CIMAT Centro de Investigación en Matemáticas, A.C.

TITULO DE LA TESIS EN MAYUSCULAS Y CENTRADO

T E S I S

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Dedication to ...

Summary

This work addresses a problem in the area of *[discipline]*, focusing on the development and evaluation of *[methods or approaches]*. The proposed methodology is analyzed and tested through *[analysis or experiments]*, and the results demonstrate *[main outcome]*. These findings contribute to the understanding of *[application or context]* and provide directions for future work.

Keywords: generative models, artificial intelligence.

Acknowledgments

To my parents . . .

Contents

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Chapter 1

Introduction

This chapter introduces the context and motivation of the work. It provides a general overview of the problem being addressed, explains its relevance within the broader field of study, and outlines the objectives pursued in this document. Additionally, the structure of the work is briefly described to guide the reader through the subsequent chapters.

1.1 Problem Statement and Motivation

The problem considered in this work arises in the context of *[area or application domain]*. Recent developments in this field have highlighted the need for efficient and reliable approaches to address *[specific challenge or limitation]*. Understanding and solving this problem is important due to its impact on *[theoretical relevance, practical applications, or both]*. This work is motivated by the need to explore methods that can improve performance, accuracy, or robustness in this setting.

1.2 Objectives and Organization of the Document

The main objective of this work is to study and develop *[methods, models, or techniques]* to address the problem described above. Specific goals include *[key objectives or tasks]*. The remainder of this document is organized as follows: Chapter 2 presents *[related work or theoretical background]*; Chapter 3 describes *[methodology or model]*; Chapter 4 discusses

the results obtained; and Chapter 5 concludes the work and outlines possible directions for future research. Bibliography usage example Ho, Jain, and Abbeel (2020).

Chapter 2

Background and Preliminaries

This chapter presents the theoretical background and fundamental concepts required to understand the material developed in the subsequent chapters. It introduces the main definitions, models, and assumptions used throughout this document, and reviews relevant work related to the problem under study.

2.1 Theoretical Background

This section summarizes the core concepts and mathematical tools relevant to this work. Key notions from *[relevant field or discipline]* are introduced, including *[important definitions, principles, or models]*. These concepts provide the foundation for the methods and analyses presented later. When appropriate, standard results and properties from the literature are recalled to ensure clarity and completeness.

2.2 Related Work

This section reviews previous studies and approaches related to the problem addressed in this document. Existing methods proposed in the literature are briefly discussed, highlighting their main contributions as well as their limitations. This overview helps position the present work within the broader research context and clarifies how it differs from or extends prior work.

Chapter 3

Methodology

This chapter describes the methodology adopted to address the problem introduced in Chapter 1. It outlines the proposed approach, explains the main components of the method, and details the procedures followed for its implementation and analysis.

3.1 Proposed Approach

This section presents an overview of the proposed approach. The general strategy used to tackle the problem is described, along with the assumptions and design choices that guide the methodology. The approach is formulated in terms of *[models, algorithms, or frameworks]*, which are selected to balance accuracy, efficiency, and interpretability.

3.2 Algorithm Description

This section provides a detailed description of the algorithm or method employed in this work. Each step of the procedure is explained clearly, including input requirements, intermediate computations, and output generation. When appropriate, mathematical formulations or pseudocode are introduced to clarify the implementation and ensure reproducibility, for example:

Algorithm 1 DDPM Sampling

1: $\mathbf{x}_K \sim \mathbf{N}(\mathbf{0}, \boldsymbol{I})$
2: **for** $k = K, \ldots, 1$ **do**
3: $\quad \mathbf{z} \sim \mathbf{N}(\mathbf{0}, \boldsymbol{I})$ if $k > 1$, else $\mathbf{z} = \mathbf{0}$
4: $\quad \mathbf{x}_{k-1} = \frac{1}{\sqrt{\alpha_k}}\left(\mathbf{x}_k - \frac{1-\alpha_k}{\sqrt{1-\bar{\alpha}_k}}\boldsymbol{\epsilon}_\theta(\mathbf{x}_k, \mathbf{p}, k)\right) + \sigma_k \mathbf{z}$
5: **end for**
6: **Return** $\mathbf{x}_0$

3.3 Implementation Details

This section discusses practical aspects of the implementation. It includes details such as the programming language used, parameter settings, data structures, and computational considerations. Any simplifications or approximations made during implementation are also described, along with their potential impact on the results, for example:

