Ramashish Gaurav
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Education

- **Virginia Tech** — Blacksburg VA, USA
  Ph.D. Candidate (Spiking Networks and Neuromorphic Computing); GPA: 4.0/4.0 — *January 2022 – Present*
  Electrical and Computer Engineering; Supervisor: Prof. Yang (Cindy) Yi
- **University of Waterloo** — Waterloo ON, Canada
  MASc. (Computational Neuroscience and Artificial Intelligence); CGPA: 95/100 — *January 2020 – December 2021*
  Systems Design Engineering; Supervisors: Prof. A. Narayan & Prof. B. Tripp
- **Indian Institute of Technology - BHU** — Varanasi UP, India
  Dual Degree (Master of Technology and Bachelor of Technology); CGPA: 9.10 / 10.0 — *July 2012 – May 2017*
  Computer Science & Engineering; Supervisor: Prof. K K Shukla

Research Interests

- Spiking Neural Networks, Neuromorphic Computing, Computational Neuroscience, AI/ML

Spiking Networks Research Experience

- **Experience on Loihi**
  Intel's Neuromorphic Hardware — *Mid 2020 – Present*
  I have been working with spiking networks on Loihi (on the INRC cloud) since my MASc. I am proficient with with NengoLoihi & NxSDK programming, and currently working with Lava on Loihi-2. In my research so far, I have developed Loihi-deployable MaxPooling approximations and Spiking Reservoir Computing based models.
- **Online and On-chip training of Spiking Neural Networks (SNNs)**
  PhD-thesis Project at Virginia Tech, Supervised by Prof. Yang (Cindy) Yi — *January 2022 – Present*
  This project focuses on two aspects of Neuromorphic Computing – *Real-time Online training* of SNNs and its *On-chip implementation*. Loihi-2 supports Three Factor Rules (TFR) based on-chip training, & I am currently investigating in that direction. So far, I have developed a novel Legendre-SNN for Time-Series Classification on Loihi, and designed TFR-based DALTON - a high-performing online local-learning method for training SNNs.
- **Driving Scene Understanding using Spiking Neural Networks (SNNs)**
  Master's Thesis (at UW), Supervised by Prof. A. Narayan & Prof. B. Tripp — *January 2020 – December 2021*
  This project involved building a low-power SNN for Driving Scene Understanding. State-of-the-Art AI models are rate-neurons (e.g., `ReLU`) based which run on power hungry GPUs/FPGAs. Spiking networks on the other hand are highly energy-efficient when deployed on neuromorphic hardware, thus well-suited for electric vehicles.

Machine Learning Research Experience

- **Resting-State Functional Connectivity analysis of Autistic Individuals**
  Self-motivated project, Collaboration with: Prof. Rahul Garg, IIT Delhi — *January 2019 – December 2019*
  This project involved a study of the alterations in the resting-state functional connectivity of autistic patients. Data-driven approaches were applied on ABIDE-I and ABIDE-II datasets to discover functionally altered links.
- **Estimation of train delays at railway stations in India**
  Self-motivated project, Collaboration with: Prof. Biplav Srivastava, UofSC, USA — *July 2017 – April 2018*
  A delay prediction algorithm inspired from the N-Order Markov Processes was formulated which leveraged the Random Forest Regressors and Ridge Regressors to predict delays at in-line stations. [Open Source at Github]
- **Algorithms for Subspace Learning**
  Master's Thesis, Supervisor: Prof. K K Shukla, IIT-(BHU), Varanasi — *August 2015 – May 2017*
  The thesis involved developing algorithms for learning latent subspaces from visual features of images for image classification – in two settings: Traditional (training/test images from same database) and Zero Shot Learning.

- **Content-based image classification via multi-modal fusion of visual features**
  Bachelor's Thesis, Supervisor: Prof. K K Shukla, IIT-(BHU), Varanasi *January 2015 – May 2015*
  A Matrix Factorization based framework for multi-modal fusion of N different modals of image datasets was designed, where a latent subspace was learned with the help of simple gradient-descent additive update rules.

Publications

- **Gaurav R.**, Agarwal S., Stewart T., Yi Y.; (In preparation)
  Benchmarking Legendre-SNN for Time Series Classification – Analysis and Enhancements
- **Gaurav R.**, Do D., Doan T., Yi Y.; (Under Review)
  DALTON - Deep Local Learning in SNNs via local Weights and Surrogate-Derivative Transfer
- **Gaurav R.**, Stewart T., Yi Y.; *Frontiers in Computational Neuroscience* (2023)
  Reservoir based Spiking Models for Univariate Time Series Classification
- **Gaurav R.**, Stewart T., Yi Y.; *Symposium on Edge Computing - EdgeComm* (2022)
  Spiking Reservoir Computing for Temporal Edge Intelligence on Loihi
- **Gaurav R.**, Tripp B., Narayan A.; *International Joint Conference on Neural Networks* (2022)
  Spiking Approximations of the MaxPooling Operation in Deep SNNs
- **Gaurav R.**, Tripp B., Narayan A.; *Canadian Conference on Artificial Intelligence* (2021)
  Driving Scene Understanding: How much temporal context and spatial resolution is necessary?
- **Gaurav R.**, Srivastava B.; *International Conference on Intelligent Transportation Systems* (2018)
  Estimating Train Delays in a Large Rail Network Using a Zero Shot Markov Model
- **Gaurav R.**, Verma M., Shukla K.; *Indian Conference on Computer Vision, Graphics and Image Processing* (2016)
  Informed Multimodal Latent Subspace Learning via Supervised Matrix Factorization
- **Gaurav R.**, Vallecha A., Verma M., Shukla K.; *UPCON* (2015)
  Multimodal Subspace Learning on Flickr Images

Technical Experience

- **Nutanix Technologies India Pvt. Ltd.** Bangalore, India
  Member of Technical Staff - 3 *June 2017 – December 2019*
  - Designed and implemented the **Remote Procedural Calls** for managing HyperV Virtual Machines (VMs) in the Acropolis Hypervisor (AHV/AOS) with Google Protocol Buffers, Powershell Cmdlets, and Python. Later, designed and implemented the **Metadata Service**, where the VMs could introspect themselves by executing REST calls. And also mentored two interns in prototyping a **Proactive CPU Scheduler** using Machine Learning algorithms.
- **Centre for e-Governance, Government of Karnataka** Bangalore, India
  Software Developer Intern *May 2015 – July 2015*
  - Developed **Online Ticket Management Tool** and **Online Asset Inventory Application** in Web2py

Skills

- **Programming Languages**: Python, C, C++
- **Technologies**: Nengo, NengoDL, NengoLoihi, Lava, NxSDK, Git, TensorFlow, PyTorch

Extracurricular Activities

- Teaching Assistant for:
  - Applied Software Design - ECE 3574 (Virginia Tech): Spring 2022, Fall 2022
  - Matrices and Linear Systems - SYDE 113 (University of Waterloo): Fall 2020
  - Systems Models - SYDE 351 (University of Waterloo): Spring 2020, Winter 2021
  - Linear Systems and Signals - SYDE 252 (University of Waterloo): Spring 2021
  - Computer Programming (IIT-BHU): 3 semesters
  - Information Security, Network Security, and Network Security Lab (IIT-BHU): 2 semesters