THESIS TITLE

by

First Middle Last

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

Master of Science

Department of Mechanical Engineering
University of Alberta

Abstract

This guide is a comprehensive resource crafted for University of Alberta students tackling their theses with LaTeX. It is designed to simplify the thesis-writing process by offering a detailed walkthrough of a custom LaTeX template tailored to meet the university's formatting requirements. The guide goes beyond mere template usage, providing step-by-step instructions, tips, and best practices for creating a well-structured thesis that adheres to academic standards.

It also delves into advanced customization techniques, allowing users to achieve specific stylistic elements and formatting nuances that suit their individual needs. Alongside these, the guide introduces JabRef, a robust reference management tool, and explains how to seamlessly integrate it with LaTeX to streamline citation management. Whether you are a novice or an experienced LaTeX user, this guide equips you with the knowledge and tools necessary to produce a polished, professional thesis. By following its clear and concise instructions, students can confidently navigate the complexities of thesis writing, ensuring their work is both technically sound and perfectly laid out. Test.

Preface

Writing a thesis is no small task, and as a graduate student at the University of Alberta, I quickly realized just how challenging it can be to meet all the formatting requirements while also producing a document that looks professional. Like many others, I started out using traditional word processors, but it didn't take long before I ran into the usual headaches—crashes, file corruption, and formatting issues that seemed to have a mind of their own.

These frustrations led me to explore LaTeX as an alternative. I discovered that LaTeX not only provided a way to keep my content and formatting separate but also offered a more reliable and consistent way to produce a high-quality thesis. The learning curve was steep, but once I got the hang of it, I found it to be a game-changer.

The original template document was born out of my experience with LaTeX and the desire to make the thesis-writing process a bit less daunting for others who might be in the same boat. My goal here with this new document is to provide a comprehensive guide that not only walks you through the basics of LaTeX but also gives you practical examples and best practices[1] to follow.

I built this template and class from the ground up with the aim of reducing the typical LaTeX learning curve. I have tried to keep it as simple as possible while still making it powerful enough to handle everything you'll need for a thesis. I hope this

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[1] These might not be the "best" practices, however, these are practices that I follow to make my work more constant.

document makes your life a little easier and that you find LaTeX as useful as I have.

Disclaimer: This guide provides practical insights and tips for writing a thesis, based on the information available at the time of writing. However, it remains *your responsibility* to verify the accuracy of all content, conclusions, and interpretations. Official university guidelines, requirements, and advice *always* takes precedence over this guide. I assume *no responsibility* for any potential inaccuracies, misrepresentations, or unintended consequences resulting from the use of any material presented in this guide or the supporting documentation and files.

To...

"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

Acknowledgements

While I would love to acknowledge every individual who has influenced this document, I realize that doing so might mean this document never gets finished.

I want to extend my deepest gratitude to my friends and family for their unwavering support throughout all my accomplishments.

A special thank-you goes out to the developers and other LaTeX users who have contributed to the LaTeX community. Without their work, this guide wouldn't exist in its current form.

I am also incredibly thankful to everyone who provided feedback and support along the way, including those new to LaTeX. Your fresh perspectives were invaluable in motivating the transformation from the previous version of this template into a full-fledged class, template, and this newly added guide to writing a thesis, complete with examples of the most requested elements to include.

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Constants

ϵ_0	Permittivity of Free Space.	$\epsilon_0 = 8.854 \times 10^{-12}$ F/m
$\hbar$	Reduced Planck Constant.	$\hbar = 1.055 \times 10^{-34}$ Js
μ_0	Permeability of Free Space.	$\mu_0 = 4\pi \times 10^{-7}$ H/m
π	Mathematical Constant Pi.	$\pi \approx 3.14159$
R_e	Rankine Number.	$\mathrm{R}_e = \frac{Lv\rho}{\mu}$
c	Speed of light in a vacuum.	$299,792,458\,m/s$
g	Acceleration due to Gravity.	$g = 9.81$ m/s^2
h	Planck constant.	$6.62607015E - 34\,Js$
k	Boltzmann Constant.	$k = 1.380649 \times 10^{-23}$ J/K
R	Gas Constant.	$R = 8.314$ J/(mol·K)

Latin

A	Cross-sectional Area.
a	Acceleration
D	Diameter.
d	Distance
E	Young's Modulus
F	Force.

G Shear Modulus.

I Area Moment of Inertia.

K Elastic Constant

L Length.

M Moment.

m Mass

P Pressure.

T Temperature.

T Torque

t Thickness.

V Volume.

v Velocity

Greek

α Primary Angle

δ Deflection.

λ Wavelength.

σ Normal Stress.

τ Shear Stress.

ε Strain

Abbreviations

AC Armor Class.

AL Adventurers League.

AoE Area of Effect.

AoO Attack of Opportunity.

BAB Base Attack Bonus.

BBEG Big Bad Evil Guy.

CHA Charisma.

CON Constitution.

CoS Curse of Strahd.

CR Challenge Rating.

CRPG Computer Role-Playing Game.

D&D Dungeons & Dragons.

DEX Dexterity.

DM Dungeon Master.

DMG Dungeon Master's Guide.

DMPC Dungeon Master Player Character.

DnD Dungeons & Dragons.

DPR Damage Per Round.

DR Damage Reduction.

ECL Effective Character Level.

HD Hit Dice.

HP Hit Points.

IC In Character.

INT Intelligence.

LA Level Adjustment.

LFG Looking For Group.

LoS Line of Sight.

LR Long Rest.

MM Monster Manual.

NPC Non-Player Character.

OGL Open Game License.

OOC Out Of Character.

PB Proficiency Bonus.

PC Player Character.

PHB Player's Handbook.

PP Passive Perception.

RAI Rules As Intended.

RAW Rules As Written.

RNG Random Number Generator.

RP Roleplaying.

SR Spell Resistance.

SRD System Reference Document.

STR Strength.

THAC0 To Hit Armor Class 0.

TPK Total Party Kill.

TTRPG Tabletop Role-Playing Game.

VTT Virtual Tabletop.

WIS Wisdom.

WotC Wizards of the Coast.

XP Experience Points.

Glossary of Terms

Ability Score One of six numbers (Strength, Dexterity, Constitution, Intelligence, Wisdom, Charisma) that represent a character's physical and mental attributes.

AC (Armor Class) A number representing how difficult it is to hit a character in combat.

Advantage/Disadvantage A mechanic where a player rolls two d20s and takes the higher (advantage) or lower (disadvantage) result.

Alignment A character's ethical and moral perspective, such as Lawful Good or Chaotic Evil.

Arcane A type of magic derived from study, such as wizardry.

Backstory The history and background of a character before the campaign begins.

Bonus Action An additional action a character can take during their turn, often granted by class features or spells.

Cantrip A spell that can be cast at will without using a spell slot.

Chaotic Free-spirited and sometimes unpredictable. Can also be reckless or reactionary.

Charisma (CHR) Social skills and sometimes physical appearance.

Class The primary archetype of a character, such as Fighter, Wizard, or Rogue, which determines abilities and progression.

Combat A structured sequence where characters and enemies take turns performing actions like attacking or casting spells.

Concentration A mechanic where certain spells require ongoing focus, and taking damage can force a concentration check to maintain the spell.

Constitution (CON) Physical resilience. This affects hit points and some physical resistances.

d20 A 20-sided die, the primary die used in D&D for most rolls.

Damage Types One of the thirteen (13) categories of damage: acid, bludgeoning, cold, fire, force, lightning, necrotic, piercing, poison, psychic, radiant, slashing, and thunder.

Dexterity (DEX) Agility and accuracy. This affects ranged attacks and dodging.

Dungeon Master (DM) The person who runs the game, narrates the story, and controls the world and NPCs.

Encounter Any situation where players must overcome a challenge, such as combat, puzzles, or social interaction.

Equipment The gear and items a character carries, including weapons, armor, and adventuring tools.

Evil Wicked and often selfish or oppressive.

Experience Points (XP) Points gained from overcoming challenges, used to level up a character.

Familiar A magical creature that assists a spellcaster, often summoned by the spell *Find Familiar*.

Feat A special ability or skill a character can choose instead of an ability score increase at certain levels.

Flanking A tactical position where a character attacks an enemy from the opposite side of an ally, often granting a combat advantage (this rule is optional and varies by DM).

Good Having a respect for life, altruism, and selflessness.

Grapple A combat action where a character attempts to grab and restrain an opponent.

Group Check A mechanic where the success of the party depends on the number of successful rolls among the group.

Hit Points (HP) A measure of a character's health, reduced when taking damage.

Hit Dice (HD) Dice used to determine a character's hit points at each level and for healing during short rests.

Initiative A roll made at the start of combat to determine the order of turns..

Inspiration A DM-awarded bonus that allows a player to gain advantage on a roll.

Intelligence (INT) The ability to process problems and wield certain magic. INT affects the number of skill points received.

Ki A resource used by monks to perform special abilities.

Lawful Abides by a core morality or honor system. Can also be judgmental and close-minded.

Level A measure of a character's progression, determining access to new abilities, spells, and increased hit points.

Long Rest A period of downtime (usually 8 hours) where characters recover hit points and spell slots.

Melee Combat at close range, typically involving hand-to-hand or short-ranged weapons.

Metagaming Using out-of-game knowledge within the game, often discouraged as it can break immersion.

Multiclassing The practice of taking levels in more than one class, allowing a character to gain abilities from multiple classes.

Neutral A balance between Lawful & Chaotic or Good & Evil.

NPC (Non-Player Character) Characters controlled by the DM that players interact with, such as villagers, shopkeepers, or enemies.

Opportunity Attack A reaction that allows a character to make a melee attack against a creature that moves out of their reach.

Party The group of player characters (PCs) adventuring together.

Perception A skill representing a character's ability to notice hidden things, typically rolled as a Wisdom check.

Proficiency Bonus A bonus added to rolls where a character has proficiency, such as with certain skills, weapons, or saving throws.

Quiver A container for holding arrows or bolts, typically used by archers and ranged combatants.

Ranged Attack An attack made with a ranged weapon or spell, targeting an enemy at a distance.

Reaction An instant response to a trigger, such as casting *Counterspell* or making an opportunity attack.

Saving Throw A roll made to resist a spell, trap, or other effect.

Short Rest A brief period of downtime (usually 1 hour) where characters can spend Hit Dice to recover hit points.

Skill Check A roll made to determine the outcome of an action related to a skill, such as Stealth or Acrobatics.

Spell Slot A resource that determines how many spells a character can cast at each level.

Strength (STR) The character's physical strength. This effects the potency of melee attacks.

Turn A player's time to act during a round of combat, typically consisting of movement, an action, and possibly a bonus action or reaction.

Vision Types Various levels of sight in D&D, such as Darkvision, Blindsight, and Truesight.

Weapon Proficiency Determines which weapons a character can use effectively, adding their proficiency bonus to attack rolls.

Wisdom An ability score representing a player character's insight, perception, and willpower.

Wisdom (WIS) Common sense and spirituality.

XP (Experience Points) See Experience Points.

Chapter 1

Introduction

1.1 Background

As a graduate student from the University of Alberta, I am familiar with the challenging task of writing a thesis that adheres to the GPS Minimum Thesis Formatting Requirements. Using a traditional word processor to create a long document filled with equations and figures can be frustrating due to frequent crashes, file corruption, unpredictable formatting changes, and the inability to output a document in the required PDF/A format for submission to GPS.

To overcome these issues, many students turn to LaTeX as an alternative to conventional word processors.

