Kaiyu Zheng

Roboticist / Research Scientist @ Boston Dynamics AI Institute
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Education

Ph.D. in Computer Science 2018/09 - 2022/12
Brown University, Providence, RI
Dissertation title: *"Generalized Object Search"*
Advisor: Stefanie Tellex
Committee: George Konidaris, Michael Littman, Ellie Pavlick, Leslie Kaelbling

M.S. in Computer Science 2017/09 - 2018/06
B.S. in Computer Science, Minor in Mathematics 2013/09 - 2017/06
University of Washington, Seattle, WA
"Learning Graph-Structured Sum-Product Networks for Probabilistic Semantic Maps"
Advisors: Andrzej Pronobis, Rajesh P. N. Rao

Professional Experience

Roboticist / Research Scientist
Boston Dynamics AI Institute, Cambridge, MA 2023/02 - now

Research Assistant, Humans To Robots Lab, Brown University
Advisor: Stefanie Tellex 2018/09 - 2022/12

Head Teaching Assistant, Learning & Sequential Decision Making, Brown CS
Instructor: Michael L. Littman 2021/09 - 2021/12

Research Intern, Learning & Intelligent Systems Lab, MIT CSAIL
Mentors: Yoonchang Sung, Rohan Chitnis 2020/06 - 2021/03
Advisors: Leslie P. Kaelbling, Tomás Lozano-Pérez

Research Assistant, Neural Systems Lab, University of Washington
Advisors: Andrzej Pronobis, Rajesh P. N. Rao 2016/03 - 2018/06

Teaching Assistant (× 5)
Computer Science & Engineering, University of Washington 2016/09 - 2018/06

Software Engineering Intern
Chicago Mercantile Exchange (CME), Chicago, IL 2015/06 - 2015/09

Research Assistant, Movement Control Lab, University of Washington
Advisors: Vikash Kumar, Emanuel Todorov 2015/04 - 2015/06

Web Developer
UW Information Technology, Seattle, WA 2014/10 - 2015/06

Honors & Awards

Robotics: Science and Systems (RSS) Pioneers 2022

IROS RoboCup Best Paper Award (winner) 2021
for "Multi-Resolution POMDP Planning for Multi-Object Search in 3D"

Andrew W. Mellon Foundation Future of Work Seed Grant 2019

Brown Graduate School Conference Travel Fund 2019

Publication of the Week, Weekly Robotics 2019
for "ROS Navigation Tuning Guide"

cum laude, with honors in Computer Science 2017

Publications

PhD Thesis

1. **Kaiyu Zheng**, "Generalized Object Search," Brown University, February, 2023.

Refereed Book Chapters

2. **Kaiyu Zheng,** "ROS Navigation Tuning Guide," in *Robot Operating System (ROS) - The Complete Reference (Volume 6)*, edited by Anis Koubaa, Springer, Cham, pp 197-226, July 2021. (Publication of the Week, Weekly Robotics)

Refereed Conference Papers

3. **Kaiyu Zheng**, Anirudha Paul, Stefanie Tellex, "A System for Generalized 3D Multi-Object Search," in *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

4. **Kaiyu Zheng**, Rohan Chitnis, Yoonchang Sung, George Konidaris, Stefanie Tellex, "Towards Optimal Correlational Object Search," in *IEEE International Conference on Robotics and Automation (ICRA)*, 2022.

5. **Kaiyu Zheng**, Deniz Bayazit, Rebecca Mathew, Ellie Pavlick, Stefanie Tellex, "Spatial Language Understanding for Object Search in Partially Observed Cityscale Environments," in *IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)*, 2021.

6. **Kaiyu Zheng**, Yoonchang Sung, George Konidaris, Stefanie Tellex, "Multi-Resolution POMDP Planning for Multi-Object Search in 3D," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2021.
IROS RoboCup Best Paper Award

7. **Kaiyu Zheng**, Andrzej Pronobis, "From Pixels to Buildings: End-to-end Probabilistic Deep Networks for Large-scale Semantic Mapping," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2019.

8. **Kaiyu Zheng**, Andrzej Pronobis, Rajesh P. N. Rao, "Learning Graph-Structured Sum-product Networks for Probabilistic Semantic Maps," in *AAAI Conference on Artificial Intelligence (AAAI)*, 2018. (oral presentation)

Refereed Workshop Papers and Extended Abstracts

9. Shangqun Yu, Sreehari Rammohan, **Kaiyu Zheng**, George Konidaris, "Hierarchical Reinforcement Learning of Locomotion Policies in Response to Approaching Objects: A Preliminary Study," in *Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM)*, 2022

10. Monica Roy*, **Kaiyu Zheng***, Jason Liu, Stefanie Tellex, "Dialogue Object Search," in *Robotics: Science and Systems (RSS) Workshop on Robotics for People: Perspectives on Interaction, Learning, and Safety*, 2021. * indicates equal contribution.

