



SYDDANSK UNIVERSITET

BACHELOR THESIS

Thesis Title

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“Thanks to my solid academic training, today I can write hundreds of words on virtually any topic without possessing a shred of information, which is how I got a good job in journalism.”

Dave Barry

SYDDANSK UNIVERSITET

Abstract

Faculty of Engineering
The Maersk Mc-Kinney Moller Institute

Bachelor degree in Spiludvikling og læringsteknologi

Thesis Title

by John SMITH

Summary of the report, including the problem, methodology, results, and conclusions (150-250 words). If applicable, include a link to a video of the project.

Acknowledgements

The acknowledgments and the people to thank go here, don't forget to include your project advisor...

Contents

Abstract	iii
Acknowledgements	v
1 Introduction	1
2 Literature review	3
3 Method/Implementation	5
3.1 Iteration X	5
3.1.1 About	5
3.1.2 Evaluation	6
3.1.3 Reflections and decisions	6
3.2 Final iteration	6
4 Evaluation	7
5 Results	9
6 Discussion	11
7 Conclusions	13
A Other useful tips	15
A.1 References	15
A.2 Figures and Tables	15
A.3 Code snippets	16
A.4 Footnotes	17
B Template guide	19
B.1 Welcome and Thank You	19
B.2 Learning L ^A T _E X	19
B.2.1 A (not so short) Introduction to L ^A T _E X	19
B.2.2 A Short Math Guide for L ^A T _E X	20
B.2.3 Common L ^A T _E X Math Symbols	20
B.2.4 L ^A T _E X on a Mac	20
B.3 Getting Started with this Template	20
B.3.1 About this Template	20
B.4 What this Template Includes	21
B.4.1 Folders	21
B.4.2 Files	21
B.5 Filling in Your Information in the <code>main.tex</code> File	22
B.6 The <code>main.tex</code> File Explained	23
B.7 Thesis Features and Conventions	24

B.7.1	Printing Format	24
B.7.2	Using US Letter Paper	24
B.7.3	References	24
	A Note on bibtex	25
B.7.4	Tables	25
B.7.5	Figures	25
B.7.6	Typesetting mathematics	27
B.8	Sectioning and Subsectioning	27
B.9	In Closing	28
	Bibliography	29

List of Figures

A.1 Example of a figure caption.	16
B.1 An Electron	26

List of Tables

A.1 Table Type Styles	16
B.1 The effects of treatments X and Y on the four groups studied.	26

List of Abbreviations

LAH List Abbreviations **Here**
WSF What (it) Stands For

Physical Constants

Speed of Light $c_0 = 2.997\,924\,58 \times 10^8 \text{ m s}^{-1}$ (exact)

List of Symbols

a	distance	m
P	power	W (J s ⁻¹)
ω	angular frequency	rad

For/Dedicated to/To my...

Chapter 1

Introduction

The purpose of this section is make the reader interested and informed in the project.

- Background of the project: what is the problem domain? A paragraph or two to give relevant factual information about what we are talking about. Ideally this should allow non-experts to more or less understand what the report is about.
- What is the problem, why is it a problem, and why is it important? (Is it something that hasn't been studied yet? Is there an unsolved issue? Previous work presents inconclusive/contradicting results? Is there a new technology we can leverage to gain more knowledge?). One or two paragraphs.
- Objectives of the report: what is your actual goal? What are you hoping to achieve? About one paragraph.
- How do you plan on achieving your goal? This is where you want to define your research questions and hypotheses. When you define these, you are forming the basis of your project, and should be the focus of the rest of the text. If you have a very broad RQ, try to break it down in smaller, more quantifiable questions. As an example:
 - H: Games can help teaching math to young pupils
 - RQ1: How can we design a game that includes math concepts while still being entertaining to young pupils?
 - RQ2: How well does it compare with traditional educational materials?

Chapter 2

Literature review

The purpose of this section is to summarize previous work in the area you are working on and describe key theories and techniques that you are going to use.

