Devashri Deulkar

+91 8421391677 deulkardr@gmail.com devadeut.github.io Linkedin github.com/Devadeut

Education

Indian Institute of Technology, Kharagpur **Dec 2021 – Present**
Bachelor's Degree (B.Tech) in Computer Science and Engineering *CGPA: 8.32/10*

Jawahar Navodaya Vidyalaya, Amravati **Sept 2015 – Mar 2019**
Class X, CBSE *Percentage: 97.00%*

Sant Tukaram National Model School, Latur **Aug 2019 – Mar 2021**
Class XII, CBSE *Percentage: 95.60%*

Experience

Undergraduate Researcher | Indian Institute of Technology | Kharagpur, India **May 2025 – Present**
Spiking Neural Networks (LSM) under Prof. Soumik Bhattacharya

- Conducted a **systematic literature review** of 30 research papers on Spiking Neural Networks (SNNs), reservoir computing, and learning rules such as STDP and reward-modulated plasticity.
- Identified gaps in existing architectures and formulated a research direction on **Reinforced Liquid State Machines (RLSM)** for temporal sequence learning.
- Built the entire **Liquid State Machine pipeline from scratch** in Python, including LIF neurons, synaptic plasticity, reservoir connectivity, and WTA readout mechanism.
- Designed and evaluated models on **temporal classification tasks (SHD/N-MNIST)**; currently benchmarking RLSM against LSTM/GRU baselines and performing ablation studies.

Research Intern | Indian Institute of Science | Bengaluru, India **May 2024 – July 2024**
Distributed ML on heterogeneous setup under CNI Lab

- Trained a **GPT-2 (124M) model using DeepSpeed** ,exploring how frameworks like ZeRO (Zero Redundancy Optimizer) can minimize memory redundancy across GPUs and improve training efficiency of clusters.
- Conducted a **literature review** of existing model parallelism, alongside optimizations like ZeRO and used in training
- Developed a **pipeline** to profile, with custom modifications introduced to track **communication** and **computation time**
- Achieved a speed of **80k tokens/sec** with **2 GPU- RTX 4060ti** to train **GPT-2 (124M) model**

Research Trainee | Neuromatch Academy | Oregon,United States **Feb 2024 – March 2024**
Computational Neuroscience: Pupil Decoder

- Developed a **GLM** predicting different aspects of occular motion from neural activity of a mouse's primary visual cortex recorded while in the dark **(Stringer et al. 2019)**
- Built a **decoder** for the pupil's position/ change of posititon / magnitude of the movement and the direction of movement
- Analyzed neural activity across **nine cortical depths** and **three time gaps** to investigate the temporal relationship between V1 neural information and behavior, determining whether neural information **precedes or follows behavior**
- Best performance was achieved for **synchronous activity 46%**,with future neural spike counts better at decoding present pupil information compared to past spike counts

Projects

Generative Modeling Benchmark on MNIST: VAE vs GAN (FID/IS Evaluation) **Nov 2025**
Advanced Machine Learning (CS60073)

- Implemented an MLP-based **Variational Autoencoder (VAE)** with reparameterized latent sampling; logged **reconstruction**, **KL**, and ELBO trends per epoch
- Implemented an MLP-based **GAN** (Generator/Discriminator) with non-saturating objective, label smoothing, and stable training loop (1D-step + 1G-step per iteration)
- Generated fixed-grid samples per epoch to qualitatively track **training progression** and diagnose **mode collapse**/diversity issues
- Built a CNN feature extractor and computed quantitative metrics: **Inception Score (IS)** and **Fréchet Distance (FID)** for VAE vs GAN comparisons
- Enforced controlled experimental settings (CPU-only, fixed splits, fixed hyperparameters, fixed noise batches) for fair model comparison

Probabilistic Inference: Gaussian Processes, EM & Variational Inference **Oct 2025 – Nov 2025**
Advanced Machine Learning (CS60073) | Full Score

- Implemented **Gaussian Process Regression** (RBF kernel) from scratch, computing posterior **predictive mean** and **uncertainty bands** for noisy function observations

