high speed mobility schemes for Wireless Mesh Networks. Design and development of embedded software for Wireless Network devices.

01/12 - 01/13 **Freelance Developer & Consultant** — Icosaedro Solutions
Design and development of Android Applications, Web Solutions, Unix and GNU/Linux software.

12/09 - 06/09 **Project Manager and Webmaster** — D.I.D.A.G., Grassano (MT), Italy
Design, development and management of an e-commerce website on Joomla!1.5 CMS platform.

06/09 - 09/09 **Part-time collaboration** — Area Sistemi Informatici, Università di Pisa, Italy
Computer technical support. Problem solving related to hardware, software and Operating Systems. Management of the internal network.

06/09 - 09/09 **Internship** — Atitlan Engineering SRL, Pisa, Italy
Management and migration of servers. Development of web templates and interfaces. Management of SQL databases.

Education

2009 - 2012 **Master's Degree in Computer Engineering** — Università di Pisa, Italy
Curriculum Networking and Multimedia.
Main subjects: Network Applications, Systems Architecture and Security, Mobile Applications, Multemedia Information Processing.
Title of the Thesis: "A Handoff Algorithm based on Link Quality Prediction for Mass Transit Wireless Mesh Networks" .
Relators: Prof. Enzo Mingozzi, Ing. Carlo Vallati, Prof. Luciano Lenzini.

2005 - 2009 **Bachelor's Degree in Computer Engineering** — Università di Pisa, Italy
Main subjects: Matematics and Physics, Programming, Operational Research, Telecommunication Systems, Digital and Analogical Electronics.
Title of the Thesis: "Development, Management and Migrations of web contents and applications".
Thesis activity carried out during an internship period at Atitlan Engineering SRL.

2000 - 2005 **Scientific Diploma.** — Liceo Scientifico, Matera, Italy
Scientific Secondary School.
Main subjects: Matematics, Physics, Computer Science.

Certifications

02/2013 **Intro to Computer Science** — Udacity. E-learning
Building a Python Search Engine

Figure: Curriculum vitæ

Showcase

Here is a showcase of what people use LaTeX for:

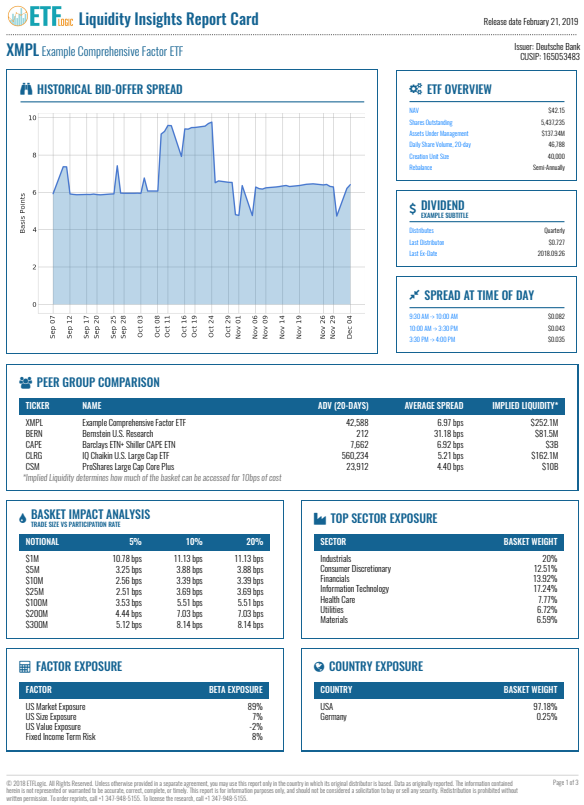

Figure: Statistical reports

Showcase

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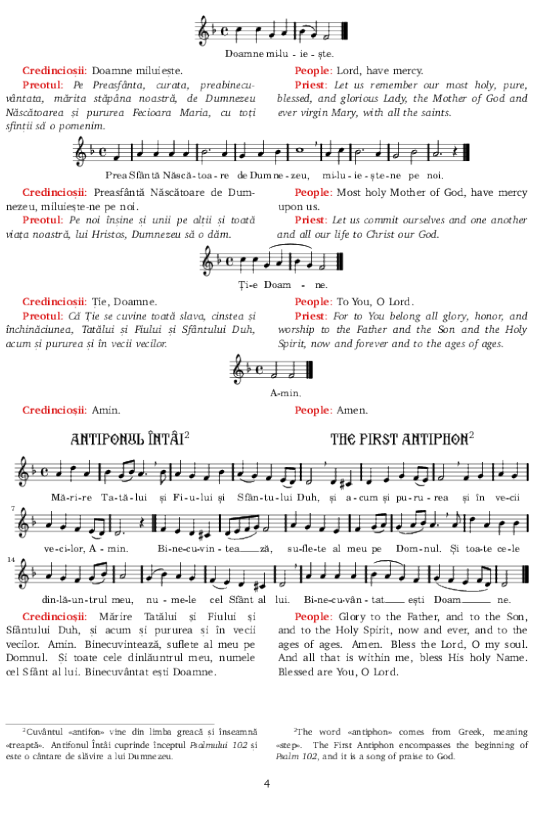


