

**This is the title of a thesis submitted to Iowa State University on the first line**  
**Note that only the first letter of the first word and proper names are capitalized and**  
**this is the second line**

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

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

2024

Copyright © Alice Wonder, 2024. All rights reserved.

## TABLE OF CONTENTS

	Page
LIST OF TABLES . . . . .	iv
LIST OF FIGURES . . . . .	v
NOMENCLATURE . . . . .	vi
ACKNOWLEDGMENTS . . . . .	vi
ABSTRACT . . . . .	vii
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 . . . . .	3
2.3.2 Second Hypothesis . . . . .	4
2.4 Criteria Review . . . . .	4
2.5 Conclusion . . . . .	4
2.6 References . . . . .	4
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 . . . . .	5
2.8.1 Procedure details . . . . .	5
CHAPTER 3. PAPER 2 TITLE GOES HERE . . . . .	6
3.1 Abstract . . . . .	6
3.2 Overview . . . . .	6
3.3 Introduction . . . . .	6
3.3.1 Hypothesis . . . . .	6
3.3.2 Second Hypothesis . . . . .	7

3.4	Criteria Review . . . . .	7
3.5	Conclusion . . . . .	7
3.6	References . . . . .	7
3.7	Appendix: Appendix Title Goes Here . . . . .	7
3.7.1	Procedure details . . . . .	7
<b>PART I Let's have a part page</b>		<b>8</b>
CHAPTER 4. PAPER 3 TITLE GOES HERE . . . . .		9
4.1	Abstract . . . . .	9
4.2	Methods and procedures . . . . .	9
4.3	Introduction . . . . .	9
4.3.1	Hypothesis . . . . .	9
4.3.2	Second Hypothesis . . . . .	11
4.4	Criteria Review . . . . .	11
4.5	Results . . . . .	11
4.6	Conclusion . . . . .	11
4.7	References . . . . .	12
4.8	Appendix: Appendix Title Goes Here . . . . .	12
4.8.1	Procedure details . . . . .	12
CHAPTER 5. PAPER 4 TITLE GOES HERE . . . . .		13
5.1	Abstract . . . . .	13
5.2	Introduction . . . . .	13
5.2.1	Hypothesis . . . . .	14
5.2.2	Second Hypothesis . . . . .	14
5.3	Criteria Review . . . . .	15
5.4	Results . . . . .	15
5.5	Conclusion . . . . .	15
5.6	References . . . . .	15
5.7	Appendix: Appendix title goes here . . . . .	15
5.7.1	Procedure details . . . . .	15
CHAPTER 6. GENERAL CONCLUSION . . . . .		16
6.1	Summary And Discussion . . . . .	16
6.1.1	Hypothesis . . . . .	16
6.2	References . . . . .	16

## LIST OF TABLES

	<b>Page</b>
Table 4.1    This table shows a standard non-empty table. Please check the code caption for extended instructions . . . . .	10
Table 4.2    This table shows a standard empty table with a limited caption width . . .	11
Table 5.1    Moon Data . . . . .	13
Table 6.1    This table shows almost nothing but is a sideways table and takes up a whole page by itself . . . . .	17

**LIST OF FIGURES**

	<b>Page</b>
Figure 4.1    This table shows a standard empty figure . . . . .	<a href="#">10</a>
Figure 5.1    Durham Centre . . . . .	<a href="#">14</a>

## 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.

## 1.3 References

Bui, V. (2023, April 13). *Every generating polytope is strongly monotypic*. arXiv: [2210.07690](https://arxiv.org/abs/2210.07690) [math]. Retrieved September 19, 2024, from <http://arxiv.org/abs/2210.07690>

