

# 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.

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## Education

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

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

**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.

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## 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.

**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

IBM Research *New York, United States*  
**AI Research Scientist Intern** May 2023 – Aug 2023  
Working on representation learning models for time-series data.

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.

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## Publications

(Google Scholar; DBLP)

<sup>+</sup>contributed equally as co-first authors, <sup>\*</sup>co-senior authors

### Journal Papers

- Schneider, A.<sup>+</sup>, **Azabou, M.**<sup>+</sup>, McDougall-Vigier, L., Parks, D.B., Ensley, S., Bhaskaran-Nair, K., Nowakowski, T.J., Dyer, E.L.<sup>\*</sup>, and Hengen, K.B.<sup>\*</sup> *Transcriptomic cell type structures in vivo neuronal activity across multiple time scales*. **Cell Reports**, Volume 42, Issue 4, April 2023.

### Conference and Workshop Papers

- **Azabou, M.**, Ganesh, V., Thakoor, S., Lin, C. H., Sathidevi, L., Liu, R., Valko, M., Veličković, P. and Dyer, E. L. *Half-Hop: A graph upsampling approach for slowing down message passing* International Conference on Machine Learning, **ICML 2023**.
- 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**
- 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*. In Neural Information Processing Systems **NeurIPS 2022** Datasets and Benchmarks Track.
- **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.**<sup>+</sup>, Dabagia, M.<sup>+</sup>, Liu, R.<sup>+</sup>, 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**.

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## 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.

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## 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

- Vinam Arora, Master’s in ECE, 2023  
Project: A Scalable Framework for Neural Population Decoding.
  - Venkataramana Ganesh, Masters in CS 2022 – 2023  
Project: Designing data augmentations for graph representation learning.
  - Michael Mendelson, Undergrad in BME 2021 – 2023  
Project: Using deep learning to decode signatures of exploration and exploitation in human decision making, Received PURA Award for Undergraduate Research at Georgia Tech.
  - Santosh Nachimuthu, Undergrad in BME, 2023  
Project: A Scalable Framework for Neural Population Decoding.
  - 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)* 2021, 2022.
- Reviewer for *International Conference on Machine Learning (ICML)* 2023.
- Reviewer for *Computer Vision and Pattern Recognition (CVPR)* 2023.
- Reviewer for *Cell Patterns*, 2022.
- Reviewer for *Learning on Graphs Conference (LOG)* 2022.
- 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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