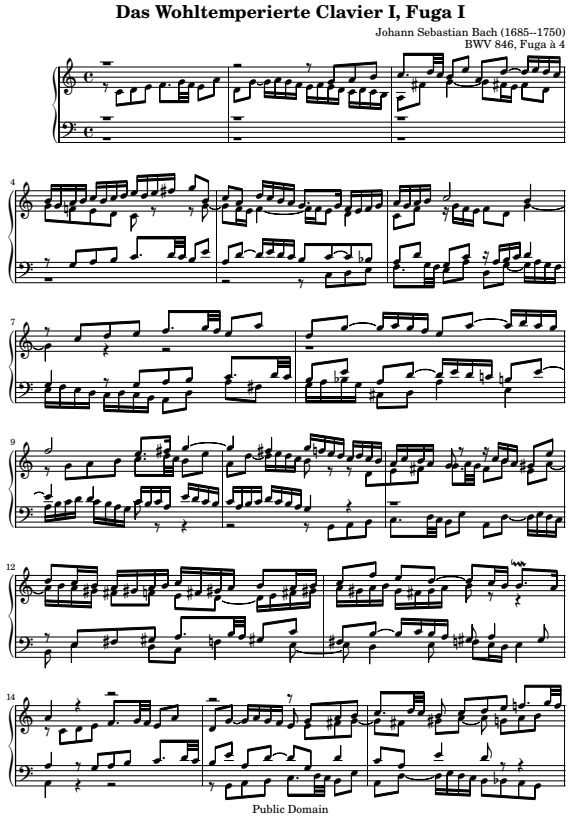


Figure: Musical typesetting

Showcase

Here is a showcase of what people use LaTeX for:

Figure: Magazines

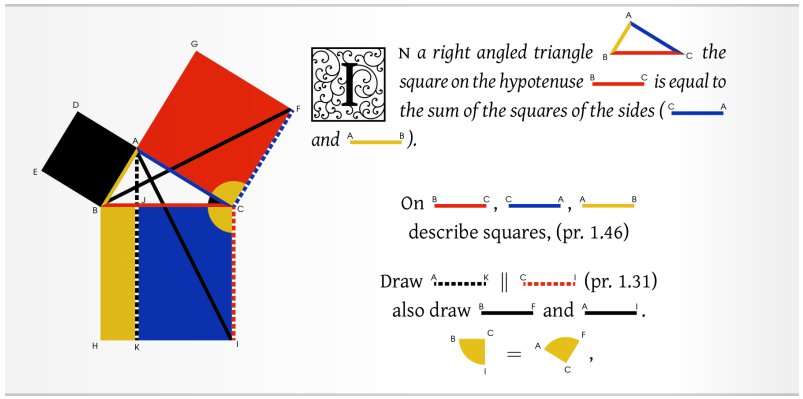
Showcase

Here is a showcase of what people use LaTeX for:

Le premier liure de Moyſe,
Dict Geneſe.

ARGVMENT.

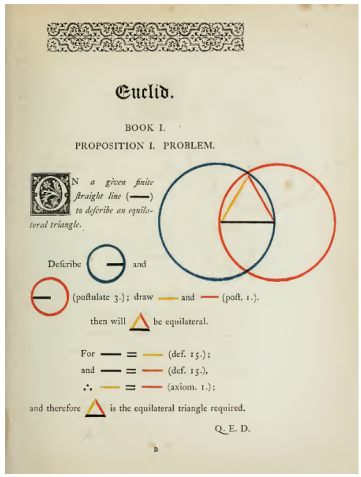
CHAPITRE I.



IN a right angled triangle the square on the hypotenuse is equal to the sum of the squares of the sides (and).

On , , , describe squares, (pr. 1.46)

Draw ‖ (pr. 1.31)
also draw and .



Euclid.

BOOK I.

PROPOSITION I. PROBLEM.

IN a given finite straight line to deſcribe an equilateral triangle.

Deſcribe and

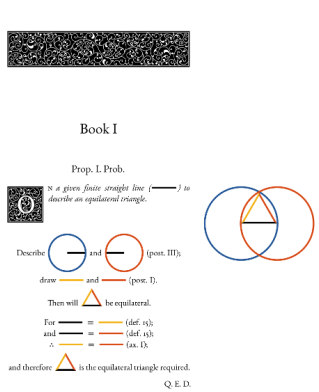
(poſtulate 3.); draw and (poſt. 1.).

then will be equilateral.

For (def. 15.);
and (def. 15.),
∴ (axiom. 1.);

and therefore is the equilateral triangle required.

Q. E. D.



Book I

Prop. I. Prob.

IN a given finite straight line ( ) to describe an equilateral triangle.

Describe and (post. III);

draw and (post. I).

Then will be equilateral.

For (def. 15);
and (def. 15);
∴ (ax. I).

and therefore is the equilateral triangle required.

Q. E. D.

Figure: Recreating French Bibles and Euclid's Elements

Showcase

Here is a showcase of what people use LaTeX for:

Figure: Making presentations!

Figure: Making presentations!

Now let's get our hands dirty.

What you need

- TeX distribution (such as TeX Live or MiKTeX),
- A text editor or a TeX IDE such as TeX Studio.

LaTeX is a language, which is 'compiled'.

