Joseph McCalmon

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EDUCATION

Wake Forest University, Winston-Salem, NC
Computer Science, B.S. • Mathematics, B.A.
GPA: 3.99/4.00 Dean's List: Fall 2018 - Spring 2021
August 2018 – May 2022

PROFESSIONAL EXPERIENCE

Wake Forest University Computer Science Department
Undergraduate Researcher
Spring 2020 – Present
- Led multiple projects focused on deep learning, security, robotics, and explainable machine learning
- Collaborated with professors from numerous universities and departments

Pennsylvania State University Computer Science Department
Undergraduate Researcher
Summer 2021 – Present • NSF Research Experience for Undergraduates
- Led a project on explainable reinforcement learning
- Continued summer work throughout the 2021 academic year

Wake Forest University Learning Assistance Center
Peer Tutor
Fall 2019 – Fall 2020
- Tutor freshmen, sophomores, and juniors weekly
- Reinforce topics from Introduction to Economics, Intermediate Microeconomics, and Intermediate Macroeconomics for struggling students

RESEARCH EXPERIENCE

CAPS: Comprehensible Abstract Policy Summaries for Explaining Reinforcement Learning Agents
Collaboration with Dr. Dongwon Lee, Penn State University
Spring 2021 – Present • REU project continuing into 2021-2022 academic year
- Created a novel algorithm to explain the decision making of reinforcement learning agents
- Work accepted at AAMAS 2022 as a full paper and oral presentation

COMPUTER SKILLS & PLATFORMS

Tensorflow 1.X, 2.X (Keras), & PyTorch

Python, C, C++, Java, JavaScript, HTML, & CSS languages

LaTex

Embedded Systems and Robotics

AWARDS

Follett Scholarship
Wake Forest University – Fall 2021
Awarded for academic excellence

Goldwater Scholar
Barry Goldwater Scholarship and Excellence Foundation – Spring 2021
Awarded for promise in research and academics

Thomas E. and Ruth Mullen Scholar
Wake Forest University – Fall 2020
Awarded for exceptional leadership and academics to under 20 undergraduates each year

CONFERENCES AND PRESENTATIONS

Advancement of Artificial Intelligence Conference
Poster Presenter – Spring 2021

International Conference on Tools with Artificial Intelligence
Keynote Presenter – Fall 2020

International Symposium on Safety, Security, Rescue, and Robotics (SSRR)
Undergraduate Presenter – Fall 2020

Observation Agnostic Reinforcement Learning

Collaboration with Dr. Sarra Alqahtani, Wake Forest University

Spring 2021 – Present

- Developing a defense against large-scale adversarial perturbations to reinforcement learning agents
- Leading two undergraduates as the main investigator

Detecting & Predicting Dark Mining with Remote Sensing Imagery

Mentored by Dr. Sarra Alqahtani & Dr. Paúl Pauca, Wake Forest University

Winter 2020 – Spring 2021

- Primary researcher on this project involving Intelligent Remote Sensing in Conservation & Discovery Group (IRSC) & CINCIA
- Used image recognition techniques, transfer learning, and change detection to identify hardly visible dark mining in varying resolutions of images in the Peruvian department of Madre De Dios
- Collaborated with professors and graduate students in remote sensing from Dartmouth University and Florida University

Defending Against Security Attacks in Multi-Agent Reinforcement Learning Systems

Mentored by Dr. Sarra Alqahtani, Wake Forest University

Fall 2020 – Fall 2021

- Developed security attacks against current multi-agent reinforcement learning systems, and created detection models to defend against such attacks
- Part of continuing research to improve the robustness of reinforcement learning agents
- Formed mathematical models and theories based on literature reviews
- Led two undergraduates and one graduate student in all phases of the project
- Work under submission at AAMAS 2022

Deep Reinforcement Learning for Adaptive Exploration of Unknown Environments

Mentored by Dr. Sarra Alqahtani, Dr. Paúl Pauca, & Dr. Miles Silman, Wake Forest University

Summer 2020 – Present • Presented at IEEE SSRR, AAAI-21 Undergraduate Consortium, and ICARA-21

- Developed algorithms to autonomously fly a drone using deep reinforcement learning and image thresholding to detect, trace, and observe illegal gold mining in South America over Amazonian Forests
- Conducted extensive experiments and testing in a simulated environment before deploying the refined algorithm into a drone

EXTRACURRICULAR ACTIVITES

Wake Forest Robotics Club

Founder & President – Fall 2020 - Present

- Led a four-person team to build a robotics club from scratch, teaching over twenty undergraduates programming, robotics, and machine learning
- Developed a website with handcrafted modules for self-guided learning
- Received grants to purchase inventory and send teams to international conferences

PUBLICATIONS

McCalmon, J., Liu, T., Lischke, C., Rahman, A., Alqahtani, S.M. (2021). **Advanced Persistent Threat in Multi-Agent Reinforcement Learning** [Manuscript Submitted for Publication]. Computer Science Department, Wake Forest University.

McCalmon, J., Le, T., Alqahtani, S.M., Lee, D. (2021). **CAPS: Comprehensible Abstract Policy Summaries for Explaining Reinforcement Learning Agents**. Manuscript accepted at the International Conference on Autonomous Agents and Multi-Agent Systems 2022.

Zhang, Y., **McCalmon, J.**, Peake, A., Alqahtani, S.M., & Pauca, V.P. (2021). **A Symbolic-AI Approach for UAV Exploration Tasks.** 2021 7th International Conference on Automation, Robotics and Applications (ICARA), 101-105.

Peake, A., **McCalmon, J.**, Zhang, Y., Myers, D., Alqahtani, S.M., & Pauca, V.P. (2021). **Deep Reinforcement Learning for Adaptive Exploration of Unknown Environments.** 2021 International Conference on Unmanned Aircraft Systems (ICUAS), 265-274.

McCalmon, J., Peake, A., Zhang, Y., Raiford, B., & Alqahtani, S.M. (2020). **Wilderness Search and Rescue**

— Analyzed the results and wrote the initial manuscript draft presenting the algorithm

Black-Box Breaker: Crafting Adversarial Examples for Deep Neural Networks without Training

Primary researcher with Dr. Sarra Alqahtani, Wake Forest University and Dr. Charles Walter, University of Mississippi

Summer 2020 • Submitted at 16th ACM ASIA Conference on Computer and Communications Security, 2021

— Created a tool to customize the training phase of deep reinforcement learning models built with convolutional neural networks using the approximated parameters by genetic algorithms

Multi-Agent Reinforcement Learning for Cooperative Adaptive Cruise Control

Primary researcher with Dr. Sarra Alqahtani, Wake Forest University

Spring 2020 • Presented at The International Conference on Tools for Artificial Intelligence ICTAI, 2020

— Adapted a multi-agent deep reinforcement learning algorithm for an environment which simulated multiple autonomous cars driving on a highway, avoiding collisions, and coordinating in one unit called platoon

Missions using Deep Reinforcement Learning. 2020 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR), 102-107.

McCalmon, J., Peake, A., Raiford, B., Liu, T., & Alqahtani, S.M. (2020). **Multi-Agent Reinforcement Learning for Cooperative Adaptive Cruise Control**. 2020 IEEE 32nd International Conference on Tools with Artificial Intelligence (ICTAI), 15-22.

RELEVANT COURSEWORK

Statistical Models

Real Analysis

Cryptography

Computer Systems I & II

Data Structures

Algorithm Design & Analysis

Security in Deep Learning

Data Mining