



Introduction to LATEX

A high-quality document preparation system

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Benha Faculty of Engineering
Benha University

Writing Technical Report, Manuscript and Thesis

LATEX

AGENDA

- **Latex Introduction.**
- **Latex Installation.**
- **Using main structures and templates.**
- **Working Other Editors.**
- **Collaborative writing using latex.**

What is LaTeX?

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Latex is a document preparation system for high quality typesetting.

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- **Plotting figures for different data.**

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- **Solving mathematical equations.**
- **Plotting figures for different data.**

The main coins of latex is that its need time and efforts to learning

Latex Introduction

Source.tex

```
\documentclass[12pt]{article}

\begin{document}
\title{Resource Allocation and Computation Offloading with Data Security for Mobile Edge Computing}

\author{Ibrahim A. Elgendy}

\begin{abstract}
\textit{Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here Write the abstract here.}
\end{abstract}

\section{Introduction} \label{sec:introduction}
Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here Write the \textit{introduction} here.

\section{Related Work} \label{relatedwork}
Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here Write the related work here.

\section{System Model} \label{systemmodel}
Write the \underline{methodology} here Write the methodology here Write the methodology here Write the methodology here Write the methodology here Write the methodology here Write the methodology here Write the methodology here Write the methodology here Write the methodology here.

\section{Conclusions} \label{conclusion}
Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here Write the conclusion here.

\end{document}
```

Class.cls

```
\catcode \B=12 \catcode \R=12
% combined action of \IEEEtranmaketocspunct and
\IEEEtranmaketocodes{\IEEEtranvaltotocspunct}

% usage: \IEEEExtractToken*()
% \IEEEExtractToken fully expands its argument (which it then stores in
% \IEEEExtractTokenarg) via \edef and then the meaning of the first
% \noexpand (but including the empty group) token found is assigned to \let
% to \IEEEExtracToketoken as well as stored in the macro
% \IEEEExtracToketoken. Tokens that would otherwise be discarded during
% the acquisition of the first are stored in \IEEEExtracToketokendiscarded,
% however their original relative brace nesting depths are not guaranteed to
% be preserved.
% If the argument is empty, or if a first \noexpand token does not exist (or
% is an empty group), \IEEEExtracToketoken will be \relax and
% \IEEEExtracToketokenmacro and \IEEEExtracToketokendiscarded will be empty.
%
% For example:
% \IEEEExtracToketoken{((ab))((cd))}((ef)g)
% results in:
%
% \IEEEExtracToketokenarg      ==> a macro containing ((ab))((cd))((ef)g)
% \IEEEExtracToketoken       ==> the letter a
% \IEEEExtracToketokenmacro  ==> a macro containing a
% \IEEEExtracToketokendiscarded ==> a macro containing bc((ef)g)
%
% the "star form, \IEEEExtractToken*, does not expand its argument
% contents during processing.
\def\IEEEExtractToken{\@first\{let\@IEEEExtracToketokendef=\IEEEExtracToketoken\}\{let\@IEEEExtracToketokendef=\IEEEExtracToketoken\}}

\def\@IEEEExtractToken#1{\@IEEEExtracToketokendef\@IEEEExtracToketokenarg\#1\relax
\def\@IEEEExtracToketokendiscarded\relax % initialize to empty
% if the macro is unchanged after being acquired as a single undelimited argument
% with anything after it being stripped off as a delimited argument
% we know we have one token without any enclosing braces. loop until this is true.
\let\@IEEEExtracToketokenarg\@IEEEExtracToketokenarg
\loop
% top case of an empty argument as this would cause a problem with
% \@IEEEExtracToketoken's first (redefined) argument acquisition
\if\@IEEEExtracToketokenarg\@empty
\let\@IEEEExtracToketokenmacro\IEEEExtracToketoken
\else
\pendefor\@IEEEExtracToketoken\@IEEEExtracToketokenarg\@IEEEExtracToketoken\@IEEEExtracToketokenarg\@IEEEExtracToketoken\relax
\if\@IEEEExtracToketokenmacro\@IEEEExtracToketokenarg
\else
\let\@IEEEExtracToketokenarg\@IEEEExtracToketokenmacro
\repeat
% we can only do a \let= here because there should be at most one token
% the \relax is needed to handle the case of no token found
\pendefor\let\@pendefor\@IEEEExtracToketoken\@IEEEExtracToketokenmacro\relax
```

Justification and hyphenation

Microsoft Word

Call me Ishmael. Some years ago – never mind how long precisely – having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the

LaTeX

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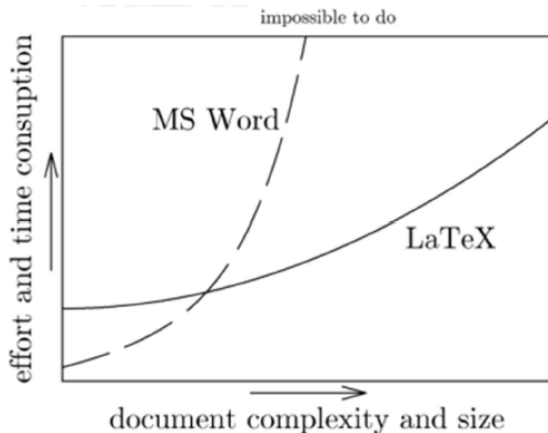
Ligatures

Microsoft Word grafiet efficiënt fles souffleur fjord
LaTeX grafi^eet effici^ent fles souff^eleur fj^erd

Kerning

Microsoft Word Tafel AVA AVA
LaTeX Tafel AVA AVA

Word and Latex Comp.