- What are the main theories and techniques that relate to your project? Have one or two paragraph for each, giving a summary of what they are and how they relate to your project. For example, these could be a theory that you use for the design of your project (e.g., gamification concepts), theories/methods that you use in the implementation (e.g., some AI technique), or theories/methods that you use in the evaluation of your project (e.g., flow theory, methods of user testing like A/B testing).
- Summary of existing studies and research on the topic. What has been done before? What other work relates to yours and how. For example: “Woodstock et al. developed a game built around algebra concepts [1] but haven’t provided a study to evaluate the efficacy of the game in a learning context”.

Chapter 3

Method/Implementation

This is likely going to be the largest part of the report. Here you want to describe the full process you went through in implementing the solution to your problem. Ideally this should be detailed enough that somebody else would be able to reproduce your work in case you drop dead. Keep in mind that, while we provide a general structure here, it could need some modifications depending on the course you are writing for.

Warning: depending on the course, coding highlights should also be included. Usually only highlighting solutions to specifically complex problems.

3.1 Iteration X

You will often go through various iterations of product/game design, duplicate this subsection for each iteration before the final one.

- Usually, iteration 1 would be a low fidelity prototype.
- Iteration 2 could be a high-fidelity prototype (vertical slice or functional prototype).
- Iteration 3 or later are refinements (extended functionality, improvements/polish, usability tweaks, bug-fixing) or the final product.

3.1.1 About

Describe what this iteration was all about.

- What is the purpose of this iteration?
- What were the goals?
- Describe and justify design decisions. For example, “we implemented feature X because it relates to gamification concept Y”, or “in the previous iteration we identified issues with the user interface, so we reworked by changing X, Y, and Z.”
- Include images/sketches.

3.1.2 Evaluation

Describe how you evaluated this iteration, for example what kind of user testing or technical testing you conducted. This should include:

- Test design: explain what is the objective of the study: what kind of information are you trying to obtain? What kind of study did you conduct? (Usability test, playtest, something more related to your RQs, etc.?) Did you use a specific established methodology? Usually this is not a very large part and serves as an introduction to your test.
- Test methodology: this is usually a larger part where you need to provide all the details of how you conducted your test.
 - How did you structure the test? For example, “The participant played the game while doing think-aloud, then compiled a survey.”
 - Ethical reflections: is there some problematic aspect that you had to address? If so, how did you address it? How are you compliant with GDPR laws?
 - Technical details: where did you conduct the study? What hardware was used?
 - Detailed information about the test. For example, if you used a survey, what questions were included? If you conducted interviews, how did you structure them? How did you collect the data?
- Results of the test
 - How many participants did you have?
 - What are some basic demographics for the participants?
 - Present the data collected (use tables and graphs, rather than text).
 - Make sure you mention what statistical methods you use (and why).

3.1.3 Reflections and decisions

In this section describe how are you using the results you described in the previous section to further your development, to answer your research questions, or in general to evaluate your project (this last part is mostly relevant for the final iteration)

- How do you interpret the results you just described? What do they mean?
- How are you planning to use these in the following iteration?

3.2 Final iteration

This section describes the final tweaks you applied from the previous iteration. Show the main differences and describe the features of the final product (just like the “About” section in the previous iterations)

Chapter 4

Evaluation

Warning: we suggest that the final evaluation of your project should have its own section rather than being in the Method/Implementation one.

This section, while structured the same as the Evaluation section defined before, should deal with the study conducted on the final product of your project. **This study must address your research questions.**

Chapter 5

Results

Again, same content as the results section described before, but it's expected that this section will be larger and more thorough than the ones for the intermediate iterations. Remember to use appropriate methods and statistical tests to provide an analysis. Make sure you respond to each research question/hypothesis!

Chapter 6

Discussion

Note on opinions: by default, try to avoid opinions, you want to base everything on facts or previous literature. The discussion section is the exception to that rule: here we want to see what your interpretation of the results is (but this should still be based on the results you obtained)

This is the section in which you want to tell the reader what the results you obtained mean, and where you want to convince the reader that you did in fact answer your research questions.

