Muhammad Ahmed

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Education

Lahore University of Management and Sciences Sep. 2020 – May 2024
BSC., Computer Science *CGPA/Percentage: 3.83*

The Lahore Alma Aug. 2018 – May 2020
A Level, Cambridge International Examinations *Grades: 4 A*s*

Research Experience

Research Assistant Sep. 2022 – Present
Networks Research Group @ LUMS *Lahore, Pakistan*

- Currently working on extending Edge-SLAM to support seamless handover across multiple edge nodes
- Worked on achieving more ecologically valid experiments on a distributed, fault-tolerant cellular control plane

Research Intern May. 2022 – Sep. 2022
Networks Research Group @ LUMS *Lahore, Pakistan*

- Self-taught the basic cellular architecture of 4G LTE and what is envisioned to be 5G
- Self-deployed the OASIM-NEXTEPC profile on POWDER to simulate 4G LTE data and control plane processes
- Analyzed network traces on Wireshark to observe the S1 Setup control plane procedure

Research Projects

MultiEdge-SLAM Jan. 2023 – Present
Networks Research Group @ LUMS

- Self-taught the inner workings of SLAM Algorithms, particularly ORB-SLAM2
- Explored various Edge-Assisted SLAM projects, particularly SwarmMap, SLAM-Share and Edge-SLAM
- Analyzed the Edge-SLAM codebase that spans over thousands of lines of code spread across a multitude of files
- Conceptualized and implemented three state migration scheme, each involving KeyFrames, Subsets of the Global Map and Local Map Updates respectively
- Deployed on a remote server and evaluated on the EuRoC and KITTI datasets with different synchronization configurations

Distributed CellClone Sep. 2022 – May. 2023
Networks Research Group @ LUMS

- Analyzed the CellClone codebase that spans over thousands of lines of code spread across a multitude of files
- Introduced a sense of heterogeneity (local and remote) in CPFs (Control Plane Functions) across the codebase
- Modified the CTA (Control Traffic Aggregator) forwarding mechanism from one hash ring (mapping all CPFs) to two hash rings (mapping local and remote CPFs, respectively) based on the quorum configuration.
- Evaluated through a series of experiments on different quorum configurations, remote communication delays, and procedures (attach, handover, and service)

Publications

CellClone: Accelerating 5G Applications with Active Control Plane Clones at the Edge

Mukhtiar Ahmad, Muhammad Ali Nawazish, Muhammad Taimoor Tariq, **Muhammad Ahmed**, Muhammad Basit Iqbal Awan, Muhammad Taqi Raza, and Zafar Ayyub Qazi ***(Under review in IEEE/ACM Transactions on Networking)***

Awards and Honors

- Ranked in the **top 10%** of LUMS SBASSE Batch of 2024 (300+ students)
- Placed on Dean's Honor List for **2020-2021, 2021-2022, 2022-2023**
- Graphic Designer for Team Teardrop, which secured 1st place in the COVID-19 Hackathon 2020 by Open Data Pakistan.

Graduate Coursework

- **CS 678 (Topics in Internet Research):** A
- **CS 582 (Distributed Systems):** A
- **CS 5714 (Network Security):** A
- **CS 370 (Operating Systems):** A
- **CS 622 (Computer Architecture):** Grade Pending
- **CS 535 (Machine Learning):** Grade Pending

Teaching Experience

CS 582: Distributed Systems (Fall 2023) Dr. Zafar Ayyub Qazi

Head Teaching Assistant

- Managed course's Slack channel, conducted tutorials, assigned tasks to TAs, and autograded/plagiarism-checked assignments
- Held weekly office hours, conducted assignment tutorials, created/reviewed/invigilated/graded quizzes, and engaged in semi-formal student counseling

CS 382: Network-Centric Computing (Spring 2023) Dr. Zafar Ayyub Qazi

Teaching Assistant

- Supported students on course's Piazza network, held weekly office hours, conducted assignment tutorials, created/invigilated/graded quizzes, created/solved practice problems, and engaged in semi-formal student counseling

CS 202: Data Structures (Fall 2022) Dr. Shafay Shamil

Teaching Assistant

- Held weekly office hours, created/graded assignments, and engaged in semi-formal student counseling

Development Projects

- **Distributed, Fault-Tolerant Key-Value Store:** Created a distributed key-value data store that is able to reach consensus through Raft, which I also implemented myself - it currently supports both Leader Elections and Log Replication with persistence.
- **Teen Patti:** Created a web-game using the MERN Stack that replicates a very popular local Cards game called Teen Patti (or Three Cards). It can support multiple simultaneous matches. It is currently hosted privately.
- **Command-line Shell:** Created a basic command-line shell in C that can currently support multiple commands in conjunction, pipelining and in-order command tree chaining.
- **User-Level Threading Library:** Created a fairly abstracted threading library that, although utilized registers for storing PCBs, did application-level context switching (I used the setjmp library to achieve this). Overall, it was a great exercise to demonstrate how threading and scheduling fundamentally take place.
- **Buddy Memory Allocator:** Created a basic buddy allocator that demonstrated how a traditional buddy allocator worked by operating a fixed size memory (attained via the malloc system call)
- **UNIX File System:** Created a UNIX-like file system in the sense that it partitioned space into superblocks, inode block(s), and datablock(s). Although it operates with some degree of abstraction, lying between a simple shell program and a disk emulator, it support file reading and writing.

Technical Skills

Languages: C/C++, Python, TypeScript, Go, Bash, SQL, HTML/CSS
Frameworks: React, ExpressJS, PyTorch, MongoDB, MySQL, ROS
Tools: Linux, Git, Docker, Postman, WordPress, VS Code