LaTeX or MS Word

Use it if:

- You type a lot of equation
- You like plain text, stable formats

Don't use it if:

- Write simple and small documents.
- You want to control every graphical aspect of whole document.(custom layout)
- You need to exchange documents with non-LaTeX people.

Latex Tools

- **Distributions.**

- **Editors.**

Latex Distributions

- **MiKTeX**

- **TeXLive**

Latex Editors










- **TeXstudio**
- **TeXworks**
- **WinEdt**
- **LyX**
- **TeXmaker**
- **TeXmacs**
- **Scientific WorkPlace**
- **Overleaf**

How to Install TeXLive

1. Go to this page:

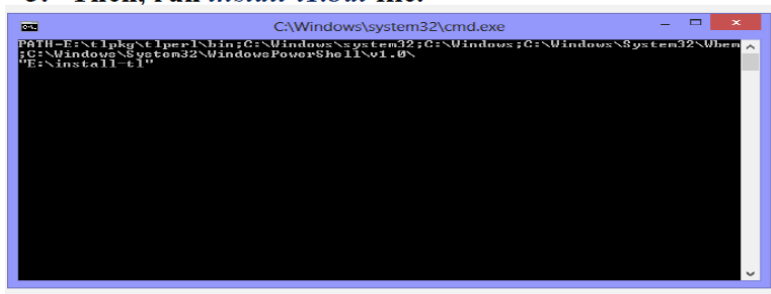
<https://mirrors.ircam.fr/pub/CTAN/systems/texlive/Images/> and
download the file [texlive2019.iso](#)

Index of /pub/CTAN/systems/texlive/Images

| Name | Last modified | Size | Description |
|---|------------------|------|-------------|
|  Parent Directory | | - | |
|  README.md | 2019-04-29 22:28 | 1.1K | |
|  texlive.iso | 2019-04-10 17:59 | 3.3G | |
|  texlive2019-20190410.iso | 2019-04-10 17:59 | 3.3G | |
|  texlive2019-20190410.iso.md5 | 2019-04-10 17:59 | 59 | |
|  texlive2019-20190410.iso.sha512 | 2019-04-10 17:59 | 155 | |
|  texlive2019-20190410.iso.sha512.asc | 2019-04-10 17:59 | 455 | |
|  texlive2019.iso | 2019-04-10 17:59 | 3.3G | |
|  texlive2019.iso.md5 | 2019-04-10 17:59 | 50 | |
|  texlive2019.iso.sha512 | 2019-04-10 17:59 | 146 | |
|  texlive2019.iso.sha512.asc | 2019-04-10 17:59 | 455 | |

How to Install TeXLive

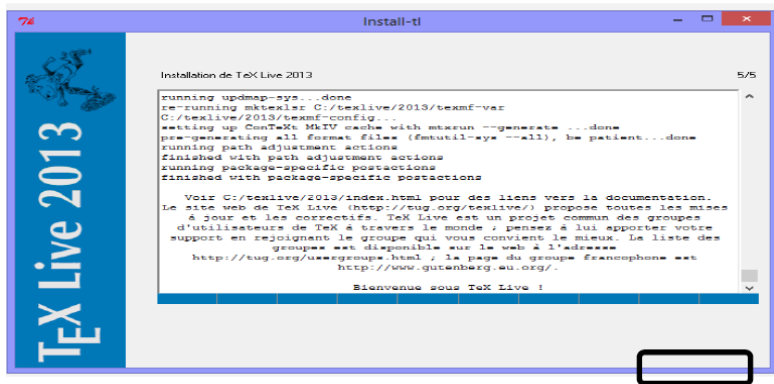
2. After downloading, mount the .iso image with any software (PowerISO, UltraISO)
3. Then, run *install-t1.bat* file.



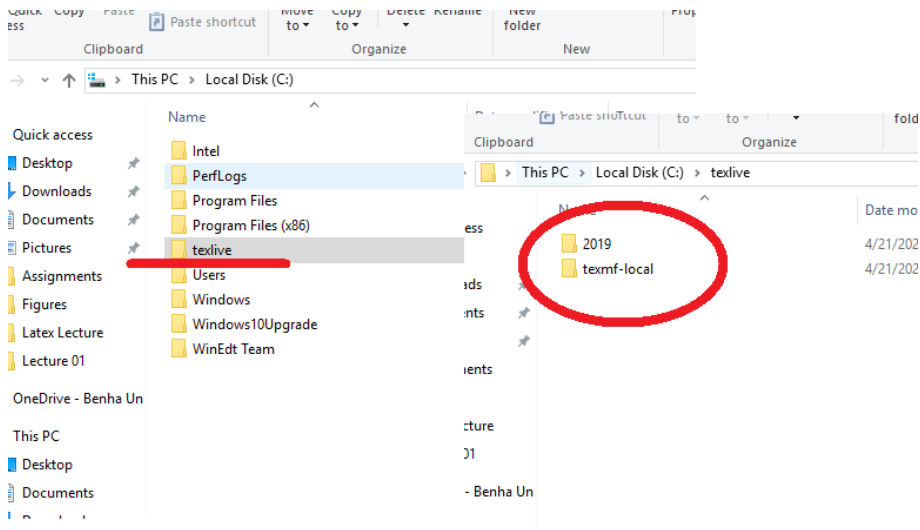
```
C:\Windows\system32\cmd.exe
PATH=E:\t1pkg\T1perl\bin;C:\Windows\system32;C:\Windows;C:\Windows\System32\Wbem
;C:\Windows\System32\WindowsPowerShell\v1.0\
"E:\install-t1"
```

How to Install TeXLive

2. Then click *Finish*.



Latex Installation



Latex Editors

- **TeXstudio**
- TeXworks
- **WinEdt**
- LyX
- TeXmaker
- TeXmacs
- **Scientific Workplace**
- **Overleaf : Online Editing**

How to Install TeXStudio

1. Go to this page: <https://www.texstudio.org/> and download the latest version.

Welcome to TeXstudio

TeXstudio is an integrated writing environment for creating LaTeX documents. Our goal is to make writing LaTeX as easy and comfortable as possible. Therefore TeXstudio has numerous features like syntax-highlighting, integrated viewer, reference checking and various assistants. For more details see the [features](#).

