

A THESIS WITH A LONG TITLE
REQUIRING TWO LINES

A Thesis

Presented to

The Faculty of the Department of Mathematics
California State University, Los Angeles

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Mathematics

By

John Q. Student

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The thesis of John Q. Student is approved.

A. Committee Chair, Committee Chair

A. Professor

B. Professor

C. Professor

A. Department Chair, Department Chair

California State University, Los Angeles

June 2015

ABSTRACT

A Thesis with a Long Title

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By

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The abstract should be 150 words or less. Avoid mathematical jargon and complicated formulas that cannot be understood by the associate dean.

This abstract should be the same as the one submitted and approved with the GS-12 form. Check with your graduate student advisor if you make changes from the original abstract.

ACKNOWLEDGMENTS

Acknowledgments go here if needed.

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CHAPTER 1

How to Use this Thesis Template

The Office of Graduate Studies sets requirements for the form of your thesis. These requirements, and much more about deadlines and the submission process, can be found at <http://www.calstatela.edu/graduatethesis>. Questions and suggestions regarding this template can be directed to Gary Brookfield (gbrookf@calstatela.edu) in Math or Arturo Pacheco-Vega (apacheco@calstatela.edu) in Engineering.

In theory, you can take this template, insert your own title, abstract, chapters, graphics, committee member names, etc. and then not have to worry about the margins, pagination, the formats of the title page, copyright page, references, appendices, etc. How to do this is explained in this .pdf document, and also in the \LaTeX source file `CSULAThesisTemplate.tex` that generated it.

This document does not teach how to use \LaTeX —that’s way to complicated. If you are new to \LaTeX , you should probably start at the Consolidated \TeX Archive Network at ctan.org. There you can download all software you need (for free). Click on “Starting out with \TeX ” on the “Cover” dropdown menu.

This template is based on the \LaTeX book document class, so the thesis is divided into front matter and main matter. The front matter includes the Title page, Copyright page, Approval page, Abstract, Acknowledgments, Table of Contents, List of Tables and List of Figures. All of these pages, except Abstract and Acknowledgments, are generated automatically by the template if you enter some names, dates and the title of your thesis etc. Look for the following lines in `CSULAThesisTemplate.tex` and edit:

```

\author{John Q.~Student}%
\department{Mathematics}%
\title{A Thesis with a Long Title\\Requiring Two Lines}%
\thesisdate{2014}{June}{30}%
\departmentchair{A.~Department Chair}
\committeechair{A.~Committee Chair}
\member{A.~Professor}%
\member{B.~Professor}
\member{C.~Professor}
%\member{D.~Professor}

```

The thesis title should be mixed upper and lower case in the `\title` command. It will be converted to all caps for the Title page, and left as is for the Abstract.

The template allows up to four committee members, in addition to the committee chair. Just add or delete `\member{...}` lines as needed. Contrary to some information available online, the committee names may now (Dec 2014) include either honorifics (e.g., Dr.) OR their highest degree(s) or licensure (e.g., PhD) OR nothing at all but their names. Whatever you chose, or your committee prefers, it should be consistent for all names.

Front matter pages are numbered i, ii, iii, etc., except that the first page, the Title page, gets no number.

The main matter is divided into chapters. Each chapter begins with the command `\chapter{Chapter Name}`. \LaTeX worries about the numbering of the chapters and generating of a Table of Contents entry. Information about how theorems, lemmas, sections, subsections and figures are numbered and used is available in later chapters and in the \LaTeX file itself.

The university requires that all text in the thesis be 12pt - including heads. This is not the default format in the book document class. So this template redefines

the commands formatting chapter and section headings. It also changes the way chapters, sections, etc. are listed in the Table of Contents.

CHAPTER 2

Theorems, Propositions, Lemmas, etc.

