

THÈSE DE DOCTORAT

DE L'ÉTABLISSEMENT UNIVERSITÉ MARIE ET LOUIS PASTEUR

École doctorale n°37

Sciences Physiques pour l'Ingénieur et Microtechniques

Doctorat d'Intelligence Artificielle

par

FIRSTNAME LASTNAME

Titre en français

Subtitle

Thèse présentée et soutenue à Belfort, le 20 avril 2025

Composition du Jury :

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DOCTORAL THESIS

OF MARIE AND LOUIS PASTEUR UNIVERSITY

Doctoral School #37

Physical Sciences for Engineering and Microtechnologies

Doctor in Artificial Intelligence

by

FIRSTNAME LASTNAME

Title in English

Subtitle

Thesis defended the April 20, 2025 at Belfort

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RÉSUMÉ LONG



You must write here a long summary of your PhD thesis in French language. According to the SPIM rules, the length of this long summary must be of minimum 3 pages for people who is not native-french speaker, and of minimum 20 pages for who is native-french speaker.

ACRONYMS

- **MAS:** Multi-Agent System



CONTEXT AND ISSUES

1

INTRODUCTION

This is an acronym: Multi-Agent System (MAS). This is the same acronym: MAS.

Research Question 1 (RQ1) – a name

Description of the research question.

Objective 1 (O1) – a name

Description of the objective.

Contribution 1 (C1) – a name

Description of the contribution.

1.1 Context

This template describes some elements that can help you write your thesis. A typical outline for a scientific thesis is also proposed.

1.2 Thesis Objectives

The main objective of your thesis can be highlighted using the environment below:

Propose a model that does something!

1.3 **Thesis Outline**

2

STATE OF THE ART

2.0

Contents

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To help you write your thesis, several tools are described below. Many other macros are available in the \LaTeX package set `tex-upmethodology` on which the style of this thesis is based. Examples include environments for automatically creating subfigures and macros for defining unnumbered sections that appear in the table of contents.

2.1 Propose a Definition

Definition 1 illustrates the proposal of a definition.

Definition 1: A Thesis

Document presented to a university jury for obtaining a doctorate.

2.2 Include a Figure

Including a figure is done using standard \LaTeX tools (environment `figure`, `\includegraphics`, etc.).

We propose a macro to simplify the inclusion of a figure.

```
\mfigure[position]{options}{filename}{title}{labelid}
```

This is equivalent to (note the addition of `fig:` as a prefix to the label):

```
\begin{figure}[position]
  \begin{center}
    \includegraphics[options]{filename}
    \label{fig:labelid}
    \caption{title}
  \end{center}
\end{figure}
```

Referencing the figure can be done using the macros:

```
\figref{labelid}
\figpageref{labelid}
```

2.3 Include a Table

Including a table is done using standard \LaTeX tools (environment `table`, environment `tabularx`, etc.).

We propose a macro to simplify the inclusion of a table.

```
\begin{mtable}[options]{width}{numberofcolumns}{columnspec}{title}{labelid}
  content
\end{mtable}
```

This is equivalent to (note the addition of `tab:` as a prefix to the label):

```
\begin{table}[options]
\begin{center}
\begin{tabularx}{width}{columnspec}
  content
\end{tabularx}
\label{tab:labelid}
\caption{title}
\end{center}
\end{table}
```

Referencing the table can be done using the macros:

```
\tabref{labelid}
\tabpageref{labelid}
```

2.3.1 Example 1

Table 2.1 is an example of a table with 4 columns, with a title added at the top.

<i>Col1</i>	<i>Col2</i>	<i>Col3</i>	<i>Col4</i>
a	b	c	d
e	f	g	h

Table 2.1: Table Title

2.3.2 Example 2

Table 2.2 is an example of a table with 5 columns, with the table title also added at the top.

Col1	Col2	Col3	Col4	Col5
a	b	c	d	x
e	f	g	h	z

Table 2.2: Table Title

Source: This is a source

2.4 Inline Enumeration

You can enumerate elements in a paragraph: *(i)* element 1, *(ii)* element 2, *(iii)* element 3; and continue your text.

2.5 Description

The description environment provided by \LaTeX has been extended:

- **Element 1:** Text 1
- **Element 2:** Text 2
- **Element 3:** Text 3

Omitting an item header is not a problem:

- **Element 1:** Text 1
- Text 2
- **Element 3:** Text 3

2.6 Enumeration

The enumerate environment provided by \LaTeX has been extended to combine the advantages of the enumerate and description environments in a single \LaTeX environment:

1. **Element 1:** Text 1
2. **Element 2:** Text 2

3. Element 3: Text 3

You can specify the type of enumeration by switching to Arabic numerals:

1Element 1: Text 1**2Element 2:** Text 2**3Element 3:** Text 3

Or in Roman numerals:

iElement 1: Text 1**iiElement 2:** Text 2**iiiElement 3:** Text 3

Or in alphabetical numerals:

aElement 1: Text 1**bElement 2:** Text 2**cElement 3:** Text 3

Omitting an item header is not a problem:

1. Element 1: Text 1**2.** Text 2**3. Element 3:** Text 3

You can place text ^{as a superscript}. You can place text _{as a subscript}.

You can highlight **text**, or highlight it **even more**.

You can format people's names uniformly, for example STÉPHANE GALLAND (other macros are available).

2.8 Mathematical Symbols

- \mathbb{R}
- \mathbb{N}
- \mathbb{Z}
- \mathbb{Q}
- \mathbb{C}
- $\mathcal{P}a$
- $\text{sgn}(a)$
- $\min(a, b)$
- $\max(a, b)$

2.9 Theorems

You can define your own environment to describe a theorem, lemma, etc. This type of environment must be declared in the preamble of your document with the macro `\declareupmtheorem` (see the example in the preamble of this template).

My Theorem 1: Some Theorem

This is the description of this theorem.

This is my optional source

At the end of your document, you can then add a chapter listing the theorems present in your document: `\listofmytheorems`

2.10 Conclusion



CONTRIBUTION

3

CONTRIBUTION

3.1 Introduction

3.2 Details of the Contribution

3.3 Conclusion

4

IMPLEMENTATION

4.1 Introduction

4.2 Presentation of the Implementation

4.3 Experimental Results

4.4 Conclusion



CONCLUSION

5

GENERAL CONCLUSION

5.1 **Summary**

5.2 **Perspectives**

LIST OF FIGURES

LIST OF TABLES

2.1 Table Title 7

2.2 Table Title 7

LIST OF DEFINITIONS

1 A Thesis 5

IV

APPENDICES

A

FIRST APPENDIX CHAPTER

B

SECOND APPENDIX CHAPTER

Title: Title in English

Keywords: Keyword 1, Keyword 2

Abstract:

This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English. This is the abstract in English.

Titre : Titre en français

Mots-clés : Mot-clé 1, Mot-clé 2

Résumé :

Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français. Ceci est un résumé en français.