



*Bachelor Thesis*

## The Bachelor in AI Thesis Using

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*Bachelor in Artificial Intelligence*



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**Supervisors:**      **First Supervisor, Affiliation**  
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# Abstract

Abstract is a short overview of the content of the work. The main goal of abstract is to give a reader an idea about the work, without the need to read it all. Thus, the abstract should be concise, but at the same time concrete on the content of the work.

Typically, abstract is not more than one page long, and presents the work in a brief and concise way. Often abstract follows the outline of the work presents a problem, method, and results.

## Keywords

Template, BSc, Thesis, Artificial Intelligence

# Chapter 1

## Introduction

This is the introduction. Here, you need to introduce your reader to the topic and guide through some logical steps to the problem formulation. Please remember who is your reader. Keep in mind that your thesis is the main deliverable of your exam work. Of course, a significant contribution (either theoretical, or scientific, or engineering) must be done in order to provide the content for the thesis.

### 1.1 Problem Formulation

At some point, after some general introduction, you need to formulate and frame your problem. The problem or the goal of the project must be clear and specific. You might want to split it up into sub-goals and objectives.

### 1.2 Outline

In the end of the introduction, it is customary to provide the structure of the remaining parts of the thesis. Here is an example.

The rest of this thesis is organised as follows:

**Chapter 3** explains how to use this template;

**Chapter 4** gives general guidelines on how to write the thesis;

**Chapter 5** contains conclusions. Not many, but some.

Of course, you are free to structure the outline in a different form.

# Chapter 2

## Software Structure

### 2.1 High-Level Architecture

In this section, we provide an overview of the software architecture used in this project. The architecture integrates various components and frameworks to achieve 3D semantic mapping and 6DoF object pose estimation. Figure 2.1 illustrates the high-level architecture of the system.

Figure 2.1: High-Level Architecture of the Software System

### 2.2 Configuration

The configuration component is crucial for setting up the system parameters and ensuring accurate operation. This includes calibration procedures and backend settings.

#### 2.2.1 Hand in Eye Calibration

Hand in Eye calibration aligns the camera's coordinate system with the robotic arm's coordinate system. This calibration is essential for precise object manipulation and interaction.

#### 2.2.2 SLAM Backend

Simultaneous Localization and Mapping (SLAM) backend is responsible for creating and updating the robot's map of the environment. This section details the SLAM algorithms and their implementation.

### 2.3 Detector

The detector module is responsible for identifying and locating objects within the environment. It utilizes YOLO (You Only Look Once) for real-time object detection and instance segmentation.

### 2.4 World

The world module manages the representation of the environment, including point clouds and spatial data structures.

### 2.4.1 KDTrees

K-Dimensional Trees (KDTrees) are used for efficient nearest neighbor searches within the point cloud data. This section explains the implementation and optimization of KDTrees.

### 2.4.2 Pointcloud Management

Pointcloud management involves processing and organizing the 3D point data. This includes filtering, segmentation, and storage.

### 2.4.3 Clean-Up Thread

The clean-up thread ensures the continuous maintenance of the point cloud data, removing outliers and ensuring data integrity. This section describes the clean-up algorithms and their integration into the system.

---

**Algorithm 1** Clean-Up Thread Algorithm

---

```
1: Initialize clean-up parameters
2: while true do
3:   Retrieve current point cloud data
4:   Apply outlier removal filter
5:   Update point cloud storage
6:   Sleep for predefined interval
7: end while
```

---

# Chapter 3

## Using This Template

Writing in L<sup>A</sup>T<sub>E</sub>X is not complicated, but you need to understand how to use the different commands [2]. Here we explain those specific to this template.

To start using this template, your .tex file should start with the lines

```
\documentclass[bac,screen]{bai-thesis}
\usepackage{thesis}
```

This initializes the template and imports the main commands. The rest depends on your content.

### 3.1 Front Matter

The title and author are set with the commands `\title{}` and `\author{}`

If you need to put a date, use the command `\date{}`. `\today` returns always the current date; you can use it to keep the date updated automatically every time you compile your document.

The last three things to specify are the subject, academic year, and name of the supervisor(s):

- `\subject{Artificial Intelligence}`
- `\AY{2023/2024}`
- `\supervisor{First Supervisor, Affiliation}`

If the thesis was supervised by more than one person, simply use the `\supervisor{}` command several times:

```
\supervisor{First Supervisor, Affiliation}
\supervisor{Second Supervisor, Affiliation}
```

The description of the front matter finishes with the two commands

```
\begin{document}
\maketitle
```

to start the document and create the title page.

### 3.2 Main Matter

The main content of your thesis starts then. You should first provide your abstract and keywords with, unsurprisingly, the `abstract` environment and the `keywords` command. A simple example is the following





**Figure 3.1:** Long caption. This figure was automatically generated by Dall-E to represent the happy and productive process of writing a thesis.

```
\begin{abstract}
  here is the abstract
\end{abstract}
\keywords{Key, Word, Another}
```

This should be followed by the table of contents and, if needed, tables of figures, tables, and algorithms. For the moment, modify the file `contents.tex` to fit your needs.

You then present all the important information. You must cite your sources. You can cite works by using their keys in the bib files, like in this example [2, 3, 1]. The bib file can be created by hand or imported from other applications, such as Mendeley or CrossRef.

Hyperrefs are enabled. This means references (to chapters, sections, figures, tables, algorithms, etc) are links, which can be clicked to navigate through the thesis. Also, backrefs are enabled, which means that references include “(Cited on page(s))” links (see the examples in the references). You can also introduce citations that are never mentioned in the text (although this should only happen in very extreme situations). In that case, the backref will explicitly mention that the reference is not cited.

