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COMPUTER SCIENCE

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Bachelor in Computer Science and Engineering

INTERACTING WITH CULTURE: A STORYTELLING APPROACH FOR ON-SITE MUSEUM VISITS

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INTERACTING WITH CULTURE: A STORYTELLING APPROACH FOR ON-SITE MUSEUM VISITS

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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 (`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

RESUMO

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) *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

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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. 16)

ACRONYMS

aaa	acronym aaa (<i>p.</i> 16)
aab	acronym aab (<i>p.</i> 16)
aba	acronym aba (<i>p.</i> 16)
abbrev	abbreviation of a longer text (<i>p.</i> 16)
bbb	acronym bbb (<i>p.</i> 16)
FCT	NOVA School of Science and Technology (<i>p.</i> 7)
novathesis	NOVATHESIS L ^A T _E X (<i>pp.</i> i, ii, 7–10)
xpto	and extension of a xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto (<i>p.</i> 16)

SYMBOLS

μ Mu (*p. 16*)

π the numerical value of pi (*p. 16*)

r the radius of a circle (*p. 16*)

INTRODUCTION

Museums exist because someone believed there was a story worth telling for generations to come, the stories collected by these institutions preserve individual and collective memories [4] and incite opportunities of learning and reconnecting with the past. However in this technological age traditional exhibits are becoming insufficient [16, pp. 326], these type of experience is no longer engaging to audiences who are accustomed to personalized ones and quick information gathering that is achieved by the mere touch of a screen. Therefor the mission of Museums and Cultural Heritage sites is changing, from places of collecting, display and storage to becoming dynamic and interactive spaces, where the coexistence of virtual information and tangible artifacts and spaces leads to a memorable and personalized experience [7, pp. 3978].

1.1 Motivation

With the expansion of the digital world and the evolution of Virtual and Mixed Reality technologies, interactive cultural experiences powered by interactive displays, mobile applications, forms of digital storytelling and gamification strategies are in high demand [8, pp. 105], and many locations have sought the development of Virtual tours or experiences specifically tailored to enhance the engagement in their exhibits. A lot of these projects are either fully virtual, or are not easily transposed to other museums, given they are developed for a specific institution or historical site, and so there is a lack of adaptable and scalable solutions in this area.

Although virtual reality allows for a much more immersive experience, the tangible artifacts and the feeling of seeing something in person still hold value, and Augmented or Mixed Reality technologies in their current state can provide a hybrid experience that encompasses both the advantages of digital overlays and of on-site exhibits with real artifacts, without compromising the state of preservation of such objects whilst still providing visitors with a closer and more detailed look. Artifacts in recovery can also be filled in digitally, reducing the impact of such pieces missing. But it is also important to note that not all relevant information about the collected objects is easily displayed in an

engaging way, some aspects like the materials of a piece, the year of it's making or even facts about the creator are important but are badly received by visitors after they have seen several similar descriptions and details. Nonetheless, this type of approach, centered in Augmented reality, enriches the physical visits without distracting from the authenticity of seeing real, tangible artifacts.

As already mentioned, museums are, in their core, storytellers and the collected objects themselves are entities that represent and tell a story, however for modern audiences, a more direct and human-like storytelling approach based on characters has proved rather effective [5], whether it be virtual guides, historical or fictional characters, having a narrator for the story who embodies the storyteller is usually well received, after all humans are also storytellers and with the rise of social media and the increasing time spent on such apps, people have started craving experiences of or that emulate human interaction.

Regarding the search for personalized and interactive moments, this need reflects a shift in the way people find and consume information, whereas before the search of information was part of the process and the journey was in itself an interaction, now people have all the information they want on their fingers [20] and expect it as quickly as possible. However the popularity of adventures such as escape rooms, the success of gamification in applications with a cultural background and the growth of choice-based video-games reveal an interest from the public in more user-centric explorations. Instances in which the visitor's actions directly influence the course of their experience.

