





John Winder

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Artificial Intelligence | Machine Learning | Reinforcement Learning

Mission

I am a Senior Staff AI/ML Research Scientist at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). In my role as the supervisor of the Advanced Artificial Intelligence Algorithms section of JHU/APL, I lead a team researching reinforcement learning (RL) for real-world platforms such as aircraft, satellites, and complex software systems.

Developing decision-making agents capable of long-term reasoning motivates my work. I aim to create agents that collaborate with humans and other AI agents to generalize learned behaviors across new circumstances, all while operating under uncertainty in dynamic and open environments. I work at the confluence of attention, RL with vision and natural language processing (grounded language acquisition), and multimodal deep generative models.

Education

- Ph.D. in Computer Science**, *University of Maryland, Baltimore County (UMBC)* **2019**
Advised by Dr. Marie desJardins, Dr. Cynthia Matuszek
Thesis: *Abstract Decision Making and Concept Formation for Adaptability and Generalization*
Research in hierarchical reinforcement learning, state abstraction, probabilistic planning
- M.S. in Computer Science**, *UMBC* **2015**
Advised by Dr. Marie desJardins, Dr. Tim Oates
Research in machine learning, computer vision, feature extraction
- B.S. in Computer Science**, *magna cum laude, UMBC* **2013**

Publications

Proposals (Awarded)

- ◇ **John Winder**, Thomas Urban. *Beyond Human Reasoning - Bridging the Information Gap*. Johns Hopkins University Applied Physics Laboratory (JHU/APL), Propulsion Grant (Internal R&D). Year 4 (competitively awarded each year), 2023-2024. Topics: *AI co-pilot for aircraft, novel neural network architectures, transformers and attention, graph neural networks (GNNs), variational auto-encoders (VAEs), multi-agent reinforcement learning (MARL), human-machine collaboration in virtual reality (VR) using Unity*.
- ◇ **John Winder**. *Eliminate the Middleman*. JHU/APL, Propulsion Grant (Internal R&D). Year 1 (competitively awarded each year), 2023-2024. Topics: *Multimodal foundation models, MARL, uncrewed autonomous vehicles (UAVs)*.

- ◇ **John Winder**, Janet Zhang. *Landsraad*. JHU/APL, CUT FACT (Internal R&D). 2023-2024. Topics: *Large language models (LLMs), agentic LLMs, retrieval augmented generation (RAG) LLMs*.
- ◇ **John Winder**, Thomas Urban. *Beyond Human Reasoning - Bridging the Information Gap*. JHU/APL, Propulsion Grant (Internal R&D). Year 3 (competitively awarded each year), 2022-2023. Topics: *Attention, GNNs, VAEs, MARL, human-machine collaboration in VR*.
- ◇ **John Winder**. *Towards Zero RL Safety Violations*. JHU/APL, AD FACT (Internal R&D). 2022-2023. Topics: *Safe reinforcement learning, simulation-to-reality (sim2real)*.
- ◇ Arpit Amin, **John Winder**. *SMOKEY: Simulating Multi-Agent RL Objectives and Key Engagements*. JHU/APL, The Wildfire Challenge: We didn't start the fire, but..., Ignition Grant (Internal R&D). 2022-2023. Topics: *MARL, cellular automata*.
- ◇ Noah Jacobsen, **John Winder**. *Advanced Neural Architectures for Human-Robot Maritime Coexistence*. JHU/APL, Let's Kick some AIS, (Internal R&D). 2022-2023. Topics: *Data visualization, VAEs*.
- ◇ Janet Zhang, **John Winder**, Stephen Vance. *Multi-Agent Dreamer for Aircraft*. JHU/APL, Mission Area Lightning Grant, (Internal R&D). 2022-2023. Topics: *World models, model-based RL, MARL*.
- ◇ **John Winder**, Thomas Urban. *Beyond Human Reasoning - Bridging the Information Gap*. JHU/APL, Propulsion Grant (Internal R&D). Year 2 (competitively awarded each year), 2021-2022. Topics: *Self-attention, GNNs, VAEs, MARL, spatiotemporal prediction, cognitive modeling*.
- ◇ Thomas Urban, Edward White, Matthew Sharp, **John Winder**. *Providentia's Potential*. JHU/APL, Propulsion Grant (Internal R&D). Year 1 (competitively awarded each year), 2021-2022. Topics: *Causal inference and machine learning, counterfactual reasoning, Bayesian networks*.
- ◇ **John Winder**. *Ender's Dilemma: Defeating the Hive Mind*. JHU/APL, AD FACT (Internal R&D). 2021-2022. Topics: *Multi-agent, hierarchical, and model-based reinforcement learning (MARL, HRL, MBRL)*.
- ◇ **John Winder**, Thomas Urban. *Beyond Human Reasoning - Bridging the Information Gap*. JHU/APL, Propulsion Grant (Internal R&D). Year 1 (competitively awarded each year), 2020-2021. Topics: *Novel neural network architectures (memory and self-attention), probabilistic graphical models, human-machine interaction, MARL*.
- ◇ **John Winder**. *Adversarial Attacks on RL & Explainable RL Agents*. JHU/APL, "I Have Hammer" Projects (Internal R&D). 2021-2022. Topics: *Adversarial attacks on reinforcement learning, explainable machine learning (XAI/XRL)*.

