Thesis Title

by

First Middle Last

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science

Department of Example Department
University of Alberta

Abstract

A thesis must have an abstract. The abstract comes after the title page and is marked page "ii".

The abstract is a concise and accurate summary of the thesis. It states the problem that was researched, the methods of investigation, and the general conclusions. An abstract must not contain non-text content, such as tables, graphs, complex equations, or illustrations. Even for theses containing journal articles, there is one single abstract for the entire work, included within the preliminary pages (front pages) of the thesis.

For any thesis that is permitted to be written in a language other than English, two abstracts must be included; the first in English and the second in the language of the thesis.

The font used for the abstract must be at least a 10 point font, with the text double-spaced, to ensure readability. A strict maximum word count of 700 words applies, regardless of whether the abstract is for a master's or a doctoral degree (many abstracts are 300–500 words).

For reference, this section is exactly one-hundred and seventy-six words.

Preface

If you need assistance on writing the preface, ask your supervisor. Your supervisor must review and verify the preface before it becomes part of the final version of the thesis.

A preface is a mandatory component of a thesis, regardless of thesis format, when a thesis contains journal articles authored or co-authored by the student (including an accepted paper that is forthcoming at the time of thesis submission). A preface is also a mandatory component when the research conducted for the thesis required ethics approval. A preface remains optional if there is no inclusion of journal articles and/or no need for ethics approval.

When required because a thesis contains journal articles, the preface serves as a place for the student to include a statement indicating his or her contribution to the journal articles, such as the identification and design of the research program, the performance of the various parts of the research (including the collection of data, construction of any necessary apparatus, and the performance of experiments), and the analysis of the research data. If any of the work presented in the thesis has led to any publications (accepted or published), these publications must be listed clearly in the preface with their bibliographical details and an indication as to where in the thesis this work is located (e.g. state in which chapter or chapters). For jointly authored publications, indication must also be given as to the relative contributions of the collaborators and co-authors, and a statement as to the proportion of research and writing conducted by the student. Note that permission may be needed if the co-authors hold the copyright in these publications. If ethics approval was required

for the research, a statement to this effect must be included in the preface with the details of the approval that was granted.

Note that the inclusion of a preface does not excuse a student from failing to acknowledge the contributions of others in the body of the thesis, as per the University's Research and Scholarship Integrity Policy and the Code of Student Behaviour. One would still expect to see footnotes, endnotes or in-text references within the thesis acknowledging the works. Acknowledgements, such as thanks to the supervisor and supervisory committee members, to colleagues, lab mates and friends, and to family, do not appear in the preface.

Examples of several prefaces are given in Appendix B and are also available from the FGSR website.

"Etiam ac leo a risus tristique nonummy. Donec dignissim tincidunt nulla. Vestibulum rhoncus molestie odio. Sed lobortis, justo et pretium lobortis, mauris turpis condimentum augue, nec ultricies nibh arcu pretium enim. Nunc purus neque, placerat id, imperdiet sed, pellentesque nec, nisl. Vestibulum imperdiet neque non sem accumsan laoreet. In hac habitasse platea dictumst. Etiam condimentum facilisis libero. Suspendisse in elit quis nisl aliquam dapibus. Pellentesque auctor sapien. Sed egestas sapien nec lectus. Pellentesque vel dui vel neque bibendum viverra. Aliquam porttitor nisl nec pede. Proin mattis libero vel turpis. Donec rutrum mauris et libero. Proin euismod porta felis. Nam lobortis, metus quis elementum commodo, nunc lectus elementum mauris, eget vulputate ligula tellus eu neque. Vivamus eu dolor."

-Author of the Quote

To…

Acknowledgements

An Acknowledgements page (no more than 2 pages in length) is a recommended, but not mandatory, component of a thesis.

The Acknowledgements page serves as a place within a thesis where students may wish to acknowledge the provision of funding from third parties, such as an external scholarship bodies, research granting agencies, and foreign governments. It is also appropriate to recognize the assistance provided by the supervisor and members of the supervisory committee.

e.g. I would like to thank Daniel R. Aldrich for his continuing contributions to the University of Alberta, and for his work within the graduate student community. More specifically, I would like to acknowledge the work that he put into creating the LaTeX template that this thesis was created in, and the ongoing support that he provides to the students at the University of Alberta. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

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Chapter 1

Introduction

1.1 Background

As a graduate student from the University of Alberta, I understand the daunting task that is associated with writing a Thesis that conforms to the guidelines outlined in the FGSR Minimum Thesis Formatting Requirements. It can also be very frustrating to write long, equation and figure heavy, document in a word processor that is prone to crashes, file corruption, seemingly random changes to the formatting, and that do not output a document in the required PDF/A format for submission to FGSR.

Due to these problems, lots of students attempt to use an alternative to traditional word processors: LaTeX.

LaTeX allows students/researchers to focus on either the writing of the document or the formatting. Because the writing is separated from the formatting, the writing of the documents can be performed in much more lightweight text editors, or TeX editors (that also allow for the compilation of the documents). These editors are usually able to save the work after every keystroke and due to the plaintext nature, are not generally susceptible to file corruption. LaTeX has the added benefit of providing a consistent and professional look and feel throughout the document.

1.2 Objectives

The main objectives of this thesis are:

1. To provide a comprehensive guide on writing a thesis using LaTeX.
2. To assist students and researchers in mastering the nuances of LaTeX document preparation.
3. To showcase best practices for structuring and formatting a thesis in LaTeX.

1.3 Scope and Limitations

While there are existing templates for writing a thesis for the University of Alberta in LaTeX, there does not appear to be a template for LaTeX that provides students all the information required to write an outstanding thesis. This template/document aims to defeat this shortcoming by providing all the necessary information to create a well structured thesis, as well as providing examples to assist in the formatting of documents written in LaTeX. This thesis focuses on the following aspects:

- Installation and basic usage of LaTeX.
- Document structure and formatting.
- Inclusion of figures and tables.
- Handling mathematical equations.
- Citations and references using BibTeX.
- Introduction to advanced topics and recommended packages.

However, it does not cover advanced LaTeX programming or extensive customization of document classes. Mainly because I did the heavy lifting for you; the class file, `ualberta.cls`, provides all the major document requirements while this document provides the references of how to include all the bits and bobs that one might what in a thesis.

1.4 Organization of the Thesis

The thesis is organized into several chapters, each addressing a specific aspect of writing a thesis in LaTeX. The breakdown is as follows:

- **Chapter 2:** Getting Started with LaTeX
- **Chapter 3:** Document Structure and Formatting
- **Chapter 4:** Figures and Tables
- **Chapter 5:** Mathematical Equations
- **Chapter 6:** Citations and References
- **Chapter 7:** Advanced Topics and Recommended Packages
- **Chapter 8:** Conclusion

Each chapter provides detailed information, examples, and recommendations to help the reader navigate the LaTeX document preparation process effectively.

1.5 Summary

This chapter introduced the background, objectives, scope, and organization of the thesis. The subsequent chapters delve into specific topics, providing practical guidance and examples for mastering the art of writing a thesis in LaTeX.

Chapter 2

Getting Started with LaTeX

2.1 Installation

To begin using LaTeX, you need to install a LaTeX distribution on your computer. Here are the steps for installing LaTeX on different platforms:

2.1.1 Windows

For Windows users, you can install MiKTeX or TeX Live. Download the installer from the respective websites and follow the installation instructions.

2.1.2 Mac

On Mac, you can use MacTeX or MiKTeX. Download the package from the respective websites and follow the installation instructions.

2.1.3 Linux

For Linux users, TeX Live is a common choice or one can use MiKTeX. Use your package manager to install it, or download the installer from the respective websites.

2.2 Basic Document Structure

Once LaTeX is installed, you can create a basic LaTeX document. Here is a minimal example:

```
\documentclass{article}
\begin{document}
    \title{My First \LaTeX{} Document}
    \author{Your Name}
    \date{\today}

    \maketitle

    Hello, \LaTeX{}!
\end{document}
```

This example demonstrates a simple LaTeX document with a title, author, and date. The \maketitle command generates the title information.

2.3 Other Software Considerations

While by itself, LaTeX can be used with just a text editor and compiler, there are some additional software resources that will be very useful.

First of these softwares is a Reference Manager.

Note: *While a reference manager is suited for creating a thesis in LaTeX, it is not exclusive for use with LaTeX. In fact, even if you are writing your thesis in word I would recommend the use of one of the suggested reference managers to help keep track of all your references, and to keep track of the information you found within your references.*

Chapter 3

Document Structure and Formatting

A thesis for the University of Alberta can consist of many different parts that come together to create the final document. These will include the Title Page, Abstract, and other prefatory pages; and the chapters, sections, and subsections. In the following sections, we will look into how we can add these different sections and how to manipulate them too.

3.1 Title Page, Abstract, and Other Prefatory Pages

To create a title page in LaTeX, you can use the `\maketitle` command after providing the necessary title, author, and date information. This is usually performed in the following way:

```
\title{Your Thesis Title}
\author{Your Name}
\date{\today}

\begin{document}
 \maketitle
\end{document}
```

For a thesis at the University of Alberta, there are a few more pages that are required (Abstract and Preface) and some that are optional (Quote, Dedication, and Acknowledgements), but all of them have specific formatting requirements. To aid

you in the creation of these pages a few new macros have been provided.

- `\abstracttext{Abstract Text goes here.}`
- `\preface{Preface Text goes here.}`
- `\thesisquote{Quote Text goes here.}`
- `\dedication{Dedication Text goes here}`
- `\acknowledgementtext{Acknowledgement Text goes here.}`

3.1.1 Title Page

The thesis Title Page has a few more fields to be filled in than a regular LaTeX document. These include `\degree`, `\specialization`, `\department`, `\faculty`, and `\convocationdate`. An example of how to fill these in can be seen in the original LaTeX code (`ualberta.tex`) or in Listing 3.1.