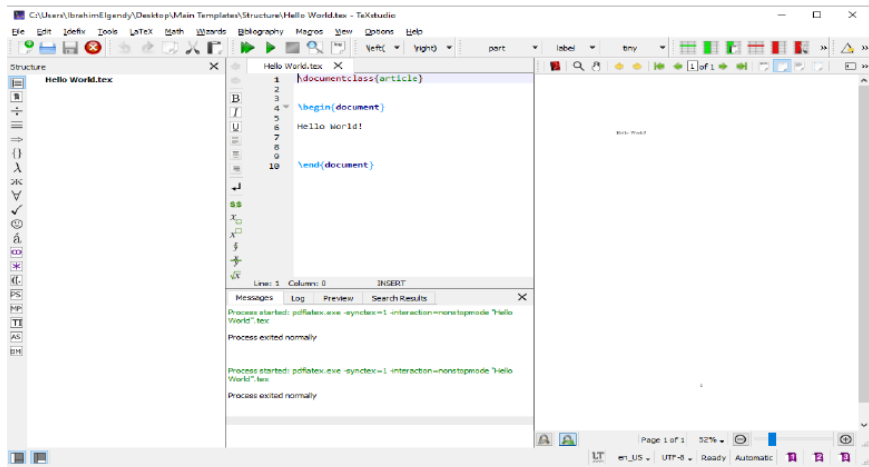
TeXstudio is open source and is available for all major operating systems.

Download now

TeXstudio 2.12.16 (Windows-Installer)



TexStudio Structure



Hello World Example

```
\documentclass{article}
```

```
\begin{document}
```

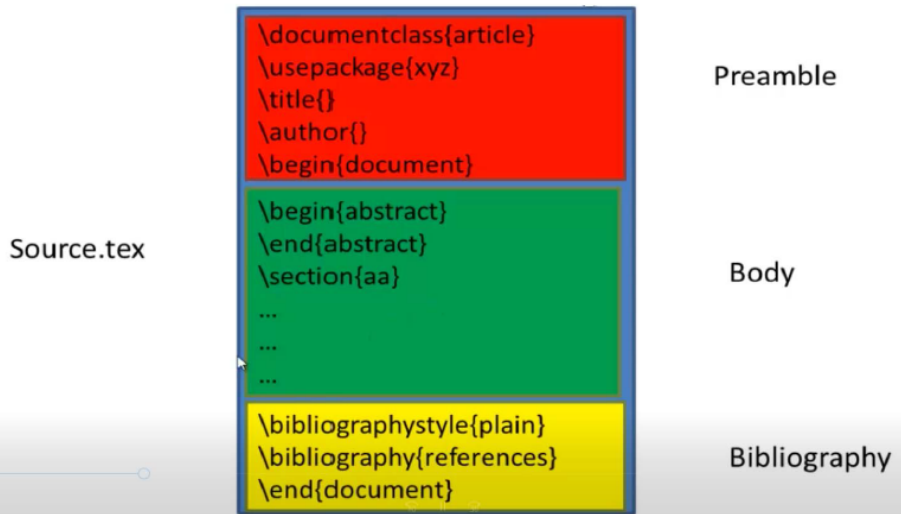
```
Hello World!
```

```
\end{document}
```

Output

Hello World!

Latex main structure



File Structure

```
\documentclass{article}
\title{Main Title}

\begin{document}

\maketitle

\section{Introduction}
Write Introduction here.

\section{Related Works}
Write related works here.

\section{Methods}
Write your methodology here

\subsection{Methods 1}
Write more text here
\subsection{Methods 2}
Write more text here
\subsection{Methods 3}
Write more text here

\section{Results and Discussion}
Write results and discussion here.

\section{Conclusion}

Write the conclusion here.

\section{References}

Add your references in this part.

\end{document}
```

Output

Main Title

November 25, 2019

- 1 Introduction**
Write Introduction here.
- 2 Related Works**
Write related works here.
- 3 Methods**
Write your methodology here
 - 3.1 Methods 1**
Write more text here
 - 3.2 Methods 2**
Write more text here
 - 3.3 Methods 3**
Write more text here
- 4 Results and Discussion**
Write results and discussion here.
- 5 Conclusion**
Write the conclusion here.

Lists

```
\documentclass{article}
\begin{document}
\section{Unordered lists}
\begin{itemize}
  \item One
  \item Two
  \item Three
\end{itemize}
\section{Ordered lists}
\begin{enumerate}
  \item One
  \item Two
  \item Three
\end{enumerate}
\section{Nested lists}
\begin{enumerate}
  \item One
  \begin{enumerate}
    \item Two
    \item Three
    \item Four
  \end{enumerate}
  \item Five
  \item Six
\end{enumerate}
\end{document}
```

Output

1 Unordered lists

- One
- Two
- Three

2 Ordered lists

1. One
2. Two
3. Three

3 Nested lists

1. One
 - (a) Two
 - (b) Three
 - (c) Four
2. Five
3. Six

Figures

```
\documentclass{article}

\usepackage{graphicx}

\begin{document}

\begin{figure}
  \centering
  \includegraphics[width=0.5\textwidth, height=1.5in]{boat.png}
  \caption{Boat.}
  \label{boat_fig}
\end{figure}

Figure \ref{boat_fig} shows a boat.

\end{document}
```

Output



Figure 1: Boat.