- ◇ Contributions to proposals for research with the Defense Advanced Research Projects Agency (DARPA) and the Air Force Research Laboratory (AFRL). JHU/APL. 2020-2023. Award total: on the order of \$1MM. Topics: Transformers, world models, MARL, novel metrics for collaboration.
- ◇ Cynthia Matuszek, Francis Ferraro, **John Winder**. NRI: FND: Semi-Supervised Deep Learning for Domain Adaptation in Robotic Language Acquisition. National Science Foundation (NSF), Information & Intelligent Systems (IIS). 2020-2023. Award total: \$748,724. Topics: Grounded language learning for robots, manifold alignment, imitation learning, inverse reinforcement learning.
- ◇ Dan Lee, **John Winder**. STTR Phase I: A Machine Learning Framework for Comprehensive Dental Caries Detection. National Science Foundation (NSF), Industrial Innovation & Partnerships (IIP). 2020-2021. Award total: \$224,999. Topics: Medical imaging, computer vision for radiology, semantic segmentation, semi- and self-supervised learning.
- ◇ Marie desJardins [and **John Winder** (student co-author)]. Concept Formation in Partially Observable Domains. National Science Foundation (NSF), Information & Intelligent Systems (IIS). 2018-2021. Award total: \$399,993. Topics: Concept-based knowledge transfer, state abstraction, online function approximation for contextual bandits.

Journal Articles

- ◇ Karan K Budhraja, **John Winder**, Tim Oates. Feature Construction for Controlling Swarms by Visual Demonstrations. ACM Transactions on Autonomous and Adaptive Systems (TAAS), 12(2), 10. 2017.

Conference Papers

- ◇ Gaoussou Youssouf Kebe, Pdraig Higgins, Patrick Jenkins, Kasra Darvish, Rishabh Sachdeva, Ryan Barron, **John Winder**, Don Engel, Edward Raff, Francis Ferraro, Cynthia Matuszek. A Spoken Language Dataset of Descriptions for Speech-Based Grounded Language Learning. Proceedings of The Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS 2021). 2021.
- ◇ **John Winder**, Stephanie Milani, Matthew Landen, Erebus Oh, Shane Parr, Shawn Squire, Marie desJardins, Cynthia Matuszek. Planning with Abstract Learned Models While Learning Transferable Subtasks. Proceedings of The Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20). 2020.
- ◇ David Abel*, **John Winder***, Marie desJardins, Michael L Littman. The Expected-Length Model of Options. Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence (IJCAI-19) [*equal contribution]. 2019.

- ◇ Nakul Gopalan, Marie desJardins, Michael L Littman, James MacGlashan, Shawn Squire, Stefanie Tellex, **John Winder**, Lawson LS Wong. *Planning with Abstract Markov Decision Processes*. Proceedings of the Twenty-Seventh International Conference on Automated Planning and Scheduling (ICAPS-17). 2017.
- ◇ Nicholay Topin, Nicholas Haltmeyer, Shawn Squire, **John Winder**, Marie desJardins, James MacGlashan. Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (IJCAI-15). 2015.