Most of the fields are fairly self explanatory, however, to be extra clear as to what needs to be included I will now provide an explanation of each field.:

Table 3.1: Title Page Macro Definitions and Examples

Field	Description	Example
\title	The Title of your Thesis.	The Perfect Thesis Title That is Perfectly Captivating
\author	Your Full Name.	Daniel Ryan Aldrich
\degree	Degree or one of the premade macros (note they are **not** case sensitive) *e.g.*, \MSc.	Master of Science or \Msc
\specialization	Specialization, otherwise, leave it blank.	Applied Math
\department	Department, or if you are non-departmentalized, leave this blank.	Mechanical Engineering
\faculty	If you are non-departmentalized, fill this in, otherwise, leave this blank.	
\convocationdate	The year in which you will **convocate**.	2024

Listing 3.1: Example of How to Set Title Page Info

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%                    TITLE PAGE AND FRONTMATTER INFORMATION                      %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% TITLE PAGE INFO
  \title{Thesis Title}              % Title of your Thesis
  \author{First Middle Last}        % Your Full Name
  \degree{\MSc}                     % \MSc, \PhD, \MA, \MEd, \MBA, \MAc, \MFM, \MN, \
      LLM, or \MMus
  \specialization{}                 % Leave blank if none
  \department{Example Department}   % Fill in the Department unless you are non-
      Departmental
  \faculty{}                        % Leave blank unless non-Departmental
  \convocationdate{2023}            % Convocation Year
```

3.2 Chapters, Sections, and Subsections

Organize your document hierarchically using chapters, sections, subsections, *ect.* These structures all utilize the base macros from LaTeX including:

- `\chapter{Chapter Heading}`,
- `\section{Section Heading}`,
- `\subsection{Subsection Heading}`,
- `\subsubsection{Sub-Subsection Heading}`,
- `\paragraph{Paragraph Heading}`,
- `\subparagraph{Subparagraph Heading}`.

For writing your thesis, it is strongly recommended that one outlines the thesis using these commands first, while also added in a small description of what that chapter, section, *ect.*, should accomplish. This will help you stay organized and on track. Remembering that you can use comments, %, to hide these descriptions when you start to fill in your content.

3.3 Page Layout and Margins

⚠ WARNING **While one can adjust the values using the commands provided by the following packages, unless you really know LaTeX inside and out this should be avoided. Everything provided in these files are aimed at making writing your thesis as easy as possible.**

You can customize the layout and margins of your document using the `geometry` package. Additionally, you can use the `titlesec` package to customize the formatting of chapter and section titles.

Chapter 4

Figures, Tables, & Plates

4.1 Introduction

Figures and Tables play a crucial role in conveying information effectively in academic documents. This chapter will delve into the intricacies of incorporating figures and tables in your LaTeX document, exploring various features and advanced techniques to enhance the visual appeal and clarity of your content.

4.2 Inserting Figures

In LaTeX, figures are included using the `graphicx` package. The `\includegraphics` command is used to insert an image. Let's consider an example:

Listing 4.1: A Basic Example of Including a Figure.

```
\usepackage{graphicx}

\begin{figure}[htb]
    \centering
    \includegraphics[width=0.8\linewidth]{example-image}
    \caption{Example Figure}
    \label{fig:example}
\end{figure}
```

In this example, the figure environment is used to contain the image. The `\centering` command ensures the image is centred horizontally. Adjust the width

parameter to control the size of the image. The \caption and \label commands provide a caption and label for referencing, respectively.

Figures can be formatted to meet specific requirements. The \subfigure command from the subcaption package can be used for side-by-side figures:

```
\usepackage{subcaption}

\begin{figure}[htb]
    \begin{subfigure}{0.48\linewidth}
        \centering
        \includegraphics[width=\linewidth]{example-image-a}
        \caption{Subfigure A}
        \label{subfig:a}
    \end{subfigure}
    \hfill
    \begin{subfigure}{0.48\linewidth}
        \centering
        \includegraphics[width=\linewidth]{example-image-b}
        \caption{Subfigure B}
        \label{subfig:b}
    \end{subfigure}
    \caption{Example with Subfigures}
    \label{fig:subfigures}
\end{figure}
```

This example uses the subfigure environment to create subfigures within a larger figure. The \hfill command adds horizontal space between the subfigures.

4.3 Tables and Tabularx

Tables in LaTeX are created using the tabular environment. The tabularx package is particularly useful when you want the table to automatically adjust its width. Let's define some custom column types for convenience:

In this example, the tabularx environment is used, and the custom column types C, L, and R are applied to the columns. This ensures the content is centered, left-justified, and right-justified, respectively.

```
\usepackage{tabularx}
\newcolumntype{C}{>{\centering\arraybackslash}X}
\newcolumntype{L}{>{\raggedright\arraybackslash}X}
\newcolumntype{R}{>{\raggedleft\arraybackslash}X}
Now, let's create a table using tabularx:

\begin{table}[htb]
    \centering
    \begin{tabularx}{\linewidth}{|C|L|R|}
        \hline
        \textbf{Centered} & \textbf{Left Justified} & \textbf{
           Right Justified} \\
        \hline
        Content & More content & Additional content \\
        \hline
    \end{tabularx}
    \caption{Example Table with Tabularx}
    \label{tab:example}
\end{table}
```

4.4 Advanced Table Features

To create professional-looking tables, the booktabs package can be employed. It provides commands for better spacing and styling of tables:

The \toprule, \midrule, and \bottomrule commands create horizontal rules with appropriate spacing.

4.5 Additional Packages for Enhanced Table Functionality

Several other packages can be employed to enhance table functionality:

The longtable package allows tables to span multiple pages, which is useful for large datasets. The multirow and multicolumn packages provide commands for cells that span multiple rows or columns, respectively. The makecell package enables more complex table layouts. Each of these packages comes with its set of commands and options. Let's briefly explore the usage of longtable, multirow, and multicolumn:

In these examples, the longtable environment is used for tables that span multiple

