LaTeX Workshop

Heuse Maxime

Workshop slides with examples and illustrations

LSM Investment Club

October 14, 2025

Overview

1. Introduction
2. Getting started
3. The Basics
4. Good Practices
5. Advanced Topics
6. Recap & conclusion
7. Bonus : CV, Slides, Templates, Useful doc

About Me

Maxime Heuse

Master's in Mathematical Engineering

Control and Finance Engineer | Quantitative Research Enthusiast

130+ LaTeX projects: reports, slides, and thesis templates

Main experiences:

- Head of quantitative analysis department (LSM Investment Club)
- Data-driven state estimation for nonlinear systems (Master's Thesis)

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Examples of projects in LaTeX

yields the following explicit iteration scheme:

$$v_m^{n+1} = \tfrac{1}{2}(\alpha n^2 - \beta n)v_{m-1}^n + (1 - \alpha n^2 - \beta)v_m^n + \tfrac{1}{2}(\alpha n^2 + \beta n)v_{m+1}^n. \tag{4}$$

Using the initial and boundary conditions, v_0^n, v_m^n, and v_m^n are known for all $n = 0, \ldots, N$ and $m = 0, \ldots, M$. The algorithm therefore computes the solution at time step $m + 1$ directly from step m.

In matrix form, this scheme can be written as

$$v^{n+1} = Av^n + z^n, \qquad m = 0, \ldots, M-1, \tag{5}$$

where

$$A = \begin{pmatrix} d_1 & u_2 & 0 & \cdots & 0 \\ l_1 & d_2 & u_3 & \ddots & \vdots \\ 0 & \ddots & \ddots & \ddots & 0 \\ \vdots & \ddots & \ddots & \ddots & u_{N-1} \\ 0 & \cdots & 0 & l_{N-2} & d_{N-1} \end{pmatrix}, \quad z^m = \begin{pmatrix} l_1 v_0^m \\ 0 \\ \vdots \\ 0 \\ u_N v_M^m \end{pmatrix},$$

with coefficients

$$d_n = 1 - \alpha n^2 - \beta, \qquad n = 1, \ldots, N-1,$$
$$u_n = \tfrac{1}{2}(\alpha(n-1)^2 + \beta(n-1)), \qquad n = 2, \ldots, N,$$
$$l_n = \tfrac{1}{2}(\alpha(n+1)^2 - \beta(n+1)), \qquad n = 0, \ldots, N-2.$$

A well-known drawback of the explicit scheme is its potential instability if the grid is not chosen carefully. According to [2] (see also [5]), stability is guaranteed provided that

$$0 < \Delta t < \frac{1}{\sigma\pi(N-1) + 0.5\sigma}. \tag{6}$$

Other stability conditions can be found, for instance, in [7].

Implementing this scheme with the conditions defined in the previous section yields the following numerical results:

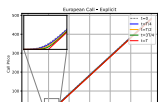


Figure 2: Call option values obtained with the explicit finite-difference scheme.

Model Parameters

Parameter	Value	Unit
L_a	20.25	H
R_a	16.4	Ω
K_e	0.0233	V/(rad/s)
K_a	0.0183	N·m/A
J	9	$g \cdot cm^2$
b	0.0064	N·m/(rad/s)

Table 4.2: Sys 1 — Parameters of the DC motor model.

State-Space Model

Let the state vector be $x = [\theta, \dot{\theta}]^T$, input vector $u = [T_a, V_a]^T$, and output $y = i$. The continuous-time state-space model is (developped in [**franklin**]):

$$\begin{bmatrix} \dot{\theta} \\ \ddot{\theta}(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -\frac{b}{J} \end{bmatrix} \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ \frac{1}{J} & -\frac{1}{K_e} \end{bmatrix} \begin{bmatrix} T_L \\ V_a \end{bmatrix} \tag{4.1.1}$$

Using the parameters from Table 4.2 and a sampling period $\Delta T = 0.001$ s, the system is discretized as:

$$x_{k+1} = \begin{bmatrix} 0.9951 & 0.2289 \\ -0.0177 & 0.6672 \end{bmatrix} x_k + \begin{bmatrix} -0.4158 & 0.0038 \\ -0.0038 & 0.0301 \end{bmatrix} u_k \tag{4.1.2}$$

$$y_k = \begin{bmatrix} 0 & 1 \end{bmatrix} x_k + v_k \tag{4.1.3}$$

This system is referred to as **Sys 1** in the following sections.

4.1.2 Kalman Filter Results

Input Signals. The system is excited using the same input sequence as in [4].

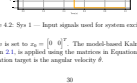


Figure 4.2: Sys 1 — Input signals used for system excitation.

The initial state is set to $x_0 = \begin{bmatrix} 0 & 0 \end{bmatrix}^T$. The model-based Kalman Filter (MBKF), described in Section 2.1, is applied using the matrices in Equations (4.1.2) and (4.1.3). The primary estimation target is the angular velocity $\dot{\theta}$.

Chapter 1

Introduction

1.1 Context

In the world of modern control and estimation, the state-space model is king. It offers a structured way to describe how dynamic systems behave over time. At the heart of this framework sits the Kalman Filter (Kalman Filter (KF)),a mathematical workhorse that has become a cornerstone in engineering and applied sciences. Under the assumptions of linearity and Gaussian noise, it's not just useful,it's optimal.