The university expects chapter names to be in lower case as above. Here is a numbered equation to start the second chapter:

$$x = \rho\tau - \rho^2 \sin \frac{\tau}{\rho} \quad \text{and} \quad y = \rho^2 \left(1 - \cos \frac{\tau}{\rho} \right) \quad (2.1)$$

This equation cannot be found in [1] or in [3, Chapter 1]. This template provides environments for theorems, propositions, corollaries, lemmas, remarks, examples and definitions. For example:

Theorem 2.1. *Here is a theorem. Theorems and similar environments are set in italic.*

Proof. Here's the proof of Theorem 2.1 with a reference to equation (2.1) and the same equation (B.1) in an appendix. □

Theorem 2.1 and its proof were created by

```
\begin{theorem}\label{th1}
Here is a theorem. Theorems and similar environments are
set in italic.
\end{theorem}

\begin{proof}
Here's the proof of \tref{th1} with a reference to
equation~\eqref{eq0} and the same equation~\eqref{eqappB} in
the appendix.
\end{proof}
```

See the L^AT_EX file for an explanation of the `\tref` command. The other environments are made similarly—replacing the word `theorem` by `proposition`, `corollary`, `lemma`, `remark`, `example` or `definition`.

Lemma 2.2. *Here is a lemma containing a list made with `\begin{enumerate}` and `\end{enumerate}`.*

- (1) *This enumerated list has three items.*
- (2) *Since this list is inside a `lemma` environment, the items would normally be numbered as 1., 2., 3. This looks terribly wrong. The template changes the enumeration to (1), (2), (3) instead.*
- (3) (a) *A subenumeration with two items numbered as (a), (b), rather than (a), (b), which is the default.*
 - (b) *The second item in the subenumeration.*

Theorem 2.3. *Here is another theorem.*

Definition 2.4. *Here is a definition.*

Example 2.5. And now an example. Examples and remarks are not set in italics.

Note that theorems, propositions, corollaries, lemmas, remarks, examples and definitions are numbered together within each chapter. Equations are numbered within each chapter, independently of theorems, propositions, etc.

2.1 A Section Name Containing Mathematics: $\Phi_n(x)$.

Here is a section within Chapter 2. The university doesn't specify how section titles should be formatted—what you see here is the default format in the book document class. To avoid trouble it may be smart to avoid sections

Note that the math in the section name is written with dollar signs, $\Phi_n(x)$, rather than `\(\Phi_n(x) \)`. This is a general rule for chapter and section names, as well as for figure and table captions. (But then maybe you already use dollar signs

for all your math, contrary to the L^AT_EX philosophy.)

Sections are numbered within the chapter, but independently of theorems and equations. Here is the second numbered equation in this chapter.

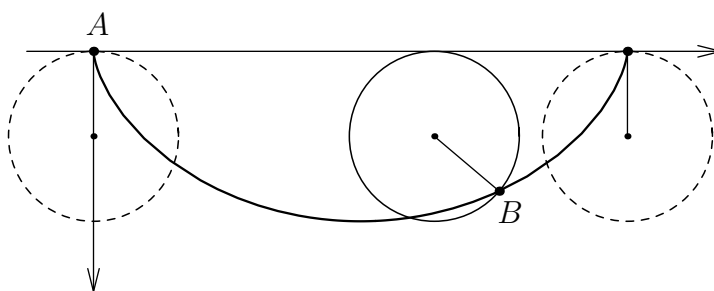
$$x = \rho\tau - \rho^2 \sin \frac{\tau}{\rho} \quad \text{and} \quad y = \rho^2 \left(1 - \cos \frac{\tau}{\rho} \right) \quad (2.2)$$

Lemma 2.6. *Here is another lemma—numbered within the chapter not the section.*

CHAPTER 3

Graphics

Here is an example of a graphic inserted into the document: The graphic is in the file `cycloid.pdf` in Portable Document Format. The package `graphicx` that was loaded at the beginning of this \LaTeX file is needed to make the insertion of graphics work right.