LaTeX allows students and researchers to focus separately on the content and the formatting of their documents. Because the writing is independent of the formatting, documents can be written in lightweight text editors or LaTeX editors, which also facilitate the compilation of the documents. These editors can often save work after every keystroke, and due to the plaintext format, they are less prone to file corruption. Moreover, LaTeX ensures a consistent and professional appearance 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

Although there are existing templates for writing a thesis in LaTeX for the University of Alberta (see Table 1.1 for a list of available templates), none seem to provide all the necessary information for creating an outstanding thesis. Most templates apply "band-aid" solutions to existing classes, such as report or book, offering a customized title page and methods for including prefatory pages. However, these templates often fall short by not providing tips and best practices on how to include the various sections and parts that make up a thesis. They also fail to offer a solid foundation for those who are new to LaTeX. Many of these templates involve extensive patching and fixing, resulting in a large *preamble* section at the beginning of the template that can be confusing to new LaTeX users and add to the already steep learning curve.

Developer	Last Updated	Link to Template Source
Shivam Garg	May 29, 2023	https://github.com/svmgrg/ualberta_thesis_template
Henry Brausen	Feb 11, 2022	https://github.com/henrybrausen/thesis_template
Bernard Llanos	Oct 05, 2019	https://drive.google.com/file/d/1wKS8fu5e6qiVDRt0VUzEtlW8p7uMyz1T/view?usp=sharing
John Bowman	Sep 30, 2019	https://github.com/vectorgraphics/uofathesis
Hongtao Yang & Benjamin Bernard	Sep 28, 2017	https://github.com/adrs0049/ThesisTemplate
GAME & Hongtao Yang	Feb 03, 2016	https://www.ualberta.ca/computing-science/media-library/grad/candidacy-template-tex.tex
Steven Taschuk	Mar 21, 2012	https://github.com/stebulus/ualberta-math-stat-templates/tree/master/thesis
CMENG	Jul 19, 1999	https://sites.ualberta.ca/CMENG/research/new-control/stythes.html

Table 1.1: List of Other Available Templates.

This template, document class, and guide aim to address these shortcomings by providing all the necessary information to create a well-structured thesis, along with examples to assist in formatting your thesis written in LaTeX. To ensure the robustness and ease of maintenance, I developed the class file from the ground up keeping the additional required packages to a minimum. This makes this LaTeX solution easier to maintain, update, and customize to suit different needs from different areas of the University of Alberta. A key goal with this was to reduce the traditionally steep learning curve associated with LaTeX to ensure that anyone could create an outstanding thesis.

While the class file (`ualberta.cls`) deserves its own comprehensive documentation, this document will focus on more specifically on the template file (`ualberta.tex`), as well as the following points:

- Installation and basic usage of LaTeX.

- Document structure and formatting.

- Inclusion of figures and tables.

- Inclusion of plots and graphs.

- Handling mathematical equations.

- Citations and references using BibTeX.

- Use of JabRef—Reference Manager.

- Inclusion of Code and PDF's.

- And more.

This guide does not cover advanced LaTeX programming or extensive customization of document classes. Instead, the class file `ualberta.cls` provides all the major

document and formatting requirements as provided by GPS, while this document offers references on how to include the various elements that might be required in a thesis. This includes all of the explanations of the packages and macros needed to perform the examples.

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, Tables, & Plates

- **Chapter 5:** Plots, Charts, & Graphs

- **Chapter 6:** Mathematical Equations

- **Chapter 7:** Citations, References, and Cross-References

- **Chapter 9:** JabRef: Managing Bibliographies Efficiently

Each chapter provides detailed information, examples, and recommendations to help you navigate the thesis writing process within the LaTeX ecosystem.

1.5 Summary

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

you will develop an understanding of how to create a thesis and manipulate content within the LaTeX ecosystem to produce an exceptional document.

Chapter 2

Getting Started with LaTeX

2.1 Installation

To begin using LaTeX, you need to install a LaTeX distribution on your computer. Here there are two main distributors: TeX Live, a free software distribution for the TeX typesetting system which is provided by the TeX User Group (TUG); or MiKTeX, a free and open-source distribution of the TeX/LaTeX typesetting system developed by Christian Schenk. Here are the links for installing LaTeX on different platforms:

2.1.1 Windows

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

2.1.2 Mac

On Mac, you can use MacTeX (Mac version of TeX Live) 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. For a test of the system, open the included program TeXWorks. Once it is open, copy the code below and press the typeset button (green play button). When the document has compiled you will get a preview of the document in a new window. Congratulations, you have compiled a new LATEX document.

```latex
\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 is a predefined command that generates the title information. The Hello, \LaTeX{}! generate the text: Hello LATEX! And the \begin{document} & \end{document} mark the beginning and end of the document's content.

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 the suggested reference managers to help keep track of all your references, and to keep track of the information you found within your references. Further, most of these reference managers provide an option to integrate as a word Add-In or allow the export of the bibliography in a word compatible file.*

Second of these is a different LATEX editor. While all of the distributions above come with TeXWorks (a simple editor that allows for compilation) you might find it more beneficial to have some additional features. For this I recommend one of the following:

- TeXstudio

- Texmaker

- TeXnicCenter

- ~~Overleaf~~[1]

I am sure there are others, but any of these will do you fine for writing your thesis.

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[1]Due to changes with Overleaf, I recommend it less and less. While it is convenient as it is web based, they have restricted it more and more which forces the users to now pay more for the software... including to get longer compile times. While this is not an issue for short articles, in longer documents, such as a thesis, this can be a large hindrance and cost ($100 CAD/year with student discount).

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 paragraphs; as well as the content, figures, tables, and other content you would like to include. In the rest of this Chapter, we will look more specifically on the inclusion of the prefatory pages and how to structure your document with the various chapter, section, and paragraph commands.

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 is more information that is re-

quired, as well as 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. GPS even provides a few different documents that attempt to provide the necessary information to create these pages[1]. To aid you in the creation of these pages I have created a few new pairs of macros (one sets the text for the section, the other one generates the page with the text):

Note: *I chose to separate the two macros to better compartmentalize the thesis (each prefatory page has its own file), as well as allow an easy way to include and exclude each of the prefatory pages via commenting*

- Abstract

    - `\abstracttext{Abstract Text Goes Here!}`

    - `\makeabstract`

- Preface

    - `\preface{Preface Text goes here.}`

    - `\makepreface`

- Quote

    - `\thesisquote{Quote Text goes here.}`

    - `\makequote`

- Dedication

    - `\dedication{Dedication Text goes here}`

    - `\makededication`

- Acknowledgement

    - `\acknowledgementtext{Acknowledgement Text goes here.}`

    - `\acknowledgements`

3.1.1   Title Page

The thesis Title Page has a few more fields to be filled in than a regular LaTeX docu-
ment. These include \degree, \specialization, \deptfac, 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 **fairly** case insensitive) *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{\insertlatexfile{selectDegree}}  % Uncomment Degree in file
  \specialization{}                        % Leave blank if none
  \deptfac{\insertlatexfile{selectDepartment}} % Uncomment Department in file
  \convocationdate{\the\year}              % Convocation Year
```

NOTICE This class, though it is designed to be used with at University of Alberta, it is not exclusive to the University of Alberta. To customize this to your specific institution, use the command \university{YOUR INSTITUTION NAME} before the \maketitle command. Note: this template still might not match your institution's guidelines on formatting a thesis.

3.1.2 Abstract

This is probably one of the simplest sections that need to be created for you thesis. Mainly because the content that can be included is so restrictive. Further, the limit on the word count makes this section quite short.

⚠ WARNING **Just because of the above does not mean this section won't be difficult to write. It will be. But the best piece of advice I can offer is write this section last. In fact, just to prove a point, I will add an appendix to this document that will go over the actual writing of this section.**

3.1.3 Preface

The following Sections will provide you with examples of how to include specific elements into your preface. The examples in the following sections have been modified from Faculty of Graduate & Postdoctoral Studies. "Appendix for thesis formatting guidelines," University of Alberta. (Jun. 2024), [Online]. Available: https://www.ual berta.ca/graduate-studies/media-library/current-students/appendix-for-thesis-form

atting-guidelines.pdf. Due to the "Appendix for Thesis Formatting Guidelines" being generated using ChatGPT3.5 there are some inconsistencies within the document and the examples provided; while these are fine for providing a general idea of what to include, this goes against the ideology of this document. To combat this I have taken the liberty of adapting the examples to better blend into the style of this document and to increase the consistency, replacing some the generated examples with real examples where possible.

Full credit still goes to the University of Alberta's Faculty of Graduate and Post-doctoral Studies for openly providing the document and I would strongly suggest anyone writing their thesis at the University of Alberta to read the updated documentation that they have put out this year (2024). This new documentation provides much more guidance than the previous iteration: Faculty of Graduate Studies & Research. "Fgsr minimum thesis formatting requirements," University of Alberta. (Mar. 2016), [Online]. Available: https://www.ualberta.ca/graduate-studies/current-students/academic-requirements/thesis-requirement-and-preparation/index.html.

Before diving right into the examples in Sections 3.1.3.1 to 3.1.3.6, we will explore some of the still applicable guidelines for including your preface. First of which is a small change: since the FGSR became the GPS, the requirement of a preface has become **mandatory** regardless of the contents of the thesis.

When 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. 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[1], indication must

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[1]Permission may be needed if the co-authors hold the copyright in these publications.

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. 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.

⚠ WARNING **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.**

⚠ CAUTION 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.

NOTICE 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.

Note: *Before preceding I would like to emphasize that the following examples are are not a one-and-done, you might need to combine elements from multiple of the following sections to build an appropriate preface for your thesis.*

❶ If **none** of the following apply **make sure** to include a preface in the style of the one shown in Section 3.1.3.6.

💡 Fun fact before you read on, Professor C. Ayranci who was mentioned in a few of the examples provided by "Appendix for Thesis Formatting Guidelines" was in-fact the supervisor for my Master's thesis.

3.1.3.1 Research Ethics Approval

If your thesis required you to get Research Ethics Approval, then you should include a preface based on the one here.

"This thesis is an original work by Daniel R. Aldrich. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board 3, Project Name "Etymolo-

gies and Entomologies: Unraveling the Threads of Language and Ecology", No. 12345, February 23, 1993."

3.1.3.2 Collaborative Work

If your thesis required you to work collaboratively with other, organizations, researchers or otherwise, then you should include a preface based on the one here.

> "Some of the research conducted for this thesis forms part of an international research collaboration, led by Professor T. Raivio at the University of Hogwarts, with Professor S. Agrawal being the lead collaborator at the University of Alberta. The technical apparatus referred to in Chapter 3 was designed by myself, with the assistance of Professor A. Shiri and Professor C. Ayranci. The data analysis in Chapter 4 and concluding analysis in Chapter 5 are my own work, as well as the literature review in Chapter 2."

3.1.3.3 Previously Published Material

If your thesis is based on or includes work previously published by yourself, or work you co-authored, then you should include a preface based on the one here.

> "Chapter 2 of this thesis has been published as D. R. Aldrich *et al.*, 'Osmclassic: An optical imaging technique for accurately determining strain,' *SoftwareX*, vol. 6, pp. 225–230, 2017. DOI: 10.1016/J.SOFTX.2017.08.007. I was responsible for the programming, data collection, and analysis as well as the manuscript composition. C. Ayranci assisted with the data collection by providing access to the Multipurpose Composites Group's Lab and Equipment, and contributed to manuscript edits. D. Nobes was

the supervisory and corresponding author and was involved with concept formation and manuscript composition."

3.1.3.4   Use of Artificial Intelligence (AI)

If your thesis used AI to help you outline, or otherwise write sections of including help with analyzing, summarizing, *etc.*, then you should include a preface based on the one here.

"The generative artificial intelligence application or Large Language Model ChatGPT 3.5 was used for data analysis, summarization, synthesis, and simulation in Chapter 3 of this thesis, as well as to generate a preliminary draft of the literature review in Chapter 1."

3.1.3.5   Receiving of Competitive Funding

If you received competitive funding used for your thesis, education, or research then you should include a preface based on the one here.

