

THÈSE DE DOCTORAT

DE L'ÉTABLISSEMENT UNIVERSITÉ DE TECHNOLOGIE DE BELFORT-MONTBÉLIARD

École doctorale n°37

Sciences 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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Mme MAN PAC	Professeure quelque part	Invité



DOCTORAL THESIS
OF BELFORT-MONTBÉLIARD UNIVERSITY OF TECHNOLOGY

Doctoral School #37
Engineering Science 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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ACKNOWLEDGEMENTS

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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

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.

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.

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

2.7 Format Text

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}
- $\mathcal{P}a$
- $\operatorname{sgn}(a)$
- $\min(a, b)$
- $\max(a, b)$

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

a	b	c	d
---	---	---	---

--

Table 2.1: Table Title

e	f	g	h
---	---	---	---

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



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

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LIST OF DEFINITIONS

1	A Thesis	5
---	--------------------	---

IV

APPENDICES



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

Titre : Titre en francais

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
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