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 a 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

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NOMENCLATURE

The nomenclature for your dissertation or thesis is optional. This list may be placed in the following places: as the last preliminary page, before the Reference section, or as an Appendix. The heading is bold if other major headings are bold, and the list is in the same font size and style as text. Nomenclature should follow a two-column format with the term in the left column and its definition or description within the right column.

Number Sets

$\mathbb{C}$ Complex Numbers

$\mathbb{H}$ Quaternions

$\mathbb{R}$ Real Numbers

Other Symbols

ρ Friction Index

V Constant Volume

Physics Constants

c Speed of light in a vacuum inertial system

g Gravitational Constant

h Plank Constant

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, 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.

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, 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

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

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

Lets 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.

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.

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

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, 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. URL: https://www.sciencedirect.com/science/article/pii/S0012365X23002029 (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.

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.

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

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, 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.

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

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, Yau, and Yeh 2001), (Chen, Yau, and Yeh 2001),(Virk 2024) Here is an equation

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

6.2 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. URL:

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

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.