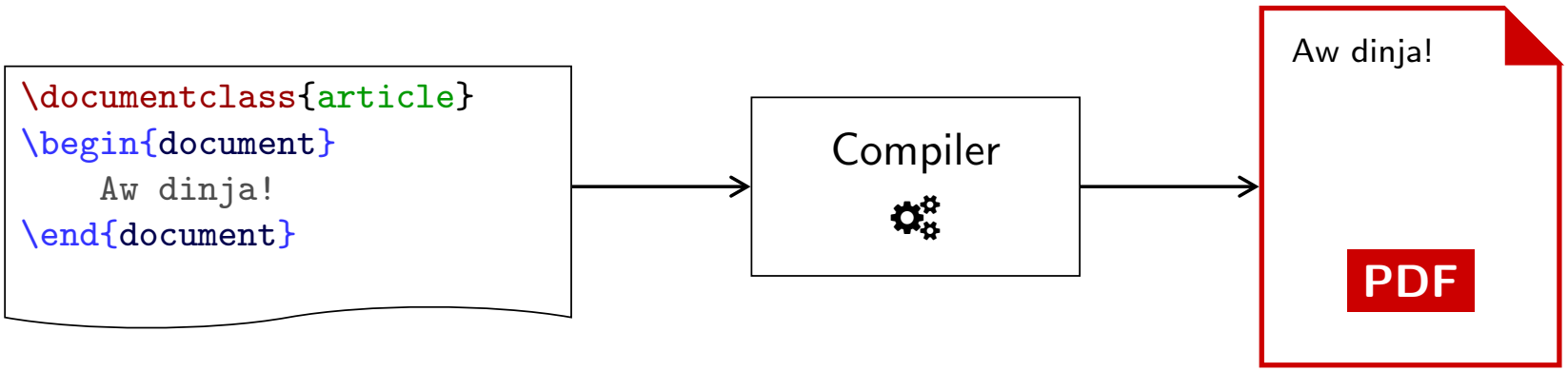


Figure: What a LaTeX compiler does

The "Hello World" example

```
\documentclass{article}
\begin{document}
    Aw dinja!
\end{document}
```

Aw dinja!

- LaTeX commands start with backslashes: `\command`.
- The `documentclass` is the "type" of document we are producing. All this does is define structural things like whether there are chapters, or sections. We chose `article`, others include `book`, `report` and `letter`.
- The text of the document itself is enclosed between `\begin{document}` and `\end{document}`. The two commands `\begin{···}` and `\end{···}` enclose what's called an *environment*.

The "Hello World" example: modified

```
\documentclass{article}
\begin{document}
    Aw   dinja!
    Caw

    dinja!  A b c d e f g h
    i j k l m n o p q r s t
    u v w x y z
\end{document}
```

Aw dinja! Caw
dinja! A b c d e f g h i
j k l m n o p q r s t u v
w x y z

- LaTeX ignores multiple white spaces in the source code (`Aw␣␣␣dinja!`) as well as single new-lines.
- A blank line starts a new paragraph. The first line of a paragraph is indented.

Some common commands

`\textbf{bold text}`	**bold text**
`\textit{italic text}`	*italic text*
`\emph{emphasised text}`	*emphasised text*
`\textsl{slanting text}`	*slanting text*
`\textsc{Small Caps}`	Small Caps
`\texttt{Typewriter}`	`Typewriter`
`\textsuperscript{superscript}`	superscript
`\textsubscript{subscript}`	subscript
`\underline{underlined}`	underlined
`\TeX and \LaTeX`	TeX and LaTeX

An Example

```
\documentclass{article}
\begin{document}
    The \textbf{quick} \textit{brown}
    \textsc{fox} \underline{jumps}
    \textsuperscript{over} the
    \textsubscript{lazy} \textsl{dog}.

    \emph{This text is \emph{very}
    important}.
\end{document}
```

The **quick** *brown* FOX jumps $^{\text{over}}$ the $_{\text{lazy}}$ *dog*.

This text is very *important.*

- Notice nesting \emph alternates between italic and non-italic text. It is better practice to use \emph instead of \textit when your goal is to *emphasise* what you are saying.

Reserved Characters

$ % ^ & _ { } ~ \

These symbols have special meaning to the LaTeX compiler, and cannot be used in a TeX file as part of your text. Instead, we use the following:

```
\# \$ \^{} \& \{ \} \~{} \textbackslash
```

- Notice that the corresponding commands for ^ and ~ are followed by "{}". This is because they are *commands* which usually take arguments, similar to `\documentclass`. In particular, they are *accents*:

`tajj\^{a}r` or just `tajj\^ar` becomes tajjâr [1]

`Jalape\~{n}o` or just `Jalape\~no` becomes Jalapeño

[1] as of 2011 (Deċiżjonijiet 1), it is technically incorrect to spell tajjar (as in cotton wool) this way, we just use it here for illustration.

Other Accents

Grave	`responsabbilt\`a`	responsabbiltà
Acute	`caf\'e`	café
Circumflex	`tajj\^ar`	tajjâr
Umlaut	`F\"ur Elise`	Für Elise
Hungarian umlaut	`Erd\H os`	Erdős
Tilde	`Jalape\~no`	Jalapeño
Cedilla	`fa\c cade`	façade
Dot	`\.ci\.cri`	ċiċri

What is a command?

