Doctoral Dissertation

Doctoral Program in Energy Engineering (29thcycle)

Writing Your Ph.D. Thesis in LaTeX

Using the POLITO Template

By

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******

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2022

Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

<div align="right">

Mario Rossi
2022

</div>

I would like to dedicate this thesis to my loving parents

Acknowledgements

And I would like to acknowledge ...

Abstract

This is where you write your abstract ... (Max= 4000 characters)

Contents

Contents

List of Figures

List of Tables

Nomenclature

Roman Symbols

F complex function

Greek Symbols

γ a simply closed curve on a complex plane

ι unit imaginary number $\sqrt{-1}$

π $\simeq 3.14\ldots$

Superscripts

j superscript index

Subscripts

0   subscript index

Other Symbols

$\oint_\gamma$ integration around a curve γ

Acronyms / Abbreviations

CIF Cauchy's Integral Formula

Chapter 1

First Chapter Title

1.1 Introduction to PhD Thesis Template

Welcome to this LaTeX Thesis Template for writing your PhD thesis using the LaTeX 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 LaTeX is highly recommended.

LaTeX 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 LaTeX to make them look stunning [1, 2].Please see appendixA for the instruction to install LaTeX.

Along with this document you have access to LaTeX file (**Polito PhD thesis template.tex**) including different partitions: Preamble, Thesis info and etc. Inside each part there are instructive comments explaining the options for different commands. The default commands are designed and recommended by PhD school of Politecnico di Torino. In this tutorial the commands essential to write a scientific document are listed and explained briefly.

1.2   Getting Started with this Template

If you are familiar with LaTeX, then you should explore the directory structure of the template and then proceed to place your own information into the block of the **Polito PhD thesis template.tex** file. You can then modify the rest of this file to your unique specifications based on your course. Chapter 2 will help you do this.

If you are new to LaTeX it is recommended that you carry on reading through the rest of the information in this document. The style of this template is confirmed and recommended by Doctoral School of Politecnico di Torino (SCUDO).

1.3   What this Template Includes

1.3.1   Folders

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

Preamble: this folder contains the **.tex** file in which the adjustments and modifications regarding the style of document is possible. It is recommended to not changing the predefined style, except for small modifications.

Thesis-info: this folder contains the **.tex** file in which the thesis informations can be inserted.

Dedication: this folder contains the **.tex** file dedicated to write the dedications of the thesis.

Declaration: this folder contains the **.tex** file dedicated to write the declaration of the thesis.

Acknowledgment: this folder contains the **.tex** file dedicated to write the acknowledgments of the thesis.

Abstract: this folder contains the **.tex** file dedicated to write the abstract of the thesis.

Chapters: these are the folders where you put the thesis chapters. Each chapter should go in its own separate **.tex** file and folder. Each chapter folder contains a **Figs**

folder which contains all figures for the chapter. A thesis usually has about five to six chapters, though there is no hard rule on this. For example 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

- Chapter 5: Discussion of the experimental results

- Chapter 6: Conclusion and future directions

This chapter layout is specialised for the experimental sciences.

Figs: This folder contains all figures for the thesis not included in chapters (for exaple the polito logo on thesis info page). These are the final images that will go into the thesis document.

References: this folder contains the **.tex** file which 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 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..

Classes and **sty**: these folders contain important files such as class file that tells LaTeX how to format the thesis.

Appendices: these are the folders where you put the appendices. Each appendix should go into its own separate **.tex** file.

1.3.2 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 LaTeX or BibTeX and which you don't need to delete or worry about:

Polito PhD thesis template.pdf: this is your beautifully typeset thesis (in the PDF file format) created by LaTeX. It is supplied in the PDF with the template and after you compile the template you should get an identical version.

Polito PhD thesis template.tex: this is an important file. This is the file that you tell LaTeX to compile to produce your thesis as a PDF file. It contains the framework and constructs that tell LaTeX 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-info* block – you have now started your thesis!

Files that are *not* included, but are created by LaTeX as auxiliary files include:**.aux**, **.bbl**, **.blg**, **.lof**, **.log**, **.lot** and **.out** files: are auxiliary files generated by LaTeX, if they are deleted LaTeX simply regenerates them when you run the main **.tex** file.

1.4 Filling in Your Information in the "Polito PhD thesis template.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 **Polito PhD thesis template.tex** file in a text editor or your favourite LaTeX environment.

Open the file and scroll down to the second large block titled *Thesis-info* where you can see the entries for *Authur*, *Supervisors*, etc . . . . Fill out the information about your thesis, yourself and your department. When you have done this, save the file and recompile **Polito PhD thesis template.tex**. All the information you filled in should now be in the PDF, complete with web links. You can now begin your thesis proper!

