# Annus Zulfiqar

Graduate Student and Research Assistant,
Computer Science and Engineering (CSE),
University of Michigan, Ann Arbor, MI

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## EDUCATION

**University of Michigan** — Ann Arbor, MI
Ph.D. in Computer Science & Engineering — Sep 2021 - Present
Dissertation: Rearchitecting the End Host Network for the Terabit Per Second Era
Advisor: Muhammad Shahbaz

**National University of Sciences and Technology (NUST)** — Islamabad, PK
Bachelor of Electrical Engineering — Sep 2015 - May 2019
Thesis: Forest Cover Detection and Change Estimation using Deep Learning
Advisors: Muhammad Shahzad, Faisal Shafait

## HONORS AND AWARDS

- Broadcom Research Award for Celeris, CAL 2025 — 2025
- Selected as mentor for P4 Language Consortium, Google Summer of Code (GSoC) — 2025
- Distinguished Artifact Award for Homunculus, ASPLOS 2023 — 2023
- Conference travel grants: ASPLOS 2022, SIGCOMM 2022, NSDI 2025, SIGCOMM 2025 — 2022-25
- Ross Fellowship at Purdue University — 2021
- National P@SHA Information and Communication Technology (ICT) Award Winner, Pakistan — 2021
- Travel award for graduate EEcamp at KAIST, South Korea — 2018
- One-year internship offered at DFKI, Kaiserslautern, Germany (passed) — 2018
- DAAD-funded internship at Technical University of Kaiserslautern (TUK), Germany — 2018
- NUST merit scholarship for top academic performance (4.00/4.00 GPA) — 2015-19

## PUBLICATIONS

### Conference Papers

**NSDI**. Murayyiam Parvez*, *Annus Zulfiqar**, Sylee Beltiukov, Shir Landau-Feibish, Arpit Gupta, Walter Willinger, and Muhammad Shahbaz. SpliDT: Partitioned Decision Trees for Scalable Stateful Inference at Line Rate. 2025. *Acceptance rate: 22.1%* (*co-primary author) — Paper

**MICRO**. Gerasimos Gerogiannis, Charles Block, Dimitrios Merkouriadis, *Annus Zulfiqar*, Muhammad Shahbaz, and Josep Torrellas. NetSparse: Hardware Acceleration for Distributed Sparse Kernels. 2025. *Acceptance rate: 20.7%* — Paper

**ASPLOS**. *Annus Zulfiqar*, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz. Gigaflow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs. 2025. *Acceptance rate: 19%* — Paper/Code

**ASPLOS**. Tushar Swamy, *Annus Zulfiqar*, Muhammad Shahbaz, Luigi Nardi, and Kunle Olukotun. Homunculus: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks. 2023. *Acceptance rate: 20%* — Paper/Code
*Distinguished Artifact Award*

### Journal Articles

**IEEE CAL**. Ertza Warraich, Ali Imran, *Annus Zulfiqar*, Shay Vargaftik, Sonia Fahmy, and Muhammad Shahbaz. Reimagining RDMA Through the Lens of ML. 2025 — Paper
*Broadcom Research Award*

**SIGCOMM CCR**. *Annus Zulfiqar*, Gianni Antichi, Ben Pfaff, William Tu, and Muhammad Shahbaz. The Slow-Path Needs an Accelerator Too! 2023 Paper

**Journal of Applied Remote Sensing (JARS)**. *Annus Zulfiqar*, Muhammad M. Ghaffar, Muhammad Shahzad, Christian Weis, Muhammad I. Malik, Faisal Shafait, and Norbert Wehn. AI-ForestWatch: Semantic Segmentation Based End-to-End Framework for Forest Estimation and Change Detection using Multi-Spectral Remote Sensing Imagery. 2021 Paper

### Preprints

**Under Review**. Ertza Warraich, Ali Imran, *Annus Zulfiqar*, Shay Vargaftik, Sonia Fahmy, and Muhammad Shahbaz. CELERIS: A Resilient and Tail-Optimal RDMA NIC For Distributed ML Workloads. 2025

### Conference & Workshop Extended Abstracts

**SIGCOMM**. *Annus Zulfiqar*, Ben Pfaff, Gianni Antichi, Arpit Gupta, and Muhammad Shahbaz. KAIRO: Incremental View Maintenance for Scalable Virtual Switch Caching. 2025 Poster

**NSDI**. Murayyiam Parvez*, *Annus Zulfiqar**, Sylee Beltiukov, Shir Landau-Feibish, Arpit Gupta, Walter Willinger, and Muhammad Shahbaz. BRANCHPIPE: Scalable Decision Trees for Stateful Processing at Line Rate. 2025 Poster

**NSDI**. *Annus Zulfiqar*, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz. A Smart Cache for a SmartNIC! Rethinking Caching, Locality, & Revalidation for Modern Virtual Switches. 2025 Poster

**SRC TECHCON**. Marilyn Rego, Murayyiam Parvez, *Annus Zulfiqar*, Sylee Beltiukov, Shir Landau-Feibish, Arpit Gupta, Walter Willinger, and Muhammad Shahbaz. SPLIDT: Partitioned Decision Trees for Scalable Stateful ML Inference at Line Rate. 2025

**Hot Chips**. *Annus Zulfiqar*, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz. A Smart Cache for a SmartNIC! – Scaling End-host Networking to 400Gbps & Beyond. 2024 Poster

**SRC TECHCON**. Venkat Kunaparaju, *Annus Zulfiqar*, Ali Imran, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz. GigaFlow: A Scalable and Efficient Hardware Fast-Path for Open vSwitch. 2024

