

Mehdi Azabou

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Bio

I am a third-year Machine Learning Ph.D. student advised by Dr. Eva L. Dyer. My main areas of interest are Deep Learning and Computational Neuroscience. I am actively working on developing methods for self-supervised representation learning for different modalities, and researching new models to learn from neural activity and behavior.

Education

PhD in Machine Learning, Georgia Institute of Technology Aug 2020 – Expected 2024
Advisor: Prof. Eva L. Dyer, GPA: 4.0.

Masters in Computer Science, Georgia Institute of Technology Aug 2018 – Dec 2020
Specialization: Machine Learning, GPA: 4.0.

Masters in Engineering, CentraleSupélec Sep 2016 – May 2019
CentraleSupélec is a top French graduate engineering school of Paris-Saclay University.
3rd year Specialization: Interactive Systems and Robotics.
Project: Prediction of Chemical Reaction Outcomes using Graph Neural Networks.

Classes Préparatoires (CPGE), IPEST Sep 2014 – May 2016
Intensive training in mathematics, physics and chemistry to prepare for competitive entrance exams.

Research Experience

Georgia Institute of Technology *Atlanta, GA, United States*
Research Assistant, NerDS Lab Aug 2020 – Present
Working with Dr. Eva L. Dyer on a wide range of problems in machine learning and neuroscience.

- Developed a self-supervised learning method based on positive neighbor mining. Showed competitive results on image and neural datasets.
- Revealed the existence of computational fingerprints of transcriptomic cell types, during neuronal activity across diverse contexts. Developed an attention-based model.

Research Assistant, Smart Cities Jan 2020 – Jul 2020
Worked on prediction systems used by Georgia DOT for the inventorying and assessment of road assets including traffic signs and pavements. Developed and deployed real-time object detection pipelines for edge devices, and improved the evaluation procedure used to track performance.

Industry Experience

Parrot Drones *Paris, France*
Computer Vision Intern May 2019 – Nov 2019
Worked on semantic segmentation tasks for drone aerial imagery. Benchmarked multiple state-of-the-art architectures. Produced software to systematically generate and validate data from simulated off-the-shelf environments, and evaluated domain adaptation methods to address the sim2real gap.

Cleed *Paris, France*
Deep Learning Intern Jun 2018 – Sep 2018
Led efforts to develop a virtual clothing try-on tool. Designed and implemented a generative model that performs garment swapping. Improved model performance by introducing more modalities like dense human pose estimate and clothing segmentation map. Collected data by scraping retail websites.

Publications

(Google Scholar; DBLP)

⁺contributed equally as co-first authors, ^{*}co-senior authors

Preprints

- Schneider, A.⁺, **Azabou, M.**⁺, McDougall-Vigier, L., Parks, D.B., Ensley, S., Bhaskaran-Nair, K., Nowakowski, T.J., Dyer, E.L.^{*}, and Hengen, K.B.^{*} *Transcriptomic cell type structures in vivo neuronal activity across multiple time scales*. bioRxiv 2022.07.10.499487, 2022. Under review at *Neuron*.
- Quesada, J., Sathidevi, L., Liu, R., Ahad, N., Jackson, J. M., **Azabou, M.**, Xiao, J., Liding, C., Urzay, C., Gray-Roncal, W., Johnson, E. C. and Dyer, E. L. *MTNeuro: A Benchmark for Evaluating Representations of Brain Structure Across Multiple Levels of Abstraction*. Under review at NeurIPS 2022 Datasets and Benchmarks Track.

