

Pranav Rajbhandari

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Education

Carnegie Mellon University
Bachelor of Science, Double Major
Artificial Intelligence;
Mathematical Sciences (Discrete Mathematics and Logic);
GPA: 4.0/4.0; University Honors

Pittsburgh, PA

Relevant Coursework	
Artificial Intelligence	Mathematics
<ul style="list-style-type: none">• AI: Representation & Problem Solving• Deep Reinforcement Learning & Control• Advanced Deep Learning• Natural Language Processing	<ul style="list-style-type: none">• Convex Optimization• Art & Machine Learning• Autonomous Agents• Search Engines• Algebraic Topology• General Topology• Graph Theory• Game Theory• Dynamics of Polish Groups• Probabilistic Combinatorics• Extremal Combinatorics• Modern Regression

Research Projects

Understanding visual attention beehind bee-inspired UAV navigation
University of New South Wales - PI: Sridhar Ravi
02/2025 - Present

Canberra, Australia

- Used the attention patterns of trained Reinforcement Learning (RL) agents to infer how a real bee makes movement decisions
- Built a goal-conditioned RL environment in OpenAI Gym to train a UAV to imitate bee behaviors using bee-like input sensors
- Used SHAP values, a tool for explaining model output, to measure visual regions that trained RL agents pay attention to

AlephZero: Extending AlphaZero to Infinite Boards
Independent Research - PI: Pranav Rajbhandari
04/2024 - Present

Pittsburgh, PA

- Defined and analyzed \aleph_0 **board games**, a class of games with potentially unbounded action spaces. Interesting examples include ‘Jenga’ and ‘5D Chess with Multiverse Time Travel’, as well as classic games like ‘Chess’ and ‘Tic-Tac-Toe’
- Developed AlephZero, an extension of AlphaZero able to learn optimal policies in \aleph_0 board games
- Utilized transformer architectures to define policy networks and value networks able to take multi-dimensional sequential input
- Compared approach to standard algorithms such as AlphaZero, Deep Q-Learning, and Monte Carlo Tree Search

Fine Tuning Swimming Locomotion Learned from Mosquito Larvae
University of New South Wales; U.S. Naval Research Laboratory - PI: Sridhar Ravi; Donald Sofge
01/2024 - Present

Canberra, Australia

- Optimized swimming locomotion copied from mosquito larvae for use on a robotic platform
- Utilized Reinforcement Learning to guide a local search algorithm optimizing swimming locomotion
- Designed an OpenAI Gym environment utilizing a Computational Fluid Dynamics (CFD) model for training
- Sped up the training process by using a pre-trained deep neural network to accurately predict forces on a robotic swimmer
- Compared performance of various architectures, including Deep Neural Networks, Recurrent Neural Networks, and LSTMs

Transformer guided coevolution: Team selection in multiagent adversarial games
U.S. Naval Research Laboratory - PI: Donald Sofge; Prithviraj Dasgupta
07/2024 - 10/2024

Washington, D.C.

- Developed BERTeam, an algorithm to learn diverse and cooperative team selection for multiagent adversarial team games
- Evaluated algorithm on Pyquaticus, a simulation of robotic Marine Capture-The-Flag
- Used Masked Language Modeling to teach optimal team composition to BERTeam’s transformer architecture
- Cotrained BERTeam with Coevolutionary Deep Reinforcement Learning to select teams from a diverse population of agents
- Compared result of training with established algorithms in literature
- Developed and maintained unstable_baselines3, a Python package extending stable_baselines3 to multiagent environments

Geodesic complexity? It’s actually quite simplex
Department of Mathematical Sciences, Carnegie Mellon University - PI: Florian Frick
08/2023 - 05/2024

Pittsburgh, PA

- Explored geodesic complexity, a measure of difficulty for creating an efficient continuous motion plan on a metric space
- Designed a technique utilizing local properties of a space to lower bound its geodesic complexity
- Created and proved correctness of an algorithm calculating cut loci on surfaces of polyhedra, a property related to their geodesic complexity
- Applied these techniques to produce a novel result for the geodesic complexity of the octahedron
- Proved existing geodesic complexity bounds in a new way, displaying the utility of our general method