11. Semanti Basu, Sreshtaa Rajesh, **Kaiyu Zheng**, Stefanie Tellex, R. Iris Bahar, "Parallelizing POMCP to Solve Complex POMDPs," in *Robotics: Science and Systems (RSS) Workshop on Software Tools for Real-Time Optimal Control*, 2021.

12. **Kaiyu Zheng**, Stefanie Tellex, "`pomdp_py`: A Framework to Build and Solve POMDPs," in *International Conference on Automated Planning and Scheduling (ICAPS) Workshop on Planning and Robotics (PlanRob)*, 2020.

Software

`pomdp-py`: A framework to build and solve POMDP problems.
https://github.com/h2r/pomdp-py/

Datasets

Spatial Language on Open Street Maps
https://h2r.github.io/sloop/html/

Cognitive rObot Localization Database (COLD).
https://www.coldb.org/site/

Talks

Generalized Object Search
Northeastern GRAIL Laboratory, Boston, MA. 2022/12/15
MIT Interactive Robotics Group, Cambridge, MA. 2022/12/02
WPI ECE Graduate Seminar Lecture, virtual. 2022/11/30
Viam, New York, NY. 2022/11/04
CMU HRI Reading Group, virtual. 2022/10/11

Representations in Robotics
Brown Robotics Group Seminar, Providence, RI. 2022/07/01

Planning Under Uncertainty for Object Search
Georgia Tech RoboGrads Seminar, Atlanta, GA. 2022/04/22

Look we have a Spot
Brown Robotics Group Seminar, virtual. 2022/02/25

Towards Optimal Correlational Object Search
Brown Robotics Group Seminar, virtual. 2021/10/01

A Peek into Robotics Research Here at Brown
Brown University Staff Development Days, virtual. 2021/06/09

Multi-Resolution POMDP Planning for Multi-Object Search in 3D
MIT CSAIL Learning and Intelligent Systems Group, virtual. 2020/07/10
Brown Robotics Group Seminar, Providence, RI. 2020/02/07

End-to-end Probabilistic Deep Networks for Large-scale Semantic Mapping. Brown Visual Computing Seminar, Providence, RI. 2019/09/23

An Introduction to Semantic Mapping in Robotics
Brown Robotics Group Seminar, Providence, RI. 2019/03/22

Probabilistic Semantic Mapping Using Graph-Structured Sum-Product Networks Allen School Industry Affiliates Research Day, Seattle, WA. 2017/11/15

Teaching Experience

Learning & Sequential Decision Making (CSCI 2951F)
Head Teaching Assistant. Instructor: Michael L. Littman. Fall 2021
Brown University, Providence, RI

- Graduate-level course on automated decision making from a computer-science perspective. Topics include Markov decision processes, stochastic and repeated games, partially observable Markov decision processes, and reinforcement learning.
- As a head teaching assistant, I contributed to the course by developing project requirements, presenting project ideas, mentoring project groups, creating homework problems and solutions, holding office hours, and managing teaching assistants.

Machine Learning (CSE 446)
Teaching Assistant. Instructor: Sham M. Kakade. Winter 2018
Teaching Assistant. Instructor: Emily B. Fox. Winter 2017

University of Washington, Seattle, WA

- Undergraduate-level machine learning course. Topics include supervised learning and predictive modeling: decision trees, rule induction, nearest neighbors, Bayesian methods, neural networks, support vector machines, and model ensembles. Unsupervised learning and clustering.
- TA responsibilities: Lead section discussions ($\sim$ 30 students), grading, office hours

Foundation of Computing I (CSE 311)
Teaching Assistant. Instructors: Paul Beame, Kevin Zatloukal. Spring 2018
Teaching Assistant. Instructors: Paul Beame, Shayan Oveis Gharan. Fall 2016
University of Washington, Seattle, WA

- First CS major course. Examines fundamentals of logic, set theory, induction, and algebraic structures with applications to computing; finite state machines; and limits of computability.
- TA responsibilities: Lead section discussions ($\sim$ 30 students), grading, office hours

Data Structures and Algorithms (CSE 373)
Teaching Assistant. Instructor: Evan McCarty. Fall 2017
University of Washington, Seattle, WA

- For non-CS majors. Fundamental algorithms and data structures for implementation. Linked lists, stacks, queues, directed graphs. Trees: representations, traversals. Searching, hashing, sorting.
- TA responsibilities: Lead section discussions ($\sim$ 30 students), grading, office hours

Teaching Certificates

Sheridan Teaching Certificate I 2021/12
Brown University, Providence, RI.

