Muhammad Hamza Khawaja

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Education

Lahore University of Management Sciences Aug. 2020 - May. 2024
Bachelor of Science in Computer Science *Lahore, Pakistan*

CGPA: 3.81 | CS CGPA: 3.89

- Received **Merit Scholarship Award** for the year 2021.
- Graduated with **High Distinction Award**.
- Placed on Dean's Honor List for years 2020-2024.
- Ranked in the top 9% of the Computer Science Batch, Class of 2024.
- Relevant Coursework: **Systems and Networking:** Distributed Systems (Graduate-Level), Operating Systems, Network-Centric Computing, Topics in Internet Research (Graduate-Level), Network Security | **AI:** Deep Learning (Graduate-Level), Machine Learning (Graduate-Level), Data Science | **Architecture:** Fundamentals of Computer Systems, Computer Architecture (Graduate-Level)

Research Experience

Research Associate Jun. 2024 - Present
Lahore University of Management Sciences

- Developing scalable LLM-powered applications for the educational assistance of teachers and students.

Research Assistant Jun. 2023 - Aug. 2023
Lahore University of Management Sciences

- Analyzed the impact of federated learning on resource-constrained devices.

Research Projects

Impact of Federated Learning on Resource-Constrained Mobile Devices Jan. 2023 - May 2024
Advisors: Dr. Zafar Ayyub Qazi and Dr. Ihsan Ayyub Qazi (LUMS)

- Conducted a measurement study to analyze the impact of Federated Learning (FL) on user experience and Android memory management performance in resource-constrained devices.
- Used FLOWER framework APIs to implement server-side functionality for aggregating model weights from distributed edge devices.
- Set up gRPC based communication interface for client-server interactions to facilitate FL tasks.
- Conducted an extensive literature review to identify appropriate kernel-level metrics for root cause analysis of user experience and performance degradation.
- Developed a testing utility using shell scripts and tools such as Ftrace, ADB, and Perfetto to trace process-level metrics, including Page Faults, Page Refaults, Page Steals via Direct Reclaim and Kswapd, Kswap runtime, and Time to Initial Display (TTID).
- Rooted and flashed mobiles with a custom kernel to implement solutions for mitigating impact of FL tasks.
- Modified Swappiness and Kswapd reclamation behavior to target unreferenced FL pages and anonymous pages, improving user experience (UE).

GradAssist Jun. 2024 - Present
Advisors: Dr. Zafar Ayyub Qazi, Dr. Ihsan Ayyub Qazi, and Dr. Agha Ali Raza (LUMS)

- Developed an LLM-powered text editor and chatbot to provide graduate application counseling for students.
- Deployed the service using Vercel Serverless Functions and Vercel Edge Runtime to deliver low-latency responses from the nearest edge server to users.
- Optimized and configured a PostgreSQL database to auto-scale using Vercel configurations for managing dynamic user traffic.
- Implemented function calls for the LLM to interact with the PostgreSQL database.
- Developed a user-friendly UI in Next.js, backend APIs, and implemented JWT-based authorization and authentication.

- Implemented Google reCAPTCHA to prevent DDoS attacks.

O Level Educational Assistance Jun. 2024 - Present

Advisors: Dr. Zafar Ayyub Qazi, Dr. Ihsan Ayyub Qazi, and Dr. Agha Ali Raza (LUMS)

- Developing a student and teacher assistance tool to help generate long-format, structured Cambridge O Level exam questions.
- Created a chain of LLM agents with specific personas to perform specialized tasks, such as generating TikZ code for diagrams and assessing the quality of questions.
- Implemented prompt engineering techniques, such as chain-of-thought and few-shot prompting, for LLM agents to produce reusable templates for generating exam questions.
- Utilized Milvus Vector DB to store vector embeddings of O Level exam data, enabling Retrieval Augmented Generation for better question generation.

Open Source Contribution

Modification of FLOWER's Android Application Sept. 2023

FLOWER, a federated learning framework developed by the Cambridge Machine Learning Systems Lab

- Implemented machine learning model training on a background thread in Java using the WorkManager library, enabling long-duration experiments on mobile devices.

Teaching Experience

Teaching Assistant Sept. 2023 - Dec. 2023

CS582: Distributed Systems | Instructor: Dr Zafar Ayyub Qazi

- Assisted in creating, managing, and grading programming assignments and quizzes for 85 students.
- Conducted weekly office hours and tutorials on Go language to facilitate student learning.

Teaching Assistant Jan. 2023 - May 2023

CS331: Intro to Artificial Intelligence | Instructor: Dr Muhammad Tahir

- Assisted in creating, managing, and grading programming assignments, homework, and quizzes for 99 students.
- Conducted weekly office hours and tutorials to facilitate student learning.

Teaching Assistant Sept. 2022 - Dec. 2022

CS100: Computational Problem Solving | Instructor: Dr Nadeem Ahmed Khan

- Assisted in creating, managing, and grading programming labs, quizzes, and projects for over 100 students.
- Conducted weekly office hours to facilitate student learning.

Course Projects

Raft: Consensus Algorithm | GO Sept. 2022 – Dec. 2022

CS582: Distributed Systems

- Developed the Raft consensus algorithm for a distributed key-value storage system.

Peer-to-Peer File Sharing Systems | Python Apr. 2022

CS382: Network-Centric Computing

- Implemented a fault-tolerant distributed hash table based key-value storage system.
- Leveraged consistent hashing for efficient load balancing in the system.

File System | C Nov. 2023

CS370: Operating Systems

- Implemented filesystem APIs (format, mount, read, write, delete, and list) for data management and retrieval from emulated disks.

Medical Image Segmentation | Python, Pandas, Pytorch, NumPy Mar. 2024

CS437: Deep Learning

- Implemented U-Net from scratch to segment 2D brain tumor images.

La-Dou: Mobile App | React Native, MongoDb, FastAPI, DigitalOcean Jan. 2023 – May 2023

CS360: Software Engineering

- Developed a food delivery app compatible with both Android and iOS.
- Developed the frontend in React Native, backend in FastAPI, and deployed the application on DigitalOcean.

Skills

- **Languages:** Python, Typescript, GO, C, C++, SQL, JAVA
- **Frameworks/Libraries:** FLOWER, FastAPI, React, NextJS, NodeJS, ReactJS, Pandas, NumPy, Scikit-Learn, Keras, TensorFlow, Seaborn, PyTorch
- **Developer Tools:** Selenium, Git, Postman, ADB, STATA, WireShark, AWS, fastboot