MUNI
FI

LaTeX

for beginners

Petr Sojka
sojka@fi.muni.cz

Faculty of Informatics
Masaryk University

Czech Republic

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Outline

What Is It TEX?

TEX [teck, $\tau\epsilon\chi$] is *the* typesetting system developed by Donald Ervin Knuth at Stanford University. TEX sets standard for typesetting in mathematics, science, and engineering. Typographic quality is comparable with the top craft typesetting.

- pronunciation
- history (1977)
- spirit, status
- principles (batch processing)

What Is It LaTeX?

"LaTeX adds to TeX a collection of commands that simplify typesetting by letting the user concentrate on the structure of the text rather than on formatting commands. In turning TeX into LaTeX, I have tried to convert a highly-tuned racing car into a comfortable family sedan. The family sedan isn't meant to go as fast as a racing car or be as exciting to drive, but it's comfortable and gets you to the grocery store with no fuss. However, the LaTeX sedan has all the power of TeX hidden under its hood, and the more adventurous driver can do everything with it that he can with TeX."

Leslie Lamport

"LaTeX is TeX for intelectuals."

Philip Taylor

Advantages of LaTeX

- There is a bunch of predefined *document styles* and page layouts. This allows beginner to prepare documents of professional look.
- Typesetting of math has special support.
- User is supposed to type only several easy understandable markers to specify *logical structure* of document and leaves the rest (typesetting) to LaTeX.
- Without much effort we may generate complex structures like table of contents, lists of tables, figures, indexes, tables, cross references etc.
- Many publishers offer LaTeX style files and accept submissions in electronic form as a LaTeX file.

Disadvantages of LaTeX

- Slightly higher demands on the computer hardware than with smaller programs for word processing.
- Created documents may be printed only on graphic output devices.
- Predefined layout can be modified by lots of parameters, but radical changes of style files require deep understanding of the system.

Typographic Design

"Typographic design ist a craft, that has to be learnt. Novice authors are making severe typesetting errors. Laymans errorously think that book design is first of all the question of æsthetics—if the document looks well, it is already well 'designed'. But documents are supposed to be read and not seen in museums—readability and better understanding are more important than appearance."

Hubert Partl

Typographic Rules

- Paragraphs
- Line length
- Quotation marks
- Choosing of typefaces, fonts
- Ligatures
- Punctuation marks
- Kerning
- Interword spacing
- Emphasizing

LaTeX Document Structure

```
\documentclass[options]{style}
%␣␣␣preamble
\begin{document}%␣␣document␣body
This␣is␣my␣first␣text␣in␣LaTeX␣(or␣rather␣\LaTeX).
No␣worries␣about␣line␣justification.␣␣It␣doesn't
matter␣how␣␣many␣␣spaces␣␣␣␣␣␣␣␣␣you␣␣␣␣␣␣␣␣␣␣␣type.

New␣paragraph␣is␣separated␣by␣one␣or
more␣blank␣lines.␣␣%␣this␣is␣comment
\end{document}
```

This is my first text in LaTeX (or rather LaTeX). No worries about line
justification. It doesn't matter how many spaces you type.
New paragraph is separated by one or more blank lines.

Preparing an Input File

- Local Guide
- Ascii editor
- `sample.tex`, `small.tex`
- 0 vs. O, 1 vs. l
- Special characters
  # $ % & ~ _ ^ \ { }
- Simple control sequences
- Comments
- Bad habits (underlining)

Special Symbols I.

$	\\$	dollar sign
&	\\&	ampersand
%	\\%	percent sign
#	\\#	hash mark
_	_	underscore
{	\\{	left curly brace
}	\\}	right curly brace
~	\\~{}	tilde
^	\\^{}	caret
\\	$\backslash$	backslash

Special Symbols II.

¶	\P	paragraph sign (pilcrow)
§	\S	section number sign
£	\pounds	pound sign
'	\lq	left quote
'	\rq	right quote
[,[	\lbrack,[	left square bracket
],]	\rbrack,]	right square bracket
†	\dag	dagger or obelisk
‡	\ddag	double dagger or diesis
©	\copyright	copyright sign
ˆ	$\hat{}$	
π	π	
♡	$\heartsuit$	
α	α	

Simple Text Generating Commands

TeX	`\TeX`
LaTeX	`\LaTeX`
...	`\ldots`
⋯	`$\cdots$`
•	`$\bullet$`
10th September 2021	`\today`

Macro Syntax

Today is 10th September 2021.

(we used macro \today␣).

```
\documentclass[11pt]{article}
\begin{document}
Today is \today .\\*[2mm]
(we used macro \verb*|\today |.)
\end{document}
```

Symbols From Those Other Languages I

ò	\`{o}	o grave
õ	\~{o}	tilde or squiggle
ó	\'{o}	o acute
ō	\={o}	bar or macron
ô	\^{o}	o circumflex (hat)
ö	\"{o}	o umlaut or dieresis
ŏ	\u{o}	o breve
ő	\H{o}	double acute (long Hungarian)
ọ	\d{o}	o dot under
o̱	\b{o}	bar under o
č	\v{c}	c caron
ç	\c{c}	c cedilla
ġ	\.{g}	g dot above
o͡o	\t{oo}	oo tie after

Symbols From Those Other Languages II

œ	\oe	oe digraph
Œ	\OE	OE digraph
å	\aa	a ring
Å	\AA	A ring
æ	\ae	ae digraph
Æ	\AE	AE digraph
ø	\o	o slash
Ø	\O	O slash
ł	\l	polish l
Ł	\L	suppressed L
ß	\ss	German Es-Zet (sharp S)
ı	\i	dotless i
ȷ	\j	dotless j

