Pranjal Garg
pranjaldun@gmail.com

Research Intern
Max Planck Institute for Biological Intelligence, Planegg, Germany

EDUCATION

- **BSDS**, Bachelor of Science in Data Science
  Indian Institute of Technology (IIT), Madras *2024 - 2027 (expected to graduate)*
- **MBBS**, Bachelor of Medicine, Bachelor of Surgery
  All India Institute of Medical Sciences (AIIMS), Rishikesh *2017 - On indefinite break*

SELECTED RESEARCH EXPERIENCE

- **Research Intern**, Max Planck Institute for Biological Intelligence *October 2024 – October 2025*
  Advisor: Dr. Lisa Fenk, PhD
  Project: Investigating neural circuitry underlying retinal movements and differential responses to environmental contrast changes.
  - Developing novel saccade (rapid retinal/eye movements) detection algorithm.
  - Conducting fly behavioral experiments.
  - Determining the role of saccdes in feature detection of natural objects.
- **Research Intern (remote)**, Southern Illinois Institute *June 2024 - October 2024*
  Advisor: Dr. Duda Kvitsiani, PhD and Dr. Ebru Demir, PhD
  Project: Social interaction-water reward trade-off in the orbitofrontal cortex
  - Conducted data analysis of calcium imaging time-series data using Python
  - Constructed and trained of recurrent neural networks to discover underlying attractor dynamics in the data
  - Trained support vector machines to deduce encoding and memory axes (vectors orthogonal to the hyperplane)
- **Research Intern (remote)**, Albert Einstein College Of Medicine *Aug 2022 - June 2024*
  Advisor: Dr. Luke Sjulson, MD, PhD
  Project: Developing novel linear dimensionality reduction algorithm, generalized contrastive principal component analysis (gcPCA)
  - Accessed and analyzed electrophysiological open datasets from Allen Institute Brain Observatory (AIBO) and trained classifier to determine the accuracy of gcPCA as compared to PCA
  - Explored MNIST, facial and other electrophysiological datasets for the utility of the method.
  - Accessed and analyzed scRNA dataset from Allen Institute and performed analysis such as differential gene expression
  - Designed artificial and biologically relevant behavioral tasks and trained continuous time recurrent neural network (CTRNN). Performed ablation experiments and representational analysis.
- **Research Fellow**, California Institute of Technology, Pasadena, USA *Aug 2021 - Oct 2021*
  Advisor: Dr. Paul Sternberg, PhD
  Project: Dye filling in the head neurons of *Steinernema hermaphroditum* and the neuroanatomy characterization
  - Developed a novel protocol for imaging head neurons in *S. hermaphroditum* using fluorescence microscopy.
  - Conducted statistical analyses to compare the new protocol with existing methods, demonstrating superior suitability.
  - Characterized the head neuroanatomy of *S. hermaphroditum* and established homology with *C. elegans*.
  - Documented findings and authored a manuscript, leading to a first-author peer-reviewed publication.
  - Presented the research at an international symposium, showcasing novel findings in nematode neuroanatomy.

SELECTED ADDITIONAL RESEARCH EXPERIENCE

- **Independent research** *January 2025-Present*
  Project: Emergent self-correction mechanisms for processing faulty prompts
  - Investigating self-repair mechanisms in Attention-only Transformer through mechanistic interpretability.
  - Theoretically defining and measuring repair difference for faulty prompt correction.
  - Exploring layer-wise contribution using residuals and weighted repair differences.
- **Independent research** *June 2023–December 2023*
  Project: Signatures of criticality in the hippocampus during awake and sleep epochs in rodents
  - Conceptualized a novel hypothesis and identified a publicly available dataset suitable for testing criticality during sharp wave ripples.
  - Detected sharp wave ripples and neuronal avalanches using rigorous computational techniques on local field potential data.
  - Conducted novel analyses to evaluate evidence of criticality in awake and sleep states.
  - Delegated computationally expensive tasks to Microsoft Azure's HPC clusters using Python SDK for scalability.

- Documented findings, authored a manuscript, and presented during SfN (Society for Neuroscience) 2024.

- **Independent research** *June 2022–August 2023 (Remote)*
  Project: Modelling Cortical Up-Down State Switching by Astrocytes
  - Assembled and led a team of peers to collaboratively conceptualize a computational modeling project.
  - Mathematically designed a neuron-astrocyte network rate model to simulate cortical up-down state switching.
  - Conducted linear stability and sensitivity analyses to evaluate the model's feasibility and robustness.
  - Documented findings, authored a manuscript, and published it as a preprint.
  - Represented the project as the corresponding author during a presentation at the International Symposium on the Mathematics of Neuroscience.