But here is the problem: the Kalman Filter needs a precise system model to function. In real-world scenarios ,such accurate models are not always available. Building them can be difficult, time-consuming, or simply infeasible.

This gap has sparked a surge of interest in data-driven approaches [11],[4],[13],[2], methods that learn system behavior directly from measured data, skipping the need for detailed models. In this thesis, we explore how such data-driven strategies can be incorporated into the Kalman filtering framework. Our goal is to assess how they stack up against classical, model-based techniques.

1.2 State of the Art

1.2.1 Filtering

Introduction

The word "filtering" pops up in many fields. In signal processing, it is about enhancing or removing parts of a signal. In mathematics, it is tied to order structures. But in the context of control and estimation, our focus here, it means something else entirely: estimating the hidden state of a system based on noisy and partial observations.

This might sound abstract, but it is not. Imagine driving with a GPS. You see a dot on your screen moving smoothly along a map. That dot represents an estimate of your position, derived from noisy GPS signals. How does it know where you are with such precision? Behind the scenes, filters like the Kalman Filter are hard at work.

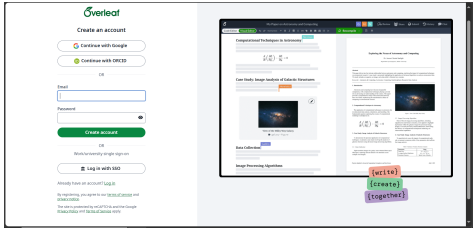
State-Space Representation

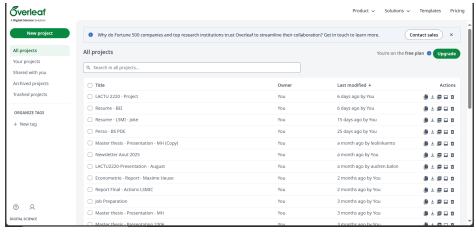
To model physical systems like robots, vehicles, or power grids, we often use the language of state-space models. These models describe how the system evolves over time based

Sec 2 - Getting Started

Create Overleaf Account

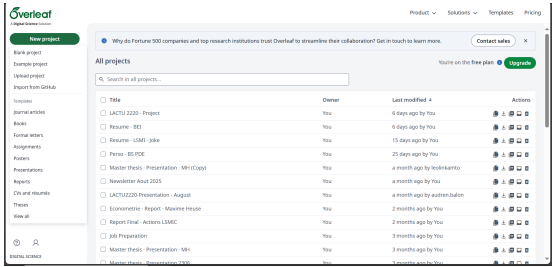
Go to the website Overleaf.





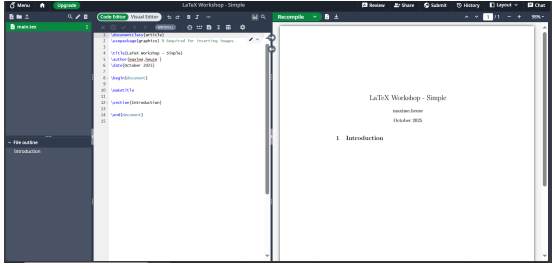
Blank Project

We can now create our first *Blank Project*.

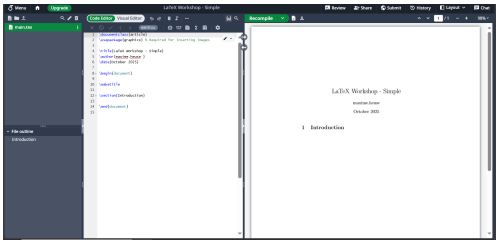


Blank Project

This is what the project looks like at first:



Overleaf Structure



Try to point out the following elements:

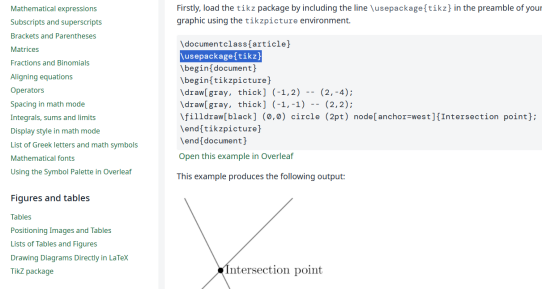
- New file
- New folder
- Recompile
- Download
- Share
- History
- Visual editor
- File outline

Packages

```
% EPL master thesis covers template
\documentclass{EPL-master-thesis-covers-EN}
% Text and Formatting
\usepackage{blindtext}
\usepackage[titlesec]
\usepackage{xcolor}
\usepackage[normalem]{ulem}
\usepackage{verbatim}

% Layout and Structure
\usepackage{geometry}
\geometry{margin=1in}
\usepackage{multicol}
\usepackage{tocloft}

% Math
\usepackage{amsmath}
\numberwithin{equation}{section}
\usepackage{amssymb}

% Figures and Graphics
\usepackage{graphicx}
\usepackage{subcaption}
\usepackage{float}

% Algorithms
\usepackage{algorithm}
\usepackage{algpseudocode}
\usepackage[linesnumbered,ruled,vlined]
{algorithm2e}

% References and Links
\usepackage[colorlinks=true,
linkcolor=blue!70!black,
citecolor=blue!80!white,
urlcolor=blue!75!white]{hyperref}
\usepackage[backend=biber,style=numeric]
{biblatex}
```

Packages are like books in a library. You can use what's inside only if you read it. Overleaf can use functions/environments of packages only if you give access to them.

