ANNUS ZULFIQAR

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EDUCATION

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

National University of Sciences and Technology (NUST) ⟶ Islamabad, Pakistan
Bachelor of Electrical Engineering (Batch rank: 3/150) ⟶ 2015 - 2019
Thesis: *End-to-End Forest Cover Detection and Change Estimation*
Advisors: Muhammad Shahzad, Faisal Shafait

ACADEMIC RESEARCH

Next-Generation Architectures Lab (Purdue University) ⟶ Aug 2021 - Present
Graduate Research Assistant ⟶ West Lafayette, IN
Advisor: Muhammad Shahbaz

- Building 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) ⟶ Sep 2020 - Jan 2021
Remote Researcher ⟶ Stanford, CA
Mentor: Muhammad Shahbaz (Postdoc)

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

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

- 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, Pakistan
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, Pakistan

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

PUBLICATIONS

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

2. Collect-And-Predict: A Recursive Abstraction for Scalable In-Network Model Inference
   *Murayyiam Parvez, *Annus Zulfiqar, Muhammad Shahbaz
   In preparation (S&P Oakland 2025)
   (* → Equal contribution)

3. 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

4. The Slow-Path Needs an Accelerator Too!
   Annus Zulfiqar, Gianni Antichi, Ben Pfaff, William Tu, Muhammad Shahbaz
   ACM 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
   Distinguished Artifact Award
   Paper, Artifact

6. 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 (bpfaff@vmware.com)
   VMware