Quotation Marks

'Convention' dictates that punctuation go inside quotes, like "this," but I think it's better to do "this". "'TEX' or 'LATEX?'" he asked.

```
'Convention' dictates that
punctuation go inside quotes,
like ''this,'' but I think
it's better to do ''this''.
''\,'\TeX' or '\LaTeX?'\,'' he asked.
```

Hyphen, Dash, Emdash, Minus Sign

one-hour lesson, 9–11 am
ano – nebo ne?, yes—or no?
0, 1 and -1

```
one-hour lesson, 9--11 am
ano~-- nebo ne?, yes---or no?
0, 1 and $-1$
```

Punctuation

TeX (LaTeX, etc.) are worth learning, IMHO.

```
\TeX\_(\LaTeX,
etc.)\_are_worth_learning,
IMHO\@.
```

```
\frenchspacing      \nonfrenchspacing
( ? ! )
```

Preventing Line Breaks

```
Mr. Major      Figure 5
Chapter 2      U. S. Grant
from 1 to 10   (1) gnats
      a clever person
    never hyphenate this
```

```
Mr.~Major        Figure~5
Chapter~2        U.~S.~Grant
from 1 to~10   (1)~gnats
      a~clever person
\mbox{never hyphenate this}
```

Emphasizing, Italic Correction

TₑX is *the* typesetting system. *Try* it!

```
\TeX\ is {\em the\/} typesetting system.
\begin{em}Try\/\end{em} it!
```

You can have *emphasized text* within *emphasized text* too.

```
You can have {\em emphasized text\/
{\em within\/} emphasized text\/} too.
```

You *should*n't do this!

```
You {\em should}n't do this!
```

Footnotes

Karel Čapek[1] has invented the word *Robot* in his drama RUR[2017].

```
Karel \v{C}apek\footnote{Famous
Czech writer} has invented the word
{\em Robot\/} in his drama
RUR\@\footnote[2017]{Rossum's
Universal Robots}.

\footnote[num]
\footnotemark[num]
\footnotetext[num]{text}
```

---

[1]Famous Czech writer

[2017]Rossum's Universal Robots

Document Styles

- standard LaTeX (Lamport) [heavily enriched in LaTeX 3].
    - article for articles in scientific magazines, seminar works
    - report for longer reports, consisting of chapters
    - book for books (parts)
    - letter for letter writing
- supported (journal styles, …) — *Local Guide*
- unsupported (misc)

`mubeamer` document class was used for preparation of these slides.

Document Style Options

[10pt], 11pt, 12pt selection of normal size of document fonts

fleqn mathematical equations are aligned to the left instead of centering them

leqno numbering of equations is on the left instead of on the right of every equation

titlepage extra title page with `article.sty`

proc proceedings option with `article.sty`

twocolumn option for two column typesetting

twoside twosided document (different typesetting (headers, margins, . . .) when on the left page or on the right one)

ifthen option for conditionals

makeidx option for makeindex support

bezier option for bezier curves support

Titlepage I

How to prove
Fermat's Last Theorem

Andrew Wiles

July 1993

```
\documentclass[11pt]{article}
\title{How to prove\\
        Fermat's Last Theorem}
\author{Andrew Wiles}
\date{July 1993}

\begin{document}
```

Titlepage II

```
\begin{titlepage}
\maketitle
\begin{abstract}
...
\end{abstract}
\end{titlepage}
...
\end{document}
```

Basic Sectioning Commands I

1   Introduction

LaTeX automatically generates the section number (or not).

About Fermat

Blank lines before or after a sectioning command have no effect.

1.0.1   About Fermat's "proof"

Basic Sectioning Commands II

```
\section{Introduction}
\LaTeX\ automatically generates
the section number.

\subsection*{About Fermat}
Blank lines before or after
a sectioning command have no effect.

\subsubsection{About Fermat's ``proof''}
```

Sectioning Commands

```
\part        \subsection
\chapter     \subsubsection
\appendix    \paragraph
\section     \subparagraph
```

Fragile Commands

```
\(  \) \[ \] \begin \end \footnote \verb
    any  * commands
```

```
\subsection{My \protect\(%
        \heartsuit\protect\)}
```

1.1 My ♡

Structuring Document Input

- \input
- \include
- \includeonly
- \endinput
- \end{document} trick

```
\documentstyle{seminar}
\includeonly{part2}
\begin{document}
\include{part1}
\include{part2}
\include{part3}
\end{document}
```

Dimensions

pt	point
pc	pica (1pc = 12pt)
in	inch (1in = 72.27pt)
bp	big point (72bp = 1in)
cm	centimeter (2.54cm = 1in)
mm	millimeter (10mm = 1cm)
dd	didot point (1157dd = 1238pt)
cc	cicero (1cc = 12dd)
sp	scaled point (65536sp = 1pt)

```
3␣in  29␣pc +42,1␣dd  -.01in 0.mm
```

Glue

- space, stretch, shrink
- natural width
- $< dimen >$ plus $< dimen >$ minus $< dimen >$

```
10pt plus 5pt minus 2pt
```

Modes

- **Vertical mode** (building the main vertical list)
- **Internal vertical mode** (building vertical list for an vbox)
- **Horizontal mode** (building a horizontal list for a paragraph)
- **Restricted horizontal mode** (building horizontal list for an hbox)
- **Math mode** (building a mathematical formula to be placed in horizontal list)
- **Display mathematical mode** (building a mathematical formula to be placed on a line by itself, temporarily interrupting the current paragraph)