Remember to use appropriate methods and statistical tests to provide an analysis of the results and **make sure you respond to each research question/hypothesis!**

Tell the reader what is bad about your study (are there some limitations? Maybe you didn't have enough participants to have some strong results? Maybe your participants are not representative of the target population? Maybe you realized the testing methods you used have some pitfalls?) How do you expect these limitations might affect your results?

What is good about your study? (Are there some strengths to it? Did you do something particularly smart? Did you use some innovative equipment?)

Can your results compare to existing literature? Why yes/no? If yes, how do they compare? Limit this to a brief summary of how your results fit with the existing knowledge.

Chapter 7

Conclusions

Your final considerations:

- Very shortly, what did you find out?
- What can this be used for? Here you want to revisit the problem domain you described in the introduction and tell us how your results fit in.
- What would be the next step in this avenue of research (if any)?

Appendix A

Other useful tips

A.1 References

The reference style to use is the IEEE one, below we provide a short summary, for more information check out <https://ieeeauthorcenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf> and the style guide.

The style guide adds referenced directly in the LaTeX file, but I suggest you use BibTeX instead. This document is set up to provide an example of BibTeX usage. The main difference is that the bibliography is stored separately (see the biblio.bib file). BibTeX provides various advantages compared with the example in the style guide, the main ones is that the order of references in the bib file doesn't matter (the references are properly ordered every time you compile the document) and that you if you don't cite a reference it is not included in the final document automatically. References are also formatted automatically to match the IEEE style.

Citations must be numbered consecutively within brackets according to when they are cited in the text [2]; this is all done/updated automatically when you use the \cite command. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”. The order of the references in the bibliography should follow the order of citation in the report, i.e. the first paper you cite will be the first in the references, the second one the second, etc. Thankfully that is done automatically by LaTeX: try to delete the citation in the literature review section and see how the numbers are updated as you recompile the project.

The reference is usually immediately after the referred theory, algorithm, author, etc. If you refer to the whole sentence or paragraph, put the reference at the end (before full stop, if it refers only to the previous sentence, after the full stop if it refers to the paragraph).

If you express somebody else's ideas by your own words, then put the reference immediately after the idea. If you express somebody's ideas by her/his own words, then it is a quote, remember to use quotation marks “...”!

If you want to reference to something that is not an academic paper (like a webpage) use a footnote instead. See appendix A.4 for how to format footnotes.

A.2 Figures and Tables

Figures and tables should be only at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text, or at most

TABLE A.1: Table Type Styles

Table Head	Table Column Head		
	<i>Table column subhead</i>	<i>Subhead</i>	<i>Subhead</i>
copy	More table copy ^a		

^aSample of a Table footnote.



FIGURE A.1: Example of a figure caption.

on the same page. Use the abbreviation “Fig. **A.1**”, even at the beginning of a sentence.

Remember that you can use labels and the `\ref` command to have LaTeX update the number automatically if you move figures/tables around. See the previous paragraph (in the code) for an example.

A.3 Code snippets

The easiest way to add code to the report is to take a screenshot and add it as if it was a figure.

Another option is to add the code directly, for example using the listings package. Here follows an example:

```
public class Player : MonoBehaviour
{
    void Start()
    {

    }

    void Update()
    {

    }
}
```

You might also want to check out the **minted** package, which has nice syntax highlighting but might require some extra steps in running your compilation¹.

¹<https://tex.stackexchange.com/questions/99475/how-to-invoke-latex-with-the-shell-escape-flag-in-tex>

A.4 Footnotes

You can add footnotes by using the `\footnote` command. That will add a new footnote automatically and number it in the text like this². Remember to use footnotes if you want to reference non-academic documents, such as links. For example, “We used a C# machine learning variable to implement an artificial neural network³.” Do not put footnotes in the abstract or reference list. Use letters instead of numbers if you need table footnotes.

²This is a footnote.

