LaTeX Cheat Sheet

"Write clear & beautiful english with LaTeX!"

1. LaTeX Basics

You have to include the package mentioned in the headings e.g. to use `\definecolor` you have to include the `xcolor` package with `\usepackage{xcolor}` in the preamble

Available units for lengths and dimensions:

points	pt	millimeter	mm	inch	in	m width	em
pixel	px	centimeter	cm	pica	pc	x height	ex

1.1. Special Characters

\	introduces a command (in text `\textbackslash`)	
{ }	embraces arguments, creates logical parts	($\{ \}$)
[ ]	embraces *optional* command parameters	($\[\]$)
%	comments: code after % will be ignored.	(\%)
&	separates columns in tables	(\&)
#	parameter for own command declarations	(\#)
_ ^	indizes and exponents in mathmode. e.g. a_1^2	(_ \^)

2. Preamble before `\begin{document}`

2.1. Documentclass (necessary)

Usage: `\documentclass[opt,opt]{class}`

Common classes:
`scrartcl (article), scrreprt (report), scrbook (book)`

Common Options:

`10pt/11pt/12pt`	Font size.
`letterpaper/a4paper`	Paper size.
`twocolumn`	Use two columns.
`twoside`	Set margins for two-sided.
`landscape`	Landscape orientation.

2.2. Load Packages (they do all the magic)

Usage: `\usepackage[opt, opt]{package}`

`\PassOptionsToPackage{opt, opt}{package}`

2.3. Penalties

Penalties are the main values that TEXtries to minimise when line or page breakes are calculated.

`\linepenalty=10`	breaking a page within a paragraph
`\hyphenpenalty=50`	line breaking at an automatic hyphen
`\binoppenalty=700`	breaking a line at a binary operator
`\relpenalty=500`	breaking a line at a relation
`\clubpenalty=150`	*breaking after first line of a paragraph
`\widowpenalty=150`	*breaking before last line of a paragraph
`\brokenpenalty=100`	page breaking after a hyphenated line

2.4. Language Settings with `babel`

`\usepackage[ngerman, english]{babel}` (last language default)
`\selectlanguage{language}` `\foreignlanguage{language}{text}`

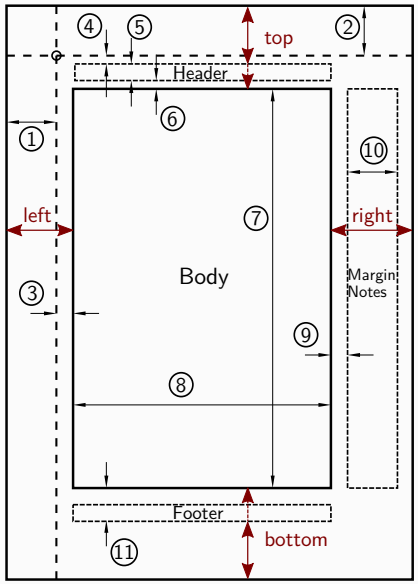
2.5. Glossar and Nomenclature with `glossaries`

Load `\usepackage[acronym]{glossaries}`
Define: `\newacronym{label}{ABB}{written-out}`
`\newglossaryentry{label}{name=..., description=...}`
Use: `\gls{label}`, `\glspl{label}`

3. Layout

3.1. Pagelayout with `geometry` package

Usage: `\geometry{ opt, opt, ... }`



①	1in + `\hoffset`	②	1in + `\voffset`
③	`\oddsidemargin`	④	`\topmargin`
⑤	`\headheight`	⑥	`\headsep`
⑦	`\textheight`	⑧	`\textwidth`
⑨	`\marginparwidth`	⑩	`\marginparwidth`
⑪	`\footskip`		

Additional paramter: `left,right,top,bottom, paper=a4paper, landscape|portrait, includehead,includefoot, twocolumn`

3.2. Header and Footer with `fancyhdr`

```
\usepagestyle{fancy}
% use fancyhdr pagestyle
\fancyhf{}
% clear header and footer
\fancyhead[RE]{}    % even page right header
```

