Kyle Vedder

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Education

- PhD in Computer Science, University of Pennsylvania (in progress) (2019 – Present)
  – Advisor: Eric Eaton, *Lifelong Machine Learning group (LML), GRASP Lab*
- BS in Computer Science, University of Massachusetts (2015 – 2019)
  – Advisor: Joydeep Biswas, *Autonomous Mobile Robotics Lab (AMRL)*

Research Interests

In 20 years I want there to be robots that can effectively provide a full range of quality care to the elderly and disabled. In service of this goal, I am interested in improving continual learning for visual and behavioral tasks, as these abilities are required to robustly perform even basic care tasks in real world settings.

Technical Skills

- Proficient with C++1X, Python 3, PyTorch, ROS 1, git, Debian Linux, LaTeX
- Knowledgeable in Robotics and Machine Learning, including 3D Object Detection ([3] [5]), Single/Multi-Agent Path Planning ([1] [2] [4]), Shapley Values for Explainable AI ([6]), Motion Control ([7] [8])

Publications

Conferences/Journals

1. *X*: Anytime Multi-Agent Path Finding For Sparse Domains Using Window-Based Iterative Repairs.*
   Kyle Vedder, Joydeep Biswas. In Artificial Intelligence (AIJ), Volume 291, 2021. [pdf] [website]

2. *X*: Anytime Multiagent Path Planning With Bounded Search.*
   Kyle Vedder, Joydeep Biswas. In Proceedings of the 18th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS), Montreal, Quebec, CA. July 2019. [pdf]

Workshops

3. *Sparse PointPillars: Exploiting Sparsity on Birds-Eye-View Object Detection.*
   Kyle Vedder, Eric Eaton. Sparsity in Neural Networks Workshop (SNN). 2021. [pdf] [arxiv] [poster]

4. *Augmenting Planning Graphs in 2-Dimensional Dynamic Environments With Obstacle Scaffolds.*
   Spencer Lane, **Kyle Vedder**, Joydeep Biswas. In Proceedings of the 5th Workshop on Planning and Robotics (ICAPS PlanRob), Pittsburgh, PA, USA. June 2017. [pdf]

Tech Reports

5. *Current Approaches and Future Directions for Point Cloud Object Detection in Intelligent Agents.*
   Kyle Vedder. UPenn WPEII. 2021. [pdf] [video] [slides]

6. *An Overview of SHAP-based Feature Importance Measures and Their Applications To Classification.*
   Kyle Vedder. 2020. [pdf] [video] [slides]

7. *UMass MinuteBots 2018 Team Description Paper.*
   Kyle Vedder, Edward Schneeweiss, Sadegh Rabiee, Samer Nashed, Spencer Lane, Jarrett Holtz, Joydeep Biswas, David Balaban. 2018. [pdf] [website]

8. *UMass MinuteBots 2017 Team Description Paper.*
   Kyle Vedder, Edward Schneeweiss, Sadegh Rabiee, Samer Nashed, Spencer Lane, Jarrett Holtz, Joydeep Biswas, David Balaban. 2017. [pdf] [website]

In Submission

9. *Sparse PointPillars: Maintaining and Exploiting Input Sparsity to Improve Runtime on Embedded Systems.* Kyle Vedder, Eric Eaton. In Submission to ICRA 2022. [pdf] [website] [video]

Honors and Awards

- *Goldwater Scholarship Honorable Mention* (2018)
  - One of 281 Honorable Mentions selected from a pool of 1280 national nominees
- *Outstanding Undergraduate Course Assistant (CS220 Programming Methodologies)* (Fall 2017)
  - Received award for contributions to course development