When you are reading documentation on LaTeX or reading forum discussions, always pay attention to which packages are used:



Mathematical expressions
Subscripts and superscripts
Brackets and Parentheses
Matrices
Fractions and Binomials
Aligning equations
Operators
Spacing in math mode
Integrals, sums and limits
Display style in math mode
List of Greek letters and math symbols
Mathematical fonts
Using the Symbol Palette in Overleaf

Figures and tables

Tables
Positioning Images and Tables
Lists of Tables and Figures
Drawing Diagrams Directly in LaTeX
TikZ package

Firstly, load the `tikz` package by including the line `\usepackage{tikz}` in the preamble of your graphic using the `tikzpicture` environment.

```
\documentclass{article}
\usepackage{tikz}
\begin{document}
\begin{tikzpicture}
\draw[gray, thick] (-1,2) -- (2,-4);
\draw[gray, thick] (-1,-1) -- (2,2);
\filldraw[black] (0,0) circle (2pt) node[anchor=west]{Intersection point};
\end{tikzpicture}
\end{document}
```

Open this example in Overleaf

This example produces the following output:

Sec 3 - The Basics

Text formatting - bold

LaTeXcode:

```
\textbf{Bold} text
```

Result:

Bold text

Required package: None

Text formatting - italic

LaTeXcode:

```
\textit{Italic} text
```

Result:

Italic text

Required package: None

Text formatting - underline

Result:

Underlined text

LaTeXcode:

```
\underline{Underlined} text
```

Required package: None

Text formatting - highlight

LaTeXcode:

```
\hl{Highlighted} text
```

Result:

Highlighted text

Required package: soul

Text formatting - color

Result:

Colored text

LaTeXcode:

```
\textcolor{red}{Colored} text
```

Required package: color

Text formatting - footnotes

LaTeXcode:

```
Automatically computed footnote\footnote{Here!}
Manually computed footnote! \footnote[36]{There}
```

Result:

Automatically computed footnote[1]

Manually computed footnote! [36]

[1] Here!

[36] There

Text formatting - example

LaTeXcode:

```
\textbf{Lorem ipsum} dolor sit amet, \textit{consectetur adipiscing elit},
\textcolor{blue}{sed do eiusmod} \hl{tempor incididunt} ut
labore et dolore magna aliqua\footnote{Source: https://www.lipsum.com/}.
```

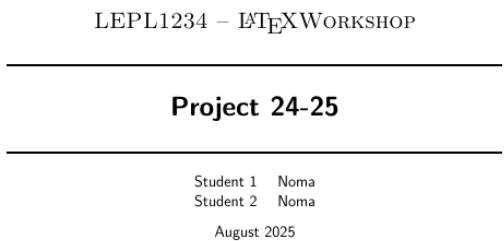
Result:

Lorem ipsum dolor sit amet, *consectetur adipiscing elit*, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua[2].

[2] Source: https://www.lipsum.com/

Text Structure

The first element one sees in a report is the title page.



Text Structure - Title Page

LaTeXcode:

```
\title{Title}
\author{Student Name}
\date{October 2025}

\begin{document}

\maketitle

Some text

\end{document}
```

Result:

Title

Student Name

October 2025

Some text

Text Structure - Sections

Contents

The structure of reports in LaTeX is easily done via **Sections** and **Subsections**.

Text Structure - Sections

LaTeXcode:

```
\section{Main Section}
\subsection{Subsection}
\subsubsection{Subsubsection}
```

Result:

1 Main Section

1.1 Subsection

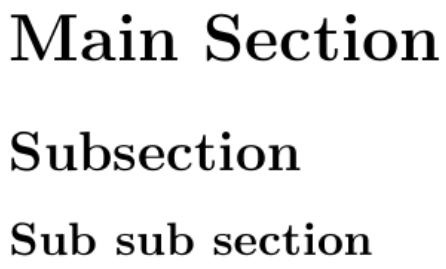
1.1.1 Sub sub section

Text Structure - Sections*

LaTeXcode:

```
\section*{Main Section}
\subsection*{Subsection}
\subsubsection*{Subsubsection}
```

Result:



Text Structure - Lists

Sometimes, one would like to list parameters as follows:

- S = price of the underlying asset,
- σ = constant volatility of the underlying asset,
- r = risk-free interest rate.

Text Structure - List itemize

LaTeXcode:

```
\begin{itemize}
    \item First element
    \item Second element
    \item Third element
\end{itemize}
```

Result:

- First element
- Second element
- Third element

Text Structure - List enumerate

LaTeXcode:

```
\begin{enumerate}
    \item First element
    \item Second element
    \item Third element
\end{enumerate}
```

Result:

1. First element
2. Second element
3. Third element

Math in LaTeX

There are many different ways to include mathematical formulas in LaTeX.
We can either write **inline math**, where the math is directly written within the text.

Example: The stock is modeled by a GBM $\frac{dS_t}{S_t} = \mu\, dt + \sigma\, dW_t$. *This is a very common choice.*

Or it can be written in **display mode**.

Example: The stock is modeled by a GBM.

$$\frac{dS_t}{S_t} = \mu\, dt + \sigma\, dW_t \tag{1}$$

This is a very common choice.

Math in LaTeX

Usually, **display mode** is always preferred as it provides cleaner writing.