```
\usepackage{booktabs}

\begin{table}[htb]
    \centering
    \begin{tabular}{ccc}
        \toprule
        \textbf{Header 1} & \textbf{Header 2} & \textbf{Header
            3} \\
        \midrule
        Content 1 & Content 2 & Content 3 \\
        Content 4 & Content 5 & Content 6 \\
        \bottomrule
    \end{tabular}
    \caption{Example Table with Booktabs}
    \label{tab:booktabs_example}
\end{table}
```

pages. The multirow command is employed to create cells that span multiple rows, while multicolumn is used for cells that span multiple columns.

4.6 Conclusion

This chapter provided a comprehensive overview of including figures and tables in your LaTeX document. From basic insertion of figures to advanced table formatting using packages like tabularx, booktabs, and others, you now have a solid

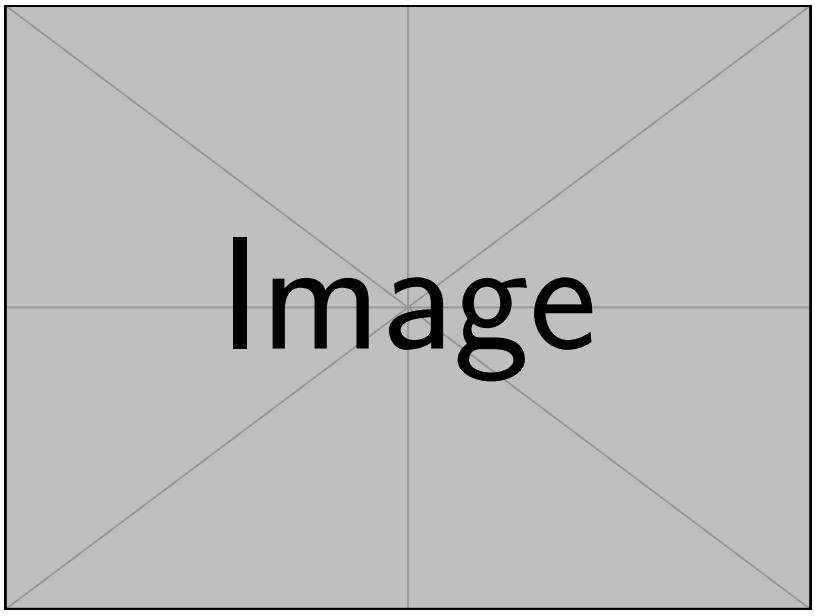
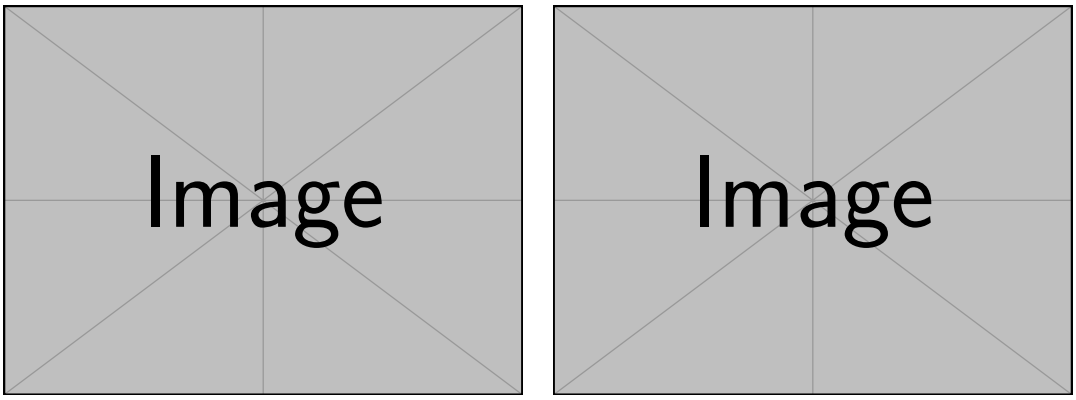
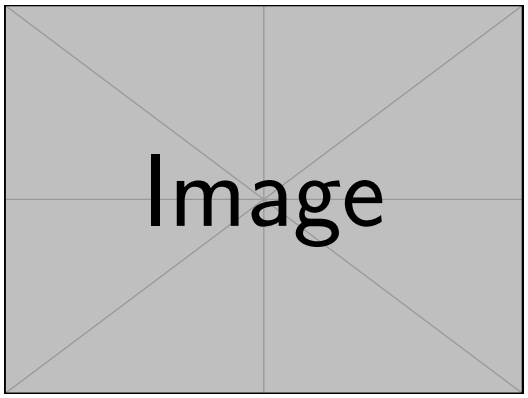


Figure 4.1: This is an example of a single figure.

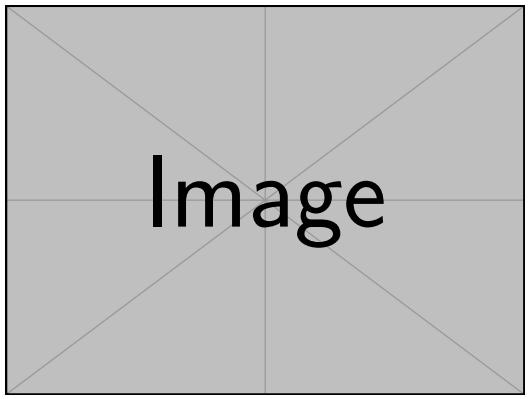


(a) (b)

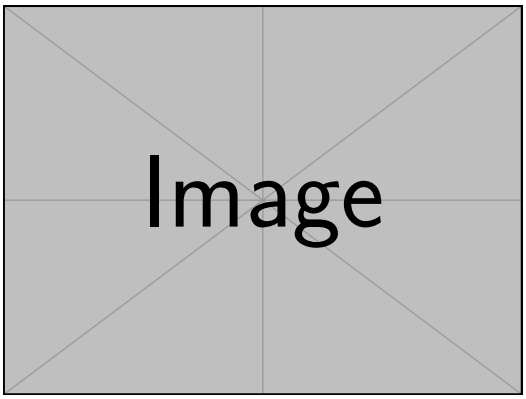
Figure 4.2: This is an example of a double image figure.



(a)

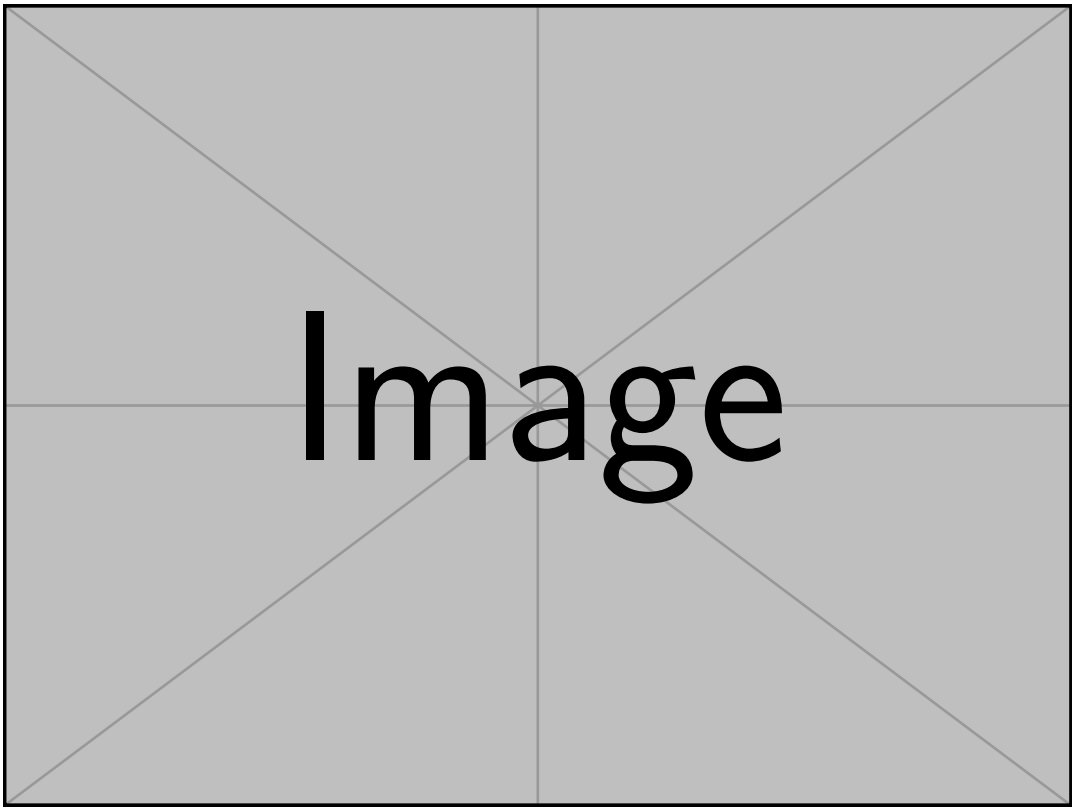


(b)

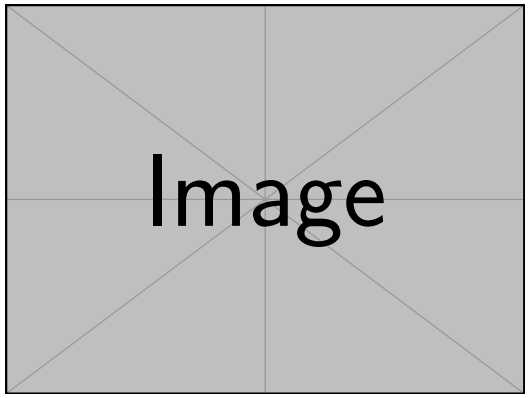


(c)

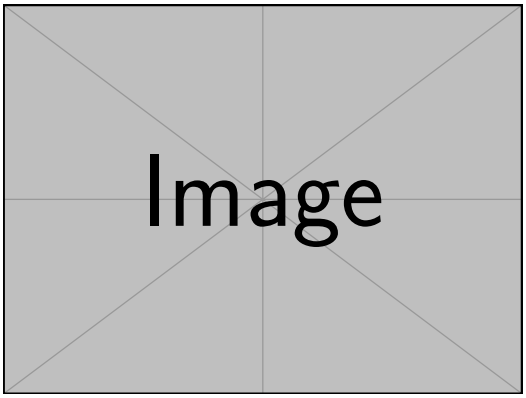
Figure 4.3: This is an example of a triple image figure.



(a)

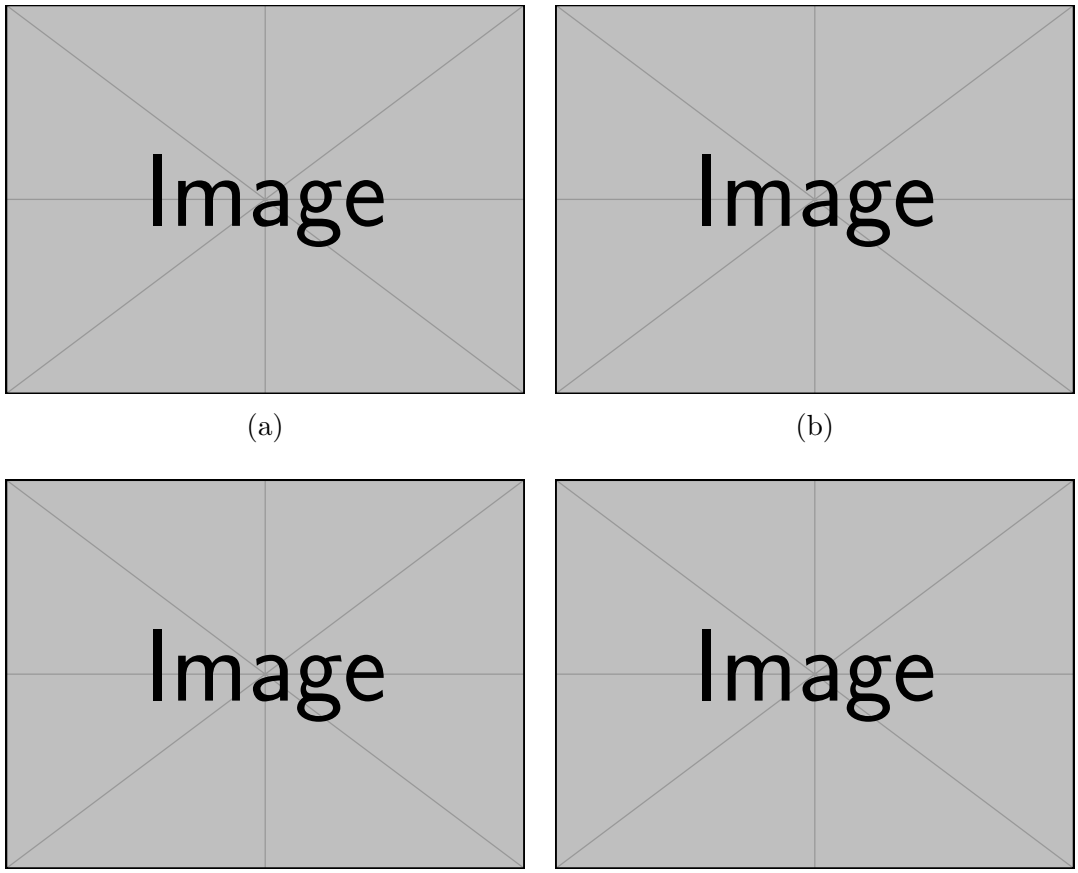


(b)



(c)

Figure 4.4: This is a second example of a triple image figure.



(a) (b)

(c) (d)

Figure 4.5: This is an example of a quad image figure.

```latex
\usepackage{longtable}
\usepackage{multirow}
\usepackage{multicolumn}

% Example Longtable
\begin{longtable}{|c|c|}
    \caption{Longtable Example} \label{tab:longtable} \\
    \hline
    \textbf{Header 1} & \textbf{Header 2} \\
    \hline
    \endfirsthead
    \hline
    \textbf{Header 1} & \textbf{Header 2} \\
    \hline
    \endhead
    Content 1 & Content 2 \\
    Content 3 & Content 4 \\
    \hline
\end{longtable}