Taking all this information and context into account the design of an interactive and adaptable museum experience for institutions such as *Museu Nacional dos Coches* (MNC) or *Museu Nacional do Traje* (MNT), among others, can be achieved by compiling character-driven storytelling with gamification techniques whilst addressing the evolving expectations of modern audiences by giving the visitors control over their experience, in carefully selected choice moments. By leveraging different forms of interaction and blending digital and physical elements, such system can bridge the gap between traditional exhibits and the dynamic digital experiences, ensuring the continuous relevance of cultural heritage.

1.2 Challenges and objectives

The main objective of this dissertation, following up to it's motivations, is the design of a storytelling experience in the context of museums and other cultural and historical sites that is adaptable to different locations. This dissertation also aims at developing an approach that complements the on-site experience with digital characters, digitized objects and information overlays without detracting from the tangible artifacts and physical characteristics of the site or exhibition and with a large focus on the narrative.

This work encompasses many challenges and is guided by some research questions, the first one, mentioned in [20, p. 463] being:

Q1 – How can a museum best frame content to make it desirable?

The answer to this question in this case is by making the content part of an overall story, presenting it with interactive characters and crafting an user-centric experience where the actions of visitors define their experience.

Q2 – Can character-based interactive storytelling serve the purpose of museums and how?

By choosing characters that blend in with the exhibition, per example a coachman in the *Museu Nacional dos Coches*, and allowing the consumers to make questions and interacting with this character a new perspective can be presented in the museum, and the transmission of information can be more dynamic and more effective.

Q3 – Can personalized experiences and variable narratives encourage repeat visits?

If the story changes based on the actions of the users, such as the choices made or questions asked, the experience, even for the same route in the museum or historical site, will always be slightly different from visit to visit. Also with a character-based approach other things can be explored such as different views for the same route, different characters. And the experience may also encompass several routes that group related points of interest and this routes can be explored across multiple visits.

Q4 – In what ways can museums use gamification to transform traditionally tedious or detailed information into engaging educational content?

The definition of games that depend on or transform this information may prove effective. The main idea is that if the user sees this information they are rewarded as if in a game, per example if they see the material of a piece they unlock this material to use in a later game or get some sort of digital achievement.

Q5 – How can pieces that are being recovered or are unavailable at the moment be digitally incorporated?

Even if an artifact is not physically present if the digitized 3D model is available it can be displayed, zoomed in and rotated by the user, diminishing the impact of the object missing.

Q6 – Can the lack of immersion of Mobile Augmented Reality be counter-balanced by it's availability and reduced price?

Although head-mounted displays and virtual reality prove more immersive, everyone now-a-days owns a smart phone, and the AR capabilities of such mobile devices have come

a long way, it is also a lot more affordable for the institutions themselves to incorporate a mobile app than acquire head-mounted displays or virtual reality hardware devices. Moreover there is not so much concern of spacial restrictions that could prevent several visitors from performing the same digital route.

Q7 – How can such experience be made easily adaptable to different museums and historical sites?

To make the experience easily adaptable a platform has to be developed, one that encompasses the steps of the created approach in a way that is low-code, accessible and that allows information, whether it be text, specific characters, specific interactions or personalized mini-games to be easily uploaded and integrated.

Along with the main objective this dissertation aims at addressing all these challenges, trying out and researching upon the purposed solutions and ultimately, this work strives to develop a platform, create an approach and design a museum exhibit experience that encompasses several routes, with interactive characters and interesting information overlays. This experience shall also take advantage of gamification techniques, include mini-games and explore the creation of non-linear narratives based on user choices and actions, in order to enrich the on-site museum experience.

1.3 Solution

This thesis proposes a solution for an easily adaptable on-site museum experience, powered by character-based digital storytelling, gamification and that encompasses a high focus on narrative generation and the enhancement of the physical museum tour. This solution takes advantage of the museums storyteller nature and transposes it into the form of historically inspired and interactive non-player characters in an attempt to create a highly engaging adventure.

The way the experience is planned to take place is by the integration of several Points Of Interest (POIs) in the institutions physical spaces, each of this POIs will have associated characters and a main character can be selected to lead the action. The interaction with the characters is made through questions, some predefined questions that are chosen in the context of the overall story, and some free question. The questions asked and their different variations alter the resulting narrative.