- Developed a full-covariance **Gaussian Mixture Model** and implemented the **EM algorithm** (responsibilities + parameter updates), verifying monotonic log-likelihood ascent
- Implemented **EM for Bayesian Linear Regression** to estimate prior/noise precisions (λ, β) and analyzed **evidence vs iterations** under polynomial feature expansions
- Built **mean-field Variational Inference** for Bayesian Logistic Regression in **PyTorch** using the **reparameterization trick**; evaluated predictive calibration via **Brier score** against MAP baseline
- Ensured numerical correctness via **Cholesky-based solves**, **log-sum-exp** stabilization, diagonal jitter/regularization, and fixed random seeds for reproducibility

Robust Image Captioning: ViT–Transformer & SmolVLM Benchmarking **Feb 2025 – Apr 2025**
Deep Learning (CS60010)

- Implemented an end-to-end **image captioning pipeline** with a **ViT-based image encoder** and a **Transformer text decoder**, trained under a strict **15GB GPU memory** constraint
- Benchmarked zero-shot captioning using **SmolVLM** and reported standardized captioning metrics (**BLEU, ROUGE-L, METEOR, BERTScore**) for a strong baseline comparison
- Designed and implemented a robustness suite using **patch-wise occlusion** (16×16 grid) at **10%, 50%, 80%** masking; measured metric deltas to quantify performance degradation
- Logged and serialized **(original caption, generated caption, occlusion level)** tuples to create a controlled dataset for downstream analysis and model attribution
- Built a **BERT-base** classifier to identify whether a caption was produced by **SmolVLM vs custom model**; enforced a strict **image-disjoint 70:10:20 split** and reported **macro Precision/Recall/F1**

Simulation of Moris Lecar Equations and Hodgkin-Huxley equations **Aug 2024 – Nov 2024**
Computational Neuroscience

- Simulated differential equations using **MATLAB's ODE** solvers to analyze dynamic systems in neuroscience
- Conducted **state space analysis** by plotting **nullclines** and solutions under varying initial conditions for the **Morris-Lecar equations**
- Investigated **diverse dynamic behaviors** exhibited by the Morris-Lecar equations by varying **key parameters** such as reference frequency ϕ; leak, Ca++, and K+ conductances through membranes channel, V1, V2, V3, V4.
- Analyzed the **Hodgkin-Huxley model** and its **reduced forms** to study neural dynamics under different physiological conditions

Achievements

- Ranked among the **top 1%** of the candidates in IIT-JEE Advanced 2021 (in a pool of 0.9 million).
- Qualified for the Indian Institute of Science fellowship in 2021 by securing an **All India Rank of 221*** reserved category /

Relevant Coursework

- **Advance Machine Learning:** Bayesian Inference, Variational Inference (VI), Gaussian Processes, Generative Adversarial Networks (GANs), Diffusion Models, Language Models (LLMs).
- **Neurochemistry:** Foundations and Cellular Neurobiology, Cholinergic System, Glutamatergic System, Inhibitory Neurotransmitter Systems (GABA and Glycine), Dopaminergic System, Serotonergic Systems, Neural Plasticity, Learning, and Memory.
- **Deep Learning:** RNN, LSTM, Attention, Transformers, CNN, Optimizers (such as Adam, RMSprop, SGD), Contrastive Learning Tasks.
- **Computational Neuroscience:** Biophysical Neuron Models (LIF, HH), Neural Encoding and Decoding, Synaptic Plasticity (STD,STF,LTD,LTF), Spike Timing Dependent Plasticity (STDP).
- **Neuronal Coding of Sensory Information (Ongoing):**Neuroanatomy of the Sensory Systems, Coding and Representation of Information, Optimal Coding and Efficient Coding Principles, Computational theories of Attention, Decision making and Learning, Probabilistic models of Cognition
- **Statistical Inference (Ongoing):** Estimation (Point and Interval Estimation, MLE, UMVUE, CRLB) and Hypothesis Testing (Null/Alternative hypotheses, Optimal tests, Likelihood ratio test), Properties of Statistics (Sufficiency, Fisher's information).
- **Linear Algebra, Numerical and Complex Analysis**
- **Advanced Calculus**

Technical Skills

Languages: *Proficient* - C/C++, Python | *Intermediate* - Matlab, Bash, Html, SQL, LaTeX
Libraries/Frameworks: PyTorch, Matplotlib, NumPy, Torchvision, scikit-learn, OpenCV, HuggingFace
Software Skills: Git, GitHub, VS Code, Google Colab