Workshop Papers & Extended Abstracts

- ◇ Patrick Jenkins, Rishabh Sachdeva, Gaoussou Youssouf Kebe, Pdraig Higgins, Kasra Darvish, Edward Raff, Don Engel, **John Winder**, Francis Ferraro, Cynthia Matuszek. *Presentation and Analysis of a Multimodal Dataset for Grounded Language Learning*. arXiv preprint arXiv:2007.14987. 2020.
- ◇ Patrick Jenkins, Pdraig Higgins, Rishabh Sachdeva, **John Winder**, Cynthia Matuszek. *GLD: A Grounded Language Dataset of Object Images and Descriptions in Natural Language Text and Speech*. The 8th Mid-Atlantic Student Colloquium on Speech, Language and Learning (MASC-SLL 2020) [Extended Abstract]. 2020.
- ◇ Monali Saraf, Pdraig Higgins, **John Winder**, Cynthia Matuszek. *A Human-Robot Interaction Data Set: Towards Active Learning*. The 8th Mid-Atlantic Student Colloquium on Speech, Language and Learning (MASC-SLL 2020) [Extended Abstract]. 2020.
- ◇ **John Winder**, Stephanie Milani, Matthew Landen, Erebus Oh, Shane Parr, Shawn Squire, Marie desJardins, Cynthia Matuszek. *Planning with Abstract, Learned Models*. Do Good Robotics Symposium (DGRS-19) [Extended Abstract]. 2019.
- ◇ **John Winder**, Marie desJardins. *Concept-Aware Feature Extraction for Knowledge Transfer in Reinforcement Learning*. Knowledge Extraction from Games (KEG-18) Workshop at the Thirty-Second AAAI Conference on Artificial Intelligence (AAAI-18). 2018.
- ◇ **John Winder**, Shawn Squire, Matthew Landen, Stephanie Milani, Marie desJardins. *Towards Planning With Hierarchies of Learned Markov Decision Processes*. Integrated Execution of Planning and Acting Workshop (IntEx-17) at the Twenty-Seventh International Conference on Automated Planning and Scheduling (ICAPS-17). 2017.
- ◇ **John Winder**. *Anomaly Reasoning through Concept Formation for Planning and Reinforcement Learning*. Proceedings of the Twenty-Seventh International Conference on Automated Planning and Scheduling (ICAPS-17) [Doctoral Consortium]. 2017.
- ◇ Shawn Squire, **John Winder**, Matthew Landen, Stephanie Milani, Marie desJardins. *R-AMDP: Model-Based Learning for Abstract Markov Decision Process Hierarchies*. The Third Conference on Reinforcement Learning and Decision Making (RLDM-17) [Extended Abstract]. 2017.

- ◇ Nakul Gopalan, Marie desJardins, Michael L Littman, James MacGlashan, Shawn Squire, Stefanie Tellex, **John Winder**, Lawson LS Wong. *Planning with Abstract Markov Decision Processes*. The Third Conference on Reinforcement Learning and Decision Making (RLDM-17) [Extended Abstract]. 2017.
- ◇ **John Winder**. *A Framework for Anomaly Reasoning: Interpretation through Concept Formation for Knowledge Transfer and Lifelong Learning*. Proceedings of the Twenty-Fifth International Joint Conference on Artificial Intelligence (IJCAI-16) [Doctoral Consortium]. 2016.
- ◇ Nakul Gopalan, Marie desJardins, Michael L Littman, James MacGlashan, Shawn Squire, Stefanie Tellex, **John Winder**, Lawson LS Wong. *Planning with Abstract Markov Decision Processes*. Abstraction in Reinforcement Learning Workshop at the Thirty-Third International Conference on Machine Learning (ICML-16). 2016.

Work Experience

Johns Hopkins University Applied Physics Laboratory <i>Advanced AI Algorithms Section, Intelligent Platforms Group Laurel, MD</i>	Section Supervisor <i>(Senior Professional Staff Scientist) Feb. 2021 - Present</i>
Johns Hopkins University Applied Physics Laboratory <i>Laurel, MD</i>	Senior Professional Staff Scientist <i>July 2020 - Feb. 2021</i>
Department of Computer Science and Electrical Engineering <i>UMBC</i>	Adjunct Assistant Professor <i>October 2020 - Present</i>
Department of Computer Science and Electrical Engineering <i>UMBC</i>	Faculty Research Assistant <i>Fall 2019 - July 2020</i>
Interactive Robotics and Language (IRAL) Lab <i>UMBC</i>	Graduate Research Assistant <i>Fall 2018 - Summer 2019</i>
Multi-Agent Planning and Learning (MAPLE) Lab <i>UMBC</i>	Graduate Research Assistant <i>Fall 2013 - Summer 2018</i>
International Computer Science Institute (ICSI) <i>Berkeley, CA</i>	Consultant <i>May - August 2016</i>
CS Matters in Maryland (CSforALL) <i>Baltimore, MD</i>	Graduate Assistant <i>May - August 2014, 2015</i>
SAIC (Leidos) <i>Columbia, MD</i>	Computer Science Intern <i>May - August 2012</i>

Teaching Experience

Reinforcement Learning and Probabilistic Planning	MAPLE Lab Instructor <i>Summer, Winter 2018 Summer, Winter 2017</i>
Principles of Operating Systems	Teaching Assistant <i>Spring 2014</i>
Object Oriented Programming	Teaching Assistant <i>Fall 2013</i>