Figure 1 shows a boat.

Tables

```

\documentclass{article}

\begin{document}

\begin{table}
  \centering
  \caption{Your first table.}
  \label{tab:table1}

  \begin{tabular}{l|c|r}
    \hline
    \textbf{Value 1} & \textbf{Value 2} & \\
    \textbf{Value 3} \\
    $\alpha$ & $\beta$ & $\gamma$ \\
    \hline
    1 & 1110.1 & a \\
    2 & 10.1 & b \\
    3 & 23.113231 & c \\
    4 & 25.113231 & d \\
    \hline
  \end{tabular}
\end{table}

\end{document}

```

Output

| Value 1 | Value 2 | Value 3 |
|----------|-----------|----------|
| α | β | γ |
| 1 | 1110.1 | a |
| 2 | 10.1 | b |
| 3 | 23.113231 | c |
| 4 | 25.113231 | d |

Equations

```

\documentclass{article}

\begin{document}

This formula  $f(x) = x^2$  is an example.

Regarding eq.(\ref{squire_equ})....

\begin{equation}
\label{squire_equ}
f(x) = x^2
\end{equation}

\end{document}

```

Output

This formula $f(x) = x^2$ is an example.
Regarding eq.(1)....

$$f(x) = x^2 \tag{1}$$

Latex main structure

The screenshot shows a LaTeX editor interface with two tabs: "Latex - ppt.pdf" and "Latex Lecture.pdf". The main document content is as follows:

```
\end{document}
```

Overlaid on the editor is a "Mathpix Snipping Tool - Snip View" window. The window title is "Mathpix Snipping Tool - Snip View" and it shows page 12 of 12. The OCR output is:

Output

This formula $f(x) = x^2$ is an example.
Regarding eq.(1)....

$$f(x) = x^2$$

The window also includes a "Confidence" bar at the bottom, which is mostly green, indicating high accuracy. Below the window, the LaTeX code `\end{document}` is visible in the editor.

Latex main structure

Mathpix Snipping Tool - Snip View

OCR Data Original Solver Snips remaining: 18 Upgrade to Pro

Output

This formula $f(x) = x^2$ is an example.
Regarding eq.(1)....

$$f(x) = x^2 \quad (1)$$

Copy PNG Open PNG

```
https://cdn.mathpix.com/clip/images/kArMFn3W0JfZUIztserSLq14LAett0QJs23YeXtoi5M.original.fullsize.png  
![[https://cdn.mathpix.com/clip/images/kArMFn3W0JfZUIztserSLq14LAett0QJs23YeXtoi5M.original.fullsize.png]  
<img src="https://cdn.mathpix.com/clip/images/kArMFn3W0JfZUIztserSLq14LAett0QJs23YeXtoi5M.original.fullsize.p
```

Confidence

References Using BibTex

1. References File (*.bib file*).
2. Reference Style.
3. Reference calling.

References File (*.bib file*).

Citation Key

```
@Article{Booba2014Comparison,  
  Title = {Comparison of ant colony optimization and particle swarm optimization in grid  
  scheduling},  
  Author = {Booba, B. and Gopal, T. V.},  
  Journal = {Australian Journal of Basic \& Applied Sciences},  
  Year = {2014},  
  Number = {4},  
  Pages = {230-235},  
  Volume = {297}  
}  
  
@Book{burton2012android,  
  Title = {Android Application Development For Dummies},  
  Author = {Burton, Michael and Felker, Donn},  
  Publisher = {For Dummies},  
  Year = {2012},  
  Pages = {pages. 15-15}  
}  
  
@InProceedings{clonecloud2011,  
  Title = {CloneCloud: elastic execution between mobile device and cloud},  
  Author = {Chun, Byung Gon and Iba, Sunghwan and Maniatis, Petros and Malik, Mayur and  
  Patti, Ashwin},  
  Booktitle = {Conference on Computer Systems},  
  Year = {2011},  
  Pages = {301-314}  
}
```

Generate BibTeX from Google Scholar

Google Scholar



Articles Case law

Generate BibTeX from Google Scholar

Any time

Since 2019

Since 2018

Since 2015

Custom range...

Sort by relevance

Sort by date

Include patents

include citations

Interaction-Oriented Service Entity Placement in Edge Computing

Y Liang, [J Ge](#), S Zhang, J Wu, L Pan... - IEEE Transactions ..., 2019 - [ieeexplore.ieee.org](#)
Distributed Interactive Applications (DIAs) such as virtual reality and multiplayer online game usually require fast processing of tremendous data and timely exchange of delay-sensitive action data and metadata. This makes traditional mobile-based or cloud-based solutions no longer effective. Thanks to edge computing, DIA Service Providers (DSPs) can rent resources from Edge Infrastructure Providers (EIPs) to place service entities that store user states and run computation-intensive tasks. One fundamental problem for a DSP is to decide ...