Regarding the routes, each route groups related POIs, the points relation can be historical, temporal or simply spacial and routes can be of three types: unordered and unrelated routes, where the points don't encompass an overall story; related but unordered, the POIs belong to the same story but can be visited by any order; ordered and related routes, the points belong to the same story and must be visited in a certain order.

At the end of each visit to a POI a part of the story is generated, at the end of a route a full story, influenced by the questions asked and the order in which the points are visited, is revealed.

The experience also includes two base mini-games that address the challenges (mentioned in section 1.2) of displaying traditionally tedious information in an engaging way and how to incorporate objects that are unavailable:

- For the first challenge, a dress-up like game will be included at the end of a route, when the more detailed information is visited in a POI a related texture or piece is unlocked to use in the game. For the MNC the visitor can build and customize their own coach 3D model, based on the unlocked textures and subsequently the visited information; for the MNT it would be an actual dress-up game with clothing pieces and fabrics to be unlocked; for a traditional art museum this mini-game could be adapted to some sort of digital canvas with different materials and types of ink.
- Regarding the unavailable object a 3D puzzle will appear during or at the end of a POI dialogue, in this puzzle the digitized 3D model of the artifact is broken into pieces either cubical or corresponding to parts of the object, when the user puts the pieces back together the 3D model is unlocked and the user can now handle and inspect the missing relic.

In order to make the solution adaptable and scalable, these steps are to be encompassed and automated by a platform to be developed. In the platform the historical information and narrative and the digitized 3D models are to be received as input, the user then also must create and allocate the characters to each Point Of Interest as well as define the routes and it's nature. New mini-games must and might also be added as well as the noting of unavailable objects and it's allocation to specific POIs, each point also must hold information of what type of rewards visiting it or seeing certain parts of it provide.

1.4 Contributions

The expected contributions of this work, apart from this proposal of thesis and the dissertation itself, are:

- The platform and approach developed for an adaptable and scalable on-site, story-telling driven museum experience;
- The mobile application that accompanies the Augmented Reality visit.
- The 3D puzzle mini-game and the system that divides a 3D model into pieces;
- The dress-up like mini-game;
- Prototypes that compare: AR foundation and the Vuforia plugin;

- Experiments with Narrative Procedural Generation as well as graph a Graph story-node system for the generation of the resulting story.
- Experiences with Knowledge-based or AI solutions for the interactive characters and the answers to the free questions.
- The result analysis through user-testing and questionnaires such as: System Usability Scale; User Experience Questionnaire; Presence Questionnaire and the Museum Experience Scale.

1.5 Document structure

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), 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 — [MikTeX](#) and [TeXLive](#) — that share lots of similarity, and \LaTeX documents are portable between them. This means that, for most users, both systems are equally usable.

TeX-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 TeXLive!

MikTeX 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 MikTeX 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 L^AT_EX. Installation of L^AT_EX is as hard as installing any other software. Just do your best and you will certainly succeed.
3. Update your L^AT_EX installation using the *T_EXLiveUtility* program of the MikT_EX console.
4. Download the **novathesis** template by either:

