

This is the title of a thesis submitted to Iowa State University on the first line.

Second line, only the first letter of the first word and names are capitalized

by

Alice Wonder

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Major: Mathematics

Program of Study Committee:
John Smith, Major Professor
Jane Dee
Allen Wrench
Katniss Everdeen

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2025

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DEDICATION

I would like to dedicate this thesis to my wife Glenda and to my daughter Alice without whose support I would not have been able to complete this work.

TABLE OF CONTENTS

	Page
LIST OF TABLES	vi
LIST OF FIGURES	vii
ACKNOWLEDGMENTS	viii
ABSTRACT	ix
CHAPTER 1. GENERAL INTRODUCTION	1
1.1 Overview Two Words	1
1.1.1 Hypothesis	1
1.1.2 Second Hypothesis	1
1.2 Criteria Review	2
1.3 References	2
CHAPTER 2. PAPER 1 TITLE GOES HERE	3
2.1 Abstract	3
2.2 Overview	3
2.3 Introduction	3
2.3.1 Hypothesis	4
2.3.2 Second Hypothesis	4
2.4 Criteria Review	4
2.5 Conclusion	5
2.6 References	5
2.7 Appendix A: Appendix A Title Goes Here After The Colon	5
2.7.1 Procedure details	5
2.8 Appendix B: Appendix B Title Goes Here After The Colon	6
2.8.1 Procedure details	6
CHAPTER 3. PAPER 2 TITLE GOES HERE	7
3.1 Abstract	7
3.2 Overview	7
3.3 Introduction	7
3.3.1 Hypothesis	8
3.3.2 Second Hypothesis	8

3.4	Criteria Review	8
3.5	Conclusion	8
3.6	References	9
3.7	Appendix: Appendix Title Goes Here	10
3.7.1	Procedure details	10
PART I Let us have a part page		12
CHAPTER 4. PAPER 3 TITLE GOES HERE		13
4.1	Abstract	13
4.2	Methods and procedures	13
4.3	Introduction	13
4.3.1	Hypothesis	14
4.3.2	Second Hypothesis	15
4.4	Criteria Review	15
4.5	Continuing Tables	16
4.6	Results	17
4.7	Conclusion	17
4.8	References	18
4.9	Appendix: Appendix Title Goes Here	19
4.9.1	Procedure details	19
CHAPTER 5. PAPER 4 TITLE GOES HERE		20
5.1	Abstract	20
5.2	Overview	20
5.3	Introduction	20
5.3.1	Hypothesis	21
5.3.2	Second Hypothesis	22
5.4	Criteria Review	22
5.5	Results	22
5.6	Conclusion	22
5.7	References	22
5.8	Appendix: Appendix title goes here	23
5.8.1	Procedure details	23
CHAPTER 6. CHAPTER WITH MATH		24
6.1	Abstract	24
6.2	Proofs and Stuff	24
6.3	Floating Practice	26
6.4	References	26
CHAPTER 7. GENERAL CONCLUSION		28
7.1	Summary And Discussion	28
7.1.1	Hypothesis	28
7.2	Criteria Review	30

7.3	References	30
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LIST OF TABLES

	Page
Table 4.1 This table shows a standard non-empty table. Please check the code caption for extended instructions	14
Table 4.2 This table shows a standard empty table with a limited caption width . .	15
Table 4.3 This is a two-part table doing things.	16
Table 5.1 Moon Data	21
Table 7.1 This table shows almost nothing but is a sideways table and takes up a whole page by itself	29

LIST OF FIGURES

	Page
Figure 3.1	A figure with two subfigures: (a) first subfigure; (b) second subfigure. . . 11
Figure 4.1	This table shows a standard empty figure 14
Figure 5.1	Durham Centre 21
Figure 5.2	Durham Centre 2 23

ACKNOWLEDGMENTS

I would like to take this opportunity to express my thanks to those who helped me with various aspects of conducting research and the writing of this thesis. First and foremost, Dr. Susan D. Ross for her guidance, patience and support throughout this research and the writing of this thesis. Her insights and words of encouragement have often inspired me and renewed my hopes for completing my graduate education. I would also like to thank my committee members for their efforts and contributions to this work: Dr. August Tanner and Dr. Lewis Hargrave. I would additionally like to thank Dr. Tanner for his guidance throughout the initial stages of my graduate career and Dr. Hargrave for his inspirational teaching style.

ABSTRACT

This is the text of my abstract that is part of the thesis itself. The abstract describes the work in general and the heading and style match the rest of the document.

