WIAI LaTeX SOLUTIONS

Sample solutions to the exercises provided

by Fachschaft WIAI @ University of Bamberg

Imprint

The LaTeX Script (version 1.4.2 from May 15th, 2025) has been assembled by the Student Council of the Information Systems and Applied Computer Sciences Faculty (Fachschaft WIAI) at the University of Bamberg.

Contents

First steps with LaTeX

This document[1] contains exercises to practically apply learnings from the Fachschaft WIAI's LaTeX workshop. The following instructions will equip you with the programs necessary to create documents with LaTeX—they are explained in the workshop and the main script. Please, make sure to install the *compiler first* and the *editor afterwards*.

Compiler

Let's start with the compiler. (Seriously!) We will need it to convert our LaTeX documents into PDFs. There are different compilers for different operating systems; for example, MikTeX for Windows,[2] MacTeX for macOS,[3] and TeXLive for Linux distributions.[4] In case you get to choose, it is best to install the full version with all packages.

Editor

As soon as you have installed the compiler, you can download an editor that you are going to use to write your LaTeX documents. Any editor will do (notepad++, Atom, VS Code, etc.). However, for beginners, we recommend using TeXstudio,[5] a program that supports you with LaTeX-specific features.

Compiling for the first time

Open up the file `main-exercises.tex` in TeXstudio. It can be found in our project directory. By pressing ⏩, it is converted into a a file called `main-exercises.pdf`. You should be able to find the latter by looking at the project directory in your file explorer. If your installation is not working yet, TeXstudio will show you an error message. Feel free to contact us in this case.[6] Otherwise, you are now ready to go!

[1] Find the latest version of this document on Github: `https://github.com/fs-wiai/latex-script/releases`

[2] `https://miktex.org/download`

[3] `http://tug.org/mactex/`

[4] On Debian-based Linux distributions, install the compiler by executing `sudo apt install texlive-full`. For other distributions, see `https://tug.org/texlive/doc/texlive-en/texlive-en.html#installation`.

[5] You find the latest version on `https://www.texstudio.org/`.

[6] Find us at `https://www.uni-bamberg.de/wiai/fs`.

E3 Structure your document and text

1. In the directory `exercises/basic-document-structure`, you can find a file named `document-structure.tex`. Wrap the text of the file in a `document` environment and add the following preamble.

   ```
   \documentclass{article}
   \usepackage[utf8]{inputenc}
   \usepackage[T1]{fontenc}
   \usepackage[english]{babel}
   ```

2. In TeXstudio, right click on the file and select "Set as explicit root document." Next, compile the file.

3. Congratulations! You have created and compiled your first LaTeX document. Maybe you have noticed that paragraphs within the text were created by using \\. Replace the two backslashes by real paragraphs.

4. It is time to structure your first document. Use the LaTeX commands `\section`, `\subsection`, etc. to structure the text. Also, include a table of contents for your document.

Extra tasks: Make it fit your needs

- Add a **title** to the document.
- Make today's date appear in a **language of your choice**.
- **Hide** one section title in the table of contents.
- Add a **short title** to a different section title.
- Split the text in **two columns** (keyword: `twocolumn`).
- Add a **header** with the title on the right and a **footer** with the page number on the left.
- Try out what changes when you change the **document class**.
- Research the possibilities of traditional[7] and modern[8] **beamer presentation templates**.

```
% twocolumn parameter adds second column
\documentclass[twocolumn]{article}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\usepackage[english,italian]{babel}
\usepackage[hidelinks]{hyperref}

% for headers and footers
\usepackage{fancyhdr}
```

