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WHICH MAY SPAN MULTIPLE LINES

(BUT NO MORE THAN 3 LINES)

by

Chris Jordan Doe

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

of

Doctor of Philosophy

in

Engineering

MONTANA STATE UNIVERSITY
Bozeman, Montana

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DEDICATION

I dedicate this to all MSU students who use LaTeX. Dedication is optional and may be no longer than one page, single spaced, and should precede the acknowledgments page.

ACKNOWLEDGEMENTS

I would like acknowledge... Acknowledgments must be double spaced and is limited to one page. Consider that you may need to include a funding acknowledgement.

VITA

Chris Jordan Doe was born in Bozeman, MT in 1893. Raised by Champ, Chris is a true Bobcat. Chris attended Bozeman High and graduated with honors. After high school, . . .

If you include a vita, it should contain the full name of the author, date and place of birth, parentage, secondary education, and collegiate degrees. The vita should be written in essay form in the third person and may not exceed one single-spaced page.

TABLE OF CONTENTS

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LIST OF ALGORITHMS

NOMENCLATURE

μ	Dynamic viscosity
$\mathbf{n}$	Normal vector
$\mathbf{u}$	Velocity vector

ABSTRACT

The abstract must be single spaced and no more than 350 words. The abstract must contain the following elements: (1) statement of the problem, (2) procedure or methods, (3) results, and (4) conclusions. Mathematical formulas, abbreviations, diagrams, and other illustrative materials should not be included. It should be written to be understood by a person who does not have expertise in the field.

1

INTRODUCTION

Welcome to the Montana State University electronic Thesis/Dissertation (ETD) LaTeX template. In this chapter various sections, subsections, and subsubsections are created and filled with random text). In Ch. 2 methods to write equations and how to include figures and tables are explored. Conclusions are drawn in Ch. 4.

Section

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Subsection

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Subsubsection Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Subsection With a Very Very Very Very Very Very Very Very Very Very Very Long Title

For long subsection titles use the command `\longsubsection{#1}{#2}`, where #1 is the first line of the long title, and #2 is the second line of the long title. You can also pass an optional argument to this command that puts a shorter title in the table of contents as shown by the subsection below.

Subsection With a Very Long Title But Shortened in the Table Of Contents

There are **not** similar commands for sections and subsubsections as these are not specified in the MSU style guide.

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THEORY

Equations

Here is an example of an equation

$$a^2 + b^2 = c^2, \tag{2.1}$$

which states the square of the hypotenuse c of a triangle is equal to the sum of the square of the other two sides (a and b).

A collection of similar equations can be written using the `\align` environment, e.g.,

$$\sin(\theta) = \frac{1}{\csc(\theta)} \tag{2.2}$$

$$\cos(\theta) = \frac{1}{\sec(\theta)} \tag{2.3}$$

$$\tan(\theta) = \frac{1}{\cot(\theta)} \tag{2.4}$$

Cases can be added using

$$x = \begin{cases} y, & \text{if } t = 1; \\ z, & \text{otherwise.} \end{cases} \tag{2.5}$$

Symbols

Symbols, like greek letters, can be used in equations, e.g., θ, γ, and ζ. When variables are referenced in the text they should be written in mathmode and enclosed in dollar signs. For example, a and a, which are written in math and text modes, respectively.

Figures

Figures can easily be added to your latex document. Graphs and figures should be designed to be printed in black and white and clearly display information. Considering using vectorized graphics that will remain sharp even if viewed zoomed (try zooming on Fig 2.1). The text in your figure should be legible and preferably the same size as the text in the rest of your document.

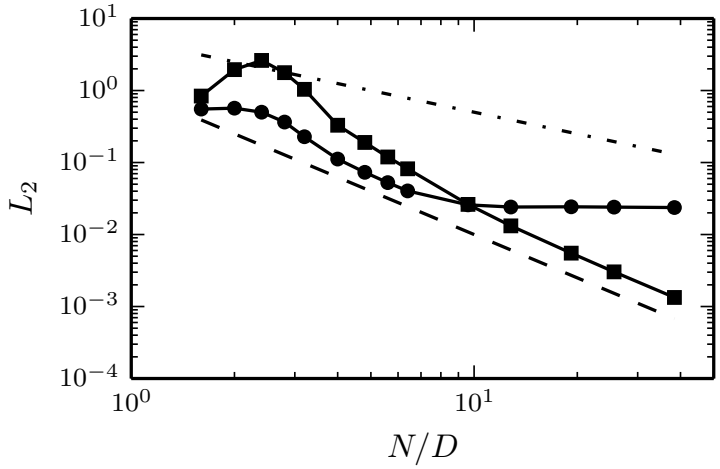

Figure 2.1: This is a figure of some data.

In LaTeX figures may float and move around to a location that is optimized using mathematics. The htbp in the definition of the figure environment means here,top,bottom,page and is the order of preference for where the figure goes.

Figure 2.2 shows you can also put pictures into LaTeX documents. The size of the figure is controlled by adjusting width. If you find your figures are often floating to a page of their own consider changing their size and/or adding more text.

Figure 2.3 shows that you can create figures directly within your LaTeX document using, for example, the tikz package.

Figure 2.2: Montana Hall on Montana State University's campus.