The **Polito PhD thesis template.tex** file contains the structure of the thesis. There are plenty of written comments that explain what pages, sections and formatting the 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 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. The next page contains a one line (or more) dedication; Who will you dedicate your thesis to.

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).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.

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. 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 **numbered**) 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.

Chapter 2

Second Chapter Title

2.1 Basic Text and Refering Hints

LaTeXgives the possibility to bold a **word** or a **phrase containing more words** or mathematical equations like $\mathbf{A} = \mathbf{B} + \mathbf{C}$. *Italic* and underline commands are designed to be used in desired partof the text. Sizing the text is another optional command: Word, Word, Word.

Refering to the sections, chapters, equations and etc . . . is possible by command `\ref{label}`. It is necessary to insert `\label{name of section}` for each of desired section and chapter and etc . . . then refer them in any part of the text. For example in chapter 1 we introduced the template and in section 1.3 different folders and files in template were discribed. Figure 2.1 shows the greek letter codes in LaTeX.

Moreover in LaTeX[1] it is possible to have foot note explanation. You can also insert web links, if you do, make sure you use the full URL, including the {http://} for this. As an example by inserting the code:

```
\href{http://www.polito.it}{polito website}
```

you will have polito website. If you don't want to link URL and name, simply write the `\url{http://www.polito.it}` and only romove the name. This is the result: (http://www.polito.it).

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[1]Here there is the foot note explanation about the word LaTeX

2.2   Writing Mathematical Equations in LaTeX

As an in-line equation example we can refer the most famous equation in the world: $E^2 = (m_0 c^2)^2 + (pc)^2$, which is known as the **energy-mass-momentum** relation. You can write an equation in **equation** environment of LaTeX, for example "Cauchy's Integral Formula" which is automatically given an equation number (tag) by LaTeX like this:

```
\begin{equation}
CIF: \hspace*{5mm}F_0^j(a) =\frac{1}{2\pi \iota} \oint_{\gamma}
\frac{F_0^j(z)}{z - a} dz
\end{equation}
```

This will produce "Cauchy's Integral Formula" equation:

$$CIF: \quad F_0^j(a) = \frac{1}{2\pi\iota} \oint_\gamma \frac{F_0^j(z)}{z-a} dz \tag{2.1}$$

As you see the equation is tagged automatically according to the chapter and order. It is also possible to personalize tag for the equation:

$$CIF: \quad F_0^j(a) = \frac{1}{2\pi\iota} \oint_\gamma \frac{F_0^j(z)}{z-a} dz \tag{Personalized tag}$$

To make the **Nomenculature** you need to Issue the `\nomenclature` command for each symbol you want to have included in the nomenclature list. The best place for this command is immediately after you introduce the symbol for the first time. For the equation above:

```
\nomenclature[Z]{$CIF$}{Cauchy's Integral Formula}
\nomenclature[A]{$F$}{complex function}
\nomenclature[G]{$\pi$}{ $\simeq 3.14\ldots$}
\nomenclature[G]{$\iota$}{unit imaginary number $\sqrt{-1}$}
\nomenclature[G]{$\gamma$}{a closed curve on a complex plane}
\nomenclature[X]{$\oint_\gamma$}{integration around a curve
$\gamma$}
\nomenclature[R]{$j$}{superscript index}
```

```
\nomenclature[S]{$0$}{subscript index}
%letter Z is for Acronyms, A is for Roman symbols, G is for Greek
Symbols, X is for Other Symbols letter, R is for superscripts, S
is for subscripts
```

To make nomenclature list you need to run "pdflatex" for **.tex** file and then run the "makeindex" command and then again run "pdflatex" for **.tex** file. (make sure in "Options> Configurations >Commands >make index" box there is "makeindex -s nomencl.ist -t %.nlg -o %.nls %.nlo", if not, just copy and paste this command in the box and follow the instruction above).

If there are several equations that you need to align vertically, the **align** environment will do it:

$$x = 5y \qquad\qquad w = -z \qquad\qquad a = b - c$$

$$2x = -y \qquad\qquad 3w = \frac{1}{2}z \qquad\qquad a = 3b$$

$$-4 + 5x = 2 + y \qquad\qquad w + 2 = -1 + w \qquad\qquad ab = \frac{-1}{3}cb$$

2.3   List Formatting in LaTeX

Convenient and predictable list formatting is one of the many advantages of using LaTeX. Latex distinguishes between three different enumeration/itemization environments:

- Enumerate for an enumerated list,

- Itemize for a bullet list,

- Description for a descriptive list.

All lists follow a basic format and each of them provide four levels, which means you can have nested lists of up to four levels.

