

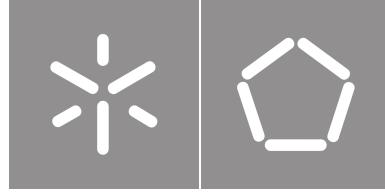


Universidade do Minho
Escola de Engenharia

António Ruben Cosinha Marinho

**Compliance and Efficiency in Risk
Assessment Tools for IT Infrastructure:
A NIS2-Aligned Comparative Analysis**

António Marinho
Compliance and Efficiency in Risk
Assessment Tools for IT Infrastructure: A
NIS2-Aligned Comparative Analysis



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**Compliance and Efficiency in Risk
Assessment Tools for IT Infrastructure:
A NIS2-Aligned Comparative Analysis**

Master's Dissertation in Informatics Engineering

Dissertation supervised by

António Luís Duarte Costa

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Acknowledgements

Acknowledgments are personal text and should be a free expression of the author.

However, without any intention of conditioning the form or content of this text, I would like to add that it usually starts with academic thanks (instructors, etc.); then institutional thanks (Research Center, Department, Faculty, University, FCT / MEC scholarships, etc.) and, finally, the personal ones (friends, family, etc.).

But I insist that there are no fixed rules for this text, and it must, above all, express what the author feels.

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the Universidade do Minho.

(Place)

(Date)

(António Ruben Cosinha Marinho)

”

*“You cannot teach a man anything; you can only
help him discover it in himself.”*

— **Galileo**, Somewhere in a book or speech
(Astronomer, physicist and engineer)

Resumo

With the growth of complexity in IT Infrastructures and the increase of cyber threats, increasingly require the use of robust risk management practices to ensure safety and resilience of the systems in a enterprise context. With the implementation of the NIS2 Directive in European Union, has become an obligation to adopt risk assessment mechanisms to ensure regulatory compliance and efficient protection of critical assets. This work aims to explore and compare the main risk assessment tools available at this moment, with emphasis on the their operational efficiency and ability to fulfill the requirements imposed by NIS2. Through a comparative analysis it is intended to identify which solutions best adapt to security needs of nowadays infraestructures, such as *Data Centers e Enterprise Networks*.

Independentemente da língua em que a dissertação está escrita, geralmente esta contém pelo menos dois resumos: um resumo na mesma língua do texto principal e outro resumo numa outra língua.

A ordem dos resumos varia de acordo com a escola. Se a sua escola tiver regulamentos específicos sobre a ordem dos resumos, o template (L^AT_EX) NOVAtesis L^AT_EX (**novathesis**) irá respeitá-los. Caso contrário, a regra padrão no template **novathesis** é ter em primeiro lugar o resumo *no mesmo idioma do texto principal* e depois o resumo *no outro idioma*. Por exemplo, se a dissertação for escrita em português, a ordem dos resumos será primeiro o português e depois o inglês, seguido do texto principal em português. Se a dissertação for escrita em inglês, a ordem dos resumos será primeiro em inglês e depois em português, seguida do texto principal em inglês. No entanto, esse pedido pode ser personalizado adicionando um dos seguintes ao arquivo `5_packages.tex`.

```
\abstractorder(<MAIN_LANG>) := {<LANG_1>, ..., <LANG_N>}
```

Por exemplo, para um documento escrito em Alemão com resumos em Alemão, Inglês e Italiano (por esta ordem), pode usar-se:

```
\ntsetup{abstractorder={de={de,en,it}}}
```

Relativamente ao seu conteúdo, os resumos não devem ultrapassar uma página e frequentemente tentam responder às seguintes questões (é imprescindível a adaptação às práticas habituais da sua área científica):

1. Qual é o problema?
2. Porque é que é um problema interessante/desafiante?

3. Qual é a proposta de abordagem/solução?
4. Quais são as consequências/resultados da solução proposta?

Palavras-chave: Primeira palavra-chave, Outra palavra-chave, Mais uma palavra-chave, A última palavra-chave

Abstract

Regardless of the language in which the dissertation is written, usually there are at least two abstracts: one abstract in the same language as the main text, and another abstract in some other language.

The abstracts' order varies with the school. If your school has specific regulations concerning the abstracts' order, the **novathesis** (L^AT_EX) template will respect them. Otherwise, the default rule in the **novathesis** template is to have in first place the abstract in *the same language as main text*, and then the abstract in *the other language*. For example, if the dissertation is written in Portuguese, the abstracts' order will be first Portuguese and then English, followed by the main text in Portuguese. If the dissertation is written in English, the abstracts' order will be first English and then Portuguese, followed by the main text in English. However, this order can be customized by adding one of the following to the file `5_packages.tex`.

```
\ntsetup{abstractorder={<LANG_1>, ..., <LANG_N>}}
\ntsetup{abstractorder={<MAIN_LANG>={<LANG_1>, ..., <LANG_N>}}}
```

For example, for a main document written in German with abstracts written in German, English and Italian (by this order) use:

```
\ntsetup{abstractorder={de={de,en,it}}}
```

Concerning its contents, the abstracts should not exceed one page and may answer the following questions (it is essential to adapt to the usual practices of your scientific area):

1. What is the problem?
2. Why is this problem interesting/challenging?
3. What is the proposed approach/solution/contribution?
4. What results (implications/consequences) from the solution?