## 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 et al., [1963](#)) the definitive model is seen.

#### 2.3.1 Hypothesis

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

---

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

### 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

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

#### 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.

## 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, V. (2023, April 13). *Every generating polytope is strongly monotypic*. arXiv: [2210.07690](https://arxiv.org/abs/2210.07690) [math]. Retrieved September 19, 2024, from <http://arxiv.org/abs/2210.07690>
- Chen, B., Yau, S.-T., & Yeh, Y.-N. (2001). Graph homotopy and Graham homotopy. *Discrete Mathematics*, 241(1-3), 153–170. [https://doi.org/10.1016/S0012-365X\(01\)00115-7](https://doi.org/10.1016/S0012-365X(01)00115-7)
- Klee, V., Danzer, L., & Grünbaum, B. (1963). Helly's theorem and its relatives. In V. Klee (Ed.), *Convexity* (pp. 101–180, Vol. 7). American Mathematical Society.

## **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 et al., [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 et al., [2001](#))

### **2.8.1 Procedure details**

Details of the paper specific appendix procedures

## CHAPTER 3. PAPER 2 TITLE GOES HERE

Authors and Affiliations

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

### 3.1 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.

### 3.2 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.

### 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.

#### 3.3.1 Hypothesis

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

---

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

### **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, [1995](#))

## **3.6 References**

Ziegler, G. M. (1995). *Lectures on polytopes*. Springer-Verlag.

## **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

## PART I

Let's have a part page

## CHAPTER 4. PAPER 3 TITLE GOES HERE

Authors and Affiliations

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

### 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.

#### 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.



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

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

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 Results

Include any results

## 4.6 Conclusion

The conclusion of the paper goes here.

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

## 4.7 References

- Dochtermann, A., Espinoza, J. F., Frías-Armenta, M. E., & Hernández, H. A. (2023). Minimal graphs for contractible and dismantlable properties. *Discrete Mathematics*, 346(10), 113516. <https://doi.org/10.1016/j.disc.2023.113516>
- Virk, Ž. (2024, August 6). *Contractibility of the Rips complexes of integer lattices via local domination*. arXiv: [2405.09134](https://arxiv.org/abs/2405.09134) [math]. Retrieved August 28, 2024, from <http://arxiv.org/abs/2405.09134>

## 4.8 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](#))

### 4.8.1 Procedure details

Details of the paper specific appendix procedures

## CHAPTER 5. PAPER 4 TITLE GOES HERE

Authors and Affiliations

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

### 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.

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.

### 5.2 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

### 5.2.1 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

#### 5.2.1.1 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.

### 5.2.2 Second Hypothesis

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

### 5.2.2.1 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.

## 5.3 Criteria Review

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

## 5.4 Results

## 5.5 Conclusion

The conclusion of the paper goes here.

## 5.6 References

Bui, V. (2023, April 13). *Every generating polytope is strongly monotypic*. arXiv: [2210.07690](https://arxiv.org/abs/2210.07690) [math]. Retrieved September 19, 2024, from <http://arxiv.org/abs/2210.07690>

Ziegler, G. M. (1995). *Lectures on polytopes*. Springer-Verlag.

## 5.7 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](#))

### 5.7.1 Procedure details

Details of the paper specific appendix procedures

(Bui, [2023](#))

## CHAPTER 6. 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.

### 6.1 Summary And Discussion

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

#### 6.1.1 Hypothesis

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

As can be seen in Table 6.1 it is truly obvious what I am saying is true.

##### 6.1.1.1 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 et al., 2001), (Chen et al., 2001),(Virk, 2024) Here is an equation

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

### 6.2 References

Chen, B., Yau, S.-T., & Yeh, Y.-N. (2001). Graph homotopy and Graham homotopy. *Discrete Mathematics*, 241(1-3), 153–170. [https://doi.org/10.1016/S0012-365X\(01\)00115-7](https://doi.org/10.1016/S0012-365X(01)00115-7)

Table 6.1: 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



Virk, Ž. (2024, August 6). *Contractibility of the Rips complexes of integer lattices via local domination*. arXiv: [2405.09134](https://arxiv.org/abs/2405.09134) [math]. Retrieved August 28, 2024, from <http://arxiv.org/abs/2405.09134>