A project report on

TITLE OF THE THESIS

Submitted in partial fulfillment for the award of the degree of

Master of Science in Data Science

by

STUDENT NAME
(Reg. No. 22MDT1000)

SCHOOL OF ADVANCED SCIENCES

April - 2024

DECLARATION

I hereby declare that the project entitled **Title of the Thesis** submitted by me to the Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Chennai, 600 127 in partial fulfillment of the requirements of the award of the degree of **Master of Science in Data Science** is a bona-fide record of the work carried out by me under the supervision of **Dr. David Raj M**. I further declare that the work reported in this project, has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma of this institute or of any other institute or University.

Place : Chennai

Date :

Student Name

Reg. No: 22MDT1000

School of Advanced Sciences

CERTIFICATE

This is to certify that the thesis entitled **Title of the Thesis** is prepared and submitted by **Student Name (Reg. No. 22MDT1000)** to Vellore Institute of Technology, Chennai, in partial fulfillment of the requirement for the award of the degree of **Master of Science in Data Science** is a bona-fide record carried out under my guidance. The project fulfills the requirements as per the regulations of this University and in my opinion meets the necessary standards for submission. The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma and the same is certified.

Signature of Guide   :
Name   :   **Dr. David Raj M**
Date   :

Signature of Internal Examiner   Signature of External Examiner
Name   :   Name   :
Date   :   Date   :

Approved by the Head of Department
M.Sc. Data Science

Name   :   Dr. K Muthunagai
Date   :

ABSTRACT

Abstract to your work. Smith (2022)

Keywords: Machine Learning, Deep Learning...

ACKNOWLEDGEMENT

Place : Chennai   Student Name
Date :   Reg. No: 22MDT1000

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List of Symbols, Abbreviations and Nomenclature

ANN	:	Artificial Neural Network
CNN	:	Convolutional Neural Network
RNN	:	Recurrent Neural Network

Chapter 1

Introduction

The introduction is a shorter version of the rest of the report, and in many cases the rest of the report can also have the same flow that summarizes the major contributions of the project. The chapter should provide a critical and concise outline of the subject to be covered by the dissertation and indicate how this study will contribute to the subject. This chapter should include the descriptions such as: (not necessarily in that order, but what is given below is a logical order). Example of a citation: Smith (2022)

- Background [The setting of the scene of the problem].

- Statement [Exact problem you are trying to solve].

- Motivation [Importance of the problem].

- Post/Related work [Existing methods including pros and cons of the methods should be cited wherever possible].

- Challenges [Difficulty in the problem solving].

- Essence of your approach [Your method of problem solving].

- Statement of assumptions [The conditions under which your solution is applicable].

- Organization of the report.

- Aim(s) and Objective(s)

- Avoid 'routine' background e.g. the C programming language.

- Don't cite endless sources that are irrelevant or that you haven't read.

Chapter 2

Literature Review

Deep learning has revolutionized artificial intelligence, enabling significant breakthroughs in various domains.

The foundation of modern deep learning is well captured by Goodfellow et al. in their book Goodfellow et al. (2016), where they provide an extensive discussion on neural networks, optimization strategies, and deep architectures. This work serves as a comprehensive resource on the mathematical and practical aspects of deep learning.

In 2016, He et al. introduced the concept of deep residual learning in He et al. (2016). Their work addresses the challenges of training very deep neural networks by introducing residual connections, which help mitigate the vanishing gradient problem. By using identity mappings, the proposed residual networks (ResNets) allow for more effective gradient flow, leading to significant improvements in deep model training. Their architecture achieved state-of-the-art performance on benchmark datasets such as ImageNet, demonstrating the importance of deeper networks in advancing computer vision tasks.

2.1 Mathematical Formulation

The research problem can be expressed as:

$$E = mc^2 \tag{2.1}$$

where E is energy, m is mass, and c is the speed of light.

2.2 Tables and Figures

Table 2.1 presents some sample data.

Category	Value 1	Value 2
A	10	20
B	15	25
C	20	30

Table 2.1: An example table.

Figure 2.1 illustrates an example image.

Category	Value 1	Value 2
A	10	20
B	15	25
C	20	30
D	10	50
E	50	80

Table 2.2: An example table with some colors.

Figure 2.1: An example figure.

2.3 Enumerations

Important points to consider:

1. First point.

2. Second point.

3. Third point.

Enumerations with alpha numerics.

(a) First point.

(b) Second point.

(c) Third point.

Roman Enumerates.

(i) First point.

(ii) Second point.

(iii) Third point.

Chapter 3

System Design

The research problem can be expressed using fundamental equations in data science. One of the key formulations in machine learning is the cost function for linear regression:

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta(x^{(i)}) - y^{(i)} \right)^2 \tag{3.1}$$

where:

- $J(\theta)$ is the cost function,

- $h_\theta(x^{(i)})$ is the hypothesis function,

- $y^{(i)}$ is the actual value,

- m is the number of training examples.

Another fundamental concept in deep learning is the softmax function used in classification:

$$\sigma(z)_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \tag{3.2}$$

where z is the input vector and K is the number of classes.