Boxes

- reference point
- baseline
- height, width, depth

Two lines
of type.
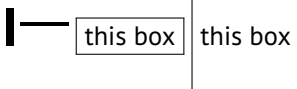
this box | this box

```
\vbox{\hbox{Two lines}\hbox{of type.}}
\rule{1mm}{5mm}
\rule[.1in]{.25in}{.02in}
\fbox{this box}
\fbox{\rule[-.5cm]{0cm}{1cm}this box}
\hrule  % \vrule
```

Raising, Lowering, Saving Boxes

You can ^{raise} or $_{lower}$ text. |text| It's   gnats   and   gnats   and
  gnats   , wherever we go.

```
You can \raisebox{.6ex}{\em raise}
or \raisebox{-.6ex}{\em lower} text.
\vrule\raisebox{.4ex}[1.5ex][.75ex]{\em text}%
\vrule
\newsavebox{\toy}
\savebox{\toy}[.65in]{gnats}
It's \usebox{\toy} and \usebox{\toy}
and \usebox{\toy}, wherever we go.
```

LR Boxes

> *gnus*   are here …
> *gnus*   are here …
>   *gnus* are here …
> *gnus* are here …
> There was not a [gnu   ] or [armadillos] in sight.

```
\begin{flushleft}
\makebox[1in]{\em gnus} are here \ldots\\
\makebox[1in][l]{\em gnus} are here \ldots\\
\makebox[1in][r]{\em gnus} are here \ldots\\
\mbox{\em gnus} are here \ldots\\
There was not a
\framebox[1in][l]{gnu} or
\fbox{armadillos} in sight.
\end{flushleft}
```

Horizontal Spacing I

Here   is 1 in space.
Here   is 1 in space.
Here   is 1 in space.

```
Here\hspace*{1in}is 1\,in space.

Here\hspace{1in}is 1\,in space.

Here \hspace*{1in} is 1\,in space.
```

left   right
leftmiddle   right

```
left\hfill right

left\hfil middle\hfill right
```

Horizontal Spacing II

`\,`	very small space
`\enspace`	as wide as number
`\quad`	as wide as a basefont is high
`\qquad`	twice as wide as `\quad`
`\hfill`	stretchable space (from 0 to ∞)
`\hss`	stretchable and shrinkable space

Vertical Spacing I

Here

is 1 in space.

Here

```
\vspace*{1in} is 1\,in space.

\vspace{1cm}
\vspace*{1cm}
```

Vertical Spacing II

\smallskip	about $\frac{1}{4}$ of lineskip
\medskip	about $\frac{1}{2}$ of lineskip
\bigskip	about 1 lineskip
\vfill	stretchable space (from 0 to ∞)
\vss	stretchable and shrinkable space

Grouping

- Global/local parameters
- Nesting
- Syntax

{ }

\begin{*environmentname*}
\end{*environmentname*}

```
\begingroup
\endgroup
```

Quotation, Quote

From the Time magazine:

> *In 1637 a French lawyer, poet and mathematician Pierre de Fermat wrote in the margin of a book:*
>
> > *"I have found a truly wonderful proof, which this margin is too small to contain."*

```
From the Time magazine:
\begin{quote}
In 1637 a French lawyer, poet and mathematician
Pierre de Fermat wrote in the margin of a book:\newline
\begin{quotation}
''I have found a truly wonderful proof,
which this margin is too small to contain.''
\end{quotation}
\end{quote}
```

Lists—Itemize

Czechoslovakia has spread into

- The Slovak Republic
- The Czech Republic. It consists of
    - Bohemia
    - Moravia
    - Silesia

```
Czechoslovakia has spread into
\begin{itemize}
\item The Slovak Republic
\item The Czech Republic. It consists of
   \begin{itemize}
     \item Bohemia
     \item Moravia
     \item Silesia
   \end{itemize}
\end{itemize}
```

Lists—Description

Three animals you should know about are:

> gnat: A small animal, found in the North Woods, that causes no end of trouble.
>
> gnu: A large animal, found in crossword puzzles, that causes no end of trouble.
>
> armadillo: A medium-sized animal, named after a medium-sized Texas city.

```
Three animals you should know about are:
\begin{description}
\item[gnat:] A small animal, found in the North
   Woods, that causes no end of trouble.
\item[gnu:] A large animal, found in crossword
   puzzles, that causes no end of trouble.
\item[armadillo:] A medium-sized animal, named
   after a medium-sized Texas city.
\end{description}
```

Lists—Enumerate

1. level one
   1.1 level two
       1.1.1 level three

```
\begin{enumerate}
\item level one
  \begin{enumerate}
   \item level two
    \begin{enumerate}
     \item level three
    \end{enumerate}
  \end{enumerate}
\end{enumerate}
```

Between Left and Right

Is there something between

Conservative

and

Labour

Party?
Yes.

```
\centerline{Is there something between}
\begin{flushright} Conservative \end{flushright}
\begin{center} and \end{center}
\begin{flushleft} Labour \end{flushleft}
\begin{center}
Party?\\[1mm]
Yes.
\end{center}
```

Simulating Typed Text

Command \input is very useful.

```
Command \verb+\input+ is very useful.
```

```
\begin{verbatim}
Command \verb+\input+ is very useful.
\end{verbatim}
```

```
\obeylines
\obeyspaces
\verb*
\begin{verbatim*}
```

Tabbing Environment

If it's raining
  then put on boots,
      take hat;
  else smile.
Leave house.

```
\begin{tabbing}
If \= it's raining         \\
   \> then \= put on boots, \\
   \>      \> take hat;      \\
   \> else \> smile.         \\
Leave house.
\end{tabbing}
```