³<https://www.ml-library.org>

Appendix B

Template guide

B.1 Welcome and Thank You

Welcome to this L^AT_EX Thesis Template, a beautiful and easy to use template for writing a thesis using the L^AT_EX typesetting system.

If you are writing a thesis (or will be in the future) and its subject is technical or mathematical (though it doesn't have to be), then creating it in L^AT_EX is highly recommended as a way to make sure you can just get down to the essential writing without having to worry over formatting or wasting time arguing with your word processor.

L^AT_EX is easily able to professionally typeset documents that run to hundreds or thousands of pages long. With simple mark-up commands, it automatically sets out the table of contents, margins, page headers and footers and keeps the formatting consistent and beautiful. One of its main strengths is the way it can easily typeset mathematics, even *heavy* mathematics. Even if those equations are the most horribly twisted and most difficult mathematical problems that can only be solved on a super-computer, you can at least count on L^AT_EX to make them look stunning.

B.2 Learning L^AT_EX

L^AT_EX is not a WYSIWYG (What You See is What You Get) program, unlike word processors such as Microsoft Word or Apple's Pages. Instead, a document written for L^AT_EX is actually a simple, plain text file that contains *no formatting*. You tell L^AT_EX how you want the formatting in the finished document by writing in simple commands amongst the text, for example, if I want to use *italic text for emphasis*, I write the `\emph{text}` command and put the text I want in italics in between the curly braces. This means that L^AT_EX is a "mark-up" language, very much like HTML.

B.2.1 A (not so short) Introduction to L^AT_EX

If you are new to L^AT_EX, there is a very good eBook – freely available online as a PDF file – called, "The Not So Short Introduction to L^AT_EX". The book's title is typically shortened to just *lshort*. You can download the latest version (as it is occasionally updated) from here: <http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf>

It is also available in several other languages. Find yours from the list on this page: <http://www.ctan.org/tex-archive/info/lshort/>

It is recommended to take a little time out to learn how to use L^AT_EX by creating several, small 'test' documents, or having a close look at several templates on:

<http://www.LaTeXTemplates.com>

Making the effort now means you're not stuck learning the system when what you *really* need to be doing is writing your thesis.

B.2.2 A Short Math Guide for L^AT_EX

If you are writing a technical or mathematical thesis, then you may want to read the document by the AMS (American Mathematical Society) called, "A Short Math Guide for L^AT_EX". It can be found online here: <http://www.ams.org/tex/amslatex.html> under the "Additional Documentation" section towards the bottom of the page.

B.2.3 Common L^AT_EX Math Symbols

There are a multitude of mathematical symbols available for L^AT_EX and it would take a great effort to learn the commands for them all. The most common ones you are likely to use are shown on this page: <http://www.sunilpatel.co.uk/latex-type/latex-math-symbols/>

You can use this page as a reference or crib sheet, the symbols are rendered as large, high quality images so you can quickly find the L^AT_EX command for the symbol you need.

B.2.4 L^AT_EX on a Mac

The L^AT_EX distribution is available for many systems including Windows, Linux and Mac OS X. The package for OS X is called MacTeX and it contains all the applications you need – bundled together and pre-customized – for a fully working L^AT_EX environment and work flow.

MacTeX includes a custom dedicated L^AT_EX editor called TeXShop for writing your '.tex' files and BibDesk: a program to manage your references and create your bibliography section just as easily as managing songs and creating playlists in iTunes.

B.3 Getting Started with this Template

If you are familiar with L^AT_EX, then you should explore the directory structure of the template and then proceed to place your own information into the *THESIS INFORMATION* block of the `main.tex` file. You can then modify the rest of this file to your unique specifications based on your degree/university. Section B.5 on page 22 will help you do this. Make sure you also read section B.7 about thesis conventions to get the most out of this template.

If you are new to L^AT_EX it is recommended that you carry on reading through the rest of the information in this document.

