John Winder, Ph.D.

Email | *johnwinderphd@gmail.com*
Website | *johnwinder.ai*
LinkedIn | *john-winder-phd*
Location | *Laurel, MD, USA*

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, surface vessels, 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, multi-agent 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*

Work Experience

Johns Hopkins University Applied Physics Laboratory — **Section Supervisor**
Advanced AI Algorithms Section, Intelligent Platforms Group — *(Senior Professional Staff Scientist)*
Laurel, MD — *Feb. 2021 - Present*

Data Science and Artificial Intelligence Institute (DSAI) — **Faculty Member**
Johns Hopkins University — *(3-Year Appointment)*
Baltimore, MD — *Sep. 2024 - Present*

Johns Hopkins University Applied Physics Laboratory — **Senior Professional Staff Scientist**
Laurel, MD — *July 2020 - Feb. 2021*

Department of Computer Science and Electrical Engineering — **Adjunct Assistant Professor**
UMBC — *October 2020 - Sep. 2021*

Department of Computer Science and Electrical Engineering — Faculty Research Assistant
UMBC — *Fall 2019 - July 2020*

Interactive Robotics and Language (IRAL) Lab — Graduate Research Assistant
UMBC — *Fall 2018 - Summer 2019*

Multi-Agent Planning and Learning (MAPLE) Lab — Graduate Research Assistant
UMBC — *Fall 2013 - Summer 2018*

International Computer Science Institute (ICSI) — Consultant
Berkeley, CA — *May - August 2016*

CS Matters in Maryland (CSforALL) — Graduate Assistant
Baltimore, MD — *May - August 2014, 2015*

SAIC (Leidos) — Computer Science Intern
Columbia, MD — *May - August 2012*

Publications

Proposals (Awarded)

- **John Winder**. *Eliminate the Middleman*. JHU/APL, Propulsion Grant (Internal R&D). Year 2 (competitively awarded each year), 2024-2025. Topics: *Multimodal foundation models, joint embedded predictive architectures (JEPA), autonomous collaborative platforms (ACPs).*
- Willa M. Mannering, **John Winder**. *AI-STRIKE*. JHU/APL, AD FACT (Internal R&D). 2024-2025. Topics: *Large language models (LLMs), human-machine teaming, mission planning, domain-specific languages.*
- **John Winder**, Sachin Chanchani. *Digital RF Dreamer*. JHU/APL, C-C5 FACT (Internal R&D). 2024-2025. Topics: *Model-based RL (MBRL), world models, electronic warfare (EW).*
- **John Winder**, Samuel Nathanson. *Firestorm Fusion*. JHU/APL, CUT FACT (Internal R&D). 2024-2025. Topics: *Multi-agent LLMs, LLM tool usage.*
- **John Winder**. *Exploring Iterative Reasoning in LLMs and the Transferability to Multimodal Models*. National Science Foundation, National Artificial Intelligence Research Resource Pilot (NAIRR). DOE Oak Ridge National Laboratory (Summit), 2024. Topics: *LLM introspection, explainable AI (XAI), iterative inference hypothesis (IIH).*

- **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: *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. 2020-2024. Award total: on the order of $1MM. Topics: *Transformers, world models, MARL, league-based training, exploiter agents, curriculum learning, simulation-to-reality (sim2real), differentiable simulations, equivariance, 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

- Joshua McClellan, Naveed Haghani, **John Winder**, Furong Huang, Pratap Tokekar. *Boosting Sample Efficiency and Generalization in Multi-agent Reinforcement Learning via Equivariance.* Proceedings of The Thirty-eighth Conference on Neural Information Processing Systems (NeurIPS 2024). 2024.

- Willa M. Mannering, Noah Ford, Justin Harsono, **John Winder**. *Generative Artificial Intelligence for Behavioral Intent Prediction.* Proceedings of the 46th Annual Conference of the Cognitive Science Society (CogSci 2024). 2024.

- Gaoussou Youssouf Kebe, Padraig 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

- Greyson Brothers, Willa M. Mannering, Amber Tien, **John Winder**. *Uncovering Uncertainty in Transformer Inference.* NeurIPS 2024 Workshop on Foundation Model Interventions. 2024.

- Patrick Jenkins, Rishabh Sachdeva, Gaoussou Youssouf Kebe, Padraig 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, Padraig 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, Padraig 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.

Talks

Bridging the Human-Machine Information Gap for AI Fighter Pilots *Summer 2024*
Institute for Assured Autonomy (Invited Talk)

Large Language Models Workshop, Panelist *Spring 2024*
Intelligent Systems Center Horizons Event

Beyond Human Reasoning *Summer 2023*
XR Symposium 2023

Teaching Experience

Reinforcement Learning and Probabilistic Planning — MAPLE Lab Instructor
Summer, Winter 2018
Summer, Winter 2017

Principles of Operating Systems — Teaching Assistant
Spring 2014

Object Oriented Programming — Teaching Assistant
Fall 2013

Enterprise Leadership

APL Research Compute Governance Body (ReCoG) — FPS Representative
Voting member, representing approx. 2000 technical staff *July 2024 - Present*

APL AI Roadmap Steering Committee — FPS Representative
2024

Service

Intelligent Systems Symposium (ISS 2024) — Organizer
Conference at JHU/APL *Fall 2024*

Intelligent Systems Symposium (ISS 2023) — Chair, AI Research
Conference at JHU/APL *Fall 2023*

AAAI Conference on Artificial Intelligence (AAAI-23) — Senior Program Committee
Fall 2022

Robotics: Science and Systems (RSS 2020) — Reviewer, *Spring 2020*

Conference on Human-Robot Interaction (HRI 2020) — Program Committee (Reviewer), *Fall 2019*

AAAI Conference on Artificial Intelligence (AAAI-20) — Program Committee (Reviewer), *Fall 2019*

Conference on Robot Learning (CoRL-19) — Reviewer, *Summer 2019*

Knowledge Extraction from Games (KEG-19)
Workshop at AAAI-18 — Program Committee (Reviewer), *Fall 2018*

Integrated Execution of Planning and Acting (IntEx-18)
Workshop at ICAPS-18 — Program Committee (Reviewer), *Spring 2018*

Maryland Computing Education Summit (CE21-Maryland) — Student Organizer, Volunteer, *April 2016*

Professional Awards

Robert J. Collier Trophy 2023, Finalist — *March 2024*
USAF X-62A VISTA / DARPA ACE, Experimentation and Integration Team

Propulsion Grant Prize for Innovation — *April 2023*
APL Achievement Award

Academic Awards

IJCAI-16 Travel Award — *June 2016*

T. Rowe Price Associates Scholarship — *May 2013*

UMBC Class of 2013 Featured Student — *May 2013*

Marshall Scholar Nominee at UMBC — *May 2013*

Phi Beta Kappa — *Fall 2012*

Undergraduate Research Award — *Spring 2011*

UMBC Honors College — *2009 - 2013*