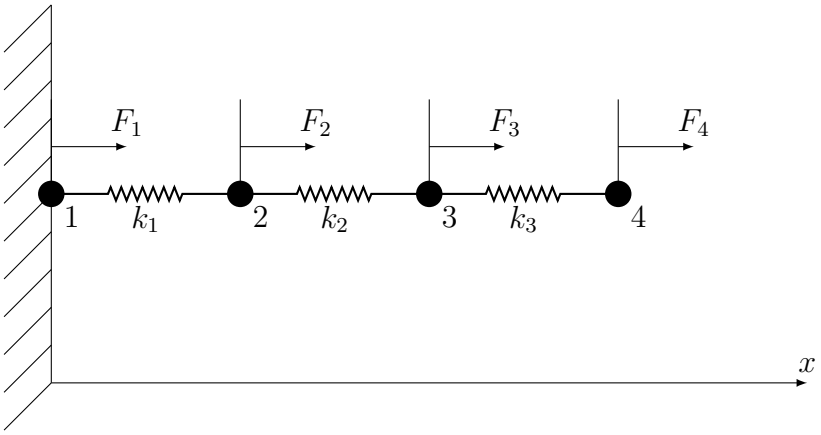

Figure 2.3: Figure created using the tikz package.

Figure 2.4: Figure forced to be on page by itself.

Tables

Tables can be created directly in your LaTeX document. Table 2.1 shows how a short caption can be used in the table of contents and a long caption in the figure. In the table of contents "Area of ice sheet" is listed and above the table "Area of ice sheet in millions of square miles with time." is shown. This is done by adding an optional argument to the `\caption` command, i.e., `\caption[Short Caption]{Long Caption}`.

Table 2.1: Area of ice sheet in millions of square miles with time.

Year	1985	1990	1995	2000	2005	2010	2015
Area	16.2	15.5	15.2	15.5	14.6	15.4	14.5

Algorithms

Algorithms can be added using the algorithmic environment as shown in Algorithm 2.1.

References and Citations

Referencing other parts of the document

Equations, figures, tables, sections, and chapters can be references using the `\ref{label}` command. For example, `\ref{fig:plot}` references Fig. 2.1.

You can also use the `\vref` command to also get the page number. For example, `\vref{fig:plot}` references Fig. 2.1 on page 4.

The `label` used in the `\ref` command can be anything you want to use. It is helpful to use a convention. For example, all figures could have a label that starts with `fig:` and all table labels could start with `tab:`.

1: **Input:** Function f to optimize, subpopulations $\mathcal{S}$
2: **Output:** Full global solution $\boldsymbol{G}$
3: // Iterate over random permutation of $\boldsymbol{X}$
4: **for each** $X_i \in \boldsymbol{X}$ **do**
5: // Initialize comparison variables
6: $bestFit \leftarrow \infty$
7: $bestVal \leftarrow \boldsymbol{S}_0[X_i]$
8: // Iterate over random permutation of $\boldsymbol{S}$
9: **for each** $\boldsymbol{S}_j \in \mathcal{S}$ **where** $X_i \in \boldsymbol{S}_j$ **do**
10: // Substitute subpopulation component into full global solution
11: $G_i \leftarrow \boldsymbol{S}_j[X_i]$
12: // Compare Fitness
13: **if** $f(\boldsymbol{G})$ is better than $bestFit$ **then**
14: $bestVal \leftarrow \boldsymbol{S}_j[X_i]$
15: $bestFit \leftarrow f(\boldsymbol{G})$
16: **endif**
17: **endfor**
18: // Copy $bestVal$ into full global solution
19: $G_i \leftarrow bestVal$
20: **endfor**
21: **return**

Algorithm 2.1: Algorithm example

Citing others work

Citing others work is an important aspect of all scientific writing. All citations should be placed in the .bib file(s) listed in your main.tex document. Cite others work using the `\cite` command, e.g., [4]. Multiple citations should be done within one cite command, e.g., [1, 2, 3].

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TITLE OF MANUSCRIPT YOU ARE INCLUDING AS A CHAPTER

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CONCLUSION

LaTeX produces documents that look great, automatically handles references and citations, and easily incorporates figures and tables. This is not a guide to LaTeX but rather an introduction to the MSU style. If you want more information about LaTeX many introductory guides can be found online.

REFERENCES CITED

[1] Olivier Desjardins, Jeremy McCaslin, Mark Owkes, and Peter Brady. Direct numerical and large-eddy simulation of primary atomization in complex geometries. *Atomization and Sprays*, 23(11):1001–1048, 2013.

[2] Mark Owkes and Olivier Desjardins. A discontinuous Galerkin conservative level set scheme for interface capturing in multiphase flows. *Journal of Computational Physics*, 249(15):275–302, September 2013.

[3] Mark Owkes and Olivier Desjardins. A computational framework for conservative, three-dimensional, unsplit, geometric transport with application to the volume-of-fluid (VOF) method. *Journal of Computational Physics*, 270(1):587–612, August 2014.

[4] Mark Owkes and Olivier Desjardins. A mesh-decoupled height function method for computing interface curvature. *Journal of Computational Physics*, 281:285–300, January 2015.

APPENDIX: EXAMPLE CODE

This work used the following MATLAB code to produce basically nothing. But, I'll include it here for the sake of an example.

```
% MATLAB code to say 'hello world'
disp('Hello world')
```