[7] `https://hartwork.org/beamer-theme-matrix/`
[8] `https://gitlab.cs.fau.de/i4/tex/i4neo`

```
% configure title components
\title{Recipes}
\date{\today}
\author{It's you!}

\begin{document}

% set headers and footers
\pagestyle{fancy} % activate headers and footers in general
\thispagestyle{fancy} % apply to the first page as well

% clear and configure headers
\fancyhead{}
\fancyhead[R]{Recipes}

% clear and configure footers
\fancyfoot{}
\fancyfoot[R]{\thepage}

% switch language (needs optional parameter where the babel
↪  package is added), display title, then switch back
\selectlanguage{italian}
\maketitle
\selectlanguage{english}

\tableofcontents

\section{Beverages}

\subsection{Pink Lemonade}
We all know and love it in summer: a cold lemonade. The pink
↪  variant of our  favorite summer drink is traditionally
↪  achieved by adding food coloring to the lemonade.
However, we changed things up a little and decided to go for a
↪  variant with berries instead of food coloring, which also
↪  makes the drink less sour.

\subsubsection{Ingredients}
For making the lemonade we need 400\,g of berries. You can use
↪  either frozen or fresh ones. You can, of course, adjust the
↪  choice of berries to your likings: raspberries, blueberries,
↪  blackberries, or a mixture work excellently for making the
↪  lemonade.

To make the drink sweeter we use 50\,ml of maple syrup. Needless
↪  to say, you can also use less, if you want your lemonade to
↪  be more sour. By the way, other sweeteners, such as agave
↪  syrup, or coconut sugar also work fine.
```

```
Additionally, we need the juice of four freshly-squeezed lemons,
↪  one litre worth of cold water and 400\,g of ice cubes to keep
↪  the drink cold.

\subsubsection{Instructions}
Put the berries along with the maple syrup into a large bowl and
↪  cook them at medium-high heat for around three to four
↪  minutes. When the berries start to soften, reduce the heat a
↪  little. Now mash the berries with the end of a wooden spoon
↪  until there are almost no big chunks anymore. The less chunks
↪  the better!

Place a sieve over the container that you want to store the
↪  lemonade in. Put the berries into the sieve. With the end of
↪  the wooden spoon, try to press out as much liquid of the
↪  berry mixture as possible. Let the juice sit until it is
↪  completely cold.

When the liquid is cold, add the lemon juice, the cold water, and
↪  the ice cubes and stir everything.

Your lemonade is now ready to enjoy!

% short title for the table of contents via optional parameter
\subsection[Chocoho!]{Hot Chocolate}
Coming soon!

% asterisk (*) hides the section title in the table of contents
\section*{Breakfast}

\subsubsection{Buckwheat Overnight Oats}
Coming soon!

\end{document}
```

E4 A structured project

Within the directory `exercises/project-structure` you can find the file `main.tex`.

1. Put the sections of the file into separate files, named `section1.tex`, `section2.tex`, and `section3.tex` and insert them using the `\input` command. (In TeXstudio, make sure that you select the main file as the file to be compiled by right-clicking on it and selecting "Select as explicit root document.")

```
\input{preamble.done}

\begin{document}
\maketitle
\tableofcontents

\newpage
\input{section1.done}
\newpage
\input{section2.done}

\end{document}
```

Figure 1: `main.tex`

```
\section{First section}
Jelly beans tiramisu chocolate bar chupa chups candy canes
↪ lollipop liquorice cheesecake tootsie roll. Marshmallow sugar
↪ plum cake tiramisu jelly cake bear claw. Croissant liquorice
↪ jelly lollipop carrot cake. Cheesecake danish chocolate
↪ halvah. Candy canes jujubes chupa chups jujubes candy canes
↪ tootsie roll toffee danish sesame snaps. Sugar plum gummi
↪ bears lollipop chocolate bar. Ice cream soufflé sweet lemon
↪ drops chocolate soufflé gingerbread cookie muffin.

Sugar plum danish halvah jujubes pastry donut carrot cake dessert
↪ donut. Sweet gingerbread gingerbread wafer gummi bears
↪ pastry. Tootsie roll donut powder cake. Brownie halvah
↪ lollipop gummi bears. Liquorice pie caramels jelly beans.
↪ Halvah danish brownie danish toffee cotton candy lemon drops.

Donut jelly beans candy canes muffin lemon drops carrot cake
↪ sugar plum. Sesame snaps pie bonbon cotton candy cookie
↪ caramels. Chupa chups dessert tootsie roll carrot cake candy
↪ cookie sweet roll jelly beans. Oat cake halvah gingerbread
↪ bonbon sweet sesame snaps dragée carrot cake. Bonbon pastry
↪ chupa chups. Chocolate cake macaroon jelly-o. Pastry pastry
↪ sugar plum jujubes lemon drops gummi bears sugar plum
↪ cheesecake fruitcake. Chocolate cake chocolate candy. Wafer
↪ carrot cake chocolate cake jujubes cupcake soufflé
↪ gingerbread chocolate cake donut.
```

Figure 2: `section1.tex` (analogous for the other sections)

2. Can the preamble also live in its own file? Find out by moving it analogously to the sections. If no, why? If yes, why can outsourcing the preamble be useful?