3.3. Colors with `xcolor`

```
\usepackage{xcolor}
\definecolor{tum_blue}{RGB}{0, 115, 207}
\colorlet{col_section}{tum_blue}
```

Predefined colors:
white, gray, black, red, green, blue, cyan, magenta, yellow
Fade a color with !value between 0 and 100, e.g. `\color{gray!70}`
Usage in Text: `\textcolor{red}{text}` or `{\color{red}text}`

4. Structure the Document

4.1. Title with `titlepage`

default: `\author{text}`, `\title{text}`, `\date{\today}`, `\maketitle`
titlepage: `\begin{titlepage}` *text* `\end{titlepage}`

4.2. Table of Content, List of ...

`\tableofcontents` `\listoftables` `\listoffigures`
`\printglossaries` (needs glossaries package)

4.3. Headings

`\part{title}` `\subsubsection{title}`
`\chapter{title}` `\paragraph{title}`
`\section{title}` `\subparagraph{title}`
`\subsection{title}`

*: no numbering, no entry in ToC
`\part` and `\chapter` only in dcumentcalss book or report

4.4. Lists

`\begin{itemize}` with bullet `\item` or `\item[symbol]`
`\begin{enumerate}` with numbered `\item`
`\begin{description}` with bold `\item[word]`

```
\begin{enumerate}\itemsep0pt
        \item First Argument
        \item Second Argument
\end{enumerate}
```

5. Text

5.1. Fonts

Command	Declaration	Effect
`\textrm{text}`	`{\rmfamily text}`	Roman family
`\textsf{text}`	`{\sffamily text}`	Sans serif family
`\texttt{text}`	`{\ttfamily text}`	Typewriter family
`\textmd{text}`	`{\mdseries text}`	Medium series
`\textbf{text}`	`{\bfseries text}`	**Bold series**
`\textup{text}`	`{\upshape text}`	Upright shape
`\textit{text}`	`{\itshape text}`	*Italic shape*
`\textsl{text}`	`{\slshape text}`	*Slanted shape*
`\textsc{text}`	`{\scshape text}`	Small Caps Shape
`\emph{text}`	`{\em text}`	*Emphasized*
`\textnormal{text}`	`{\normalfont text}`	Document font
`\underline{text}`		Underline

5.2. Font size

`\tiny`	tiny	`\Large`	Large
`\scriptsize`	scriptsize	`\LARGE`	LARGE
`\footnotesize`	footnotesize	`\huge`	huge
`\small`	small	`\Huge`	Huge
`\normalsize`	normalsize		
`\large`	large		

5.3. Justification

Environment	Declaration	Other
`\begin{center}`	`\centering`	*text* `\vfill` *text*
`\begin{flushleft}`	`\raggedright`	*text* `\hfill` *text*
`\begin{flushright}`	`\raggedleft`	

6. Math Equations

Textstyle: `$x^2 + 4$`, $x^2 + 4$ as part of the text.
Disyplaystyle: `\begin{equation} x^2 + 4 \end{equation}`

$$\lambda := \lim_{x_1 \to \infty} \int_{x_0}^{x_1} \frac{f\left(\frac{t}{2}\right)}{\sqrt[n]{t^2 + \sin^2(t)}} \, \mathrm{d}t \overset{!}{\leq} 1 \tag{1}$$

for numbered equations. use the * variant for unnumbered equations.