Keywords: One keyword, Another keyword, Yet another keyword, One keyword more, The last keyword

Contents

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Glossary

computer An electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals. This is a test that adds a citation [2] to the glossary! (*p. 20*)

Acronyms

aaa	acronym aaa (<i>p. 20</i>)
aab	acronym aab (<i>p. 20</i>)
aba	acronym aba (<i>p. 20</i>)
abbrev	abbreviation of a longer text (<i>p. 20</i>)
 bbb	 acronym bbb (<i>p. 20</i>)
 DI	 Department of Computer Science (<i>p. 2</i>)
 FCT	 NOVA School of Science and Technology (<i>pp. 2, 11</i>)
 NOVA	 NOVA University Lisbon (<i>p. 2</i>)
 novathesis	 NOVAtethesis \LaTeX (<i>pp. ix, xi, xv, 1–4, 6–9, 11–14</i>)
 xpto	 and extension of a xpto (<i>p. 20</i>)

Symbols

μ Mu (p. 20)

π the numerical value of pi (p. 20)

r the radius of a circle (p. 20)

Introduction



This is the **novathesis** \LaTeX template Version 7.3.1 from Template!date2025-01-23.

This work is licensed under the \LaTeX Project Public License v1.3c. To view a copy of this license, visit the LaTeX project public license.

1.1 Welcome to the novathesis Template

This first Chapter introduces the **novathesis** template and how it is organized. In Chapter 2 you can find some specific instructions on how to use this template. Chapter 3 shows some examples and give some hints on how to write your text. Please read these next Chapters carefully.

1.1.1 Your Time is Precious

Did you learn how to drive by sitting by the wheel and throwing your car into the road? Most probably you did take your time *learning the rules* and *practicing* first! Likewise, it is not wise to throw yourself at the task of writing a thesis/dissertation in \LaTeX without seriously considering the following recommendation!

If you are going to spend zillions of hours writing your thesis/dissertation using the **novathesis** \LaTeX template (or some other \LaTeX template), be wise and spend a couple of hours learning how to use it properly by reading its manual. And then, be even wiser, and spend a few more hours learning some \LaTeX . I am sure that the time you are investing now will pay itself countless times before you submit your thesis/dissertation.

— João Lourenço

1.1.2 Recognition

The **novathesis** template was born in 1996, and what you see now accumulates to many many hundreds (thousands?!) of working hours, unpaid and stolen from family and friends. This work is available to the community under the \LaTeX Project Public License v1.3c, which means you are entitled to use it for free and change it at your will. However, if you decide to use this template to write your thesis/dissertation, **be fair to the developers** and:

1. Cite the **novathesis** manual [11] in a place of your choice (e.g., in the *Acknowledgments*) of your thesis/dissertation with “\cite{novathesis-manual}” . If you cite it this way, the correct entry will be added automatically to your bibliography (no need to worry with the necessary BibTeX entry, as it will be added automatically);
2. Go to the project web page in GitHub and give the project a star (marked with a red ellipse at the top-right in Figure 1); and
3. Make a donation by visiting the **novathesis** project page and clicking in the button marked with a green ellipse at the top-center in Figure 1). Alternatively, just click **HERE** and your browser will be directed to the right page.

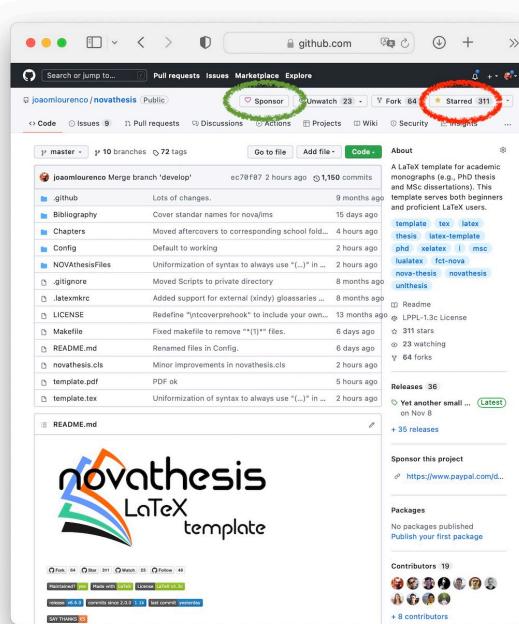


Figure 1: The **novathesis** project web page in GitHub.

1.2 The NOVAthesis Template

The **novathesis** template was born at the Department of Computer Science (DI) of NOVA School of Science and Technology (FCT) of NOVA University Lisbon (NOVA), Portugal. But the user base grew...

initially grew to other Departments of FCT-NOVA, then to other Schools of NOVA, and later to other Schools of other Universities. Currently more than 25 Schools are natively supported by the **novathesis** template (see Tables 4, 5, 6, 7, 8, and 9).

Table 4: NOVA University Lisbon's Schools supported by the **novathesis** template

NOVA University Lisbon	
A thumbnail image of the NOVA School of Science and Technology thesis template, showing a green cover with the title and NOVA logo.	NOVA School of Science and Technology (FCT-NOVA) <ul style="list-style-type: none"> • All PhD Programs (PhD) • All MSc Programs (MSc)
A thumbnail image of the NOVA School of Social Sciences and Humanities thesis template, showing a white cover with the title and NOVA logo.	NOVA School of Social Sciences and Humanities (FCSH-NOVA) <ul style="list-style-type: none"> • All PhD Programs (PhD) • All MSc Programs (MSc)
A thumbnail image showing two versions of the NOVA Information Management School thesis template, labeled NOVA-IMS and NOVA-MGI, both featuring a black and white design.	NOVA Information Management School (NOVA-IMS) <ul style="list-style-type: none"> • All PhD Programs (PhD) • Master's in Data Science and Advanced Analytics (MMAA) • Master's in Statistics and Information Management (MEGI) • Master's in Information Management (MGI) • Master's in Geographic Information Systems and Science (MCSIG) • Master's in Geospatial Technologies (GeoTech)
A thumbnail image of the National School of Public Health thesis template, showing a white cover with the title and NOVA logo.	National School of Public Health (ENSP-NOVA) <ul style="list-style-type: none"> • All PhD Programs (PhD) • All MSc Programs (MSc)



