

DIPARTIMENTO DI INGEGNERIA E ARCHITETTURA

Corso di Laurea Magistrale Ingegneria Informatica

Enhancing Fault Isolation in Hardware Systems Using Large Language Models (LLM)

Miglioramento dell'isolamento dei guasti nei sistemi hardware utilizzando modelli linguistici di grandi dimensioni (LLM)

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Introduzione

- Ambito dell’attività di tesi

- Obiettivi dell’attività di tesi

Stato dell’arte

- Documentare tutto ciò che esisteva prima della tesi in termini di tecnologie, metodologie e modelli

2/3 capitoli di metodologia in cui spiega cosa ha effettivamente svolto, progettato e realizzato (architettura software, addestramento di modelli, dati utilizzati e loro composizione etc..)

- 1 capitolo su i risultati

- 1 breve capitolo di conclusioni in cui ricapitola il tutto traendo le conclusioni e proponendo degli sviluppi futuri.

***Enhancing Fault Isolation in Hardware Systems Using Large Language Models (LLM): A Real-Time Diagnostic Framework***

*This thesis explores the application of Large Language Models (LLM) to improve fault isolation in hardware systems. Thanks to their ability to analyse large amounts of unstructured data, LLMs can identify patterns and anomalies in system logs and telemetry data collected from hardware devices. The objective is to develop a framework that uses LLMs to diagnose faults in real-time, reducing downtime and improving the overall reliability of the system. Case studies and experimental results will be presented to demonstrate the effectiveness of the proposed approach.*

# Introduction

In this thesis work we want to explore the use of Large Language Models (LLMs) in hardware diagnostics. LLMs have shown good memorization and "understanding" capabilities of natural language, even in reasoning tasks. Especially in the case in which the models know the environment in which they operate.

In our case, we initially want to make the LLMs understand how a hardware architecture is structured so that the model is able to solve the diagnostics at its best. Subsequently, we want to exploit the capabilities of the LLMs to identify any problems in the hardware by analysing system logs, telemetry data and hardware functionality test results. To carry out these activities it was necessary to create a specific dataset and a simulation environment. We also implemented the Open WebUI graphical interface.

So, we have two objectives, the first is to verify that the LLMs are able to understand the hardware architecture. While the second is to verify that the LLMs are able to understand and solve hardware problems. This work was based on In-Context Learning (ICL) and Prompt Engineering. In particular, we compared the performance of different models according to various metrics.

# State Of The Art

## Large Language Models (LLMs)

LLMs are machine learning models with many parameters, designed for natural language processing tasks, especially text generation. They are trained with self-supervised learning on a vast amount of text.

## Self-supervised learning (SSL)

## Diagnostics