LaTeX-workshop (Instructions)

De Leidsche Flesch

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1 Introduction

This is the manual for the LaTeX workshop of De Leidsche Flesch. Please read through this manual first. You can then start working on the corresponding exercises. When working on these exercises, you should use both this manual and the internet to look things up.

You will probably stumble upon several errors, because you made a mistake *somewhere in the code*. This is the intended design of the workshop, because later, when using LaTeX, you will definitely make more mistakes, and therefore it is important that you are able to solve these problems. Furthermore, please remember that there are often several ways to portray things, with a slightly different layout. This is simply a matter of preference.

If you find creating LaTeX documents quite difficult, please utilize the online help. The wikibook about LaTeX (`https://en.wikibooks.org/wiki/LaTeX`) is very approachable and most recurring situations are extensively described there. Another useful source of help can be found at `https://www.sharelatex.com/learn/`, related to the online editor ShareLaTeX.

If you can not find the command of a certain symbol, please try `http://detexify.kirelabs.org`. On this website, you can draw the symbol you are looking for, and it will find the corresponding command for you[1].

1.1 Starting

To start with the workshop, please complete the following steps:

1. Start your computer and log in.

2. Click on the startmenu → all programs → MiKTeX 2.9 → TeXworks[2]

3. Read this manual. The manual and exercises can (also) be found on our website[3].

4. Take your bundle of exercises.

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[1]An Android app is also available: `https://play.google.com/store/apps/details?id=website.marty.detexify&hl=en`.

[2]You can download the MiKTeX program at home at `http://miktex.org/download`, this is an easy program for making LaTeX code.

[3]`http://www.deleidscheflesch.nl/p/latex-workshop`
After the workshop, these files will stay online.

5. You can now start making the exercises. For inspiration, read the manual carefully and scour the internet.

An online TeX editor has existed for a few years: Sharelatex[4], which is for making LaTeX documents *in the cloud*. It works like Google Docs: it is accessible from every computer and all files you make will be saved online. This way, you can never forget your homework.

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[4]`https://www.sharelatex.com`

2 New document

A LaTeX document consists of 2 parts. The first part is the preamble. The things written here will be valid throughout the whole document, such as the right packages and fonts. The second part starts at `\begin{document}` and ends at `\end{document}`. The contents of your document are inbetween these two commands.

You can put comments in your .tex file, without them being displayed in your PDF. You can accomplish this by using % in front of your commentary.

2.1 Preamble

1. At the top, you put `\documentclass{article}`. This command tells your compiler what kind of text you are writing, in this case an article. It specifies for example the font size. The article class is the best in almost every situation.

2. Directly below this you put the packages you want to use. These make it possible to add extra functies to LaTeX that are not standard. Add a package by putting `\usepackage{packagename}` at the top of your document.

   A couple of commands that are often used in documents are:

   1) `\usepackage[a4paper]{geometry}` It specifies the dimensions of your document to the A4 format.

   2) `\usepackage[dutch, english]{babel}` This one is for correct translations and word wrapping. For example 'Chapter' instead of 'Hoofdstuk'. Here also Dutch is loaded, so you could use Dutch quotes for example. The last language in the block is the main language of the document.

   3) `\usepackage{parskip}` For a correct display of paragraphs.

   4) `\usepackage{amsmath, amssymb}` A package that displays formulas and other mathematical object in a better looking way.

   5) `\usepackage{graphicx}` To add images to your document.

   6) `\usepackage{enumerate}` To easily make numbered lists.

   7) `\usepackage{url}` To display urls properly.

   8) `\usepackage{float}` To ensure proper placement of images in the document

   9) `\usepackage[hidelinks]{hyperref}` To make a clickable table of contents, where clicks transport you to that part of the document.

   10) `\usepackage{color}` To type text in color.

3. Put the following commands in your peamble:

   `\title{title}`
   `\author{A. Uthor}`
   `\date{\today}`, the command `\today` automatically adds the correct date.

4. The last thing you do is to add `\begin{document}` and `\end{document}`. Between these two commands you put the body of your document.

5. Compile your document.

2.2 Text in a document

2.2.1 Title and Author

At the top of your document body put `\maketitle`. This makes sure the information you put in the preamble as the title will be at the right place in the document. In this case a title, author and date.

2.2.2 Table of Contents

You make a table of contents with the command `\tableofcontents`. Then you will want to start a new page using `\newpage`.