In matrix form, this scheme can be written as

$$v^{m+1} = Av^m + z^m, \qquad m = 0, \dots, M-1, \tag{5}$$

where

$$A = \begin{pmatrix} d_1 & u_2 & 0 & \cdots & 0 \\ l_1 & d_2 & u_3 & & \vdots \\ 0 & \ddots & \ddots & \ddots & 0 \\ \vdots & & \ddots & \ddots & u_{N-1} \\ 0 & \cdots & 0 & l_{N-2} & d_{N-1} \end{pmatrix}, \qquad z^m = \begin{pmatrix} l_0 v_0^m \\ 0 \\ \vdots \\ 0 \\ u_N v_N^m \end{pmatrix}.$$

with coefficients

$$\begin{aligned} d_n &= 1 - \alpha n^2 - \beta, && n = 1, \dots, N-1, \\ u_n &= \tfrac{1}{2}\big(\alpha(n-1)^2 + \beta(n-1)\big), && n = 2, \dots, N, \\ l_n &= \tfrac{1}{2}\big(\alpha(n+1)^2 - \beta(n+1)\big), && n = 0, \dots, N-2. \end{aligned}$$

A well-known drawback of the explicit scheme is its potential instability if the grid is not chosen carefully. According to [2] (see also [5]), stability is guaranteed provided that

$$0 < \Delta t < \frac{1}{\sigma^2(N-1) + 0.5r}. \tag{6}$$

Math in LaTeX- Inline

Some useful formulas in **inline mode**:

LaTeXcode:

```
\begin{itemize}
    \item $\frac{Num}{Denom}$
    \item $e^{x}$
    \item $\frac{\partial f}{\partial x}$
    \item $A \rightarrow B$
    \item $\neg A \Rightarrow B$
    \item $0 \geq -1$ and $0 \leq 1$
\end{itemize}
```

Result:

- $\frac{Num}{Denom}$
- e^{x}
- $\frac{\partial f}{\partial x}$
- $A \rightarrow B$
- $\neg A \Rightarrow B$
- $0 \geq -1$ and $0 \leq 1$

Math in LaTeX- Display

First way to do **display mode**:

LaTeXcode:

```
Numbered equation:
\begin{equation}
    x^{4-t} = 3
\end{equation}
Unnumbered equation:
\begin{equation*}
    x^{4-t} = 2
\end{equation*}
```

Result:

Numbered equation :

$$x^{4-t} = 3 \tag{1}$$

Unnumbered equation :

$$x^{4-t} = 2$$

Required package: amsmath

Math in LaTeX- Display

Second way to use **display mode** (multi-line equations):

LaTeXcode:

```
Aligned numbered equations:
\begin{align}
    f(x) & = (x - a)^2 \\
         & = x^2 - 2ax + a^2
\end{align}
Aligned unnumbered equations:
\begin{align*}
    f(x) & = (x - a)^2 \\
         & = x^2 - 2ax + a^2
\end{align*}
```

Result:

Aligned numbered equations :

$$f(x) = (x-a)^2 \tag{1}$$
$$= x^2 - 2ax + a^2 \tag{2}$$

Aligned unnumbered equations :

$$f(x) = (x-a)^2$$
$$= x^2 - 2ax + a^2$$

Required package: amsmath

Math in LaTeX- Special Characters

Some special characters:

LaTeXcode:

```
\&, \\
\%
```

Result:

&,
%

Illustrations / Visualizations

In reports, you can present data in two different ways: using **tables** and **figures**.

Maturity (Years)	Coupon Rate (%)	Credit Spread (%)	Nominal (€)	Dirty Price (€)	Market Value (€)
4	2.00	0.50	400 000 000	92.14	368 561 160.59
7	4.50	2.25	700 000 000	89.85	628 924 015.69
10	3.50	1.25	900 000 000	85.26	767 312 507.31

Table 4: Summary of dirty prices and market values for each bond in the portfolio.

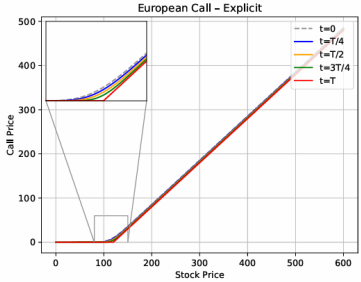


Figure 2: Call option values obtained with the explicit finite-difference scheme.

Illustrations / Visualizations - Tables

First, let us build a table with 4 columns and 3 rows.

LaTeXcode:

```
\begin{table}[H]
    \centering
    \begin{tabular}{|c|c|c|c|}
        \hline
        Row 1 & a & b & c  \\
        Row 2 & e & f & g  \\
        Row 3 & i & j & k  \\
        \hline
    \end{tabular}
    \caption{Caption}
    \label{tab:example}
\end{table}
```

Result:

Row 1	a	b	c
Row 2	e	f	g
Row 3	i	j	k

Table 1: Caption

Required package: float

Illustrations / Visualizations - Figures

LaTeXcode:

```
\begin{figure}[H]
    \centering
    \includegraphics[width=0.5\linewidth]
    {Graphics/Explicit.pdf}
    \caption{Illustration}
    \label{fig:Illu}
\end{figure}
```

Result:

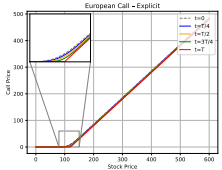


Figure: Illustration

Required packages: float, graphicx

Illustrations / Visualizations

At first, it might seem like complicated code. Good news: Overleaf has *auto-completion*! You just need to type the first few letters, and it will suggest how to complete the code for you.[3]

Figure: Overleaf suggests starting a "figure"

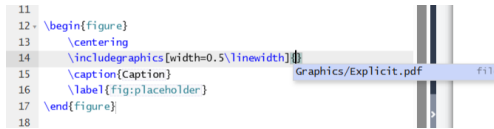


Figure: Overleaf suggests files for the figure

[3] This also works for equations, alignments, tables, etc.