HONORS AND AWARDS

- **COSYNE Undergraduate Travel Award** *2024 and 2023*
  Selected to receive the travel award to attend the Computational and Systems Neuroscience (COSYNE) conference (not availed due to delay in visa processing).
- **Openscope Program (Allen Institute)** *2023*
  Independent proposal on Successor Representation selected for the second stage of the Openscope program (proposal was subsequently withdrawn due to lack of resources and mentorship).
- **NIH's SPARC FAIR Codeathon – 3rd Prize ($7000)** *2023*
  `https://doi.org/10.5281/zenodo.8223110`
- **Grants received under the leadership of Project Encephalon:**
  - IndiaBioscience Outreach Grant ($1300) *2022*
  - Finalist at Falling Walls Engage *2022*
  - IBRO APRC Grant (€1250) *2020*
- **Summer Undergraduate Research Fellowship ($6,620)** *2021*
  California Institute of Technology (Caltech)
- **Developing Indian Physician Scientist (DIPS) Workshop – Shortlisted** *2021*
  Prestigious program to develop Indian physician-scientists.
- **India International Science Festival (IISF) Travel Grant** *2018*
  Awarded by the Department of Science and Technology, Government of India, to present a poster.
- **Young Scientist Incentive Plan, Kishore Vaigyanik Protsahan Yojana (KVPY)** *2017*
  Awarded by the Department of Science and Technology, Government of India.

SELECTED PUBLICATIONS

- de Oliveira E.F., **Garg P**, Hjerling-Leffler J, Batista-Brito R, Sjulson L. Identifying patterns differing between high-dimensional datasets with generalized contrastive PCA. *PLOS Computational Biology*. 2025. DOI: `10.1371/journal.pcbi.1012747`
- **Garg P**. Mixed signatures for subcritical dynamics in rodent hippocampus during sleep and awake epochs. *bioRxiv*. 2023. DOI: `10.1101/2023.10.30.564597`
- Verma J, **Garg P**. Computational Modeling of Hyperpolarizing Astrocytic Influence on Cortical Up-Down State Transitions. *bioRxiv*. 2023. DOI: `10.1101/2023.10.16.562461`
- Singhal C, Aremu T O, **Garg P**, et al. Awareness of the Malaria Vaccine in India. *Cureus*. 2022 14(9): e29210. DOI:`10.7759/cureus.29210`
- **Garg P**, Tan CH, Sternberg PW*. DiI staining of sensory neurons in the entomopathogenic nematode Steinernema hermaphroditum. *microPublication Biology*. 2022. DOI: `10.17912/micropub.biology.000516`

BOOKS

- Garg, P. and Gupta, S. (2022) "IoT-Based Disease Prediction," in Smart and Secure Internet of Healthcare Things. 1st edn. Florida: *CRC Press.* DOI:10.1201/9781003239895-2

SELECTED CONFERENCE PRESENTATIONS

- **Garg P**, Nema V. Modeling neural dynamics using periodic structured state space model. Neural Information Processing (NeurIPS) workshop (WiML); 2024 [Selected for Presentation].
- **Garg P**, Trisal J, Krishnamurthy A, Chunduri A, Satav D, Muthiah S, Anand H J, Thakur P. The Mind Gala science writing mentorship program: Time-constrained online matched group mentoring approach to writing a popular science book. SfN (Society for Neuroscience) Meeting; 2024 October; USA. [Theme J Abstract]
- **Garg P**. Mixed signatures for subcritical dynamics in rodent hippocampus during sleep and awake epochs. SfN (Society for Neuroscience) Meeting; 2024 October; USA.
- Oliveira E. F. de, **Garg P**, Sjulson, L*. Generalized Contrastive PCA (gcPCA): a generalized framework for finding low-dimensional subspaces that differ between experimental conditions. SfN (Society for Neuroscience) Meeting; 2023

November; USA.

- Verma J, **Garg P**. Computational Modeling of Hyperpolarising Astrocytic Influence on Cortical Up-Down State Transitions. 4th International Symposium on the Mathematics of Neuroscience; 2023 August; Greece. [online mode]
- **Garg P**, Chunduri R, Balusu C. Exploring the relationship between popular culture and perceptions of social standing in STEMM careers: A pilot study using Structural Equation Modeling. Cognitive Science Society Meeting; 2023 July; Australia. [online mode]

SELECTED LEADERSHIP EXPERIENCE

- **Founder and Managing Trustee**, Project Encephalon Foundation *June 2020 – Present*
  Project Encephalon is an international, trainee-led non-profit organization for neuroscience enthusiasts, facilitating seminars, symposia, conferences, mentorship sessions, and more.
  - Organized global neuroscience outreach programs and events for resource-limited settings.
  - Built a diverse team of international volunteers and managed operations spanning multiple time zones.
  - Established collaborations with academic and professional organizations to expand program reach.
- **Student Editor**, International Journal of Medical Students *August 2022 – February 2023*
  - Reviewed and edited scientific manuscripts for publication in a globally recognized journal.
  - Mentored aspiring student researchers in improving their writing and presentation skills.
  - Streamlined the peer-review process to enhance efficiency and uphold publication standards.