2.2.3 Headers

An Article document in LaTeX uses sections, subsections, subsubsections and paragraphs. 'New document' in this document is a section for example. You make these by typing `\section{Name header}`.

The header 'Text in document' is a subsection. You make these by typing `\subsection{Name Header}`.

the header 'Headers' is een subsubsection. You make these by typing `\subsubsection{Name Header}`.

Paragraph   Finally there are paragraph headers, you make these by typing `\paragraph{paragraph name}`. This header is a paragraph type.

2.2.4 Paragraph

You can make paragraphs without a title by leaving an empty line between the text.

2.2.5 Enumerations and lists

You can make a non-numbered enumaration using `\begin{itemize}`. An item in your enumaration is then made using `\item`. Behind this command you type a space and then the text you want for this bullet-point. When your enumeration is done you close it using `\end{itemize}`. Any following item can be put on a new line by again starting it with `\item`.

- This is the first item of a non-numbered enumaration
- This is the second
- This is the third

A numbered enumaration, as seen earlier in this guide, is made using `\begin{enumerate}`. You create numbered items on you list by again using `\item`. Again you close of with `\end{enumerate}`. This will give you:

1. Example 1
2. Example 2

If you want a different item text or lay-out, you type `\begin{enumerate}[a.]`. This will yield:

a. Example 1

b. Example 2

In the same way you can enumarate using roman numerals using `\begin{enumerate}[i.]`

  i. Example 1

 ii. Example 2

3   Text

Just like Microsoft Word, LATEX provides the option of presenting text in different styles. A few of the possibilities are listed below.

- **bold**, type `\textbf{text}`
- *italics*, type `\textit{text}`
- color, typ `\textcolor{color}{text}` or `{\color{color}text}`
- small, type `\small` followed by text.
- big, type `\large`
- bigger, type `\Large`
- even bigger, type `\huge`
- biggest, type `\Huge` .

Type `\normalsize` after this to continue in the usual textsize.

4   Math Mode

4.1   Display Equations

If you want formula's and equations in your reports then you will have to work in "Math Mode". There are multiple way to enter Math Mode, the 3 most used methods are *math*, *displaymath* and *align*, in which you can type mathematical formula's. In *math* the mathematical symbols will just appear inline so on the textline itself[5], like so: $a^n + b^n = c^n$. This environment can be invoked in multiple ways. The most used way is putting `$`-signs around the equations.

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[5]for some reason this does not always work for titles. You will need the package *fixltx2e* to make this work

The *displaymath* environment is used to center on the mathematical symbols, like:

$$\frac{\hbar^2}{2m}\nabla^2\Psi + V(\mathbf{r})\Psi = -i\hbar\frac{\partial\Psi}{\partial t}$$

This environment can be invoked by putting the equation between the following brackets: \[...\].

Lastly we have the *align* method, with this environment mathematical symbols will be aligned and they will get a reference number behind the equation, like so:

$$\int_{-\infty}^{\infty}\frac{\cos x}{x^2+1} = \frac{\pi}{e} \tag{1}$$

$$\int_{-\infty}^{\infty}\frac{\cos x}{x^2+1} = \frac{\pi}{e} \tag{2}$$

To display an equation like this use \begin{align} and \end{align}. If you want to use this method without the reference numbers, type \begin{align*} and \end{align*}. To list multiple equations below eachother, type \\ behind the equations. Use the &-sign to align the formulas correctly, most often you will want to use the &-sign before the =-sign in the formula. If you are feeling adventurous, try finding out what happens if you use multiple &'s in the same line.

4.2   Superscript and subscript

When working in Math Mode, subscript (_) and superscript (^) are often used. This way we can for instance display $a_1, a_2, \dots, a_{n-1}$ with the following code: `a_1, a_2, \dots, a_{n-1}` and the equation $a^b \cdot a^c = a^{b+c}$ can be constructed by typing `a^b \cdot a^c = a^{b + c}`. Pay attention if you want to subscript or superscript more than a single symbol you have to put { and } around it.

4.3   Brackets

When putting brackets around larger parts of equations in displaymath, such as fractions, the brackets need to be scaled. This can be done by putting \left and \right before the brackets that need to be scaled:

$$\left| -\frac{1}{2} \right|^3 = \left(\frac{1}{8} \right)$$

Is created by the following code:
\[\left| -\frac{1}{2} \right| ^3 = \left(\frac{1}{8} \right)\]

If you want to match an opening bracket with a closing bracket on a different line, use the invisible bracket \right. denoted with a period, e.g. the end of a long set definition on a new line:

$$\text{s.t. } f^2(x) < \frac{\epsilon}{2}\Big\}$$

Is created using the following code:
`\[\left.\text{s.t. } f^2(x) < \frac{\epsilon}{2} \right\} \]` (Note the escape of the curly bracket here).