Sec 4 - Good Practices

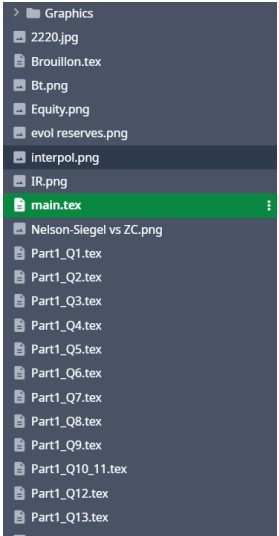
A Good Structure

Why is it important?

- Easier debugging
- Quick access to the parts you need to modify
- Easy to share

A Good Structure

Bad example — No words needed.



A Good Structure

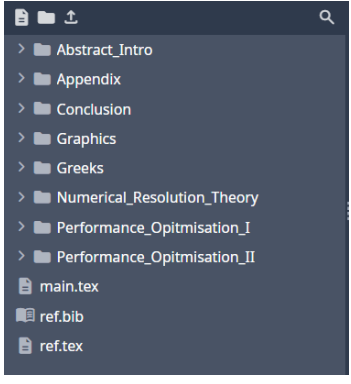
Recommended structure:

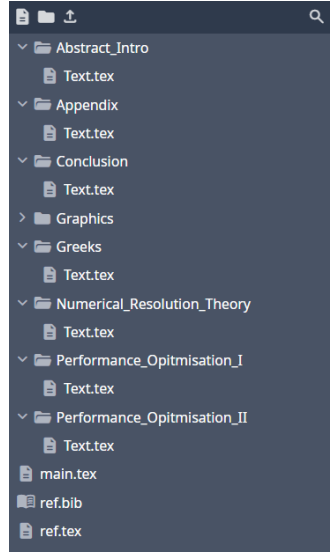
- One folder per section (*"Sec 1"*, *"Sec 2"*, ...)
- A folder named *"Graphics"*
- A folder named *"Appendices"*
- A main file *"main.tex"*
- Files required for automated bibliography (see following slides)

A Good Structure

Example:

1) The structure of the project





A Good Structure

With the structure defined above, my *"main.tex"* simply looks like this:

```
\date{September 2025}

\begin{document}

% Title Page
\begin{sffamily}
\maketitle
\thispagestyle{empty}

%\clearpage
\end{sffamily}

% Table of Contents
\tableofcontents
\newpage

\include{Abstract_Intro/Text}
\include{Numerical_Resolution_Theory/Text}
\include{Performance_Opitmisation_I/Text}
%\include{Performance_Opitmisation_II/Text}
\include{Greeks/Text}
\include{Conclusion/Text}

\newpage
\printbibliography


\end{document}
```

Formats

When using figures, import your images in `.pdf` format!

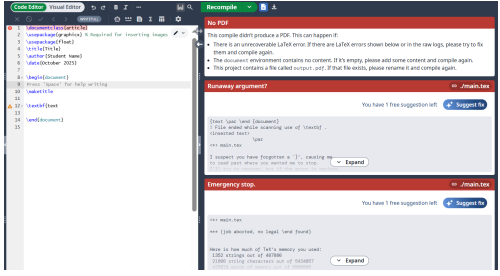
Compilation

Errors on Overleaf are not always easy to understand.
The following code:

LaTeXcode:

```
\textbf{text
```

produces the following:



just because a "}" is missing.

Compilation

A good practice to avoid losing time debugging your report is to compile as often as possible. You can recompile your project using the green "Recompile" button or with `Ctrl + S`.

If you encounter an error, remember that you still have access to your compilation history!

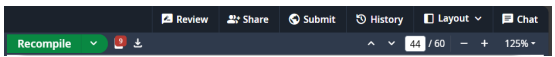


Figure: Recompile button and history

Comments

LaTeXcode:

```
% Illustration of comments
\begin{equation}
    2x = 3x' - 2 % ODE
\end{equation}
\begin{equation}
    2x = 3x' - 2 EDO
\end{equation}
```

Result:

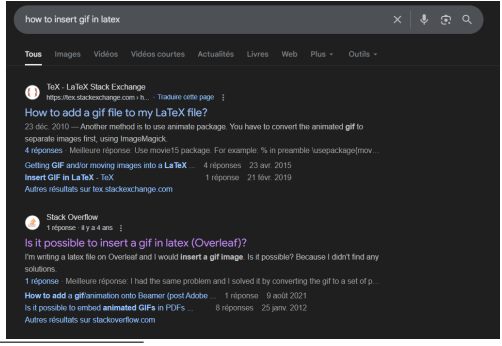
$$2x = 3x' - 2 \tag{1}$$

$$2x = 3x' - 2EDO \tag{2}$$

Stack Overflow and Documentation

If you want to try something new in LaTeX, you will probably search online for "How to ... in LaTeX." I recommend looking at solutions posted on Stack Overflow, TeX Stack Exchange, and the official Overleaf documentation.

For example, let's assume I want to insert a GIF in my report[4].