Service

AAAI Conference on Artificial Intelligence (AAAI-23)	Senior Program Committee <i>Fall 2022</i>
Robotics: Science and Systems (RSS 2020)	Reviewer <i>Spring 2020</i>
Conference on Human-Robot Interaction (HRI 2020)	Program Committee (Reviewer) <i>Fall 2019</i>
AAAI Conference on Artificial Intelligence (AAAI-20)	Program Committee (Reviewer) <i>Fall 2019</i>
Conference on Robot Learning (CoRL-19)	Reviewer <i>Summer 2019</i>
Knowledge Extraction from Games (KEG-19) Workshop at AAAI-18	Program Committee (Reviewer) <i>Fall 2018</i>
Integrated Execution of Planning and Acting (IntEx-18) Workshop at ICAPS-18	Program Committee (Reviewer) <i>Spring 2018</i>
Maryland Computing Education Summit (CE21-Maryland)	Student Organizer, Volunteer <i>April 2016</i>

Academic Awards

IJCAI-16 Travel Award	<i>June 2016</i>
T. Rowe Price Associates Scholarship	<i>May 2013</i>
UMBC Class of 2013 Featured Student	<i>May 2013</i>
Marshall Scholar Nominee at UMBC	<i>May 2013</i>
Phi Beta Kappa	<i>Fall 2012</i>
Undergraduate Research Award	<i>Spring 2011</i>
UMBC Honors College	2009 - 2013

Knowledge & Skills

Areas: Artificial intelligence / machine learning (AI/ML) and reinforcement learning (RL) algorithms.

- Classic and Deep RL (DRL) algorithms such as Value Iteration, Q-learning, SARSA, Proximal Policy Optimization (PPO) Soft Actor-Critic (SAC), AlphaZero, MuZero;

- NN architectures such as transformers, graph neural networks (GNNs), convolutional neural networks (CNNs), recurrent NNs (RNNs & LSTMs), multi-layer perceptrons (MLPs);
- Deep generative models such as Generative Adversarial Networks (GANs, e.g., StyleGAN, BigGAN), variational auto-encoders (VAEs), diffusion models;
- Natural Language Processing (NLP) tasks: neural machine translation, fine-tuning large language models (LLMs), using foundation models (FMs), reinforcement learning with human feedback (RLHF);
- Computer Vision (CV) tasks: object detection, object recognition, semantic segmentation, fine-tuning large CV models;
- Techniques: data augmentation (e.g., CutMix), self-supervised training (e.g., triplet loss), model surgery, curriculum learning, population-based training;
- Traditional supervised ML such as decision trees, random forests, logistic regression, naive Bayes, Bayesian networks, support vector machines;
- Unsupervised learning (dimensionality reduction and clustering) such as t-SNE, UMAP, PCA;
- Designing ML experiments, collecting and annotating large scale data sets, managing dozens of annotators, conducting inter-annotator reliability assessments and data quality reviews.

AI/ML, Deep learning Frameworks: Python: PyTorch, Tensorflow/Keras, JAX, ray/RLlib, stable-baselines3, OpenAI gym (also Mujoco, DM Control Suite, PettingZoo, OpenSpiel, many more), HuggingFace Transformers, scikit-learn, fast.ai, MONAI); C/C++: Nvidia CUDA; Java: BURLAP, Weka.

Data analysis, visualization: Python (NumPy/SciPy, IPython / Google Colab, Matplotlib, Plotly, Tensorboard, Weights & Biases), D3.js, Excel, R, MATLAB, Mathematica; explainability techniques and confidence measurements; data de-identification for HIPAA compliance.

General software development: Python (PyQt, Cython), Java/Kotlin, C, C++.

Web development: PHP (Laravel), SQL, JavaScript (Node.js, React), HTML, CSS.

Misc. programming: Java/Kotlin (Android development), libGDX (game development), C# (Unity), Git, LaTeX, Bash, Linux.

Software Architecture (API/Library Design): At JHU/APL I have designed two large-scale libraries for training reinforcement learning agents using a reproducible, configuration-driven paradigm. The libraries feature curriculum learning, population-based training, self-play and mixed heuristic-vs-RL play. They have been used to train hundreds of highly performant agents including those used on projects for DARPA and AFRL. As a PhD student I redesigned and refactored our lab's BURLAP library to include more advanced serialization, parallelization, and deep RL algorithms.

Leadership: Principal investigator or technical lead on 5+ projects; proposal/grant writing, raising funds from customers and investors (Lt Cols, VCs / Angels, CEOs); project scoping, planning, and execution for technical teams with 10+ SMEs.

Operations: Project management, budgeting (DFARS compliance, SBIR/STTR for NSF).