## INVITED TALKS, DEMOS, AND POSTERS

Gigaflow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs

- Intel Corporation, San Jose — Oct 2025
- Google Networking Summit — Oct 2025
- P4 Workshop Demo At Open Compute Project (OCP) Link — Oct 2025
- ACE Center for Evolvable Computing — Demo at Annual Meeting Link — Oct 2025
- P4 Developer Days Event Link — Jun 2025
- NetΣyn Lab, Princeton University — Apr 2025
- IBM Thomas J. Watson Research Center — Apr 2025
- Networked Systems Group (NSG), ETH Zurich — Apr 2025
- ACM ASPLOS Conference — Apr 2025
- Network Operations and Internet Security Lab, University of Chicago — Mar 2025
- Systems Seminar, University of Michigan — Mar 2025
- Politecnico di Milano — Mar 2025
- ACE Center for Evolvable Computing — Demo at Annual Meeting Link — Oct 2024
- ACE Center for Evolvable Computing — Demo at Spring Meeting Link — Mar 2024

Homunculus: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks

- ACE Center for Evolvable Computing (Link) Jul 2023
- PurNet Seminar, Purdue University Sep 2023

The Slow Path Needs an Accelerator Too!

- VMware Research Group (VRG) Aug 2022

## OPEN SOURCE PROJECTS AND CONTRIBUTIONS

- **aisuite** [★ 12.8K, 1.3K] https://github.com/andrewyng/aisuite
- **AI-ForestWatch** [★ 31, 8] https://github.com/annusgit/ForestCoverChange
- **Taurus In-Network ML** https://gitlab.com/dataplane-ai/tutorials/sigcomm22
- **Gigaflow vSwitch** https://github.com/gigaflow-vswitch
- **Homunculus Framework** https://gitlab.com/dataplane-ai/homunculus/artifact-asplos23

## EXPERIENCE

**Next-Generation Architectures Lab, University of Michigan** Ann Arbor, MI
Graduate Student Research Assistant Jan 2025 - Present
Advisor: Muhammad Shahbaz
Rearchitecting the end host network for the terabits per second era

**VMware Research Group** Palo Alto, CA
Research Intern May - Aug 2022
Mentor: Ben Pfaff
Characterized the Open vSwitch slow path performance bottlenecks and proposed an accelerator for the SDN slow path

**Next-Generation Architectures Lab, Purdue University** West Lafayette, IN
Research Assistant Aug 2021 - Dec 2024
Advisor: Muhammad Shahbaz
Explored architectures for the slow path in SDN; Built a Neural Architecture Search (NAS) framework, Homunculus, for data plane ML

**Pervasive Parallelism Laboratory, Stanford University** Stanford, CA
Remote Researcher Sep 2020 - Jan 2021
Mentor: Muhammad Shahbaz
Designed discrete-event network simulations for data center load balancing algorithms

**Center for Advanced Research in Engineering** Islamabad, PK
Design Engineer Jun 2019 - Jul 2021
Designed Ethernet/WiFi/LTE/BLE-capable, PoE-enabled, IoT Sensor Networks for industrial machine sensing and telemetry

**Technical University of Kaiserslautern** Kaiserslautern, DE
Research Intern Jun - Sep 2018
Advisors: Norbert Wehn, Christian Weis
Worked on multi-temporal forest cover change detection to analyze the largest afforestation drive in Pakistan using remote sensing and deep learning

**TUKL Lab, NUST** Islamabad, PK
Research Intern Jun 2017 - May 2019
Advisors: Faisal Shafait, Muhammad Shahzad
Worked on document processing and land cover classification problems using object detection and sequence learning techniques from deep learning

## PROFESSIONAL SERVICE

- Volunteer Reviewer – Ph.D. Admissions Committee, University of Michigan — Dec 2025
- Program Committee (PC) Member – SIGCOMM 2025 Artifact Evaluation — Aug 2025
- Program Committee (PC) Member – NSDI 2026 Artifact Evaluation — Jul 2025
- Mentor – P4 Language Consortium, Google Summer of Code (GSoC) — Jan 2025
- Volunteer Reviewer – Ph.D. Admissions Committee, University of Michigan — Dec 2024

## MENTORING EXPERIENCE

- Advay Singh, undergrad at University of Michigan – Cloud Infrastructure — 2025 - Present
- Murayyiam Parvez, Ph.D. student at Purdue University – ML for Systems — 2024 - Present
- Ali Imran, Ph.D. student at University of Michigan – SmartNICs, ML Systems — 2024 - Present
- Venkat Kunaparaju, undergrad at Purdue University – Cloud Infrastructure — 2023 - 2024

## TEACHING EXPERIENCE

**SIGCOMM**. Tushar Swamy, *Annus Zulfiqar*, Alex Rucker, Muhammad Shahbaz, Kunle Olukotun. Link/Code
In-Network Machine Learning using Taurus. 2022

**Purdue University**. CS 38100 – Introduction to the Analysis of Algorithms (GTA). Fall 2023

## CERTIFICATIONS

**Intel Connectivity Academy – Level 1A/B**: Tofino Native Architecture (TNA) & P4 Link

## REFERENCES


1. **Muhammad Shahbaz**
   Assistant Professor of Computer Science and Engineering (CSE) msbaz@umich.edu
   University of Michigan
2. **Gianni Antichi**
   Associate Professor of Computer Science gianni.antichi@polimi.it
   Politecnico di Milano
3. **Ben Pfaff**
   Chief Engineer/Co-Founder blp@cs.stanford.edu
   Feldera