"This work was supported by a Doctoral Fellowship from the Social Sciences and Humanities Research Council, a grant from the Entomological Association of Edmonton, and the National Scholarship Council of Narnia."

3.1.3.6   Previous Prefaces Did Not Apply

If your thesis did not fall into any of the categories shown previously, then you should include a preface based on the one here.

Note: *This was previously an **Optional** inclusion in your thesis, however, since the FGSR transitioned to the GPSand have released new guidelines for formatting your thesis, this has now become **mandatory**.*

"This thesis is an original work by YOUR FULL NAME. No part of this thesis has been previously published."

3.1.4   Dedication or Quotations

Dedications or Quotations are limited to maximum of one page.

In the template provided you may fill in the appropriate Quote and Dedication fields in the document `01_Prefatory/Quotes_Dedications.tex`. These can be filled out if you plan to include them or not. To control whether they show up in the document you will want to un-comment **ONLY ONE** of the following commands in the `ualberta.tex` file.

Listing 3.2: Quote and Dedication Inclusion Options (un-comment only one)

```
%\makequote                  % Creates the Quote Page
%\makededication             % Creates the Dedication Page
%\makededicationandquote     % Creates the Quote/Dedication Page
```

3.1.5   Acknowledgements

The Acknowledgements is a strongly recommended, but not a strictly mandatory section of the thesis. For a thesis at the University of Alberta, an Acknowledgement page must be no more than two (2) pages in length, and **must** be double-spaced.

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. Additional, you can recognize any help or support that you have received from family, friends, classmates, lab-mates, or any other individual that was able to help you in any way. A clear example of this would be the inclusion of the following, assuming that his template, class, or guide helped you in any significant way[2]:

---

[2]Please be aware that it is not necessary to include this statement in any way, shape, or form it is only provided as an example on how to include these type of statement; this template/guide

"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 has 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 in formatting their theses."

3.1.6   Table of Contents

Include chapter headings and 2–4 levels of subheadings. This template will automatically include all required chapters including the correct ones from the prefatory pages. However, due to stylistic considerations you may want more or less levels included the in the Table of Contents. To accomplish this I have created the command near the top of the `ualberta.tex` file that allows you to set both the depth of the Numbered Headings and the level of depth for the Table of Contents. To do this change the number shown in Listing 3.3 to 2, 3, or 4.

Listing 3.3: Set Numbered Heading and ToC Level

```
% Option to change the Level of subheading included in the Table of Contents
%  This should be set at 2, 3, or 4 (As per \Fac)
  \settoclevel{3}
```

💡 For the `\settoclevel{n}` command, setting `n` to `2` will included everything down to `subsection`, `3` will include everything down to `subsubsection`, and `4` will include everything down to `paragraph` in the Table of Contents.

3.1.7   Lists of Figures, Tables, ...

Include a separate list, beginning on a new page, for each kind of non-textual item appearing in the body of the thesis (one list for tables, another for illustrations, etc.). Lists can be in any order. These are included with the following set of commands:

---

is provided in good faith with the **only** expectation being that you **will** share it with your fellow colleagues, supervisor, and or anyone else that may benefit from this.

- `\listoffigures`

- `\listoftables`

- `\listofplates`

Note: *None of these commands need to be commented out, they can stay uncommented, and as long as LaTeX is run at minimum twice (as is required for BiBTeX, and any reference updates) they will update themselves to be included or excluded automatically.*

3.2 Nomenclature, Glossary, & Acronyms

3.2.1 Lists of Symbols/Abbreviations

3.2.2 Glossary of Terms

3.3 Chapters, Sections, Subsections, *etc.*

Organize your document hierarchically using chapters, sections, subsections, *etc.* 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, *etc.*, 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.

3.4 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. While there are many types of figures that one might have in their document, this Chapter more specifically focuses on the inclusion of graphic figures (pictures), as well as how to lay out multi figures (sub-figures).

⚠ WARNING **Throughout this Chapter there will be code listings that include lines that show the required packages. These lines should be included in your LaTeX preamble, not in the body of your document. To make this easy I have actually included a document specifically to add your packages too. This can be found in the includePackages.tex file found in the 00_LaTeX_Files folder.**

💡 `./00_LaTeX_Files/includePackages.tex` includes all the packages required for creating all the examples in this document, some of these will not be necessary for your own thesis, however, I have included comments on all packages for what they are used for. This allows you to make a decision on if you will need them as well. If you are unsure, you may just comment out the line so as to not forget the packages that were originally included.

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=0.7\linewidth]{example-image}
    \caption{Example Figure}
    \label{fig:example}
\end{figure}
```
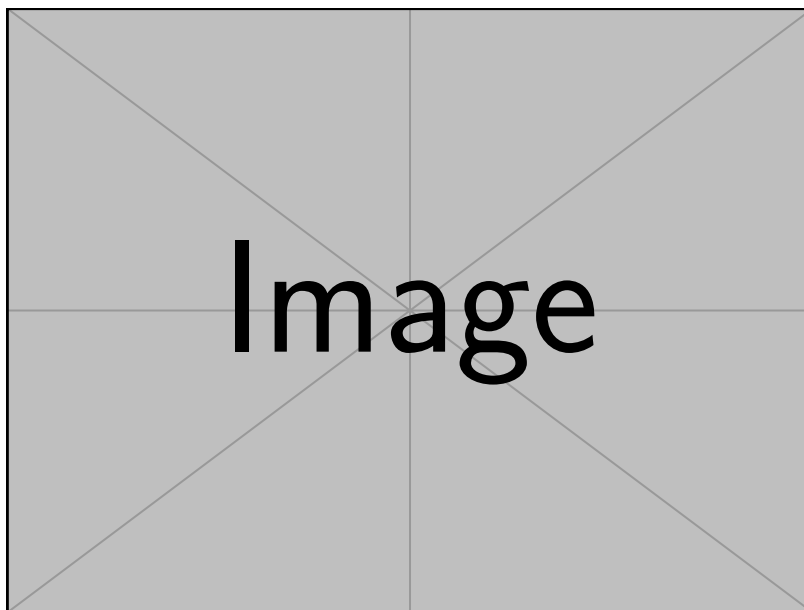

Figure 4.1: This is an example of a single figure similar to that produced by Listing 4.1.

In this example, the `figure` environment is used to contain the image. The `\centering` command ensures the image is centred horizontally. The `width` parameter is used to control the size of the image; in this case, it has been set to `0.45\cmd {linewidth}` which will make it fill a space that is 0.45 tiems the width of

the current line. 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}{0.45\linewidth}
        \centering
        \includegraphics[width=\linewidth]{example-image-a}
        \caption{Subfigure A} % Leave blank for just letter
        \label{subfig:a}
    \end{subfigure}
    \hfill
    \begin{subfigure}{0.45\linewidth}
        \centering
        \includegraphics[width=\linewidth]{example-image-b}
        \caption{Subfigure B} % Leave blank for just letter
        \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 (as show in Figure 4.2. The \hfill command adds horizontal space between
the subfigures.
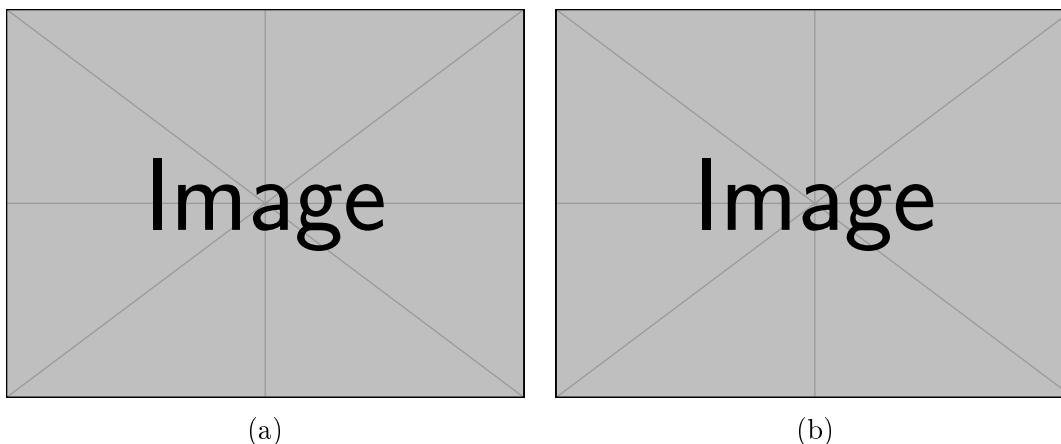
Figure 4.2: This is an example of a double image figure similar to that produced by Section 4.2.

While this section provided a few examples on how to make some figures and sub-figures, I would strongly recommend checking out some of the more complex examples of figures shown in Appendix A. This will provide the code and examples for how to create more intricate subfigures and layouts.

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:

```
\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:

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.

```
\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:

```
\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}
```

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 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 foundation to include tables and figures in your thesis. While this provides a lot of details on how to add figures that have already been pre-generated, one might want to generate figures on the spot potentially even using data generated from other programs (such as MatLab®, Python, *etc*.). For this Chapter 5 provides in-depth workings of the `pgfplots` package and how to generate consistent and professional looking plots and graphs.

```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}
```

References

[1] Faculty of Graduate & Postdoctoral Studies. "Appendix for thesis formatting guidelines," University of Alberta. (Jun. 2024), [Online]. Available: https://www.ualberta.ca/graduate-studies/media-library/current-students/appendix-for-thesis-formatting-guidelines.pdf.

[2] Faculty of Graduate Studies & Research. "Fgsr minimum thesis formatting requirements," University of Alberta. (Mar. 2016), [Online]. Available: https://www.ualberta.ca/graduate-studies/current-students/academic-requirements/thesis-requirement-and-preparation/index.html.

[3] D. R. Aldrich, C. Ayranci, and D. S. Nobes, "Osm-classic: An optical imaging technique for accurately determining strain," *SoftwareX*, vol. 6, pp. 225–230, 2017. DOI: 10.1016/J.SOFTX.2017.08.007.

Chapter 5

Plots, Charts, & Graphs

Throughout this chapter we will be exploring some of the different ways of displaying your data in your thesis. Mainly this will be accomplished with the `pgfplots` package. In the following sections, there will be a few examples of how to generate different plots. For more information on how to create plots, here is the manual for `pgfplots`(the package used to generate the information for TikZ to create the plots). For an extensive list of examples please refer to this

5.1   Line Plots

A simple line plot can be effectively created using the `axis` environment from the `pgfplots` package in LATEX. The `pgfplots` package is a powerful tool for creating high-quality plots directly within LATEX documents. It builds upon the `TikZ` package and provides a comprehensive set of options for plotting and customizing graphs.

The following code (see Figure 5.1a) can be used to create the figure shown in Figure 5.1b. Expanding on this example, we can add a second plot by adding the following code below the closing bracket and semi-colon (`}`;) of the `\addplot` command: This will result in the addition of the second red line shown in Figure 5.2.

