

Matthew Retchin



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RESEARCH EXPERIENCE

Harvard John A. Paulson School of Engineering and Applied Sciences

PhD Student in Prof. Amin's Lab

- Designing novel neural network architectures with neuro-symbolic inductive biases inspired by computational cognitive science, theoretical neuroscience, and programming language theory.
- Intended areas of application include automated theorem proving, natural language processing, computer vision, and reinforcement learning.

Columbia Artificial Intelligence and Robotics Lab

Master's Thesis: Koopman Constrained Policy Optimization

- Accepted for publication at [ICML 2023 Workshop](#) in Honolulu, Hawaii.
- Developed a novel neural network architecture in PyTorch for box-constrained model predictive control using Koopman operator theory.
- This architecture can swap constraints at test time without any retraining necessary with better generalization than baselines.
- Researched the use of this architecture with classic control tasks where system dynamics are completely unknown to the controller.

Kriegeskorte Visual Inference Lab

Visual Concept Learning in Artificial Neural Networks

- Created Flying Objects, an interactive psychophysics video game framework that tests object permanence / working memory. Humans can interact using mouse and keyboard, neural net via API.
- Published in the [Conference on Cognitive Computational Neuroscience](#).
- Currently a foundation for a major research direction in the Kriegeskorte lab.
- Reviewed and presented literature on neural network architectures with object oriented inductive biases.

Philips Research North America

Natural Language Processing & Computer Vision

- Worked on neural image captioning algorithm for radiology using PyTorch.
- Built pipeline to extract text and image features via sentence parsing, word embedding, and image augmentation with NLTK, Gensim, NumPy/SciPy.

MIT Department of Brain and Cognitive Sciences

Speech Recognition

- Implemented algorithms for statistical analysis, monkey speech recognition, and an ETL pipeline using Keras, SciPy, and the HDF5 serialization format.

HONORS & AWARDS

Dean's List (Spring 2017, Spring 2019, Fall 2019, Fall 2020)

Columbia Engineering Ignition Grant for COVID-19 Tracing App (2020)

- Ignition Grants are financial grants to assist Columbia University students in launching new businesses, both social and not-for-profit ventures.

EDUCATION

Harvard University

2024 – PRESENT Doctor of Philosophy
Computer Science
CUM. GPA: 0.00/0.00

Columbia University

2021 – 2023 Master of Science
Computer Science
CUM. GPA: 3.80/4.00

2016 – 2020 Bachelor of Arts
Computer Science
CUM. GPA: 3.66/4.00

SKILLS

Programming Languages

Python, JavaScript, Java, Bash/Shell, PostgreSQL, HTML, CSS, C#, \LaTeX , C, C++, Haskell

Libraries & Frameworks

JAX, PyTorch, Equinox, NumPy, SciPy, Matplotlib, Keras, Scikit-Learn, Pandas, Node.js, React

Software

Linux, Vim, git, tmux, Unity3D, Blender

RELEVANT COURSEWORK

Master's Thesis

2023 doi:10.7916/5xtw-x577

Graduate

Computer Vision
Robot Learning
Analysis of Algorithms
Parallel Functional Programming

Undergraduate

Computational Aspects of Robotics
Computer Science Theory
Natural Language Processing
Artificial Intelligence
Fundamentals of Computer Systems

INTERESTS

Piano, Guitar, Creative Writing, Cycling, Squash, Kayaking, Go, Chess

Hult Prize Regional Finalist (2017)

- Chosen as one of 300 Regional Finalists of over 50,000 team applicants (Undergraduates, MBAs, and Graduates) from around the world.
- Created a social enterprise to provide opportunities to refugee populations, competing for \$1 million in seed funding.

Best of Category, Computational Biology at International Science and Engineering Fair (ISEF) (2015)

- Placed first in inaugural Computational Biology category.
- Overall top 20 of over 1300 projects at the largest international science competition.
- Trained miRNA-mRNA interaction model with Keras and created search engine.