Showing the best result for this search. [See all results](#)

Generate BibTeX from Google Scholar



The screenshot shows a 'Cite' dialog box with a close button (X) in the top left. The title of the paper is 'Cite'. Below the title, there are five citation styles listed with their corresponding text:

- MLA** Liang, Yu, et al. "Interaction-Oriented Service Entity Placement in Edge Computing." *IEEE Transactions on Mobile Computing* (2019).
- APA** Liang, Y., Ge, J., Zhang, S., Wu, J., Pan, L., Zhang, T., & Luo, B. (2019). Interaction-Oriented Service Entity Placement in Edge Computing. *IEEE Transactions on Mobile Computing*.
- Chicago** Liang, Yu, Jidong Ge, Sheng Zhang, Jie Wu, Lingwei Pan, Tengfei Zhang, and Bin Luo. "Interaction-Oriented Service Entity Placement in Edge Computing." *IEEE Transactions on Mobile Computing* (2019).
- Harvard** Liang, Y., Ge, J., Zhang, S., Wu, J., Pan, L., Zhang, T. and Luo, B., 2019. Interaction-Oriented Service Entity Placement in Edge Computing. *IEEE Transactions on Mobile Computing*.
- Vancouver** Liang Y, Ge J, Zhang S, Wu J, Pan L, Zhang T, Luo B. Interaction-Oriented Service Entity Placement in Edge Computing. *IEEE Transactions on Mobile Computing*. 2019 Nov 8.

At the bottom of the dialog box, there are five buttons: **BibTeX** (highlighted with a red box), EndNote, RefMan, and RefWorks.

Generate BibTeX from Google Scholar

```
@article{liang2019interaction,  
  title={Interaction-Oriented Service Entity Placement in Edge Computing},  
  author={Liang, Yu and Ge, Jidong and Zhang, Sheng and Wu, Jie and Pan, Lingwei and Zhang, Tengfei and Luo, Bin},  
  journal={IEEE Transactions on Mobile Computing},  
  year={2019},  
  publisher={IEEE}  
}
```

Reference calling.

`\cite{CitationKey}`

Reference Style

plain, ieeeTRAN, modell-num-names, ...etc.

```
\bibliographystyle{Style}
\bibliography{ReferencesFile}
```

Bai, Qingshun, et al. "Development of dynamics for design procedure of novel grating tiling device with experimental validation." *Applied Sciences* 11.24 (2021): 11716. MLA

Bai, Q., Shehata, M., Nada, A., & Shao, Z. (2021). Development of dynamics for design procedure of novel grating tiling device with experimental validation. *Applied Sciences*, 11(24), 11716. APA

BAI, Qingshun, et al. Development of dynamics for design procedure of novel grating tiling device with experimental validation. *Applied Sciences*, 2021, 11.24: 11716. ISO 690

Using **LATEX** to write Benha Faculty Of Engineering Reports.

Benha Faculty Of Engineering Report Template



[Write your title here, Write your title here, Write your title here, Write your title here]

By

- 1- Type your name here
- 2- Type your name here
- 3- Type your name here
- 4- Type your name here
- 5- Type your name here
- 6- Type your name here
- 7- Type your name here
- 8- Type your name here

Department of Mechanical Engineering
Benha Faculty of Engineering
Benha University
2024

Title page

[Write your title here, Write your title here, Write your title here, Write your title here]

By

- 1- Type your name here
- 2- Type your name here
- 3- Type your name here
- 4- Type your name here
- 5- Type your name here
- 6- Type your name here
- 7- Type your name here
- 8- Type your name here

THIS REPORT IS SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENT FOR THE
DEGREE OF BACHELOR OF MECHANICAL
ENGINEERING

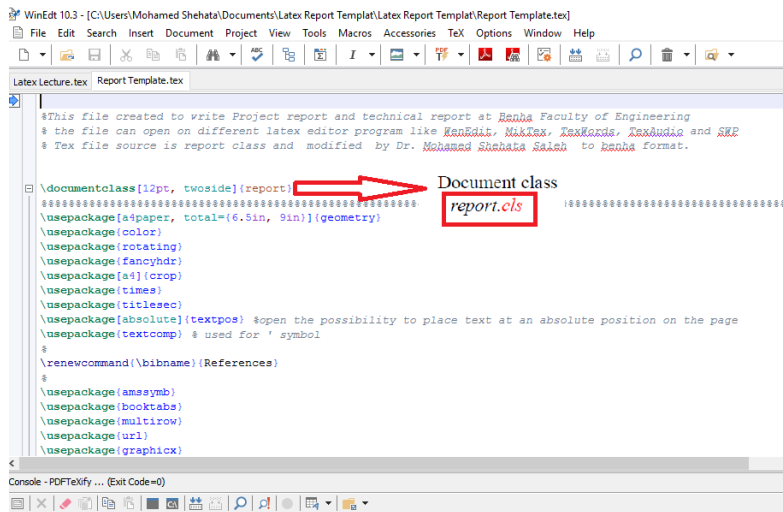
Supervisor:

Prof. /Dr. xxxxxxxx

Department of Mechanical Engineering
Benha Faculty of Engineering
Benha University
2024

Working Other Editors

Benha Faculty Of Engineering Report Latex Template



WinEdt 10.3 - [C:\Users\Mohamed Shehata\Documents\Latex Report Templat\Latex Report Templat\Report Template.tex]

File Edit Search Insert Document Project View Tools Macros Accessories TeX Options Window Help

Latex Lecture.tex Report Template.tex

```
%This file created to write Project report and technical report at Benha Faculty of Engineering
% the file can open on different latex editor program like WinEdt, MikTeX, TeXworks, TeXstudio and SVP
% Tex file source is report class and modified by Dr. Mohamed Shehata Saleh to benha format.

\documentclass[12pt, twoside]{report}
\usepackage[a4paper, total={6.5in, 9in}]{geometry}
\usepackage{color}
\usepackage{rotating}
\usepackage{fancyhdr}
\usepackage[a4]{crop}
\usepackage{times}
\usepackage{titlesec}
\usepackage[absolute]{textpos} %open the possibility to place text at an absolute position on the page
\usepackage{textcomp} % used for ' symbol
%
\renewcommand{\bibname}{References}
%
\usepackage{amssymb}
\usepackage{booktabs}
\usepackage{multirow}
\usepackage{url}
\usepackage{graphicx}
```