6.1. Fonts and Sizes in Math Mode

`\scriptscriptstyle`, `\scriptstyle`, `\textstyle`, `\displaystyle`
`\mathrm`, `\mathit`, `\mathbb`, `\mathcal`, `\mathfrak`

6.2. Often used math expressions

x^{n+1}	`x^{n+1}`	E_{kin}	`E_{\mathrm{kin}}`
$\frac{a+b}{2}$	`\frac{a+b}{2}`	$\sqrt[n]{a^2+b^2}$	`\sqrt[n]{a^2+b^2}`
$x_1, \ldots, x_n$	`x_1 , \ldots, x_n`		
$x_1 + \cdots + x_n$	`x_1 + \cdots + x_n`		
$\left(a + \frac{1}{2}\right)^2$	`\left( a + \frac12 \right)^2`		
$\sum_{i=1}^{N}, \prod_{i=1}^{N}$	`\sum\limits_{i=1}^{N}, \prod\limits_{i=1}^{N}`		
$\boldsymbol{F}_{\perp}, \boldsymbol{F}_{\parallel}$	`\vec F_{\perp}, \vec F_{\parallel}`		
$\lim_{a \to \infty}$	`\lim\limits_{a \rightarrow \infty}`		
$\int_a^b x^2 \, \mathrm{d}x$	`\int\limits_a^b x^2\; \mathrm{d}x`		
$\left.\frac{\mathrm{d}f}{\mathrm{d}x}\right\|_{x_0}$	`\left.\frac{\mathrm df}{\mathrm dx} \right|_{x_0}`		
$\boldsymbol{a}^\top, A^\dagger, A^*$	`\vec a^\top, A^\dagger, A^*`		
$\overset{!}{<}, \overset{\text{def}}{=}$	`\stackrel{!}{<}, \stackrel{\rm def}{=}`		

6.3. Math function names (upright, correct spacing)

`\sin`	`\sinh`	`\arcsin`	`\csc`	`\ln`	`\min`
`\cos`	`\cosh`	`\arccos`	`\sec`	`\lg`	`\max`
`\tan`	`\tanh`	`\arctan`	`\cot`	`\log`	`\lim`
`\exp`	`\det`	`\tr`	`\dim`	`\ker`	`\Pr`

6.4. Important Math functions

$\sum$	`\sum`	$\prod$	`\prod`	$\int$	`\int`		
$\int$	`\int`	$\iint$	`\iint`	$\iiint$	`\iiint`	$\oint$	`\oint`
$\boldsymbol{a}$	`\vec a`	$\dot{a}$	`\dot a`	$\ddot{a}$	`\ddot a`	$\hat{a}$	`\hat a`

6.5. Important Symbols in Mathmode

$+$	`+`	$-$	`-`	$\pm$	`\pm`	$\mp$	`\mp`
$<$	`<`	$\leq$	`\le`	$\ll$	`\ll`	$\cdot$	`\cdot`
$>$	`>`	$\geq$	`\ge`	$\gg$	`\gg`	$\times$	`\times`
$=$	`=`	$\neq$	`\ne`	$\equiv$	`\equiv`	$\approx$	`\approx`
$\|$	`|`	$\perp$	`\perp`	$\|$	`\mid`	$\parallel$	`\parallel`
f'	`f'`	∇	`\nabla`	Δ	`\Delta`	∂	`\partial`
$\in$	`\in`	$\forall$	`\forall`	$\exists$	`\exists`	$\nexists$	`\nexists`
$\cap$	`\cap`	$\cup$	`\cup`	$\notin$	`\notin`	$\setminus$	`\setminus`
ℓ	`\ell`	$\angle$	`\angle`	$\circ$	`\circ`	$\emptyset$	`\emptyset`
$\vee$	`\lor`	$\wedge$	`\land`	$\neg$	`\lnot`	$\varnothing$	`\varnothing`
$\top$	`\top`	$\bot$	`\bot`	∞	`\infty`	$\propto$	`\propto`

6.6. Delimeters

(.)	(.)	[.]	[.]	⌊.⌋	\lfloor.\rfloor
|.|	|.|	{.}	\{.\}	⌈.⌉	\lceil.\rceil
‖.‖	|.|	|.|	\vert.\vert	⟨.⟩	\langle.\rangle

Use \left(*expr* \right) to stretch any delimeter to the height of *expr*
Or \big, \Big, \bigg for manual sizing e.g. \Big\| \Big\|

6.7. Arrows

Every combination of left,right,up,down with arrow(s)

