Vivswan Shah

Ph.D. Candidate, Machine Learning Systems

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Education

Ph.D., **University of Pittsburgh** & **Carnegie Mellon University** — Machine Learning Systems, (Expected 2024)
Dissertation: *Hybrid Digital-Analog Distributed Deep Learning Systems*
M.S., **University of Pittsburgh** — Electrical and Computer Engineering
B.S., **Illinois College** — Computer Science and Physics

Technical Skills

AI/ML	Computer Vision, Reinforcement Learning, Generative AI, Large Language Models
Frameworks	PyTorch, TensorFlow, Qiskit, Cirq, Keras, scikit-learn, Lumerical, Node.JS, Mathematica, MATLAB, Firebase, Docker
NanoFab	E-Beam Lithography, PhotoLithography, Thin Film Deposition, Dry Etching, Surface Profiler, SEM, FEI, BEAMER
Languages	Python, Typescript, Kotlin, JavaScript, C/C++, JAVA, LaTeX, SQL (MySQL, PostgreSQL, NoSQL)

AI/ML Research Experience

Research Assistant, AI/ML Optimization
06/2020 - Present
Youngblood Photonics Lab, Supervise by Dr. Nathan Youngblood — Pittsburgh, US

- Developed hardware-aware deep learning models optimized for analog hardware, resulting in efficient deployment and improved performance on resource-constrained devices.
- Worked on projects with **Google X**, **Accipiter Systems**, **TD Securities**, and **U.S. Department of Defense (DOD)**.
- Built and set up new research lab, including research equipments and internal networking, as the first PhD student.

Research Intern, AI for Science
05/2019 - 08/2019
Supervised by Dr. Keenan Mack, Illinois College — Jacksonville, US

- Used novel clustering algorithms on DNA/RNA and other protein networks to find high correlation between degree correlation and degree distribution, and set a baseline for future research.
- Used unsupervised k-means clustering to analyze data of *E. coli* two component systems.
- Studied and modeled the *E. coli* two-component system for attractant and repellent to monte carlo simulations.
- Repaired and rebuilt RapidCell program, and added new GUI, decreasing runtime by 60%.

Research Assistant, Reinforcement Learning
08/2018 - 01/2019
Supervised by Dr. Takako Soma, Illinois College — Jacksonville, US

- Successfully modeled self play reinforcement learning agent based on AlphaGo Zero to teach chess by expertise matching.

Selected Publication

- **Real-Time 4K 480 fps Low Power Object Detection System**, ongoing.
- **Analog-Layers: Translating Photonics Components for Convolution and Self-Attention Mechanisms**, ongoing.
- **Deep Learning acceleration using non-reciprocal photonic computing**, in review (*Nature*)
- **Leveraging Continuously Differentiable Activation for learning in Quantized Noisy Environments**, in review
- **AnalogVNN: A fully modular framework for modeling and optimizing analog neural networks**, *Applied Physics Letters Machine Learning*, **Vivswan Shah**, Nathan Youngblood. DOI: 10.1063/5.0134156
- **Computational, photonic crossbar arrays for scalable and efficient matrix operations**, *Silicon Photonics XVIII*, Nathan Youngblood, **Vivswan Shah**. DOI: 10.1117/12.2646996
- **Fast & efficient electrically driven phase change photonics using waveguide-integrated microheaters**, *Optics Express*, John R Erickson, **Vivswan Shah**, Qingzhou Wan, Nathan Youngblood, Feng Xiong. DOI: 10.1364/OE.446984
- **Realization of an integrated photonic platform for coherent photo-electric processing**, *Optica*, Sadra Rahimi Kari, Nicholas Nobile, Dominique Pantin, **Vivswan Shah**, Nathan Youngblood. DOI: 10.1364/OPTICA.507525

Work Experience

Lead Automation Engineer
07/2022 - Present

Youngblood Photonics Lab, University of Pittsburgh — Pittsburgh, US

- Unified process fabrication and characterization into a single software for UPitt & CMU Ebeams, MLAs, SEMs, etc.
- Built and developed unified software to control multiple probe stations for testing photonic integrated circuits.
- Developed novel software utilizing photonic chips to perform optical convolutions over fiber optic channels.