The symbols A and B are not part of the graphic. They are put on top of the graphic by \LaTeX in a `picture` environment. This seems to be the only way to guarantee that the symbols in the graphic are identical in size, font and weight to the same symbols in the text. Here's how this graphic was created:

```
\[ \includegraphics{cycloid}
  \begin{picture}(0,0)
    \put(-255,107){\(\ A \)}
    \put(-100,36){\(\ B \)}
  \end{picture}
\]
```

WARNING: The university seems to prefer that all graphics are placed in `figure` environments as described in the next chapter.

CHAPTER 4

Figures and Tables

Figures and tables are floating bodies, meaning that they will appear (usually) at the top or the bottom of a page, independent of where they appear in the source. They are also numbered, have captions, and are listed in the List of Figures or List of Tables right after the Table of Contents. Fortunately \LaTeX does most of the work. If you do not have figures or tables in your thesis, delete the relevant parts of this template.

Here is an example of a figure made using

```
\begin{figure}[tbp]
  \centering
  \includegraphics{cycloid}
  \caption{A floating figure with a caption.}
  \label{fig1} %% \label needs to follow \caption
\end{figure}
```

Figure 4.1 is a float—it moves to the top or to the bottom of the page independent of where it is in the text. This is what you might want for a large table or graphic that would otherwise cause page break problems. But this is probably not what you want for a small graphic such as Figure 4.1. To make \LaTeX put the

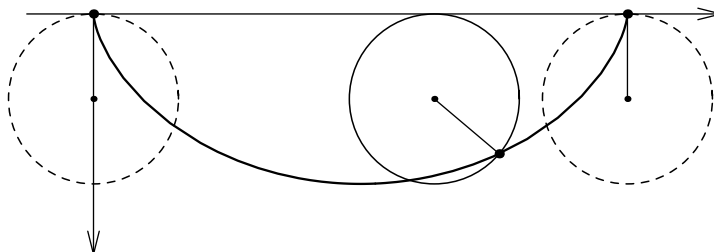


Figure 4.1: A floating figure with a caption.

+	0	1	a	b
0	0	1	a	b
1	1	0	b	a
a	a	b	0	1
b	b	a	1	0

Table 4.1: Addition table for \mathbb{F}_4 .

figure within the text surrounding the `figure` environment, replace the option `[tbp]` by `[h]`. Here is the same figure embedded in the middle of a sentence using the `[h]`

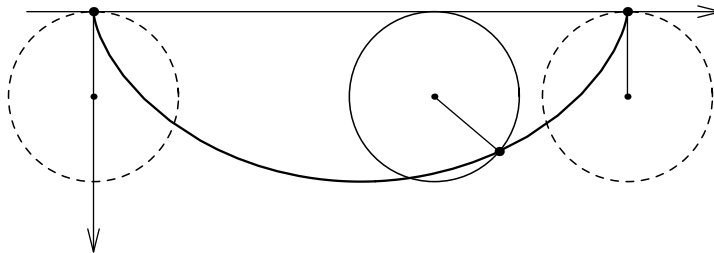


Figure 4.2: This is a non-floating cycloid figure with a caption so long that it needs two lines here and in the List of Figures.

option. Perhaps between paragraphs would be a better place for floats.

Table 4.1 is a table float. It appears at the top of the page even though it appears in the source file right here.

The table environment is essentially the same as the figure environment. The main difference is that figures are listed in the List of Figures and tables are listed in the List of Tables.

WARNING: I am told that the most common format issue students have when submitting the thesis is keeping within the margins. Make sure that your tables, figures, and equations fit within the 1.25 inch right and left margins.