CHAPTER 1. GENERAL INTRODUCTION

This chapter will have the introduction to your thesis as a whole.

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

1.1 Overview Two Words

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

1.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

1.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

1.1.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

1.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny (Bui, 2023), abcd.

1.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

Theorem 1.1. *Here's a theorem!*

1.3 References

Bui, Vuong (Apr. 13, 2023). *Every Generating Polytope Is Strongly Monotypic*. arXiv: 2210.07690 [math]. URL: <http://arxiv.org/abs/2210.07690> (visited on 09/19/2024). Pre-published.

CHAPTER 2. PAPER 1 TITLE GOES HERE

Authors and Affiliations

Modified from a manuscript to be submitted to/ under review/ published in *Name of the Journal*

2.1 Abstract

This is the text of my abstract that is part of the thesis itself. The abstract describes the work in the first paper general. You can use the same abstract as your paper here.

2.2 Overview

The construct of this section or any further section is same as the authors paper. This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

2.3 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

(Klee, Danzer, and Grünbaum, [1963](#)) the definitive model is seen.

A version of this chapter appears in Journal of Discipline, Volume 18, Issue 3

2.3.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

2.3.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

2.3.2 Second Hypothesis

Heading

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

Even smaller heading

Another sentence.

2.3.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

Theorem 2.1. *If true, then this theorem is vacuous.*

2.4 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

2.5 Conclusion

The conclusion of the paper goes here. (Bui, 2023)

2.6 References

Bui, Vuong (Apr. 13, 2023). *Every Generating Polytope Is Strongly Monotypic*. arXiv: 2210.07690 [math]. URL: <http://arxiv.org/abs/2210.07690> (visited on 09/19/2024). Pre-published.

Chen, Beifang, Shing-Tung Yau, and Yeong-Nan Yeh (Oct. 2001). “Graph Homotopy and Graham Homotopy”. In: *Discrete Mathematics* 241.1-3, pp. 153–170. ISSN: 0012365X. DOI: 10.1016/S0012-365X(01)00115-7. URL: <https://linkinghub.elsevier.com/retrieve/pii/S0012365X01001157> (visited on 08/28/2024).

Klee, Victor, Ludwig Danzer, and Branko Grünbaum (1963). “Helly’s Theorem and Its Relatives”. In: *Convexity*. Seventh Symposium in Pure Mathematics. Ed. by Victor Klee. Vol. 7. Proceedings of Symposia in Pure Mathematics ; v. 7. Providence: American Mathematical Society, pp. 101–180.

2.7 Appendix A: Appendix A Title Goes Here After The Colon

If there is an appendix that needs to go with the paper it can be as a section (Klee, Danzer, and Grünbaum, 1963)

2.7.1 Procedure details

Details of the paper specific appendix procedures

2.8 Appendix B: Appendix B Title Goes Here After The Colon

If there is an appendix that needs to go with the paper it can be as a section (Chen, Yau, and Yeh, [2001](#))

2.8.1 Procedure details

Details of the paper specific appendix procedures

CHAPTER 3. PAPER 2 TITLE GOES HERE

Authors and Affiliations

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3.1 Abstract

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With more general information given here than really necessary.

3.3 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

did the initial work the definitive model is seen.

A version of this chapter appears in Journal of Discipline, Volume 18, Issue 3

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3.3.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

3.3.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

3.3.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

3.4 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

3.5 Conclusion

The conclusion of the paper goes here.

(Ziegler, [1995a](#)) (Ziegler, [1995b](#))

