ARNA GHOSH

Paradigms of Intelligence, Google Research, Toronto, Canada

Email ◇ GitHub ◇ Linkedin ◇ Scholar ◇ Twitter

Research Scientist at Google Research investigating intelligent systems by combining AI and Neuroscience.

EDUCATION

McGill University & MILA, Montréal *September 2019 - February 2025*
Ph.D. Computer Science (Vanier Scholar) CGPA: 4.0/4.0

McGill University, Montréal *September 2017 - August 2019*
M.Sc. Neuroscience CGPA: 4.0/4.0

Indian Institute of Technology (IIT) Kharagpur *July 2013 - May 2017*
B.Tech. Electrical Engineering, Minor in Computer Science (Institute **Silver medal**) CGPA: 9.26/10.0

RELEVANT INDUSTRY EXPERIENCE

Research Scientist, Paradigms of Intelligence, Google Research *Mar 2025 - Present*

- Working on co-evolving learning algorithms and hardware architectures for efficient AI systems.

Student Researcher, Google Deepmind *July 2024 - Jan 2025*

- Developing a **JAX**-based brain-inspired neural network architecture for energy-efficient AI systems.

Research Scientist Intern, FAIR, Meta Reality Labs *May 2023 - Jul 2023*

- Developed unsupervised metrics of representation quality to evaluate and improve *self-supervised learning* models for time series data, specifically electromyography (EMG) data.

AI Research Scientist Intern, CTRL-labs, Meta Reality Labs *Aug 2022 - Dec 2022*

- Surgical inspection of pretrained networks to investigate learned feature space and *few-shot learning* for rapidly adapting a suitable feature space for identifying new categories.

Scientist in Residence, Innodem Neurosciences *Oct 2020 - Dec 2020*

- Developed a **Tensorflow** module implementing the *Deepdream* algorithm to visualize features extracted by eye gaze-prediction neural networks and to improve interpretability for application in healthcare industry.

PUBLICATIONS

Full Papers:

1. M.Z. Li*, K.K. Agrawal*, **A. Ghosh***, K.K. Teru, A. Santoro, G. Lajoie, B.A. Richards, *Tracing the Representation Geometry of Language Models from Pretraining to Post-training*, 39th Conference on Neural Information Processing Systems (NeurIPS), San Diego, Dec 2025.
2. **A. Ghosh***, K.K. Agrawal*, S. Sodhani, A. Oberman†, B.A. Richards†, *Harnessing small projectors and multiple views for efficient vision pretraining*, 38th Conference on Neural Information Processing Systems (NeurIPS), Vancouver, Dec 2024.
3. R. Chua, **A. Ghosh**, C. Kaplanis, B.A. Richards, D. Precup, *Learning Successor Features the Simple Way*, 38th Conference on Neural Information Processing Systems (NeurIPS), Vancouver, Dec 2024.
4. R. Pogodin*, J. Cornford*, **A. Ghosh**, G. Gidel, G. Lajoie, B.A. Richards, *Synaptic Weight Distributions Depend on the Geometry of Plasticity*, 12th International Conference on Learning Representations (ICLR), Vienna, May 2024 [**spotlight**].

*,† Equal contribution

5. P. Li*, J. Cornford*, **A. Ghosh**, B.A. Richards, *Learning better with Dale's law: a spectral perspective*, 37th Conference on Neural Information Processing Systems (NeurIPS), New Orleans, Dec 2023.

6. Z. Chorghay, V.J. Li, A. Schohl, **A. Ghosh**, E.S. Ruthazer. *The effects of the NMDAR co-agonist D-serine on the structure and function of the optic tectum.* Scientific Reports, Aug 17 2023;13(1):13383.

7. **A. Ghosh**, Y.H. Liu, G. Lajoie, K.P. Körding, B.A. Richards, *How gradient estimator variance and bias impact learning in neural networks*, 11th International Conference on Learning Representations (ICLR), Kigali, Rwanda, May 2023.

8. K.K. Agrawal*, A.K. Mondal*, **A. Ghosh***, B.A. Richards, *α-ReQ: Assessing representation quality by measuring eigenspectrum decay*, 36th Conference on Neural Information Processing Systems (NeurIPS), New Orleans, Dec 2022.

9. Y.H. Liu, **A. Ghosh**, B.A. Richards, E. Shea-Brown, G. Lajoie, *Beyond accuracy: generalization properties of bio-plausible temporal credit assignment rules*, 36th Conference on Neural Information Processing Systems (NeurIPS), New Orleans, Dec 2022.

10. A. Xifra-Porxas*, **A. Ghosh***, G.D. Mitsis, M.H. Boudrias, *Estimating brain age from structural MRI and MEG data: Insights from dimensionality reduction techniques*, NeuroImage 231, 117822, May 2021.

11. **A. Ghosh**, F. Dal Maso, M. Roig, G.D. Mitsis, M.H. Boudrias, *Unfolding the effects of acute cardiovascular exercise on neural correlates of motor learning using Convolutional Neural Networks*, Frontiers in Neuroscience 13 (2019): 1215, November 2019.

12. **A. Ghosh**, S. Singh, D. Sheet, *Simultaneous Localization and Classification of Acute Lymphoblastic Leukemic Cells in Peripheral Blood Smears Using a Deep Convolutional Network with Average Pooling Layer*, IEEE 12th International Conference on Industrial & Information Systems (ICIIS), December 2017.