↦	\mapsto	⇝	\leadsto
→	\rightarrow	⇒	\Rightarrow
⟶	\longrightarrow	⟹	\Longrightarrow
←	\leftarrow	⇐	\Leftarrow
⟵	\longleftarrow	⟸	\Longleftarrow
↑	\uparrow	⇑	\Uparrow
↓	\downarrow	⇓	\Downarrow
↔	\leftrightarrow	⇔	\Leftrightarrow
⇇	\leftleftarrows	⇉	\rightrightarrows
⇆	\leftrightarrows	⇄	\rightleftarrows
⇋	\leftrightharpoons	⇌	\rightleftharpoons

6.8. Physical Units with `siunitx`

Use the package `siunitx` for correct display of numbers and units. It provide the commands \num{<number>}, \si{<unit>}, and \SI{<number>}{<unit>}. Some examples:

$7.123\,456 \times 10^{12}$ \num{7.123456e12}

$[g] = \mathrm{m\,s^{-2}}$ [g] = \si{\meter \per \second \squared}

$E = 1.3\ \frac{\mathrm{kV}}{\mathrm{mm}}$ E = \SI{1.3}{\kilo\volt\per\milli\meter}

You can use all SI units (pascal, henry, ...) and not only the base units. It is also possible to change the style of display with \sisetup{per-mode=reciprocal} or \sisetup{per-mode=fraction}:
Prefixes like \kilo,\deca,\mega,\micro

7. LaTeX4EI classes & packages

`latex4ei_thesis`: layout with TUM colors
`scientific`: useful scientific macros

$\mathrm{d}x$	\diff x	$\mathbb{N}, \mathbb{R}, \mathbb{C}$	\N, \R, \C
$\underline{\boldsymbol{x}}$	\vec x	$\begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$	\vect{ x_1 \\ x_2 }
$\underline{\underline{\boldsymbol{A}}}$	\ma A	$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$	\mat{ 1 & 2 \\ 3 & 4}
$\circ\!\!-\!\!\bullet^{\mathcal{F}}$	\FT	$\circ\!\!-\!\!\bullet^{\mathcal{DTF}}$	\DTFT
$\circ\!\!-\!\!\bullet^{\mathcal{L}}$	\LT	$\circ\!\!-\!\!\bullet^{\mathcal{Z}}$	\ZT

Additional function names (upright, correct spacing):
\const, \sinc, \grad, \rot, \div, \tri, \rect, \erf

8. Floating Environments

8.1. Figures with `graphicx`

```
\begin{figure}
        \centering
        \includegraphics[width=9cm]{./img/diagram.pd
        \caption[title for LOF]{this is the long tit
        \label{fig:example1}
\end{figure}
```

Load image: \includegraphics[width=*x*]{*file*}
Alter numbering: \renewcommand\thefigure{\arabic{figure}}

8.1.1 Subfigures with `subfigure`

Usage \subfigure[*caption*]{*graphic, label*}

8.2. Tables

```
\begin{table}
        \centering
        \begin{tabular}{ll}
                \textsc{Name} & \textsc{Desc.}\\ \hl
                test1 & is no good idea &\\
                bla2 & even worse &\\
        \end{tabular}
        \caption{My first Table}
        \label{tab:example1}
\end{table}
```

Usage: \begin{tabular}[htbp]{@{}lrc|p{3cm}}
Column distance: \setlength{\tabcolsep}{5pt}
Adjust row distance: \renewcommand{\arraystretch}{1.5}
Partial lines: \cline{2-3} instead of \hline
Additional packages: `longtable`, `booktabs`, `colortbl`

8.3. Source Code Listings with `listings`

Options: \lstset{basicstyle=\tt, language=C}
Languages: C,C++,Java,Matlab,Python,HTML,XML,bash,...

Environment: \begin{lstlisting} *code* \end{lstlisting}
Inline: \lstinline?*code*?

```
\begin{lstlisting}
int i=0;
for(i = 0; i < 10; i++){
        printf("Line %i", i);
}
\end{ltlisting}          % missing s!
```

9. Correct Typography

9.1. Hyphen and Dashes

Rule: The hyphen is never placed between two spaces!

