



## OVERVIEW

**Languages:** Python, C & C++ (including CUDA, OpenCL, & oneDNN), C#, Java, RISC-V, Julia, Lua, JavaScript, Rust, Perl, R

**Competencies:** ROS, Actor-Critic, Tensor Libraries & Math, Sockets, NumPy, Linux, Computer Networking, 2D & 3D Physics and Simulation Engines

**Research Background:** Robotics & AI; Object Manipulation, Audio & Image Processing, Perception Modeling, Reinforcement Learning, Transformers

**Interests:** Predictive Models, NLP, Multi-Agent Learning & AI, Cognitive Science, Generative Models, Data Science, Acoustic Guitar, Piano, BJJ

## EDUCATION

**Bachelor of Science in Computer Science, Concentration in Robotics and AI**

**Cumulative GPA:**

*University of South Florida College of Engineering | Tampa, FL | Fall 2020 - Spring 2024*

*3.7/4.0*

## EXPERIENCE

**Research and Development Group Founder**

**December 2023 – Present**

Prometheus Software & AI

*Remote*

- Founded development group to introspect potential industry applications of educational-based generative AI agents.
- Developed a scalable backend running our AI Tutor Agent, which runs on natural language interaction with a student.
- Working closely with local privatized coding schools for incorporating our architecture into their business model.

**Data Science Data Engineering Co/Op**

**November 2023 – Present**

CAE USA Research and Development Facility <https://cae.com/>

*Tampa FL*

- Prototyped and developed Generative Agents via finetuned LLMs capable of performing actions in simulation.
- Incorporated contrastive learning and pretraining into text classification improving models from 93% to 98% accuracy.
- Integrated ensemble model for IOB NER incorporating heuristics, finetuned models and LLMs for <99% accuracy.

**Software Engineering Co/Op**

**May 2022 - November 2023**

CAE USA Research and Development Facility <https://cae.com/>

*Tampa FL*

- Developed Windows and Linux lab nodes of in parallel computer clusters for simulation and hardware.
- Added 4 untested base repository trees into a Continuous Integration pipeline including over 35 independent repositories.
- Worked alongside embedded developers to map sensor data from touchscreen hardware to screen positions from device.

**Research Scientist**

**Fall 2021 – Present**

Robot Perception and Action Laboratory, *University of South Florida*, <https://rpal.cse.usf.edu/>

*Tampa FL*

- Research in robotic object manipulation through supervised and reinforcement learning; construct and pretrain a transformer network tasked for encoding spatial information, explore methods for improving accuracy of a policy.
- Utilization of graph neural networks and transformers for learning relationships between states and actions.
- Probabilistically modeled dynamics for policy optimization via contrastive divergence in latent space conditioning, leveraging historical state-action pairs to enhance predictive accuracy and representation quality.

**Senior Coding Coach and Instructor**

**Fall 2021 – Summer 2023**

theCoderSchool Tampa <https://github.com/theCoderSchoolTampa/CoderSchoolAI>

*Tampa FL*

- Spearheaded initiative for effectively delivering Agent AI concepts in a simpler and more digestible interface for kids.
- Developed an educational library built on-top of Python designed to remove complexity of Agent AI and Neural Network training; create and train a Neural Network for Image Classification in 7 lines of code.
- 15+ projects at theCoderSchool have integrated the library in their project; used in games, scripts, and AI Camp.

**Vice Chair; AI Group, VEX Robotics**

**Fall 2020 - Present**

USF IEEE Student Chapter

*Tampa FL*

- Organize and oversee Professional Development events/forums, plan our Spring/Fall Picnics and Banquets, introduce new students and act as the main POC for all USF students interested in joining IEEE's Technical Clubs and Teams.
- Founded AI Group; leadership in AI projects, including Auton-Drone and Just Dance Robots, and AI Workshops.
- Founded programming team for VEX with currently 20 active members, raised \$10k towards scholarship endowment.

# PROJECTS

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## IEEE VEX Robotics Software Stack

October 2021 - Present

<https://github.com/USF-IEEE/> (The code is distributed amongst various repositories)

(Competition Video) <https://www.instagram.com/reel/CdJ00oyvc0V/>

- Enables full autonomous capability and task implementation, distributed computation via usage of multiple computers enabling perception, SLAM, and planning while enabling low latency control and reaction.
- Modeled the dynamics of the environment and the variance in the resulting next state. Utilized latent representations for behavior cloning and reinforcement learning, enabling advanced perception systems for edge devices (Jetson Nano).