```latex
\begin{figure}[htbp]
    \centering
    \begin{tikzpicture}
        \begin{axis}[
            title={Simple Line Plot},
            xlabel={X-axis},
            ylabel={Y-axis},
        ]
            \addplot coordinates {
                (0,0)
                (1,1)
                (2,4)
                (3,9)
                (4,16)
            };
        \end{axis}
    \end{tikzpicture}
    \caption{A simple line plot.}
    \label{fig:line-plot}
\end{figure}
```

(a)
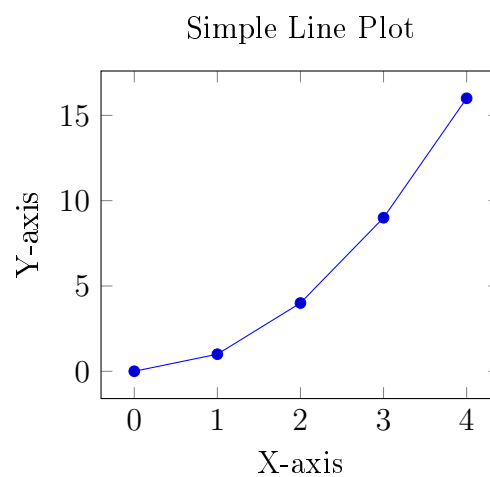
(b)

Figure 5.1: A simple line plot (b) and the code to generate the plot (a)

```latex
\begin{tikzpicture}
    \begin{axis}[
        title={Dual Line Plot},
        xlabel={X-axis},
        ylabel={Y-axis},
    ]
        \addplot coordinates {
            (0,0)
            (1,1)
            (2,4)
            (3,9)
            (4,16)
        };
        \addplot coordinates {
            (0,16)
            (1,9)
            (2,4)
            (3,1)
            (4,0)
        };
    \end{axis}
\end{tikzpicture}
```

(a)
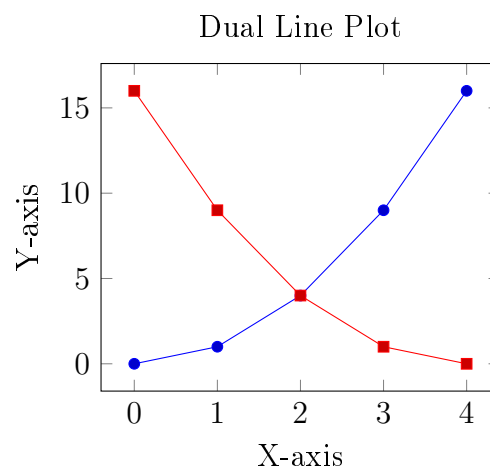
(b)

Figure 5.2: A simple line plot with two sets of data.

```
\addplot coordinates {
    (0,16)
    (1,9)
    (2,4)
    (3,1)
    (4,0)
};
```

5.2 Customizing Plots

This section provides some ways to increase the readability and customization of the plots we generate.

5.2.1 Adding a Legend

Legends can be added to plots for better readability. To add a legend to your plot you can use the code in Section 5.2.1 to generate the plot shown in Figure 5.3. Each plot is individually added to the legend by adding a `\addlegendentry{YOUR LEGEND ENTRY HERE}` command following the `\addplot` command.

Note: *The position of the legend can be specified by using the optional parameter*
         `legend pos=`
followed by a set of compass coordinates.

```
\begin{figure}[H]
    \centering
    \begin{tikzpicture}
        \begin{axis}[
            title={Plot with Added Legend},
            xlabel={X-axis},
            ylabel={Y-axis},
            legend pos=north west,
        ]
```