Notice that those accents whose commands contained letters were followed by a space, e.g., `Erd\H os` for Erdős. If we want, we could have done `Erd\H{o}s`.

The reason for this is commands are made up of all the alphabetical characters following the `\` character. Commands do not usually contain numbers or other symbols (things like `\.`, `\^` etc. are exceptions).

So if we do `Erd\Hos`, the compiler thinks `\Hos` is the command we are invoking, and gets confused. On the other hand, we can do things like `Erd\H0s` (Erd0̋s) or `Erd\H.s` (Erd˝.s) without spaces, since these are not alphabetical characters and are therefore not treated as part of the command.

What is a command?

Spaces immediately after a command are ignored, so we could equally do `tajj\^ ar` for tajjâr.

Commands consume the object which immediately follows them, e.g.

`\textbf abc` becomes **abc**

If we want a group of things to be treated as one, we *group* them using curly brackets:

`\textbf {abc}` becomes **abc**

We can also feed `\textbf` nothing:

`\textbf {} abc` becomes ␣abc

Notice that the space immediately after the command is ignored, but the space after the curly brackets is visible.

Examples

`\`A\c ce`	Àçe
`\`A\cce`	*Error*
`\`A\c1e`	À1̧e
`\textbf xyz`	**x**yz
`\textsc {xy}z`	Xyz
`\LaTeX is great!`	LaTeXis great!
`\LaTeX{} is great!`	LaTeX is great!
`\textbf\textit xyz`	*Error (left associativity)*
`\textbf{\textit xyz}`	***x***yz

Document Structure

A document should be split into logical parts, say:

- Title
- Table of Contents
- Chapters
  - Sections
    - Subsections
      - Subsubsections
- Appendices

The exact structure and how customisable it is will depend on the choice of document class. For example, an `article` does not have chapters, but sections as the top-level object.

Which document class should I use?

article is ideal for a paper in scientific journals (divided into sections, subsections, etc.). Usually has an abstract.

report is ideal for longer reports, containing chapters, say a thesis, small book, etc. Also usually has an abstract.

book is for actual books.

letter is for writing letters.

beamer is for making slideshows (like this one).

The Typical Document Skeleton

```
\documentclass{article}

% Document Info
\title{How to Write a \LaTeX{} Document}
\author{Luke Collins}
\date{25\textsuperscript{th} November, 2019}

\begin{document}
    \maketitle  % title

    The first step is to download a \TeX{} distribution.
\end{document}
```

The Typical Document Skeleton

```
\documentclass{article}

% Document Info
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\author{Luke Collins}
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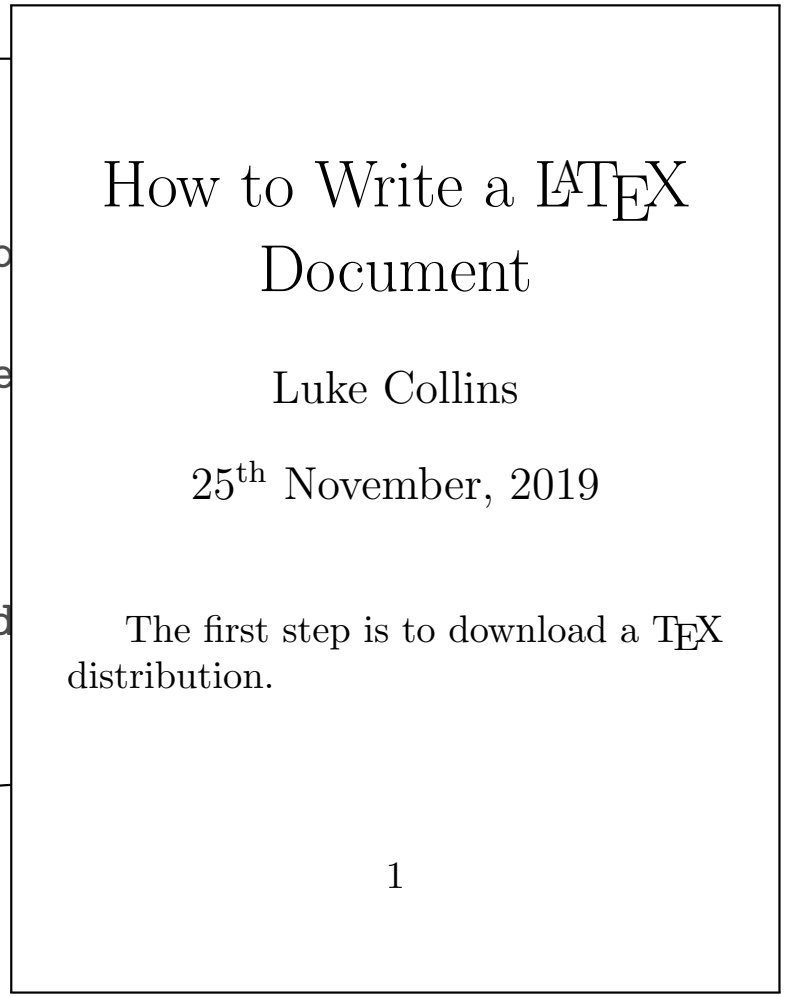
\end{document}
```