Document class
report.cls

Console - PDFTeXify ... (Exit Code=0)

Working Other Editors

Report text file can be opened on different editor to fill your report.
Reference bib file is used to collect all references used in your report

Benha Faculty of Engineering reports latex templat

is PC > Documents > Latex Report Templat > Latex Report Templat

| Name | Date modified | Type | Size |
|---------------------------|----------------------|--------------------|--------|
| Figures | 5/10/2024 4:17 PM | File folder | |
| Proposal_Template.synctex | 11/28/2019 9:17 AM | SYNCTEX File | 170 KB |
| references | 5/8/2024 3:47 PM | BIB File | 1 KB |
| Report Template.aux | 5/9/2024 3:10 PM | AUX File | 4 KB |
| Report Template.bbl | 5/9/2024 3:10 PM | BBL File | 1 KB |
| Report Template | 5/9/2024 3:10 PM | Performance Mon... | 1 KB |
| Report Template.lof | 5/9/2024 3:10 PM | LOF File | 1 KB |
| Report Template | 5/9/2024 3:10 PM | Text Document | 44 KB |
| Report Template.lot | 5/9/2024 3:10 PM | LOT File | 1 KB |
| Report Template | 5/9/2024 3:10 PM | Adobe Acrobat D... | 432 KB |
| Report Template.synctex | 5/9/2024 3:10 PM | SYNCTEX File | 219 KB |
| Report Template | 5/9/2024 3:10 PM | TEX File | 14 KB |
| Report Template.toc | 5/9/2024 3:10 PM | TOC File | 2 KB |
| report | 11/24/2018 11:05 ... | CLS File | 24 KB |

• TeXstudio

• WinEdt

• SWP Editor

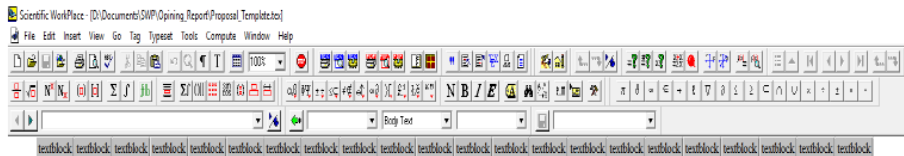


• TeXstudio

The screenshot shows the TeXstudio interface with a LaTeX document open. The document content includes a table of contents, a list of components, and a table of results. The table of results is as follows:

| Components | Mass(kg) | $I_{xx}(kg \cdot m^2)$ | $I_{yy}(kg \cdot m^2)$ | $I_{zz}(kg \cdot m^2)$ |
|----------------|----------|------------------------|------------------------|------------------------|
| Frame | 21.6 | 0.511 | 0.484 | 0.1173 |
| Crank | 0.735 | 0.001037 | 0.000965 | 0.000021 |
| Connecting rod | 0.735 | 0.00598 | 0.00598 | 0.0033 |
| Cylinder | 0.298 | 0.000277 | 0.000277 | 0.0000134 |
| Slider | 0.640 | 0.00103 | 0.000961 | 0.0000207 |

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Source, Objective and Significance

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Figure

Example calling

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This formula $f(x) = x^2$ is an example.

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Figure
 Example calling

$$f(x) = x^2$$

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tions inside text as Eq. ref E1.

$$C^h(q^i, q^j, t) = R^i + A^i q_p^i - R^j - A^j q_p^j = 0$$

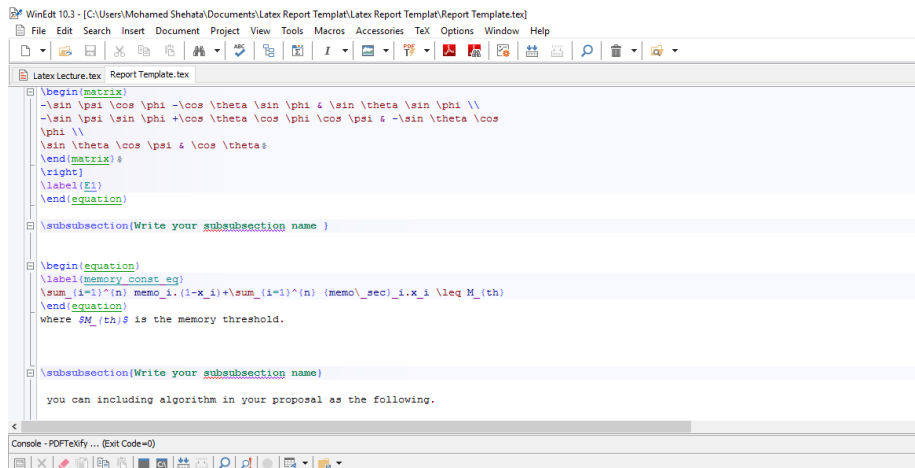
ate systems of bodies i and j , respectively. A^i and A^j are the transformation matrices of the two bodies connected and expr

$$A = \begin{bmatrix} \cos \psi \cos \phi - \cos \theta \sin \phi \sin \psi & -\sin \psi \cos \phi - \cos \theta \sin \phi & \sin \theta \sin \phi \\ \cos \psi \sin \phi - \cos \theta \cos \phi \sin \psi & -\sin \psi \sin \phi + \cos \theta \cos \phi \cos \psi & -\sin \theta \cos \phi \\ \sin \psi \sin \psi & \sin \theta \cos \psi & \cos \theta \end{bmatrix}$$

$$\sum_{i=1}^n memo_i (1-x_i) + \sum_{i=1}^n memo_sec_i x_i \leq Msh$$

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```
\begin{matrix}
-\sin \psi \cos \phi - \cos \theta \sin \psi & \sin \psi & \sin \theta \sin \psi \\
-\sin \psi \sin \phi + \cos \theta \cos \phi \cos \psi & -\sin \theta \cos \psi \\
\sin \theta \cos \psi & \cos \theta
\end{matrix}
\end{matrix}
\right)
\label{E1}
\end{equation}

