Muhammad Ayain Fida Rana

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Education

University of Cambridge — Cambridge, UK
Master of Philosophy in Advanced Computer Science — *Oct 2025 – Present*

Lahore University of Management Sciences (LUMS) — Lahore, Pakistan
Bachelor of Science in Computer Science; ***CGPA: 3.97/4.00*** — *Sep 2021 – Jun 2025*

Relevant Coursework: Advanced Programming, Algorithms, Artificial Intelligence, Data Science, Data Structures, Databases, Digital Logic Circuits, *Distributed Systems*, *Machine Learning*, Network Centric Computing, *Network Security*, Operating Systems, *Operations Research*, Software Engineering, *Topics in LLM Systems* (Graduate-level courses *italicized*)

Research Experience

Distributed and AI Systems Lab @ LUMS — Lahore, Pakistan
Research Assistant — *Aug 2023 – May 2025*

- Designed a semantic caching system that reused semantically similar images across news articles, yielding ∼**10%** greater byte savings than traditional caching, directly reducing bandwidth costs for end users.
- Collected **4,200+** images from **50** global news websites, along with article headlines and alt text as metadata to capture context. Annotated these into **40,000+** image pairs for semantic similarity analysis, uncovering categories where up to **37%** of images were reusable. The dataset is publicly available.
- Engineered a cost-efficient **two-step** LLM pipeline (LLaVA-NeXT + LLaMA 3.1) to evaluate image replaceability, achieving performance comparable to commercial multimodal models at a fraction of the cost.
- Devised a systematic data scraping methodology to scrape data using Selenium with FirefoxDriver.
- Submitted findings (under-review) at the ACM Workshop on Hot Topics in Networks (**HotNets 2025**).

Networks and Systems Group @ LUMS — Lahore, Pakistan
Research Intern — *May 2023 – July 2023*

- Contributed to a "A Framework for Improving Web Affordability and Inclusiveness" **SIGCOMM'23** that optimized mobile browsing for users in developing regions.
- Led a user study with **35** participants, benchmarking industry browsers (Brave, Opera Mini) against the proposed framework, uncovering trade-offs between accessibility, performance, and user experience.
- Identified a gap in documentation on Chrome's mobile caching; devised and executed cache measurement experiments on Android devices using ADB shell, Chrome DevTools, and Chrome Cache Viewer, identifying eviction thresholds and system-level effects under crash and storage stress.
- Automated large-scale page loads (**10,000+** sites) with Appium and ADB Shell, revealing that Chrome's cache can expand to nearly full device storage before evictions, and visualized growth and eviction trends.

Publications

Cache By Meaning: Server-Driven Semantic Image Reuse for Affordable Web Access

Hafsa Akbar, Danish Athar, **Muhammad Ayain Fida Rana**, Zartash Afzal Uzmi, Ihsan Ayyub Qazi, Zafar Ayyub Qazi ***(Under review in HotNets 2025)***

Teaching Experience

CS 582: Distributed Systems (Fall 2024) — Dr. Zafar Ayyub Qazi
Teaching Assistant — *Sep 2024 – Dec 2024*

- Conducted weekly office hours and tutorials for over 70 students, created and graded quizzes, and implemented automated grading for assignments.
- Managed the course Slack channel, addressing student queries and facilitating discussions to enhance learning.

CS 310: Algorithms (Fall 2024) — Dr. Imdad Ullah Khan
Teaching Assistant — *Sep 2024 – Dec 2024*

- Supported students on course's Slack channel, and engaged in semi-formal student counseling.
- Conducted weekly office hours for over 200 students, created/invigilated/graded quizzes, and provided feedback on homeworks.

CS 202: Data Structures (Spring 2024) — Dr. Ihsan Ayyub Qazi
Teaching Assistant — *Jan 2024 – May 2024*

- Managed course's Slack channel, created/reviewed/invigilated/graded quizzes and programming assignments.
- Held weekly office hours for over 100 students, providing additional academic support and guidance to students.

Development Projects

RAFT: A Distributed Consensus Protocol | *Go*

- Implemented the Raft based on the paper "*In Search of an Understandable Consensus Algorithm*".
- Created a fault-tolerant key-value server on top of RAFT.

SastaGPT | *Python, PyTorch, NumPy, Matplotlib, Pandas*

- Implemented a Transformer model from scratch based on the paper *"Attention Is All You Need"*.
- Trained on a custom language modeling dataset, monitoring loss metrics and generating coherent text sequences.

RAG-Based Researcher Chatbot | *Python, LangChain, Pinecone, FAISS*

- Built a RAG-based chatbot using LangChain with FAISS/Pinecone to provide accurate, source-cited answers from PDFs and Wikipedia, reducing hallucinations through citation-grounding and prompt templates.

LLM-Powered Evaluation System | *Python, Regex, LaTeX, Pandas*

- Developed an automated assignment grading system that utilizes regex to extract responses from LaTeX files, then applies few-shot learning and CoT reasoning to grade assignments based on a rubric, achieving ∼**96%** accuracy.

Command Line Shell | *C*

- Programmed a minimal command-line interpreter that emulates core UNIX shell functionalities, including support for I/O redirection, piping output between commands, wildcards, and chaining commands in sequence.

User Level Threading Library | *C*

- Created a fairly abstracted threading library that, although utilized registers for storing PCBs, did application-level context switching.
- Implemented a Round Robin scheduler for thread management and developed concurrency and synchronization primitives to handle thread coordination and avoid conflicts.

Simple File System | *C*

- Developed a UNIX-like file system with partitions for superblocks, inodes, and datablocks, supporting file reading and writing, and operating between a simple shell program and a disk emulator.

Succession Planning Portal | *React, JavaScript, Node.js, MongoDB, TensorFlow*

- Developed an HR portal to assess promotion readiness via centralized tracking of performance, skills, and feedback.
- Automated promotion predictions and career path visualization, reducing bias and enabling fairer, data-driven decisions.

SarmayaCar: Intelligent Used Car Recommender | *Python, Selenium, Pandas, PuLP*

- Collected a longitudinal dataset of **66,000+** listings from PakWheels.com for depreciation analysis, and applying NLP to translate natural-language buyer preferences into weighted decision criteria.
- Developed a first-of-its-kind goal-programming model for optimal car selection under user-defined priorities, which led to an invitation from the collaborating firm (PakWheels) to implement the workflow.

Awards & Honors

- Awarded the **Vicky Noon Scholarship** (Cambridge) for **2025–26**.
- Graduated with **High Distinction**, ranked in the **top 3%** of the LUMS SBASSE Class of 2025.
- Placed on Dean's Honor List for **2021-22, 2022-23, 2023-24, 2024-25**.
- Awarded Merit Scholarship (LUMS) for **2022-23, 2023-24, 2024-25**.
- **Top in World** in A Level Mathematics in **2020**.
- Roll of Honor **(Highest Student Award)** at Beaconhouse Johar Town in **2019**.

Skills

Languages: C/C++, Python, Go, JavaScript, TypeScript, Bash, Haskell, SQL, MATLAB, VBA

Frameworks: React, ExpressJS, PyTorch, MongoDB, TensorFlow, PyAutogui, PyTesseract

Tools: Linux, Git, Docker, Postman, VS Code, ADB, ChromeDevTools