Before you begin using this template you should ensure that its style complies with the thesis style guidelines imposed by your institution. In most cases this template style and layout will be suitable. If it is not, it may only require a small change to bring the template in line with your institution's recommendations. These modifications will need to be done on the `MastersDoctoralThesis.cls` file.

B.3.1 About this Template

This L^AT_EX Thesis Template is originally based and created around a L^AT_EX style file created by Steve R. Gunn from the University of Southampton (UK), department

of Electronics and Computer Science. You can find his original thesis style file at his site, here: <http://www.ecs.soton.ac.uk/~srg/softwaretools/document/templates/>

Steve's `ecsthesis.cls` was then taken by Sunil Patel who modified it by creating a skeleton framework and folder structure to place the thesis files in. The resulting template can be found on Sunil's site here: <http://www.sunilpatel.co.uk/thesis-template>

Sunil's template was made available through <http://www.LaTeXTemplates.com> where it was modified many times based on user requests and questions. Version 2.0 and onwards of this template represents a major modification to Sunil's template and is, in fact, hardly recognisable. The work to make version 2.0 possible was carried out by **Vel** and Johannes Böttcher.

B.4 What this Template Includes

B.4.1 Folders

This template comes as a single zip file that expands out to several files and folders. The folder names are mostly self-explanatory:

Appendices – this is the folder where you put the appendices. Each appendix should go into its own separate `.tex` file. An example and template are included in the directory.

Chapters – this is the folder where you put the thesis chapters. A thesis usually has about six chapters, though there is no hard rule on this. Each chapter should go in its own separate `.tex` file and they can be split as:

- Chapter 1: Introduction to the thesis topic
- Chapter 2: Background information and theory
- Chapter 3: (Laboratory) experimental setup
- Chapter 4: Details of experiment 1
- Chapter 5: Details of experiment 2
- Chapter 6: Discussion of the experimental results
- Chapter 7: Conclusion and future directions

This chapter layout is specialised for the experimental sciences, your discipline may be different.

Figures – this folder contains all figures for the thesis. These are the final images that will go into the thesis document.

B.4.2 Files

Included are also several files, most of them are plain text and you can see their contents in a text editor. After initial compilation, you will see that more auxiliary files are created by $\text{\LaTeX}$ or BibTeX and which you don't need to delete or worry about:

example.bib – this is an important file that contains all the bibliographic information and references that you will be citing in the thesis for use with BibTeX. You can write it manually, but there are reference manager programs available that will create and manage it for you. Bibliographies in $\text{\LaTeX}$ are a large subject and you

may need to read about BibTeX before starting with this. Many modern reference managers will allow you to export your references in BibTeX format which greatly eases the amount of work you have to do.

MastersDoctoralThesis.cls – this is an important file. It is the class file that tells L^AT_EX how to format the thesis.

main.pdf – this is your beautifully typeset thesis (in the PDF file format) created by L^AT_EX. It is supplied in the PDF with the template and after you compile the template you should get an identical version.

main.tex – this is an important file. This is the file that you tell L^AT_EX to compile to produce your thesis as a PDF file. It contains the framework and constructs that tell L^AT_EX how to layout the thesis. It is heavily commented so you can read exactly what each line of code does and why it is there. After you put your own information into the *THESIS INFORMATION* block – you have now started your thesis!

Files that are *not* included, but are created by L^AT_EX as auxiliary files include:

main.aux – this is an auxiliary file generated by L^AT_EX, if it is deleted L^AT_EX simply regenerates it when you run the main .tex file.

main.bbl – this is an auxiliary file generated by BibTeX, if it is deleted, BibTeX simply regenerates it when you run the main.aux file. Whereas the .bib file contains all the references you have, this .bbl file contains the references you have actually cited in the thesis and is used to build the bibliography section of the thesis.

main.blg – this is an auxiliary file generated by BibTeX, if it is deleted BibTeX simply regenerates it when you run the main .aux file.

main.lof – this is an auxiliary file generated by L^AT_EX, if it is deleted L^AT_EX simply regenerates it when you run the main .tex file. It tells L^AT_EX how to build the *List of Figures* section.