Linux System Engineer
03/2021 - 07/2022

Youngblood Photonics Lab, University of Pittsburgh — Pittsburgh, US

- Added new High Computing Server to Lab, and trained coworkers on the use of all functionalities.
- Implemented secured internal network for all devices and computers of the lab with DHCP, DNS, and Kemp load balancer.
- Implemented RDP, VPN, and configured non-networked devices to add work from home functionality.
- Deployed Jupyterhub, NI server, and other management tools to control lasers, DAQ, and other measurement equipment.

Software Engineer - Backend
05/2018 - 08/2018

Internship, Pehla Kadam Foundation — London, UK (Remote)

- Setuped and tested the new donation system, decreasing errors by 20%.
- Optimized the main website's api functions, decreasing latency by 30%.

Software Engineer - Backend & Database
08/2017 - 05/2018

Internship, IT Department, Illinois College — Jacksonville, US

- Developed alarm system for Illinois College Archives, increasing lifespan of antique books and artifacts.
- Automated IT request system, decreasing 15% workload, & updated Sharepoint 13 to 16, improving 20% performance.

Projects

- **gdsfactory, as Developer for Google X,** gdsfactory.github.io, analog, quantum chip design — Since 04/2023

Feature development, bug fixes, and documentation for gdsfactory on behalf of University of Pittsburgh for YPL Lab.

- **AnalogVNN,** analogvnn.github.io, framework for modeling and optimizing analog neural networks — Since 08/2022
- **DeDuplicationDict,** deduplicationdict.github.io, HashMap with deduplication to optimize memory — Since 05/2023

- **DynPartition**, Optimal Pipeline Parallelism of Dynamic Networks over Heterogeneous GPUs using Reinforcement Learning
- **ChatGPTAdversarialAttack2023**, LLM Adversarial Attack Challenge using ChatGPT for The Pitt Challenge 2023
- **YPL-Servers-Setup**, Configure DNS, DHCP, access control, backup server, and activity logger for research lab.
- **Probe-Automation**, Centralized web interface for probe station enabling automated measurement of 1000's of devices.
- **EBeam-Processor**, Unified workflow to convert chip layouts into compatible formats for E-Beams, MLA, ICP-RIE, etc.
- **SEM-Image-Labeler**, Image Labeler for SEM Image from University of Pittsburgh and Carnegie Mellon University NanoFab

Contributions to Open Source Projects: pytorch, torchmetrics, tensorboard

Leadership & Activities

Organizer & Mentor	Pitt Challenge (Medical/Phrama Hackathon) at University of Pittsburgh	08/2022 - Present
Mentor	AWAP'23 at CMU, HackCMU'22 at CMU, HackMIT'22 at MIT	2022 - 2023
Tutor	Physics, Mathematics, Computer Science, and Chemistry at Illinois College	08/2018 - 05/2020
Teaching Assistant	College Physics and Calculus at Illinois College	08/2018 - 01/2020

Honors & Presentations

2022	**IEEE Photonics Conference**, AnalogVNN	Vancouver, Canada
2020	**OnePlus Crackables 2.0**, Among top 10 hackers to solve all the puzzles	OnePlus
2018-2020	**HackMIT Puzzles 2018, 2019, and 2020**, One of first 10 hackers to solve all the puzzles	MIT
2019	**1st Prize in ISAS in the Physics, Math, and Astronomy Division**, MorseCodeRS2	ISAS

Selected Coursework

Deep Reinforcement Learning & Control, Adv. Computer Vision, Probabilistic Graphical Models, Adv. Machine Learning & Deep Learning, Quantum Computing Systems, Computational Game Solving, Quantum Information, Adv. Operating System & Distributed Systems, Modern Computer Architecture & Design, Adv. Machine Learning: Theory and Methods, Algorithm Design and Analysis, Complexity Theory, etc.