ARNA GHOSH

Computer Science, McGill University & MILA, Montréal, Canada

Email ⋄ GitHub ⋄ Linkedin ⋄ Scholar ⋄ Twitter

Third year PhD student investigating intelligent systems by combining Artificial Intelligence and Neuroscience.

EDUCATION

McGill University & MILA, Montréal *September 2019 - Present*
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, Kharagpur *July 2013 - May 2017*
B.Tech. Electrical Engineering, Minor in Computer Science (Institute **Silver medal**) CGPA: 9.26/10.0

RELEVANT WORK EXPERIENCE

Scientist in Residence, Innodem Neurosciences *June 2020 - Feb 2021*

- 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

Developer, CBrain, McGill Centre for Integrative Neuroscience *July 2019 - August 2019*

- Designed a well-documented **Python** wrapper library around the CBrain web platform to run neuroimaging tasks on a high-performance cluster from a UNIX terminal

MITACS Globalink Research intern, McGill University *May 2016 - July 2016*
Mechanism underlying sensorimotor integration during motor learning
Supervisor: Dr. Marie-Hélène Boudrias

- Designed the software and hardware interface to leverage EEG, EMG and fMRI setups for studying motor learning under different external stimulation conditions using **Python**, **C++** and **OpenCV** [Media]

Summer intern, University of British Columbia Okanagan *May 2015 - July 2015*
Slide-Scanning Microscopy on a Smart Phone by High-Frame-Rate Video Capture
Supervisor: Dr. Kenneth Chau

- Developed the image processing module for fast deblurring of microscopic images extracted from video and developed an integrated hardware-software interface using an Arduino

MAJOR PROJECTS

Biologically-plausible credit assignment for representation learning *Sep 2019 - Present*
Doctoral thesis project, Supervisor: Dr. Blake 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-EEG signatures.
- Designed a ML-based **brain age prediction** system from MRI and 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 DL-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 DL framework to localize and identify mitotic nuclei from *breast histopathological* images on **Torch** and extended the idea to *leukemia detection.*

IndicView *Oct 2014 - Dec 2015*

Google-IIT Pilot Project, Supervisor: Dr. Pawan Goyal

- Implemented a binarization algorithm to segregate text from background and extract words from a document written in an Indian language. Accepted to be integrated into **Google Translate**.

PUBLICATIONS

Full Papers:

1. 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.
2. **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.
3. E. Renda, S.A. Karmali, I. Yordanova, S. Schwartz, Y. Mahdid, **A. Ghosh**, S. Blain-Moraes, M.H. Boudrias, *Effect of Transcranial Direct Current Stimulation on an Individual's Ability to Learn to Control a Brain-Computer Interface*, McGill Journal of Medicine, October 2019.
4. **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.

Preprints:

1. Z. Chorghay, V.J. Li, **A. Ghosh**, A. Schohl, E.S. Ruthazer. *The effects of the NMDAR co-agonist D-serine on the structure and function of the optic tectum.* BioRxiv, August 2021.
2. L.Y. Prince, E. Boven, R.H. Eyono, **A. Ghosh**, J. Pemberton, F. Scherr, C. Clopath, R.P. Costa, W. Maass, B.A. Richards, C. Savin. *CCN GAC Workshop: Issues with learning in biological recurrent neural networks.* ArXiv, May 2021.
3. V. Mohanty, S. Agrawal, S. Datta, **A. Ghosh**, V.D. Sharma, D. Chakravarty, *DeepVO: A Deep Learning approach for Monocular Visual Odometry*, ArXiv, November 2016.

Key Poster Presentations:

1. **A. Ghosh***, K.K. Agrawal*, B.A. Richards. *Characterizing High Dimensional Representation Learning in Overparameterized Neural Networks.* Workshop on the Theory of Overparameterized Machine Learning, April 2021.
2. **A. Ghosh**, J. Cornford, B.A. Richards. *BP2T2: Moving towards Biologically-plausible BackPropagation Through Time.* 34th Annual Conference on Neural Information Processing Systems (NeurIPS) workshop: Beyond BackPropagation: Novel Ideas for Training Neural Architectures, December 2020.

*Equal contribution

3. M. Samiei*, **A. Ghosh***, B.A. Richards. *Mimicking mammalian navigation in watermaze using brain-inspired representations.* 34th Annual Conference on Neural Information Processing Systems (NeurIPS) workshop: Biological and Artificial Reinforcement Learning, December 2020.

4. **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

5. **A. Ghosh***, A. Xifra-Porxas*, G.D. Mitsis, M.H. Boudrias. *Biological brain age prediction using structural MRI: Insights from dimensionality reduction techniques*, International Society for Magnetic Resonance in Medicine (ISMRM), Annual Meeting, May 2019. Link

6. **A. Ghosh**, B. Bhattacharya, S.B.R. Chowdhury, *AdGAP: Advanced Global Average Pooling*, AAAI-18 Student Abstract and Poster Program (SA-18), February 2018.

7. **A. Ghosh**, B. Bhattacharya, S.B.R. Chowdhury, *Handwriting Profiling using Generative Adversarial Networks*, AAAI-17 Student Abstract and Poster Program (SA-17), February 2017. Link

8. **A. Ghosh**, B. Bhattacharya, S.B.R. Chowdhury, *SAD-GAN: Synthetic Autonomous Driving using Generative Adversarial Networks*, 30th Annual Conference on Neural Information Processing Systems (NeurIPS) 2016: Deep Learning for Action and Interaction, December 2016. Link

TEACHING AND VOLUNTEERING EXPERIENCE

Lab Representative, Member of student body 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; ML Reproducibility Challenge 2020; ICLR Reproducibility Challenge 2019

Teaching Assistant, McGill University Jan 2019-Apr 2021
Artificial Intelligence; Applied Machine Learning; Computational Perception

Co-organizer
Computational Cognitive Neuroscience (CCN) GAC workshops Recurrent Networks *Oct 2020*
Neural Information Processing Systems Montreal meetup *Dec 2019*

Tutor, Deep Learning for Visual Computing Summer School 2-8 Jul 2017
Dr. Debdoot Sheet, IIT Kharagpur

SCHOLARSHIPS AND AWARDS

- **Vanier** Canada Graduate Scholarship, September 2021 ($50,000/year)
- 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)
- **MITACS** Globalink Research Internship award 2016 for summer internship 2016 ($7,500)
- **Honda** Young Engineer and Scientist award, January 2016 ($3,000)