

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

- Broadcom Research Award for Celeris, CAL 2025 2025
- Selected as mentor for Google Summer of Code (GSoC) for P4 Language Consortium 2025
- Distinguished Artifact Award for Homunculus, ASPLOS 2023 2023
- 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
- Travel award for graduate EECamp at KAIST, South Korea 2018
- Funded internship offered 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. [Paper](#)
Gerasimos Gerogiannis, Charles Block, Dimitrios Merkouriadis, *Annus Zulfiqar*, Muhammad Shahbaz, and Josep Torrellas. *Acceptance rate: 20.7%*

[ASPLOS 2025] GIGAFLOW: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs. [Paper](#), [Code](#)
Annus Zulfiqar, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, and Muhammad Shahbaz. *Acceptance rate: 19%*

[ASPLOS 2023] HOMUNCULUS: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks. Tushar Swamy, *Annus Zulfiqar*, Muhammad Shahbaz, Luigi Nardi, and Kunle Olukotun. *Acceptance rate: 20%* [Paper](#), [Code](#)

Distinguished Artifact Award

Journal Articles

[Computer Architecture Letters 2025] Reimagining RDMA Through the Lens of ML. [Paper](#)
Ertza Warraich, Ali Imran, *Annus Zulfiqar*, Shay Vargaftik, Sonia Fahmy, and Muhammad Shahbaz. [Broadcom Research Award](#)

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

[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.

[Link](#), [Code](#)

Tushar Swamy, *Annus Zulfiqar*, Alex Rucker, Muhammad Shahbaz, Kunle Olukotun.

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** <https://github.com/andrewyng/aisuite> [★ 12.8K, ⚡ 1.3K]
- **AI-ForestWatch** <https://github.com/annusgit/ForestCoverChange> [★ 31, ⚡ 8]
- **Taurus In-Network ML** <https://gitlab.com/dataplane-ai/tutorials/sigcomm22> [★ 4, ⚡ 1]
- **Gigaflow vSwitch** <https://github.com/gigaflow-vswitch> [★ 2, ⚡ 4]
- **Homunculus Framework** <https://gitlab.com/dataplane-ai/homunculus/artifact-asplos23>

EXPERIENCE

Next-Generation Architectures Lab, University of Michigan

Graduate Student Research Assistant

Ann Arbor, MI

Advisor: Muhammad Shahbaz

- 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

Palo Alto, CA

Mentor: Ben Pfaff

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

West Lafayette, IN

Advisor: Muhammad Shahbaz

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

Stanford, CA

Mentor: Muhammad Shahbaz

Sep 2020 - Jan 2021

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

Center for Advanced Research in Engineering

Design Engineer

Islamabad, PK

Manager: Dr. Shoab Khan

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

Kaiserslautern, DE

Jun - Sep 2018

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

TUKL Lab, NUST

Research Intern

Advisors: Faisal Shafait, Muhammad Shahzad

Islamabad, PK

Jun 2017 - May 2019

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

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 - 2024

TEACHING EXPERIENCE

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

CERTIFICATIONS

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

REFERENCES

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