Instituto de Tecnologia Química e Biológica (ITQB-NOVA)

- All PhD Programs (PhD)
- All MSc Programs (MSc)

Table 5: University of Lisbon's Schools supported by the **novathesis** template

University of Lisbon



Instituto Superior Técnico (IST-UL)

- All PhD Programs (PhD)
- All MSc Programs (MSc)

Faculdade de Ciências (FCUL)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



Faculdade de Medicina Veterinária (FMV-UL)

- All PhD Programs (PhD)
- All MSc Programs (MSc)

Table 6: University of Minho's Schools supported by the **novathesis** template

University of Minho



School of Architecture (EA-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Sciences (EC-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Law (ED-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Engineering (EE-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Economics and Management (EEG-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Medicine (EM-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Psychology (EP-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Nursing (ESE-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



Institute of Social Sciences (ICS-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



Institute of Education (IE-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



School of Arts and Humanities (ELACH-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)



Research Institute 13Bs (I3B-UMINHO)

- All PhD Programs (PhD)
- All MSc Programs (MSc)

Table 7: Instituto Politécnico de Lisboa's Schools supported by the *novathesis* template

Instituto Politécnico de Lisboa



Instituto Superior de Engenharia de Lisboa (ISEL-IPL)

- All MSc Programs (MSc)

Table 8: Instituto Politécnico de Setúbal's Schools supported by the *novathesis* template

Instituto Politécnico de Setúbal



Escola Superior de Tecnologia de Setúbal (ISEL-IPL)

- All MSc Programs (MSc)

Table 9: Other Universities/Schools/Degrees's Schools supported by the **novathesis** template

Other Universities/Schools/Degrees



Escola Superior de Enfermagem do Porto (ESEP)

- All MSc Programs (MSc)

1.3 Getting Started

The template provides an easy to use setting for you to write your thesis/dissertation in \LaTeX :

- Select your school;
- Fill your thesis metadata (title, research field, etc) in the file “template.tex”;
- Create your thesis/dissertation contents using the files in folder “Chapters”; and
- Process using you favorite \LaTeX processor (pdf \LaTeX , X \LaTeX or Lua \LaTeX).

1.3.1 Using Overleaf

Overleaf is a collaborative cloud-based \LaTeX editor used for writing, editing and publishing scientific documents. Like “Google Docs”, for \LaTeX users. You can edit and compile your \LaTeX source on the cloud, without installing software in your own computer, and, much like Google Docs, you can share your document with others users and everybody can edit the same file at the same time (this may be dangerous).

If you do not have an account in Overleaf, you must create one first.

Once you have an account, please access the **novathesis** template in Overleaf and select the green button *Open as Template* (see Figure 2).

Please notice that the version currently available in Overleaf (v7.1.18) is slightly outdated (current version is v7.3.1). A new version (v7.1.29) will be submitted to Overleaf soon. Until then, please:

1. Download the latest version from the GitHub repository as a Zip file.
2. Login to your favorite \LaTeX cloud service. I recommend Overleaf but there are alternatives (these instructions apply to Overleaf and you'll have to adapt for other providers).

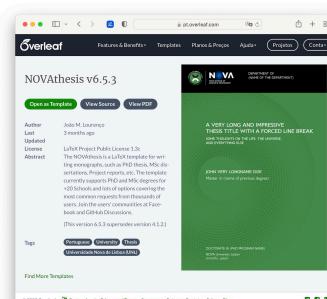


Figure 2: NOVAthesis template in Overleaf.

3. In the menu select: *New project* → *Upload project*.
4. Upload the zip file.
5. Select “*template.tex*” as the main file.
6. Let Overleaf compile the document.

Notice that you need a (student) subscription to compile the **novathesis** template in Overleaf, otherwise your compilation will always time out.

1.3.2 Using a Local \LaTeX Installation Local

First of all, start by installing \LaTeX in your computer. There are two main distributions, Mik \TeX and $\text{\TeX}Live$, and both of them are available for the 3 most popular Operating Systems: Linux, macOS and Windows.

Be aware that a full installation of Mik \TeX or $\text{\TeX}Live$ will take near 5 GB of hard disk space. So, think twice before installing the full distribution. See the **novathesis** Wiki for the list of packages required to compile the template.

Once you have \LaTeX up and running, remember to install a good \LaTeX text editor. I recommend you to take a look at this post in the `.tex.stackexchange.com` site. If you want a quick and dirty recommendation, try TeXStudio.

Now, you must access the **novathesis** repository in GitHub, select the green button *Code* and then *download* (or *clone*) the template. You will always get the latest version of the template (currently v7.3.1 from 2025-01-23).

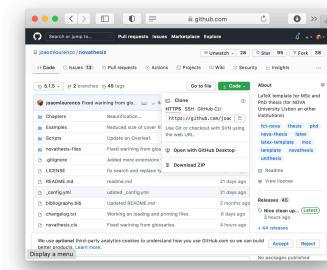


Figure 3: The NOVATHesis Project page in GitHub.

1.4 Getting Help

No! You don't have to use this template to write your thesis. You don't even have to use \LaTeX . However, writing a thesis is serious stuff, and which tool you shall use to write it is not a decision to make lighthearted.