Tabbing Environment I

Gnat: swatted by: men
                     cows
             and gnus
      not very filling
Armadillo: not edible
(note also the: aardvark éèē
    albatross eton)
Gnu: eaten by   gnats

Tabbing Environment II

```
\begin{tabbing}
  Armadillo: \=                      \kill
  Gnat:      \> swatted by: \= men \+\+ \\
                                 cows       \\
                      and \' gnus  \-  \\
              not very filling    \-    \\
  Armadillo: \> not edible                \\
\pushtabs
 (note also the: \= aardvark \a'e\a`e\a=e\\
              \> albatross  \' eton)   \\
\poptabs
 Gnu:       \> eaten by   \> gnats
\end{tabbing}
```

Tabular Environment I

GG&A Hoofed Stock		
Year	**Price**	**Comments**
1971	97–245	Bad year for farmers in the west.
72	245–245	Light trading due to a heavy winter.
73	245–2001	No gnus was very good gnus this year.

Tabular Environment II

```
\begin{tabular}{|r||c|p{.4\textwidth}|}
\hline
\multicolumn{3}{|c|}{\sc GG\&A Hoofed Stock} \\
\hline\hline
\multicolumn{1}{|c||}{\bf Year}
 & \bf Price
   & \multicolumn{1}{c|}{\bf Comments} \\
\hline
\it 1971 & 97--245  & Bad year for
      farmers in the west. \\ \hline
\it   72 & 245--245 & Light trading
    due to a heavy winter. \\ \hline
\it   73 & 245--2001& No gnus was
 very good gnus this year. \\ \hline
\end{tabular}
```

Tabular Parameters

```
\arraycolsep
\tabcolsep
\arrayrulewidth
\doublerulesep
\arraystretch

\begin{tabular}{\textwidth}[t]
 {@{\extracolsep{\fill}}|l|*{3}{r}|%
 p{3cm}@{--}r|}
```

Floats—Figure

In Figure 1 (page 55) you see Czechia.

$\square$

Figure 1: Map of Czechia

```
In Figure~\ref{czechia} (page~\pageref{czechia}) you
see Czechia.
\begin{figure}[htbp]
  \centerline{\framebox{{\CountriesOfEuropeFamily
                           \EUCountry{136}}}}
\caption{Map of Czechia}
\label{czechia}
\end{figure}
```

Floats I

Tables

Table 1 gives the overview of the presidents of parts of the former Czechoslovakia.

Table 1: Presidents

State	President
The Czech Republic	V. Havel
The Slovak Republic	M. Kováč

Floats II

Tables

```
Table~1 gives the overview of the presidents
of parts of the former Czechoslovakia.
\begin{table}[tbp]
\caption[Presidents]{Presidents}
\label{presidents}
\begin{tabular}{|l|r|}\hline
State                  & President\\
\hline\hline
The Czech Republic:  & V. Havel \\
The Slovak Republic: & V. Kov\'{a}\v{c}\\
\hline
\end{tabular}
\end{table}
```

Parameters of Float Placement

```
\topfraction
bottomnumber
\bottomfraction
totalnumber
\textfraction
\floatpagefraction
dbltopnumber
\dblfloatpagefraction
\floatsep
\textfloatsep
\intextsep
\dblfloatsep
\dbltextfloatsep
```

Picture Environment I
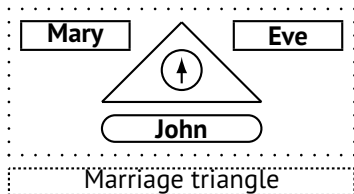

```
\setlength{\unitlength}{1mm} \thicklines
\begin{picture}(130,70)
\put(0,0){\dashbox(130,10){{\sf Marriage triangle}}}
\multiput(0,15)(5,0){27}{\circle*{1}}
\multiput(0,70)(5,0){27}{\circle*{1}}
\multiput(0,15)(0,5){11}{\circle*{1}}
\multiput(130,15)(0,5){11}{\circle*{1}}
\put(65,25){\oval(60,10)}
\put(65,20){\makebox(0,10){{\normalsize\bf John}}}
\put(35,35){\line(1,0){60}}
```

Picture Environment II

```
\put(35,35){\line(1,1){30}}
\put(95,35){\line(-1,1){30}}
\put(65,47){\circle{15}}
\put(65,42){\vector(0,1){10}}
\put(5,55){\framebox(40,10){{\normalsize\bf Mary}}}
\put(85,55){\framebox(40,10){{\normalsize\bf Eve}}}
\end{picture}
```

Fonts

Basic Concepts

- Shape
- Series
- Size
- Family
- font table, `testfont.tex`
- NFSS, `oldlfont`

Fonts
Shapes

```
\rm \textrm{...}    roman
\bf \textbf{...}    boldface
\it \textit{...}    italic
\sl \textsl{...}    slanted
\sf \textsf{...}    'sans serif'
\sc \textsc{...}    'Caps and Small Caps'
\tt \texttt{...}    typewriter
\boldmath           bold type in math formulæ

\shape{sc}\selectfont
\normalshape
```

Fonts
Series

Weight		Width	
Ultra Light	ul	Ultra Condensed	uc
Extra Light	el	Extra Condensed	ec
Light	l	Condensed	c
Semilight	sl	Semicondensed	sc
Medium (normal)	m	Medium	m
Semibold	sb	Semiexpanded	sx
Bold	b	Expanded	x
Extra Bold	eb	Extra Expanded	ex
Ultra Bold	ub	Ultra Expanded	ux

```
\series{bx}\selectfont
\mediumseries
```