Conference and Workshop Papers

- Liu, R., **Azabou, M.**, Dabagia, M., Xiao, J., and Dyer, E. L. *Seeing the forest and the tree: Building representations of both individual and collective dynamics with transformers*. Advances in Neural Information Processing Systems **NeurIPS 2022**
- **Azabou, M.**, Mendelson, M., Sorokin, M., Thakoor, S., Ahad, N., Urzay, C., and Dyer, E. L. *Learning Behavior Representations Through Multi-Timescale Bootstrapping*. Workshop on Multi-Agent Behavior, **CVPR 2022**, selected for Oral.
- Thakoor, S., Tallec, C., Azar, M.G., **Azabou, M.**, Dyer, E.L., Munos, R., Veličković, P., and Valko, M. *Large-Scale Representation Learning on Graphs via Bootstrapping*. In Proceedings of the International Conference on Learning Representations, **ICLR 2022**.
- Liu, R., **Azabou, M.**, Dabagia, M., Lin, C.H., Gheshlaghi Azar, M., Hengen, K., Valko, M., and Dyer, E. L. *Drop, swap, and generate: A self-supervised approach for generating neural activity*. Advances in Neural Information Processing Systems **NeurIPS 2021**, selected for Oral (1% submissions).
- **Azabou, M.**, Azar, M.G., Liu, R., Lin, C.H., Johnson, E.C., Bhaskaran-Nair, K., Dabagia, M., Avila-Pires, B., Kitchell, L., Hengen, K.B. Gray-Roncal, W., Valko, M., and Dyer, E. L. *Mine your own view: Self-supervised learning through across-sample prediction*. Workshop on Self-supervised Learning: Theory and Practice, **NeurIPS 2021**, selected for Oral.
- **Azabou, M.**⁺, Dabagia, M.⁺, Liu, R.⁺, Lin, C. H., Hengen, K. B., and Dyer, E. L. *Using self-supervision and augmentations to build insights into neural coding*. Workshop on Self-supervised Learning: Theory and Practice, **NeurIPS 2021**.
- Lin, C. H., **Azabou, M.**, and Dyer, E. L. *Making transport more robust and interpretable by moving data through a small number of anchor points*. International Conference on Machine Learning, **ICML 2021**.

Abstracts

- Urzay, C.⁺, Ahad, N.⁺, **Azabou, M.**, Schneider, A., Atmakuri, G., Hengen, K.B., and Dyer, E. L. *Detecting change points in neural population activity with contrastive metric learning*. To appear at the Cognitive and Computational Neuroscience (CCN) Annual Meeting, San Francisco, CA, August, 2022. (+ co-first authors)

Awards

- Travel award to attend CVPR 2022.
- First place, GT Convergence Innovation Competition, Climate Solutions category, Fall 2018.
- French-Tunisian merit-based Scholarship for Grandes Écoles, 2016-2019 – awarded to 40 students per year.
- Tunisian Excellence Scholarship, 2014-2016 – highest undergraduate scholarship nationally.

Teaching

- Co-Instructor at the Caltech/Chen Institute’s Data Science and AI for Neuroscience Summer School, 2022. Developed and led the representation learning hands-on session.
 - Content Developer for BMED 6517 Machine Learning in Biosciences at Georgia Tech, 2021.
 - Developed and led a Python bootcamp session for DL@MBL: Deep Learning for Microscopy Image Analysis course at the Marine Biological Laboratory, MBL, 2021.
 - Teaching Assistant for CS 4261 Mobile applications and Services, Spring 2019. Guided students through the different stages of app creation: ideation, market research, and front-end and back-end development.
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Mentorship

- Michael Mendelson, Undergrad in BME 2021 – 2022
Project: Using deep learning to decode signatures of exploration and exploitation in human decision making, Received PURA Award for Undergraduate Research at Georgia Tech.
 - Carolina Urzay, Undergrad in BME 2021 – 2022
Project: Detecting change points in neural population activity with contrastive metric learning.
 - Zijing Wu, Undergrad in CS/Math 2020 – 2021
Project: Revealing aging dynamics in *C. elegans* by modeling behavior dynamics throughout lifespan.
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Talks

- “Mine your own view: Self-supervised learning and evaluation for neural data”, Summer School on Data Science, AI, and Neuroscience, **California Institute of Technology**, Chen Institute for Neuroscience, Pasadena, CA, July 14, 2022.
 - “Learning Behavior Representations Through Multi-Timescale Bootstrapping”, Workshop on Multi-Agent Behavior, New Orleans, LA, **CVPR 2022**.
 - “Mine your own view: Self-supervised learning through across-sample prediction”, Workshop on Self-supervised Learning: Theory and Practice, Virtual, **NeurIPS 2021**.
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Reviewing

- Reviewer for *Neural Information Processing Systems (NeurIPS)* 2022.
 - Reviewer for *Cell Patterns*, 2022.
 - Reviewer for *Neural Information Processing Systems (NeurIPS)* 2021.
 - Sub-reviewer for *Neuron*, 2021.
 - Reviewer for *International Conference on Artificial Intelligence and Statistics (AISTATS)* 2021.
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Skills

★★Expert, ★Advanced

- **Programming Languages** Python★★, Java, C++, Matlab, Mathematica.
 - **ML Frameworks** PyTorch★★, PyG★★, TensorFlow★, Bokeh★, Flask★, scikit-learn★, OpenCV.
 - **Misc.** Docker★, gcloud, aws, PostgreSQL, Android, ROS, Adobe Creative Cloud.
 - **Languages** Fluent English, French and Arabic. Intermediate Spanish. Beginner Mandarin.
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