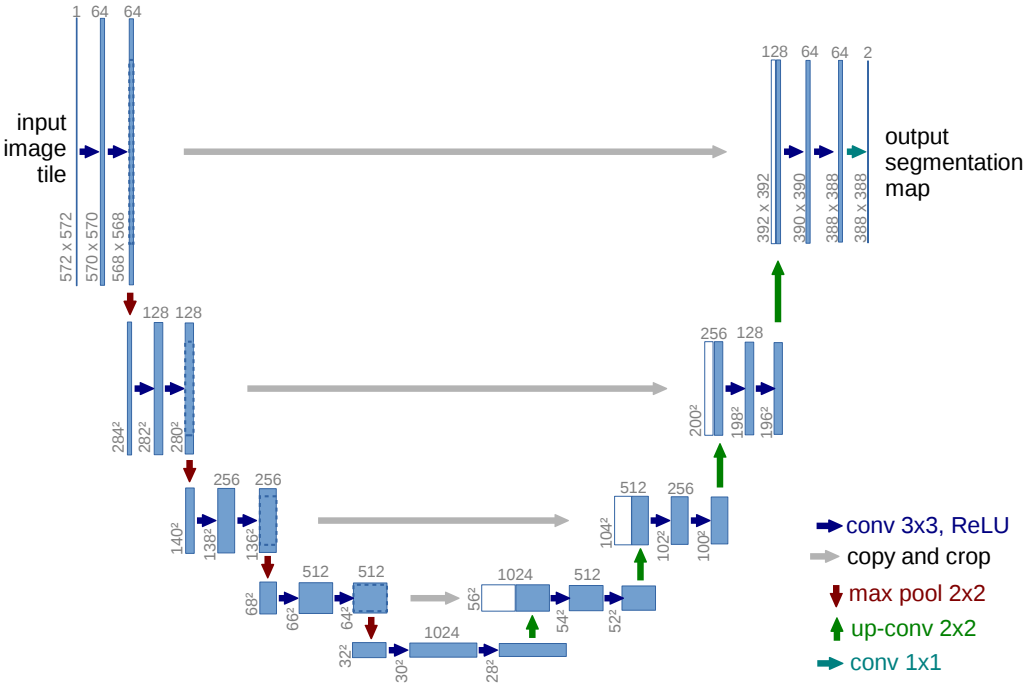

Figure 3.1: The U-Net architecture. Each blue square is a feature map with the number of channels labeled on top and the height × width dimension labeled on the left bottom side. The gray arrows mark the shortcut connections. (Image source: (Ronneberger et al., 2015)).

Chapter 4

Results and Discussion

This chapter presents the results obtained using the methodology described in Chapter 3. The performance of the proposed approach is evaluated, and the results are analyzed and discussed in the context of the objectives stated in Chapter 1.

4.1 Experimental Setup

This section describes the experimental or evaluation setup used to obtain the results. It includes information about the data or test cases considered, parameter settings, evaluation metrics, and any assumptions made during the experiments. These details ensure that the results can be properly interpreted and reproduced.

4.1.1 Results

This section reports the main results obtained from the experiments or analyses. The outcomes are presented using *tables, figures, or quantitative measures*, as appropriate. Key observations are highlighted, and the behavior of the proposed method is examined under different conditions or parameter choices.

Table 4.1: Summary of results obtained for different test cases.

Test Case	**Parameter Setting**	**Metric 1**	**Metric 2**
Case 1	Setting A	Value 1	Value 2
Case 2	Setting B	Value 3	Value 4
Case 3	Setting C	Value 5	Value 6

4.2 Discussion

This section provides an interpretation of the results. The findings are discussed in relation to the objectives of the work and compared, when relevant, with existing methods or theoretical expectations. Strengths and limitations of the proposed approach are identified, and possible explanations for the observed behavior are provided.

Chapter 5

Conclusions and Future Work

This chapter summarizes the main contributions of this work and discusses possible directions for future research. The conclusions are drawn based on the results and analyses presented in the previous chapters.

5.1 Conclusions

This section reviews the objectives stated at the beginning of the document and summarizes the key findings of the study. The effectiveness of the proposed methodology is assessed, and the main insights gained from the results are highlighted. Overall, this work contributes to a better understanding of *[problem or application domain]* and demonstrates the potential of *[methods or approaches]* for addressing the problem considered.

5.2 Future Work

This section outlines possible extensions and improvements that could be explored in future work. These may include refining the proposed methods, considering alternative approaches, extending the analysis to more complex scenarios, or applying the methodology to other related problems. Such directions provide opportunities for further research and development beyond the scope of this document.

References

Ho, J., Jain, A., & Abbeel, P. (2020). Denoising diffusion probabilistic models. *arXiv preprint arxiv:2006.11239*.

Ronneberger, O., Fischer, P., & Brox, T. (2015). U-net: Convolutional networks for biomedical image segmentation. *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2015*, *9351*, 234–241.

Appendix A

Additional Material

This appendix contains supplementary information that supports the content presented in the main body of the document. The material included here is intended to provide additional details without interrupting the flow of the main chapters.

A.1 Additional Derivations or Proofs

This section presents derivations, proofs, or extended mathematical details that are relevant to the work but were omitted from the main text for clarity. These results complement the theoretical development discussed in the previous chapters.

A.2 Additional Figures or Tables

This section includes figures or tables that provide further insight into the results presented in Chapter 4. These materials are referenced in the main text when necessary and are included here for completeness.

A.3 Implementation Details or Code Snippets

This section contains supplementary implementation details, pseudocode, or short code snippets that support the methodology described in Chapter 3. Full source code, if required,

may be provided separately or referenced as external files.