# Lily Xu

lily_xu@g.harvard.edu
lily-x.github.io

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| EDUCATION | **Harvard University**. Cambridge, MA<br>PhD Candidate, School of Engineering and Applied Sciences<br>Advised by Prof. Milind Tambe | 2019 – present |
| | **Dartmouth College**. Hanover, NH<br>A.B. with Honors in Computer Science, minor in Spanish<br>*Magna cum laude* | 2014 – 2018 |

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| HONORS AND AWARDS | Google PhD Fellowship | 2022 |
| | INFORMS Doing Good with Good OR Competition Winner | 2021 |
| | AAAI Best Paper Award Runner Up | 2021 |
| | Harvard University Certificate of Distinction in Teaching | 2021 |
| | Certificate of Appreciation from the SMART Consortium | 2018 |
| | Five Citations for Academic Excellence at Dartmouth College | 2014 – 2018 |

> *Special distinction rarely awarded by faculty members "for meritorious characteristics not indicated adequately by academic grades."*
> > Computational Photography (Wojciech Jarosz, CS 89.15)
> > Latin American Film (Silvia Spitta, Spanish 63.01)
> > Computer Graphics (Emily Whiting, CS 77)
> > Object-Oriented Programming (Travis Peters, CS 10)
> > Introduction to Programming and Computation (Hany Farid, CS 1)

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| Adobe Women-In-Technology Scholarship – Honorable Mention | 2017 |
| Rick Angulo World Experience Award | 2016 |

> *For "intellectual openness, enthusiasm, and impressive academic performance" following a study abroad program in Cusco, Peru. Award in $1,500.*

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| James O. Freedman Presidential Scholar | 2016 |
| Willis S. Fitch '17 Metropolitan Washington Scholarship | 2015 |
| Bank of America's Joe Martin Scholarship | 2014 |

## PUBLICATIONS

\* *indicates equal contribution*
† *indicates undergraduate I advised*
$(\alpha-\beta)$ *indicates alphabetical ordering*

**Decisions without models: Bridging adaptive management and artificial intelligence**
*Under review*
Melissa Chapman, **Lily Xu**, Marcus Lapeyrolerie, Carl Boettiger

**Artificial Replay: A Meta-Algorithm for Harnessing Historical Data in Bandits**
*Under review*
$(\alpha-\beta)$ Siddhartha Banerjee, Sean R. Sinclair, Milind Tambe, **Lily Xu**, Christina Lee Yu

**Ranger Patrols Deter Poachers: Causal Inference with Bayesian Modeling and Field Tests as an Instrument**
*In preparation; preliminary at EAAMO 2022*
Rachel Guo†, **Lily Xu**, Andrew Perrault

**Robust Planning over Restless Groups: Engagement Interventions for a Large-Scale Maternal Telehealth Program**
*Under review; preliminary at EAAMO 2022*
Jackson A. Killian*, Arpita Biswas*, **Lily Xu**\*, Shresth Verma, Vineet Nair, Aparna Taneja, Aparna Hegde, Neha Madhiwalla, Paula Rodriguez Diaz, Sonja Johnson-Yu, Milind Tambe

**Optimistic Whittle Index Policy: Online Learning for Restless Bandits**
*Under review*
Kai Wang*, **Lily Xu**\*, Aparna Taneja, Milind Tambe

**Flexible Budgets in Restless Bandits: A Proximal Primal-Dual Algorithm for Efficient Budget Allocation**
*Under review*
Paula Rodriguez Diaz, Jackson A. Killian, **Lily Xu**, Aparna Taneja, Arun Sai Suggala, Milind Tambe

**Restless and Uncertain: Robust Policies for Restless Bandits via Deep Multi-Agent Reinforcement Learning**
*UAI 2022.* Proc. 38th Conference on Uncertainty in Artificial Intelligence
Jackson A. Killian, **Lily Xu**, Arpita Biswas, Milind Tambe

**Ranked Prioritization of Groups in Combinatorial Bandit Allocation**
*IJCAI 2022.* Proc. 31st International Joint Conference on Artificial Intelligence
**Lily Xu**, Arpita Biswas, Fei Fang, Milind Tambe

**Coordinating Followers to Reach Better Equilibria: End-to-End Gradient Descent for Stackelberg Games**
*AAAI 2022.* Proc. 36th AAAI Conference on Artificial Intelligence
Kai Wang, **Lily Xu**, Andrew Perrault, Michael K. Reiter, Milind Tambe

