

Introduction to Writing in LaTeX

LARICS - Laboratory for Robotics and Intelligent Control
Systems

University of Zagreb, Faculty of Electrical Engineering and Computing

May, 2017

Prerequisites

- ▶ Create [Overleaf](#) account and go through [short tutorial](#)
- ▶ Download FER-LARICS LaTeX template from [here](#)
- ▶ Create Overleaf project by uploading FER-LARICS template as .zip
- ▶ Ensure that output .pdf file is created without errors

Outline

- ▶ How to structure a LaTeX project?
- ▶ How to typeset text, equations, lists?
- ▶ How to add figures and tables?
- ▶ How to add and cite literature?

Why LaTeX?

LaTeX is a document preparation system that:

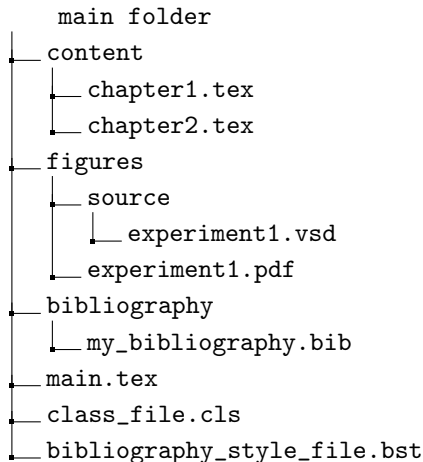
- ▶ allows you to focus on your content and not on how it looks
- ▶ makes beautifully formatted documents
- ▶ is a standard for the publication of scientific documents.
- ▶ is powerful and extendable (new templates, packages etc.)

How to use LaTeX?

- ▶ Overleaf (highly recommended)
 - ▶ a free service that lets you create, edit and share your work online using LaTeX
 - ▶ enables version control
 - ▶ runs git in the background
 - ▶ www.overleaf.com
- ▶ Install LaTeX distribution on your computer
 - ▶ LaTeX program + packages + editor

Project structure

- ▶ Structure:



- ▶ if you use an online repository, **upload only files which are necessary** to generate the desired output file, that is, .tex, .bib files and figures

Overview of main.tex

- ▶ `\documentclass{class}`
 % preamble (information LaTeX will need
 % to format the document correctly)
`\begin{document}`
 % content
`\end{document}`
- ▶ Loading LaTeX class file (.cls)
`\documentclass[times, utf8, diplomski]{fer}`
- ▶ Loading packages `\usepackage{...}`
- ▶ Setting the path to folder with figures
`\graphicspath{{./figures/}}`
- ▶ Including separate .tex files to content
`\input{content/uvod.tex}`
- ▶ Loading bibliography files (.bib and .bst files)
`\bibliography{bibliography/literatura}`
`\bibliographystyle{fer}`

Typesetting basics

- ▶ Words are separated by one or more **spaces**.
- ▶ Paragraphs are separated by one or more **blank lines**.
- ▶ Multiple spaces and blank lines are **ignored**
- ▶ Basic formatting

<code>\textbf{Bold}</code> word	Bold word
<code>\textit{italic}</code> word	<i>italic</i> word

- ▶ Characters %, #, &, \$, _, { } have special function in LaTeX; in text we use them as `\%`, `\#`, `\&`, `\$`, `_`, `\{` `\}`
- ▶ To write and link webpages use `hyperref` package commands `\href` and `\url`

Link to <code>\href{www.google.com}{google}</code>	Link to <code>\url{www.google.com}</code>
--	---

Link to google <code>www.google.com</code>

Lists

- ▶ Bulleted lists (use `itemize` environment)

<pre>\begin{itemize} \item First \item Second \end{itemize}</pre>	<ul style="list-style-type: none">▶ First▶ Second
---	--

- ▶ Enumerated lists (use `enumerate` environment)

<pre>\begin{enumerate} \item First \item Second \end{enumerate}</pre>	<ol style="list-style-type: none">1. First2. Second
---	--

- ▶ Custom lists

<pre>\begin{enumerate}[a)] \item First \item Second \end{enumerate}</pre>	<ol style="list-style-type: none">a) Firstb) Second
---	--

Chapters, sections and subsections

- Syntax:

<code>\chapter{Chapter title}</code>	1. Chapter title
<code>\section{First section}</code>	1.1. First section
<code>\subsection{Subsection}</code>	1.1.1. Subsection
<code>\section{Second section}</code>	1.2. Second section

- Use `\label` and `\ref` command pair for referencing
- Always add meaningful labels to sections. For example:

```
\section{Introduction}  
\label{sec:intro}
```

- In that way you can reference and link them easily using `\ref` command as follows:

Introduction is given in Section <code>\ref{sec:intro}</code>	Introduction is given in Section 1.
--	--