Key Poster Presentations:

1. M. Gamba, **A. Ghosh**, K.K. Agrawal, B.A. Richards, H. Azizpour, M. Björkman *On the varied faces of model scaling in supervised and self-supervised learning*, SSL theory & practice workshop, NeurIPS, New Orleans, Dec 2023 **[Oral]**.

2. **A. Ghosh**, K.K. Agrawal, Z. Chorghay, A.K. Mondal, B.A. Richards, *Neural Population Geometry across model scale: A tool for cross-species functional comparison of visual brain regions*, 20^{th} Computational and Systems Neuroscience (COSYNE), Montreal, March 2023.

3. J. Cornford, **A. Ghosh**, G. Gidel, B.A. Richards, *Learning in neural networks with brain-inspired geometry*, 20^{th} Computational and Systems Neuroscience (COSYNE), Montreal, March 2023.

4. D. Lin, R. da Silva, **A. Ghosh**, R. Tong, S. Trenholm, B.A. Richards. *Neuronal optimal stimuli synthesized with deep learning reveal functional segregations in the mouse visual cortex.* The Society for Neuroscience, 52^{nd} Annual Meeting, San Diego, CA, November 2022.

5. **A. Ghosh***, K.K. Agrawal*, B.A. Richards. *Characterizing High Dimensional Representation Learning in Over-parameterized Neural Networks.* Workshop on the Theory of Overparameterized Machine Learning, April 2021.

6. **A. Ghosh***, A. Xifra-Porxas*, G.D. Mitsis, M.H. Boudrias. *Combining structural MRI images and MEG recordings for Biological brain age prediction*, Organization of Human Brain Mapping (OHBM), Annual Meeting, June 2019. Link

MAJOR PROJECTS

Representation geometry in the brain and machines *Jan 2021 - Jan 2025*
Doctoral thesis project, Supervisor: Dr. Blake A. Richards

- Characterizing the geometry of learned representations in artificial neural networks trained using self-supervised learning (**SSL**) and connecting these properties to generalization performance.
- Using population geometry to understand and improve learning dynamics in large language models **(LLMs)** and SSL vision models, drawing parallels to representation learning dynamics in the brain.

Biologically-plausible credit assignment for representation learning *Sep 2019 - Jan 2025*
Doctoral thesis project, Supervisor: Dr. Blake A. Richards

- Understanding the impact of imperfect credit assignment on performance of learning systems.
- Developing a biologically-plausible temporal credit assignment and a self-supervised learning algorithm for representation learning from continuous stream of visual experience.

Deep Learning for Neuroimaging data analysis *Sep 2017 - Aug 2019*
Masters thesis project, Supervisors: Dr. Marie-Hélène Boudrias & Dr. Georgios D. Mitsis

- Developed a deep learning-based prediction framework and a network interpretability module in **Torch** to identify exercise-induced task signatures for electroencephalography (EEG) data.
- Designed a ML-based **brain age prediction** system from magnetic resonance imaging (MRI) and magnetoencephalography (MEG) recordings in **PyTorch**.

Brexting: Brain Texting *Dec 2017 - Aug 2018*
*Intel Innovate FPGA Grand Finalists (**Silver** & **Iron** awards in regional & grand finals resp.)*

- Built a deep learning-powered brain-computer interface on an Intel FPGA board to enable real-time typing from imagined motor movements. Code available on github repo.

Deep Learning for mitotic figure detection *Jul 2016 - May 2017*
Bachelor's Thesis Project, Supervisor: Dr. Debdoot Sheet **(Systems Society award)**

- Built a deep learning framework to localize and identify mitotic nuclei from breast histopathological images on **Torch** and extended the idea to leukemia detection.

TEACHING AND VOLUNTEERING EXPERIENCE

Student Lab Representative Aug 2020 - Oct 2021
Montreal Institute for Learning Algorithms (MILA)

Content Creator, Un/Self-supervised Learning Methods Aug 2021
Dr. Blake Richards & Dr. Tim Lillicrap, Neuromatch Academy: Deep Learning

Reviewer
IEEE Signal Processing Magazine; IEEE Journal of Biomedical and Health Informatics; Transactions on Medical Imaging; NeurIPS 2022 (Top reviewers); ICLR 2023; NeurIPS 2023, 2024, 2025;

Teaching Assistant, McGill University Jan 2019-Apr 2022
Artificial Intelligence; Applied Machine Learning; Computational Perception; Brain-inspired AI

Co-organizer
Computational and Systems Neuroscience (COSYNE) workshop on representation geometry *Mar 2024*
Computational Cognitive Neuroscience (CCN) GAC workshop on Neural Representations *Aug 2023*
Computational Cognitive Neuroscience (CCN) GAC workshop on Recurrent Networks *Oct 2020*

SCHOLARSHIPS AND AWARDS

- **Vanier** Canada Graduate Scholarship, September 2021 ($50,000/year, 3 years)
- Healthy Brains for Healthy Lives **(HBHL)** Doctoral fellowship, September 2020 ($15,000)
- 2^{nd} prize in McGill **TechIdea** Pitch Competition, January 2019 ($250)
- Healthy Brains for Healthy Lives **(HBHL)** Masters fellowship, September 2018 ($10,000)
- McGill **Faculty of Medicine** Internal fellowship, September 2018 ($10,000)
- Quebec Bio-Imaging Network **(QBIN)** Foreign Students Scholarship, December 2017 ($7,000)
- **MITACS** Graduate Fellowship award 2017 for pursuing graduate studies in Canada ($15,000)
- **Honda** Young Engineer and Scientist award, January 2016 ($3,000)