3.7 Appendix: Appendix Title Goes Here

If there is an appendix that needs to go with the

3.7.1 Procedure details

Details of the paper specific appendix procedures

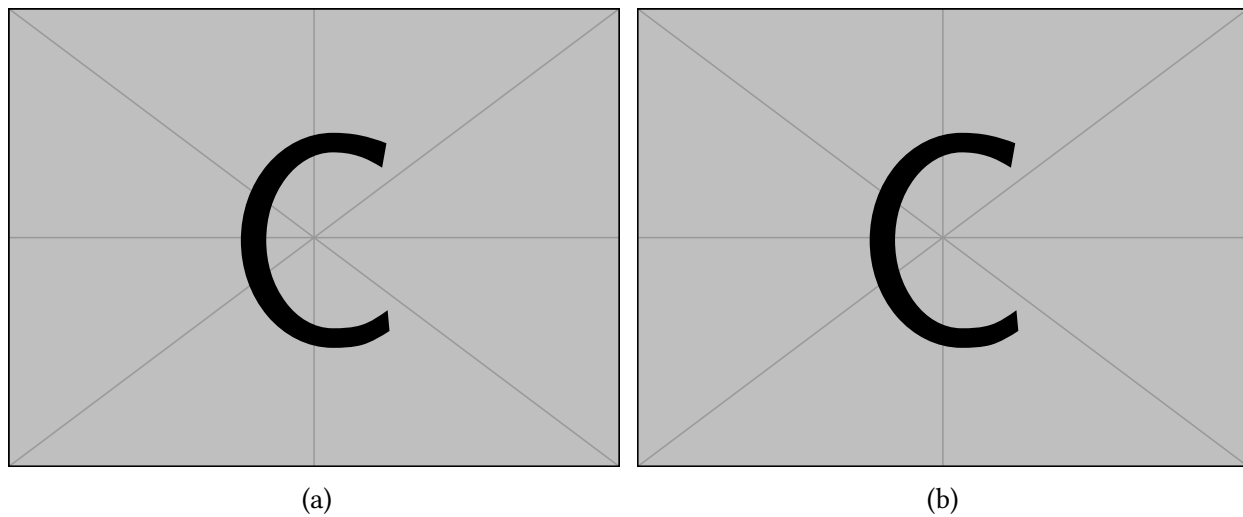


Figure 3.1: A figure with two subfigures: (a) first subfigure; (b) second subfigure.

PART I

Let us have a part page

CHAPTER 4. PAPER 3 TITLE GOES HERE

Authors and Affiliations

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4.1 Abstract

This is the text of my abstract that is part of the thesis itself. The abstract describes the work in the first paper general. You can use the same abstract as your paper here.

4.2 Methods and procedures

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

4.3 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

As can be seen in [Table 4.1](#) it is truly obvious what I am saying is true.

Table 4.1: This table shows a standard empty table. In case of long captions, we want to use the long caption as the description to the table and image but not use it in the table of contents and list of figures/ tables. In order to do this, there are two captions which have been provided, remove the first square bracket options if there is only one small caption. You can use citations like this to

Bach	Cello Suite Number 1
Beethoven	Cello Sonata Number 3
Brahms	Cello Sonata Number 1

4.3.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

This can also be seen in [Figure 4.1](#) that the rest is obvious.

Figure 4.1: This table shows a standard empty figure

4.3.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

4.3.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

4.3.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

4.4 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion as can be seen in [Table 4.2](#).

Table 4.2: This table shows a standard empty table with a limited caption width

4.5 Continuing Tables

Note, tables with cells spanning multiple columns work automatically, but cells spanning multiple rows require extra tagging.

Table 4.3: This is a two-part table doing things.

k	q	p+	p-	s1	s2	s3	RHS
2	2	2	1	1	0	0	1
-T	0	1	1	0	1	0	0
T	-1	0	1	0	0	1	0
-1	1	-1	1				
2(T+1)	2	0	1	1	-2	0	1
-T	0	1	1	0	1	0	0
T	-1	0	1	0	0	1	0
-(T+1)	1	0	1	0	1	0	
0	2+2(T+1)/T	0	1	1	-2	-2(T+1)/T	1
0	-1	1	1	0	1	1	0
1	-1/T	0	1	0	0	1/T	0
0	1-(T+1)/T	0	1	0	1	(T+1)/T	
0	2(2T+1)/T	0	1	1	-2	-2(T+1)/T	1
0	-1	1	1	0	1	1	0
1	-1/T	0	1	0	0	1/T	0
0	-1/T	0	1	0	1	(T+1)/T	
0	1	0	1	T/2(2T+1)	-T/(2T+1)	-1	T/2(2T+1)
0	0	1	1	T/2(2T+1)	1-T/(2T+1)	0	T/2(2T+1)
1	0	0	1	1/2(2T+1)	-1/(2T+1)	0	1/2(2T+1)
0	0	0	1	1/2(2T+1)	1-1/(2T+1)	-1+(T+1)/TT	
0	0	0	1	1/2(2T+1)	1-1/(2T+1)	-1+(T+1)/TT	
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0	1/2(2T+1)	1/2(2T+1)	1/2(2T+1)	
0	0	0	0				
0	0	0	0				
0	0	0	0				