[4] Yes, it is possible — but use it only if strictly necessary for illustration purposes.

Sec 5 - Advanced Topics

References

In LaTeX, you can create references to previous figures, equations, tables, or sections of your report.

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0, \tag{1}$$

where

- S = price of the underlying asset,
- σ = constant volatility of the underlying asset,
- r = risk-free interest rate.

Two additional parameters of particular importance are:

- K = strike price of the option,
- T = maturity of the contract.

In this report, we focus primarily on the valuation of European call options. Following [2], equation (1) can be written for a call as

$$\frac{\partial V}{\partial t}(S,t) - \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2}(S,t) - rS\frac{\partial V}{\partial S}(S,t) + rV(S,t) = 0. \tag{2}$$

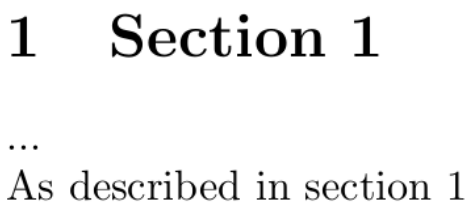
References

In your figures, equations, sections, etc., include a descriptive label.

LaTeXcode:

```
\section{Section 1} \label{sec:first_section}
...
As described in Section \ref{sec:first_section}
```

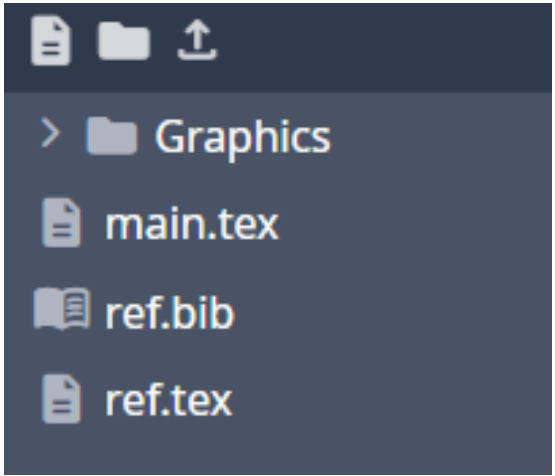
Result:



Erratum : you also need package 'hyperref' !

Automated Bibliography

It is important to cite your sources — and it's very easy to do in LaTeX.
First, create the following files next to your *"main.tex"*:



Automated Bibliography

Your file *"ref.tex"* should look like this:

LaTeXcode:

```
\bibliographystyle{halpha}
\bibliography{ref}
\nocite{*}

\hspace{3cm}
```

And *"ref.bib"* contains your sources. Here is an example:

```
@article{dura2010numerical,
  title={Numerical approximation of Black-Scholes equation},
  author={Dura, Gina and Mosneagu, Ana-Maria},
  journal={Annals of the Alexandru Ioan Cuza University-Mathematics},
  volume={56},
  number={1},
  pages={39--64},
  year={2010}
}
```

Figure: Example of a bibliographic source

Automated Bibliography

You can cite any source using the following syntax (see lines 3, 4, 13, and 14).

```
1  \documentclass{article}
2
3  \usepackage[backend=biber,style=numeric,citestyle=numeric]{biblatex}
4  \addbibresource{ref.bib}
5  \title{Title}
6  \author{Student Name}
7  \date{October 2025}
8
9  \begin{document}
10
11 \maketitle
12
13 According to this paper : \cite{dura2010numerical}
14 \printbibliography
15
16 \end{document}
```

According to this paper : [1]

References

[1] Gina Dura and Ana-Maria Mosneagu. "Numerical approximation of Black-Scholes equation". In: *Annals of the Alexandru Ioan Cuza University-Mathematics* 56.1 (2010), pp. 39–64.

Erratum : you also need to add package 'hyperref' !

Matrices and Vectors

In LaTeX, both matrices and vectors are written in a similar way.

LaTeXcode:

```
\begin{align}
    A & = \begin{bmatrix}
        a_{11} & a_{12} \\
        a_{21} & a_{22}
    \end{bmatrix} \\
    B & = \begin{bmatrix}
        b_1 \\ b_2
    \end{bmatrix}
\end{align}
```

Result:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

Required package: amsmath

Additional note : Pay attention that indices of variables (for example 11 in a_{11}) are done via the special character underscore "_".

Algorithms

LaTeXcode :

```
\begin{algorithm}
\caption{Algo 1}
\begin{algorithmic}
\State $i \gets 10$
\If{$i\geq 5$}
    \State $i \gets i-1$
\Else
    \If{$i\leq 3$}
        \State $i \gets i+2$
    \EndIf
\EndIf
\end{algorithmic}
\end{algorithm}
```

Result :

Algorithm 1 Algo 1

$i \leftarrow 10$
if $i \geq 5$ **then**
  $i \leftarrow i - 1$
else
  if $i \leq 3$ **then**
    $i \leftarrow i + 2$
  end if
end if

Required packages :
algorithm, algpseudocode

Code - Easy

LaTeXcode :

```
\begin{lstlisting}
import random

def PrintHelloWorld():
    print("Hello, World!")

def AddTwoNumbers(a, b):
    return a + b
\end{lstlisting}
```

Result :

```
import random

def PrintHelloWorld():
    print("Hello, World!")

def AddTwoNumbers(a, b):
    return a + b
```

Required package : listings

Code - Advanced

Before starting your document, add :