```
            \addplot coordinates {
                 (0,0)
                 (1,1)
                 (2,4)
                 (3,9)
                 (4,16)
            };
            \addlegendentry{\(y = x^2\)}
            \addplot coordinates {
                 (0,16)
                 (1,9)
                 (2,4)
                 (3,1)
                 (4,0)
            };
            \addlegendentry{\(y = 16 - x^2\)}
        \end{axis}
    \end{tikzpicture}
    \caption{A customized plot with a legend.}
    \label{fig:legend-plot}
\end{figure}
```

Plot with Added Legend
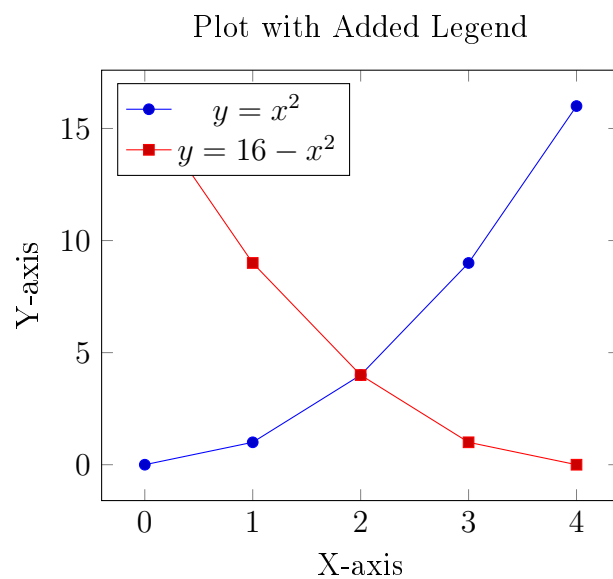
Figure 5.3: A customized plot with a legend.

5.2.2   Adding Grid Lines

To add gridlines to your plot

Plot with Added Gridlines
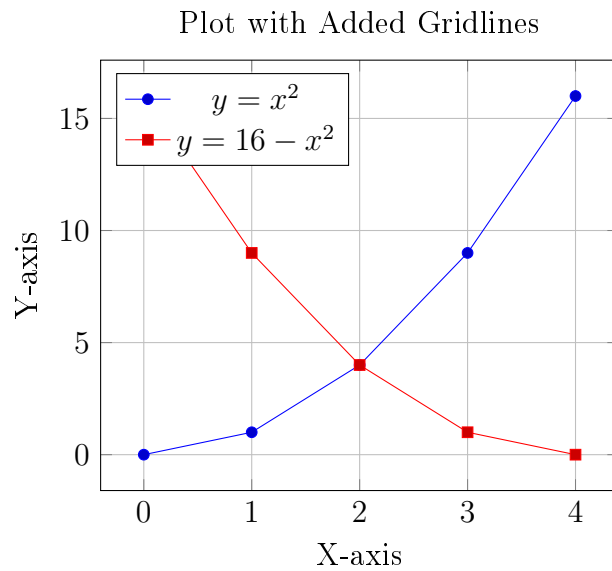
Figure 5.4: A customized plot with added gridlines.

5.2.3   Changing Colors and Line Styles

Colors and line styles can be easily modified:

Colored and Styled Plot
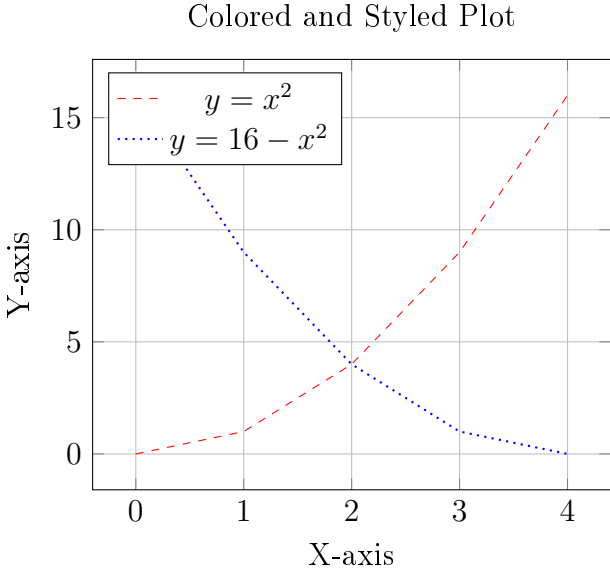
Figure 5.5: A plot with customized colors and line styles

5.3   Advanced Plot Types

5.3.1   Equations
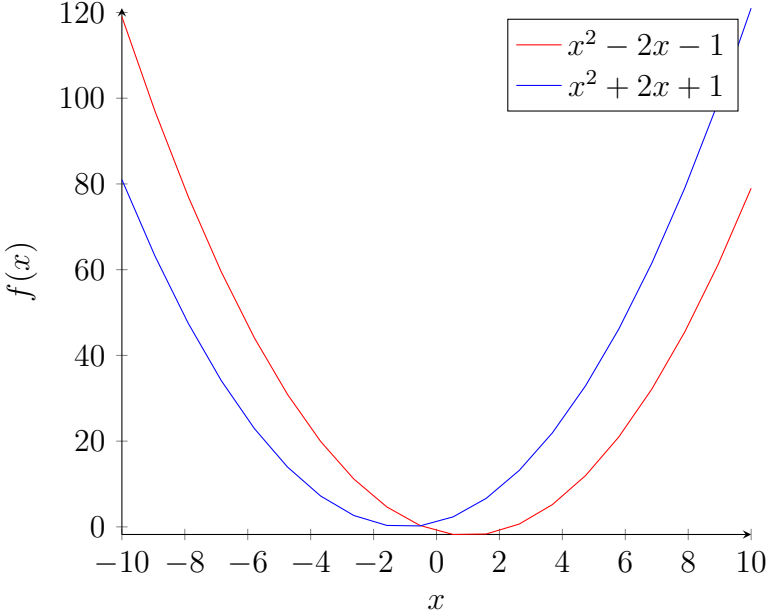
Figure 5.6: Plot of two parabola.

5.3.2   Scatter Plot with External Data
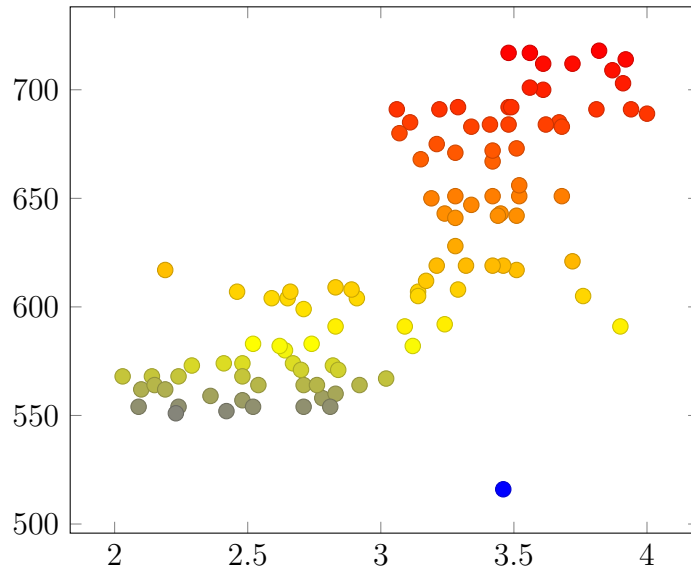
Figure 5.7: Example of a Scatter Plot.

5.3.3   Bar Plot

Bar plots are useful for categorical data. Here's how to create one:
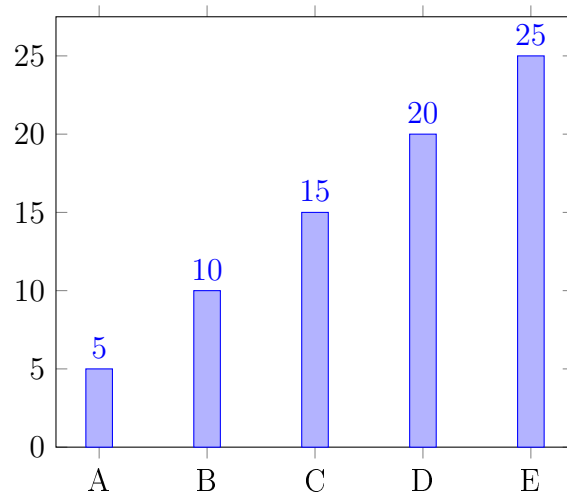
Figure 5.8: A bar plot
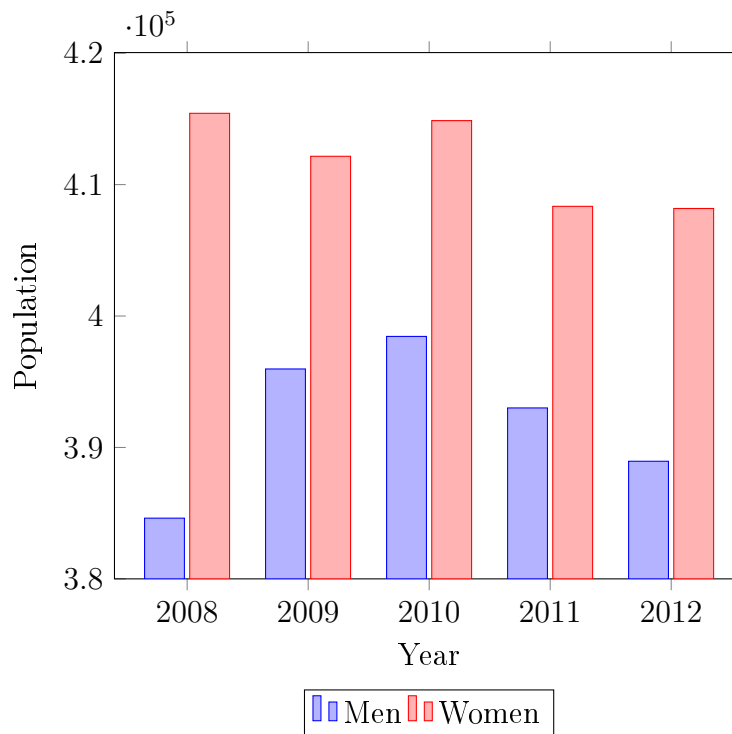
Figure 5.9: Example of a Bar Graph.

5.3.4 Pie Chart

Pie charts are less common in LaTeX, as well as, a lot of other media due to the pour representation of the data. However, if you are still inclined to use them the remainder of this section will show how the package `pgf-pie` can be used to create consistent graphs that look good.
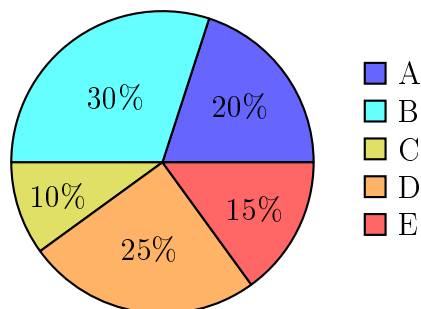
Figure 5.10: A basic pie chart.
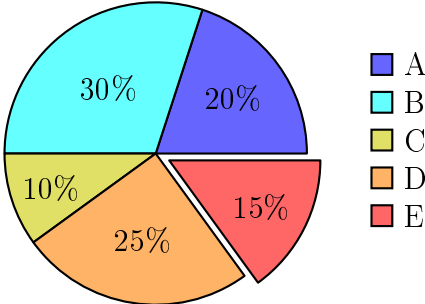
Figure 5.11: A pie chart with an "Exploded" slice.
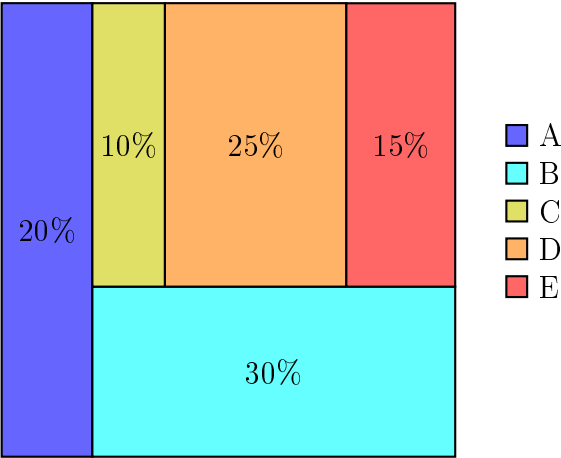
Figure 5.12: A "square" pie chart.

5.3.5   3D Plot

3D plots can be created for more complex data visualization:
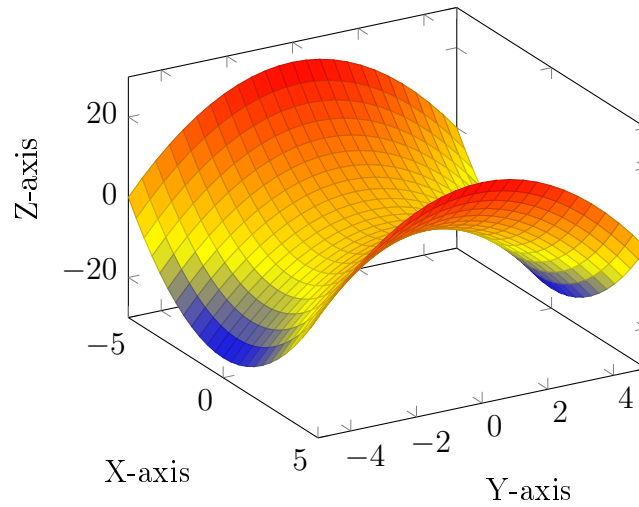
Figure 5.13: A 3D surface plot

Example using the mesh parameter
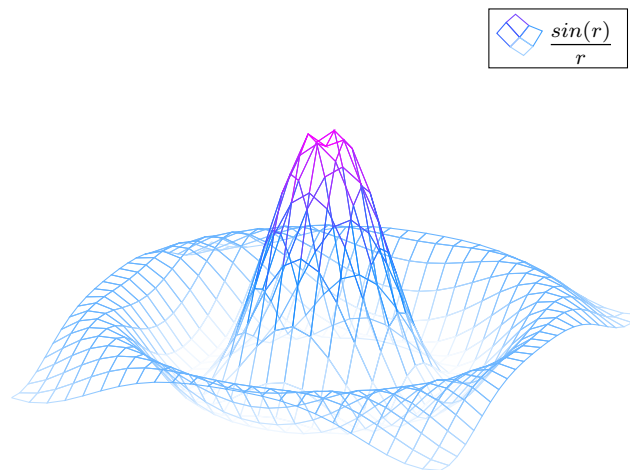
Figure 5.14: Example of a 3D Plot

5.3.6   Polar Plot

Polar plots are useful for circular data:
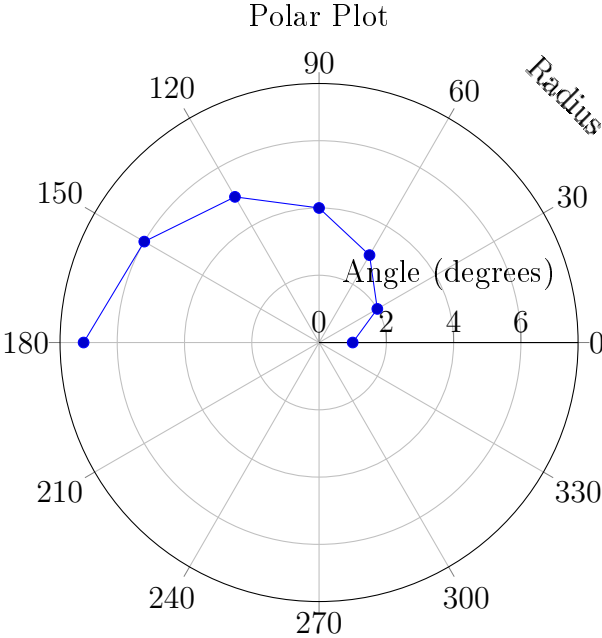
Figure 5.15: A polar plot

5.3.7 Box Plot

Box plots are used to visualize the distribution of data:
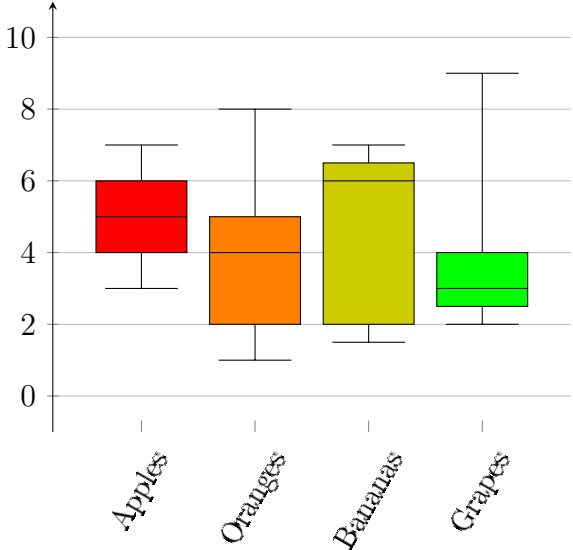
Figure 5.16: A box plot

5.4   Conclusion

The `pgfplots` package is an incredibly versatile tool for creating a wide range of plots and graphs in LATEX. This chapter has provided examples of various plot types and customization options, showcasing the power and flexibility of `pgfplots`. By leveraging these capabilities, you can create high-quality, publication-ready figures for your thesis.

Chapter 6

Mathematical 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 `\(` and `\)` 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 inline 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 main ways of creating the reference, the first one, see Equation (6.1), creates a numbered reference; the other one, see Equation (Constant pi), creates a reference with a 'tag'. The difference between the two is the inclusion of a `\tag{<text>}` command that will replace the regular number with `<text>` and the changing from the `equation` environment to the `equation*` environment. If you do not want the brackets around the tag, as shown in Equation (Constant pi), use the starred version of the command: `\tag*{<text>}`. This will not remove the braces in the reference for the equation, but will remove them from appearing next to the equation definition.

NOTICE   Using the `\tag` command in conjunction with the `\label` command can create a LaTeX warning when used in the non-star `equation` environment. This warning can be safely ignored, however, the better way to deal with this is to make sure one is using the star version, `equation*`.

$$\pi = 3.14... \tag{6.1}$$

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

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

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 (6.2) to (6.4). Note that it is the & symbol that determines what will be aligned. Further note that spaces in "math mode" are ignored and need to be specified using the space commands in

$$Equation1 = 1 \tag{6.2}$$

$$Equation2 = 2 + 2 \tag{6.3}$$

$$Equation3 = 3 + 3 + 3 \tag{6.4}$$

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.

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

$$f(x) = \begin{cases} x^{2*\ln x}, & \text{if } x < 3 \\ -\frac{x}{2}, & \text{if } 3 \le x \le 4 \\ x, & \text{if } 4 < x \end{cases} \tag{6.5}$$

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

$$x \in \{1, 2, 3, 4, 5, 6, 7\} \tag{6.6}$$

$$V_1 = \begin{pmatrix} a, & b, & c, & d \end{pmatrix} \tag{6.7}$$

$$V_2 = \begin{pmatrix} a \\ b \\ c \\ d \end{pmatrix} \tag{6.8}$$

$$M = \begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{bmatrix} \tag{6.9}$$

$$p(x) = 3x^6 + 14x^5 y + 590x^4 y^2 + 19x^3 y^3$$

$$- 12x^2 y^4 - 12xy^5 + 2y^6 - a^3 b^3$$

$$ralign = lalign \tag{6.10}$$

$$ralign = lalign \tag{6.11}$$

$$x = y \qquad\qquad w = z \qquad\qquad a = b + c$$

$$2x = -y \qquad\qquad 3w = \frac{1}{2}z \qquad\qquad a = b$$

$$-4 + 5x = 2 + y \qquad\qquad w + 2 = -1 + w \qquad\qquad ab = cb$$

m	Modulo	$m > 0$
a	Multiplier	$0 < a < m$
c	Constant	$0 \leq c < m$
x_0	Initial Value	$0 \leq x_0 < m$

m	Modulo	$m > 0$
a	Multiplier	$0 < a < m$
c	Constant	$0 \leq c < m$
x_0	Initial Value	$0 \leq x_0 < m$

$$eqn1 = fdsjalk \tag{6.12}$$

$$eqn2 = fdsa * 243 \tag{6.13}$$

$$eqn$$

$$= eqn \tag{6.14}$$

6.2   Functions

\sin	sin	\cos	cos	\tan	tan
\arcsin	arcsin	\arccos	arccos	\arctan	arctan
\sec	cos	\csc	csc	\cot	cot
\sinh	sinh	\cosh	cosh	\tanh	tanh
\ln	ln	\log	log	\exp	exp

6.3

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

Chapter 7

Citations, References, and Cross-References

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` command.

7.1   Cross-References

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

`\chapter{Citations/References, and Cross-References}\label{ch:citref}`

By using `\ref{ch:citref}|`, this allows you to insert a cross-reference that look like this 7. Now this by itself is not the most useful, to make it a bit better we should keep track of what we are cross-referencing, in this case a **Chapter**, and add this label in front of the cross-reference (`Chapter~\ref{sec:citref}`) and this will display like this: Chapter 7.

Note: *To ensure the reference is not split we need add a non-breaking space ($\sim$) to prevent LaTeX from accidentally adding a line-break between the label we added and the actual cross-reference.*

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 loaded we can now use the commands listed in Table 7.1.[1]

---

[1]Note that because 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 7.1: Built-in, hyperref, and cleveref commands and outputs

Command	Output
built-in	
`\ref{}`	7.1
`\pageref{}`	49
hyperref	
`\autoref{}`	Table 7.1
cleveref	
`\cref{}`	table 7.1
`\Cref{}`	Table 7.1
`\cref*{}`	table 7.1
`\Cref*{}`	Table 7.1
`\cpageref{}`	page 49
`\Cpageref{}`	Page 49
`\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:
    tripleImage1,fig:quadImage}
```

Noting that there are **NO** spaces between the labels; this will produce: Figures 4.1, 4.2, A.2 and A.4. 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.

