

# ANNUS ZULFIQAR

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## EDUCATION

### University of Michigan

Ph.D. in Computer Science & Engineering

Area: *Programmable Networks, Domain-Specific Architectures*

Advisor: Muhammad Shahbaz

Ann Arbor, MI

Jan 2025 - Present

### Purdue University

Ph.D. in Computer Science (*Transferred to the University of Michigan*)

Area: *Programmable Networks, Domain-Specific Architectures*

Advisor: Muhammad Shahbaz

West Lafayette, IN

Sep 2021 - Dec 2024

### National University of Sciences and Technology (NUST)

Bachelor of Electrical Engineering (GPA: 3.96/4.00)

Thesis: *End-to-End Forest Cover Detection and Change Estimation*

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'23) 2023
- Student travel grants: ASPLOS'22, SIGCOMM'22, NSDI'25 2022-24
- Ross Fellow 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 merit scholarship recipient 2015-19

## PUBLICATIONS (\* $\rightarrow$ Equal Contribution)

### Conference Papers

[S&P Oakland 2026] SPLIDT: Partitioned Decision Trees for Scalable Stateful Inference at Line Rate.

Murayyiam Parvez\*, *Annus Zulfiqar*\*, Sylee Beltikov, Shir Landau Feibish, Arpit Gupta, Walter Willinger, Muhammad Shahbaz. (In Submission)

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

Gerasimos Gerogiannis, Charles Block, Dimitrios Merkouriadis, *Annus Zulfiqar*, Muhammad Shahbaz, Josep Torrellas. (In Submission)

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

*Annus Zulfiqar*, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, Muhammad Shahbaz. (Paper, [Code](#))

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

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

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

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

## Workshop Papers

[Hot Interconnects 2025] Reimagining RDMA Through the Lens of ML.

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

(In Submission)

## Conference & Workshop Extended Abstracts

[SIGCOMM 2025] KAIRO: Incremental View Maintenance for Scalable Virtual Switch Caching.

*Annus Zulfiqar*, Ben Pfaff, Gianni Antichi, Arpit Gupta, Muhammad Shahbaz. (In Submission)

[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, 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, Muhammad Shahbaz. ([Poster](#))

[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, Muhammad Shahbaz. ([Poster](#))

## Journal Articles

[**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, Norbert Wehn. ([Paper](#))

## TUTORIALS

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

## TALKS AND DEMOS

- Gigaflow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs Mar - Jun 2025  
**Politecnico di Milano, University of Chicago, ETH Zurich, IBM Research, Princeton University, P4 Developer Days**
- Gigaflow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs (*with Demo*) Oct 2024  
**[SRC JUMP 2.0](#)** – Annual Review Meeting
- Gigaflow: Line-Rate, Pipeline-Aware Caching for Modern SmartNICs (*with Demo*) May 2024  
**[SRC JUMP 2.0](#)** – Spring Meeting
- Homunculus: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks Jul 2023  
**[SRC JUMP 2.0](#)**
- The Slow Path Needs an Accelerator Too! Aug 2022  
**VMware Research Group**

## 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

May - Aug 2022

Palo Alto, CA

- 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

Jun 2019 - Jul 2021

Islamabad, PK

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

## Technical University of Kaiserslautern

Research Intern

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

Jun 2017 - May 2019

Islamabad, PK

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

## PROFESSIONAL SERVICE

- Mentor — Google Summer of Code (GSoC), P4 Language Consortium Jan 2025
- Volunteer Reviewer — PhD Admissions Committee, University of Michigan Jan 2025

## MENTORING EXPERIENCE

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

## TEACHING EXPERIENCE

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- CS 38100 – Introduction to the Analysis of Algorithms (Teaching Assistant) Fall 2023

## CERTIFICATIONS

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

## REFERENCES

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