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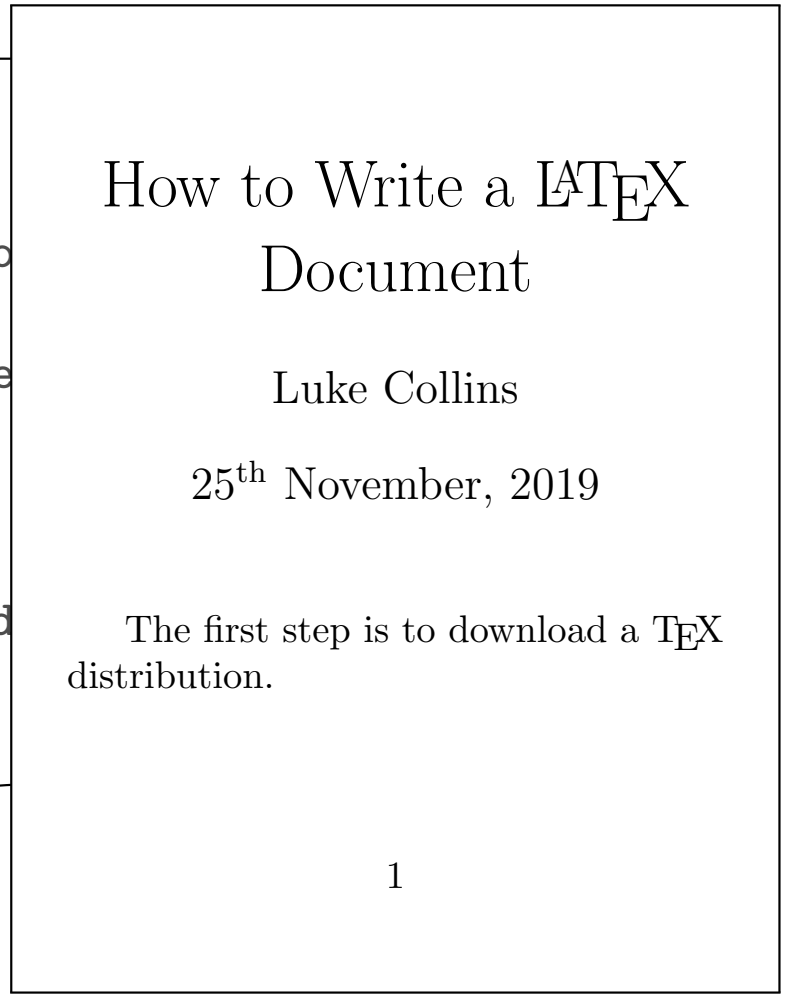

- Remember that % was a reserved character—it is used for *comments*.

Chapters, Sections, Subsections, etc.

```
\documentclass{report}
\begin{document}
    \chapter{Complex Analysis}

    \section{What is Complex Analysis?}
    Complex analysis is the study of functions of complex
    variables.

    \subsection{Holomorphic Functions}
    A function is \emph{holomorphic} if it is differentiable
    at every point in some open region of the complex plane.

    \subsection{Cauchy}
    A lot of nice results in complex analysis are due to
    Augustin-Louis Cauchy.
\end{document}
```

Chapters, Sections, Subsections, etc.

```
\documentclass{report}
\begin{document}
    \chapter{Complex Analysi

    \section{What is Complex
    Complex analysis is the
    variables.

    \subsection{Holomorphic
    A function is \emph{holo
    at every point in some o

    \subsection{Cauchy}
    A lot of nice results in
    Augustin-Louis Cauchy.
\end{document}
```

Chapter 1

Complex Analysis

1.1 What is Complex Analysis?

Complex analysis is the study of functions of complex variables.

1.1.1 Holomorphic Functions

A function is *holomorphic* if it is differentiable at every point in some open region of the complex plane.

1.1.2 Cauchy

A lot of nice results in complex analysis are due to Augustin-Louis Cauchy.

1

The Abstract

```
\documentclass{article}

\title{Fermat's Last Theorem}
\author{Andrew Wiles}
\date{23\textsuperscript{rd} June, 1993}

\begin{document}
    \maketitle  % title

    \begin{abstract}
        In this paper, we give a proof of Fermat's 1637
        conjecture, his so-called last theorem.
    \end{abstract}

    \section{Introduction}
    We start with some computations of cohomology groups.
\end{document}
```