7.2 Citations/References

7.3 Citation Managers

7.3.1 JabRef

Information on the use of this has been moved to it's own Chapter

7.4 This is old Material

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.

7.4.1 Cross-References

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

> `\subsection{Cross-References}\label{subsec:cross-reference}`

By using `\ref{subsec:cross-reference}`, this allows you to insert a reference that look like this: 7.4.1. 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{subsec:cross-reference}`) and this will display like this: Section 7.4.1. Note to ensure the reference is not split we add a non-breaking space (`~`) to prevent LaTeX from adding a line break.

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 7.1.[2]

Table 7.2: Built-in, hyperref, and cleveref commands and outputs

Command	Output
built-in	
\ref{}	7.2
\pageref{}	51
hyperref	
\autoref{}	Table 7.2
cleveref	
\cref{}	table 7.2
\Cref{}	Table 7.2
\cref*{}	table 7.2
\Cref*{}	Table 7.2
\cpageref{}	page 51
\Cpageref{}	Page 51
\namecref{}	table
\nameCref{}	Table

[2]Note that because 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.

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

$$\textcolor{blue}{\texttt{\textbackslash Cref}}\texttt{\{fig:doubleImage,fig:singleImage,fig:}$$
$$\texttt{tripleImage1,fig:quadImage\}}$$

Noting that there are **NO** spaces between the labels; this will produce: Figures 4.1, 4.2, A.2 and A.4. 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 document.

7.4.2   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 7.3, and more information of the use of JabRef can be found in Chapter 9. Single citations can be included with the

Table 7.3: Comparison of Reference Softwares

Software	Developer	Version	Cost	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[4]. 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[5–9]. Finally this sentence shows how a gap in the citations is handled, this is created with the `\cite{testone,cite2,cite3,cite5}` command[5–7, 9].

Chapter 8

Submitting Your Thesis

So you have seemingly gotten to the end of the writing, and you may be already taking the steps to set up your last review with your supervisor, set up your thesis defence, or even submit your thesis to GPS... but now what do you do?

Quick answer is a lot, long answer will be discussed throughout this Chapter.

There are a number of steps that you will want to take to make sure that you are submitting the best version of your work. This includes checking for some of the more obvious and less obvious pitfalls that writing a Thesis in LaTeX or really any software poses.

References

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

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

[6]   A. two, "Article 2," *Journal 2*, 1900.

[7]   A. three, "Article 3," *Journal 3*, 1990.

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

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

Chapter 9

JabRef: Managing Bibliographies Efficiently

9.1 Introduction

JabRef stands as a powerful tool for researchers and academics engaged in scholarly writing. JabRef offers a robust solution for bibliography management, including a number of features to ensure that you are not only able to organize your references but keep track of progress, and notes on each reference. This chapter aims to provide an review of JabRef, including its myriad features that I find particularly useful, and to guide you through its implementation in writing your thesis.

9.2 Key Features of JabRef

JabRef, with its versatile features, emerges as an indispensable tool for bibliography/reference management. Delving deeper into its functionalities reveals a wealth of tools designed to streamline the often cumbersome process of handling references.

9.2.1 BibTeX Compatibility

JabRef's commitment to the BibTeX format is a testament to its roots in the LaTeX ecosystem. This compatibility ensures a seamless integration between the reference

management process and the LATEX document preparation workflow. Users can easily export and import BibTeX files, facilitating collaboration and compatibility across various platforms.

9.2.2   Reference Import

The capability to import references directly from online databases and journal websites significantly accelerates the reference collection process. JabRef supports various import formats, allowing users to effortlessly populate their databases with accurate and structured reference information. This feature is particularly valuable for researchers dealing with large/extensive bibliographies.

9.2.3   Customizable Entry Types

The flexibility offered by customizable entry types allows users to categorize references based on the nature of the source. Whether it's a book, article, conference proceeding, or any other reference type, JabRef accommodates diverse sources, ensuring a well-organized and easily navigable bibliography.

9.2.4   Search and Filter

The ability to efficiently search and filter references is a hallmark of JabRef's usability. Researchers dealing with extensive databases will appreciate the quick and precise retrieval of references based on author names, titles, keywords, or any other criteria. This feature is crucial for maintaining order in a rapidly growing bibliography.

9.2.5   Grouping

JabRef's grouping functionality provides a systematic approach to organizing references. Users can create custom groups to categorize references based on themes, projects, or any other criteria. This feature is especially useful for large research

projects where a systematic organization of references is essential for maintaining clarity and coherence.

9.2.6 Integration with LaTeX

The seamless integration of JabRef with LaTeX editors fortifies the synergy between bibliography management and document preparation. This integration minimizes the manual effort required for citation insertion and ensures consistency between the bibliography and the in-text citations. Users can easily copy citation keys from JabRef and paste them directly into their LaTeX documents.

9.3 Getting Started with JabRef

Now that we've outlined the key features of JabRef, let's embark on a comprehensive guide on how to get started with JabRef. This step-by-step walkthrough will cover everything from installation to creating a new bibliography and populating it with references.

9.3.1 Installation

The initial step in utilizing JabRef is to install the software on your system. For all users, regardless of OS, the easiest way to download JabRef is to visit their website: https://www.jabref.org/. Once there select 'Download' from the navigation bar, and press the "Download JabRef" button. This will take you to the FossHub page where you can select the appropriate version for your OS and download and install it.

9.3.2 Creating a New Bibliography

Once JabRef is successfully installed, launch the application. When the program loads you will be faced with a window that looks like the one shown in Figure 9.1. Now that the program is open, to create a new bibliography:
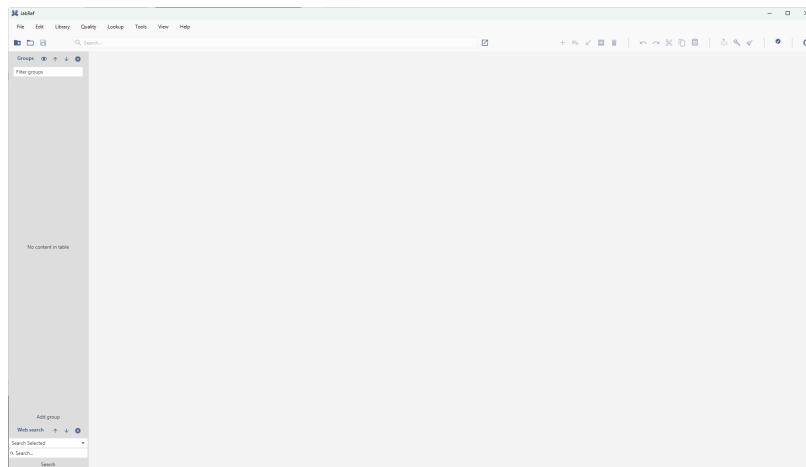
Figure 9.1: JabRef Main Window.

1. Click on 'File → New Library'.

To save the database:

1. Click on 'File → Save Library'.

2. Choose an appropriate and location.

3. Click 'Save'.

Congratulations! You've initiated your bibliography using JabRef. Now that we have this created, the next step is to add references to the database.

9.3.3   Adding References

JabRef offers multiple avenues for adding references to your database. Some of the methods are generally more useful than others but we will go over a few that you are likely to use:

9.3.3.1   Web Search

JabRef's integrated web search (see Figure 9.2) feature simplifies the process of importing references from online sources. This is by-far the easiest way to enter a

reference.

Figure 9.2: JabRef Web Search Tool.

1. Click on 'Web Search'.

2. Search for the desired reference using the integrated search feature.
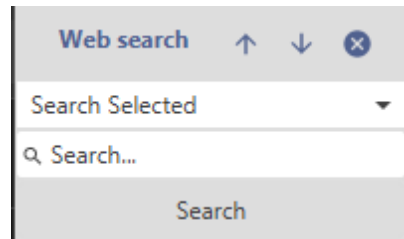
3. Select the reference all the references you wish to import,as shown in Figure 9.3.

4. Click 'Import entries' to import the selected entries.

5. The references are added to your library.
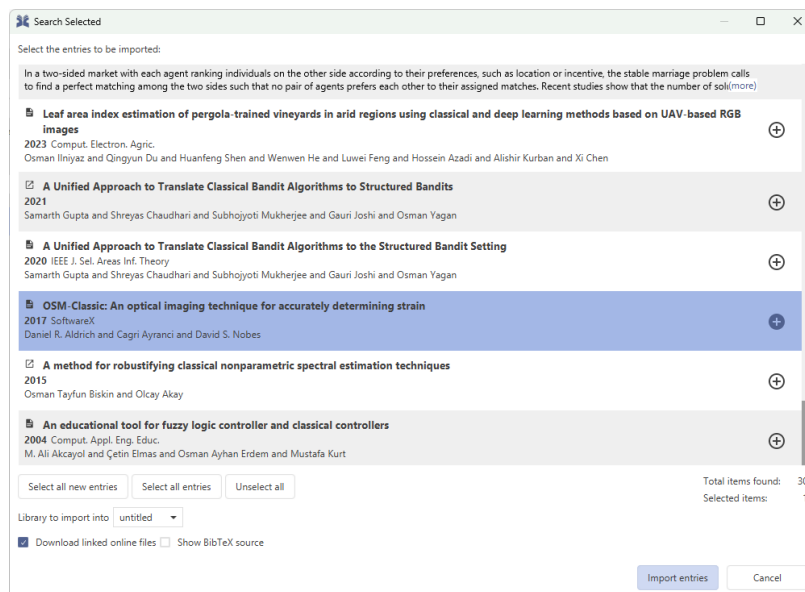
Figure 9.3: Example Web Search Results for ''`OSM-Classic`''.

Note: *The Web Search tool by default uses a general search, however, a specific database can be chosen as well using the drop down arrow next to "Search Selected".*

9.3.3.2 Manual Entry

Manually adding a reference can be done in a 'manual' and 'automatic' way. When adding a new entry you will be faced with the option to select an entry type or to enter an ID (DOI, ArXiv, ISBN, *etc.*). If you enter an ID, the information for the reference will be automatically pulled from the internet. Otherwise to manually enter all the information for a reference:

1. Click Library → 'New entry' or use the shortcut 'Ctrl + N' and this will show the following window.
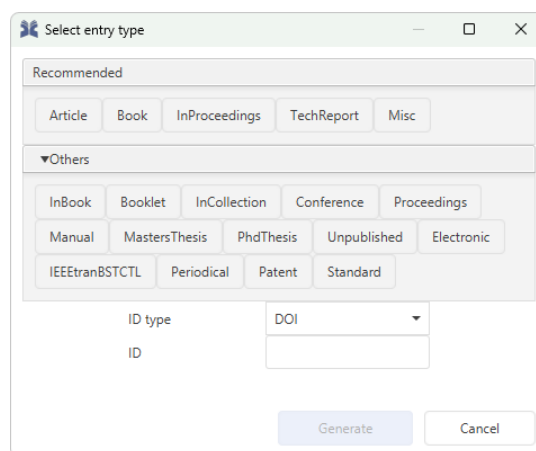
2. Choose the entry type (*e.g.*, article, book, inproceedings).

