

Debosmit Neogi

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EDUCATION

University at Buffalo

Buffalo, NY

MS in Computer Science GPA:3.833/4 (After 2nd Semester)

Fall 2023 - 2024

- Courses taken: Intro to ML (CSE 574), Computer Security (CSE 565), Algorithm Analysis and Design (CSE 531), Data Intensive Computing (CSE 587), Operating System (CSE 521), Data Models and Query Language (CSE 565), Computer Vision (CSE 573), Deep Learning (CSE 676)

National Institute of Technology Agartala

Tripura, India

B.Tech in Computer Science and Engineering CGPA:9.0/10 [First Class with Distinction]

2019 - 2023

- EX GRADE ($\geq 90\%$) in : **Deep Learning, Web Technology, Introduction To Programming, Data Structure, Engineering Mathematics -III, Formal Language and Automata Theory (FLAT), Algorithms Lab, Data Communication, Microprocessor and Microcontroller, Basic Electronics.**

RESEARCH EXPERIENCE

RESEARCH INTERN

Roy Lab, Jacobs School of Medicine and Biomedical Sciences

- Working on building Spiking Neural Network based computational neuroscience models to simulate the Anterior Thalamus-Retrosplenial cortex circuit to explain the roles of various parts of thalamus components in the engram formation in response to visual stimuli, under the advise of Dr. Dheeraj Roy.
- Working in collaboration with Dr. Douglas Feitosa Tome, Vogels lab, IST Austria.
- Supported by SUNY Research Foundation.
- <https://dsroy.lab.medicine.buffalo.edu/team>

GRADUATE RESEARCH ASSISTANT

X-Lab, University at Buffalo

- Worked on Indoor Plant growth and disease monitoring system, under the advise of Prof. Jinjun Xiong. Developed NeRF based algorithms to monitor plant growth and track photosynthesis.
- Worked on computational reconstruction problems from RGB to hyper-spectral imaging.

RESEARCH INTERN

Computational Light Lab, University College London

- Worked on semi-supervised learning techniques to compress RGB-D images. Achieved an average PSNR of 30 over validation image set.
- Worked on learning invertible holographic light transport model using self supervised learning.
- Alumni at: <https://complightlab.com/people/#research-interns>

RESEARCH INTERN

Indian Institute of Technology Jodhpur (IIT Jodhpur)

- Worked on building models that predicts Out Of Distribution (OOD) data with low confidence.
- Applied mixup augmentation and Monte Carlo dropout separately with Knowledge Distillation and computed the Calibration metrics for OOD data.
- Also worked on developing new approach to mitigate privacy concerns of users' data as a result of knowledge distillation as side project.

TEACHING EXPERIENCE

Graduate Teaching Assistant CSE 473/573 [Fall 2024]

- Serving as GTA for the course CSE 473/573 (Computer Vision and Image Processing), taught by Dr. Chen Wang.
- Responsibilities include: Help preparing course materials, grading exams and assignments and holding weekly office hours.

ACHIEVEMENTS & HONORS

Jonsson School Dean's Scholarship [NOT AVAILABLE]

- Received prestigious Jonsson School Dean's Scholarship from Department of Electrical and Computer Engineering, UT Dallas to pursue MS for the academic year Fall 23-24.

Drexel University Dean's Scholarship [NOT AVAILABLE]

- Received Dean's Scholarship from Department of Computer Science, Drexel University to pursue MS for the academic year Fall 23-24.

Presented at CSE Demo Days

- My project titled: "HoloZipper: A self Supervised Learning based RGB-D image Compression Algorithm", using GDN-iGDN non-linearity was selected as one of the top projects from CSE 676. Presented at CSE Demo Days at UB.

Received grant in aid for research project

- Received grant in aid to support POC pitching and validation for: *An omni directional autonomous robot for transporting office commodity from room to room*; Department of Computer Science and Engineering, NIT Agartala.

PUBLICATIONS

- **A Deep Neural Approach Toward Staining and Tinting of Monochrome Images** (Springer LNNS series)
 - Paper presented in ICACIT 2021. Paper published in LNNS series Vol. 218. (Scopus indexed)
 - D.O.I: https://doi.org/10.1007/978-981-16-2164-2_3
- **FitNet: A deep neural network driven architecture for real time posture rectification** (IEEE, Bahrain section)
 - Paper presented at 3ICT 2021, Bahrain (Peer reviewed conference).
 - D.O.I: <https://doi.org/10.1109/3ICT53449.2021.9582113>
- **Blink-Con: A hands free mouse pointer control with eye gaze tracking** (IEEE, Bangalore section)
 - Paper presented at MysuruCon 2021 to be published by IEEE.
 - D.O.I: [10.1109/MysuruCon52639.2021.9641704](https://doi.org/10.1109/MysuruCon52639.2021.9641704)
- **Eye-Gaze Based Hands Free Access Control System for Smart City Public Interfaces** (Springer)
 - This work has been added to **World Health Organization (WHO)** database for global literature on Covid 19.
 - Published as a book chapter in "AI and IOT for Smart City Applications", Springer, Singapore (Scopus indexed).
 - WHO database link: <https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-1626328?lang=en>
 - D.O.I: https://link.springer.com/chapter/10.1007/978-981-16-7498-3_9
- **L-BFGS Optimization Based Human Body Posture Rectification- a smart interaction for computer guided workout.**
 - Paper presented at 12th SocPros 2023, IIT Roorkee, India. Paper published in LNNS series Vol. 995. (Scopus indexed).
 - DOI: https://doi.org/10.1007/978-981-97-3292-0_4

PERSONAL STATEMENT

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My journey with research oriented academics began at National Institute of Technology Agartala, India, where I did my Bachelor's of Technology in Computer Science and Engineering and graduated with First Class with Distinction. During my undergraduate study, I was fortunate enough to get introduced to research in deep learning. I had worked with [Dr. Suman Deb](#), in the intersection of Computer Vision and Human Computer Interaction, which resulted in a number of [publications](#).