LaTeXcode (pt I)

```
\definecolor{dkgreen}{rgb}{0,0.6,0}
\definecolor{gray}{rgb}{0.5,0.5,0.5}
\definecolor{mauve}{rgb}{0.58,0,0.82}
\lstset{frame=tb,
  language=python,
  showstringspaces=false,
  columns=flexible,
  basicstyle={\small\ttfamily},
  numbers=none,
  numberstyle=\tiny\color{gray},
  keywordstyle=\color{blue},
  commentstyle=\color{dkgreen},
...
```

LaTeXcode (pt II)

```
    ...
  stringstyle=\color{mauve},
  breaklines=true,
  breakatwhitespace=true,
  tabsize=3,
  morekeywords={while, true},
  numbers=left,
  numberstyle=\tiny\color{gray},
  stepnumber=1,
}
```

Code - Advanced

It seems complicated, but you get much nicer code.

```
import random

def PrintHelloWorld():
    print("Hello, World!")

def AddTwoNumbers(a, b):
    return a + b
```

Figure: Before

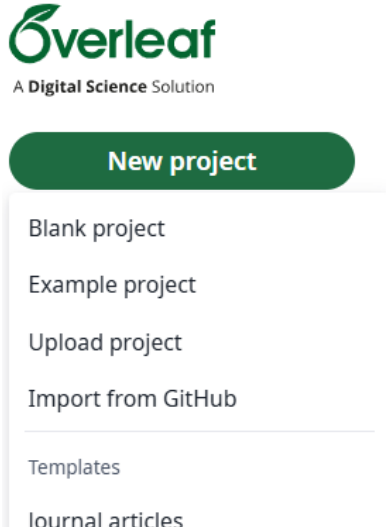
```
1 import random
2
3 def PrintHelloWorld():
4     print("Hello, World!")
5
6 def AddTwoNumbers(a, b):
7     return a + b
```

Figure: After

Sec 6 - Recap

Create a New Document

→ Blank Project



Structure

Recommended structure:

- One folder per section (*"Sec 1"*, *"Sec 2"*, ...)
- A folder named *"Graphics"*
- A folder named *"Appendices"*
- A main file *"main.tex"*
- Files required for automated bibliography (see following slides)

Writing, References, and Sourcing

- Text formatting — basic commands
- Mathematics in LaTeX
- Illustrations / Visualizations (tables, figures)
- Using references
- Citing your sources

Sec 7 - Bonus

CV Template

Firstname Lastname

firstname.lastname@email.com | +00 000 00 00 00 | LinkedIn: username | GitHub: username

ABOUT ME

Motivated and analytical professional with a strong background in quantitative analysis and mathematical modeling. Passionate about applying data-driven methods to solve complex problems in finance, engineering, and technology. Adaptable, detail-oriented, and committed to continuous learning.

EDUCATION

University of Somewhere - *Master's Degree in Applied Mathematics and Engineering* — *City, Country*
Sept 2023 – June 2025
Relevant Courses: Optimization, Probability and Statistics, Financial Engineering, Machine Learning, Control Theory

University of Anywhere - *Bachelor's Degree in Engineering Science* — *City, Country*
Sept 2020 – June 2023
Relevant Courses: Linear Algebra, Numerical Methods, Data Analysis, Programming Fundamentals

EXPERIENCE

Quantitative Analyst Intern — *ABC Financial Group*
April 2024 – Sept 2024

- Assisted in developing pricing models for derivatives and risk metrics under stochastic volatility.
- Supported asset allocation and backtesting strategies using Python and R.

Teaching Assistant - Probability and Statistics — *University of Somewhere*
Sept 2023 – June 2024

- Guided undergraduate students through lab sessions and assignments.
- Created Python notebooks for interactive demonstrations of stochastic processes.

Junior Data Analyst — *XYZ Consulting*
June 2021 – Aug 2022

- Collected and analyzed financial data for market reports.
- Automated reporting workflows, reducing manual processing time by 40%.

PROJECTS

Interest Rate Modeling and Option Pricing — *University Project*

- Implemented Monte Carlo simulations for pricing interest rate derivatives under the Hull–White model.
- Developed scripts to compare analytical vs. numerical methods for option valuation.

Portfolio Optimization Dashboard — *Personal Project*

- Designed a web-based dashboard using Python, Dash, and Plotly for visualizing efficient frontiers.
- Integrated live financial data via APIs (Yahoo Finance, AlphaVantage).

Data-Driven Kalman Filter Implementation — *Research Project*

- Built a data-driven filtering approach for nonlinear systems using behavioral theory concepts.
- Compared results to classical Kalman Filter and Extended Kalman Filter performance.

TECHNICAL SKILLS AND LANGUAGES

Slides Template

Blocks of Highlighted Text

In this slide, some important text will be highlighted because it's important. Please, don't abuse it.

Block

Sample text

Alertblock

Sample text in red box

Examples

Sample text in green box. The title of the block is "Examples".

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Basic Report Template

1 First section

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

1.1 First Subsection

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

An image

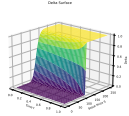


Figure 1: Caption

with some math

$$\frac{dS_t}{S_t} = \mu dt + \sigma dW_t \tag{1.1}$$

and some data

Maturity (Years)	Coupon Rate (%)	Credit Spread (%)	Nominal (€)	Dirty Price (€)	Market Value (€)
4	2.00	0.50	400 000 000	91.84	367 350 618.15
7	4.50	2.25	700 000 000	88.80	621 574 679.13
10	3.50	1.25	900 000 000	84.23	758 073 263.91

Table 1: Summary of dirty prices and market values for each bond in the portfolio.