Table 4.3: Continued

k	q	p+	p-	s1	s2	s3	RHS
2	2	2	-2	1	0	0	1
-T	0	1	-1	0	1	0	0
T	-1	0	0	0	0	1	0
-1	1	-1	1				
2(T+1)	2	0	0	1	-2	0	1
-T	0	1	-1	0	1	0	0
T	-1	0	0	0	0	1	0
-(T+1)	1	0	0	0	1	0	
0	$2+2(T+1)/T$	0	0	1	-2	$-2(T+1)/T$	1
0	-1	1	-1	0	1	1	0
1	$-1/T$	0	0	0	0	$1/T$	0
0	$1-(T+1)/T$	0	0	0	1	$(T+1)/T$	
0	$2(2T+1)/T$	0	0	1	-2	$-2(T+1)/T$	1
0	-1	1	-1	0	1	1	0
1	$-1/T$	0	0	0	0	$1/T$	0
0	$-1/T$	0	0	0	1	$(T+1)/T$	
0	1	0	0	$T/2(2T+1)$	$-T/(2T+1)$	-1	$T/2(2T+1)$
0	0	1	-1	$T/2(2T+1)$	$1-T/(2T+1)$	0	$T/2(2T+1)$
1	0	0	0	$1/2(2T+1)$	$-1/(2T+1)$	0	$1/2(2T+1)$
0	0	0	0	$1/2(2T+1)$	$1-1/(2T+1)$	$-1+(T+1)/TT$	

4.6 Results

Include any results

4.7 Conclusion

The conclusion of the paper goes here.

(Dochtermann et al., [2023](#)) (Ziegler, [1995](#))

and on and on and on Graduate Texts in Mathematics that goes on and on and on and on Graduate Texts in Mathematics that goes on and on and on and on Graduate Texts in Mathematics that goes on and on and on and on Graduate Texts in Mathematics that goes on and on and on and on 1523333342424343333333334424243134234234234324234. New York: Springer-Verlag that is super long et al. ISBN: 978-0-387-94329-9.

4.9 Appendix: Appendix Title Goes Here

If there is an appendix that needs to go with the paper it can be as a section (Virk, [2024](#))

4.9.1 Procedure details

Details of the paper specific appendix procedures

CHAPTER 5. PAPER 4 TITLE GOES HERE

Authors and Affiliations

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5.1 Abstract

This is the text of my abstract that is part of the thesis itself. The abstract describes the work in the first paper general. You can use the same abstract as your paper here.

5.2 Overview

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

5.3 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

Of course, data on this as seen in [Table 5.1](#) is few and far between.

Table 5.1: Moon Data

Element	Control	Experimental
Moon Rings	1.23	3.38
Moon Tides	2.26	3.12
Moon Walk	3.33	9.29

5.3.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

Or graphically as seen in [Figure 5.1](#) it is certain that my hypothesis is true.



Figure 5.1: Durham Centre

5.3.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

5.3.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

5.3.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

5.4 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

5.5 Results

5.6 Conclusion

The conclusion of the paper goes here.

5.7 References

Bui, Vuong (Apr. 13, 2023). *Every Generating Polytope Is Strongly Monotypic*. arXiv: [2210.07690](https://arxiv.org/abs/2210.07690) [math]. URL: <http://arxiv.org/abs/2210.07690> (visited on 09/19/2024). Pre-published.

Ziegler, Günter M. (1995). *Lectures on Polytopes*. Graduate Texts in Mathematics 152. New York: Springer-Verlag. ISBN: 978-0-387-94329-9.

5.8 Appendix: Appendix title goes here

If there is an appendix that needs to go with the paper it can be as a section (Ziegler, [1995](#))

5.8.1 Procedure details

Details of the paper specific appendix procedures.



Figure 5.2: Durham Centre 2

(Bui, [2023](#))

CHAPTER 6. CHAPTER WITH MATH

Authors and Affiliations

Modified from a manuscript to be submitted to/ under review/ published in *Name of the Journal*

6.1 Abstract

This is the text of my abstract that is part of the thesis itself. The abstract describes the work in the first paper general. You can use the same abstract as your paper here.

6.2 Proofs and Stuff

Definition 6.1. A set A is something.

