

# 1 Basic text formatting

L<sup>A</sup>T<sub>E</sub>X is a markup language in which we concentrate on highlighting the logical structure of the document. Normal text is written as usual. The whitespace characters are treated as follows. Multiple spaces mean the same thing as a single space. A single newline means the same thing as a space, but an empty line is used to separate paragraphs.

This is the beginning of the second paragraph. Characters that have a special meaning in LaTeX are usually inserted with a backslash, e.g. `\%` is `%`. Similarly `\$` is written as `\$`, `\#` as `\#`, `\{` as `\{`. Exceptions are `@` written directly, `\` as `\textbackslash`, `~` written as `\sim`.

Boldface and italics are introduced using the commands `\textbf{some text}` and `\textit{some text}`. More about fonts can be found in the corresponding Wikibooks chapter.

**Exercises** Make some words in this paragraph to appear in italics and boldface.

# 2 Document structure

A document starts with a preamble containing `\documentclass` command, various definitions, and library imports. The text of the document is located in an environment starting with `\begin{document}` and ending with `\end{document}`.

Sectioning is done by commands `\section`, `\subsection`, `\subsubsection`, .... The parameter of the command is the title of the section. Bigger documents can also use `chapter`, but then `documentclass` should be changed from `article` to `book`. The command `\paragraph` creates a heading located at the beginning of the paragraph, followed by the text on the same line (see an example in Section 4).

The heading of the document can be produced using `\maketitle` command, and an automatically generated table of contents can be created using `\tableofcontents`. For more details, see the exercises below.

Bulleted lists are created using `itemize` environment, as illustrated by the exercise below, numbered lists by `enumerate`.

**Exercise**

- Add command `\maketitle` after `\begin{document}`. This typesets a title on the top of the first page using the information entered in the header of the document using `\title`, `author` and `date`. Try to fill in the author name and see how it appears.
- Add a subsection somewhere in this document.
- Add a command `\tableofcontents` to the document, process the document twice with `pdflatex` to produce a correct table of contents.
- Change this list of tasks from a bulleted list to a numbered list.

### 3 Mathematics

Mathematical symbols or short expressions placed directly in the text are placed between dollar signs, e.g. `$x$` produces  $x$ . Bigger formulas are placed between `$$` or in a special environment, such as `equation`.

Table 1 shows examples of useful macros for typesetting mathematical expressions. More information can be found in chapter from Wikibooks.

Definitions, theorems, lemmas etc. can be typeset and numbered by defining custom environments. Here is an example of a theorem.

**Theorem 1.** *If  $x, y \geq 0$  then  $\frac{x}{y} \geq 0$ .*

*Proof.* This is so obvious that I do not now how to prove it. □

#### Exercise

- Typeset in mathematical notation that the limit of  $1 + 1/n$  raised to the power of  $n$  tends to  $e$  as  $n$  approaches infinity. Use commands such as `lim`, `frac`, `to`, `infty`. Note that the first sentence of this exercise incorrectly uses mathematical symbols such as  $e$  and  $n$  without enclosing them in dollar signs.
- Add `newtheorem` definition of lemma to the top of the file similarly as we have theorem right now and then try to add a lemma to the text.

Table 1: Examples of common mathematical notation

| Commands                                  | Result                     | Note                                        |
|-------------------------------------------|----------------------------|---------------------------------------------|
| <code>\$x_1\$</code>                      | $x_1$                      | subscripts                                  |
| <code>\$x^2\$</code>                      | $x^2$                      | superscripts                                |
| <code>\$x_{j+1}^{10}\$</code>             | $x_{j+1}^{10}$             | <code>{ }</code> needed here                |
| <code>\$\alpha, \Delta\$</code>           | $\alpha, \Delta$           | greek letters                               |
| <code>\$\log_2 n\$</code>                 | $\log_2 n$                 | many special functions available            |
| <code>\$\log_2 n\$</code>                 | $\log_2 n$                 | ugly, use the form above                    |
| <code>\$\sum_{k=1}^n k\$</code>           | $\sum_{k=1}^n k$           | sum ( $\prod$ also available)               |
| <code>\$\{1,2,\dots, n\}\$</code>         | $\{1, 2, \dots, n\}$       | note <code>\dots</code> and <code>\{</code> |
| <code>\$\left(\frac{n}{k}\right)\$</code> | $\left(\frac{n}{k}\right)$ | fraction, bigger parentheses                |
| <code>\${n \choose k+1}\$</code>          | $\binom{n}{k+1}$           | binomial coefficients                       |
| <code>\$x\cdot y\leq z\$</code>           | $x \cdot y \leq z$         | multiplication, inequality                  |
| <code>\$x*y &lt;= z\$</code>              | $x * y <= z$               | ugly, use the form above                    |
| <code>\$A\cup B\cap C\$</code>            | $A \cup B \cap C$          | set notation                                |
| <code>\$A \setminus \emptyset\$</code>    | $A \setminus \emptyset$    |                                             |
| <code>\$A \subseteq B\$</code>            | $A \subseteq B$            |                                             |
| <code>\$a \in A, a \notin B\$</code>      | $a \in A, a \notin B$      |                                             |
| <code>\$A\lor B\land C\$</code>           | $A \vee B \wedge C$        | logic                                       |
| <code>\$\neg A\Rightarrow B\$</code>      | $\neg A \Rightarrow B$     |                                             |
| <code>\$\foreach x \exists y\$</code>     | $\forall x \exists y$      |                                             |

## 4 Some typesetting details

**Non-breaking space.** A non-breaking space is written as `~`. You can use it to avoid having a single-letter word at the end of the line (type `a~word` instead of `a word`) or to avoid longer space after a dot which does not represent the end of a sentence (such as `e.g.~word`).