Matrices play a crucial role in data science, especially in neural networks. A typical forward propagation step in a neural network can be expressed as:

$$A^{[l]} = g(W^{[l]} A^{[l-1]} + b^{[l]}) \tag{3.3}$$

where:

$A^{[l]}$ is the activation at layer l,

$W^{[l]}$ is the weight matrix,

$b^{[l]}$ is the bias vector,

$g(\cdot)$ is the activation function.

An example of a weight matrix in a neural network with three inputs and two neurons is:

$$W = \begin{bmatrix} 0.2 & 0.4 & 0.6 \\ 0.8 & 1.0 & 1.2 \end{bmatrix} \tag{3.4}$$

3.1 Typing theorems and definitions

Definition 3.1 (Probability Distribution). A probability distribution is a function that provides the probabilities of occurrence of different possible outcomes in an experiment. Formally, for a discrete random variable X, the probability mass function (PMF) is defined as:

$$P(X = x) = f(x), \quad \sum_x f(x) = 1. \tag{3.5}$$

Lemma 3.2 (Universal Approximation Theorem). *A feedforward neural network with a single hidden layer containing a finite number of neurons can approximate any continuous function on a compact subset of $\mathbb{R}^n$, provided the activation function is nonconstant, bounded, and monotonically increasing.*

Theorem 3.3 (Central Limit Theorem). *Let $X_1, X_2, ..., X_n$ be a sequence of independent and identically distributed random variables with mean μ and variance σ^2. Then, as n approaches infinity, the standardized sum:*

$$Z_n = \frac{\sum_{i=1}^{n} X_i - n\mu}{\sigma \sqrt{n}} \tag{3.6}$$

converges in distribution to the standard normal distribution:

$$Z_n \sim \mathcal{N}(0, 1). \tag{3.7}$$

If you want more such environments to be numbered and formatted consistently, add the following code in the preamble of your document and replace the commands, what you need and use it as environments.

```
\newtheorem{corollary}[theorem]{Corollary}
```

Note that, this follows the numbering of theorem environment.

Remark 1. This remark is typed using the similar theorem environment but without numbering. Note that, we have added the following in the preamble to achieve this:

```
\newtheorem{remark}{Remark}
```

Chapter 4

Methodology

This chapter should reflect development of the project such as: implementation, experimentation, optimization, evaluation etc. and unit integration testing should be discussed in detail. The unit test cases and system test cases should describe the input, expected output and output obtained. It can also include the details of the tools used for implementation, justification for the selected tool and the detailed description of implemented modules. Screen shots, Pseudocode etc. In case of simulation, modeling, programming techniques, programming steps, flow-charts, simulation results, verification of the approach followed and the like depending on the nature of the project.

4.1 Some section

some dummy data is written here... Please change it according to your need...

The materials required, techniques followed, sample preparations, research design and methods should be clearly mentioned. The experimental procedure should be clearly defined.

Chapter 5

Results and Discussions

This is part of the set of technical sections, and is usually a separate section for experimental/design papers. This chapter should include:

- Performance metrics.

- Parameters under study

- Comparison of cases/ studies with respect to existing and proposed work / algorithm/ design–comparison/ with the published data and deviations / improvements if any as expected in the aims and objectives

- Expected and obtained results- Analysis of the results- statistical analysis, plots, simulated results, synthesis of process, interpretation of the results

- Detailed results for each logical component of the project with an accompanying discussion section [Can include screen shots, graphs etc.].

- The results can be tabulated, graphically presented and photographs to be displayed if any.

- Discuss the results which should include an interpretation of the results and their relationship to the aims and objectives.

Chapter 6

Summary and Future Work

This chapter should summarize the key aspects of your project (failures as well as successes) and should state the conclusions you have been able to draw. Outline what you would do if given more time (future work). Try to pinpoint any insights your project uncovered that might not have been obvious at the outset. Discuss the success of the approach you adopted and the academic objectives you achieved. Avoid meaningless conclusions, [e.g. NOT " I learnt a lot about C++ programming "]. Be realistic about potential future work. Avoid the dreaded: "All the objectives have been met and the project has been a complete success". You have to crisply state the main take-away points from your work. Describe how your project is performed against planned outputs and performance targets. Identify the benefits from the project. Be careful to distinguish what you have done from what was there already. It is also a good idea to point out how much more is waiting to be done in relation to a specific problem, or give suggestions for improvement or extensions to what you have done. Future scope of the work for improvement may also be included

References

Goodfellow, I., Bengio, Y., and Courville, A. (2016). *Deep Learning*. MIT Press.

He, K., Zhang, X., Ren, S., and Sun, J. (2016). Deep residual learning for image recognition. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 770–778.

LeCun, Y., Bengio, Y., and Hinton, G. (2015). Deep learning. *Nature*, 521(7553):436–444.

Smith, J. (2022). The effects of climate change. *Scientific American*, 327(1):44–49. This is a sample entry for an article in a magazine.

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, L., and Polosukhin, I. (2017). Attention is all you need. *Advances in Neural Information Processing Systems (NeurIPS)*, 30.

Appendix A

Appendix Chapter

Here is the appendix chapter. Usually, the code and the other related items are given here.