## Teach-A-Bull (AI Tutor)

November 2023 - Present

<https://github.com/USF-IEEE/AITutor-Backend/blob/main/README.md>

(Read the Paper)

- Made high-quality, personalized, and cheap education available to all students, regardless of socioeconomic status.
- Proposed iterative prompting techniques to generate progressively more complex data structures (Chapters, Lessons, Presentations, Homework, Evaluation, Schedule); *LLMs as Actors in Text-Based Environments* (LLMaAiT-BE).
- Measured high (*cosine*) similarity between generated content and Expert data for educational content and materials.
- 10x decrease in the cost of SAT/ACT prep (73\$ per session vs. \$7.30 per content generation session in API requests).

## MicrogradPlus

November 2023

<https://github.com/Johnnykoch02/MicroGradPlus>

- Simple computational graph / auto-differentiation API implemented with only NumPy as a weekend hobby project.
- Inspired by Andrej Karpathy's Micrograd which implements scalar auto-diff, MicroGradPlus approaches the task similarly by utilizing vector-based differentiation for mathematical operations including *sum*, *mean*, *sigmoid*, and *matmul*.
- Achieves perfect (100%) accuracy on all vector gradient tests when compared to PyTorch, 94% accuracy on MNIST.

## CoderSchoolAI (pip install CoderSchoolAI)

May 2023 – August 2023

<https://github.com/theCoderSchoolTampa/CoderSchoolAI/blob/master/README.md>

(Demo) [https://youtu.be/\\_cpspq18Chw?si=III8mxfdjF8rDdph](https://youtu.be/_cpspq18Chw?si=III8mxfdjF8rDdph)

- Neural Network API, AI tools, and Reinforcement *learning* library built on-top of PyTorch; beginner-friendly docs.
- MDP implementation in 10 lines of code, created simple API for training many-to-many DNN function approximators, various data and tensor utilities for optimized data manipulation, implementation of PPO, DQN, and DDPG algorithms.
- Used in my robotics research in *RPAL*. Continuously developing and expanding capabilities. Find it on [PyPi](#).

## Micromouse E-puck Robot

May 2023

<https://github.com/theCoderSchoolTampa/CoderSchoolAI/blob/master/README.md>

(Demo) [https://youtu.be/\\_cpspq18Chw?si=III8mxfdjF8rDdph](https://youtu.be/_cpspq18Chw?si=III8mxfdjF8rDdph)

- Implementation of a E-puck robot in Webots used to solve the Micromouse competition via SLAM and pathfinding.
- The robot starts in a corner and has 10 minutes to map the maze. My implementation utilizes various heuristics to encourage exploration of the map and decides which cells to visit by naively estimating their novelty and utility.

## Robbie the Danci-Bull Robot (HackaBull Entry)

March 2023

<https://github.com/Johnnykoch02/USF-HackaBull-2023>

(Dancing!) <https://youtu.be/zSz2d7ekwHU>

- Our mission was to develop a Simulated Robot that can dance to any song you provide as input.
- Pretrained the policy network of our robot on hundreds of Just Dance videos using MediaPipe to estimate joint position.
- Our policy implements a convolutional neural network which receives audio data and current joint angles as observations, and outputs a discretized probability distribution corresponding to a dθ in each of the seventeen joints on the robot.

## AI Chess

August 2022 - Present

<https://github.com/Johnnykoch02/ChessEngine>

(Video Detailing Project) <https://www.screencast.com/t/f4BB4gmnz>

- theCoderSchool Project with an advanced Python Student, who had the desire to learn about Game Development
- Inspired by AlphaZero, developed a self-play pipeline guided by neural networks and Monte-Carlo tree search.
- Utilizes the CoderSchoolAI Markov implementation templates allowing me to research and experiment algorithm design.

## Virtual Assistant

August 2022 – Present

<https://github.com/Johnnykoch02/VirtualAssistant/blob/main/README.md>

- Converts spoken Natural Language prompts into a sequence of tasks which execute sequentially to solve the problem.
- Keyword Detection via Audio Sequence Modeling, avoiding 1000's of Speech-To-Text Charges from Google ♥
- Developed my understanding for using LLMs in problem solving, deepened my curiosity for using LLMs as Actors.