- Cloning the [GitHub repository](#) with

```
git clone --depth=1 https://github.com/joaomlourengo/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/joaomlourengo/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/joaomlourengo/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 (pdfLaTeX, XeLaTeX or LuaLaTeX).

- 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 L^AT_EX 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 2.2](#).

8. Recompile the 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 2.1](#).

Table 2.1: 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 has many bibliography files as you want.
template.pdf			A possible result of applying pdfL ^A T _E X 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 T _E Xmagician, don't mess up with the files and folders inside this folder.

Table 2.2: 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. [15], 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. <i>Otherwise ignored.</i>
9_ulisboa_fmv.tex			Configurations specific to ULISBOA FMV. <i>Otherwise ignored.</i>
9_ulisboa_ist.tex			Configurations specific to ULISBOA IST. <i>Otherwise ignored.</i>
9_uminho.tex			Configurations specific to UMINHO (all schools). <i>Otherwise ignored.</i>

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 <i>phd, phdprop, phdplan, msc, mscplan, bsc, plain</i>	The type of the document. phd → PhD thesis (⇐ <i>default</i>). 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/fnv, uminho/eaad, uminho/ec,
uminho/ed, uminho/eeg,
uminho/eeng, uminho/elach,
uminho/emed, uminho/epsi,
uminho/ese, uminho/i3bs,
uminho/ics, uminho/ie, iscteiul/eta,
ips/ests, ipl/isel, ipl/isel/meb,
ullht/deisi, ullht/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 document to some specific School formatting 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 (⇐ *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 (⇐ *default*).

paper → Empty / white pages are added when necessary.

print/webography=OPT

User defined title

Generate a separate bibliography for @online references.

⇒ Default: *print/webography=undefined*

If undefined, the @online references are list 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).

⇒ Default: *color/links=DarkBlue*

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

color/gls=OPT <i>Color name</i>	The color for the glossary managed hyperlinks (glossary, symbols, etc). \Rightarrow <i>Default: color/gls=Black</i> The valid color names as listed in “xcolor” manual, the “svgname” color set.
print/index=OPT <i>true,</i> <i>false</i> (\Leftarrow default)	Print the (words) index at the end of the document. Print the index (in Portuguese <i>Índice Remissivo</i>).

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. \Rightarrow <i>Default: abstractorder={en={en,pt}} for english</i> \Rightarrow <i>Default: abstractorder={L={L,en}} for lang L</i> 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). \Rightarrow <i>Default: lang/extra={}</i> L_i is a two-letters language code from the set of valid language codes, following ISO 3166-1 (alfa-2).
gnumberlist=OPT <i>true</i> , (\Leftarrow default) <i>false</i>	Shall the glossary entries list the page numbers where those entries are used? (Like a reverse index!)
numberallpages=OPT <i>true</i> , <i>false</i> (\Leftarrow default)	Shall all the pages (except cover) be numbered?
tocintoc=OPT <i>true</i> , <i>false</i> (\Leftarrow default)	Shall table of contents be listed in the table of contents?
tocintoc=OPT <i>true</i> , <i>false</i> (\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 <i>true,</i> <i>false</i>	Shall the evaluation committee be printed? <i>⇒ Default: print/committee=true if docstatus=final</i> <i>⇒ Default: print/committee=false otherwise</i>
print/frontmatter=OPT <i>true, (⇐ default)</i> <i>false</i>	Shall the front matter be printed? Set to false to generate a PDF with only the cover and the book chapters.
print/statement=OPT <i>true,</i> <i>false (⇐ default)</i>	Shall the honor/originality statement be printed?
print/copyright=OPT <i>true, (⇐ default)</i> <i>false</i>	Shall the copyright message be printed?
print/timestamp=OPT <i>true,</i> <i>false</i>	Shall a timestamp (with the PDF generation date/time) be printed in the cover? <i>⇒ Default: print/timestamp=true if docstatus=working</i> <i>⇒ Default: print/timestamp=false otherwise</i>
style/url=OPT <i>default, (⇐ default)</i> <i>same</i>	Use the same (main) font in URLs?
