Ryan Sullivan

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Profile

Applying to research internships for reinforcement learning. Currently focusing on automatic curriculum learning, generalizable exploration methods, and open-ended learning.

Education

University of Maryland at College Park | GPA: 3.8 / 4.0 | August 2020 – Present
- Pursuing a Ph.D. in Computer Science, researching reinforcement learning and artificial intelligence.

Purdue University | GPA: 3.7 / 4.0 | August 2016 – May 2020
- Bachelor of Science in Computer Science Honors | Major GPA: 3.8 / 4.0
  - Concentrations in Software Engineering and Machine Learning
- Bachelor of Science in Statistics - Math Emphasis
- Bachelor of Science in Mathematics/Statistics
- Honors College Curriculum

Honors and Awards

- National Merit Scholarship
- Northrop Grumman, Raytheon, and Cisco Corporate Scholarships
- Intel Scholar in the Semiconductor Research Corporation's Undergraduate Research Program

Research

Automatic Curriculum Learning | January 2022 – Present
- Developing automatic curriculum methods to solve procedural content generation (PCG) environments.
- Applying learning-progress based methods to RL conference competitions.

Reward Surfaces of Policy Networks | January 2021 – January 2022
- Wrote library and performed experiments plotting the reward surface of RL agent policy networks.
- Identified new source of optimization challenges in the policy gradient direction via visualizations.
- Accepted as a full paper at **ICML 2022**. Also appeared at the RL for Games AAAI22 workshop.

TCAV Explanations for Reinforcement Learning Agents | May 2021 – October 2021
- Using TCAV to explain which concepts in the state space that RL agents use for decision making.

Multiagent Evaluation for Real World Conditions | January 2021 – May 2021
- Tested state of the art methods for game theoretic evaluation of multiagent performance in a population.
- Researched impact of sampling noise and agent collusion on DeepMind's AlphaRank and Meta-Nash.

Computer Vision Research at Michigan State University | May 2019 – July 2019
- Used a U-Net-style convolutional neural network to automatically segment tubes and catheters in pediatric chest X rays, achieving visually accurate results on an unsolved medical computer vision task.
- Experimented with deep learning and image processing techniques, presented findings throughout the summer, and taught Keras and machine learning concepts to other researchers.
- Presented poster at Mid-SURE 2019 and published in **SPIE Medical Imaging 2020**

Intel Scholar at Center for Brain-Inspired Computing | February 2018 – May 2020
- Used C++ to create a simulator for Intel's neuromorphic hardware, Loihi, allowing researchers to test the energy saving benefits of spiking neural networks, under supervision of C-BRIC's director, Kaushik Roy.

Conference Publications and Proceedings

- **Sullivan, R.**, Terry, J. K., Black, B., (2022). "Cliff Diving: Exploring Reward Surfaces in Reinforcement Learning Environments". In The International Conference on Machine Learning, 2022.
- Terry, J. K., Black, B., Grammel, N., Jayakumar, M., Hari, A., **Sullivan, R.**, … Ravi, P. (2021). PettingZoo: Gym for Multi-Agent Reinforcement Learning. In *Advances in Neural Information Processing Systems, 2021*.
- Rodriguez-Rivera G., Turkstra J., Buckmaster J., LeClainche K., Montgomery S., Reed W., **Sullivan R**. and Lee J., "Tracking Large Class Projects in Real-Time Using Fine-Grained Source Control," In *SIGCSE '22: Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*, 2022.
- **Sullivan, R.,** Holste, G., Burkow, J., & Alessio, A. (2020). Deep learning methods for segmentation of lines in pediatric chest radiographs. In *SPIE*, *Medical Imaging 2020: Computer-Aided Diagnosis* (Vol 11314, bll 577–583). doi:10.1117/12.2550686
- Holste, G., **Sullivan, R.,** Bindschadler, M., Nagy, N., & Alessio, A. (2020). Multi-class semantic segmentation of pediatric chest radiographs. In *SPIE*, *Medical Imaging 2020: Image Processing* (Vol 11313, bll 323–330). doi:10.1117/12.2544426

Workshop Papers, Talks, and Posters

- J. K. Terry, Benjamin Black, Nathaniel Grammel, Mario Jayakumar, Ananth Hari, **Ryan Sullivan**, Luis Santos, Rodrigo Perez, Caroline Horsch, Clemens Dieffendahl, Niall L. Williams, Yashas Lokesh, & Praveen Ravi (2021). PettingZoo: Gym for Multi-Agent Reinforcement Learning. In *OptLearnMAS-21, Proceedings of the 20th International Conference on Autonomous Agents and MultiAgent Systems 2021.*
- J. K. Terry, Benjamin Black, Nathaniel Grammel, Mario Jayakumar, Ananth Hari, **Ryan Sullivan**, Luis Santos, Rodrigo Perez, Caroline Horsch, Clemens Dieffendahl, Niall L. Williams, Yashas Lokesh, & Praveen Ravi (2020). PettingZoo: Gym for Multi-Agent Reinforcement Learning. In *Deep Reinforcement Learning Workshop, Advances in Neural Information Processing Systems 2020*.
- **R. Sullivan**, G. Holste, A. Alessio (2020). Deep Learning Methods for Automatic Evaluation of Lines in Chest Radiographs. In MID-SURE Symposium, East Lansing, MI, 2019.

Professional Experience

Research Scientist at Oak Ridge National Lab | September 2022 – Present

- Working part time to apply automatic curriculum learning and RL methods to cybersecurity.
- Competing in online AI for cybersecurity competitions to benchmark methods and identify challenges

Applied Scientist Intern at Amazon | May 2022 – September 2022

- Used offline and online reinforcement learning to optimize security rules Amazon sign-in systems.
- Worked with science and product teams to formulate problem as a sequential decision-making process.
- Created efficient simulator of sign-in process to generate new experiences for exploration.
- Developed models that will be deployed globally to reduce friction in the user sign in experience.

PettingZoo | August 2020 – Present

- Maintainer and developer of PettingZoo, a unified API for multi-agent reinforcement learning environments.
- Updated and rewrote environments, improved documentation, and patched significant bugs.
- Published PettingZoo paper at **NeurIPS 2021** and gave multiple workshop talks at top-tier conferences.
- Since I joined the team, PettingZoo became the third most installed RL library, and is supported by many major RL frameworks including Stable Baselines 3, RLLib, and the Autonomous Learning Library.
- Worked alongside J Terry to make design decisions for the maintenance of OpenAI's Gym library.

Graduate Research Assistant for Multi-Agent RL Benchmarking | August 2020 – Present

- Cofounded Umshini, a service for benchmarking in competitive and cooperative multi-agent games.
- Leveraged PettingZoo's universal environment API to develop a tool that allows researchers to directly test their AI agents against others in a tournament setting via online matchmaking.
- Organize and manage team of developers through regular meetings to develop a working demo.
- Received funding to continue the development of Umshini as a research assistant.