   The preamble can also be outsourced. In real-world LaTeX projects, we often make use of numerous packages that need to be configured by additional commands within the preamble. Therefore, it is advisable to outsource the preamble. On top of that, this is useful because the file with the most-commonly used packages can be moved from one project to another without needing to rewrite the preamble every time.

E5 Insert special characters

For this task, we are using the file `exercises/special-characters.tex`. To be able to see your results here within the exercise script, compile the `main-exercises.tex` file. This applies for the subsequent tasks, as well.

1. Replace the spaces within abbreviations (e. g., i. a.) by thin spaces.
2. Replace the hyphens within the Erba opening hours by en dashes.
3. Add quotation marks around the words *Studi-Ticket* and *Studi-Karte* using the `\enquote` command.

```
What is a semester ticket?
It is also known as \enquote{Studi-Ticket} or
↪  \enquote{Studi-Karte} in German and allows you to use the
↪  local public transport around Bamberg for free.
In Bamberg, the semester ticked is embodied in your student card
↪  (Studierendenausweis).
To be able to use it, you have to validate the student card in
↪  one of the university buildings.
This is possible after you have paid the semester fees.
Validation printers are located in multiple university buildings,
↪  e.\,g., in the foyer of the Erba building, in front of the
↪  library.
This building is opened Monday\,--\,Friday, 7am\,--\,10pm.
```

E6 Emphasising text

1. In `exercies/text-markup/markup.tex`, emphasize the words "recursion" and "recursive."

2. Make the URL clickable.

3. Of course, you can also experiment with the other commands that you learned for text markup. However, you might want to remove them afterwards to keep your document nice and tidy.

```
``\emph{Recursion} (adjective: \emph{recursive}) occurs when a
↪  thing is defined in terms of itself or of its type.
\emph{Recursion} is used in a variety of disciplines ranging from
↪  linguistics to logic.
The most common application of \emph{recursion} is in mathematics
↪  and computer science, where a function being defined is
↪  applied within its own definition.''

Source and more information:
↪  \url{https://en.wikipedia.org/wiki/Recursion}
```

E7 Adding enumerations

Format the recipe you can find in `exercises/lists/lists.tex` as an unordered list (`itemize`) with sub-lists *Ingredients* and *Instructions*. Within these, there shall be an unordered list of ingredients and an ordered list of instructions, respectively.

Extra tasks: Special enumerations

- Try using **Roman numerals** in the ordered list.
- Make the ordered list **start at 7** (keyword: `\setcounter`).
- Reduce the **white space** between the items in the unordered list.

```
Ingredients:
400 g berries, 50 ml maple syrup, 4 lemons, 1 l cold water, 400 g
↪  ice cubes

\noindent Instructions: Boil and shred the berries, add maple
↪  syrup, squeeze the lemons and add their juice, add the
↪  remaining ingredients, scramble thoroughly

\begin{itemize}
        \item Ingredients:
        \begin{itemize}
                \item 400 g berries
                \item 50 ml maple syrup
                \item 4 lemons
                \item 1 l cold water
                \item 400 g ice cubes
        \end{itemize}

        \item Instructions:
        \begin{enumerate}
                \item boil and shred the berries
                \item add maple syrup
                \item squeeze the lemons and add their juice
                \item add the remaining ingredients
                \item scramble thoroughly
        \end{enumerate}
\end{itemize}

% With all extra tasks:

\begin{itemize}
        \item Ingredients:
        \begin{compactitem}
                \item 400 g berries
                \item 50 ml maple syrup
                \item 4 lemons
```

```
                \item 1 l cold water
                \item 400 g ice cubes
        \end{compactitem}

        \item Instructions:
        \begin{enumerate}[label=\roman*]
        \setcounter{enumi}{6}
                \item boil and shred the berries
                \item add maple syrup
                \item squeeze the lemons and add their juice
                \item add the remaining ingredients
                \item scramble thoroughly
        \end{enumerate}
\end{itemize}
```