style/font=OPT <i>arial, bookman, calibri, erewhon,</i> <i>kieranhealy, kpfonts, libertine, newpx,</i> <i>newsgott, scholax</i>	Which font set to use in the document? arial → Use 'arial' font. Requires Xe ^L AT _E X or Lua ^L AT _E X. bookman → Use 'bookman' font. calibri → Use 'calibri' font. Requires Xe ^L AT _E X or Lua ^L AT _E X. erewhon → Use 'erewhon' font. kieranhealy → Use 'kieranhealy' font. kpfonts → Use 'palatino' font. libertine → Use 'libertine' font. newpx → Use 'palatino' font. (⇐ <i>default</i>) newsgott → Use 'newsgott' font. Requires Xe ^L AT _E X or Lua ^L AT _E X. scholax → 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, dowing, komalike, ntglke, tandh, wilsondob), the customized list of chapter styles below is also available.

`bar` → Use ‘bar’ chapter style. (\Leftarrow *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.** \Rightarrow *Default: The same as the main language.***lang/copyright=OPT***en, pt, de, es, fr, gr, it***The main language for the copyright message.** \Rightarrow *Default: The same as the main language.***spine/layout=OPT***no, full, trim***Print the “book spine” at the end of the document?** \Rightarrow *Default: ‘trim’ if docstatus=final* \Rightarrow *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 \LaTeX dimension**Force the width of the “book spine”.** \Rightarrow *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.** \Rightarrow 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 xpto xpto xpto xpto xpto xpto xpto xpto xpto xpto 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 L^AT_EX TUTORIAL WITH EXAMPLES

This Chapter aims at exemplifying how to do common stuff with L^AT_EX. 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 [[6](#), [11](#), [13](#)].

3.3 Inserting Tables

3.4 Importing Images

3.5 Floats, Figures and Captions

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur 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. Suspendisse 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. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

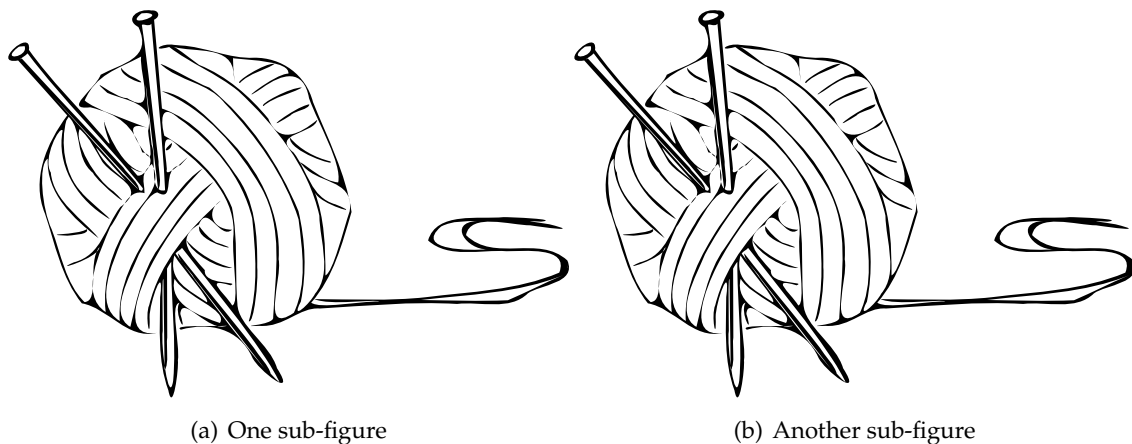


Figure 3.1: A figure with two sub-figures!

And this is a small text that references the [Figure 3.1](#) and its Subfigures [3.1\(a\)](#) and [3.1\(b\)](#).

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur 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

placemat. 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. Suspendisse 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. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

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 [8], usar um “~” para ligar o `\cite{...}` à palavra que o precede (...referência~\cite{Artho04}). Caso queira fazer múltiplas citações [17, 18, 10], 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 3.1 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 3.1: 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

¹This is a simple footnote.

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 [12]	1	0	0	—	1
Account [19]	1	1	1	—	0
Jigsaw [19]	1	2	1	C	0
Over-reporting [19]	0	2	0	1A, 1C	0
Under-reporting [19]	1	1	1	—	0
Allocate Vector [14]	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 3.2) do not scale well and have negative effects on the quality of your document. On the other hand, *vector* images Figure 3.3 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 3.4 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 numbered

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

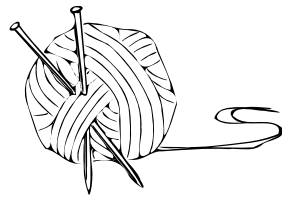
which can latter be referenced as equation 3.1



Figure 3.2: Bitmap image (JPG/PNG)



Figure 3.3: Vectorial image (PDF)



(a) Novelo de lã



(b) Tempestade com neve

Figure 3.4: Exemplo de utilização de *subbottom*

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”.

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/NOVAthesiFiles/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.ldf`, 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_novathesis.tex` and near line 28 uncomment the line with key `\ntsetup{school=<SOMETHING>}`;
 - 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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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.

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APPENDIX 2 LOREM IPSUM

This is a test with citing something [\[9\]](#) in the appendix.

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ANNEX 1 LOREM IPSUM

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