Currently, I am pursuing an MS in Computer Science at the University at Buffalo, and I have a GPA of 3.833/4.0. I secured **A** grades in CSE 676 (Deep Learning) and CSE 573 (Computer Vision). This reflects my interests and passion for deep learning and Computer vision. I was amongst the top scorers in my class for CSE 573, and I am serving as Graduate Teaching Assistant for Fall 2024 under [Dr. Chen Wang](#). My final project for CSE 676 titled: "[HoloZipper: A Self supervised Learning based RGB-D image compression algorithm](#)" based on GDN/iGDN non-linearity was selected as one of the top projects, which was presented during the Spring UB CSE Demo Days. Along with AI/ML track courses, I also have a good foundation in the core CS subjects like CSE 521: Operating Systems. Considered as one of the most challenging graduate level courses at UB, I have secured **A** grade in the subject. I got a perfect score in the projects and in the mid-semester exams. I believe these rigorous graduate courses have set me on the right path to become a successful PhD candidate at Columbia University.

During the summer, I was a research intern at the [Jacobs School of Medicine and Biological Sciences](#) under the advice of [Dr. Dheeraj Roy](#). Here I worked on building Spiking Neural Network (SNN) based computational models to simulate the Anterior Thalamus and Cortex Retrosplenial circuit. I built a balanced SNN model simulating 5000 thalamus and cortex neurons combined, with additional Poisson stimulus. I have implemented plasticity mechanisms incorporating triplet STDP (Hebbian), non-Hebbian Heterosynaptic plasticity and short term plasticity rules. Novel stimulus was provided during the training and consolidation phase, whereas, partial stimulus was provided during the recall phase to identify active

neurons (engrams). For this I used a technique called Non-Negative Matrix Factorization (NMF). I have used both Python and C++ based simulators. In the C++ based simulation, I was able to reduce computation time by employing OpenMPI based parallelization. Using this extensive computational modeling, we were able to put forward some preliminary novel hypotheses that explain engram formation in the thalamus and how cortex influences thalamus. My work was supported by the *SUNY Research Foundation*. For this project I was co-mentored by Dr. Douglas Feitosa Tome of the Vogels lab, IST Austria.

Under Dr. Roy, I also studied the encoding of head direction behavior in the thalamus region. I took calcium imaging as well as behavior data to jointly train a ResNet based encoder architecture with triplet loss to leverage contrastive learning. The encoder returned joint latent embeddings, which were further used to study the correlation between neural activity and behavior. Establishing consistency across embeddings of different dimensions is crucial to identify the relation between neural activity and behavior. For this, we have used Persistent-Homology to identify topological similarity between embeddings at different dimensions to ensure consistency. We have used Davies-Bouldin Index to quantify the performance of clustering of different behaviors across models. This methodology is first of kind for the study of the thalamic region.

At Columbia, I would be grateful to get an opportunity to work under the advice of **Dr. David Knowles**. I would like to use my experience in computational neuroscience to develop machine learning models for high-dimensional biological data analysis. Under Dr. Knowles' advice, I want to work on single cell RNA sequencing, to study the gene expression of individual neurons. In the context of Anterior thalamus, I want to study how different subgroups (AD, AV, AM) encode behaviors.

I am also highly interested in working under the advice of **Dr. Mohammed AlQuraishi**. My background in computational neuroscience and my experience with applying deep learning based methodology for studying thalamic neurons, positions me well to contribute to the lab's cutting-edge research in applying machine learning to study protein molecule structure and build frameworks to analyze biological data.

During the semester, I have worked with Prof. Jinjun Xiong at X-Lab. Our research was on developing an AI based system for early detection of disease in indoor plants. I used the Normalized Difference Vegetation Index (NDVI) to evaluate the health of the plants. This was done by using a Raspberry Pi camera and a NoIR Raspberry Pi camera to capture images of the plants in the Red and NIR spectrum respectively. This helped us to calculate NDVI. Following this line of research, I worked on computational reconstruction problems from RGB to hyperspectral imaging. I built a lightweight baseline model consisting of modified UNet like architecture with perceptual loss that reconstructs 31 channels spectral from 3 channel RGB images. I will be grateful to get a chance to work under the advice of **Dr. Shalmali Joshi**. In the **reAlm lab**, I want to use my past experience of applying advanced deep learning algorithms on biological data, to develop novel and equitable healthcare solutions.

My research experience, so far, has been highly interdisciplinary, spanning computer science, electrical engineering as well as life sciences. I believe my past academic and extracurricular records along with the undertaken research projects have made me a good fit for the PhD program at Columbia University. What really excites me, is Columbia's extensive focus on the research in the intersection of ML and Biology. Finally, my career goal is to remain in academia, where I can contribute to cutting-edge research and guide the next generation of researchers towards developing innovative and responsible AI. I strongly believe that a Ph.D. degree from Columbia University will equip me with the required knowledge and experience to achieve these goals.