

BRIDGING THE GAP

INTEGRATING LINEAR ALGEBRA IN THE DEVELOPMENT AND UNDERSTANDING OF LARGE LANGUAGE MODELS FOR SOFTWARE ENGINEERING APPLICATIONS.

BY

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BACHELOR'S THESIS
IN
COMPUTER ENGINEERING

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Preface

This bachelor's thesis was written for the Department of Electrical and Computer Engineering, Aarhus University. It is part of the Computer Engineering study program, and was written in the spring of 2024.

All source files associated with this thesis are found at: https://github.com/asgersong/BSc

Asger Poulsen, February 13, 2024

Abstract

Acknowledgements

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Chapter 1 Introduction

Literature Review

- 2.1 Overview of Large Language Models
- 2.2 Linear Algebra in Machine Learning
- 2.3 Previous Studies on LLM Compression and Optimization

Theoretical Foundations

- 3.1 Linear Algebra in Deep Learning
- 3.2 Understanding LLMs

Methodology

- 4.1 Educational Synergy Development
- 4.2 Software Engineering Application
- 4.3 Evaluation Method
- 4.3.1 Compression of LLM (Flan-T5-Base) Using Low Rank Decomposition
- 4.3.2 Metrics for Evaluation

Implementation

- 5.1 Curriculum Component Implementation
- 5.2 Chatbot Development
- 5.2.1 Tools and Libraries Used
- 5.2.2 Integration of LLM

Evaluation and Results

- 6.1 Curriculum Effectiveness
- 6.2 Chatbot Performance and Usefulness
- 6.3 Compression and Optimization of LLM
- 6.3.1 Methodology Applied
- 6.3.2 Results and Analysis

Discussion

- 7.1 Interpretation of Results
- 7.2 Theoretical and Practical Implications
- 7.3 Limitations and Challenges

Conclusion and Future Work

- 8.1 Summary of Key Findings
- 8.2 Contributions to the Field
- 8.3 Recommendations for Future Research