Fonts

Sizing

`\tiny`	tiny
`\scriptsize`	scriptsize (indexes)
`\footnotesize`	footnotesize (footnotes)
`\small`	small
`\normalsize`	normalsize
`\large`	large
`\Large`	Large
`\LARGE`	LARGE
`\huge`	huge
`\Huge`	Huge

`\size{14}{18pt}\selectfont`

Fonts
Families

Font file name	Family

`cmr10, cmti10, cmsl10,`
`cmcsc10, cmu10, cmbx10,`
`cmbxti, cmbxsl, cmb10`
	Computer
	modern
	roman (`cmr`)

`cmss10, cmssi10,` `cmssbx10, cmssdc10`	Computer modern sans serif (`cmss`)
`cmtt10, cmitt10, cmsltt,` `cmtcsc10`	Computer modern typewriter (`cmtt`))

```
\renewcommand{\rmdefault}{pstr}
\renewcommand{\sfdefault}{pshel}
\renewcommand{\sldefault}{it}
```

Loading Fonts

```
\newfont{\EUmapf}{countriesofeurope scaled 10000 }
\newcommand{\Czechoslovakia}{{\EUmapf
      \symbol{136} and \symbol{162}}}
\Czechoslovakia
```

Math in text

For the equation $x^n + y^n = z^n$ where n is an integer greater than 2, there is no solution in positive integers.

```
For the equation $x^n+y^n=z^n$ where $n$
is an integer greater than $2$, there is
no solution in positive integers.
```

or

```
For the equation
\begin{math} x^n+y^n=z^n \end{math} where
\(n\) is an integer greater than $2$,
there is no solution in positive integers.
```

Math Styles

```
\displaystyle
\textstyle
\scriptstyle
\scriptscriptstyle
```

$\frac{1^1}{2^2}$
$\frac{1^1}{2^2}$

```
$\frac{\frac{1^1}{2^2}}
      {\textstyle\frac{1^1}{2^2}}$
\jot
\mathindent
\abovedisplayskip
\belowdisplayskip
\abovedisplayshortskip
\belowdisplayshortskip
```

Math Formulæ
On separate line

For the equation
$$x^n + y^n = z^n$$
where *n* is an integer greater than 2, there is no solution in positive integers.

```
For the equation
\begin{displaymath}
x^n+y^n=z^n
\end{displaymath}
where \(n\) is an integer
greater than $2$, there is
no solution in positive integers.
```

Math Symbols

$$\det_i, \gcd_i, \inf_i, \lim_i, \limsup_i, \max_i, \min_i, \Pr_i, \sup_i$$

$$a \bmod b, a \pmod{10}, \aleph, \prime, \forall, \infty, \hbar$$

$$\emptyset, \exists, \Box, \imath, \nabla, \neg, \Diamond, \ldots$$

```
\[ \det_i, \gcd_i, \inf_i, \lim_i,
   \limsup_i, \max_i, \min_i, \Pr_i,
   \sup_i \]
\[ a \bmod b, a \pmod{10}, \aleph,
   \prime, \forall, \infty, \hbar \]
\[ \emptyset, \exists, \Box, \imath,
    \nabla, \neg, \Diamond, \ldots \]
```

Numbered Equations

For the equation

$$x^n + y^n = z^n \qquad (1)$$

where n is an integer greater than 2, there is no solution in positive integers.

```
For the equation
\begin{equation}
x^n+y^n=z^n
\end{equation}
where \(n\) is an integer
greater than $2$, there is
no solution in positive integers.
```

Math Formulæ I

Exponents and indexes

$$x^5 \qquad x_1$$

```
x^5 \qquad x_1
```

Square roots

$$\sqrt{x^2 + \sqrt[3]{y}}$$

```
\sqrt{x^2+\sqrt[3]{y}}
```

Math Formulæ II

Fractions

$$\frac{1}{\frac{x^2+y^2+z^2}{x+y}}$$

```
\frac{1}{\frac{x^2+y^2+z^2}{x+y}}
```

Binomic coeficients

$$\binom{n}{n-k}$$

```
{n\choose {n-k}}
```

Math Formulæ III

Integrals

$$\int\limits_{-\infty}^{\infty} x^3\,dx$$

```
\int \limits_{-\infty}^{\infty}x^3 dx
```

Sums

$$\sum_{i=1}^{n} a_i$$

```
\sum_{i=1}^{n}a_i
```

Math Formulæ IV

Parentheses

$$\Bigl((x+1)(x-1)\Bigr)^2$$

```
\Bigl( (x+1) (x-1)\Bigr) ^{2}
```

$$((x+1)(x-1))^2$$

```
\left( (x+1) (x-1)\right) ^{2}
```

Math Formulæ V

Arrays

$$\mathcal{X} = \begin{pmatrix} x_{11} & x_{12} & \ldots \\ x_{21} & x_{22} & \ldots \\ \vdots & \vdots & \ddots \end{pmatrix}$$

```
{\cal X} =
\left( \begin{array}{ccc}
x_{11} & x_{12} & \ldots \\
x_{21} & x_{22} & \ldots \\
\vdots & \vdots & \ddots
\end{array} \right)
```

Math Formulæ VI

System of Equations

$$f(x) = \cos x \qquad (2)$$
$$f'(x) = -\sin x$$
$$\int_0^x f(y)dy = \sin x \qquad (3)$$

```
\begin{eqnarray}
f(x)                  & = & \cos x \\
f'(x)                 & = & -\sin x \nonumber\\
\int_{0}^{x} f(y)dy & = & \sin x
\end{eqnarray}
```

Spacing in Math Mode I

Name	Command	⊔←Size→⊔
Double quad	\qquad	
Quad	\quad	
Space	\␣	
Thick space	\;	
Medium space	\>	
Thin space	\,	
Negative thin space	\!	