main.log – this is an auxiliary file generated by L^AT_EX, if it is deleted L^AT_EX simply regenerates it when you run the main .tex file. It contains messages from L^AT_EX, if you receive errors and warnings from L^AT_EX, they will be in this .log file.

main.lot – this is an auxiliary file generated by L^AT_EX, if it is deleted L^AT_EX simply regenerates it when you run the main .tex file. It tells L^AT_EX how to build the *List of Tables* section.

main.out – this is an auxiliary file generated by L^AT_EX, if it is deleted L^AT_EX simply regenerates it when you run the main .tex file.

So from this long list, only the files with the .bib, .cls and .tex extensions are the most important ones. The other auxiliary files can be ignored or deleted as L^AT_EX and BibTeX will regenerate them.

B.5 Filling in Your Information in the main.tex File

You will need to personalise the thesis template and make it your own by filling in your own information. This is done by editing the main.tex file in a text editor or your favourite LaTeX environment.

Open the file and scroll down to the third large block titled *THESIS INFORMATION* where you can see the entries for *University Name*, *Department Name*, etc ...

Fill out the information about yourself, your group and institution. You can also insert web links, if you do, make sure you use the full URL, including the http:// for this. If you don't want these to be linked, simply remove the \href{url}{name} and only leave the name.

When you have done this, save the file and recompile `main.tex`. All the information you filled in should now be in the PDF, complete with web links. You can now begin your thesis proper!

B.6 The `main.tex` File Explained

The `main.tex` file contains the structure of the thesis. There are plenty of written comments that explain what pages, sections and formatting the $\text{\LaTeX}$ code is creating. Each major document element is divided into commented blocks with titles in all capitals to make it obvious what the following bit of code is doing. Initially there seems to be a lot of $\text{\LaTeX}$ code, but this is all formatting, and it has all been taken care of so you don't have to do it.

Begin by checking that your information on the title page is correct. For the thesis declaration, your institution may insist on something different than the text given. If this is the case, just replace what you see with what is required in the `DECLARATION PAGE` block.

Then comes a page which contains a funny quote. You can put your own, or quote your favourite scientist, author, person, and so on. Make sure to put the name of the person who you took the quote from.

Following this is the abstract page which summarises your work in a condensed way and can almost be used as a standalone document to describe what you have done. The text you write will cause the heading to move up so don't worry about running out of space.

Next come the acknowledgements. On this page, write about all the people who you wish to thank (not forgetting parents, partners and your advisor/supervisor).

The contents pages, list of figures and tables are all taken care of for you and do not need to be manually created or edited. The next set of pages are more likely to be optional and can be deleted since they are for a more technical thesis: insert a list of abbreviations you have used in the thesis, then a list of the physical constants and numbers you refer to and finally, a list of mathematical symbols used in any formulae. Making the effort to fill these tables means the reader has a one-stop place to refer to instead of searching the internet and references to try and find out what you meant by certain abbreviations or symbols.

The list of symbols is split into the Roman and Greek alphabets. Whereas the abbreviations and symbols ought to be listed in alphabetical order (and this is *not* done automatically for you) the list of physical constants should be grouped into similar themes.

The next page contains a one line dedication. Who will you dedicate your thesis to?

Finally, there is the block where the chapters are included. Uncomment the lines (delete the `%` character) as you write the chapters. Each chapter should be written in its own file and put into the *Chapters* folder and named `Chapter1`, `Chapter2`, etc... Similarly for the appendices, uncomment the lines as you need them. Each appendix should go into its own file and placed in the *Appendices* folder.

After the preamble, chapters and appendices finally comes the bibliography. The bibliography style (called *authoryear*) is used for the bibliography and is a fully featured style that will even include links to where the referenced paper can be found online. Do not underestimate how grateful your reader will be to find that a reference to a paper is just a click away. Of course, this relies on you putting the URL information into the BibTeX file in the first place.