\LaTeX is hard enough by itself. This template aims at making your life easier, but not easy. If you choose to use this template to write your thesis, you are very welcome. However, don't expect me to provide you help with \LaTeX . Look for help with your friends (you have some friends, don't you?), or search the web, or try even to read some book(s) on \LaTeX . In the end you will certainly find the experience rewarding.

When you come to the point of “*How do I do this with the novathesis template?*”, remember...

1. To check the **novathesis** wiki and have some hope! :D
2. Google is your best friend.

3. Search the GitHub Discussions page for a question related to yours. *If and only if* you don't find one, then post your own question in English please!
4. Search the NOVAtheis Facebook group for a question related to yours. *If and only if* you don't find one, then post your own question in either Portuguese or English, at your preference.

When you post your own question, remember to **always** state the **novathesis** version number you are using and referring to.

Please do not attempt to contact me directly (email, Messenger, etc)...

I WILL NOT REPLY!

1.4.1 Suggestions, Bugs and Feature Requests

Help: If you just need some help, see above Section 1.4.

Suggestion: Do you have a suggestion/recommendation? Please add it to the wiki and help other users!

Bug: Did you find a bug? Please open an issue. Thanks!

New Feature: Would you like to request a new feature (or support of a new School)? Please open an issue. Thanks!

1.5 Donors

The list of *Donnors* is available in the **novathesis** Project page.

1.6 Disclaimer

Although the **novathesis** template is endorsed by some Schools (e.g., linked from FCT-NOVA web site), the **novathesis** template **this not an official template** for any School.

The **novathesis** template exists to make your life easier and we do our best to make it compliant to the supported (+25) Schools' regulations but, in the end of the line, you and only you are accountable for both the look and the contents of the document you submit as your thesis/dissertation.

NOVAthesis Template User's Manual

This manual is outdated and must be revised!

2.1 Introduction

This Chapter describes how to use the NOVAthesis \LaTeX (`novathesis`) template. It is assumed that you have a working of \LaTeX , either local (in your own computer) or remote (in Overleaf), and that you were able to generate a PDF for the default configuration of the template: a PhD thesis for NOVA School of Science and Technology (FCT).

2.2 Quick Start

2.2.1 With a Local \LaTeX Installation

Follow these steps to get started with a local \LaTeX installation:

1. Download \LaTeX . There are two major \LaTeX distributions — `MiK\TeX` and `T\EXLive` — that share lots of similarity, and \LaTeX documents are portable between them. This means that, for most users, both systems are equally usable.

T\EX-Live is maintained by (La) \TeX developers and is certainly the best distribution you may install in your computer: However, the default distribution will take more than 5 GB on your hard disk... so, if you are not short on disk space, install `T\EXLive`!

MiK\TeX will, by default, install only a minimal set of packages. The extra/additional packages will be installed on the fly. Installing packages on the fly is useful if disk space is limited, but has its own caveats in the longer term. Definitely choose `MiK\TeX` if you're short on disk space.

Which one to download? There are pros and cons for both distributions so it is essentially a question of where does your heart fall first! Mine falls to `T\EXLive`, but yours can fall elsewhere! :D

2. Install \LaTeX . Installation of \LaTeX is as hard as installing any other software. Just do your best and you will certainly succeed.
3. Update your \LaTeX installation using the $\text{\TeX}LiveUtility$ program of the Mik \TeX console.
4. Download the **novathesis** template by either:

- Cloning the GitHub repository with

```
git clone --depth=1 https://github.com/joaomlourenco/novathesis.git
```

or

- Downloading the latest version from the GitHub repository as a Zip file.

5. Download additional School specific files if applicable:

Universidade do Minho (UMINHO) download the required *NewsGotT* font files from <https://github.com/joaomlourenco/novathesis-extras/raw/main/Fonts/NewsGotT.zip>

then unzip the file and copy the 3 font files

“n015002t.ttf”, “n015003t.ttf”, and “n015006t.ttf”

to the folder

“NOVAthesisFiles/FontStyles/Fonts”.

Escola Superior de Enfermagem do Porto (ESEP) download the required *Calibri* font files

from <https://github.com/joaomlourenco/novathesis-extras/raw/main/Fonts/Calibri.zip>

then unzip the file and copy the 4 font files

“Calibri.ttf”, “Calibrib.ttf”, “Calibrii.ttf”, and “Calibriz.ttf”

to the folder

“NOVAthesisFiles/FontStyles/Fonts”.

6. Compile the document with you favorite \LaTeX processor (pdf \LaTeX , Xe \LaTeX or Lua \LaTeX).

- The main file is named “template.tex”, but you are free to rename it as you please.
- Either load the main file in your favorite \LaTeX text editor and press the appropriate (*magic*) button to generate a PDF file, or open a terminal and compile it with “`latexmk -pdf template`”. If you use a \LaTeX text editor, please notice that the **novathesis** template uses “*biber*” and not “*bibtex*” to process the bibliography, which means that most probably you have to open the *Editor Preferences* and somewhere (depending on the Editor you are using) change “*bibtex*” to “*biber*”.

