Mustafa Abbas

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Education

BS in Computer Science, Lahore University of Management Sciences — Sep 2021 - May 2025

- **GPA:** 3.96/4.00, In top 4% BS graduating class of 2025
- **Relevant Coursework**: Advanced Topics in ML, Computer Vision, Generative AI, Applied Probability, Machine Learning, Algorithms, Artificial Intelligence, Linear Algebra, Calculus I & II

A Levels - CAIE, Lahore Grammar School — Aug 2019 - June 2021

- **Grades:** 4A*
- **Subjects:** Mathematics, Physics, Computer Science, Further Mathematics

Honors and Achievements

Dean's Honor List (LUMS)	2022, 2023, 2024.
Top 10 in batch ranking	Recipient of 50% merit scholarship for 2021, 2022, 2023, and 2024.
1580/1600 SAT Score	99th percentile.
O Levels - CAIE Distinction	Best across 8 subjects in Punjab, Pakistan

Publications

Arif, Samee, Sualeha Farid, Aamina Jamal Khan, **Mustafa Abbas**, Agha Ali Raza, and Awais Athar (2024). *WER We Stand: Benchmarking Urdu ASR Models**. arXiv: 2409.11252 [cs.CL]. URL: https://arxiv.org/abs/2409.11252.

* In submission at COLING 2025.

Research Experience

Multi-Agent Path Finding with LLMs — Sep 2024 - Present

- Developed a novel multi-agent pathfinding solution for warehouse environments using a fine-tuned GPT-3.5 model as the controller. The model generates real-time commands for agents using carefully curated prompts, leveraging LLM knowledge and removing the need for Reinforcement Learning training.
- Integrated a feedback loop mechanism to parse predicted paths, identify errors and apply corrective prompts, enhancing path accuracy and ensuring collision-free paths.
- Fine-tuned the GPT model using data derived from BFS (single-agent shortest paths) and Conflict-Based Search (CBS) for multi-agent scenarios, ensuring collision-free navigation and adaptability to varying warehouse configurations.
- Achieved initial success with single and dual agents, now expanding to optimize path finding across multiple agents.

WER We Stand: Benchmarking Urdu ASR Models — Jun 2024 - Nov 2024

Second Author

- Conducted a comprehensive evaluation of 9 state of the art Urdu Automatic Speech Recognition (ASR) models from the following families: Whisper, MMS, and Seamless-M4T.
- Performed benchmarking using Word Error Rate (WER) on both read and conversational Urdu datasets for base and fine-tuned models, along with error analysis, and model performance assessment.
- Developed the first conversational speech dataset for benchmarking Urdu ASR models, consisting of 471 recordings captured in real-world settings. The recordings were conducted over Zoom in groups of 2, 3, and 4, featuring impromptu conversations to enhance naturalness and diversity.

– Released fine-tuned models, datasets, evaluation scripts, and results to the open-source community, promoting further research and development in Urdu ASR.

Urdu NLTK Sep 2023 – May 2024

Research Intern, CSaLT Lab

– Researched specialized functions within the Natural Language Toolkit (NLTK) for Urdu language processing, focusing on tasks like Urdu POS tagging, named entity recognition (NER), and text summarization.

– Conducted extensive literature reviews on Urdu NLP, evaluating current approaches for NLP tasks.

– Performed evaluation of large language models (LLMs) such as GPT and LLaMA for Urdu Part-of-Speech (POS) tagging, comparing their performance to existing techniques.

Wiki-UQA Dataset Creation for Urdu Question-Answering Jan 2023 - May 2023

Research Intern, CSaLT Lab

– Developed the Wiki-UQA dataset, featuring over 200 question-answer pairs annotated from Urdu Wikipedia articles to advance research in Urdu question-answering tasks. Published on Hugging Face to support open-access research and reproducibility in Urdu NLP.

– Selected Wikipedia articles to ensure domain diversity, high linguistic complexity, and the availability of factual information, aligning the dataset with real-world information retrieval tasks.

– Annotated the dataset using a semi-automated pipeline with Python-based frameworks, leveraging tools like spaCy and Pandas for text preprocessing and manual review to ensure linguistic accuracy and consistency in annotations.