2.3.1   Enumerate

1. The first topic is "Good"

2. The second topic is "Intermediate" (Lev. 1)

	(a) The first subtopic is "high intermediate"

	(b) The second subtopic is "low intermediate"(Lev. 2)

		i. The first subsubtopic is "very low intermediate"(Lev. 3)

			A. The first subsubsubtopic is "too low intermediate"(Lev. 4)

3. The third topic is "Bad"

2.3.2   Itemize

- The first topic is "Good"

- The second topic is "Intermediate"

	- The first subtopic is "high intermediate"

	- The second subtopic is "low intermediate"

		* The first subsubtopic is "very low intermediate"

- The third topic is "Bad"

2.3.3   Description

The first topic is "Good"

The second topic is "Intermediate"

    The first subtopic is "high intermediate"

    The second subtopic is "low intermediate"

        The first subsubtopic is "very low intermediate"

The third topic is "Bad"

2.4 Figures

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

```
\begin{figure}[H]
\centering
\includegraphics[width=1.0\textwidth]{Greek_letters}
\caption[Greek letters in latex]{List of greek letters in Latex}
\label{fig:Greek}
\end{figure}
```

Also look in the source file. Putting this code into the source file produces the Figure 2.1 that you can see in the figure below. By changing the value of figure width (`width=1.0\textwidth`) you can change the figure dimension.

αA	`\alpha A`	νN	`\nu N`
βB	`\beta B`	$\xi \Xi$	`\xi\Xi`
$\gamma \Gamma$	`\gamma \Gamma`	oO	`o O`
$\delta \Delta$	`\delta \Delta`	$\pi \Pi$	`\pi \Pi`
$\epsilon \varepsilon E$	`\epsilon \varepsilon E`	$\rho \varrho P$	`\rho\varrho P`
ζZ	`\zeta Z`	$\sigma \Sigma$	`\sigma \Sigma`
ηH	`\eta H`	τT	`\tau T`
$\theta \vartheta \Theta$	`\theta \vartheta \Theta`	$\upsilon \Upsilon$	`\upsilon \Upsilon`
ιI	`\iota I`	$\phi \varphi \Phi$	`\phi \varphi \Phi`
κK	`\kappa K`	χX	`\chi X`
$\lambda \Lambda$	`\lambda \Lambda`	$\psi \Psi$	`\psi \Psi`
μM	`\mu M`	$\omega \Omega$	`\omega \Omega`

Fig. 2.1 List of greek letters in Latex

(a) Arrows

(b) Binary operations symbols

(c) Miscellaneous sybols

Fig. 2.2 Useful math symbols in Latex

Subplots

The multiple figure example in landscape form is presented here. Here you can refer any subfigure for example arrows (see Fig. 2.2a) and binary operation symbols in (Fig. 2.2c) or you can cite the whole figure as Fig. 2.2

2.5   Tables

The layout of a table has been established over centuries of experience and should only be altered in extraordinary circumstances [3].

When formatting a table, remember two simple guidelines at all times:

1. Never, ever use vertical rules (lines).

2. Never use double rules.

These guidelines may seem extreme but I have never found a good argument in favour of breaking them. For example, if you feel that the information in the left half of a table is so different from that on the right that it needs to be separated by a vertical line, then you should use two tables instead. Not everyone follows the second guideline:

There are three further guidelines worth mentioning here as they are generally not known outside the circle of professional typesetters and subeditors:

3. Put the units in the column heading (not in the body of the table).

4. Always precede a decimal point by a digit; thus 0.1 *not* just .1.

5. Do not use 'ditto' signs or any other such convention to repeat a previous value. In many circumstances a blank will serve just as well. If it won't, then repeat the value.

A frequently seen mistake is to use '\begin{center}' ... '\end{center}' inside a figure or table environment. This center environment can cause additional vertical space. If you want to avoid that just use '\centering'

Table 2.1 A badly formatted table

Dental measurement	Species I		Species II	
	mean	SD	mean	SD
I1MD	6.23	0.91	5.2	0.7
I1LL	7.48	0.56	8.7	0.71
I2MD	3.99	0.63	4.22	0.54
I2LL	6.81	0.02	6.66	0.01
CMD	13.47	0.09	10.55	0.05
CBL	11.88	0.05	13.11	0.04

Table 2.2 A nice looking table

Dental measurement	Species I		Species II	
	mean	SD	mean	SD
I1MD	6.23	0.91	5.2	0.7
I1LL	7.48	0.56	8.7	0.71
I2MD	3.99	0.63	4.22	0.54
I2LL	6.81	0.02	6.66	0.01
CMD	13.47	0.09	10.55	0.05
CBL	11.88	0.05	13.11	0.04

Table 2.3 Even better looking table using booktabs

Dental measurement	Species I		Species II	
	mean	SD	mean	SD
I1MD	6.23	0.91	5.2	0.7
I1LL	7.48	0.56	8.7	0.71
I2MD	3.99	0.63	4.22	0.54
I2LL	6.81	0.02	6.66	0.01
CMD	13.47	0.09	10.55	0.05
CBL	11.88	0.05	13.11	0.04

Chapter 3

My third chapter

You should break your thesis up into nice, bite-sized sections and subsections. LATEX 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 **PhDThesisPSnPDF.cls**. If you need this changed, you can do it in **Polito PhD thesis template.tex**.