\subsection{Write your subsection name }

\begin{equation}
\label{memory_const_eq}
\sum_{i=1}^n \text{memo}_i \cdot (1-x_i) + \sum_{i=1}^n (\text{memo}_{\text{sec}})_i \cdot x_i \leq M_{\text{th}}
\end{equation}
where  $M_{\text{th}}$  is the memory threshold.

\subsection{Write your subsection name }

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  author={Bai, Qingshun and Shehata, Mohamed and Nada, Ayman},  
  journal={International Journal of Dynamics and Control},  
  volume={10},  
  number={5},  
  pages={1707--1725},  
  year={2022},  
  publisher={Springer}  
}  
  
@article{R2,  
  title={On the use of two-dimensional Euler parameters for the dynamic simulation of planar rigid multibody systems},  
  author={Pappalardo, Carmine M and Guida, Domenico},  
  journal={Archive of Applied Mechanics},  
  volume={87},  
  pages={1647--1665},  
  year={2017},  
  publisher={Springer}  
}  
  
@book{R3,  
  title={Mechanical design},  
  author={Childs, Peter RN},  
  year={2003},  
  publisher={Elsevier}
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\pagenumbering{arabic}
\section{Background and Motivation}

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\section{Research Objectives}

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\item Don't forget pray to person help created this file
\item Don't forget pray to person help created this file
\end{enumerate}