The Abstract

```
\documentclass{article}

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\author{Andrew Wiles}
\date{23\textsuperscript{rd}

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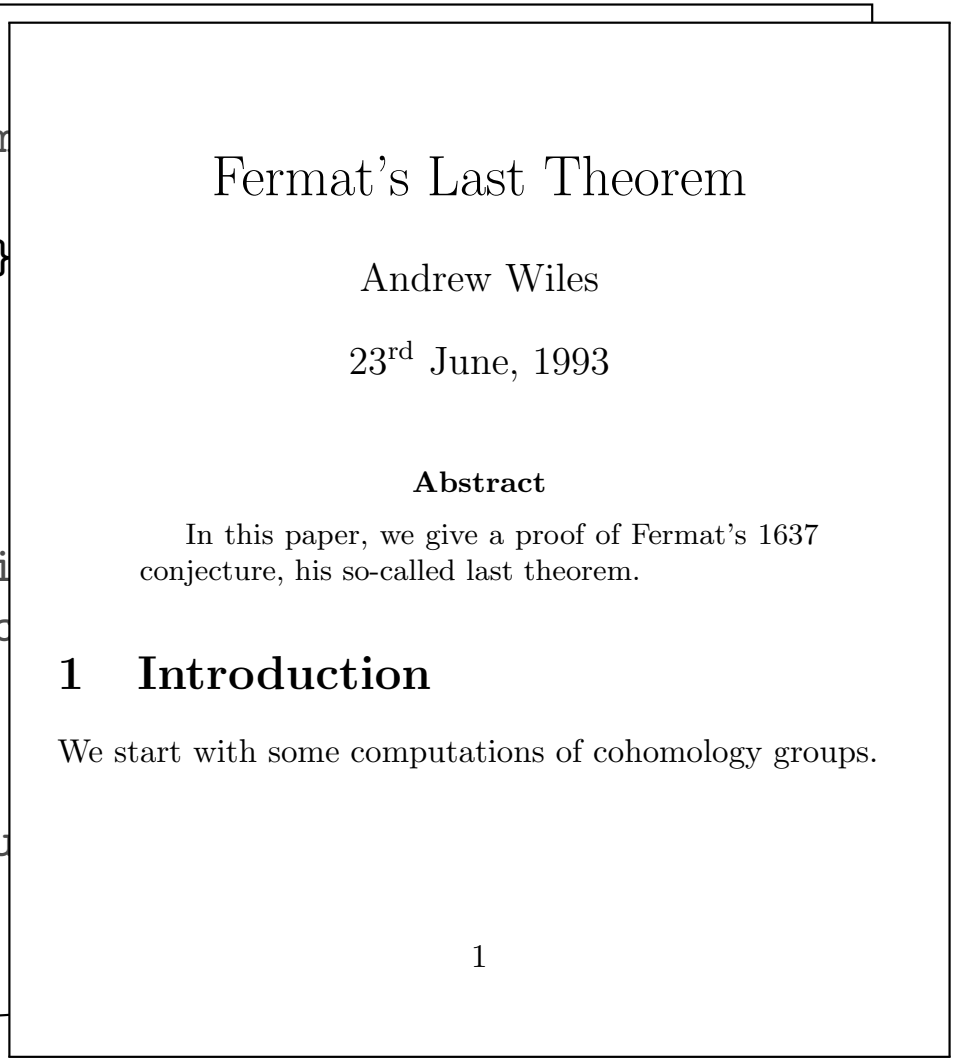

Fermat's Last Theorem

Andrew Wiles

23rd June, 1993

Abstract

In this paper, we give a proof of Fermat's 1637 conjecture, his so-called last theorem.

1 Introduction

We start with some computations of cohomology groups.

1

Table of Contents

- A table of contents can be automatically generated from chapters, sections, etc. by invoking `\tableofcontents`.
- **WARNING:** The `\tableofcontents` command depends on an auxiliary file which is generated during compilation. For this reason, you should **compile twice**, once to generate the file, and a second time to ensure the correct file is used in displaying the table of contents.

Table of Contents

```
⋮
\begin{document}
    \maketitle          % title
    \tableofcontents    % contents

⋮

\end{document}
```

Some notes on LaTeX

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Contents

1

Including Images

- This is the first time we will be making use of a *package*.
- At the top of the TeX file, after `\documentclass{···}` but before `\begin{document}`, do

  ```
  \usepackage{graphicx}
  ```

  This will allow us to make use of extra commands in the graphicx package which are not available in LaTeX by default.
- Images can be the usual .jpeg, .png, etc., but also .pdf (for vectorised images). Place the image file (say, `image.jpg`) in the same directory as the TeX file, and do

  ```
  \includegraphics{image}
  ```

  at the place in the text you want the image to appear (the file extension is optional).

Including Images

```
\documentclass{article}
\usepackage{graphics}
\begin{document}
    Aw dinja!
    \includegraphics{dinja}
\end{document}
```

Aw dinja!

Including Images — Optional Arguments

- Remember, command arguments are placed immediately after a command, often in curly brackets.

```
\command{argument}
```

  Some commands take multiple arguments, we'll see some of those later on:

```
\command{argument1}{argument2}{argument3}
```

- Other times, commands have *optional* arguments (usually just called *options*.) Options are placed in square brackets, usually before the mandatory arguments.

```
\command[option]{argument}
\command[option1,option2]{argument1}{argument2}
```

Including Images — Optional Arguments

For example, say we want to make an included image smaller/larger.
There are optional arguments we can pass to `\includegraphics` for this.