- Develop and refine fundamental teaching and assessment strategies and communication skills based on how students learn.

Mentoring

Brown University

Anirudha Paul, MSc. student in CS	2021/10 - 2022/10
Semanti Basu, PhD student in CS (advised by R. Iris Bahar)	2020/09 - 2022/09
Vedant Gupta, BSc. student in CS	2022/03 - 2022/05
Eliza Sun, BSc. student in Math & CS	2022/03 - 2022/05
Haowei Gao, MSc. student in CS	2022/02 - 2022/05
Shangqun Yu, MSc. student in CS	2022/01 - 2022/05
Monica Roy, BSc. student in CS	2021/02 - 2022/05
Thomas Ottaway, BSc. student in CS	2020/09 - 2020/12
Deniz Bayazit, BSc. & MSc. student in CS (Now pursuing PhD in CS at EPFL in Switzerland)	2020/04 - 2021/03
Rebecca Mathew, BSc. student in CS & Linguistics	2020/04 - 2021/03

Service

Organizer
Brown Robotics Group Seminar Series. 2021
Organized a total of 40 talks, including 27 with external speakers.

Co-Organizer
Workshop on Language and Robot Learning, Conference on Robot Learning 2022

Program Committee
AAAI Student Abstract and Poster Program, AAAI 2023, 24

Reviewer

IEEE Transactions on Robotics (T-RO)	2022
IEEE Robotics and Automation Letters (RA-L)	2021 – 24
International Conference on Robotics and Automation (ICRA)	2019, 21 – 24
International Conference on Intelligent Robots and Systems (IROS)	2019, 21, 23
International Conference on Humanoid Robots (Humanoids)	2022
ACM SIGGRAPH Posters	2022

Extracurricular

Demonstrator, Brown Corporation Lab Tour, Brown Engineering.	2022
Organizer, Board Games Night, Brown CS.	2022
Presenter, Staff Development Day, Brown University.	2021
Peer mentor, PhD Mentorship Program, Brown CS.	2020 - 2022
Moderator, PhD Alumni Panel, Brown CS.	2020
Peer mentor, International Graduate Student Orientation.	2019, 2021
Producer, the "Working Robots" podcast.	2019 - 2021
Representative, Graduate Student Council, Brown CS.	2019 - 2020
Programming teacher, Asa Messer Elementry School, Providence, RI.	2018
Tutor, Allen School of Computer Science & Engineering.	2017
Food Packer, Food Lifeline, Seattle, WA.	2014
Table Demonstrator, Paws-on Science: Husky Weekend, Seattle, WA.	2014

Technical Skills

Programming Languages: Python, C, C++, Cython, JavaScript, Java, Lisp, SQL.
Robots: Boston Dynamics Spot, Kinova MOVO Mobile Manipulator.
Frameworks & Libraries: ROS, PyTorch, TensorFlow, Pyro, OpenCV, Open3D, OpenGL, Pandas, NumPy, Scipy, Matplotlib, Seaborn.
Simulation: AirSim, AI2-THOR, PyGame, MuJoCo, Unreal Engine 4, Unity3D
Design: InkScape, Blender, SolidWorks, Google Sketchup
Web: HTML, CSS, JavaScript, Flask, Ruby on Rails, PHP, PostgreSQL, MySQL, Sass, Unicorn & Nginx, AWS, gRPC.
Developer Tools: Emacs, Git, Docker, GNU Screen, Linux

Coursework

Advanced Probabilistic Methods (Grad-Level; Brown CSCI 2540; 4.0/4.0)
Designing Humanity-Centered Robots (Grad-Level; Brown CSCI 1951C; 4.0/4.0)
Machine Learning (Grad-Level; UW CSE 546; 4.0/4.0)
Distributed Systems (UW CSE 452; 4.0/4.0)
Operating Systems (UW CSE 451; 3.9/4.0)
Computer Vision (UW CSE 455; 4.0/4.0)
Computer Graphics (UW CSE 457; 3.9/4.0)
Database Systems (Grad-Level; UW CSE 544; 3.8/4.0)
Artificial Intelligence (UW CSE 473; 3.8/4.0)
Systems Programming (UW CSE 333; 3.9/4.0)
Data Structures and Parallelism (UW CSE 332; 4.0/4.0)
Digital Circuit and Systems (UW EE 271; 4.0/4.0)
Linear Analysis (UW Math 309; 4.0/4.0)
Matrix Algebra (UW Math 308; 4.0/4.0)
Differential Equations (UW Math 307; 4.0/4.0)

Languages

English (fluent); Chinese (Mandarin and Cantonese; native); French (basic)

Hobbies

Arts, Drawing, Painting, Go, History, Hiking, Sports, Piano.