Lemma 6.1. *If cool, then great.*

Proof. Without loss of generality, it works.

$$d(x, y) = d(x, z) + d(z, y) \geq d(x, x - \langle x, n \rangle n) + 0 = \langle x, n \rangle. \quad (6.1)$$

A version of this chapter appears in Journal of Discipline, Volume 18, Issue 3

Furthermore,

$$\ell_1(\hat{x}, y) = \ell_1(x, y) \quad (6.2)$$

$$= |\ell_1(x, y) - 2\langle x, n \rangle \ell_1(n, 0)| \quad (6.3)$$

$$\left(\frac{x+y+z}{2x+y} \right) - (2x^2 - y) \quad (6.4)$$

$$B\left\langle \frac{4}{x} + x^3 \right\rangle \quad (6.5)$$

$$\left(x^2 - 2x \right) \quad (6.6)$$

From [Equation 6.1](#), it follows

$$\ell_1(\hat{x}, y) \ell_1(\hat{x}, y) - 2\langle x, n \rangle \leq$$

□

Lemma 6.2. *A lemma.*

Proof.

$$3x + 4 = 12$$

□

Then, we should also have some in-line math $B\left(\frac{3x}{2y-x}\right)$ and then $d(x, y)$ if it is alright. We might also have $\sqrt{x^2 + \frac{3}{x}}$.

Theorem 6.1. *If true, then it all collapses.*

Proof. By Zorn's lemma, Zorn has the best name (Martini, Montejano, and Oliveros, [2019](#)). Also, (Chen, Yau, and Yeh, [2001](#)) and (Dochtermann et al., [2023](#)).

$$x^2 + y^2 + x^2 = 2.$$



6.3 Floating Practice

Text here.

Algorithm 6.1 Score Algorithm

- 1: **Input:** s is a sensor
 - 2: **for** $j \in \{1, 2, \dots, 15\}$ **do**
 - 3: Randomly choose 5 days
 - 4: **for** $x \in \{1, 2, \dots, 1000\}$ **do**
 - 5: Set a to be something in this very long state that will have to be wrapped quite possibly around and around and around
-

More text here. Now what is we ?

6.4 References

- Chen, Beifang, Shing-Tung Yau, and Yeong-Nan Yeh (Oct. 2001). “Graph Homotopy and Graham Homotopy”. In: *Discrete Mathematics* 241.1-3, pp. 153–170. ISSN: 0012365X. DOI: [10.1016/S0012-365X\(01\)00115-7](https://doi.org/10.1016/S0012-365X(01)00115-7). URL: <https://linkinghub.elsevier.com/retrieve/pii/S0012365X01001157> (visited on 08/28/2024).
- Dochtermann, Anton et al. (Oct. 1, 2023). “Minimal Graphs for Contractible and Dismantlable Properties”. In: *Discrete Mathematics* 346.10, p. 113516. ISSN: 0012-365X. DOI: [10.1016/j.disc.2023.113516](https://doi.org/10.1016/j.disc.2023.113516). URL: <https://www.sciencedirect.com/science/article/pii/S0012365X23002029> (visited on 08/28/2024).

Martini, Horst, Luis Montejano, and Déborah Oliveros (2019). “Complete and Reduced Convex Bodies”. In: *Bodies of Constant Width: An Introduction to Convex Geometry with Applications*. Ed. by Horst Martini, Luis Montejano, and Déborah Oliveros. Cham: Springer International Publishing, pp. 143–165. ISBN: 978-3-030-03868-7. DOI: [10.1007/978-3-030-03868-7_7](https://doi.org/10.1007/978-3-030-03868-7_7). URL: https://doi.org/10.1007/978-3-030-03868-7_7 (visited on 09/18/2024).

CHAPTER 7. GENERAL CONCLUSION

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

7.1 Summary And Discussion

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

7.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

As can be seen in [Table 7.1](#) it is truly obvious what I am saying is true.

Table 7.1: This table shows almost nothing but is a sideways table and takes up a whole page by itself

Element	Control	Experimental
Moon Rings	1.23	3.38
Moon Tides	2.26	3.12
Moon Walk	3.33	9.29

7.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny. (Chen, Yau, and Yeh, 2001), (Chen, Yau, and Yeh, 2001),(Virk, 2024) Here is an equation

$$x^2 + y^2 = 8.$$

7.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

7.3 References

Chen, Beifang, Shing-Tung Yau, and Yeong-Nan Yeh (Oct. 2001). “Graph Homotopy and Graham Homotopy”. In: *Discrete Mathematics* 241.1-3, pp. 153–170. ISSN: 0012365X. DOI: [10.1016/S0012-365X\(01\)00115-7](https://doi.org/10.1016/S0012-365X(01)00115-7). URL: <https://linkinghub.elsevier.com/retrieve/pii/S0012365X01001157> (visited on 08/28/2024).

Virk, Žiga (Aug. 6, 2024). *Contractibility of the Rips Complexes of Integer Lattices via Local Domination*. arXiv: 2405.09134 [math]. URL: <http://arxiv.org/abs/2405.09134> (visited on 08/28/2024). Pre-published.