Exercise 1

1.1. First exercise

1. The research firm said that global **robotics** spending in 2015 was \$71 billion, and is set to grow at a compound annual growth rate of 17%.
2. This is Section 1.1.
3. www.fer.unizg.hr

Mathematics (1)

- ▶ Inline expressions are enclosed with dollar signs $\$ \dots \$$

This is a quadratic equation $x^2+4x^2+5=0$.		This is a quadratic equation $x^2 + 4x^2 + 5 = 0$.
--	--	--

- ▶ Enumerated mathematical expressions are written using equation environment

$\begin{aligned} &\backslash\mathrm{begin}\{\mathrm{equation}\} \\ &\quad y^2 = 3x + \frac{2}{3} \\ &\quad \backslash\mathrm{label}\{\mathrm{eq:y}\} \\ &\backslash\mathrm{end}\{\mathrm{equation}\} \end{aligned}$		$y^2 = 3x + \frac{2}{3} \quad (1)$
---	--	------------------------------------

- ▶ For non-enumerated expressions use `equation*` environment or `\[...\]`
- ▶ Add labels to mathematical expressions

align environment (package amsmath)

► `\usepackage{amsmath}`

```
\begin{align*}
```

```
2x - 5y &= 8 \\
```

```
3x + 9y &= -12
```

```
\end{align*}
```

$$2x + 3y + 7z = 5$$

$$2x + 3y = 6$$

Mathematics (2) - Matrices

- Use matrix environment

```
\begin{equation}
  \mathbf{T} =
  \left[
    \begin{matrix}
      \alpha & \beta & \gamma \\
      d_{12} & e_2 & f \\
      g & h & i
    \end{matrix}
  \right]
  \mathbf{T} = \begin{bmatrix} \alpha & \beta & \gamma \\ d_{21} & e_2 & f \\ g & h & i \end{bmatrix} \quad (2)
\end{equation}
\label{eq:matrix}
\end{equation}
```

Exercise 2

1.2. Second exercise

$$f(x) = \frac{1}{1-x^2} + \gamma_{ij} \quad (3)$$

Expression for $f(x)$ is given in Eq. 3.

Tables

- ▶ use booktabs package
- ▶ avoid using vertical column separators

```
\begin{table}[ht!]  
  \centering  
  \caption{Table description}  
  \begin{tabular}{cc}  
    \toprule  
    Station & t[h] \\ \br/>    \midrule  
    1 & 1.5 \\ \br/>    2 & 1.6 \\ \br/>    \bottomrule  
  \end{tabular}  
  \label{tab:experiment1_data}  
\end{table}
```

Table 1: Table description

Station	t[h]
1	1.5
2	1.6

- ▶ don't forget to add meaningful labels to tables
- ▶ table can be referenced using \ref command as follows

Table \ref{tab:experiment1_data} Table 1
--

Exercise 3

1.3. Third exercise

Simulation results are given in Table 2.

Table 2: Energy cost with respect to number of vehicles N

N	10	20	30
total path [m]	64	60.84	61.04
useful path [m]	63.48	59.92	59.4

Figures (1)

- ▶ recommended image format is .pdf, other supported formats are .png, .jpg
- ▶ images are included using `\includegraphics` command from `graphicsx` package
- ▶ Image size can be changed by varying optional arguments of `\includegraphics` command (given in [])

```
\begin{figure}[ht!]  
  \centering  
  \includegraphics[width=0.2\textwidth]  
    {nao}  
  \caption{Nao robot}  
  \label{fig:nao}  
\end{figure}
```

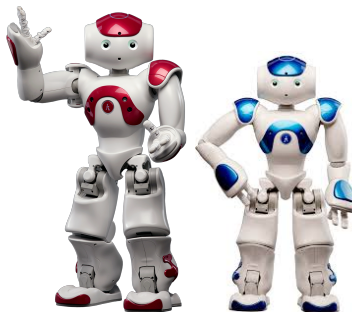


Figure 1: Nao robot

Figures (2) - subfig Package

► `\usepackage[font=footnotesize]{subfig}`

```
\begin{figure}
  \centering
  \hfill
  \subfloat[Orange Nao]
  {
    \label{fig:robot_a}
    \includegraphics
      [width=0.4\textwidth]{nao}
  }
  \subfloat[Blue Nao]
  {
    \label{fig:robot_b}
    \includegraphics
      [width=0.4\textwidth]{nao_blue}
  }
  \caption{Different robots}
\end{figure}
```