4.4   Roots and fractions

When using math you will often encounting roots and fractions. For displaying the fraction $\frac{a}{b}$ type the code `\frac{a}{b}`. For displaying the square root $\sqrt{a}$ we use `\sqrt{a}` and for $\sqrt[n]{a}$ we use `\sqrt[n]{a}`.

4.5   Special symbols

There are a lot of symbols that are used in math. In this paragraph a number of them will be named, but there are more. To quickly find which code belongs to which symbol you can use the website or the app Detexify[6]. Example of symbols are integrals, but also for instance α and β. Below are the most used symbols of the Greek alfabet:

	code		code		code		code		code		code
α	`\alpha`	β	`\beta`	γ	`\gamma`	δ	`\delta`	ϵ	`\epsilon`	ε	`\varepsilon`
ζ	`\zeta`	θ	`\theta`	λ	`\lambda`	μ	`\mu`	ξ	`\xi`	π	`\pi`
ρ	`\rho`	σ	`\sigma`	τ	`\tau`	ϕ	`\phi`	φ	`\varphi`	χ	`\chi`
ψ	`\psi`	Γ	`\Gamma`	Δ	`\Delta`	Λ	`\Lambda`	Φ	`\Phi`	Ψ	`\Psi`

Apart from symbols of the Greek alfabet, we also have standard functions, for which commands exist in LaTeX . These standard functions will be displayed when the appropiate command is used. The most used commands for functions are:

	code		code		code		code		code		code
arccos	`\arccos`	arcsin	`\arcsin`	arctan	`\arctan`	arg	`\arg`	sinh	`\sinh`	cos	`\cos`
cosh	`\cosh`	deg	`\deg`	det	`\det`	dim	`\dim`	tan	`\tan`	ker	`\ker`
lim	`\lim`	log	`\log`	max	`\max`	min	`\min`	sin	`\sin`		

In addition symbols for sums, products, integrals etc. can be easily put in math mode. These symbols adapt to the math mode they are in, they are larger in *displaymath* and super- and subscripts align nicely. Below are the most often used examples:

	code		code		code		code
$\sum$	`\sum`	$\bigcap$	`\bigcap`	$\iint$	`\iint`	$\bigcup$	`\bigcup`
$\prod$	`\prod`	$\int$	`\int`	$\iiint$	`\iiint`	$\oint$	`\oint`

For $\sum$ and $\prod$ and lim it looks cleaner if in the *displaymath* environment the upper en lower limits are directly above or below the quantifier. You can use subscript and superscript to achieve this. For example you get:

$$\sum_{n=1}^{\infty} \frac{1}{n}$$

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

by using the next code: `\sum_{n=1}^{\infty} \frac{1}{n}`. You can make double integrals look cleaner by using the command `\limits`. This makes sure the limits will align properly. For example compare:

$$\iint_D \text{ with } \iint\limits_D$$

obtained by the code `\[\iint_D \text{ with } \iint\limits_D\]`. The second one is the correct notation.

If you want to use $\sum$ or $\prod$ in the *math* environment and still want the upper en lower limits directly above or below the quantifier, you can use the command `\displaystyle`. So for example $\displaystyle\sum_{n=0}^{\infty} \frac{1}{n}$ is obtained by the code `\displaystyle\sum_{n=1}^{\infty} \frac{1}{n}`.

Finally there are a few more symbols that are useful to know.