3.1 First section of the third chapter

And now I begin my third chapter here . . .

3.1.1 First subsection in the first section

. . . and some more

3.1.2 Second subsection in the first section

. . . and some more . . .

First subsub section in the second subsection

. . . and some more in the first subsub section otherwise it all looks the same doesn't it? well we can add some text to it . . .

3.1.3   Third subsection in the first section

. . . and some more . . .

First subsub section in the third subsection

. . . and some more in the first subsub section otherwise it all looks the same doesn't it? well we can add some text to it and some more . . .

Second subsub section in the third subsection

. . . and some more in the second subsub section otherwise it all looks the same doesn't it? well we can add some text to it . . .

3.2   Second section of the third chapter

and here I write more . . .

3.3   In Closing

You have reached the end of this mini-guide. You can now rename or overwrite this pdf file and begin writing 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 fun!

References

[1] Leslie Lamport. *Latex*. Addison-Wesley, 1994.

[2] Peter Hertel. Writing articles with latex. 2010.

[3] Simon Fear. Publication quality tables in latex, 2005.

Appendix A

How to install LATEX

Windows OS

TeXLive package - full version

1. Download the TeXLive ISO (2.2GB) from
   https://www.tug.org/texlive/

2. Download WinCDEmu (if you don't have a virtual drive) from
   http://wincdemu.sysprogs.org/download/

3. To install Windows CD Emulator follow the instructions at
   http://wincdemu.sysprogs.org/tutorials/install/

4. Right click the iso and mount it using the WinCDEmu as shown in
   http://wincdemu.sysprogs.org/tutorials/mount/

5. Open your virtual drive and run setup.pl

 or

Basic MikTeX - TEX distribution

1. Download Basic-MiKTEX(32bit or 64bit) from
   http://miktex.org/download

2. Run the installer

3. To add a new package go to Start » All Programs » MikTex » Maintenance (Admin) and choose Package Manager

4. Select or search for packages to install

TexStudio - TeX editor

1. Download TexStudio from
   http://texstudio.sourceforge.net/#downloads

2. Run the installer

Mac OS X

MacTeX - TeX distribution

1. Download the file from
   https://www.tug.org/mactex/

2. Extract and double click to run the installer. It does the entire configuration, sit back and relax.

TexStudio - TeX editor

1. Download TexStudio from
   http://texstudio.sourceforge.net/#downloads

2. Extract and Start

Unix/Linux

TeXLive - TeX distribution

Getting the distribution:

1. TexLive can be downloaded from
   http://www.tug.org/texlive/acquire-netinstall.html.

2. TexLive is provided by most operating system you can use (rpm,apt-get or yum) to get TexLive distributions

Installation

1. Mount the ISO file in the mnt directory

   ```
   mount -t iso9660 -o ro,loop,noauto /your/texlive####.iso /mnt
   ```

2. Install wget on your OS (use rpm, apt-get or yum install)

3. Run the installer script install-tl.

   ```
   cd /your/download/directory
   ./install-tl
   ```

4. Enter command 'i' for installation

5. Post-Installation configuration:
   http://www.tug.org/texlive/doc/texlive-en/texlive-en.html#x1-320003.4.1

6. Set the path for the directory of TexLive binaries in your .bashrc file

For 32bit OS

For Bourne-compatible shells such as bash, and using Intel x86 GNU/Linux and a default directory setup as an example, the file to edit might be

```
edit $~/.bashrc file and add following lines
PATH=/usr/local/texlive/2011/bin/i386-linux:$PATH;
export PATH
MANPATH=/usr/local/texlive/2011/texmf/doc/man:$MANPATH;
export MANPATH
INFOPATH=/usr/local/texlive/2011/texmf/doc/info:$INFOPATH;
export INFOPATH
```

For 64bit OS

```
edit $~/.bashrc file and add following lines
PATH=/usr/local/texlive/2011/bin/x86_64-linux:$PATH;
export PATH
MANPATH=/usr/local/texlive/2011/texmf/doc/man:$MANPATH;
export MANPATH
INFOPATH=/usr/local/texlive/2011/texmf/doc/info:$INFOPATH;
export INFOPATH
```

Fedora/RedHat/CentOS:

```
sudo yum install texlive
sudo yum install psutils
```

SUSE:

```
sudo zypper install texlive
```

Debian/Ubuntu:

```
sudo apt-get install texlive texlive-latex-extra
sudo apt-get install psutils
```