

Annus Zulfiqar

Graduate Student and Research Assistant,
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EDUCATION

University of Michigan

Ph.D. in Computer Science & Engineering
Research: Programmable Networks, Domain-Specific Architectures
Advisor: Muhammad Shahbaz

Ann Arbor, MI
Sep 2021 - Present

National University of Sciences and Technology (NUST)

Bachelor of Electrical Engineering
Thesis: Forest Cover Detection and Change Estimation using Deep Learning
Advisors: Muhammad Shahzad, Faisal Shafait

Islamabad, PK
Sep 2015 - May 2019

HONORS AND AWARDS

- Selected as mentor for Google Summer of Code (GSoC) for P4 Language Consortium 2025
- Distinguished Artifact Award for Homunculus, ASPLOS 2023 2023
- Received conference travel grants: ASPLOS 2022, SIGCOMM 2022, NSDI 2025, SIGCOMM 2025 2022-25
- Ross Fellowship recipient at Purdue University 2021
- National P@SHA ICT Awards Winner with WiserMachines, IoT spin-off of CARE 2021
- MS EE/ECE acceptances: Stanford, UMichigan, UCLA, Columbia, Duke, NYU, KAIST (passed) 2020
- Travel award for graduate EECamp at KAIST, South Korea 2018
- Funded internship offer for one year at DFKI, Kaiserslautern, Germany (passed) 2018
- DAAD-funded internship at Technical University of Kaiserslautern (TUK), Germany 2018
- NUST scholarship for top academic performance (4.00/4.00 GPA) 2015-19

PUBLICATIONS (*Equal Contribution)

Conference Papers

[Micro 2025] NETSPARSE: Hardware Acceleration for Distributed Sparse Kernels.

Gerasimos Gerogiannis, Charles Block, Dimitrios Merkouriadis, *Annus Zulfiqar*, Muhammad Shahbaz, and Josep Torrellas.

[ASPLOS 2025] GIGAFLow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs.

Annus Zulfiqar, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz.

([Paper](#), [Code](#))

[ASPLOS 2023] HOMUNCULUS: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks.

Tushar Swamy, *Annus Zulfiqar*, Muhammad Shahbaz, Luigi Nardi, and Kunle Olukotun. ([Paper](#), [Code](#))

Distinguished Artifact Award

Journal Articles

[Computer Architecture Letters 2025] Reimagining RDMA Through the Lens of ML.

Ertza Warraich, Ali Imran, *Annus Zulfiqar*, Shay Vargaftik, Sonia Fahmy, and Muhammad Shahbaz.

[SIGCOMM CCR 2023] The Slow-Path Needs an Accelerator Too!

Annus Zulfiqar, Gianni Antichi, Ben Pfaff, William Tu, and Muhammad Shahbaz. ([Paper](#))

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

Preprints

[Arxiv 2025] SPLIDT: Partitioned Decision Trees for Scalable Stateful Inference at Line Rate. Murayyiam Parvez*, *Annus Zulfiqar**, Sylee Beltiukov, Shir Landau-Feibish, Arpit Gupta, Walter Willinger, and Muhammad Shahbaz. ([Paper](#))

Conference & Workshop Extended Abstracts

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

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

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

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

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

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

TUTORIALS

[SIGCOMM 2022] Tutorial: In-Network Machine Learning using Taurus. Tushar Swamy, *Annus Zulfiqar*, Alex Rucker, Muhammad Shahbaz, Kunle Olukotun. ([Link](#), [Code](#))

INVITED TALKS, DEMOS, AND POSTERS

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

- | | |
|--|----------|
| • Intel Corporation, San Jose | Oct 2025 |
| • Google Networking Summit 2025 | Oct 2025 |
| • P4 Workshop 2025 Demo (Link) | Oct 2025 |
| • ACE Center for Evolvable Computing — Demo at Annual Meeting (Link) | Oct 2025 |
| • P4 Developer Days Event (Link) | Jun 2025 |
| • NetSvn 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](#))
- PurNet Seminar, Purdue University

Jul 2023
Sep 2023

The Slow Path Needs an Accelerator Too!

- VMware Research Group (VRG)

Aug 2022

OPEN SOURCE PROJECTS AND CONTRIBUTIONS

- **aisuite** [★ 12.4K, 🍏 1.2K] <https://github.com/andrewyng/aisuite>
- **AI-ForestWatch** [★ 31, 🍏 8] <https://github.com/annusgit/ForestCoverChange>
- **Taurus In-Network ML** [★ 4, 🍏 1] <https://gitlab.com/dataplane-ai/tutorials/sigcomm22>
- **Gigaflow vSwitch** [★ 2, 🍏 4] <https://github.com/gigaflow-vswitch>
- **Homunculus Framework** <https://gitlab.com/dataplane-ai/homunculus/artifact-aspl0s23>

EXPERIENCE

Next-Generation Architectures Lab, University of Michigan

Graduate Student Research Assistant

Advisor: Muhammad Shahbaz

Ann Arbor, MI

Jan 2025 - Present

- Building advanced caching mechanisms for modern SmartNICs
Collaborators: Ben Pfaff (Feldera/VMware) and team
- Built an architecture search and training framework for scalable decision trees in the data plane
Collaborators: Walter Willinger and team

VMware Research Group

Research Intern

Mentor: Ben Pfaff

Palo Alto, CA

May - Aug 2022

- Characterized the Open vSwitch slow path performance bottlenecks and proposed to build an accelerator for the slow path

Next-Generation Architectures Lab, Purdue University

Research Assistant

Advisor: Muhammad Shahbaz

West Lafayette, IN

Aug 2021 - Dec 2024

- Explored architectures for the slow path at the control-plane/data-plane interface in SDN
Collaborators: Ben Pfaff (Feldera/VMware) and team
- Built a Neural Architecture Search framework (Homunculus) for ML-capable data planes
Collaborators: Kunle Olukotun (Stanford) and team

Pervasive Parallelism Laboratory, Stanford University

Remote Researcher

Mentor: Muhammad Shahbaz

Stanford, CA

Sep 2020 - Jan 2021

- Designed discrete-event network simulations for data center load balancing algorithms

Center for Advanced Research in Engineering

Design Engineer

Manager: Dr. Shoab Khan

Islamabad, PK

Jun 2019 - Jul 2021

- Designed Ethernet/Wi-Fi/LTE-capable PoE-enabled IoT Sensor Networks for industrial machine sensing and telemetry

Technical University of Kaiserslautern

Research Intern

Advisors: Norbert Wehn, Christian Weis

- Worked on multi-temporal forest cover change detection to analyze the largest afforestation drive in Pakistan using remote sensing imagery and deep learning

Kaiserslautern, DE

Jun - Sep 2018

TUKL Lab, NUST

Research Intern

Advisors: Faisal Shafait, Muhammad Shahzad

- Worked on document processing and land cover classification problems using object detection and sequence learning techniques from deep learning

Islamabad, PK

Jun 2017 - May 2019

PROFESSIONAL SERVICE

- 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 Jan 2025

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 - Present

TEACHING EXPERIENCE

- CS 38100 – Introduction to the Analysis of Algorithms Fall 2023

CERTIFICATIONS

- Tofino Native Architecture (TNA) & P4 Feb 2022
Intel Connectivity Academy – Level 1A/B ([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