```
\documentclass{article}
\usepackage{graphics}
\begin{document}
    Aw dinja!
    \includegraphics[scale=0.5]{dinja}
\end{document}
```

Aw dinja!

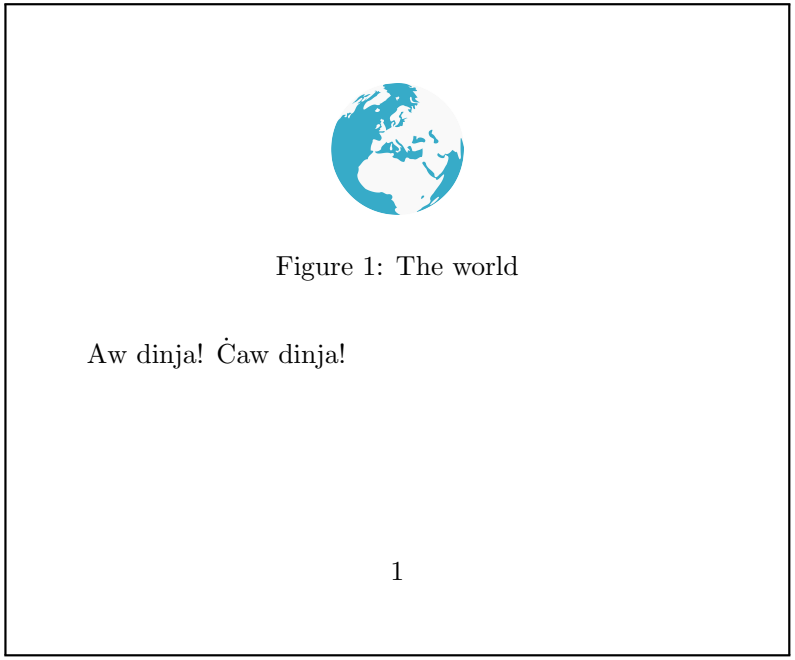
Other options for `\includegraphics` are `width`, `height` and `angle`.

Try experimenting with multiple options at the same time.

Including Images — Figures

If you do not want to include an image among the text (as is often the case), it is best to make use of the `figure` environment. Place the environment in the document where it should logically be, and LaTeX will determine an ideal position for it. All figures will be numbered automatically.

```
\documentclass{article}
\begin{document}
    Aw dinja!  \.Caw dinja!
    \begin{figure}
        \centering  % to centre stuff
        \includegraphics{dinja}
        \caption{The world}
    \end{figure}
\end{document}
```



Including Images — Figures

Environments also sometimes have options and arguments.

You can suggest to LaTeX where you would like the figure to be placed by doing `\begin{figure}[option]`, where `option` is one of:

- `t`, top of the page,
- `b`, bottom of the page,
- `h`, *here*, i.e., where it appears in the text,
- `p`, on a page where other figures are present.

These are only suggestions to LaTeX, they are not definite. If you really want to insist, you can do `[!h]` to insist that LaTeX put the figure `h` (also `!t`, `!b`, `!p`), but this is still not guaranteed.

Tables

- First choose a layout for the columns by combining the symbols

  `l` `c` `r` `|` `||` `p{`x`}`

  where x is a length, for example, `3.5cm` or `50pt`.

  For example, `lc|c||p{2.4cm}` corresponds to a table with a left aligned column, a centred column, a vertical line, a centred column, two vertical lines, and a "paragraph" column of width 2.4 cm.
- The `&` character is used as a column separator, `\\` starts a new line, and `\hline` creates a horizontal line.

Tables

```
\begin{tabular}{lc|c||p{2.4cm}}
    Name       & ID       & Grade & Description                    \\
    \hline \hline
    A Cauchy   & 555555F & 10    & Bad \LaTeX{} skills.           \\
    JP Ebejer & 123456M & 75    & OK \LaTeX{} skills.            \\
    L Collins & 987654M & 100   & God-tier \LaTeX{} skills.
\end{tabular}
```

Name	ID	Grade	Description
A Cauchy	555555F	10	Bad LaTeX skills.
JP Ebejer	123456M	75	OK LaTeX skills.
L Collins	987654M	100	God-tier LaTeX skills.

Tables – Table Environment

The `table` environment is identical to the `figure` environment, but for tables.

```
\begin{table}[b]
    \centering  % centres everything within the table environment
    \begin{tabular}{lc|c||p{2.4cm}}
        Name       & ID       & Grade & Description                    \\
        \hline \hline
        A Cauchy   & 555555F & 10    & Bad \LaTeX{} skills.           \\
        JP Ebejer & 123456M & 75    & OK \LaTeX{} skills.            \\
        L Collins & 987654M & 100   & God-tier \LaTeX{} skills.
    \end{tabular}
    \caption{Results of the \LaTeX{} exam}
\end{table}
```

Tables – Table Environment

The table environmer
tables.

```
\begin{table}[b]
    \centering  % c
    \begin{tabular}
        Name        &
        \hline \hli
        A Cauchy    &
        JP Ebejer   &
        L Collins   &
    \end{tabular}
    \caption{Result
\end{table}
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Name	ID	Grade	Description
A Cauchy	555555F	10	Bad LaTeX skills.
JP Ebejer	123456M	75	OK LaTeX skills.
L Collins	987654M	100	God-tier LaTeX skills.