**Dashes.** LaTeX provides three lengths of dashes. A single minus sign is used as a minus sign and as a hyphen, e.g. “memory-efficient”, number -1. An en dash, written as `--`, is longer and is used for example for ranges, such as 11:30–13:00. Finally an em dash, written as `---`, is used instead of colon or parenthesis in a sentence, such as “We use efficient sorting algorithms—mergesort and quicksort.”

**Quotes.** As you can see in the sentence above, English-language quotes are produced by two back-ticks `“` at the beginning of a quoted text and two apostrophes `”` at the end.

In Slovak, macro `\uv{text}` is used to correctly quote text. First Slovak language has to be switched on in `babel` package, as shown in a separate Slovak tutorial.

**Spacing and word division.** LaTeX has many macros for adding or decreasing spaces both horizontally and vertically. However, in most cases it is better to leave the layout of the text as is rather than make manual adjustments. LaTeX should correctly divide words at the end of lines, but if you want to suggest a different word break, use `\-`. For example, `im\~pos\~si\~ble` suggests three possible places where the word can be divided, and LaTeX will choose the one that fits best.<sup>1</sup>

## 5 Figures and tables

Figures can be included using `\includegraphics` command. In formal technical texts, figures should be included in a `figure` environment and described

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<sup>1</sup>This is the correct division of the word according to the Merriam-Webster dictionary. This is also an example of a footnote produced by `footnote` command, but do not use too many footnotes in your text.

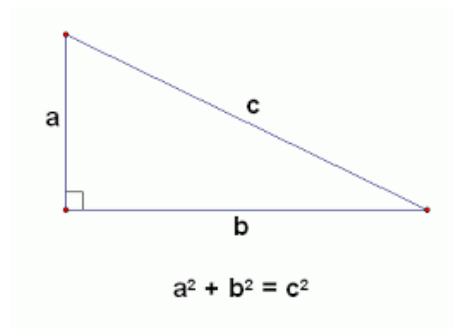


Table 2: This is an example of a table. This text is the caption and should explain the meaning of the table.

| Left-justified column | Centered-column     | Right-justified column |
|-----------------------|---------------------|------------------------|
| The first longer text | Another longer text | Another longer text    |
| Short                 | Short               |                        |

using `caption` command. An example of a figure (with a missing caption to be added as an exercise) is shown in Figure 5.

Tables are created using `tabular` environment. Columns are specified using justification left (l), center (c) or right (r), e.g. a table started with `\begin{tabular}{llr}` will have two left-justified columns and one right-justified. Columns are separated with `&` and rows with `\\`. Tables should be included in `table` environment, as shown in Tables 1 and 2.

### Exercise

- Add a caption to the figure similarly as it is done in the tables. Figure caption should be below the figure but before the label command.
- Add another row to Table 2, which will have the first two columns merged into a single cell. This is achieved using command `\multicolumn{2}{c}{content of the merged cell}`

## 6 References to parts of a document

You can label various parts of the document using `\label{yourId}` command. Then refer to the section, figure, theorem, equation, etc. using `\ref{yourId}`. This is one of the most useful features of LaTeX.

**Exercise** Which parts of the document already have `\label` command? Add label to the theorem. Then refer to it.

## 7 Citing literature

To cite your sources in LaTeX it is common to use BibTeX. Details of cited sources are written in a `.bib` file, which can be then referenced in the text using `cite` command.

**Exercise**

- Towards the end of the file, just before `\end{document}` add commands

```
\bibliographystyle{plain}
\bibliography{sources}
```

- Somewhere in the text use command `\cite{someArticle}`. Look at the source IDs in `sources.bib` and cite one more source using `cite`.
- Run commands

```
pdflatex tutorial
bibtex tutorial
pdflatex tutorial
pdflatex tutorial
```

The end of the pdf file should now contain the list of cited sources.

## 8 Algorithms and source code

The simplest way of including source code is the `verbatim` environment, which was used in this document. To create a nicer output with syntax highlighting, you can use the `lstlisting` environment from the `listings` package, in which you can choose the used programming language (see Algorithm 1).

To produce a nicely formatted pseudocode with mathematical formulas, you can use the `algpseudocode` package. However, it may be simpler to use `lstlisting`, where you can add setting `escapeinside={(*){*)}` and then place LaTeX code, such as formulas, between `(*` and `*)`, as shown in Algorithm 2).

Algorithm 1: Algorithm for computing factorial in C language

```
int factorial = 1;
for(int i = 1; i <= n; i++) {
    factorial *= i;
}
```

Algorithm 2: Pseudocode for computing factorial

```
 $f \leftarrow 1$ 
for  $i = 1, 2, \dots, n$  :
     $f \leftarrow f \cdot i$ 
```