B.7 Thesis Features and Conventions

To get the best out of this template, there are a few conventions that you may want to follow.

One of the most important (and most difficult) things to keep track of in such a long document as a thesis is consistency. Using certain conventions and ways of doing things (such as using a Todo list) makes the job easier. Of course, all of these are optional and you can adopt your own method.

B.7.1 Printing Format

This thesis template is designed for double sided printing (i.e. content on the front and back of pages) as most theses are printed and bound this way. Switching to one sided printing is as simple as uncommenting the *oneside* option of the `documentclass` command at the top of the `main.tex` file. You may then wish to adjust the margins to suit specifications from your institution.

The headers for the pages contain the page number on the outer side (so it is easy to flick through to the page you want) and the chapter name on the inner side.

The text is set to 11 point by default with single line spacing, again, you can tune the text size and spacing should you want or need to using the options at the very start of `main.tex`. The spacing can be changed similarly by replacing the *singlespacing* with *onehalfspacing* or *doublespacing*.

B.7.2 Using US Letter Paper

The paper size used in the template is A4, which is the standard size in Europe. If you are using this thesis template elsewhere and particularly in the United States, then you may have to change the A4 paper size to the US Letter size. This can be done in the margins settings section in `main.tex`.

Due to the differences in the paper size, the resulting margins may be different to what you like or require (as it is common for institutions to dictate certain margin sizes). If this is the case, then the margin sizes can be tweaked by modifying the values in the same block as where you set the paper size. Now your document should be set up for US Letter paper size with suitable margins.

B.7.3 References

The `biblatex` package is used to format the bibliography and inserts references such as this one [4]. The options used in the `main.tex` file mean that the in-text citations of references are formatted with the author(s) listed with the date of the publication. Multiple references are separated by semicolons (e.g. [4, 5]) and references with more than three authors only show the first author with *et al.* indicating there are more authors (e.g. [6]). This is done automatically for you. To see how you use references, have a look at the `Chapter1.tex` source file. Many reference managers allow you to simply drag the reference into the document as you type.

Scientific references should come *before* the punctuation mark if there is one (such as a comma or period). The same goes for footnotes¹. You can change this but the most important thing is to keep the convention consistent throughout the thesis. Footnotes themselves should be full, descriptive sentences (beginning with a capital letter and ending with a full stop). The APA6 states: "Footnote numbers should be

¹Such as this footnote, here down at the bottom of the page.

superscripted, [...], following any punctuation mark except a dash.” The Chicago manual of style states: “A note number should be placed at the end of a sentence or clause. The number follows any punctuation mark except the dash, which it precedes. It follows a closing parenthesis.”

The bibliography is typeset with references listed in alphabetical order by the first author’s last name. This is similar to the APA referencing style. To see how L^AT_EX typesets the bibliography, have a look at the very end of this document (or just click on the reference number links in in-text citations).

A Note on bibtex

The bibtex backend used in the template by default does not correctly handle unicode character encoding (i.e. "international" characters). You may see a warning about this in the compilation log and, if your references contain unicode characters, they may not show up correctly or at all. The solution to this is to use the biber backend instead of the outdated bibtex backend. This is done by finding this in `main.tex`: `backend=bibtex` and changing it to `backend=biber`. You will then need to delete all auxiliary BibTeX files and navigate to the template directory in your terminal (command prompt). Once there, simply type `biber main` and biber will compile your bibliography. You can then compile `main.tex` as normal and your bibliography will be updated. An alternative is to set up your LaTeX editor to compile with biber instead of bibtex, see [here](#) for how to do this for various editors.

B.7.4 Tables

Tables are an important way of displaying your results, below is an example table which was generated with this code:

```
\begin{table}
\caption{The effects of treatments X and Y on the four groups studied.}
\label{tab:treatments}
\centering
\begin{tabular}{l l l}
\toprule
\thead{Groups} & \thead{Treatment X} & \thead{Treatment Y} \\
\midrule
1 & 0.2 & 0.8 \\
2 & 0.17 & 0.7 \\
3 & 0.24 & 0.75 \\
4 & 0.68 & 0.3 \\
\bottomrule
\end{tabular}
\end{table}
```

You can reference tables with `\ref{<label>}` where the label is defined within the table environment. See `Chapter1.tex` for an example of the label and citation (e.g. Table [B.1](#)).

