

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

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Titre en français

Subtitle

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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

To help you write your thesis, several tools are described below. Many other macros are available in the  $\text{\LaTeX}$  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  $\text{\LaTeX}$  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  $\text{\LaTeX}$  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.

<i>Col1</i>	<i>Col2</i>	<i>Col3</i>	<i>Col4</i>	<i>Col5</i>
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  $\text{\LaTeX}$  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  $\text{\LaTeX}$  has been extended to combine the advantages of the `enumerate` and `description` environments in a single  $\text{\LaTeX}$  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 <sup>as a superscript</sup>. You can place text <sub>as a subscript</sub>.

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`



## 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



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# LIST OF DEFINITIONS

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# IV

## APPENDICES







## **FIRST APPENDIX CHAPTER**



# B

## SECOND APPENDIX CHAPTER