You will likely introduce figures, tables, and algorithms. There are standard environments to do this. Make sure that they are “floating” (at the top or at the bottom of the page, not between the text) and that they are all references in the main text.

Figure 3.1 contains a picture generated by Dall-E. Please note the realistic position of the typewriter and of the pen at the person’s hand. The caption should briefly explain the figure, and should always appear below it.

Table 3.1 contains some made up stuff. Tables can be very complicated. The template imports the `booktabs` package which allows for some better looking tables. To make cleaner and more elegant tables, avoid vertical lines as much as possible. For tables, specially if they are long, the caption should appear at the top. If the table is very long, you

**Table 3.1:** Long caption. This is a table which uses some advanced features like `multirow` and `multicolumn` and row separators

Categories		Heading1	Heading2
Heading3	Heading5	Data element	Data element
	Heading6	Some stuff in a table.	Some stuff in a table.
Some	Other	Data	Here

---

**Algorithm 2** Long caption. This is an algorithm.

---

**Require:** The first input.

**Require:** The second input.

**Ensure:** The output.

```

1: First statement.
2: for all Something. do
3:   if A condition. then
4:     Statement.
5:   else if Another condition. then
6:     Statement.
7:   else
8:     Statement.
9:   end if
10:  Statement.
11: end for
```

---

may want to use a coloring scheme on some rows to help reading (and reduce the use of horizontal lines).

Finally, we also present an example of an algorithm in Algorithm 2. This is constructed using the `algorithmic` package, but you are free to choose other packages according to your needs. The caption is also at the top, but it is usually short. The workings of the algorithm are described in the main text.

### 3.3 Back Matter

After you have written all your text (including your conclusions) you still need to add the reference (bibtex) file and call the command to create the reference section. Modify the file `backmatter.tex` to achieve this. The additional (seemingly obscure) commands used there help building an adequate table of contents, and allow for pdf readers to get a navigation index.

# Chapter 4

## Guidelines

This chapter provides general recommendations for writing a thesis for the Bachelor of Science in Artificial Intelligence. These guidelines are not meant to be prescriptive; they are just tips that give minimal guidance. You are the author of the thesis, and you have the final word about it.

### 4.1 The Thesis

The thesis must document a practical activity carried out as part of one of the labs offered by the Bachelor program or during a stage in a company. Considering the credits awarded for the thesis, it is reasonable to expect a 30 to 50-page document (all-inclusive).

A typical thesis includes

- an introduction that summarizes the work;
- a presentation of the topic addressed (for instance, the description of a problem or the definition of a task);
- an analysis of the relevant literature for that topic and a summary of the most important state-of-the-art solutions;
- a description of the main contribution of the thesis;
- a report of the results obtained;
- conclusions reviewing the main points;
- the list of bibliographic references cited in the thesis.

These can be presented as separate chapters or sections of chapters covering multiple points.

### 4.2 The Advisor

You will write the thesis under the supervision of an advisor who will give you directions and advice. Regular meetings with your advisor are strongly recommended during thesis preparation. When you have a draft of a chapter, please send it to them for revision. Leave a reasonable time for the revision (e.g., one week per chapter); otherwise, the advisor may be forced to delay your graduation to the following session.

The advisor **is not** supposed to proofread the text. Please ensure the text is written in clear and correct English before submitting it for revision.

## 4.3 General Advice

The goal of writing a thesis is to document your work in a way that can be evaluated by others. Be explicit in what is your personal contribution, and if adequate, make sure to present the challenges encountered and the ideas generated.

There are no extra points for being prolific. You should be clear, precise, and concise. A good advice is to write everything that you think that is necessary, and then **stop**. Then go back and get rid of things that were not really necessary.

Remember that writing is difficult and takes time. Most students underestimate the effort required to produce a good manuscript. Please take this into account. You are finishing a 3-year course on AI, and surely know about generative AI tools. If you are planning to use these for writing your thesis, check first what is the official policy from the programme and, in any case, use them only as **aids**. You should be aware of all the limitations and drawbacks of these methods and you (and only you) are responsible for what is written in your thesis.

# Chapter 5

## Conclusions

These are conclusions. Here you can look at the problem, method, results, and reflect on the overall project outcomes, particular objectives and other aspects.

### 5.1 Review of Project Goals

If you provided clear and detailed goals and objectives in the introductory part of your thesis, then it is a good idea to review them here and outline how (if, or to what extent) each of them has been achieved.

### 5.2 Context

It is important to be able to put your work in the environmental, societal, ethical, and enterprise context. Of course, not all works contribute significantly to each of the aspects, however it is important to provide critical review of your work.

### 5.3 Future Works

In most cases, the completed work open new opportunities. Or it might be that not all possible ways to solve the problem could be explored. In this section you can outline possible directions of future work that you find the most relevant given your knowledge and experiences in this project.

# References

- [1] Ting Chen, Ruixiang Zhang, and Geoffrey E. Hinton. Analog bits: Generating discrete data using diffusion models with self-conditioning. In *The Eleventh International Conference on Learning Representations, ICLR 2023, Kigali, Rwanda, May 1-5, 2023*. Open-Review.net, 2023. (Cited on page 7)
- [2] Leslie Lamport. *LaTeX: a Document Preparation System*. Addison Wesley, Massachusetts, 2 edition, 1994. (Cited on pages 6 and 7)
- [3] Jianwen Li, Moshe Y. Vardi, and Kristin Y. Rozier. Satisfiability checking for mission-time LTL (MLTL). *Inf. Comput.*, 289(Part):104923, 2022. (Cited on page 7)