- Notice that, due to the external font sets used, pdf \LaTeX will not work for both **UMINHO** and **ESEP**, and you have to use either X \LaTeX ("latexmk -pdfxe template") or Lua \LaTeX ("latexmk -pdflua template").
7. Edit the files in the "Config" folder. See Table 11.
 8. Recompile de document.
 9. And you're done with a beautifully formatted thesis/dissertation! :D

2.2.2 With a Remote Cloud-based Service

Follow these steps to get started with a remote \LaTeX installation:

- Download the latest version from the GitHub repository as a Zip file.
- Login to your favorite \LaTeX cloud service. I recommend Overleaf but there are alternatives. These instructions apply to Overleaf and you'll have to adapt for other providers.
- In the menu select **New project** → **Upload project**.
- Select "template.tex" as the main file.
- Follow from Step 5 above in Section 2.2.1 (With a Local \LaTeX Installation).

2.3 Folder and Files

The `novathesis` template is organized into many files and folders. At the main level it includes the following files and folders listed in Table 10.

Table 10: The folders and files (top level).

Name	Type	Access	Contents
template.tex			The main template file. You need to <i>compile</i> this file with one of pdf \LaTeX , X \LaTeX , or Lua \LaTeX to obtain the PDF file ("template.pdf"). I recommend the usage of the "latexmk" command or, if you use a UN*X-like OS, you may use "make" (and the given "Makefile").
Config			Configuration files. Please customize your template by changing the files in this folder!
Chapters			Examples of document contents, including Chapters, Appendices, Annexes, Abstracts, Glossaries, Lists of Symbols, etc. Replace them with your own.

Bibliography		Where all your bibliography files should be located. You may have many bibliography files as you want.
template.pdf		A possible result of applying pdfLATEX to the "template.tex" file. The look and feel of the document will depend on the parametrization/configuration (e.g., School) of this template.
novathesis.cls		The main class file.
NOVAthesisFiles		Additional files for the novathesis template. This is where all the juice is so, unless you are a LATEXmagician, don't mess up with the files and folders inside this folder.

Table 11: The configuration files (Config folder).

Name	Type	Access	Contents
0_memoir.tex			Options specific for the memoir class. <i>Don't touch this file unless you know what you are doing!</i>
1_novathesis.tex			The main configuration file for the template, e.g., select the document type, the school, the used languages, etc.
2_biblatex.tex			Select how your citations and bibliographic references will be printed. The default is numbers inside square brackets, e.g. [11], but you can change it to other formats, such as author-year, e.g., Lourenço (2021).
3_cover.tex			Configure cover contents (e.g., author's name, thesis/dissertation title, author, advisers, committee, etc)
4_files.tex			Select which files shall be included in the document as chapters, appendices, annexes, etc...
5_packages.tex			User's customization, such as loading additional packages and declare user defined commands.
6_list_of.tex			Configure the lists to be printed (table of contents, list of figures, list of tables, list of listings, etc). <i>Don't touch this file unless you know what you are doing!</i>
9_nova_fct.tex			Configurations specific to NOVA FCT. Otherwise ignored.
9_ulisboa_fmv.tex			Configurations specific to ULISBOA FMV. Otherwise ignored.
9_ulisboa_ist.tex			Configurations specific to ULISBOA IST. Otherwise ignored.

9_uminho.tex



Configurations specific to UMINHO (all schools). Otherwise ignored.

2.4 Customizing the *novathesis* template

The *novathesis* template can be customized by editing the files in the Config folder.

2.4.1 Options in 1_novathesis.tex

2.4.1.1 Most Relevant Options (1_novathesis.tex)

doctype=OPT

*phd, phdprop, phdplan, msc, mscplan,
bsc, plain*

The type of the document.

phd → PhD thesis (← default).
phdprop → PhD thesis proposal (for FCT-NOVA).
phdplan → PhD thesis plan.
msc → MSc thesis.
mscplan → MSc thesis plan.
bsc → BSc report.
plain → Other report.

school=OPT

*nova/fct, nova/fcsh, nova/ims,
nova/ims/mcsig, nova/ims/mgt,
nova/ensp, nova/itqb/green,
nova/itqb/gray, ulisboa/ist, ulisboa/fc,
ulisboa/fmv, uminho/eaad, uminho/ec,
uminho/ed, uminho/eeg, uminho/eeng,
uminho/elach, uminho/emed,
uminho/epsi, uminho/ese, uminho/i3bs,
uminho/ics, uminho/ie, iscteiu/eta,
ips/est, ipl/isel, ipl/isel/meb, ulht/deisi,
ulht/mge, other/esep*

Selection of the university and of the school (and degree variant).

⇒ Default: *school=nova/fct*

This option changes the typesetting of the de document to some specific School formating and layout, like covers, margins, fonts, paragraph spacing and indentation, etc.

docstatus=OPT

draft, provisional, final

The current status of the document.

working → Working version (← default).
provisional → Version for submission.
final → Final version.

lang=OPT*en, pt, de, es, fr, gr, it***The main language for the document.***en* → English (\Leftarrow default).*pt* → Portuguese.*de* → German.*es* → Spanish.*fr* → French.*gr* → Greek.*it* → Italian.**media=OPT***screen, paper***The target media for the PDF.***screen* → No empty/white pages (\Leftarrow default).*paper* → Empty/white pages are added when necessary.**print/webography=OPT***User defined title***Generate a separate bibliography for @online references.** \Rightarrow Default: *print/webography=undefined*

If undefined, the @online references are listed in the main bibliography. If defined, the @online references will be printed in a separate bibliography titled as given in the option.

color/links=OPT*Color name***The color for the hyperlinks (URLs, cross references, citations).** \Rightarrow Default: *color/links=DarkBlue*

The valid color names as listed in “xcolor” manual, the “svgnames” color set.

color/gls=OPT*Color name***The color for the glossary managed hyperlinks (glossary, symbols, etc).** \Rightarrow Default: *color/gls=Black*

The valid color names as listed in “xcolor” manual, the “svgnames” color set.

print/index=OPT*true,**false* (\Leftarrow default)**Print the (words) index at the end of the document.**

Print the index (in Portuguese Índice Remissivo).