$\iint z\,dx\,dy$ vs. $\int\int zdxdy$
$\sqrt{2}\,x$ vs. $\sqrt{2}x$
different vs. *different*

```
$\int\!\!\int z\,dx\,dy$ vs.
          $\int\int z dx dy$\\
$\sqrt{2}\,x$ vs. $\sqrt{2} x$\\
$different$ vs. {\em different}
```

Math Mode Accents

$\hat{a}$	`\hat{a}`	$\check{a}$	`\check{a}`
$\breve{a}$	`\breve{a}`	$\acute{a}$	`\acute{a}`
$\grave{a}$	`\grave{a}`	$\tilde{a}$	`\tilde{a}`
$\bar{a}$	`\bar{a}`	$\vec{a}$	`\vec{a}`
$\dot{a}$	`\dot{a}`	$\ddot{a}$	`\ddot{a}`

Here are two sizes of wide hat: $\widehat{1-x} = \widehat{-y}$.

```
Here are two sizes of wide hat:
$\widehat{1-x} = \widehat{-y}$.
```

There are no dots in $\vec{\imath} + \tilde{\jmath}$.

```
There are no dots in
$\vec{\imath} + \tilde{\jmath}$.
```

Over- and Underlining

You can have nested overlining: $\overline{\overline{x}^2 + 1}$.

```
You can have nested overlining:
$\overline{\overline{x}^{2} + 1}$.
```

$$\underbrace{a + \overbrace{b + \cdots + y}^{24} + z}_{26}$$

```
$\underbrace{a + \overbrace{b
 + \cdots + y}^{24} + z }_{26}$
```

Stacking Symbols

$$A \xrightarrow{a'} B \xrightarrow{b'} C \; \vec{x} \stackrel{\mathsf{def}}{=} x_1, \ldots, x_n)$$

```
\( A \stackrel{a'}{\rightarrow} B
    \stackrel{b'}{\rightarrow} C \)
\( \vec{x} \stackrel{\mbox{def}}{=}
   x_1,\ldots,x_n) \)
```

New Commands—Macros I

1. first item
2. second item
    2.1 first item in second item
    2.2 …

```
\newcommand{\be}{\begin{enumerate}}
\newcommand{\ee}{\end{enumerate}}
\be
\item first item
\item second item
   \be
     \item first item in second item
     \item \ldots
   \ee
\ee
```

It's a bit boring to write **Popocatepetl** again and again.

New Commands—Macros II

```
\newcommand{\sw}{{\bf Popocatepetl}}
It's a bit boring to write
\sw\ again and again.
```

Macros with Parameters

This text will be typeset in *italics*.

```
\newcommand{\emcorr}[1]{{\em #1\/}}
This text will be typeset
in \emcorr{italics}.
```

Let $f((a_1, \ldots, a_n), (b_1, \ldots, b_n))$ be ...:

```
\newcommand{\fvec}[2]{$f((#1_1, \ldots,
  #1_n),(#2_1, \ldots, #2_n))$}
Let \fvec{a}{b} be \ldots:
```

Simple New Environments

We now have new environment:

- *We use italics.*
- *It's OK, isn't it?*

```
\newenvironment{emphit}
   {\begin{itemize}\em}
   {\end{itemize}}
```

We now have new environment:

```
\begin{emphit}
\item We use italics.
\item It's OK, isn't it?
\end{emphit}
```

New Environments with Parameters

We can now define new environment with parameters:
    Example: Environment quote with emphasized beginning.

```
\newenvironment{descit}[1]
    {\begin{quote}\emph{#1\/}:}
    {\end{quote}}
```

```
We can now define new environment
with parameters:
```

```
\begin{descit}{Example}
Environment \texttt{quote} with
emphasized beginning.
\end{descit}
```

New Theorem Environments

> ## Conjuncture (Fermat)
> *There do not exist integers $n > 2$, x, y, and z such that $x^n + y^n = z^n$.*

```
\newtheorem{guess}{Conjuncture}
\begin{guess}[Fermat]
There do not exist integers $n>2$,
$x$, $y$, and $z$ such that
$x^n + y^n = z^n$.
\end{guess}
```

Theorem Numbering I

1   New Theorem, New Joy

We start this section with one of the basic axiom:

Axiom 1.1

The only thing two TₑXers can agree on is what the third TₑXer has no need of.

```
\newtheorem{axiom}{Axiom}[section]
\section{New Theorem, New Joy}
We start this section with
one of the basic axiom:
\begin{axiom}
The only thing two \TeX ers
can agree on is what the third
\TeX er has no need of.
\end{axiom}
```
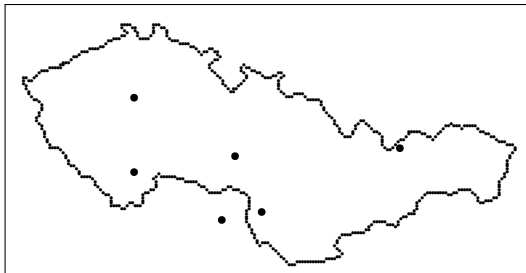
Macro Definitions I


```
\newcounter{xx}\newcounter{yy}
\def\step(#1,#2){\put(\value{xx},\value{yy}){.}%
 \addtocounter{xx}{#1}\addtocounter{yy}{#2}}
\def\1{\step(-1,-1)} \def\2{\step(0,-1)}
\def\3{\step(1,-1)}  \def\4{\step(-1,0)}
\def\6{\step(1,0)}   \def\7{\step(-1,1)}
\def\8{\step(0,1)}   \def\9{\step(1,1)}
```
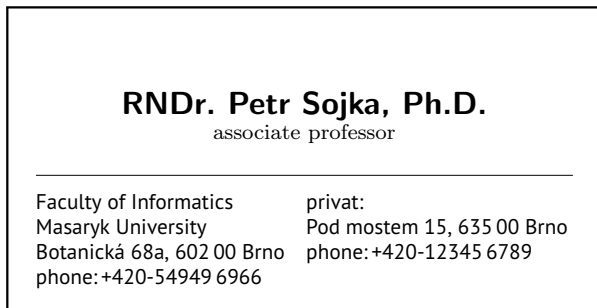
Macro Definitions II

```
\fbox{
\begin{picture}(188,95)
\setcounter{xx}{0}\setcounter{yy}{70}
\6\3\6\9\9\9\9\6\6\9\6\6\6\6\8
...
\8\9\8\8\7\7\4\7\7\8\7\8\7\8\8
\end{picture}}
```

Business Card Example I

RNDr. Petr Sojka, Ph.D.

associate professor

Faculty of Informatics
Masaryk University
Botanická 68a, 602 00 Brno
phone: +420-549 49 6966

privat:
Pod mostem 15, 635 00 Brno
phone: +420-12345 6789

```
\newfont{\fnt}{cmssbx10 scaled \magstep 1}
\newcommand{\foren}{\,+420-}}
\newcommand{\card}[9]{
  \fboxrule .3mm    \fboxsep 3mm
  \framebox[79mm][l]{
  \vbox{ \footnotesize\rm \vskip 8mm
    \makebox[71mm][c]{\normalsize\fnt #1}\\
```

Business Card Example II

```
    \makebox[71mm][c]{#2}\\[1.5mm]
    \sf    \rule[0mm]{71mm}{0.1mm}\\[1mm]
    \makebox[35mm][l]{#3}  \hbox{#7} \\
    \makebox[35mm][l]{#4}  \hbox{#8} \\
    \makebox[35mm][l]{#5}  \hbox{#9} \\
    \makebox[35mm][l]{#6}
} } }
\newcommand{\mycard}
  {\card{RNDr.\ Petr Sojka, Ph.D.}{associate professor}
      {Faculty of Informatics}{Masaryk University}
      {Botanick\'a 68a, 602\,00 Brno}
      {phone:\foren 54949\,6966}
      {privat:}
      {Pod mostem 15, 635\,00 Brno}
      {phone:\foren 12345\,6789}
  }
\centerline{\mycard}
```

Length Parameters

```
\setlength{\parindent}{0pt}
\setlength{\parskip}{5pt plus 2pt minus 1pt}
\addtolength{\textwidth}{60pt}
\addtolength{\baselineskip}
                {0pt plus 0.1pt minus 0.1pt}
```

Petr

```
\newlength{\mylength}
\setlength{\mylength}{1cm}
\addtolength{\mylength}{1cm}
\settowidth{\mylength}
      {{\rm Petr}\hspace*{.5\mylength}}
\hbox{\strut\vrule\hspace*{\mylength}\vrule}\par
Petr\rule{1cm}{0.4pt}
```

Counters

```
\setcounter{page}{0}
\addtocounter{page}{-2}
```

It was $\boxed{\text{Gnats[2] and Gnus[3]}}$ as we trekked through Africa

---

   [1] Small insects.
   [2] Large mammals.

```
\begin{minipage}{.7\textwidth}
It was \fbox{Gnats\footnotemark\ and
            Gnus\footnotemark}%
\addtocounter{footnote}{-1}%
\footnotetext{Small insects.}%
\addtocounter{footnote}{1}%
\footnotetext{Large mammals.} as we
trekked through Africa
\end{minipage}
```

Line Breaking

```
\linebreak[num]
\nolinebreak[num]
\\[len]
\newline
\-
\hyphenation{words}
\sloppy
\fussy
\begin{sloppypar} pars \end{sloppypar}
```

Page Breaking

```
\pagebreak[num]
\nopagebreak[num]
\samepage
\newpage
\clearpage
\cleardoublepage
```

Page Layout

Figure 1: LaTeX single-column page layout. The actual proportions correspond to parameter values in the 11pt BOOK document style. Note that standard-conforming DVI drivers are required to place the TeX upper-left page corner one inch over and down from the corner of the physical output page. This figure is scaled to 50% actual page size. It was produced on October 21, 2020 at 8:33.
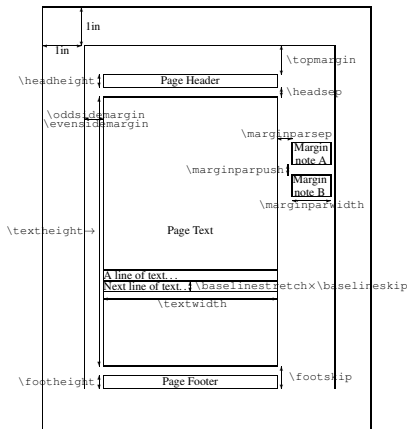
Parshape command

`\parshape` n $i_1 l_1$ $i_2 l_2$ $\ldots i_n l_n$

```
\parshape 30 0pt 120pt 1pt
118pt 2pt 116pt 4pt 112pt 6pt
108pt 9pt 102pt 12pt 96pt 15pt
90pt 19pt 84pt 23pt 77pt 27pt
68pt 30.5pt 60pt 35pt 52pt 39pt
45pt 43pt 36pt 48pt 27pt 51.5pt
21pt 53pt 16.75pt 53pt 16.75pt 53pt
```

`...`

The wines of France and California may be the best known, but they are not the only fine wines. Spanish wines are often underestimated, and quite old ones may be available at reasonable prices. For Spanish wines the vintage is not so critical, but the climate of the Bordeaux region varies greatly from year to year. Some vintages are not as good as others, so there years ought to be specially noted: 1962, 1964, 1966. 1958, 1959, 1960, 1961, 1964, 1966 are also good California vintages. Good luck finding them!