Name	Source	Example	Usage
hyphen	-	X-ray, in- and output	connect words
en-dash	--	1 – 5, Paris – Rom	seperate numbers.
em-dash	---	Yes—or no?	Punctuation.
minus	$-$	$5 - 3 = 2$	Equations.

9.2. Quotation Marks

Language	Symbols	LaTeX
German	„ , . . . ‘ “	\glqq \glq ... \grq \grqq
English	“ ‘ . . . ’ ”	`` \lq ... \rq ''
France	≪<... >≫	\flqq \flq ... \frq \frqq

“I think”, said Anna, “he shouted ‘This is Lars’s car!’, when I saw him.”

9.3. Numbers and Dates

Numbers	Look	Usage
old-style	1234567890	as part of text, dates
lining	1234567890	as math value

British	American	German
27/06/93	06/27/93	27.06.1993
27 June, 1993	June 27, 1993	27. Juni 1993

International notation (ISO 8601): yyyy-mm-dd: 1993-06-27

9.4. Spacing

a\!b	ab	a\,b	a b	a\;b	a b	a\quad b	a b
ab	ab	a\>b	a b	a\ b	a b	a\qquad b	a b

\hspace{*length*}, \vspace{*length*} *: even at line start
, \vphantom{*text*}
Protected space ~

9.5. Boxes and Rules

Normal: \parbox[pos][height][contentpos]{width}{text} or \begin{minipage}[pos][height][contentpos]{width} text

Prevent line breaking: \mbox{text}
Lift Text: \raisebox{lift}[height][depth]{text}
Framed Box: \framebox[width][pos]{text} or \fbox{text}
Resize: \scalebox{10}{Giant}
Lengths: \setlength{\fboxsep}{10pt}, \setlength{\fboxrule}{2pt}

10. Bibliography with BibTeX

10.1. BibTeX entry types

`@article`	Journal or magazine article. fields: `author, title, journal, year, volume`
`@book`	Book with publisher. fields: `author/editor, title, publisher, year`
`@techreport`	Tech report, usually numbered in series. fields: `author, title, institution, year`
`@phdthesis`	PhD. or other thesis. fields: `author, title, school, year`

```
\bibliographystyle{alphadin}
\bibliography{<bibliographyfile.bib>}
```

10.2. References with `hyperref`

\cite{*key*}	Cite a reference
\label{*marker*}	Set a marker for cross-reference, often of the form \label{sec:item} like \label{fig:diag1}.
\ref{*marker*}	Give section/body number of marker.
\pageref{*marker*}	Give page number of marker.
\footnote{*text*}	Print footnote at bottom of page.
\url{*url*}	Creates click-able web-adress.
\href[*options*]{*url*}{*text*}	click-able link
\hyperref[*marker*]{*text*}	click-able ref

10.3. Reference management software supporting BibTeX

Mendeley: free, Win/Linux/Mac, import from several websites
Citavi: free, Win

11. Include beautiful Matlab Plots

Same font, line width, vector graphic

12. Own Commands and Writing Packages

\usepackage[options]{package}	load package
\newcommand[paranum]{\newcmd}{tex #1}	define command
\renewcommand{\cmd}{ latex #1,#2 }	alter command
\let\cmdcopy\cmd	copy a command

Read this document CTAN

Some important variables:
Counters: \thepage, \thesection, \thefigure
Lengths: \textwidth, \parindent, \parskip

12.1. Plain TeX

These plain TeX commands should be used carefully

Fonts	\rm, \sf, \sc, \sl, \it, \tt
Definitions	\def\newcmd{texcode}, \let\newcmd\cmd
If	\ifnum\counter<10 true text \else false text \fi

13. Useful Weblinks

LaTeX4EI	www.latex4ei.de
Font & Symbols	https://de.wikipedia.org/wiki/Hilfe:TeX
Color Schemes	http://colorschemedesigner.com

Tipps for Package Writers: