

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

- SPLIDT: Partitioned Decision Trees for Scalable Stateful Inference at Line Rate
Murayyiam Parvez*, *Annus Zulfiqar**, Sylee Beltiukov, Shir Landau Feibish, Arpit Gupta,
Walter Willinger, Muhammad Shahbaz
S&P Oakland 2026 (In Submission)
- NETSPARSE: Hardware Acceleration for Distributed Sparse Kernels
Gerasimos Gerogiannis, Charles Block, Dimitrios Merkouriadis, *Annus Zulfiqar*, Muhammad Shahbaz,
Josep Torrellas
Micro 2025 (In Submission)
- GIGAFLow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs
Annus Zulfiqar, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, Muhammad Shahbaz
ASPLOS 2025 [[Paper](#), [Artifact](#)]
- The Slow-Path Needs an Accelerator Too!
Annus Zulfiqar, Gianni Antichi, Ben Pfaff, William Tu, Muhammad Shahbaz
SIGCOMM CCR 2023 [[Paper](#)]

5. HOMUNCULUS: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks
Tushar Swamy, *Annus Zulfiqar*, Muhammad Shahbaz, Luigi Nardi, Kunle Olukotun
ACM ASPLOS 2023 [[Paper](#), [Artifact](#)]
Distinguished Artifact Award

Workshop Papers

1. Reimagining RDMA Through the Lens of ML
Ertza Warraich, Ali Imran, *Annus Zulfiqar*, Shay Vargaftik, Sonia Fahmy and Muhammad Shahbaz
Hot Interconnects 2025 (In Submission)

Journal Articles

1. 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
SPIE Journal of Applied Remote Sensing 2021 [[Paper](#)]

Conference & Workshop Extended Abstracts

1. KAIRO: Incremental View Maintenance for Scalable Virtual Switch Caching
Annus Zulfiqar, Ben Pfaff, Gianni Antichi, Arpit Gupta, Muhammad Shahbaz
SIGCOMM 2025 (In Submission)
2. 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
NSDI 2025 [Poster]
3. 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
NSDI 2025 [[Poster](#)]
4. 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
HotChips 2024 [[Poster](#)]

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!
VMware Research Group

Aug 2022

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

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

CERTIFICATIONS

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

REFERENCES

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