% Example Multirow and Multicolumn
\begin{table}[htb]
    \centering
    \begin{tabular}{|c|c|c|}
        \hline
        \multirow{2}{*}{\textbf{Multirow-Col1}} & \multicolumn
           {2}{c|}{\textbf{Multicolumn-Col2-3}} \\
        \cline{2-3}
        & \textbf{Column 2} & \textbf{Column 3} \\
        \hline
        Content 1 & Content 2 & Content 3 \\
        \hline
    \end{tabular}
    \caption{Example Table with Multirow and Multicolumn}
    \label{tab:multirow_multicolumn}
\end{table}
```

Chapter 5

Example Chapter

This chapter aims to provide examples how how to structure and create specific components in your thesis document. Throughout this section, LaTeX's automatic placement for figures and tables will be disabled in most cases. This is being done to add a specific flow to **THIS DOCUMENT**; this should be avoided in one's thesis as it can lead to poor placement of figures, tables, and other "floats", as well as cause unnecessary white space.

5.1 General Text Layouts

5.1.1 Document Structure

LaTeX provides a set of commands that can be used to provide the structure for your document. Depending on the document class, the different commands shown in Table 5.1 may be used. Originally this thesis template was created as a modification to the `book` class, however, it included certain definitions that are unlikely to be included in a thesis document. Due to this, the latest versions of this document (2.0.0+) do not include definitions for `part`.

Table 5.1: Document Structure Commands

Level	Command	Notes
-1	`\part{}`	Not Recommended for Thesis
0	`\chapter{}`	
1	`\section{}`	
2	`\subsection{}`	
3	`\subsubsection{}`	
4	`\paragraph{}`	
5	`\subparagraph{}`	Not Recommended for Thesis

5.1.2 Text Alignment

Generally, the alignment of the text should be left alone and handled by LaTeX. However, in some rare cases it may be beneficial or even required to change the style of the alignment. While LaTeX does have built in environments for handling the changing of the alignment, the package `\usepackage{ragged2e}` provides some improvements. Of these improvements, the most obvious is the allowing of hyphenated text to appear in 'ragged' or 'centred' text.

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5.1.3 Lists

LaTeX has a few built-in ways for handling lists. The three that we will be looking at here (formatted in an enumerated list) are:

1. `enumerate`
2. `itemize`
3. `description`

These each create lists in a slightly unique way. And all of these lists can be nested in each other. For `enumerate`, this creates a numbered list, where each level has a different style of "numbered list".

1. First Item
    (a) First Sub Item
        i. First Sub Sub Item
        ii. Second Sub Sub Item
    (b) Second Sub Item
2. Second Item

For `itemize`, this creates a non-numbered list. Every level that is created will have a different style bullet.

- First Item
    – First Sub Item

        - First Sub Sub Item
        - Second Sub Sub Item
    - Second Sub Item
- Second Item

For `description`, this creates a descriptive list. Descriptions should have the optional argument included for each `\item` otherwise the line will have a blank in the beginning like the *Second Item* in the next list and not align with the other items.

LVL1 First Item

LVL1-1 First Sub Item

LVL1-1-1 First Sub Sub Item

LVL1-1-2 Second Sub Sub Item

LVL1-2 Second Sub Item

Second Item

Beyond the previous examples, there are no limitation on the types of lists that are nested, allowing for combined styles as shown in the following list.

1. First Item
    - First Sub Item

      LVL1-1-1 First Sub Sub Item

      LVL1-1-2 Second Sub Sub Item
    - Second Sub Item
2. Second Item

5.1.4 Footnotes

LaTeX can have footnotes added in very easily. Generally these footnotes will be inserted in one of two ways. Using the in-line command:

```
\footnote{footnote text}
```
[1]

Or by using the split footnote. For a split footnote, the macro:

```
\footnotemark[n]
```
[2]

is used to indicate where the mark should be inserted. And the macro:

```
\footnotetext[n]{split footnote text}.
```

is used to signify what the text for the indicated foot note should be. This allow you to help keep your document more organized with the drawback that it is the user's responsibility to keep track of the foot note numbers or ensure that a `footnotemark` is followed by it's corresponding `footnotetext`. For this reason, I recommend using the in-line footnotes.

5.2 Cross-References and Citations

This section will be showing off some of the different ways to include "citations" and "cross-references" within your document. Note that **cross-references** in LaTeX utilize `\ref{}` as a command, while one might think that this is short for reference this is not the case citation/references utilize the `\cite{}` commands.

5.2.1 Cross-References

In LaTeX, references will "reference" a `\label{Reference:Label}` command. This section has the following command to define the the section:

```
\section{Citations and References}\label{sec:citref}
```

[1] footnote text
[2] split footnote text

By using `\ref{sec:citref}`, this allows you to insert a reference that look like this: 5.2. Now this by itself is not the most useful, to make it a bit better we should keep track of what we are referencing, in this case a **Section**, and add this label in front of the reference (`Section~\ref{sec:citref}`) and this will display like this: Section 5.2. Note to ensure the reference is not split we add a non-breaking space (`~`) to prevent LaTeX from adding a linebreak.

While using the ref command, you might ask "*Why does LaTeX not just know what it is that I am referencing and insert that automatically in front of the reference?*" The answer is to provide more flexibility to the user. However, that being said, individuals have created a number of packages that work to enhance the workflow of adding these cross-references. Some of these are provided by the **hyperref** and **cleveref** packages. To include these packages add the following lines to the bottom of your preamble (order matters, cleveref needs to be after hyperref and hyperref should be one of the last packages loaded):

```
\usepackage{hyperref}
\usepackage[nameinlink]{cleveref}
```

With these packages installed we can now use the commands in Table 5.2.[3]

[3]Note that becase the floats are added where they are in the text this causes them to insert large amounts of white space because it only fits on the following page.

Table 5.2: Built-in, hyperref, and cleveref commands and outputs

Command	Output
built-in	
\ref{}	5.2
\pageref{}	26
hyperref	
\autoref{}	Table 5.2
cleveref	
\cref{}	table 5.2
\Cref{}	Table 5.2
\cref*{}	table 5.2
\Cref*{}	Table 5.2
\cpageref{}	page 26
\Cpageref{}	Page 26
\namecref{}	table
\nameCref{}	Table

Further, the **cleveref** also includes features that allows for the auto sorting and combining of references:

```
\Cref{fig:doubleImage,fig:singleImage,fig:tripleImage
    1,fig:quadImage}
```

Noting that there are **NO** spaces between the labels; this will produce: Figures 5.1 to 5.3 and 5.5. Allowing one to quickly and efficiently keep references up-to-date and consistent in their style. More examples of the use of the **cleveref** cross-referencing is found through the rest of this Chapter.

5.2.2 Citations

Citations are a lot easier than dealing with the cross-referencing. There are no additional packages required for citations, the built-in ones are feature-rich enough. Now, while there are no additional packages required to make citations in your document, there are in fact a few programs that should help you manage all of your citations/references. These programs can include Mendeley, JabRef, or Zotero; a comparison of the softwares can be found in Table 5.3, and more information of the use of JabRef can be found in Chapter 6. Single citations can be included with the

Table 5.3: Comparison of Reference Softwares

Software	Developer	Version	Free	License
JabRef	The JabRef Team	5.11	Free	MIT
Mendeley	Elsevier	2.99.0	Free up to 2 GB	Proprietary
Zotero	CDS	6.0.27	Free up to 300 MB	AGPL

`\cite{citationKey}` command, the one at the end of this sentence is created with the `\cite{TEST}` command[1]. Multiple citations can be included in a single cite command by adding commas in between the citation keys. The citation at the end of this sentence shows how to create more than one citation and how they are grouped together, it is created with the `\cite{testone,cite2,cite3,cite4,cite5}` command[2–6]. Finally this sentence shows how a gap in the citations is handled, this is created with the `\cite{testone,cite2,cite3,cite5}` command[2–4, 6].

5.3 Tables

Within this section we will explore some of the typical uses for a table, how to create them, and how to create a consistent look throughout your thesis. LaTeX provides the default floats environment `table` that can be combined with the `tabular` environment to create tables in your works. While these tables are functional they have a very plain

look and feel to them. The package `tabularx` can be combined with the `booktabs` package to create elegant and consistent looking tables. A direct comparison of a standard table and the `tabularx` with `booktabs` can be seen in Table 5.4.

Table 5.4: Tabular vs. Tabularx Comparison

(a)

Left	**Centre**	**Right**
Left Column	Centre Column	Right Column

(b)

Left	**Centre**	**Right**
Left Column	Centre Column	Right Column

As can be see in Table 5.4, well maybe not due to the overlap... the included `tabular` environment in LaTeX does not restrict a table to being a specific size; it is completely up to the user to determine if a table will overflow, and, if it does, to break or change the layout to make the data fit. On the other hand, the `tabularx` package allows us to set the width of the table and inform it which columns should be scaled to fit the the data and the `tabularx` package will handle the heavy lifting for us. Thus creating a table that, first, fits in the space one specifies and, secondly, re-flows the data to fit the cells rather than running the contents into neighbouring content or into the margins and off the page.

`Tabularx` uses similar formats to the tabular environment, except there is an additional column type: `X`. This column type, or one of the derivative column types shown below, must be included in the use of a `tabularx` table. Failing to do so will cause an error. The additional column types that one might like to create for use with the `tabularx` environment are as follows:

- **C** - Centred Auto Sizing Column

  ```
  \newcolumntype{C}{>{\centering\arraybackslash}X}
  ```

- **L** - Left Justified Auto Sizing Column