Utilizing Sim-to-Real Methods for Training a Robot Arm

Pittsburgh, PA

Reliable Autonomous Systems Laboratory, Carnegie Mellon University - PI: Reid Simmons

01/2023 - 05/2024

- Led a team of four to design and maintain an OpenAI Gym environment for a Kinova Jaco Gen3 6DOF robot arm
- Simulated a model of the robot arm compatible with the control scheme of the physical arm using the Gazebo simulator
- Utilized ROS to handle communication between the robot arm and Python scripts
- Trained a 'real life filter' with the CycleGAN algorithm to make photo-realistic simulation images used for training
- Implemented a training pipeline for a robotic manipulation task, trained in simulation and refined on the real arm

Learning NEAT Emergent Behavior in Robot Swarms

Washington, D.C.

U.S. Naval Research Laboratory - PI: Donald Sofge

05/2023 - 08/2023

- Developed an algorithm for training local policies to produce emergent behaviors in a robot swarm
- Designed a training pipeline applying the NeuroEvolution of Augmenting Topologies (NEAT) algorithm to robot swarm control
- Tested the algorithm's performance on a variety of tasks and simulated robotic swarms using the CoppeliaSim simulator
- Utilized ROS to handle communication between Python scripts and robotic swarms (both real and simulated)

UAV Routing for Enhancing the Performance of a Classifier-in-the-loop

Washington, D.C.

U.S. Naval Research Laboratory - PI: Swaroop Darbha

05/2023 - 08/2023

- Collaborated on an interdisciplinary research project optimizing the information gained from targets by robot swarms
- Designed a heuristic algorithm for planning robot paths inspired by approximate solutions to the Traveling Salesman Problem
- Utilized Mathematica software, as well as methods from 'Convex Optimization' to optimize solutions for large test cases
- Tested our algorithm on both generated and real-life problem instances using Julia and the Gurobi optimizer

Comparing Transfer Learning Methods for Continuous Reinforcement Learning

Washington, D.C.

U.S. Naval Research Laboratory - PI: Laura Hiatt

05/2022 - 08/2022

- Planned and executed a research project evaluating various transfer learning methods on robot arm manipulation tasks
- Designed an OpenAI Gym environment for a robotic manipulation task using the MuJoCo simulator
- Compared the performance of known transfer learning methods in transferring knowledge between Deep Neural Networks
- Utilized ROS to handle communication between the robot arm and Python scripts

Creating a Strategic Agent to Play Jenga

Pittsburgh, PA

Reliable Autonomous Systems Laboratory, Carnegie Mellon University - PI: Reid Simmons

02/2021 - 05/2022

- Planned and executed a research project evaluating the performance of various adversarial AI algorithms playing Jenga
- Implemented algorithms such as Monte Carlo Tree Search, Deep Q-Networks, and Inverse Reinforcement Learning
- Created a statistical model to estimate the stability of a Jenga tower for use in Model Based Reinforcement Learning
- Trained the model through repeatedly sampling stabilities of towers with the PyBullet physics engine

Publications

- [1] **Pranav Rajbhandari**, Prithviraj Dasgupta, and Donald Sofge. Transformer Guided Coevolution: Improved Team Formation in Multiagent Adversarial Games. In *Proc. of the 24th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2025)*, Detroit, Michigan, USA, May 19 – 23, 2025. IFAAMAS, 2025.
- [2] **Pranav Rajbhandari** and Donald Sofge. Learning NEAT Emergent Behaviors in Robot Swarms. In *2024 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, pages 414–419, 2024.
- [3] **Pranav Rajbhandari**, Karthick Dhileep, Sridhar Ravi, and Donald Sofge. Fine Tuning Swimming Locomotion Learned from Mosquito Larvae. In *2024 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, pages 2082–2085, 2024.
- [4] Deepak Prakash Kumar, **Pranav Rajbhandari**, Loy McGuire, Swaroop Darbha, and Donald Sofge. UAV Routing for Enhancing the Performance of a Classifier-in-the-loop. *Journal of Intelligent & Robotic Systems*, 110(134), 2024.
- [5] **Pranav Rajbhandari** and Florian Frick. Geodesic complexity? It's actually quite simplex. 2025. (In preparation).
- [6] **Pranav Rajbhandari**. AlephZero: Extending AlphaZero to Infinite Boards. 2025. (In preparation).

