

COMP39/9900 Computer Science/IT Capstone Project

School of Computer Science and Engineering, UNSW

Project Number: P3

Project Title: Comparative Analysis of Fine-Tuning Techniques for Large Language Models on Domain-Specific Tasks

Project Clients: Dr Basem Suleiman, Piyavachara Nacchanandana

Project Specializations: Software development; Web application development; Artificial Intelligence (Machine/Deep Learning, NLP); Big data analytics and visualization.

Number of groups: 5

Main contact: Piyavachara Nacchanandana

Background:

Large language models (LLMs) have showcased remarkable performance across various natural language processing tasks. However, their out-of-the-box capabilities can be further enhanced by fine-tuning them on specific datasets and tasks. This project delves into the empirical comparison of different fine-tuning techniques on at least two large language models, aiming to identify the most effective strategies for various domain-specific applications.

Project Goals:

Comparative Analysis: The primary goal is to systematically compare and evaluate the effectiveness of different fine-tuning techniques (e.g., full fine-tuning, parameter-efficient fine-tuning, prompt tuning, knowledge distillation) on at least two pre-trained LLMs.

Performance Benchmarking: Establish performance benchmarks for the selected LLMs on two chosen datasets, assessing their baseline capabilities before and after fine-tuning.

Domain-Specific Insights: Analyze the impact of different fine-tuning techniques on domain-specific tasks. Identify which techniques are most suitable for different types of tasks or domains.

Resource Optimization: Explore methods for efficient fine-tuning, such as parameter-efficient techniques, to reduce computational costs and training time.

Generalization: Assess the ability of fine-tuned models to generalize to new, unseen data within the chosen domain.

Requirements and Scope:

The project will encompass the following:

LLM Selection: Choose at least two pre-trained LLMs (e.g., GPT-3, BERT, T5) with different architectures and training objectives.

Dataset Selection: Select two datasets relevant to the chosen domain(s) with diverse characteristics (e.g., size, text types, task complexity).

Fine-Tuning Techniques: Implement and evaluate at least three different fine-tuning techniques, such as: Full fine-tuning, Parameter-efficient fine-tuning (PEFT) methods (e.g., LoRA, AdapterHub), Prompt tuning and Knowledge distillation

Experimental Design: Design a rigorous experimental framework to compare the performance of different fine-tuning techniques across multiple tasks and datasets.

Evaluation Metrics: Choose appropriate evaluation metrics (e.g., accuracy, F1 score, BLEU score) to measure the performance of each model and fine-tuning technique.

Analyze the results and draw conclusions about the effectiveness of different techniques.

Out of Scope:

Training LLMs from Scratch: This project will focus on fine-tuning existing LLMs, not training new ones.

Large-Scale Deployment: The project will not involve deploying models in a production environment.

Required Knowledge and skills:

Machine Learning and NLP: Strong understanding of ML and NLP concepts, including transformers, language models, and fine-tuning techniques.

Programming: Proficiency in Python and experience with deep learning frameworks (e.g., PyTorch, TensorFlow) and libraries (e.g., Hugging Face Transformers).

Experimental Design: Ability to design and conduct rigorous experiments to compare different methods.

Data Analysis: Skills in analyzing and interpreting experimental results.

Expected outcomes/deliverables:

A comprehensive comparative analysis of different fine-tuning techniques for LLMs on domain-specific tasks.

Performance benchmarks for the chosen LLMs on the selected datasets.

Insights into the most effective fine-tuning strategies for different types of tasks and domains.

A well-documented report detailing the project's methodology, results, and conclusions.

Supervision:

Piyavachara Nacchanandana

Additional resources:

TBC