Numbering

```
\newcounter{myctr}
\setcounter{myctr}{\value{page}}
\arabic{myctr},
\setcounter{myctr}{2}
\stepcounter{myctr}
\roman{myctr}, \Roman{myctr}
$\fnsymbol{myctr}$,
\addtocounter{myctr}{-1}
\refstepcounter{myctr}
\alph{myctr}, \Alph{myctr}
```

2, iii, III ‡, b, B

Letters

```
\documentclass[12pt]{letter}
\makelabels  % to make address labels
\address{My address\\
My home, my castle}
\signature{me}

\begin{document}
\begin{letter}{Address}
  \opening{Dear ...}
  \closing{Best regards}
  \cc{Address 1,...}
  \encl{Attachment 1,...}
  \ps{P.S. ...}
\end{letter}
\end{document}
```

Marginal Notes

```
\marginpar{This is a marginal note}
\marginpar[$\Rightarrow$]{$\Leftarrow$}

\marginparwidth
\marginparsep
\marginparpush
\reversemarginpar
\normalmarginpar
```

Structuring a Document

- `\tableofcontents`
- `\listoffigures`
- `\listoftables`
- `\nofiles`

Titlepage Example I

<div align="center">

LaTeX

PC course

Aston, August 2–5, 1993

Lecturers:

Jiří Zlatuška   Petr Sojka

Masaryk University Brno, The Czech Republic

</div>

```
\clearpage \thispagestyle{empty}
\begin{figure}[p]
\begin{center}{\huge\bf \LaTeX}\\[3mm]
{\LARGE\bf PC course}\par\vspace{3mm}
{\normalsize Aston, August 2--5, 1993}
\par\vspace{3mm}
```

Titlepage Example II

```
{\footnotesize
\begin{tabular}{c@{}p{1cm}@{}c}
\multicolumn{3}{c}{\bf Lecturers:}\\
 & \rule{0pt}{5pt} & \\
Ji\v{r}\'\i\ Zlatu\v{s}ka & & Petr Sojka\\
\multicolumn{3}{l}{Masaryk University Brno,
     The Czech Republic}
\end{tabular}}\end{center}
\end{figure}  \clearpage
```

Keyboard Input and Screen Output

```
\documentclass{article}
\typein[\answer]{Name of your style
                 file (without .sty)}
\makeatletter
  \title{\answer}
  \author{Unknown}
  \input{\answer.sty}
  \typeout{I'll be typesetting
                  using \answer.sty}
\makeatother
\begin{document}
\maketitle
...
\end{document}
```

The Bibliography I

Definitive guides to TeX and LaTeX are [Knuth84] and [Lamport86].

[Knuth84]   D. E. Knuth: *TeXbook*. Addison-Wesley, 1984.

[Lamport86] L. Lamport: *A Document Preparation System LaTeX*. Addison-Wesley, 1986.

```
Definitive guides to \TeX\ and \LaTeX\
are~\cite{texbook} and~\cite{latexbook}.

\begin{thebibliography}{Lamport86}
\bibitem[Knuth84]{texbook}
   D.~E.~Knuth: \textit{\TeX book}.
   Addison-Wesley, 1984.
\bibitem[Lamport86]{latexbook}
   L.~Lamport: \textit{A Document
   Preparation System \LaTeX}.
   Addison-Wesley, 1986.
\end{thebibliography}
```

The Bibliography II

Definitive guides to TeX and LaTeX are [1] and [2].

[1] D. E. Knuth: *TeXbook*. Addison-Wesley, 1984.

[2] L. Lamport: *A Document Preparation System LaTeX*. Addison-Wesley, 1986.

```
Definitive guides to \TeX\ and
\LaTeX\ are~\cite{texbook} and
\cite{latexbook}.

\begin{thebibliography}{9}
\bibitem{texbook}
   D.~E.~Knuth: \textit{\TeX  book}.
   Addison-Wesley, 1984.
\bibitem{latexbook}
   L.~Lamport: \textit{A Document
   Preparation System \LaTeX}.
   Addison-Wesley, 1986.
\end{thebibliography}
```

Bibtex

```
\cite[text]{key_list}
\nocite{key_list}
\bibliography{bib_files}
```

Index and Glossary

- `\index` and `\glossary` commands
- `\makeindex`, `\makeglossary`
- `theindex` environment (defines `\item`, `\subitem`, `\subsubitem` commands)

Figure Insertions

- `graphicx` package with \includegraphics command to include external graphics in PDF, PNG, JPEG, (pdfTeX or XeLaTeX) or EPS (LaTeX), `epsf.sty`
- METAFONT, METAPOST, `tikz`, `mfpic`, `jfig` and many other possibilities
- already obsolete: bm2font, `epic.sty`, `eepic.sty`
- most portable is internal graphics done by macros, e.g. with macroexpansion like `tikz`,...