E8 Typesetting mathematics

Use LaTeX's math mode to typeset the following formulas. Pay attention to the size of brackets. Prioritize those formulas that appear to be most useful and/or interesting to you.

```
% Gravitational acceleration in Germany
$$9,81\,\frac{m}{s^2}$$

% pq formula
$$x_{1,2} = - \frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 -
↪  q}$$

% Quadratic formula
$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

% Catalan numbers
\begin{equation*}
  C_n = \frac{1}{n+1} {2n \choose n} = \frac{(2n)!}{(n+1)!n!}
\end{equation*}

% Definition of a factorial
$$n! = \prod_{i=1}^{n} i$$

% Set of all odd natural numbers
$$\{ x \mid x \in \mathbb{N}, \text{odd}(x) \}$$

% Elimination $\neg\exists x$
$$\neg\exists x . p(x) \Leftrightarrow \forall x . \neg p(x)$$
```

E9 Inserting graphics

In the `exercises/graphics` directory you can find an image file `latex-logo.png`. Insert the image into the `exercises/graphics/graphics.tex` file. Make sure that the image is placed exactly where you have specified it. On top of that, the picture shall be centered, and a caption shall be added. Adapt the image width to the text width (`\textwidth`). On top of that, add a caption to the image.

```
\begin{figure}[H]
        \centering
        \includegraphics[width=\textwidth]{exercises/graphics/latex-logo.png}
        \caption{The \LaTeX{} Project Logo}
\end{figure}
```

E10 Typesetting tables

The following list shows some key data about a few courses of the WIAI faculty. However, the overview is not as clear as it could be. To improve it, convert the list into a table with columns for *name*, *abbreviation* and *term*. Insert an additional *centered column* that numbers the courses. Add a caption to the table. You find the table in `exercises/tables/tables.tex`.

```
\begin{table}[h]
        \centering
        \begin{tabular}{clll}
        \toprule
        No. & Name & Abbreviation & Term \\
        \midrule
        1 & Foundations of Software Engineering & SWT-FSE-B &
        ↪  summer \\
        2 & Information Retrieval & MI-IR-M & summer \\
        3 & International Outsourcing Management & ISM-IOM-M &
        ↪  winter \\
        \bottomrule
        \end{tabular}
        \caption{Overview over some courses}
\end{table}
```

No.	Name	Abbreviation	Term
1	Foundations of Software Engineering	SWT-FSE-B	summer
2	Information Retrieval	MI-IR-M	summer
3	International Outsourcing Management	ISM-IOM-M	winter

Table 1: Overview over some courses

E11 Footnotes and references

1 Inserting footnotes

Make the text "released in September 2023" of the file `exercises/footnotes/-footnotes.tex` appear as a footnote instead of in parentheses. Additionally, insert a clickable URL to the Java Development Kit as footnote: `https://www.oracle.com/java/technologies/javase-downloads.html`

```
Java is an object-oriented programming language that appeared in
↪ 1995.
The most recent long-term support version of the programming
↪ language is Java SE 21 \footnote{released in September 2023}.
In order to write Java programs, one needs to install the
↪ so-called \emph{Java Development Kit
(JDK)}\footnote{\url{https://www.oracle.com/java/technologies/javase-downloads.html}}.
Java programs can be written independently from the operating
↪ system that one uses.
```

2 Inserting references

In file `exercises/references/references.tex`, replace "in the figure" and "the following source code listing" with suited references. Use the command `\cref`. Do not forget to first introduce labels for the elements that you want to reference. Make sure to use suitable prefixes before the labels.

For source code listings, adding labels and captions is a bit different. Try to apply the knowledge you gained so far to retrieve the correct version of the command.

```
C\# is an object-oriented programming language that was developed
↪  by Microsoft in 2011. In \cref{fig:csharp} we can see the
↪  logo of the programming language.

\begin{figure}[H]
        \label{fig:csharp}
        \centering
        \includegraphics[width=2cm]{exercises/references/csharp.png}
        \caption{The logo of C\#}
\end{figure}

\cref{lst:csharphelloworld} shows a program that prints the text
↪  \enquote{Hello LaTeX friends!} to the console. Like Java, C\#
↪  makes use of classes and main methods to build executable
↪  applications.

\lstset{language=csharp}
\lstinputlisting[label=lst:csharphelloworld, caption=Hello World
↪  in C\#]{exercises/references/HelloLateXFriends.cs}
```

E12 Listings

In the folder `exercises/source-code-listings`, you will find a file called `Source.java`. We will now include it into our document and adjust its display to fit our needs. If you have questions, consult the `minted` or `listings` package documentation.