  ```
  \newcolumntype{L}{>{\raggedright\arraybackslash}X}
  ```

- **R** - Right Justified Auto Sizing Column

  `\newcolumntype{R}{>{\raggedleft\arraybackslash}X}`

These new column types should be included in the preamble (before the `\begin{document}`; better yet, to help keep things organized it is recommended to include them in the `includeMacros.tex` file.

Table 5.5: This is a basic table

Left Aligned Title	**Centred Title**	**Right Aligned Title**
This is left aligned	This is centred	This is right aligned
This is left aligned	This is centred	This is right aligned
This is left aligned	This is centred	This is right aligned
This is left aligned	This is centred	This is right aligned

In the following table, Table 5.6, we use the `multirow` and `multicol` packages. These two packages allow one to merge cells together in a table. Beyond this, to include lines, the `\cmidrule(l{<length>}r{<length>}){start_cell-end_cell}` from the `booktabs` package is used. To add a bit of a cleaner look the lines can be trimmed by including the `l{<length>}` or `r{<length>}` in the round brackets to trim the lines by the specified length for the left and right sides, respectively. Note that both line trim specifications do not need to be specified, in-fact one or none can be provide if the line does not need to be trimmed, *e.g.*, `\cmidrule{1-5}` or `\cmidrule(r{3em}){2-3}`.

Table 5.6: This is a complex table.

This is two row	**This is two columns**	
	Centred Title	**Right Aligned Title**
This is two row	This is centred	This is right aligned
	This is centred	This is right aligned
This is two row	This is centred	This is right aligned
	This is centred	This is right aligned

5.4 Figures

This section will provide examples of how to create figures, and different types of multi/sub-figures. Additionally, if you have many figures in a section and they are bleeding too much into the following sections a `\clearpage` command can be issued before the next section. However, note that this will force the next section to begin on a new page. Note that the first "figure" is actually a **plate**; a plate is the proper title associated with a *photograph*, however, is not always used in every department... if your are unsure ask your supervisor if the use of plates is common. Using the environment `plate` instead of `figure` and command `\listofplates` will generate everything for you.

