# AHMAD FARAZ KHAN

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## EDUCATION

**Ph.D. in Computer Science,** Virginia Tech, Blacksburg, VA *December 2020 - Present*
**Research Focus:** Machine Learning Systems (**CGPA 3.8)**
**B.S. in Computer Science,** LUMS, Lahore, Pakistan *2016-2020*
**Advanced Courses:** Distributed Systems, Deep Learning, Machine Learning, Cloud Development, Computer Systems

## TECHNICAL PROFICIENCY

**Programming Languages:** Python, Javascript, C/C++, Java, Go.
**Tools & Libraries:** PySpark, AWS Suite, Pandas, Numba, Dask, Docker, Pytorch, Tensorflow, IBMfl lib, FedScale, Selenium, Appium, gnuplot, ES6+, TypeScript, React/Redux, Node, Express, MongoDB, SQL, FLSim.

## PUBLICATIONS

**Graduate Research Assistant, DSSL, Virginia Tech** December 2020 - Present
*Mentor: Dr. Ali Butt, PhD. Purdue University*

- Introduced "FLOAT", a framework optimizing Federated Learning's resource utilization and model performance amid heterogeneity, leveraging Reinforcement Learning with Human Feedback. Published in **ACM EuroSys'24**.
- Developed a framework for monetizing personalized FL with system and data heterogeneity. Paper submitted in **ICML'24**.
- Developed an adaptive FL aggregator for Edge and IoT, achieving 4× scalability, 8× time efficiency, and 2× cost savings over conventional methods. Published in **IEEE BigData'24**.
- Proposed a lossless and efficient defense for inference attacks in Vertical Federated Learning (VFL). Paper submitted in **AAMAS'24**.
- Analyzed personalized FL algorithms, revealing trade-offs between privacy and performance, and underscoring the role of speed and communication in FL scalability. Paper submitted in **AAMAS'24**.
- Conducted a survey on adversarial tactics in DNN, DRL, FL, and TL deep learning models, emphasizing their applications and distinct features. Published in **IEEE Access'24**.
- Monetized VFL with `PERFACY-FL`, an incentive mechanism valuing data quality and privacy using Homomorphic Encryption, boosting participation and profitability. Paper under review.
- Designed and developed an incentivized FL system using IBMfl lib. Published in **FL-AAAI'22, IEEE CLOUD'22**.
- Designed a heterogeneity-aware adaptive FL scheduling system to tune (1) accuracy, (2) resource and accuracy fairness, and (3) training time of the model according to user preferences using IBMfl lib. Paper published in **IEEE BigData'22**.

**Research Assistant, Networks and Systems Group, LUMS** January 2019 - May 2020
*Mentor: Dr. Ihsan Ayyub Qazi, PhD. University of Pittsburgh*

- Executed a comprehensive measurement study on YouTube performance, aiming to pinpoint bottlenecks affecting user experience on low-end devices and networks. Innovated a data-driven video streaming algorithm (DAVS), realizing a 20% QoE enhancement over the state-of-the-art ABR algorithm Pensieve.

## KEY PROJECTS

**ML System Optimization:** Pioneered algorithms to enhance the architecture of ML systems, targeting resource allocation, scalability, and cost-time efficiency. This work culminated in the research papers published and submitted to (IEEE CLOUD'22, BigData'22, EuroSys'24, BigData'24).
**Federated Learning Frameworks:** Spearheaded the design and development of both Horizontal and Vertical Federated Learning (HFL & VFL) frameworks. Furthermore, implemented MLOps pipelines integrated with AWS cloud resources and popular ML libraries such as PyTorch, TensorFlow, and FedScale (AAAI'24, AAMAS'24).
Designed a distributed and containerized system with a dynamic pipeline to support the data analytical modules for Cyber Infrastructure for Waterborne Antibiotic Resistance Risk Surveillance (CI4-WARS).
**Counter Fuzzing with LLVM:** Developed an LLVM-based counter fuzzing approach that's undetectable by leading fuzzers like AFL and balances performance with countermeasures.

## ADDITIONAL EXPERIENCES

**Teaching Roles,** Virginia Tech: Instructed courses such as Web/Cloud Development (Fall'23), Python Programming (Spring'20, Fall'21), and Principles of Computer Security (Spring'22).
**Associate Data Engineer,** i2c Inc. (May 2020 - December 2020): Spearheaded the development and upkeep of distributed sequential databases. Successfully accelerated query times for read-only tasks through database optimization techniques.
**Internships:** Contributed to game development using Unity 3D at Game Storm Studios and fostered intra-company communication with an application in meteorJS at Packages Ltd.