Presentations

- [1] **Pranav Rajbhandari** and Donald Sofge. Learning Emergent Behavior in Robot Swarms with NEAT. Naval Applications of Machine Learning, March 2024.
- [2] **Pranav Rajbhandari**, Sophia Zalewski, and Reid Simmons. Sim-to-real Transfer Reinforcement Learning. Carnegie Mellon University Meeting of the Minds, May 2023.
- [3] **Pranav Rajbhandari** and Reid Simmons. Creating Agents to Learn Jenga. Carnegie Mellon University Meeting of the Minds, May 2022. <https://symposium.foragerone.com/meeting-of-the-minds-2022/presentations/45991>.

Experience

Contract Researcher

Mountain View, CA

National Aeronautics and Space Administration - Ames Research Center

01/2023 - 05/2023

- Created an AI system to automate calling airport TMI events, especially Ground Stops and Ground Delay Programs
- Explored Imitation Reinforcement Learning methods to compete against the baseline of training a classifier model
- Processed historical data and created models to approximate decision processes using Python and R

Teaching Assistant

Pittsburgh, PA

Carnegie Mellon University

08/2021 - 12/2022

- Teaching assistant for 'AI: Representation and Problem Solving' (3 semesters), 'Concepts of Mathematics' (1 semester), and 'Probability Theory for Computer Scientists' (1 semester)
- Collaborated in a team of up to 10 Teaching Assistants to manage classes of up to 100 students
- Planned and led class-wide review sessions, as well as recitations of about 20 students
- Held office hours to help students understand course material in a one-on-one setting
- Created, tested, and graded programming assignments and written homework

Research Assistant

Pittsburgh, PA

Carnegie Mellon University

05/2021 - 08/2021

- Collaborated with a team of three researchers to develop and maintain an R package for Natural Language Processing
- Utilized Rust's BERT Natural Language Processing to tokenize and classify strings in R

Programmer

Atlanta, GA

Centers for Disease Control and Prevention - Chronic Viral Diseases Branch Immunology Lab

12/2020 - 01/2021

- Designed a Constraint Satisfaction Problem instance to automate generating laboratory experiment setup procedures
- Utilized Python and R to automate post-experiment data processing
- Refined and deployed these programs across the laboratory after prototyping and incorporating feedback from lab members

Awards and Honors

05/2024 Dean's List, High Honors (8 semesters)

Carnegie Mellon University

05/2024 Senior Leadership Recognition Award

Carnegie Mellon University

05/2024 Dr. William Brown Academic Achievement Award

Carnegie Mellon University

05/2024 Tartan Leaders of Tomorrow

Carnegie Mellon University

03/2023 Winner of AI/ML Innovation Challenge

Naval Surface Warfare Center

- Was awarded \$50,000 cash prize at three-day competition hosted by the US Navy

Dahlgren Division

- Designed algorithm to protect ships from enemy missiles

Extracurricular Activities

Carnegie Mellon University Super Informal Topology Discussion Group

Pittsburgh, PA

Presenter, Member

08/2023 - 05/2024

Carnegie Mellon University Track & Field

Pittsburgh, PA

Sprint Team Captain

08/2020 - 05/2024

Carnegie Mellon University PRISM Club

Pittsburgh, PA

Volunteer, Member

08/2020 - 05/2024

Technical Skills

Languages

Python; Julia; Mathematica; R; Java; C++; Octave; SML; Golang; Matlab;

Software & Tools

Pytorch; TensorFlow; OpenAI Gym; Stable Baselines; Git; ROS; Gazebo; CoppeliaSim; MuJoCo; L^AT_EX;

Other Languages

English (Native); Nepali (Native); Latin;