REFERENCES

- [1] R. H. Crowell and R. H. Fox, *Introduction to Knot Theory*, Graduate Texts in Mathematics Vol. 57, Springer-Verlag, 1977.
- [2] N. Johnson, *The Brachistochrone Problem*, College Math J., **35**, No 3, (2004), 192–197.
- [3] L. Kappe and B. Warren, *An Elementary Test for the Galois Group of a Quartic Polynomial*, Amer. Math. Monthly, **96**, (1989), 133–137.
- [4] C. Maclachlan, A. W. Reid, *The Arithmetic of Hyperbolic 3-Manifolds*, Graduate Texts in Mathematics Vol. 219, Springer-Verlag, 2003.
- [5] J. R. Munkres, *Topology*, 2nd ed., Prentice Hall, 2000.
- [6] S. Rees, *Knot Theory: The Knot Group and its Wirtinger Presentation*, Course material for MAS265 at the University of Newcastle, 2003,
http://www.mas.ncl.ac.uk/~nser/teaching/265/265_chap10.pdf
- [7] K. Reidemeister, *Knot Theory*, translated by L. Boron, C. Christiansen and B. Smith, BCS Associates, 1983. Originally published as *Knotentheorie*, Ergebnisse der Mathematik und Ihrer Grenzgebiete, (Alte Folge), Band 1, Heft 1, 1938.
- [8] D. Rolfsen, *Knots and Links*, Mathematics Lecture Series 7, Publish or Perish Inc., 1976, pp. 56–63.
- [9] F. Y. M. Wan, *An Introduction to the Calculus of Variations and its Applications*, Chapman & Hall, 1995.

Each math journal has its own rules about the order and formatting of the entries in a list of references, but the university has no special requirements of its own. In the absence of better guidance (perhaps from your thesis supervisor), you can use the following rules:

- (1) The reference list should be alphabetized by the first author's last name.
- (2) **Journal articles:** List author(s), title in italic, journal name (usually abbreviated), volume in bold, issue number if needed, year in parentheses, and page numbers. The page numbers are separated by an en-dash like this: 12--24.
- (3) **Books:** List author(s), title in italic, series name and number if needed, publisher, year. It is common to follow the publisher's name by its address, for example, Springer-Verlag, New York-Heidelberg-Berlin. This convention is no longer useful. (Your thesis supervisor may disagree!)
- (4) To be careful, there should be a tilde ~ between an author's initials and his/her name, for example, D.~Rolfson, so that LaTeX doesn't think that the period is the end of a sentence and put in a bit of extra space. (This advice applies to the entire thesis, not just the list of references.)
- (5) The university seems to prefer consistency about the use of first names or initials of authors. Probably easier to use initials only.

APPENDIX A

The First Appendix

Appendices are just chapters that are numbered A, B, C, etc. Theorems, sections and equations are numbered A.1, A.2, etc. within this appendix.

Theorem A.1. *This is a theorem in Appendix A.*

A.1 A Section within Appendix A

And an equation within Appendix A:

$$\Phi(\rho, \tau) = \begin{cases} \rho\tau - \rho^2 \sin \frac{\tau}{\rho} & \text{if } \rho > 0 \\ \rho^2 \left(1 - \cos \frac{\tau}{\rho}\right) & \text{if } \rho < 0 \end{cases} \quad (\text{A.1})$$

If you need only one appendix, the university wants it called “Appendix” rather than “Appendix A”. This makes it unclear how theorems, lemmas, equations, tables and figures are supposed to be numbered in the appendix. You may have to discuss this with the Office of Graduate Studies.

APPENDIX B

The Second Appendix

This is the second appendix. Theorems, sections and equations within this appendix are numbered B.1, B.2, etc.

Theorem B.1. *This is a theorem in Appendix B.*

B.1 A Section within Appendix B

And an equation too:

$$x = \rho\tau - \rho^2 \sin \frac{\tau}{\rho} \quad \text{and} \quad y = \rho^2 \left(1 - \cos \frac{\tau}{\rho}\right) \quad (\text{B.1})$$

It is the same equation as in Appendix A. See (A.1).