3. Fill in the required fields like author, title, journal, *etc.*

By following these steps, you can efficiently populate your JabRef database with the necessary references.

9.3.4   Organizing References

Effectively organizing references is essential for a streamlined bibliography. JabRef's grouping feature allows you to categorize references based on your preferences:

1. On the left panel, select 'Add Group'.

2. Give the group an appropriate name.

3. Optionally you can add a Description, Icon, Colour, *etc.*

To assign a reference to a group:

1. Select the Reference(s) from the centre list.

2. Drag them to the group on the left of the screen.

Note: *Groups can even be nested into groups to provide more levels of organization.* Organizing references into groups enhances accessibility and facilitates a more systematic approach to bibliography management.

9.4   Exploring Advanced Features of JabRef

JabRef's capabilities extend beyond the basics covered in the previous sections. In this section, we'll explore some of the advanced features that enhance the efficiency and effectiveness of JabRef as a reference manager.

9.4.1   Quality Assurance: Checking and Correcting Entries

Ensuring the accuracy and completeness of references is crucial. JabRef provides tools for quality assurance, allowing users to check and correct entries.

To check for duplicate entries:

1. Click on 'Quality → Find duplicates'.

2. JabRef will identify and display duplicate entries.

To correct entries:

1. Click on 'Quality → Cleanup entries'.

2. JabRef will provide some useful option to ensure conformity within the different references. This includes renaming Linked PDF's to match the standard of "`CitationKey - Title`".

These quality assurance features contribute to maintaining a clean and error-free bibliography.

9.4.2   Managing PDFs and File Links

JabRef facilitates the management of associated PDF's and file links, offering a consolidated approach to reference and document management.

To link a PDF or file:

1. Open the entry editor for a reference.

2. Click on 'General' and use the 'PDF' or 'File' field to link the document.

This integration helps to streamline the retrieval of PDF's or other associated documents directly from JabRef. Further, this allows JabRef to keep track of the comments and highlights in a single place (see Figure 9.4). These annotations can be found by selecting the entry, and selecting the 'File annotations' tab.

9.4.3   Additional Information

JabRef keeps track of a lot of information and can even help you with your research. Some additional information JabRef provides includes:

• Citation information
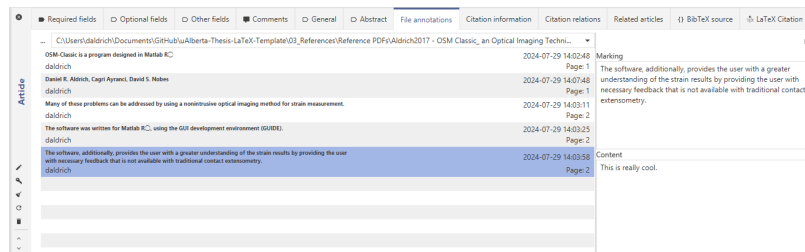
Figure 9.4: Showcase of the file annotations in JabRef.

- Citation relationships (what the reference cites and who has cited the reference). This further lets you open the links to the reference's source, or even add these references directly to your library.

- If one right clicks an entry you are provided the following options:

  - Rank - rank the reference with one to five stars.

  - Toggle Relevance - add a marker to show this is a relevant source.

  - Priority - rank items as low, medium, or high priority.

  - Read Status - set the status to read or skimmed.

Bibliography

[1] Faculty of Graduate & Postdoctoral Studies. "Appendix for thesis formatting guidelines," University of Alberta. (Jun. 2024), [Online]. Available: https://www.ualberta.ca/graduate-studies/media-library/current-students/appendix-for-thesis-formatting-guidelines.pdf.

[2] Faculty of Graduate Studies & Research. "Fgsr minimum thesis formatting requirements," University of Alberta. (Mar. 2016), [Online]. Available: https://www.ualberta.ca/graduate-studies/current-students/academic-requirements/thesis-requirement-and-preparation/index.html.

[3] D. R. Aldrich, C. Ayranci, and D. S. Nobes, "Osm-classic: An optical imaging technique for accurately determining strain," *SoftwareX*, vol. 6, pp. 225–230, 2017. DOI: 10.1016/J.SOFTX.2017.08.007.

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

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

[6] A. two, "Article 2," *Journal 2*, 1900.

[7] A. three, "Article 3," *Journal 3*, 1990.

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

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

Appendix A

Additional Example Figures

Each of the following pages will provide an example of a different figure configuration. In addition to the examples the code that generates the figure will be provided and explanations of what the different parts of the code do will be included. From all of the included information in this Appendix it should be possible to even develop your own figures that potentially suit your needs best.

(a) (b)
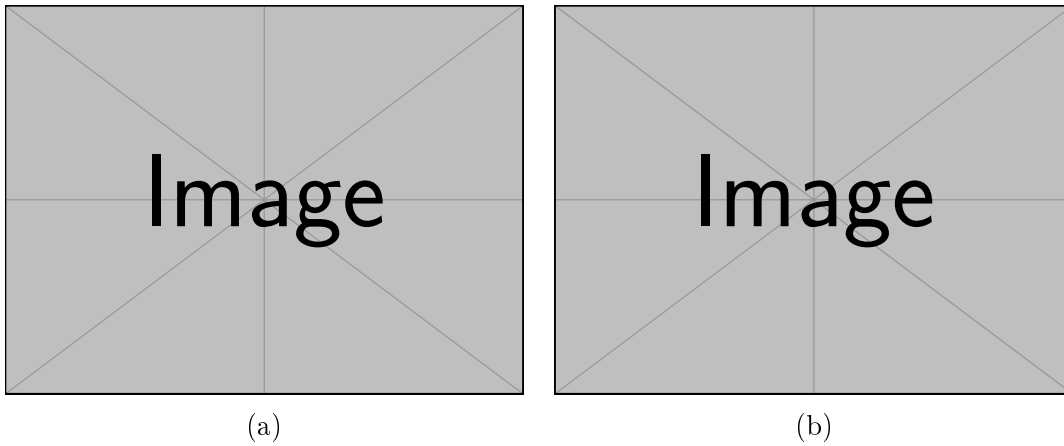
Figure A.1: This is an example of a double image figure.

```latex
\begin{figure}[H]
    \centering
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:doubleImage2:a}
    \end{subfigure}
    ~
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:doubleImage2:b}
    \end{subfigure}
    \caption{This is an example of a double image figure.}
    \label{fig:doubleImage2}
\end{figure}
```
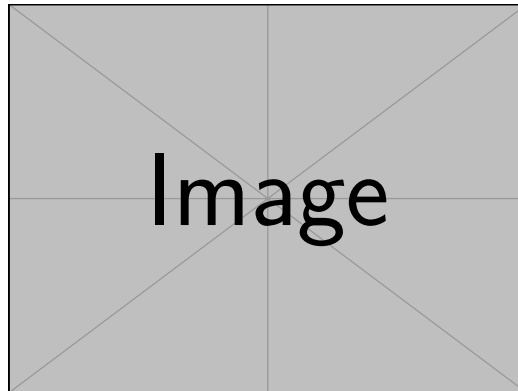
(a)

(b)

(c)

Figure A.2: This is an example of a triple image figure.

```latex
\begin{figure}[H]
    \centering
    \hspace*{\fill}% Adds space to left of top image (prevents two images from going to top)
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage1:a}
    \end{subfigure}
    \hspace*{\fill} % Adds space to right of top image (prevents two images from going to top)
    \par\vspace{1em}% Adds space between upper and lower images
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage1:b}
    \end{subfigure}
    ~ % Adds space between the two lower figures
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage1:c}
    \end{subfigure}
    \caption{This is an example of a triple image figure.}
    \label{fig:tripleImage1}
\end{figure}
```
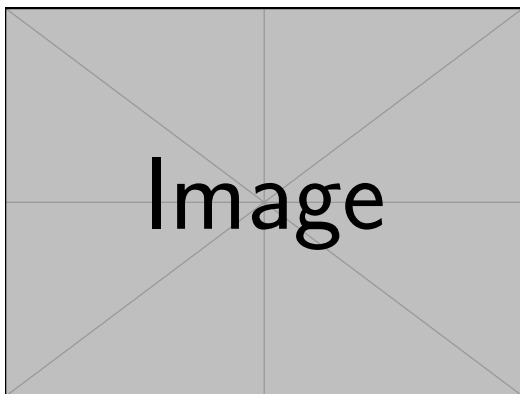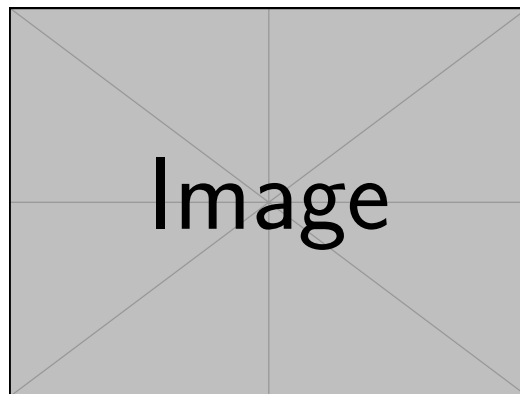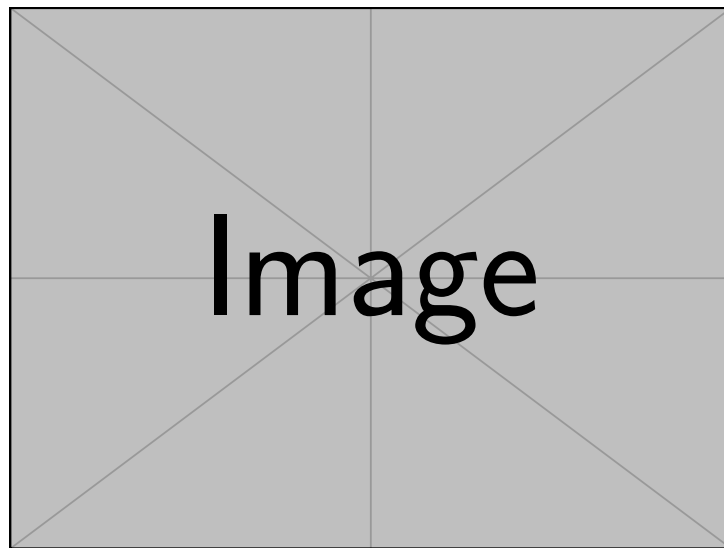
(a)

(b)
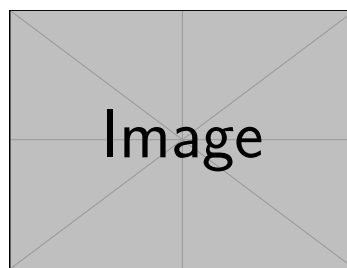
(c)