	code		code		code		code
$\pm$	\pm	$\times$	\times	$\backslash$	\setminus	$\cdot$	\cdot
$\mp$	\mp	$\gg$	\gg	$\ll$	\ll	$\top$	\top
$\leq$	\leq	$\in$	\in	$\subset$	\subset	$\subseteq$	\subseteq
$\cong$	\cong	$\geq$	\geq	$\approx$	\approx	$\mid$	\mid
$\equiv$	\equiv	$\sim$	\sim	$\neq$	\neq	$\leftarrow$	\leftarrow
$\Leftarrow$	\Leftarrow	$\leftrightarrow$	\leftrightarrow	$\Leftrightarrow$	\Leftrightarrow	$\mapsto$	\mapsto
$\hookleftarrow$	\hookleftarrow	$\rightarrow$	\rightarrow	$\Rightarrow$	\Rightarrow	$\updownarrow$	\updownarrow
$\Updownarrow$	\Updownarrow	$\uparrow$	\uparrow	$\Uparrow$	\Uparrow	$\downarrow$	\downarrow
$\Downarrow$	\Downarrow	$\cdots$	\cdots	$\vdots$	\vdots	$\ddots$	\ddots
$\forall$	\forall	$\exists$	\exists	∞	\infty	∇	\nabla
∂	\partial	$\ni$	\ni	$\supseteq$	\supseteq	$\Longrightarrow$	\Longrightarrow

For comparative operators such as $\leq$, $\in$ and $\subset$ you can create the negavtive operator by putting `\not` for the operatot. Doing that you get $\nleq$, $\notin$ and $\not\subset$ for example.

4.6 Matrices

There are different types of matrices. The most frequently used matrix is the matrix enclosed in round brackets as delimiters. Another matrix you will probably use a lot is the matrix between straight lines as delimiters. You will use this for calculating the determinant. There are a lot of other types of matrices, but you will not use them that often.

		LaTeX-code
Ordinary	$\begin{matrix} a & b \\ c & d \end{matrix}$	\begin{matrix} a & b \\ c & d \end{matrix}
Between round brackets	$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$	\begin{pmatrix} a & b \\ c & d \end{pmatrix}
Between straight lines	$\begin{vmatrix} a & b \\ c & d \end{vmatrix}$	\begin{vmatrix} a & b \\ c & d \end{vmatrix}

5 Tables

There are different ways to create a table in a LATEX-file. The most frequently used are the table (\begin{tabular}[position of the table]{layout of the table}) and the array (\begin{array}[position of the table]{layout of the table}). You can only create an array in a math evironment.

To separate the elements in a row, you use & and to close a row you use \\. To insert lines between columns, you place \hline in the code the table was created with.

You can use the next commands to determine the position of the table:

Command	Result
t	The top of the table is aligned on the bottom of the line.
b	The bottom of the table is aligned to the bottom of the line.
c	The center of the table is aligned at the bottom of the line.

In the definition of the layout you also need to define how many columns are in the table. To define the layout of the columns the following specifiers exist:

Command	Result
l	Adds a column with left-justified text.
r	Adds a column with right-justified text.
c	Adds a column with centered text.
p{x}	The text is justified to the width of x.
*{x}{layout}	Repeats the structure in layout x times.
		Adds vertical line.
||	Adds double vertical line.
@{text}	Uses text as a vertical line.

Example

Time in months	Number of rabbits	Computation
0	1	1
1	2	1+1
2	3	1+2
3	5	2+3
4	8	3+5
5	13	5+8
6	21	8+13
⋮	⋮	⋮

This table can be invoked by the next code:

```
\begin{tabular}[c]{| l | c | r |}
\hline
Time in months & Number of rabbits & Computation \\
\hline
0 & 1 & 1 \\
1 & 2 & 1+1  \\
```

```
2 & 3 & 1+2 \\
3 & 5 & 2+3 \\
4 & 8 & 3+5 \\
5 & 13 & 5+8 \\
6 & 21 & 8+13 \\
$\vdots$ & $\vdots$ & $\vdots$ \\
\hline
\end{tabular}
```

6 Inserting images

It is possible to include images to LaTeX. You first need to place `\usepackage{graphicx}` in your preamble. This package makes sure you can include images. Secondly you use the code `\includegraphics{picture.jpg}` to actually include the image. The image needs to be in the folder of your LaTeX-code to actually include it. Be aware: LaTeX can only include `.pdf`-, `.png`- and `.jpg`-images with the `graphicx` package.

You can use `\includegraphics[scale=0.5]{picture.jpg}` to alter the size of your picture. You can give the scale of the images, but you can also use `[width=0.9\textwidth]`. This way the images will also be scaled to the desired size.

6.1 Placement of the picture

It is often difficult to place the picture on the desired spot. Therefore you need to place the picture in a floating environment. This can be accomplised by

```
\begin{figure}[]
\centering
\caption{Caption of picture}
\includegraphics[width=0.5\textwidth]{picture.jpg}
\end{figure}
```

Commands can be given between the square brackets of `\begin{figure}[]` for the placement of the picture. Below you can find some commands that are useful.