Table 1: Results of the LaTeX exam

1

List Environments

Another collection of useful environments is that of the *list environments*. These are:

- Unordered lists (`itemize`)
- Ordered lists (`enumerate`)
- Description lists (`description`)

```
\begin{itemize}
    \item A thing
    \item Another thing
    \item Oh and another thing
\end{itemize}
```

- A thing
- Another thing
- Oh and another thing

List Environments

```
\begin{enumerate}
    \item A first thing
    \item A second thing
\end{enumerate}
```

1. A first thing
2. A second thing

List environments can be nested:

```
\begin{enumerate}
    \item Question 1
    \item Question 2
        \begin{enumerate}
            \item Question 2(a)
            \item Question 2(b)
        \end{enumerate}
    \item \begin{enumerate}
            \item Question 3(a)
        \end{enumerate}
\end{enumerate}
```

1. Question 1
2. Question 2
   (a) Question 2(a)
   (b) Question 2(b)
3. (a) Question 3(a)

List Environments

The enumerate package allows us to customise the format of the enumerate counter, write \usepackage{enumerate} in your preamble.

```
\begin{enumerate}[i.]
    \item A first thing
    \item A second thing
\end{enumerate}
```

i. A first thing
ii. A second thing

```
\begin{enumerate}[((A))]
    \item A first thing
    \item A second thing
\end{enumerate}
```

((A)) A first thing
((B)) A second thing

List Environments

Description lists are for scripts, dictionaries, etc.

```
\begin{description}
    \item[Gloucester] Now is the
       winter of our discontent
       made glorious summer by
       this sun of York\dots
    \item[Clarence] Because my
       name is George.
\end{description}
```

Gloucester Now is the winter of our discontent made glorious summer by this sun of York...

Clarence Because my name is George.

Other Useful Environments

- To centre text, you can use the `center` environment.

```
\begin{center}
    Aw dinja!
\end{center}
```

Aw dinja!

If you just have one line, you can use `\centerline{Aw dinja!}` to achieve the same effect.

Do *not* confuse any of these with the `\centering` command which we used in things like the `figure` environment. That command is "dangerous", because it centres **everything** that follows it and is in the same group. (In the case of figures, it centres everything within the `figure` environment, for example.)

Another example of a "dangerous" command is \bfseries. Compare what the following do:

- \bfseries{Aw} dinja, kif int?
- \textbf{Aw} dinja, kif int?
- {\bfseries Aw} dinja, kif int?

- The verbatim environment prints everything typed in literally using a typewriter font (including indentation and new lines!).

```
  \begin{verbatim}
# $ % ^ & _ { } ~ \
int main(){printf("Aw
dinja!"); return 0;}
  \end{verbatim}
```

```
# $ % ^ & _ { } ~ \
int main(){printf("Aw
dinja!"); return 0;}
```

In-line, the command \verb|code| or \verb+code+ does the same (notice we use characters like | or + to open/close).

Know your Hyphens and Dashes!

There are three kinds of "dashes" in the English language. The **hyphen** is used to join words such as semi-prime. The **en dash** is used to state ranges, e.g., pages 5–10, or to adjoin names together e.g., the Hardy–Littlewood conjecture. Finally, the **em dash** is used as a punctuation mark to serve as a long pause—like this. (Notice there are no spaces between the words around the dash).

These are entered differently in LaTeX:

hypen	non-zero	`non-zero`
en dash	Borsuk–Ulam theorem	`Borsuk--Ulam theorem`
em dash	so—as I was saying—he was going to Tipperary	`so---as I was saying---he was going to Tipperary`

Other Mistakes

- Using `\\` to end a paragraph instead of a blank line.
- Literally typing `...` for *ellipsis* (i.e., dot dot dot). In LaTeX you should use the command `\dots` to get the correct spacing (and don't put a . after it!)
- Using the `"` character for quotes. In LaTeX, the single quote `'` *always* denotes a close quote (’), and the grave accent `` ` `` *always* denotes an open quote (‘). To use “double quotes”, type them twice: ``` ``double quotes'' ``` and do not use the `"` character.
- LaTeX puts more space after a full-stop than it does between words, since it assumes a new sentence is starting. If you want to have a fullstop followed by a space mid-sentence, use `\␣` (i.e., backslash space). An example:

✗	Prof. Borg	`Prof. Borg`
✓	Prof. Borg	`Prof.\ Borg`

Other Mistakes

- On a similar note, honorifics such as Dr, Mr, Mrs, etc. should *not* be followed by a full-stop. The rule is: *If the last letter of the abbreviation is the same as last letter of the word, then* **no** *full-stop*. (Similarly, it's ABC Ltd, not ABC Ltd.)

  Full-stops should also be omitted from capitalised abbreviations, so it's UK not U.K., NATO not N.A.T.O., and CV not C.V.

- Lower-case abbreviations such as e.g., i.e., etc. have a full-stop and the end of every word (etc. is an exception).

i.e.	*id est*	that is	ca.	*circa*	approximately
e.g.	*exempli gratia*	for example	etc.	*et cetera*	and so on
cf.	*confer*	see/compare	vs.	*versus*	against

  It is better to always put a comma after i.e. and e.g., rather than a space (in which case do \␣), since they should be read as "that is," and "for example," respectively.

Next Time

- How to typeset maths formulæ, such as

$$f(z_0) = \frac{1}{2\pi i} \oint_\gamma \frac{f(z)}{z - z_0}\, dz,$$

  and get numbered theorems.
- Other document elements such as footnotes, bibliography, index, etc.
- How to add links and cross references within a document.
- How to draw your own diagrams!
- How to use the UM LaTeX dissertation template, and where to find other LaTeX templates and resources.

Thank you!

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