Lalanth Shobhith Vadlamudi

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EDUCATION

Indian Institute of Technology, Madras   Chennai, India
Dual Degree - B.Tech in Engineering Design, M.Tech in Data Science, CGPA: 8.97/10   *Aug. 2021 – May 2026*

RESEARCH FOCUS

Language, cognition, and reasoning through distributed and symbolic representations; connectionist and dynamical models of sentence processing; learning dynamics; and interpretable computational systems bridging neural and symbolic levels.

PUBLICATIONS & POSTERS

Sahoo A., Mowlali P., **Vadlamudi S.**. Understanding the Significance of Syntactic Errors in Dyslexic Writing - under review at *Linguistics Vanguard*

Bandyopadhyay A., **Vadlamudi S.**, Chakravarthy V. S., Roy D. A Bi-directional Multimodal Generative Model to Capture Visceral and Cerebral Dynamics - Poster presented at Brain Networks Dynamics Conference (2026)

Vadlamudi S., Mohammed N., Creasy A., Yang S. Hybrid Neural–Mechanistic Modeling for Fast Simulation of Nonlinear Dynamical Systems (applied to Hydrophobic Interaction Chromatography) - in preparation

EXPERIENCE

Closed-Loop Heart–Brain Interaction Modeling - Dual Degree Thesis   Apr 2025 – Present
Guide: Prof. V S. Chakravarthy, Computational Neuroscience Lab, IIT Madras

- Modeling bidirectional brain–heart interaction as a dynamical system using coupled Hopf oscillators (68 cortical regions + 2 cardiac oscillators), grounded in subject-specific structural connectivity.
- Developing a generative Neural ODE framework that jointly predicts ECG and MEG activity from latent neural states, integrating mechanistic oscillators with learnable MLP-based observation models.
- Learning circuit-level dynamics through Hebbian plasticity and sequential inference of latent coupling parameters from multimodal neural data. Looking to extend this paradigm for modeling Vagus nerve stimulations
- Introducing a closed-loop inference mechanism: using ECG reconstruction error to compute corrective feedback via an MLP that adapts cardiac oscillator states during inference.
- Source reconstruction and multimodal preprocessing performed on CAM-CAN MEG–ECG dataset to map sensor-space signals to 68 cortical parcels using sLORETA.

Cognitive Processing of Voice Constructions: An Eye-Tracking Study   Dec 2024 – Present
Guide: Prof. A. Sahoo, Language and Cognition lab, IIT Madras

- Utilized PsychoPy to design a psycholinguistic experiment on the EyeLink Portable Duo system to track gaze patterns, investigating the cognitive load associated with language voice constructions (Active and Passive).
- Employing Generalized Additive Mixed Models (GAMMs) to analyze eye-movement data from 48 participants, aiming to uncover the cognitive patterns of sentence processing and validating the agent-first hypothesis.
- Formalized voice alternations as representational transformations and examined how syntactic role assignment impacts incremental sentence parsing.

Bioprocess R&D Intern   Dec 2024 – Aug 2025
Guide: Dr.Arch Creasy, Pfizer Pvt. Ltd

- Designed and implemented a CNN-based active learning workflow for parameter fitting in the Hydrophobic Interaction chromatography isotherm, reducing fitting time and improving accuracy by 5%.
- Generalized the workflow to support all isotherm models and validated performance against two experimental molecules ready for production.
- Built and deployed an interactive GUI for chromatography simulations using Streamlit (interface), Chromatography Analysis and Design Toolkit (CADET) (backend), and DataIku (deployment), enabling laboratory scientists to run and analyze chromatography experiments efficiently.

Active Knee prosthesis development - CYBATHLON 2024   Dec 2023 – Dec 2024
Guides: Prof. M. Anand, Prof. S. Srinivasan,
TTK Center for Rehabilitation Research and Device Development (R2D2), IIT Madras

- Implemented a closed-loop vibrotactile feedback system using A301 force sensors and coin vibration motors, with Arduino-based real-time control to restore proprioceptive cues for transfemoral amputees during locomotion.
- Evaluated sensory feedback effectiveness through Cybathlon task performance and cognitive load measures
- Explored multimodal feedback design (vibrotactile, visual, auditory) with diverse feedback strategies to enhance sensorimotor perception in lower-limb prosthetics.
- Represented IIT Madras at Cybathlon 2024 in Zurich, achieving an 8th-place global finish as the only Indian team, validating system performance in a competitive, real-world evaluation setting.

Teaching Assistant - Intro to Computational Physics July 2025 – Nov 2025
Prof. Sivakumar Ambikarasan
- Served as the Teaching Assistant for the course Intro to Computational physics taken by 50+ sophomore students

PROJECTS

Neuromatch Academy Jan 2024 – Feb 2024
- Successfully completed the Neuromatch Academy Computational Neuroscience course and project
- Applied Generalized Linear Models (GLMs) and Deep Learning methodologies to establish connections between neural recordings and diverse behavioral activities.
- Built a comprehensive representation of mixed behavioral and cognitive states across the forebrain, both in the presence and absence of visual stimuli using data from the Steinmetz dataset

Predictive Coding in Visual Information Processing - SENAI Lab Feb 2024 - Nov 2024
- Conducted extensive literature review on the predictive coding paradigm for information processing in the brain
- Replicated the predictive coding framework from scratch for the MNIST dataset

Mechanical Engineer - Team Abhiyaan Apr 2022 – Apr 2023
- Designed and developed brake-by-wire and steer-by-wire systems for a commercial golf cart to make it autonomous
- Placed first out of 25+ global universities in the Design Challenge at the Intelligent Ground Vehicle Competition held at Oakland University, Michigan
- Presented Team Abhiyaan to 50+ delegates from the education ministries of the G20 countries

COURSES

Computational Models of Cognition (CS6251)	Computational Neuroscience (BT6270)
Principles of Neuroscience (BT5270)	Introduction to Linguistics (HS3017)
Linguistic Typology (HS5025)	Digital Signal Processing (ED5017)
Reinforcement Learning (CS6700)	Numerical Optimization (MA5895)

COURSE PROJECTS

Language-Based Hierarchical Agent for Solving Reasoning Tasks July 2024 – Nov 2024
Guide: Prof. B.Ravindran, Course: Recent Advances in Reinforcement Learning
- Utilized language representation to encode image based POMDP environment for reasoning and action selection
- Built autoencoder-like model to reconstruct images from text, to extract features for a downstream PPO agent
- Analyzed failure stemming from limited scene context extraction - that was linked to shortcomings in the capacity of language model, possibly reduced model complexity of autoencoder, and the text-based representation itself

Circulomics: A Case-Based Reasoning Framework for Circularity Problems July 2025 – Nov 2025
Guide: Prof. Sutanu Chakraborti, Course: Computational Models of Cognition
- Designed a Case-Based Reasoning framework to detect and resolve circular dependencies in AI and cognitive systems by representing feedback loops as structured cases.
- Created a feature schema and topology-aware similarity retrieval to identify analogous loop structures across domains (e.g., mapping the Barber Paradox to instability in recurrent neural networks).
- Adapted solutions using a guided LLM-based procedure with symbolic validation for reliable cross-domain transfer.

TECHNICAL SKILLS

Programming: Python, MATLAB
Computational Modeling & Representation Learning : PyTorch, SciPy, Scikit-learn, torchdiffeq (Neural ODEs), Active Learning, CNNs, Reinforcement Learning, WandB
Neuroscience & Signal Processing: MNE-Python, sLORETA, MEG/ECG preprocessing, GAMMs, Hopf oscillators
Data & Development Tools: Git, Streamlit, Dataiku, Jupyter