Command	Result
h	Place environment here.
t	Place environment on the top of the page.
b	Place environment on the bottom of the page.
!	Override LaTeX's internal parameters for determining "good" float positions.

As you can see in the code above, it is possible to include a caption to your image. This can be done by placing `\caption{Description}` in the floating environment of the image. The description will then be put under the image. It is also possible to place the description next to the image by the following code:

```
\begin{SCfigure}
\caption{Short description}
\includegraphics[width=0.5\textwidth]{image.jpg}
\end{SCfigure}
```

It is possible to wrap the text around the image. The image will be put in the text. First you need to include the package: \usepackage{wrapfig}. To place the image you need to use the following code:

```
\begin{wrapfigure}{r}{0.5\textwidth}
\includegraphics[width=0.45\textwidth]{picture.jpg}
\caption{Short description}
\end{wrapfigure}
```

The placement of the image can be determined by the text between the two braces with r in the example. Next there are a few nifty commands that are useful for placement:

commando	resultaat
r	At the right side.
l	At the left side.
R	At the right side in floating environment, to prevent splitting over pages.
L	At the left side in floating environment, to prevent splitting over pages.

To conclude it is also possible to put different pictures next to or above each other. This can be useful to compare graphs. You first need to include \usepackage{subfig} in the preamble. The following code can then be use to build a block of four images of two rows and two columns.

```
\begin{figure}
\centering
\subfigure[Description 1]{\includegraphics[width=0.4\textwidth]{graph1}}
~
\subfigure[Description 2]{\includegraphics[width=0.4\textwidth]{graph2}} \\
\subfigure[Description 3]{\includegraphics[width=0.4\textwidth]{graph3}}
~
\subfigure[Description 4]{\includegraphics[width=0.4\textwidth]{graph4}}
\caption{Four graphs of ...}
\end{figure}
```

7 Inserting code

For displaying code you can use the package *listings*. This gives an environment *lstlisting*. You put yout code between \begin{lstlisting} and \end{lstlisting}. However, you need to specify which programming language you use; If you use C++ for example put \lstset{language=C++} *above* \begin{document}.

The LaTeX-code

```
\begin{lstlisting}
  int main (int argc, char** argv) {
    std::cout << "Hello world" << std::endl;
    return 0;
  }
\end{lstlisting}
```

gives for example

```
  int main (int argc, char** argv) {
```

```
    std :: cout  <<  "Hello world"  <<  std :: endl ;
    return  0;
}
```

as output.

You can easily implement the file by using:

`\lstinputlisting{filename.extension}`

8 References & Citations

When numbering things you can use the command `\label{HereAName}`.

When you have put `\label{HereAName}` on the right spot, then you can use the number with `\ref{HereAName}`. You can also use `\pageref{HereAName}` to refer to the page where the label is placed.

If you want a footnote in your text use `\footnote{This is a footnote}`[7].

For extensive citations use

```
\begin{thebibliography}{99}
    \bibitem{afbeeldingen} Wikibooks, \emph{LaTeX/Floats, Figures and Captions
        --- Wikibooks{,} The Free Textbook Project}.
        \url{http://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions}
\end{thebibliography}
```

Afterwards, you can use `\cite{image}` to refer to the url with more information about the image.

For references it is important to compile the code twice. Otherwise questionmarks or outdated numberings will appear.

9 Other interesting packages

Beside all this, there are several other packages to make your life easier. You should search for them on the internet!

- `\usepackage{fancyhdr}` For intelligent headers en footers on your page
- `\usepackage[section]{placeins}` Enforce that floats such as figures do not cross sections. In addition the command `\FloatBarrier` can be used to manually define a barrier for all floating objects.
- `latexmk` Is able to automise the whole compilation process.
- `\usepackage{sidecap}` For captions beside your floats instead of under or above them.
- `\usepackage{beamer}` To create beamer-presentations (powerpoint).

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[7]This is a footnote

- Did you know, \\, the command for linebreak, has an optional argument. try for example \\[5cm] .

- Lion has its own L&ATEX-class for writing templates[3]. This basic template does a lot of the work for you, for example the layout of the front page.

References

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

[2] Wikibooks, *LaTeX/Floats, Figures and Captions — Wikibooks, The Free Textbook Project.* http://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions

[3] https://www.physics.leidenuniv.nl/bachelor/80-education/ 606-education-thesis-templates