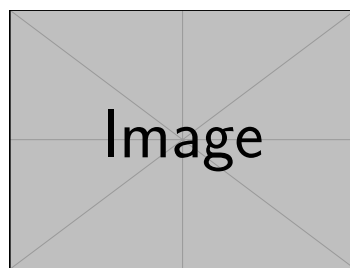Figure A.3: This is a second example of a triple image figure.

```latex
\begin{figure}[H]
    \centering
    \hspace*{\fill}% Adds space to left of top image (prevents two images from going to top)
    \begin{subfigure}{0.90\linewidth+1em} % 0.9 = 0.45 + 0.45, and 1em is the width of ~
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage2:a}
    \end{subfigure}
    \hspace*{\fill} % Adds space to right of top image (prevents two images from going to top)
    \par\vspace{1em}% Adds space between upper and lower images
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage2:b}
    \end{subfigure}
    ~ % Adds space between the two lower figures
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:tripleImage2:c}
    \end{subfigure}
    \caption{This is a second example of a triple image figure.}
    \label{fig:tripleImage2}
\end{figure}
```

(a)

(b)

(c)

(d)
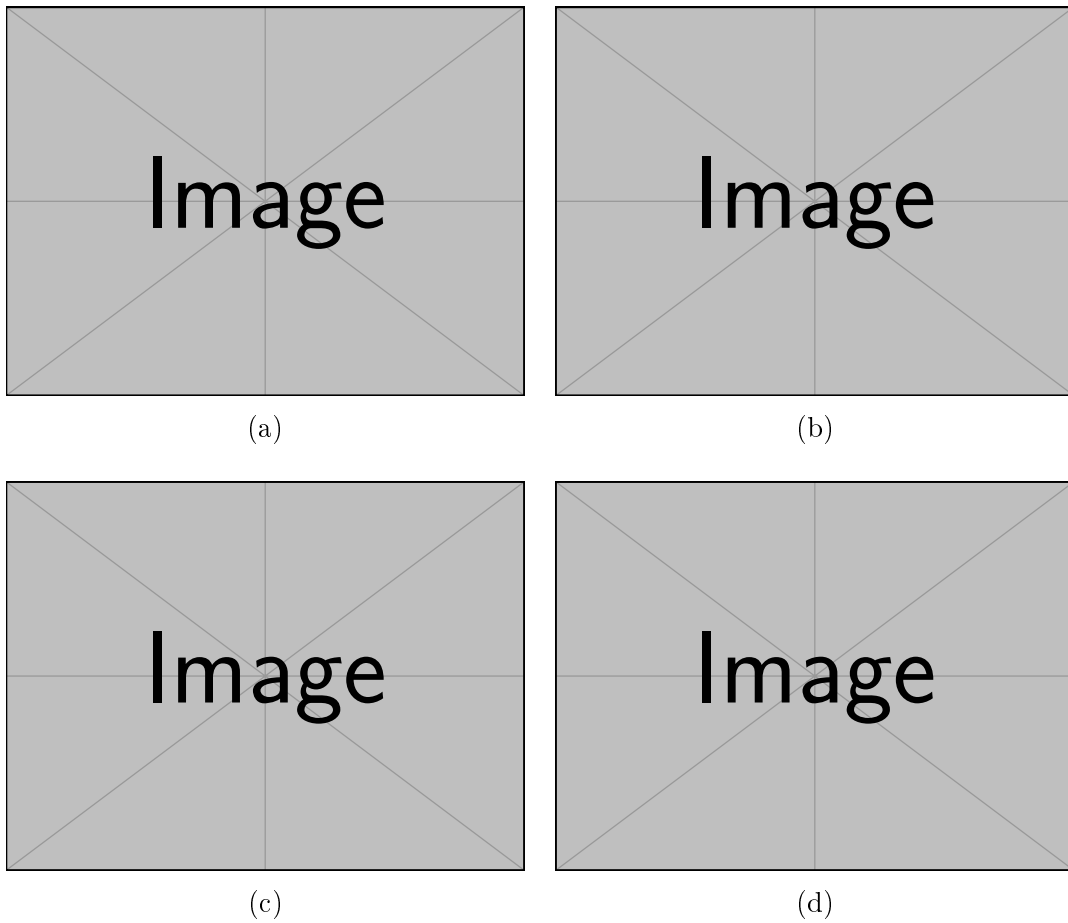
Figure A.4: This is an example of a quad image figure.

```latex
\begin{figure}[H]
    \centering
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:quadImage:a}
    \end{subfigure}
    ~ % Adds space between the two top figures
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:quadImage:b}
    \end{subfigure}
    \par\vspace{1em} % Adds space between upper and lower images
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:quadImage:c}
    \end{subfigure}
    ~ % Adds space between the two lower figures
    \begin{subfigure}{0.45\linewidth}
        \includegraphics[width=\linewidth]{example-image}
        \caption{} % Leave blank for just letter
        \label{fig:quadImage:d}
    \end{subfigure}
    \caption{This is an example of a quad image figure.}
    \label{fig:quadImage}
\end{figure}
```

Appendix B

Additional Example Tables

B.1   Section 1

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B.2 Section 2

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Appendix C

Including Code Listings

This appendix provides guidelines for including code listings in your thesis. Code listings are often used to demonstrate algorithms, data processing scripts, or other relevant programming content. Proper formatting ensures that code is both readable and aesthetically pleasing.

C.1 Using the `listings` Package

The `listings` package is a powerful tool for displaying code in LaTeX. It supports syntax highlighting for a wide variety of programming languages and offers many customization options.

C.1.1 Basic Usage

To include a simple code listing, you can use the following command:

```
\begin{lstlisting}[language=Python]
    # Your code here
    print("Hello, world!")
\end{lstlisting}
```

The `language` option specifies the programming language, which enables syntax highlighting. Replace `Python` with the appropriate language for your code.

C.1.2   Customizing Listings

The `listings` package allows for extensive customization. You can adjust the appearance of your code by setting options such as `frame`, `backgroundcolor`, `keywordstyle`, and more.

Here is an example of how to customize your code listing:

```
\lstset{
    language=Python,
    frame=single,
    backgroundcolor=\color{gray!10},
    keywordstyle=\color{blue}\bfseries,
    commentstyle=\color{green},
    stringstyle=\color{red},
    basicstyle=\ttfamily,
    breaklines=true
}
```

This configuration adds a single-line frame around the code, sets a light gray background, and defines styles for keywords, comments, and strings.

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';
```

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;
}

void main(){
```

```
    // Calling the function
    cout << 'The sum is:' << sum(1,99);
}
```

C.2 Advanced Features

C.2.1 Including External Files

The `listings` package allows you to include code from external files. This is particularly useful if you have long code files that you want to reference directly.

```
\lstinputlisting[language=Python]{path/to/your/code.py}
```

Replace path/to/your/code.py with the actual path to your file. Or you can use the \addmedia{./99_Inclusions/} and \addcode{Code/} commands to define the location for code files, then you can just use \insertcode{filename.ext} command instead of the full path. You can customize the display in the same way as inline listings.

C.2.2 Handling Special Characters

If your code contains special characters (*e.g.*, #, %, $), you may need to escape them or use the `literate` option to ensure proper display.

```
\lstset{
    literate={~} {$\sim$}{1}
}
```

This command, for example, replaces the tilde symbol with the appropriate LaTeX command.

C.3 Line Breaks in Long Code Lines

To automatically break long lines of code, use the breaklines=true option as shown in the earlier examples. This prevents code from running off the page and maintains readability.

C.4 Conclusion

Including well-formatted code listings in your thesis can enhance the clarity of your work and demonstrate your technical skills. By following the guidelines in this appendix, you can ensure that your code is presented professionally.

Appendix D

Including PDFs

⚠ WARNING While it is possible to have horizontal pages with the page numbers centered on the bottom long edge, I *DO NOT* recommended it. This is because, while it looks okay in a digital format, this is not suitable for printing... this would print page numbers on the side of the page rather than consistently on the bottom or in the heading.

The package that is used to include PDF's is `pdfpages`. This provide the main command `\includepdf` that can be used to include a PDF. Further, this package provides another command, `\includepdfset`, that can be used in the start of the document to pre-set some of the default values. This class file detects the presence of this package and invokes this command as follows:

```
\includepdfset{pages=-,scale=0.85,pagecommand=\
   thispagestyle{STYLE}}
```

Where `pages=-` defaults to including all pages from the PDF and `scale=0.85` scales the inserted PDF to 85% of its original size, so that the documents fit within the page's margins, headers, and footers.

Further, the option `pagecommand=\cmd {thispagestyle}\mopt {STYLE}` sets the pagestyle for the PDF pages, where, `STYLE` is replaced with the current pagestyle[1]

---

[1]To change the pagestyle of this one can add or remove the class option `fancyheaders`.

that is in use.

D.1 How to Insert a Portrait PDF

To insert a portrait-oriented PDF into your LaTeX document, you can use the pdfpages package, which provides a convenient way to include external PDF files. The following code snippet demonstrates how to include a portrait PDF with the specified options:

```
\includepdf{./99_Inclusions/PDFs/examplePDF}
```

This is an Example PDF that is Portrait

This is the second page

D.2 How to Insert a Landscape PDF

Inserting a landscape-oriented PDF is similarly straightforward using the pdfpages package. The code snippet below demonstrates how to include a landscape PDF:

```
\includepdf[landscape=true]{./99_Inclusions/PDFs/
    landscapePDF}
```

Here, landscape sets the orientation to landscape. This configuration ensures that your landscape PDF is correctly oriented and properly sized within your document.

This is an Example PDF that is Landscape

This is the second page

Appendix E

Math Lettering

Table E.1: 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

Table E.2: Blackboard Bold Letters

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

Table E.3: Calligraphic Letters

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

Table E.4: Fraktur Letters

Command	Output	Command	Output	Command	Output
\mathfrak\mopt {a}	𝔞	\mathfrak\mopt {b}	𝔟	\mathfrak\mopt {c}	𝔠
\mathfrak\mopt {d}	𝔡	\mathfrak\mopt {e}	𝔢	\mathfrak\mopt {f}	𝔣
\mathfrak\mopt {g}	𝔤	\mathfrak\mopt {h}	𝔥	\mathfrak\mopt {i}	𝔦
\mathfrak\mopt {j}	𝔧	\mathfrak\mopt {k}	𝔨	\mathfrak\mopt {l}	𝔩
\mathfrak\mopt {m}	𝔪	\mathfrak\mopt {n}	𝔫	\mathfrak\mopt {o}	𝔬
\mathfrak\mopt {p}	𝔭	\mathfrak\mopt {q}	𝔮	\mathfrak\mopt {r}	𝔯
\mathfrak\mopt {s}	𝔰	\mathfrak\mopt {t}	𝔱	\mathfrak\mopt {u}	𝔲
\mathfrak\mopt {v}	𝔳	\mathfrak\mopt {w}	𝔴	\mathfrak\mopt {x}	𝔵
\mathfrak\mopt {y}	𝔶	\mathfrak\mopt {z}	𝔷		
\mathfrak\mopt {A}	𝔄	\mathfrak\mopt {B}	𝔅	\mathfrak\mopt {C}	ℭ
\mathfrak\mopt {D}	𝔇	\mathfrak\mopt {E}	𝔈	\mathfrak\mopt {F}	𝔉
\mathfrak\mopt {G}	𝔊	\mathfrak\mopt {H}	ℌ	\mathfrak\mopt {I}	ℑ
\mathfrak\mopt {J}	𝔍	\mathfrak\mopt {K}	𝔎	\mathfrak\mopt {L}	𝔏
\mathfrak\mopt {M}	𝔐	\mathfrak\mopt {N}	𝔑	\mathfrak\mopt {O}	𝔒
\mathfrak\mopt {P}	𝔓	\mathfrak\mopt {Q}	𝔔	\mathfrak\mopt {R}	ℜ
\mathfrak\mopt {S}	𝔖	\mathfrak\mopt {T}	𝔗	\mathfrak\mopt {U}	𝔘
\mathfrak\mopt {V}	𝔙	\mathfrak\mopt {W}	𝔚	\mathfrak\mopt {X}	𝔛
\mathfrak\mopt {Y}	𝔜	\mathfrak\mopt {Z}	ℨ		