2.4.1.2 Less Relevant Options (1_novathesis.tex)

abstractorder=OPT $L_0 = \{L_1, L_2, \dots, L_n\}$	Forces the abstracts languages and order for documents in language L_0. ⇒ Default: <code>abstractorder={en={en,pt}}</code> for english ⇒ Default: <code>abstractorder={L={L,en}}</code> for lang L L_i is a two-letters language code from the set of valid language codes, following ISO 3166-1 (alfa-2).
lang/extra=OPT $\{L_1, L_2, \dots, L_n\}$	List of additional languages are used in the document besides the main language and those used in the abstracts (above). ⇒ Default: <code>lang/extra={}</code> L_i is a two-letters language code from the set of valid language codes, following ISO 3166-1 (alfa-2).
gnumberlist=OPT <code>true</code> , (\Leftarrow default) <code>false</code>	Shall the glossary entries list the page numbers where those entries are used? (Like a reverse index!)
numberallpages=OPT <code>true</code> , <code>false</code> (\Leftarrow default)	Shall all the pages (except cover) be numbered?
tocintoc=OPT <code>true</code> , <code>false</code> (\Leftarrow default)	Shall table of contents be listed in the table of contents?
tocintoc=OPT <code>true</code> , <code>false</code> (\Leftarrow default)	Shall a second cover page be forced? If the contents for the second page are not defined, the second cover will be a replica of the first cover.
print/committee=OPT <code>true</code> , <code>false</code>	Shall the evaluation committee be printed? ⇒ Default: <code>print/committee=true</code> if <code>docstatus=final</code> ⇒ Default: <code>print/committee=false</code> otherwise
print/frontmatter=OPT <code>true</code> , (\Leftarrow default) <code>false</code>	Shall the front matter be printed? Set to false to generate a PDF with only the cover and the book chapters.
print/statement=OPT <code>true</code> , <code>false</code> (\Leftarrow default)	Shall the honor/originality statement be printed?

print/copyright=OPT

true, (\Leftarrow default)

false

Shall the copyright message be printed?**print/timestamp=OPT**

true,

false

Shall a timestamp (with the PDF generation date/time) be printed in the cover?

\Rightarrow Default: *print/timestamp=true if docstatus=working*

\Rightarrow Default: *print/timestamp=false otherwise*

style/url=OPT

default, (\Leftarrow default)

same

Use the same (main) font in URLs?**style/font=OPT**

*arial, bookman, calibri, erewhon,
kieranhealy, kpfonts, libertine, newpx,
newsgott, scholax*

Which font set to use in the document?

- | | |
|--------------------|---|
| <i>arial</i> | \rightarrow Use ‘arial’ font. Requires Xe \LaTeX or Lua \TeX . |
| <i>bookman</i> | \rightarrow Use ‘bookman’ font. |
| <i>calibri</i> | \rightarrow Use ‘calibri’ font. Requires Xe \LaTeX or Lua \TeX . |
| <i>erewhon</i> | \rightarrow Use ‘erewhon’ font. |
| <i>kieranhealy</i> | \rightarrow Use ‘kieranhealy’ font. |
| <i>kpfonts</i> | \rightarrow Use ‘palatino’ font. |
| <i>libertine</i> | \rightarrow Use ‘libertine’ font. |
| <i>newpx</i> | \rightarrow Use ‘palatino’ font. (\Leftarrow default) |
| <i>newsgott</i> | \rightarrow Use ‘newsgott’ font. Requires Xe \LaTeX or Lua \TeX . |
| <i>scholax</i> | \rightarrow Use ‘scholax’ font. |
-

style/chapter=OPT

See list on the side!

Which chapter style to use in the document?

Besides the standard memoir chapter styles (default, section, article, reparticle, hangnum, companion, demo, bianchi, bringhurst, brotherton, chappell, culver, dash, demodemoell, ger, lyhne, madsen, pedersen, southall, thatcher, veelo, verville, crosshead, dowding, komalike, ntglike, tandh, wilsondomb), the customized list of chapter styles below is also available.

bar	→ Use ‘bar’ chapter style. (← default)
bar-compact	→ Use ‘bar-compact’ chapter style.
bluebox	→ Use ‘bluebox’ chapter style.
compact	→ Use ‘compact’ chapter style.
elegant	→ Use ‘elegant’ chapter style.
fmv	→ Use ‘fmv’ chapter style.
hansen	→ Use ‘hansen’ chapter style.
ist	→ Use ‘ist’ chapter style.
ist2	→ Use ‘ist2’ chapter style.
pedersen	→ Use ‘pedersen’ chapter style.

lang/cover=OPT

en, pt, de, es, fr, gr, it

The main language for the cover.

⇒ Default: *The same as the main language.*

lang/copyright=OPT

en, pt, de, es, fr, gr, it

The main language for the copyright message.

⇒ Default: *The same as the main language.*

spine/layout=OPT

no, full, trim

Print the “book spine” at the end of the document?

⇒ Default: `trim' if docstatus=final

⇒ Default: `no' otherwise

no → do not print the book spine.

full → print the book spine in a full page.

trim → print and trim the page to the width of the book spine.

spine/width=OPT

TEX dimension

Force the width of the “book spine”.

⇒ Default: *The "natural width".*

The default width for the book spine will be the width of the number of pages of the document if printed in standard paper ($80g/m^2$).

debug=OPT

cover, spine

Activate debug mode for cover and/or book spine.