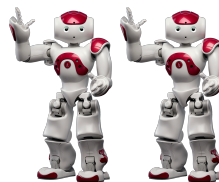


(a) Orange Nao (b) Blue Nao

Figure 2: Different robots

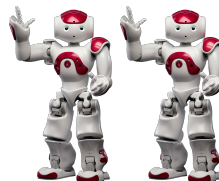
Figures (3) - subfig Package

```
\begin{figure}
\centering
\subfloat[A]{
\label{fig:a}
\includegraphics
[width=0.23\textwidth]{nao}}
\subfloat[B]{
\label{fig:b}
\includegraphics
[width=0.23\textwidth]{nao}}
\\ %newline
\subfloat[C]{
\label{fig:c}
\includegraphics
[width=0.23\textwidth]{nao}}
\subfloat[D]{
\label{fig:d}
\includegraphics
[width=0.23\textwidth]{nao}}
\caption{Four figures in one}
\label{fig:robots}
\end{figure}
```



(a) A

(b) B



(c) C

(d) D

Figure 3: Four figures in one

Figures (4) - Graphics Quality and File Size

- ▶ For your own drawings, always create **vectorized images** using a tool like **Inkscape** and export them to PDF format
- ▶ Included graphics have by far the biggest impact on **file size**.
- ▶ **Always scale** rasterized images (e.g. photos) to the appropriate resolution (300 dpi) using a tool like **gimp**
- ▶ Difference between vector and raster graphics can be seen if the Figure 4 is zoomed in:

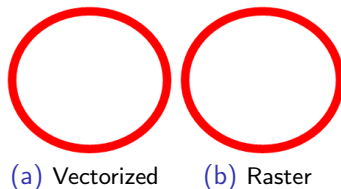
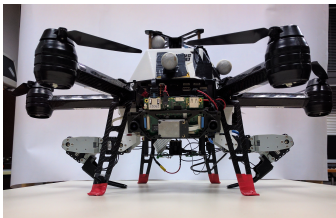


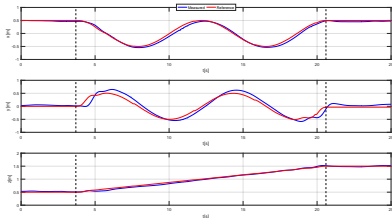
Figure 4: Different types of graphics

Exercise 4

1.4. Fourth exercise



(a) Used UAV



(b) UAV trajectory

Figure 5: Experiment one

Figure 5a shows the used Unmanned Aerial Vehicle, and Figure 5b shows the resulting trajectory.

Typesetting source code (with syntax highlighting)

- ▶ `\usepackage{minted}`
- ▶ Package documentation can be found [here](#)

```
\begin{minted}{c}
int main() {
    printf("hello, world");
    return 0;
}
\end{minted}
```

```
int main() {
    printf("hello, world");
    return 0;
}
```


Bibliography

- ▶ References are stored in .bib file
- ▶ References are in 'bibtex' format

```
@misc{lavalle2006planning,  
  title={Planning algorithms},  
  author={LaValle, Steven M},  
  year={2006},  
  publisher={Cambridge university press}}
```
- ▶ The best place to search for a 'bibtex' entry is on the publisher's website
- ▶ <http://www.doi2bib.org/>
- ▶ References are cited using bibtex key; citing format depends on the used .bst (bibliography style) file

State-of-the art planning algorithms are given in <code>\cite{lavalle2006planning}</code>

State-of-the art planning algorithms are given in <code>[LaValle(2006)]</code>
--

Excercise 5

Cite all the papers in the bibliography file given in FER-LARICS template.

Useful packages (1)

- ▶ **nag**
This package checks for obsolete LaTeX packages and outdated commands. Package needs to be loaded in the first lines of your preamble, before the documentclass command.
- ▶ **TikZ**
Powerful tool to create graphic elements in LaTeX. Info can be found [here](#).
- ▶ **hyperref**
This package provides useful commands for inserting links pointing inside or outside the document. When included, it automatically turns all your internal references into hyperlinks. Package info can me found [here](#).

Useful packages (2)

- ▶ **booktabs**

This package is used to create nicer tables than provided by Latex by default. Package info can be found [here](#). Package `csvsimple` is used for importing `.csv` format tables.

- ▶ **todonotes**

The `todonotes` package allows you to insert to do items in your document.

- ▶ **amsmath**, `amsthm`, `amssymb`, `amsfonts`

Compared to other similar packages, `amsmath` has many advantages, such as more versatile **alignment** options. Nice intro to `amsmath` can be found [here](#).

Useful packages (3)

- ▶ algorithm2e

Algorithm2e is an environment for writing algorithms, where an algorithm behaves as a floating object. Algorithm 1 is written using algorithm2e package.

Data: n

Result: n^{10}

$res = n; i = 1;$

while $i < 10$ **do**

$i++;$

$res = res * n;$

end

return $res;$

Algorithm 1: Basic algorithm

Further reading

- ▶ Overleaf LaTeX tutorial
- ▶ Getting to Grips with LaTeX - A very good set of online tutorials for LaTeX beginners.
- ▶ FER LaTeX tutorial
- ▶ Ne baš tako kratak Uvod u LaTeX - autora Šime Ungara

References



Steven M LaValle.

Planning algorithms, 2006.