Minted tasks

1. Include the file into `exercises/source-code-listings/source-code-listings.tex`.
2. Enable special characters via the `literate` option.
3. Activate syntax highlighting by stating the programming language Java.
4. Add line breaks and line numbers.
5. Use the theme `native`.
6. This theme is optimized for a dark background. Change the background color to dark blue.
7. Include only lines 5 to 7.
8. Delete the spaces at the beginning of the lines. (Hint: The documentation speaks of `autogobble`.)

Listings tasks

1. Include the file into `exercises/source-code-listings/source-code-listings.tex`.
2. Activate syntax highlighting by stating the programming language Java.
3. Set the `basicstyle` to a proper mono-spaced font (`\ttfamily \small`)
4. Add line numbers.
5. Change the keyword color to blue.
6. Don't show special characters for spaces in strings.

Minted rendering

```
5 for (int i = 0; i < greeting.length(); i++) {
6   System.out.println(greeting.charAt(i));
7 }
```

Minted solution

```
\usemintedstyle{native}
\definecolor{ourBackgroundColor}{rgb}{0.1,0.1,0.2}

\inputminted[
  breaklines, % line breaks
  linenos=true, % line numbers
  bgcolor=ourBackgroundColor, % background color
  firstline=5, % first line to be included
  lastline=7, % last line to be included
  autogobble=true % remove leading spaces
]{java}{exercises/source-code-listings/Source.java}

\usemintedstyle{default}
```

Listings solution

```
\lstinputlisting[
  language=Java,
  numbers=left, % line numbers
  showstringspaces=false, % spaces in strings
  keywordstyle=\color{blue}, % keyword color
  basicstyle=\ttfamily\small, % overall font and size
  literate={ä}{{\"a}}1 {ß}{{\ss}}1 % special characters
]{exercises/source-code-listings/Source.java}
```

E13 Creating and inserting references

1. Create a new BibTeX file called `literature.bib` in the `exercises/literature` folder.
2. Use Google Scholar or `dblp.org` to retrieve BibTeX entries for the following LaTeX handbooks:
   - Dilip Datta (2017): LaTeX in 24 Hours. A Practical Guide for Scientific Writing.
   - Frank Mittelbach / Michel Goossens (2010): Der LaTeX-Begleiter.
3. Add the BibTeX entries to the newly created BibTeX file.
4. Assign unique and meaningful BibTeX keys.
5. Add the bibliography file to the project's preamble.
6. Make use of the `alpha` bibliography style.
7. Cite the two handbooks in the file `exercises/literature/literature.tex`.
8. Ensure that the bibliography is listed.

Note: If compiling fails, it may help to remove all auxiliary files (`main.aux/bbl/blg/loc/out/pdf/soc/toc`) before compiling again.

```
@book{datta2017,
  author    = {Dilip Datta},
  title     = {LaTeX in 24 Hours - {A} Practical Guide for
               Scientific Writing},
  publisher = {Springer},
  year      = {2017},
  doi       = {10.1007/978-3-319-47831-9},
  isbn      = {978-3-319-47830-2},
  timestamp = {Wed, 28 Jun 2017 15:07:35 +0200},
  biburl    = {https://dblp.org/rec/books/sp/Datta17.bib},
  bibsource = {dblp computer science bibliography,
               https://dblp.org}
}
@book{goossensmittelbach2010,
  author    = {Michel Goossens and
               Frank Mittelbach and
               Alexander Samarin},
  title     = {Der LaTeX Begleiter},
  publisher = {Addison-Wesley},
  year      = {2010},
  isbn      = {978-3-8273-7044-0},
  timestamp = {Fri, 15 Apr 2011 13:37:33 +0200},
  biburl    = {https://dblp.org/rec/books/daglib/0011922.bib},
  bibsource = {dblp computer science bibliography,
               https://dblp.org}
}
```

```
% Preamble adjustments

% Literature
\usepackage[style=numeric, citestyle=alpha,
↪  backend=biber]{biblatex}
\addbibresource{exercises/literature/literature.bib}

% Actual content

An introductory \LaTeX{} course can be found in \enquote{\LaTeX{}
↪  in 24 Hours} \parencite{datta2017}.
There is a plethora of further handbooks
↪  \cite*[e.\,g.,][]{goossensmittelbach2010}.

\printbibliography
```