⇒ Default: *debug={}.*

2.5 How to Write Using \LaTeX

Please have a look at Chapter 3, where you may find many examples of \LaTeX constructs, such as Sectioning, inserting Figures and Tables, writing Equations, Theorems and algorithms, exhibit code listings, etc.

2.6 Example glossary, acronyms, and symbols

This is the first occurrence of an abbreviation: abbreviation of a longer text (abbrev). And now the second occurrence of the same abbreviation: abbrev. And a new acronym with capital letter: And extension of a xpto (xpto) and reused xpto. Let's also use a few other acronyms such as acronym aaa (aaa), acronym aab (aab), acronym aba (aba), acronym bbb (bbb) and xpto. In geometry, the area enclosed by a circle of radius r is πr^2 . Here the Greek letter π is equal to the ratio of the circumference of any circle to its diameter. Lets add "computer" to the glossary! Be carefull with mathematical symbols in acronyms, please see the definition of μ .

A Short \LaTeX Tutorial with Examples

This Chapter aims at exemplifying how to do common stuff with \LaTeX . We also show some stuff which is not that common! ;)

Please, use these examples as a starting point, but you should always consider using the *Big Oracle* (aka, Google, your best friend) to search for additional information or alternative ways for achieving similar results.

3.1 Document Structure

3.2 Dealing with Bibliography

Citing something online [4, 7, 9].

3.3 Inserting Tables

3.4 Importing Images

3.5 Floats, Figures and Captions

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspen-disse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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. Maece-nas 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.

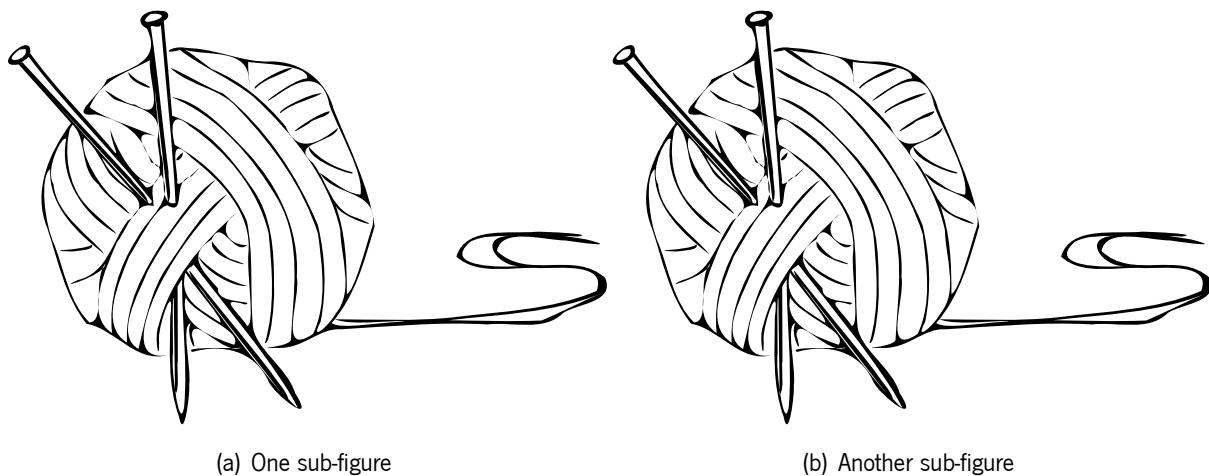


Figure 4: A figure with two sub-figures!

And this is a small text that references the Figure 4 and its Subfigures 4(a) and 4(b).

 Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspen-disse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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. Maece-nas 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.

3.6 Text Formatting

3.7 Generating PDFs from \LaTeX

3.7.1 Generating PDFs with pdflatex

You may create PDF files either by using `latex` to generate a DVI file, and then use one of the many DVI-2-PDF converters, such as `dvipdfm`.

Alternatively, you may use `pdflatex`, which will immediately generate a PDF with no intermediate DVI or PS files. In some systems, such as Apple, PDF is already the default format for \LaTeX . I strongly recommend you to use this approach, unless you have a very good argument to go for `latex + dvipdfm`.

A typical pass for a document with figures, cross-references and a bibliography would be:

```
$ pdflatex template  
$ bibtex template  
$ pdflatex template  
$ pdflatex template
```

You will notice that there is a new PDF file in the working directory called `template.pdf`. Simple :)

Please note that, to be sure all table of contents, cross-references and bibliographic citations are up-to-date, you must run `latex` once, then `bibtex`, and then `latex` twice.

3.7.2 Dealing with Images

You may process the same source files with both `latex` or `pdflatex`. But, if your text include images, you must be careful. `latex` and `pdflatex` accept images in different (exclusive) formats. For `latex`

you may use EPS ou PS figures. For pdflatex you may use JPG, PNG or PDF figures. I strongly recommend you to use PDF figures in vectorial format (do not use bitmap images unless you have no other choice).

3.7.3 Dealing with Citations

Para fazer citações, deverá usar-se a chave da referência no ficheiro BibTeX. Se for uma única referência [2], usar um “~” para ligar o \cite{...} à palavra que o precede (...referência~\cite{Artho04}). Caso queira fazer múltiplas citações [12, 13, 6], deverá agrupá-las dentro de um único \cite{...}.

Note que o ficheiro de bibliografia pode ter tantas entradas quantas quiser. Apenas aquelas cuja chave seja referenciada no texto é que serão incluídas na listagem de bibliografia.