**Robust Reinforcement Learning Under Minimax Regret for Green Security**
*UAI 2021.* Proc. 37th Conference on Uncertainty in Artificial Intelligence
**Lily Xu**, Andrew Perrault, Fei Fang, Haipeng Chen, Milind Tambe
    **Oral Presentation**
    *Top 6.17% of submissions*

**Envisioning Communities: A Participatory Approach Towards AI for Social Good**
*AIES 2021.* Proc. 4th AAI/ACM Conference on AI, Ethics, and Society
Elizabeth Bondi*, **Lily Xu**\*, Diana Acosta-Navas, Jackson A. Killian

**Dual-Mandate Patrols: Multi-Armed Bandits for Green Security**
*AAAI 2021.* Proc. 35th AAAI Conference on Artificial Intelligence
**Lily Xu**, Elizabeth Bondi, Fei Fang, Andrew Perrault, Kai Wang, and Milind Tambe
    **Best Paper Award Runner Up**
    *Top 6 of 1692 accepted papers (top 0.08% of submissions)*

**Stay Ahead of Poachers: Illegal Wildlife Poaching Prediction and Patrol Planning Under Uncertainty with Field Test Evaluations**
*ICDE 2020.* Proc. 36th IEEE International Conference on Data Engineering
**Lily Xu**\*, Shahrzad Gholami*, Sara Mc Carthy, Bistra Dilkina, Andrew Plumptre, Milind Tambe, Rohit Singh, Mustapha Nsubuga, Joshua Mabonga, Margaret Driciru,

Fred Wanyama, Aggrey Rwetsiba, Tom Okello, Eric Enyel

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| WORKSHOP PAPERS | **Enhancing Poaching Predictions for Under-Resourced Wildlife Conservation Parks Using Remote Sensing Imagery** |

*NeurIPS MD4D.* Workshop on Machine Learning for Development 2020
Rachel Guo[†], **Lily Xu**, Andrew Plumptre, Drew Cronin, Francis Okeke, and Milind Tambe

   **Best Lightning Paper**

**Game Theory on the Ground: The Effect of Increased Patrols on Deterring Poachers**
*Working paper*
*Appeared at Harvard CRCS Workshop on AI for Social Good 2020*
**Lily Xu**, Andrew Perrault, Andrew Plumptre, Margaret Driciru, Fred Wanyama, Aggrey Rwetsiba, and Milind Tambe

**A High-Performance Graph Model for Near-Optimal Payments for Ecosystem Services**
*Working paper*
*Appeared at Mechanism Design for Social Good (MD4SG) Workshop 2020*
Florian Berlinger\*, **Lily Xu\***, Yiling Chen
*\*Equal contribution*

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| NON-PROFIT SERVICE | **SMART Conservation Partnership.** |

*AI Lead*         2022 – present

   *I advise SMART on how to effectively integrate AI, computation, and research into their management activities. SMART is a consortium of 9 leading conservation NGOs: WWF, WCS, Peace Parks Foundation, Wildlife Protection Solutions, Frankfurt Zoological Society, ZSL, NC Zoo, Panthera, and Re:wild.*

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| RESEARCH EXPERIENCE | **Harvard University**. Cambridge, MA |

*Doctoral Research Assistant*         2019 – present
Advised by Prof. Milind Tambe

**University of Southern California**. Los Angeles, CA
*Doctoral Research Assistant*         2018 – 2019
Advised by Prof. Bistra Dilkina and Prof. Milind Tambe

**Dartmouth College**. Hanover, NH
*Undergraduate Senior Thesis Researcher*         2017 – 2018
Advised by Prof. Amro Farid

*Presidential Scholar Research Assistant*         2016 – 2017
Advised by Prof. Emily Whiting and Prof. David Kotz

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| WORK EXPERIENCE | **Google Research**. India, AI for Social Good lab |

*Student Researcher*         Spring 2022

**Google**. Seattle, WA
*Software Engineering Intern*         Summer 2017

**Dyn, Inc**. Hanover, NH

|  | Data Analytics Research Intern | Spring 2016 |
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| TEACHING EXPERIENCE | → *Guest Lecturer* | |
| | *Harvard University.*  CS 288. AI for Social Impact | Fall 2022 |
| | *Wellesley University.*  CS 115. Computing for the Socio-Techno Web | Fall 2022 |
| | *Ohio State University.*  CSE 3521. Survey of Artificial Intelligence I | Fall 2022 |
| | *University of Southern California.*  ISE 599. Analytics for Social Impact | Spring 2022 |
| | *University of Pennsylvania.*  OIDD 941. Recent Advances in Data-Driven Decision-Making | Spring 2022 |
| | *Harvard University.*  CS 96. Machine Learning for Social Impact | Spring 2022 |
| | *Cornell Tech.*  ORIE 5355/INFO 5370. People, Data, Systems | Fall 2021 |
| | *Wellesley University.*  CS 115. Computing for the Socio-Techno Web | Fall 2021 |
| | *Australian National University.*  CECS8001. Building Cyber-Physical Systems | Fall 2021 |
| | *University of Pittsburgh.*  CS 1699. AI for Good: Ethics and Implications | Spring 2021 |
| | *University of Michigan.*  SI 431. Algorithms and Society | Spring 2021 |
| | *Harvard University.*  CS 182. Artificial Intelligence | Fall 2020 |
| | *Dartmouth College.*  CS 11. Foundations of Applied Computer Science | Spring 2018 |