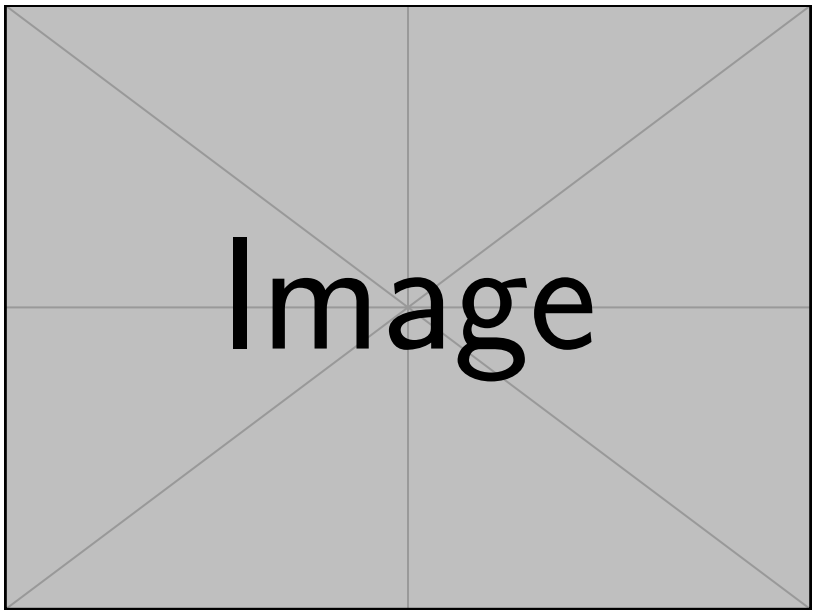


Plate 5.1: This is an example of a single image plate.

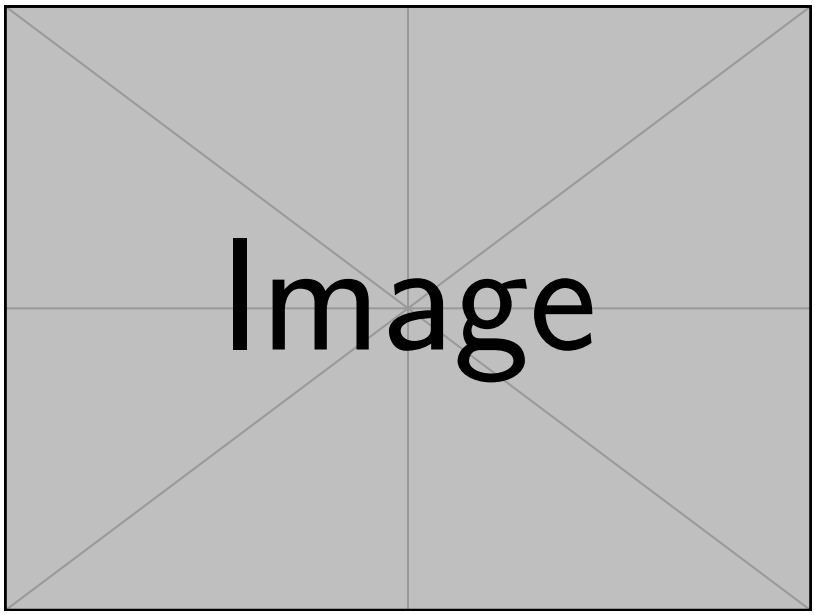
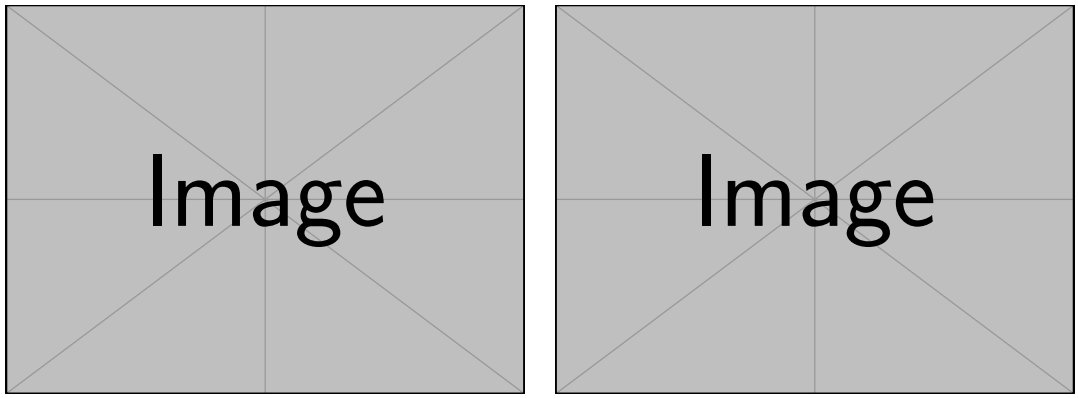
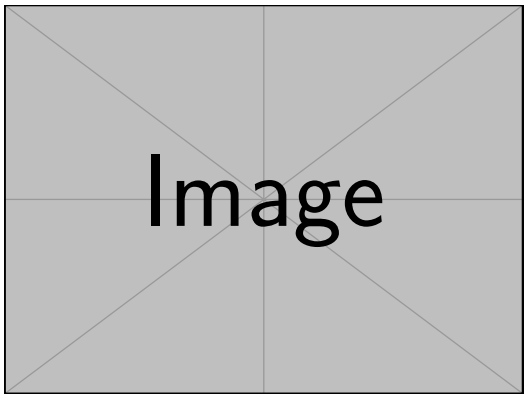


Figure 5.1: This is an example of a single figure.

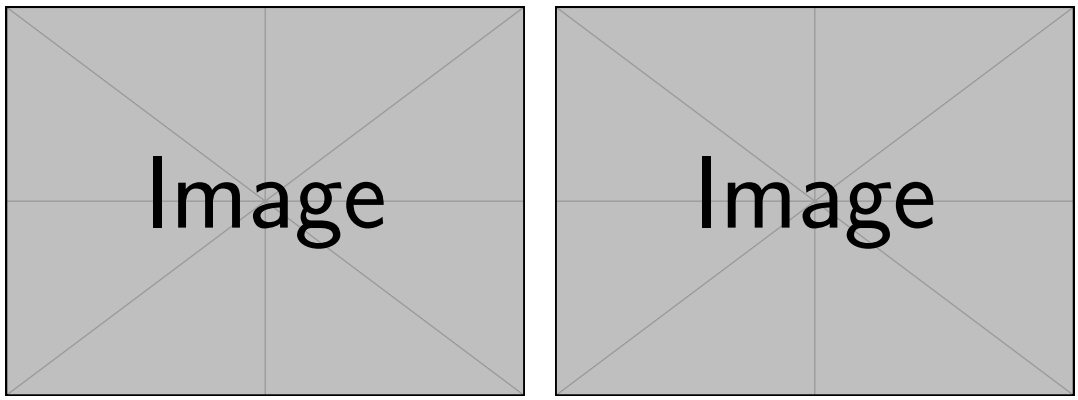


(a) (b)

Figure 5.2: This is an example of a double image figure.

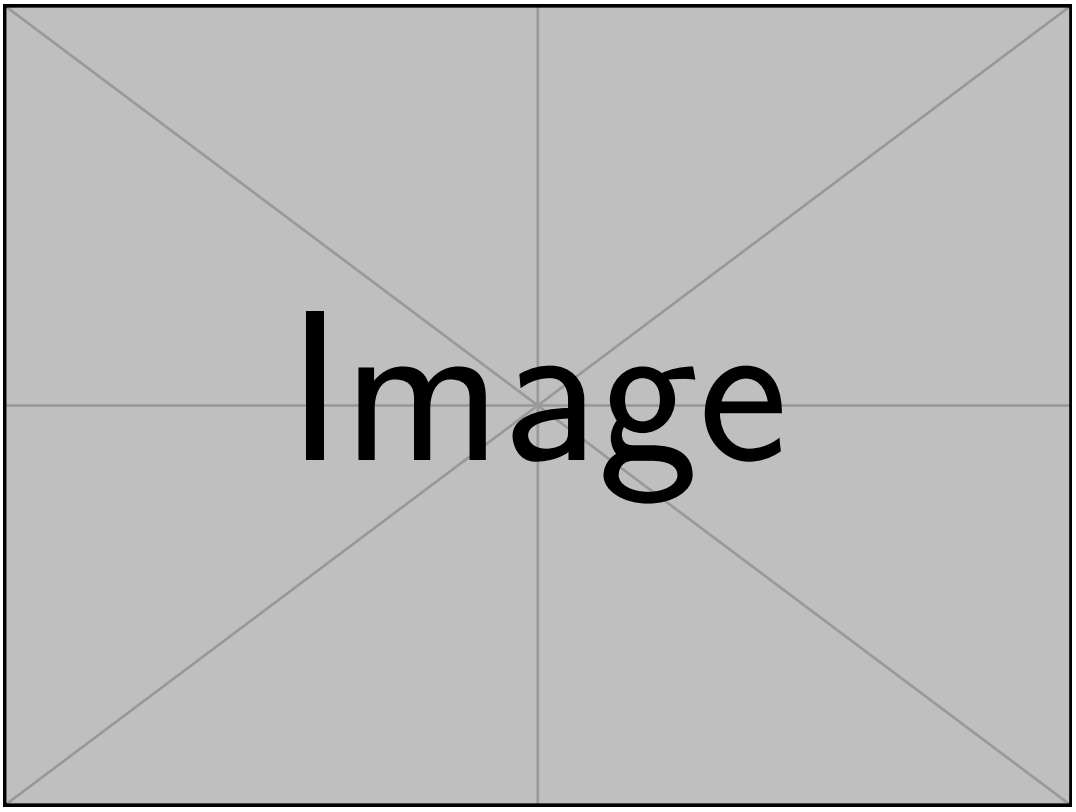


(a)

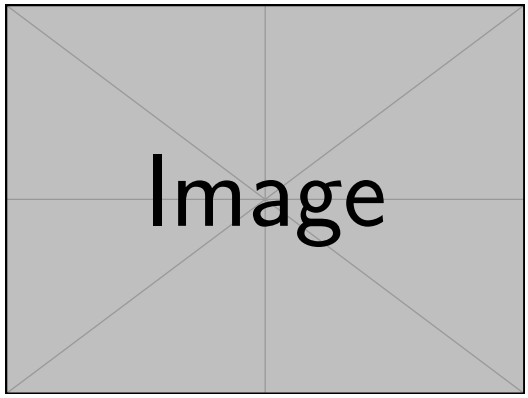


(b) (c)

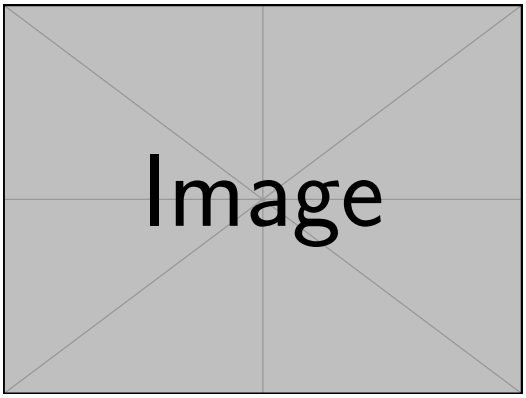
Figure 5.3: This is an example of a triple image figure.



(a)

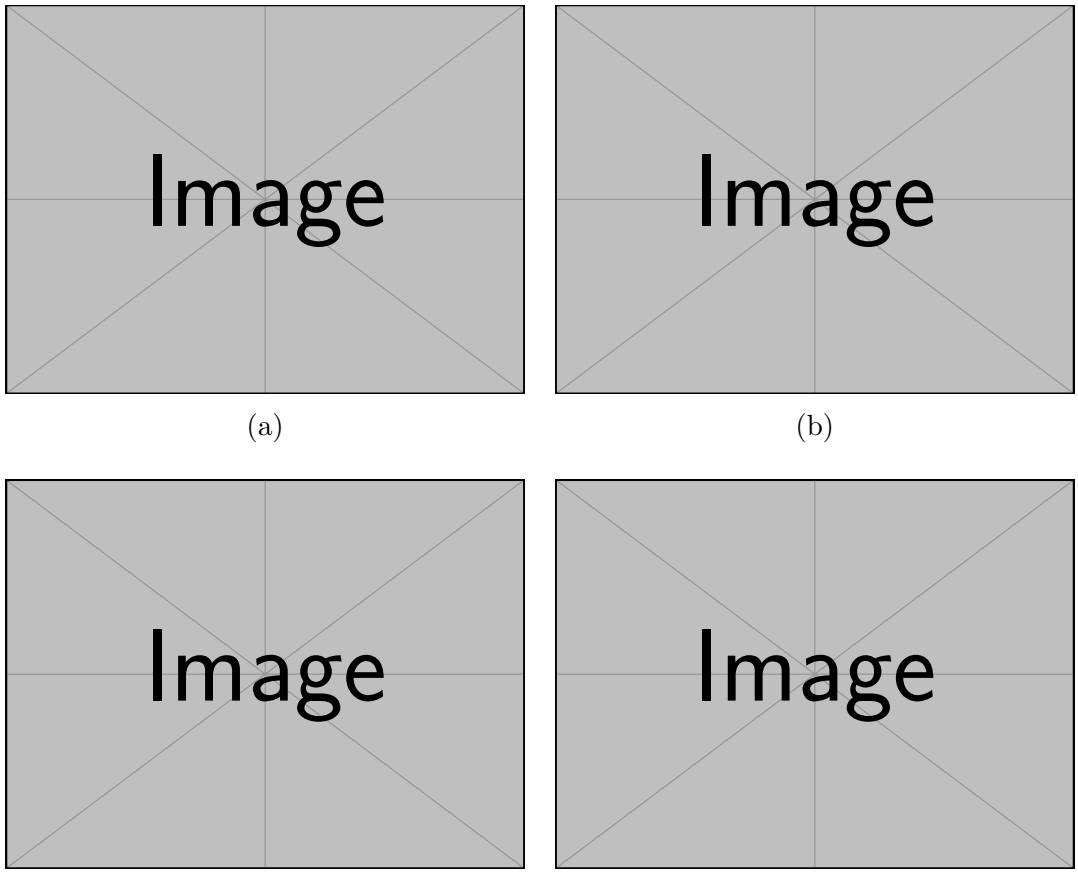


(b)



(c)

Figure 5.4: This is a second example of a triple image figure.



(a) (b)

(c) (d)

Figure 5.5: This is an example of a quad image figure.

5.5 Graphs & Plots

In the following section there will be a few examples of how to generate plots. For more information on how to create plots, here is the manual for pgfplots.

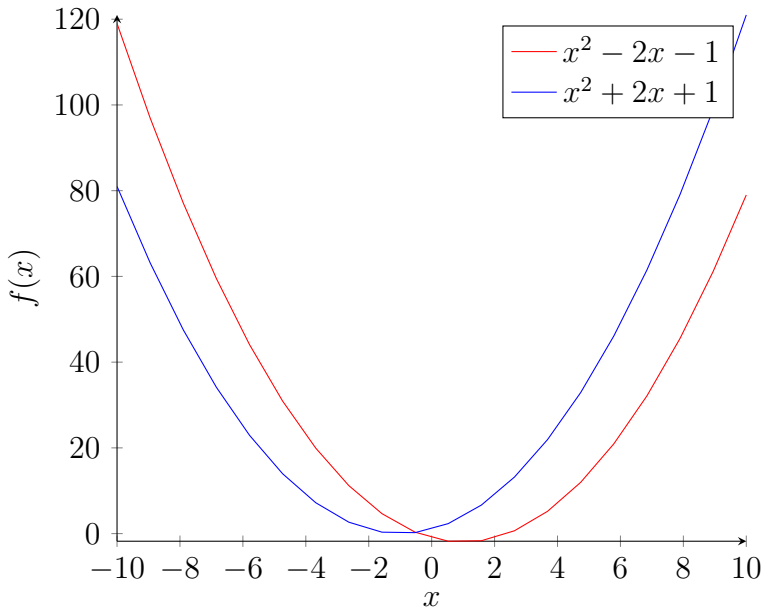


Figure 5.6: Plot of two parabola.

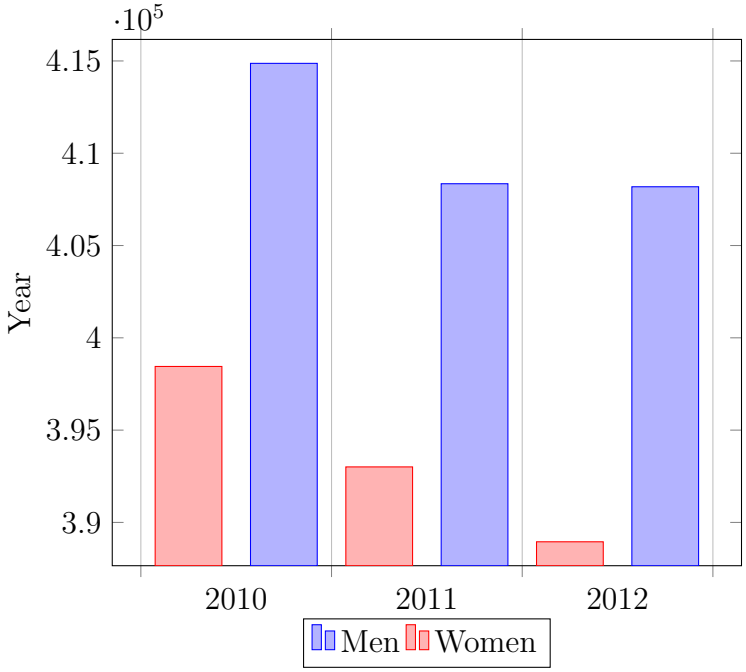


Figure 5.7: Example of a Bar Graph.

Example using the mesh parameter

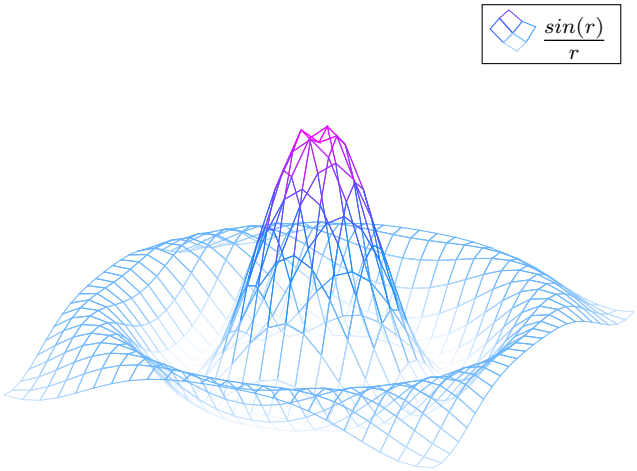


Figure 5.8: Example of a 3D Plot

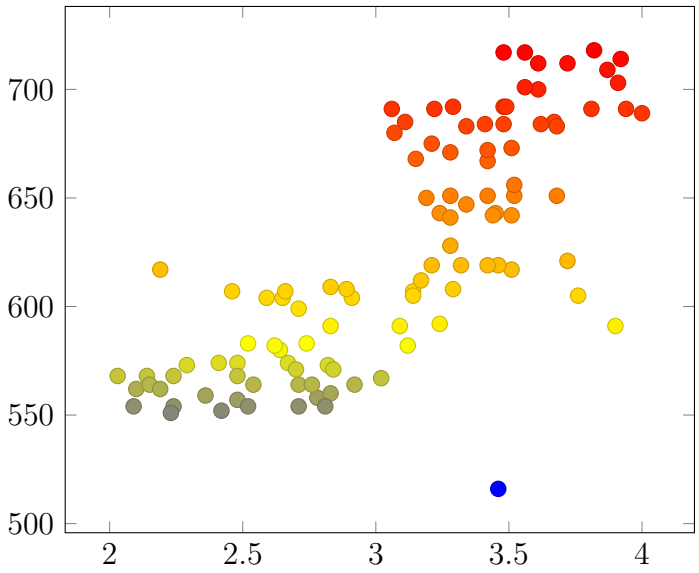


Figure 5.9: Example of a Scatter Plot.

5.6 Math & Equations

There are many ways to include formulas in your thesis. This section will provide some different ways of adding them (inline and standalone), as well as provide some ways of referencing the equations.

To start the simplest way to add an equation is using the built-in LaTeX math mode. To enter and exit math mode one just needs to use the `\(<Equation>\)` symbols around an equation. While there also exists `$<Equation>$` to add math, it is not recommended due to potential compatibility issues. Additionally, this, `\(<Equation>\)`, method is capable of being redefined to add further customization. An example of using math mode to get an inline equation is by using the following command:

```
\(\vec{F_{d}}=\frac{1}{2}\ A\ C_{d}\ \vec{V}^{2}\)
```

The above command has the effect of creating the following output: $\vec{F_d} = \frac{1}{2}\, A\, C_d\, \vec{V}^2$. Sometimes it can be quite beneficial to separate what would be an in-line equation to be on its own line. For this, we have two different ways of doing it. The first was will produce an equation that has no reference:

$$E = m\ c^2$$

$$E = m\ c^2$$

The second will produce an equation with a reference. For this, there are two many ways of creating the reference, the first one, see Equation (5.1), creates a numbered reference, the other one, see Equation (Constant pi), creates a reference with a 'tag'. The difference between the two is just the inclusion of a `\tag{<text>}` command that will replace the regular number with `<text>`.

$$\pi = 3.1415... \tag{5.1}$$

$$\pi = 3.1415... \tag{Constant pi}$$

If you have multiple equations that you want arranged very neatly, use the align environment and you can assign individual equations numbers as shown in Equations (5.2) to (5.4).

$$Equation1 = 1 \tag{5.2}$$

$$Equation2 = 2 + 2 \tag{5.3}$$

$$Equation3 = 3 + 3 + 3 \tag{5.4}$$

Table 5.7: Math Mode Greek Letters

Command	Output	Command	Output	Command	Output
\alpha	α	\beta	β	\gamma	γ
\delta	δ	\epsilon	ϵ	\zeta	ζ
\eta	η	\theta	θ	\iota	ι
\kappa	κ	\lambda	λ	\mu	μ
\nu	ν	\xi	ξ	o	o
\pi	π	\rho	ρ	\sigma	σ
\tau	τ	\upsilon	υ	\phi	ϕ
\chi	χ	\psi	ψ	\omega	ω
A	A	B	B	\Gamma	Γ
\Delta	Δ	E	E	Z	Z
H	H	\Theta	Θ	I	I
K	K	\Lambda	Λ	M	M
N	N	\Xi	Ξ	O	O
\Pi	Π	P	P	\Sigma	Σ
T	T	\Upsilon	Υ	\Phi	Φ
X	X	\Psi	Ψ	\Omega	Ω

It may be very important in a math heavy thesis to be able to show your equations, or even data in a readable way. For this, we will explore some of the ways to create specific data.

Table 5.8: Blackboard Bold Letters

Command	Output	Command	Output	Command	Output
`\mathbb{A}`	$\mathbb{A}$	`\mathbb{B}`	$\mathbb{B}$	`\mathbb{C}`	$\mathbb{C}$
`\mathbb{D}`	$\mathbb{D}$	`\mathbb{E}`	$\mathbb{E}$	`\mathbb{F}`	$\mathbb{F}$
`\mathbb{G}`	$\mathbb{G}$	`\mathbb{H}`	$\mathbb{H}$	`\mathbb{I}`	$\mathbb{I}$
`\mathbb{J}`	$\mathbb{J}$	`\mathbb{K}`	$\mathbb{K}$	`\mathbb{L}`	$\mathbb{L}$
`\mathbb{M}`	$\mathbb{M}$	`\mathbb{N}`	$\mathbb{N}$	`\mathbb{O}`	$\mathbb{O}$
`\mathbb{P}`	$\mathbb{P}$	`\mathbb{Q}`	$\mathbb{Q}$	`\mathbb{R}`	$\mathbb{R}$
`\mathbb{S}`	$\mathbb{S}$	`\mathbb{T}`	$\mathbb{T}$	`\mathbb{U}`	$\mathbb{U}$
`\mathbb{V}`	$\mathbb{V}$	`\mathbb{W}`	$\mathbb{W}$	`\mathbb{X}`	$\mathbb{X}$
`\mathbb{Y}`	$\mathbb{Y}$	`\mathbb{Z}`	$\mathbb{Z}$		

5.6.1 Vector, Sets, Piecewise Functions, Matrix Math, and More

$$\mathrm{f}(x) = \begin{cases} x^{2*\ln x}, & \text{if } x < 3 \\ -\frac{x}{2}, & \text{if } 3 \leq x \leq 4 \\ x, & \text{if } 4 < x \end{cases} \tag{5.5}$$

Vectors and Matrices are used in many fields of math and science and provide a convenient way to represent 2-Dimensional arrays of numbers.

$$x \in \{1, 2, 3, 4, 5, 6, 7\} \tag{5.6}$$

$$V_1 = \begin{pmatrix} a, & b, & c, & d \end{pmatrix} \tag{5.7}$$

$$V_2 = \begin{pmatrix} a \\ b \\ c \\ d \end{pmatrix} \tag{5.8}$$

$$M = \begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{bmatrix} \tag{5.9}$$

Table 5.9: Calligraphic Letters

Command	Output	Command	Output	Command	Output
\mathcal{A}	$\mathcal{A}$	\mathcal{B}	$\mathcal{B}$	\mathcal{C}	$\mathcal{C}$
\mathcal{D}	$\mathcal{D}$	\mathcal{E}	$\mathcal{E}$	\mathcal{F}	$\mathcal{F}$
\mathcal{G}	$\mathcal{G}$	\mathcal{H}	$\mathcal{H}$	\mathcal{I}	$\mathcal{I}$
\mathcal{J}	$\mathcal{J}$	\mathcal{K}	$\mathcal{K}$	\mathcal{L}	$\mathcal{L}$
\mathcal{M}	$\mathcal{M}$	\mathcal{N}	$\mathcal{N}$	\mathcal{O}	$\mathcal{O}$
\mathcal{P}	$\mathcal{P}$	\mathcal{Q}	$\mathcal{Q}$	\mathcal{R}	$\mathcal{R}$
\mathcal{S}	$\mathcal{S}$	\mathcal{T}	$\mathcal{T}$	\mathcal{U}	$\mathcal{U}$
\mathcal{V}	$\mathcal{V}$	\mathcal{W}	$\mathcal{W}$	\mathcal{X}	$\mathcal{X}$
\mathcal{Y}	$\mathcal{Y}$	\mathcal{Z}	$\mathcal{Z}$		

Table 5.10: Fraktur Letters

Command	Output	Command	Output	Command	Output
\mathfrak{A}	$\mathfrak{A}$	\mathfrak{B}	$\mathfrak{B}$	\mathfrak{C}	$\mathfrak{C}$
\mathfrak{D}	$\mathfrak{D}$	\mathfrak{E}	$\mathfrak{E}$	\mathfrak{F}	$\mathfrak{F}$
\mathfrak{G}	$\mathfrak{G}$	\mathfrak{H}	$\mathfrak{H}$	\mathfrak{I}	$\mathfrak{I}$
\mathfrak{J}	$\mathfrak{J}$	\mathfrak{K}	$\mathfrak{K}$	\mathfrak{L}	$\mathfrak{L}$
\mathfrak{M}	$\mathfrak{M}$	\mathfrak{N}	$\mathfrak{N}$	\mathfrak{O}	$\mathfrak{O}$
\mathfrak{P}	$\mathfrak{P}$	\mathfrak{Q}	$\mathfrak{Q}$	\mathfrak{R}	$\mathfrak{R}$
\mathfrak{S}	$\mathfrak{S}$	\mathfrak{T}	$\mathfrak{T}$	\mathfrak{U}	$\mathfrak{U}$
\mathfrak{V}	$\mathfrak{V}$	\mathfrak{W}	$\mathfrak{W}$	\mathfrak{X}	$\mathfrak{X}$
\mathfrak{Y}	$\mathfrak{Y}$	\mathfrak{Z}	$\mathfrak{Z}$		

Chapter 6

Paper 2

6.1 Introduction

Chapter 7

Background

7.1 General Information

Donec et nisl id sapien blandit mattis. Aenean dictum odio sit amet risus. Morbi purus. Nulla a est sit amet purus venenatis iaculis. Vivamus viverra purus vel magna. Donec in justo sed odio malesuada dapibus. Nunc ultrices aliquam nunc. Vivamus facilisis pellentesque velit. Nulla nunc velit, vulputate dapibus, vulputate id, mattis ac, justo. Nam mattis elit dapibus purus. Quisque enim risus, congue non, elementum ut, mattis quis, sem. Quisque elit.

Maecenas non massa. Vestibulum pharetra nulla at lorem. Duis quis quam id lacus dapibus interdum. Nulla lorem. Donec ut ante quis dolor bibendum condimentum. Etiam egestas tortor vitae lacus. Praesent cursus. Mauris bibendum pede at elit. Morbi et felis a lectus interdum facilisis. Sed suscipit gravida turpis. Nulla at lectus. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Praesent nonummy luctus nibh. Proin turpis nunc, congue eu, egestas ut, fringilla at, tellus. In hac habitasse platea dictumst.

Vivamus eu tellus sed tellus consequat suscipit. Nam orci orci, malesuada id, gravida nec, ultricies vitae, erat. Donec risus turpis, luctus sit amet, interdum quis, porta sed, ipsum. Suspendisse condimentum, tortor at egestas posuere, neque metus tempor orci, et tincidunt urna nunc a purus. Sed facilisis blandit tellus. Nunc risus sem, suscipit nec, eleifend quis, cursus quis, libero. Curabitur et dolor. Sed vitae sem.

Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Maecenas ante. Duis ullamcorper enim. Donec tristique enim eu leo. Nullam molestie elit eu dolor. Nullam bibendum, turpis vitae tristique gravida, quam sapien tempor lectus, quis pretium tellus purus ac quam. Nulla facilisi.

7.2 Specific Information

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

Donec tempus neque vitae est. Aenean egestas odio sed risus ullamcorper ullamcorper. Sed in nulla a tortor tincidunt egestas. Nam sapien tortor, elementum sit amet, aliquam in, porttitor faucibus, enim. Nullam congue suscipit nibh. Quisque convallis. Praesent arcu nibh, vehicula eget, accumsan eu, tincidunt a, nibh. Suspen-

disse vulputate, tortor quis adipiscing viverra, lacus nibh dignissim tellus, eu suscipit risus ante fringilla diam. Quisque a libero vel pede imperdiet aliquet. Pellentesque nunc nibh, eleifend a, consequat consequat, hendrerit nec, diam. Sed urna. Maecenas laoreet eleifend neque. Vivamus purus odio, eleifend non, iaculis a, ultrices sit amet, urna. Mauris faucibus odio vitae risus. In nisl. Praesent purus. Integer iaculis, sem eu egestas lacinia, lacus pede scelerisque augue, in ullamcorper dolor eros ac lacus. Nunc in libero.

7.3 Gap in Research

Quisque consectetuer. In suscipit mauris a dolor pellentesque consectetuer. Mauris convallis neque non erat. In lacinia. Pellentesque leo eros, sagittis quis, fermentum quis, tincidunt ut, sapien. Maecenas sem. Curabitur eros odio, interdum eu, feugiat eu, porta ac, nisl. Curabitur nunc. Etiam fermentum convallis velit. Pellentesque laoreet lacus. Quisque sed elit. Nam quis tellus. Aliquam tellus arcu, adipiscing non, tincidunt eleifend, adipiscing quis, augue. Vivamus elementum placerat enim. Suspendisse ut tortor. Integer faucibus adipiscing felis. Aenean consectetuer mattis lectus. Morbi malesuada faucibus dolor. Nam lacus. Etiam arcu libero, malesuada vitae, aliquam vitae, blandit tristique, nisl.

Maecenas accumsan dapibus sapien. Duis pretium iaculis arcu. Curabitur ut lacus. Aliquam vulputate. Suspendisse ut purus sed sem tempor rhoncus. Ut quam dui, fringilla at, dictum eget, ultricies quis, quam. Etiam sem est, pharetra non, vulputate in, pretium at, ipsum. Nunc semper sagittis orci. Sed scelerisque suscipit diam. Ut volutpat, dolor at ullamcorper tristique, eros purus mollis quam, sit amet ornare ante nunc et enim.

7.4 Conclusions

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetuer tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

Chapter 8

Paper 1

8.1 Introduction

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim.

Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

8.2 Methods and Procedure