Academic Experience

- *PhD Student – Lifelong Machine Learning group (LML), UPenn* (2019 – Present)
  - Developed *Sparse PointPillars*, a point cloud 3D object detector for embedded systems
    * Based on popular detector *PointPillars*, with modified backbone to maintain and exploit input sparsity using end-to-end submanifold convolutions, significantly reducing model FLOPs
    * Contributed bugfixes and improvements to Open3D implementation of *PointPillars* [commits]
    * Workshop paper at Sparse Neural Networks Workshop; in submission to ICRA 2022
  - Core Team Lead for Phase 2 of DARPA Lifelong Learning Machines (L2M) program
    * Led multi-University team to develop core infrastructure for RL and Perception subgroups atop the AIHabitat sim using Matterport3D, a dataset of 3D indoor scans of real houses
    * Worked with DARPA SETAs and other performers to refine fundamental cross-domain definition of lifelong learning systems along with domain agnostic evaluation approaches
    * Worked with subcontractors to develop concrete tasks for lifelong learning for an embodied agent in Matterport3D
    * Coordinated RL and Perception subgroups to provide system diagrams and metrics for evaluation by JHU APL, DARPA's independent evaluator, using APL's metrics definitions
    * Worked on adapting and tuning our group's Lifelong RL algorithm, LPG-FTW, for AIHabitat
  - Developed from scratch open-source control stack for LML Service Robots in C++14 [code]
    * Provides efficient implementation of particle filter-based localization on vector maps, velocity space obstacle avoidance, hierarchical path planning for real-time performance, visualization support via ROS, and integration with a multi-agent robot simulator
    * Basis for getting started homework assignment and several final group projects in CIS700 Integrated Intelligence, Fall 2020
- *Research Assistant – Autonomous Mobile Robotics Lab (AMRL), UMass* (2016 – 2019)
  - Developed *X**, an anytime multiagent planner for realtime systems
    * Designed, proved correct, implemented, and evaluated all novel algorithms
    * Performed literature review and wrote paper with high level editing input from coauthor
  - Developed *Obstacle Scaffolds*, an extension to roadmap planners for finer near-obstacle navigation
    * Implemented baseline and experimental planners
    * Evaluated planner characteristics across multiple scenarios
  - Founding member of the UMass Minutebots, the RoboCup Small Size League team that serves as AMRL's research platform for autonomous multiagent systems
    * Architected and implemented majority of the core software infrastructure for the control stack
    * Implemented state-of-the-art realtime path planning, low level collision avoidance, and portions of the motion planning system
- *Academic Reviewer* (2019 – Present)
  - AAAI 2020 – 2022, AAMAS 2021, JMLR (Secondary) 2021
  - Reviewed articles on topics across robotics, vision, machine learning, and classical AI
- *Teaching Assistant – CIS 519 Applied Machine Learning, UPenn* (Spring 2021)
  - Head TA managing 14 TAs doing homework assignment creation, running office hours, and performing small group cohort sessions
- *Teaching Assistant – CIS 700 Integrated Intelligence, UPenn* (Fall 2020)
  - Developed assignments, led paper discussions, led technical lessons on ROS and C++1X, and helped students with ideation and execution of final project
- *Undergraduate Course Assistant – CIS 220 Programming Methodologies, UMass* (2016 – 2017)
  - Led discussion sections, held office hours, answered Q&A forum questions, overhauled course material, and restructured discussion sections to better suit student needs

Industry Experience

- *Amazon Lab126 – Software Development Intern* (Summer 2019)
  - Worked on Amazon Astro, a small mobile service robot, doing novel classical multi-modal IR camera and ToF sensor fusion for detecting small obstacles such as wires or boxes to avoid collisions
- *Google – Software Engineering Intern* (Summer 2017)
  - Worked on Ads Quality Metrics team to deliver statistics about bad ads. Developed information theoretic optimization approach to aquire maximally diverse training data for automated detectors
- *Google – Software Engineering Intern* (Summer 2016)
  - Worked on AdWords Next Overview, the homepage of redesigned AdWords. Developed offline pipelines to do statistical analysis over entire customer dataset to provide automated insights
- *Unidesk Corporation – C++ Development Intern* (Summer 2015)
  - Designed and implemented testing framework for proprietary Windows registry manipulation APIs, ensuring bug-for-bug compatability with Windows' implementation of fixed width UTF-16
- *Unidesk Corporation – Robotics Intern* (Summer 2014)
  - Worked with CTO and CMO to implement a trade show display using a 6DOF robot arm controlled via high level pick-and-place commands. Wrote Java backend to maintain world state and dynamically generate FORTH written over a serial bus to execute robot trajectories requested from high level RESTful API