ANNUS ZULFIQAR

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EDUCATION

University of Michigan — Ann Arbor, MI
Ph.D. in Computer Science Engineering — Jan 2025 - Present
Area: *Programmable Networks, Domain-Specific Architectures*
Advisor: Muhammad Shahbaz

Purdue University — West Lafayette, IN
Ph.D. in Computer Science — Sep 2021 - Dec 2024
Area: *Programmable Networks, Domain-Specific Architectures*
Advisor: Muhammad Shahbaz

National University of Sciences and Technology (NUST) — Islamabad, PK
Bachelor of Electrical Engineering (GPA: 3.96/4.00) — Sep 2015 - May 2019
Thesis: *End-to-End Forest Cover Detection and Change Estimation*
Advisors: Muhammad Shahzad, Faisal Shafait

ACADEMIC RESEARCH

Next-Generation Architectures Lab, University of Michigan — Ann Arbor, MI
Graduate Student Research Assistant — Jan 2025 - Present
Advisor: Muhammad Shahbaz

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

Next-Generation Architectures Lab, Purdue University — West Lafayette, IN
Research Assistant — Aug 2021 - Dec 2024
Advisor: Muhammad Shahbaz

- 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 emerging ML-capable data planes
  Collaborators: Kunle Olukotun (Stanford) and team

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

Technical University of Kaiserslautern (TUK) — Kaiserslautern, DE
Research Intern — Jun - Sep 2018
Funded by DAAD

- 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 — Jun 2017 - May 2019
Research Intern — Islamabad, PK
Advisors: Faisal Shafait, Muhammad Shahzad

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

INDUSTRY EXPERIENCE

VMware Research Group (VRG) May - Aug 2022
Research Intern Palo Alto, CA
Mentor: Ben Pfaff

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

Center for Advanced Research in Engineering (CARE) Jun 2019 - Jul 2021
Design Engineer Islamabad, PK

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

PUBLICATIONS ($* \rightarrow$ Equal Contribution)

1. 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
   SIGCOMM 2025 (In Submission)

2. NetSparse: Hardware Acceleration for Distributed Sparse Kernels
   Gerasimos Gerogiannis, Charles Block, Annus Zulfiqar, Muhammad Shahbaz, Josep Torrellas
   ISCA 2025 (In Submission)

3. Gigaflow: Pipeline-Aware Sub-Traversal Caching for Modern SmartNICs
   Annus Zulfiqar, Ali Imran, Venkat Kunaparaju, Gianni Antichi, Ben Pfaff, Muhammad Shahbaz
   ASPLOS 2025

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

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

6. Homunculus: Auto-Generating Efficient Data-Plane ML Pipelines for Datacenter Networks
   Tushar Swamy, Annus Zulfiqar, Muhammad Shahbaz, Luigi Nardi, Kunle Olukotun
   ACM ASPLOS 2023
   Distinguished Artifact Award
   Paper, **Artifact**

7. 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

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 (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

TEACHING

- CS 38100 – Introduction to the Analysis of Algorithms (Graduate TA) Fall 2023

CERTIFICATIONS

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

HONORS AND AWARDS

- Distinguished Artifact Award for Homunculus (ASPLOS 2023)
- Ross Fellowship recipient at Purdue University
- Travel award for ASPLOS (2022), and SIGCOMM (2022)
- National (Pakistan) P@SHA ICT Awards Winner (with *WiserMachines*, IoT spin-off of CARE)
- Travel award for EECamp at KAIST, South Korea
- Funded internship offer for one year at DFKI, Kaiserslautern, Germany (passed)
- DAAD-funded internship at Technical University of Kaiserslautern (TUK), Germany
- NUST merit scholarship recipient from 2015 - 2019

REFERENCES

1. Muhammad Shahbaz (mshahbaz@purdue.edu)
   Purdue University
2. Gianni Antichi (gianni.antichi@polimi.it)
   Politecnico di Milano
3. Ben Pfaff (blp@cs.stanford.edu)
   Feldera