– Contributed to the EMNLP 2024 paper *"Generalists vs. Specialists: Evaluating Large Language Models for Urdu,"* benchmarking models like GPT-4-Turbo and LLaMA-3-8B across 13 tasks, highlighting trade-offs between generalist and specialist models. Got recognized in the acknowledgments for aforementioned contributions.

Teaching Experience

Teaching Assistant – CS-370: Operating Systems Sep 2024 – Present

Lahore University of Management Sciences

– Assisted in a core course with approximately 220 students across two sections, and conducted office hours twice a week to support students with course material and assignments.

– Designed, tested, and guided students through complex programming assignments, delivering assignment-based tutorials to reinforce key concepts.

– Graded course material such as exams and assignments, ensuring timely feedback and academic support.

Teaching Assistant – Introduction to Artificial Intelligence Jan 2024 – May 2024

Lahore University of Management Sciences

– Supported a class of around 120 students, holding weekly office hours to provide course assistance and address queries.

– Developed and delivered assignments that aligned with key AI concepts, fostering an engaging and interactive learning experience.

– Conducted tutorials that not only helped with assignments but also delved deeper into AI course content, while grading quizzes and assignments to offer constructive feedback.

Projects

Model Compression Techniques for Deep Learning Models

– Implemented and evaluated pruning, quantization, and knowledge distillation on VGG architectures with CIFAR-100 to enhance efficiency and reduce memory footprint for resource-limited environments.

- **Pruning**: Optimized model size and performance through both unstructured and structured pruning, focusing on channel removal based on L2 norms, while preserving model accuracy.
- **Quantization**: Compared Post-Training Quantization (PTQ) and Quantization-Aware Training (QAT) across bit-widths (int8, int4, float16, bfloat16); achieved notable accuracy retention with QAT.
- **Knowledge Distillation**: Used logit matching, hint-based distillation, and contrastive representation distillation (CRD) to closely approximate teacher model performance.
- Project Repository: Contains the code, results, and a detailed write-up that outlines the methodology and provides an analysis of the results.

Course Recommendation System Using Retrieval-Augmented Generation (RAG)

- Developed a course and instructor recommendation system using a Retrieval-Augmented Generation (RAG) pipeline with the LangChain framework, designed to help students make informed decisions about course selection based on their individual academic profiles and preferences.
- Scraped and preprocessed course and instructor reviews from the university discussion forum, as well as course outlines from the registrar portal, creating a tailored dataset for personalized recommendations.
- Utilized vector databases for efficient information retrieval, enabling precise recommendations based on academic year, CGPA, major, and learning interests.
- Made the system accessible to the entire university, providing personalized course suggestions and feedback on expected workloads.

Succession Planning Software Project

- Developed a machine learning-driven HR management platform in collaboration with Devsinc, designed to aid corporations in succession planning and workforce optimization.
- Developed regression based predictive models using historical performance data to assess employee performance KPIs, identify high-potential candidates, and highlight at-risk employees for proactive interventions.
- Ensured platform security with role-based access control, two-factor authentication, and data encryption to safeguard sensitive employee data, and support compliance with industry standards.
- Integrated mentor-mentee matching, personalized training recommendations, and progress tracking features based on skill gaps and career goals to enhance employee development.
- Built admin dashboards providing real-time analytics for strategic decision-making on promotions, terminations, and workforce planning.
- Project Repository: Contains the code, results, and a detailed write-up that outlines the methodology and provides an analysis of the results.

Extracurricular Activities

Media & IT Assistant Director – LUMS Students' Mathematics Society Sep 2022 – May 2023

- Managed the society's official HTML/CSS website, ensuring a seamless user experience.
- Designed the society's logo and created engaging media posts for outreach and events.

Event Head – Sigma 7 Math Olympiad Jan 2022

- Led the flagship mathematics competition, managing logistics and coordinating activities for over 100 participants.

Skills

Languages	Python, TypeScript, JavaScript, C/C++, SQL, Haskell, HTML/CSS
Developer Tools	Git, Docker, Valgrind, Google Colab, Kaggle, VS Code
Libraries & Frameworks	PyTorch, TensorFlow, LangChain, Hugging Face, Pandas, NumPy, Matplotlib, Sci-kit Learn, StreamLit

Last updated: November 23, 2024