3.7.4 Footnotes

Footnotes¹ will be numbered and shown in the bottom of the page.

3.7.5 Tables

The Table 14 illustrates some important concepts associated with table construction:

- i) Do not use vertical lines;
- ii) The caption should be above the table;
- iii) Use the macros \toprule, \midrule and \bottomrule to make the top, inner and bottom horizontal lines, respectively.

Table 14: Test results summary.

Test	Anomalies	Warnings	Correct	Categories	Missed
Connection [3]	2	2	1	C	1
Coordinates'03 [1]	1	4	1	2B, 1C	0
Local Variable [1]	1	2	1	A	0
NASA [1]	1	1	1	—	0
Coordinates'04 [2]	1	4	1	3C	0
Buffer [2]	0	7	0	2A, 1B, 2C, 2D	0
Double-Check [2]	0	2	0	1A, 1B	0
StringBuffer [8]	1	0	0	—	1
Account [14]	1	1	1	—	0
Jigsaw [14]	1	2	1	C	0
Over-reporting [14]	0	2	0	1A, 1C	0
Under-reporting [14]	1	1	1	—	0

¹This is a simple footnote.

Allocate Vector [10]	1	2	1	C	0
Knight Moves [3]	1	3	1	$2B$	0
Total	12	33	10	5A, 6B, 10C, 2D	2

3.7.6 Figures

The images inserted in the document must be of good quality, preferably in vector format (vector PDF) and not in *bitmap* (PNG, JPG, etc.). *bitmap* images (Figure 5) do not scale well and have negative effects on the quality of your document. On the other hand, *vector* images Figure 6 scale as much as necessary without degrading the quality of the image.

You should only use *screenshots* for your plots, charts, etc, if you absolutely have no other alternative. Instead of generating a *screenshot*, try using a virtual PDF printer and printing to a PDF file. As a general rule, you will get a vector PDF. Even if your PDF contains images, they will always be of higher or equal quality than what you would get with a *screenshot*.

To combine several figures into a single one... You can then reference the set as Figure 7 or the sub-figures separately as 3.7.6 and 3.7.6.

3.8 Equations

LaTeX is a powerful tool for writing in a mathematical style. It allows you to insert formulas into the text, such as this: $ax^2 + bx + c = 0$. It also allows formulas to be highlighted on a separate line and centered on the page.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

or numbererd

$$e = mc^2 \tag{3.1}$$

which can latter be referenced as equation 3.1

3.9 Test for algorithms

Uncomment the algorithms source below and add the following to file “5_packages.tex”

```
\usepackage{algorithm2e}
\RestyleAlgo{ruled}
```

and uncomment

```
\ntaddlistof{listofalgorithms}
```

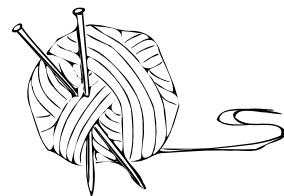
in file “8_list_og.tex”.



Figure 5: Bitmap image (JPG/PNG)



Figure 6: Vectorial image (PDF)



(a) Novelo de lã



(b) Tempestade com neve

Figure 7: Exemplo de utilização de *subbottom*

Adding Support to a New School (work in progress)

My advice to customize the **novathesis** template to another School/University/Department/Degree is to browse the existing supported degrees to find one that is *close enough*, and depart from there!

The multitude of layouts supported by the **novathesis** template is based in a three-tier naming scheme, separated by slashes: University / School / Department-or-Degree. This three-tier naming scheme is also reflected in a three-tier directory (folder) structure in: <project_root>a/NOVAthesisFiles/Schools. For example:

```
...
|
+-- nova
|   +-- Images
|   +-- fct
|   |   \-- Images
|   +-- ims
|   |   \-- Images
|   ...
|
\-- uminho
    +-- Images
    +-- ea
    |   \-- Images
    +-- ec
    |   \-- Images
    ...
...
```

The directory `uminho` contains the customization for all Schools of Universidade do Minho. This university is an example of the case where the regulations are defined at University level and all the schools apply the same thesis layout and organization. So, the all the customization is done in the file `uminho/uminho-defaults.1df`, except the definition of the name and logo of each individual school.

As another example, the directory `nova` contains the customization for all Schools from NOVA University Lisbon. This university grants a lot of freedom in the definition of the thesis layouts. In some cases, they are defined at the School level (e.g., NOVA FCT), while in some other cases they are defined separately for each degree (e.g., NOVA IMS).

1. Try all the already supported schools and check which one is closer to your needs;
 - a) Edit `Config/1_novatheresis.tex` and near line 28 uncomment the line with key `\ntsetup{school=<SO`
 - b) For each school supported (see the comment), replace `<SOMETHING>` with the school name, e.g., make it `\ntsetup{school=ulisboa/fmv}`
 - c) Recompile and check the document. Particularly, check the cover layout, the front-page (second cover) layout, the front-matter contents, the bibliography style;
 - d) Repeat for the next school, until you find one close enough.
- 2.

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A

NOVAthesis covers showcase

This Appendix shows examples of covers for some of the supported Schools. When the Schools have very similar covers (e.g., all the schools from Universidade do Minho), just one cover is shown. If the covers for MSc dissertations and PhD thesis are considerable different (e.g., for FCT-NOVA and UMinho), then both are shown.

 Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

 Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspen-disse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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APPENDIX A. NOVATHESIS COVERS SHOWCASE

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Appendix 2 Lorem Ipsum

This is a test with citing something [5] in the appendix.

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Annex 1 Lorem Ipsum

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ANNEX I. ANNEX 1 LOREM IPSUM

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