Advanced Report Template

3 Third section

3.1 How to do references and citations

As seen in (1.1)

As we can see on 1

As the table 1 shows

According to paper [1] and [2]

3.2 More complicated maths

In matrix form, this scheme can be written as

$$v^{m+1} = Av^m + z^m, \qquad m = 0, \ldots, M-1, \tag{3.1}$$

where

$$A = \begin{pmatrix} d_1 & u_2 & 0 & \cdots & 0 \\ l_1 & d_2 & u_3 & & \vdots \\ 0 & \ddots & \ddots & \ddots & 0 \\ \vdots & & \ddots & \ddots & u_{N-1} \\ 0 & \cdots & 0 & l_{N-2} & d_{N-1} \end{pmatrix}, \qquad z^m = \begin{pmatrix} l_0 v_0^m \\ 0 \\ \vdots \\ 0 \\ u_N v_N^m \end{pmatrix}.$$

with coefficients

$$\begin{aligned} d_n &= 1 - \alpha n^2 - \beta, & n &= 1, \ldots, N-1, \\ u_n &= \tfrac{1}{2}(\alpha(n-1)^2 + \beta(n-1)), & n &= 2, \ldots, N, \\ l_n &= \tfrac{1}{2}(\alpha(n+1)^2 - \beta(n+1)), & n &= 0, \ldots, N-2. \end{aligned}$$

Useful Documents

LaTeX Mathematical Symbols

The more unusual symbols are not defined in base LaTeX (NFSS) and require `\usepackage{amssymb}`

1 Greek and Hebrew letters

α	\alpha	κ	\kappa	ψ	\psi	$\digamma$	\digamma	Δ	\Delta	Θ	\Theta
β	\beta	λ	\lambda	ρ	\rho	ε	\varepsilon	Γ	\Gamma	Υ	\Upsilon
χ	\chi	μ	\mu	σ	\sigma	$\varkappa$	\varkappa	Λ	\Lambda	Ξ	\Xi
δ	\delta	ν	\nu	τ	\tau	φ	\varphi	Ω	\Omega		
ϵ	\epsilon	o	o	θ	\theta	ϖ	\varpi	Φ	\Phi	$\aleph$	\aleph
η	\eta	ω	\omega	υ	\upsilon	ϱ	\varrho	Π	\Pi	$\beth$	\beth
γ	\gamma	ϕ	\phi	ξ	\xi	ς	\varsigma	Ψ	\Psi	$\daleth$	\daleth
ι	\iota	π	\pi	ζ	\zeta	ϑ	\vartheta	Σ	\Sigma	$\gimel$	\gimel

2 LaTeX math constructs

$\frac{abc}{xyz}$	\frac{abc}{xyz}	$\overline{abc}$	\overline{abc}	$\overrightarrow{abc}$	\overrightarrow{abc}
f'	f'	$\underline{abc}$	\underline{abc}	$\overleftarrow{abc}$	\overleftarrow{abc}
$\sqrt{abc}$	\sqrt{abc}	$\widehat{abc}$	\widehat{abc}	$\overbrace{abc}$	\overbrace{abc}
$\sqrt[n]{abc}$	\sqrt[n]{abc}	$\widetilde{abc}$	\widetilde{abc}	$\underbrace{abc}$	\underbrace{abc}

3 Delimiters

$\vert$	\vert	$\{$	\{	$\lfloor$	\lfloor	$/$	/	$\Uparrow$	\Uparrow	$\llcorner$	\llcorner
$\vert$	\vert	$\}$	\}	$\rfloor$	\rfloor	$\backslash$	\backslash	$\uparrow$	\uparrow	$\lrcorner$	\lrcorner
$\Vert$	\Vert	$\langle$	\langle	$\lceil$	\lceil	$[$	[	$\Downarrow$	\Downarrow	$\ulcorner$	\ulcorner
$\Vert$	\Vert	$\rangle$	\rangle	$\rceil$	\rceil	$]$	]	$\downarrow$	\downarrow	$\urcorner$	\urcorner

Use the pair `\lefts1` and `\rights2` to match height of delimiters s_1 and s_2 to the height of their contents, e.g.,
`\left| expr \right|` `\left\{ expr \right\}` `\left\Vert expr \right.`.

4 Variable-sized symbols (displayed formulae show larger version)

$\sum$	\sum	$\int$	\int	$\biguplus$	\biguplus	$\bigoplus$	\bigoplus	$\bigvee$	\bigvee		
$\prod$	\prod	$\oint$	\oint	$\bigcap$	\bigcap	$\bigotimes$	\bigotimes	$\bigwedge$	\bigwedge		
$\coprod$	\coprod	$\iint$	\iint	$\bigcup$	\bigcup	$\bigodot$	\bigodot	$\bigsqcup$	\bigsqcup		

5 Standard Function Names

Function names should appear in Roman, not Italic, e.g.,

Correct: `\tan(at-n\pi)` $\longrightarrow \tan(at - n\pi)$
Incorrect: `tan(at-n\pi)` $\longrightarrow tan(at - n\pi)$

On GitHub

- Available in `.zip` format
- Explanation on how to download and open the files
- Available here: GitHub Repository

Thank you