B.7.5 Figures

There will hopefully be many figures in your thesis (that should be placed in the *Figures* folder). The way to insert figures into your thesis is to use a code template like this:

TABLE B.1: The effects of treatments X and Y on the four groups studied.

Groups	Treatment X	Treatment Y
1	0.2	0.8
2	0.17	0.7
3	0.24	0.75
4	0.68	0.3

```

\begin{figure}
\centering
\includegraphics{Figures/Electron}
\decoRule
\caption[An Electron]{An electron (artist's impression).}
\label{fig:Electron}
\end{figure}

```

Also look in the source file. Putting this code into the source file produces the picture of the electron that you can see in the figure below.



FIGURE B.1: An electron (artist's impression).

Sometimes figures don't always appear where you write them in the source. The placement depends on how much space there is on the page for the figure. Sometimes there is not enough room to fit a figure directly where it should go (in relation to the text) and so $\text{\LaTeX}$ puts it at the top of the next page. Positioning figures is the job of $\text{\LaTeX}$ and so you should only worry about making them look good!

Figures usually should have captions just in case you need to refer to them (such as in Figure B.1). The `\caption` command contains two parts, the first part, inside the square brackets is the title that will appear in the *List of Figures*, and so should be short. The second part in the curly brackets should contain the longer and more descriptive caption text.

The `\decoRule` command is optional and simply puts an aesthetic horizontal line below the image. If you do this for one image, do it for all of them.

L^AT_EX is capable of using images in pdf, jpg and png format.

B.7.6 Typesetting mathematics

If your thesis is going to contain heavy mathematical content, be sure that L^AT_EX will make it look beautiful, even though it won't be able to solve the equations for you.

The “Not So Short Introduction to L^AT_EX” (available on CTAN) should tell you everything you need to know for most cases of typesetting mathematics. If you need more information, a much more thorough mathematical guide is available from the AMS called, “A Short Math Guide to L^AT_EX” and can be downloaded from: <ftp://ftp.ams.org/pub/tex/doc/amsmath/short-math-guide.pdf>

There are many different L^AT_EX symbols to remember, luckily you can find the most common symbols in [The Comprehensive L^AT_EX Symbol List](#).

You can write an equation, which is automatically given an equation number by L^AT_EX like this:

```
\begin{equation}
E = mc^2
\label{eqn:Einstein}
\end{equation}
```

This will produce Einstein's famous energy-matter equivalence equation:

$$E = mc^2 \tag{B.1}$$

All equations you write (which are not in the middle of paragraph text) are automatically given equation numbers by L^AT_EX. If you don't want a particular equation numbered, use the unnumbered form:

```
\[ a^2=4 \]
```

B.8 Sectioning and Subsectioning

You should break your thesis up into nice, bite-sized sections and subsections. L^AT_EX automatically builds a table of Contents by looking at all the `\chapter{}`, `\section{}` and `\subsection{}` commands you write in the source.

The Table of Contents should only list the sections to three (3) levels. A `\chapter{}` is level zero (0). A `\section{}` is level one (1) and so a `\subsection{}` is level two (2). In your thesis it is likely that you will even use a `\subsubsection{}`, which is level three (3). The depth to which the Table of Contents is formatted is set within `MastersDoctoralThesis.cls`. If you need this changed, you can do it in `main.tex`.

B.9 In Closing

You have reached the end of this mini-guide. You can now rename or overwrite this pdf file and begin writing your own Chapter1.tex and the rest of your thesis. The easy work of setting up the structure and framework has been taken care of for you. It's now your job to fill it out!

Good luck and have lots of fun!

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Vel: LaTeXTemplates.com

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