Case 1 *Suspendisse vitae elit. Aliquam arcu neque, ornare in, ullamcorper quis, commodo eu, libero. Fusce sagittis erat at erat tristique mollis. Maecenas sapien libero, molestie et, lobortis in, sodales eget, dui. Morbi ultrices rutrum lorem. Nam elementum ullamcorper leo. Morbi dui. Aliquam sagittis. Nunc placerat. Pellentesque tristique sodales est. Maecenas imperdiet lacinia velit. Cras non urna. Morbi eros pede, suscipit ac, varius vel, egestas non, eros. Praesent malesuada, diam id pretium elementum, eros sem dictum tortor, vel consectetuer odio sem sed wisi.*

Case 2 *Nulla in ipsum. Praesent eros nulla, congue vitae, euismod ut, commodo a, wisi. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Aenean nonummy magna non leo. Sed felis erat, ullamcorper in, dictum non, ultricies ut, lectus. Proin vel arcu a odio lobortis euismod. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Proin ut est. Aliquam odio. Pellentesque massa turpis, cursus eu, euismod nec, tempor congue, nulla. Duis viverra gravida mauris. Cras tincidunt. Curabitur eros ligula, varius ut, pulvinar in, cursus faucibus, augue.*

In hac habitasse platea dictumst. Proin at est. Curabitur tempus vulputate elit. Pellentesque sem. Praesent eu sapien. Duis elit magna, aliquet at, tempus sed, vehicula non, enim. Morbi viverra arcu nec purus. Vivamus fringilla, enim et commodo malesuada, tortor metus elementum ligula, nec aliquet est sapien ut lectus. Aliquam

mi. Ut nec elit. Fusce euismod luctus tellus. Curabitur scelerisque. Nullam purus. Nam ultricies accumsan magna. Morbi pulvinar lorem sit amet ipsum. Donec ut justo vitae nibh mollis congue. Fusce quis diam. Praesent tempus eros ut quam.

Donec in nisl. Fusce vitae est. Vivamus ante ante, mattis laoreet, posuere eget, congue vel, nunc. Fusce sem. Nam vel orci eu eros viverra luctus. Pellentesque sit amet augue. Nunc sit amet ipsum et lacus varius nonummy. Integer rutrum sem eget wisi. Aenean eu sapien. Quisque ornare dignissim mi. Duis a urna vel risus pharetra imperdiet. Suspendisse potenti.

Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius. Cras ante. Vestibulum commodo sem tincidunt massa. Nam justo. Aenean luctus, felis et condimentum lacinia, lectus enim pulvinar purus, non porta velit nisl sed eros. Suspendisse consequat. Mauris a dui et tortor mattis pretium. Sed nulla metus, volutpat id, aliquam eget, ullamcorper ut, ipsum. Morbi eu nunc. Praesent pretium. Duis aliquam pulvinar ligula. Ut blandit egestas justo. Quisque posuere metus viverra pede.

8.3 Results and Discussion

Nunc velit. Nullam elit sapien, eleifend eu, commodo nec, semper sit amet, elit. Nulla lectus risus, condimentum ut, laoreet eget, viverra nec, odio. Proin lobortis. Curabitur dictum arcu vel wisi. Cras id nulla venenatis tortor congue ultrices. Pellentesque eget pede. Sed eleifend sagittis elit. Nam sed tellus sit amet lectus ullamcorper tristique. Mauris enim sem, tristique eu, accumsan at, scelerisque vulputate, neque. Quisque lacus. Donec et ipsum sit amet elit nonummy aliquet. Sed viverra nisl at sem. Nam diam. Mauris ut dolor. Curabitur ornare tortor cursus velit.

Morbi tincidunt posuere arcu. Cras venenatis est vitae dolor. Vivamus scelerisque semper mi. Donec ipsum arcu, consequat scelerisque, viverra id, dictum at, metus. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut pede sem, tempus ut, porttitor bibendum, molestie eu, elit. Suspendisse potenti. Sed id lectus sit amet

purus faucibus vehicula. Praesent sed sem non dui pharetra interdum. Nam viverra ultrices magna.

Aenean laoreet aliquam orci. Nunc interdum elementum urna. Quisque erat. Nullam tempor neque. Maecenas velit nibh, scelerisque a, consequat ut, viverra in, enim. Duis magna. Donec odio neque, tristique et, tincidunt eu, rhoncus ac, nunc. Mauris malesuada malesuada elit. Etiam lacus mauris, pretium vel, blandit in, ultricies id, libero. Phasellus bibendum erat ut diam. In congue imperdiet lectus.

8.4 Conclusions

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetuer tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

Chapter 9

Paper 2

9.1 Introduction

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim.

Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

9.2 Methods and Procedure

In hac habitasse platea dictumst. Proin at est. Curabitur tempus vulputate elit. Pellentesque sem. Praesent eu sapien. Duis elit magna, aliquet at, tempus sed, vehicula non, enim. Morbi viverra arcu nec purus. Vivamus fringilla, enim et commodo malesuada, tortor metus elementum ligula, nec aliquet est sapien ut lectus. Aliquam mi. Ut nec elit. Fusce euismod luctus tellus. Curabitur scelerisque. Nullam purus. Nam ultricies accumsan magna. Morbi pulvinar lorem sit amet ipsum. Donec ut justo vitae nibh mollis congue. Fusce quis diam. Praesent tempus eros ut quam.

Donec in nisl. Fusce vitae est. Vivamus ante ante, mattis laoreet, posuere eget, congue vel, nunc. Fusce sem. Nam vel orci eu eros viverra luctus. Pellentesque sit amet augue. Nunc sit amet ipsum et lacus varius nonummy. Integer rutrum sem eget wisi. Aenean eu sapien. Quisque ornare dignissim mi. Duis a urna vel risus pharetra imperdiet. Suspendisse potenti.

Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius. Cras ante. Vestibulum commodo sem tincidunt massa. Nam justo. Aenean luctus, felis et condimentum lacinia, lectus enim pulvinar purus, non porta velit nisl sed eros. Suspendisse consequat. Mauris a dui et tortor mattis pretium. Sed nulla metus, volutpat id, aliquam eget, ullamcorper ut, ipsum. Morbi eu nunc. Praesent pretium. Duis aliquam pulvinar ligula. Ut blandit egestas justo. Quisque posuere metus viverra pede.

9.3 Results and Discussion

Nunc velit. Nullam elit sapien, eleifend eu, commodo nec, semper sit amet, elit. Nulla lectus risus, condimentum ut, laoreet eget, viverra nec, odio. Proin lobortis. Curabitur dictum arcu vel wisi. Cras id nulla venenatis tortor congue ultrices. Pellentesque eget pede. Sed eleifend sagittis elit. Nam sed tellus sit amet lectus ullamcorper tristique. Mauris enim sem, tristique eu, accumsan at, scelerisque vulputate, neque. Quisque lacus. Donec et ipsum sit amet elit nonummy aliquet. Sed viverra nisl at sem. Nam diam. Mauris ut dolor. Curabitur ornare tortor cursus velit.

Morbi tincidunt posuere arcu. Cras venenatis est vitae dolor. Vivamus scelerisque semper mi. Donec ipsum arcu, consequat scelerisque, viverra id, dictum at, metus. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut pede sem, tempus ut, porttitor bibendum, molestie eu, elit. Suspendisse potenti. Sed id lectus sit amet purus faucibus vehicula. Praesent sed sem non dui pharetra interdum. Nam viverra ultrices magna.

Aenean laoreet aliquam orci. Nunc interdum elementum urna. Quisque erat. Nullam tempor neque. Maecenas velit nibh, scelerisque a, consequat ut, viverra in, enim. Duis magna. Donec odio neque, tristique et, tincidunt eu, rhoncus ac, nunc. Mauris malesuada malesuada elit. Etiam lacus mauris, pretium vel, blandit in, ultricies id, libero. Phasellus bibendum erat ut diam. In congue imperdiet lectus.

9.4 Conclusions

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetuer tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci,

scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

Chapter 10

Conclusions, Recommendations, & Future Work

10.1 Conclusions

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius.

Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

10.2 Future Work

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetuer justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.[1]

Bibliography

[1] A. Thor, "Cited article," *Journal Name*, 2020.

[2] A. one, "Article 1," *Journal 1*, 1989.

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[5] A. four, "Article 4," *Journal 4*, 1990.

[6] A. five, "Article five," *Journal five*, 1990.

Appendix A: First Appendix

A.1 Section 1

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum

ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

A.2 Section 2

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetuer justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.

Appendix B: Second Appendix

B.1 Section 1

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetuer vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum

ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

B.2 Section 2

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetuer justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.

Appendix C: Third Appendix

C.1 Section 1

Listing C.1: This is a caption for the inserted code

```
function [outputs] = functionName(inputs)
  %{
    This is a Comment Block
    That
    can
    span
    multiple
    lines.
  %}

  % This is a regular comment
  a = 1 + 2 * sin(angle);
  b = 'This is a String';
```

C.2 Section 2

Listing C.2: This is a caption for the inserted code

```
#include <iostream>
using namespace std;
/* This function adds two integer values
 * and returns the result
 */int
sum(int num1, int num2){
    int num3 = num1 + num2; return num3;
}

int main(){
    //Calling the function
    cout << 'The sum is:' << sum(1,99);
    return 0;
}
```

Appendix D: Inserting PDFs

D.1 how to insert a portrait PDF

This is an Example PDF that is Portrait

This is the second page

D.2 How to insert a landscape PDF

This is an Example PDF that is Landscape

This is the second page