\chapter{Literature Review}
\section{Write your section name}

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\begin{figure*}[h]
```

Introduction

1.1 Background and Motivation

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1.2 Research Objectives

You can make list of objects by using the following part

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Literature Review

2.1 Write your section name

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| 3.2 write you section | 3 |
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List of Symbols

x position
 v velocity
 a acceleration
 t time
 F force

Conclusion and future work

5.1 Study Plan

Notes:

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Figure 5.1: Mechatronics department Logo

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References

- [1] Qingshun Bai, Mohamed Shehata, and Ayman Nada. Review study of using euler angles and euler parameters in multibody modeling of spatial holonomic and non-holonomic systems. *International Journal of Dynamics and Control*, 10(5):1707–1725, 2022.
- [2] Peter RN Childs. *Mechanical design*. Elsevier, 2003.
- [3] Carmine M Pappalardo and Domenico Guida. On the use of two-dimensional euler parameters for the dynamic simulation of planar rigid multibody systems. *Archive of Applied Mechanics*, 87:1647–1665, 2017.

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Modeling and analysis of an RUU Delta Robot using SolidWorks and SimMechanics

Hoai Nam Le¹ · Nhu Thanh Vo¹

Received: 31 July 2023 / Revised: 4 December 2023 / Accepted: 22 December 2023

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Abstract

This paper illustrates the methodology for modeling, implementing, and controlling an RUU Delta Robot using computer-aided design and simulation software. Specifically, SolidWorks is employed to construct a CAD model with suitable properties, which is then exported to the MATLAB/SimMechanics environment for generating a multibody system block diagram. A PID controller is implemented to control the robot's position and trajectory movement. The study analyzes moment signal graphs at active joints, comparing them with existing research to validate the accuracy of the results. The investigation reveals that the influence of damping coefficients on the robotic dynamics is negligible, with simulation errors less than 0.02% for different end effect masses. Additionally, the study explores the impact of end effect mass on robotic dynamics and trajectory. Simulation results recommend an optimal operating range with an end effect mass of less than 3 kg, ensuring trajectory errors remain below 2%. As the end effect mass increases, a corresponding fluctuation in the robot's trajectory is observed, leading to longer times to reach the designed trajectory. This study provides valuable insights for practical applications, indicating that the proposed simulation approach is instrumental in assessing the performance of the robot controller before its deployment in an actual prototype.

Keywords SolidWorks · Simulation · MATLAB SimMechanics · RUU Delta Robot · CAD model · PID controller

1 Introduction

The RUU-type Delta Robot, pioneered by Professor Raymond Clavel's team in the early 1980s [1], is a successful

then exported to the MATLAB/SimMechanics environment for control implementation. Previous studies by Sen, et al. [5] and Ibrahim [6], and Olaya [7] have tackled similar issues but focused on Scara and mobile robots and controlled only the

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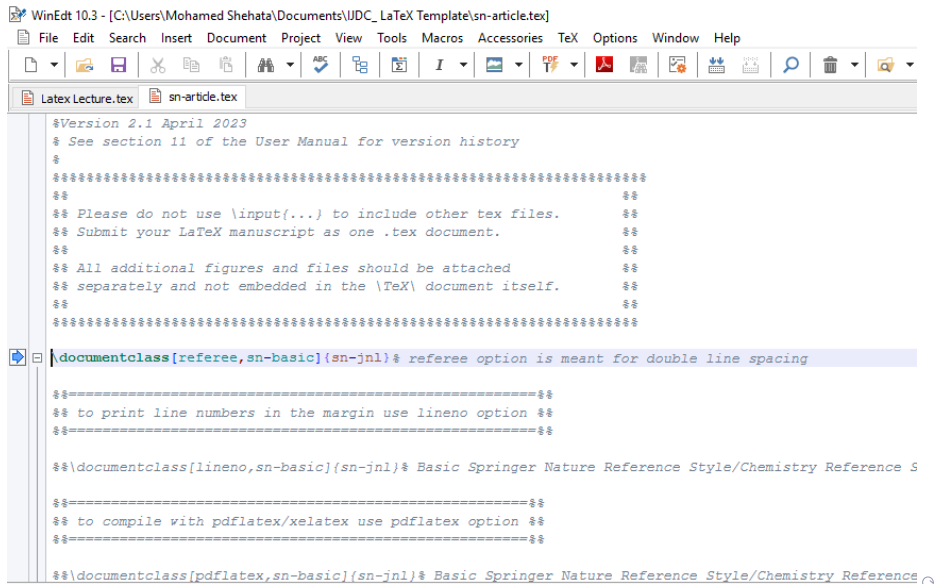
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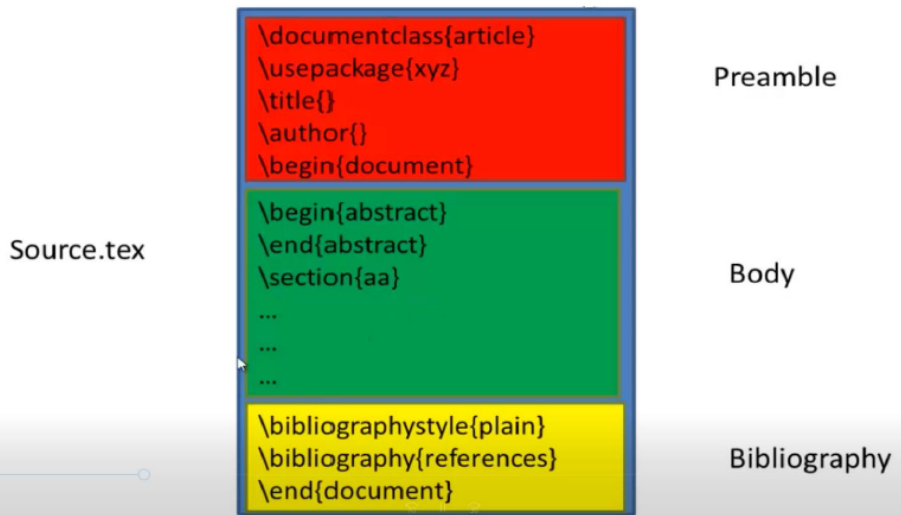
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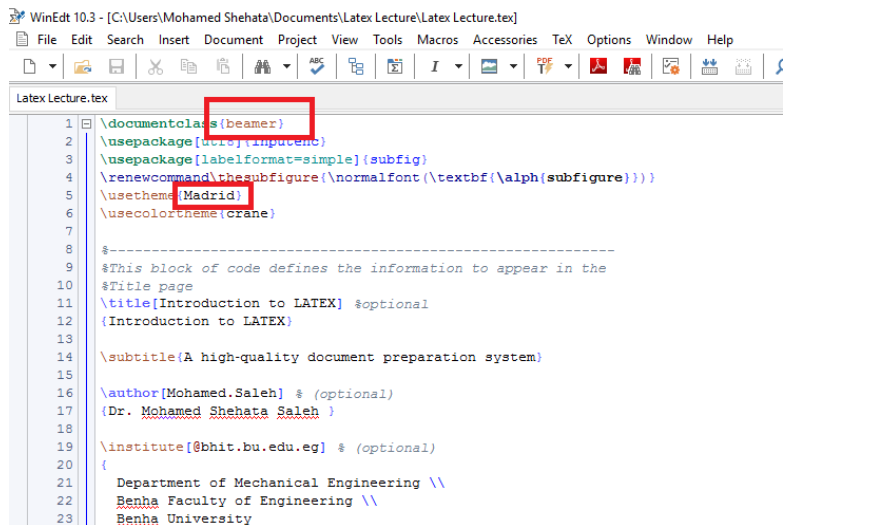
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Lecture Notes on Robotics

Course Code (M1596)

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Department of Mechanical Engineering
Benha Faculty of Engineering
Benha University

Lecture 01: Introduction to Robotics Course

February 13, 2024

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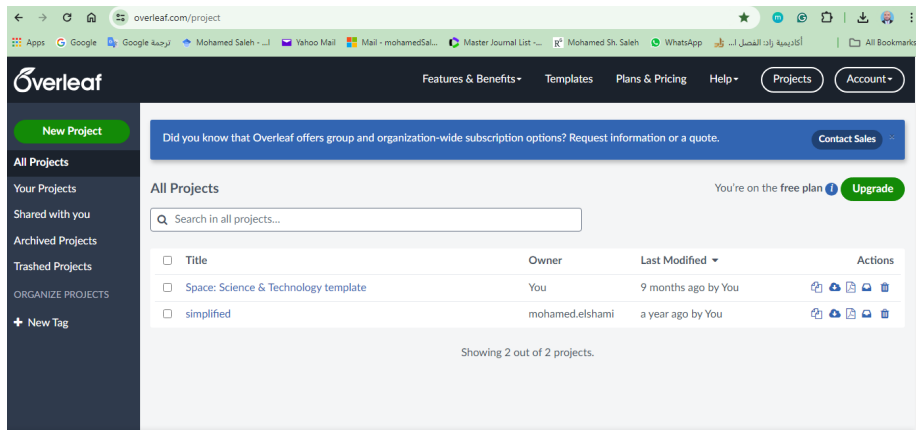
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