**Harvard University**
→ *Head Teaching Fellow*

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|---|---|
| CS 182: Artificial Intelligence | Fall 2020 |

**Dartmouth College**
→ *Teaching Assistant, Department of Computer Science*

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|---|---|
| CS 31: Algorithms | Winter 2017 |
| CS 11: Foundations of Applied Computer Science, *head TA* | Spring 2018 |
| CS 10: Object-Oriented Programming | Spring 2016 |
| CS 10: Object-Oriented Programming | Spring 2015 |
| CS 1: Intro to Programming and Computation | Spring 2018 |
| CS 1: Intro to Programming and Computation | Fall 2017 |
| CS 1: Intro to Programming and Computation | Spring 2017 |
| CS 1: Intro to Programming and Computation | Winter 2016 |
| CS 1: Intro to Programming and Computation | Fall 2015 |

→ *Teaching Assistant, Tuck School of Business*

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|---|---|
| Tuck FWP: Fundamentals of Web Programming | Spring 2017 |
| Tuck DSA: Data Structures and Analytics | Spring 2017 |

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| STUDENTS ADVISED | → *At Harvard College* | |
| | Vincent Börsch-Supan '25 | Sept 2022 – |
| | Alejandra Perea Rojas '24 | June 2022 – |
| | Christopher Ong '23 | Spring 2022 |
| | April Chen '22 | Summer 2021 |
| | *Adobe Research Women-In-Technology Scholarship Winner* | |
| | Ezenia Diaz-Lembert '23 | Spring 2021 |
| | Emilia Cabrera '21 | Sept 2020 – Dec 2021 |
| | *Thesis: Protecting the Lion's Share: Mitigating Illegal Wildlife Poaching with Multi-Agent Reinforcement Learning* | |
| | Rachel Guo '22 | June 2020 – |
| | *NCWIT Collegiate Award Winner* | |
| | *CRA Outstanding Undergraduate Researcher Award — Honorable Mention* | |

*Harvard Hoopes Prize for Outstanding Thesis*
*Thesis: On the Effect of Ranger Patrols on Deterring Poaching: A Bayesian*
*Approach for Causal Inference Using Field Tests as an Instrument*

| PROFESSIONAL SERVICE | | |
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**Initiative Organization**

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|---|---|
| Co-organizer, Mechanism Design for Social Good (MD4SG) | March 2021 – |
| Co-lead, MD4SG Community Engagement | Oct 2020 – Apr 2021 |
| Co-organizer, MD4SG Working Group on Environment | Jan 2020 – Apr 2021 |

**Program Organization**

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|---|---|
| Co-organizer, AI-Assisted Decision Making for Conservation Workshop at Harvard CRCS | October 2022 |
| Social chair, ACM EAAMO'22 | October 2022 |
| Organizer, SMART/PAWS Workshop. Rio Bravo, Belize | August 2022 |
| Co-organizer, Harvard CRCS Panel on the Future of AI for Social Impact | April 2022 |
| Co-organizer, Harvard CRCS Social Impact Seminar Series | Spring 2022 |
| Social co-chair, ACM EAAMO'21 | October 2021 |
| Co-organizer, Harvard CRCS Rising Stars Speaker Series | April 2021 |
| Co-organizer, CompSust Open Graduate Seminar (COGS) | Spring 2020 |
| Social co-chair, Fourth Workshop on MD4SG | August 2020 |
| Lead organizer, Harvard CRCS Rising Stars Workshop | March 2020 |
| Co-organizer, Computational Sustainability Doctoral Consortium | October 2019 |

**Program Committee (Reviewing)**

→ *Conferences*

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|---|---|
| *AAAI.* AAAI Conference on Artificial Intelligence | 2023 |
| *AAAI AISI track.* AAAI Conference on Artificial Intelligence | 2020, 2021, 2022 |
| *IAAI.* AAAI Innovative Applications of Artificial Intelligence | 2023 |
| *EAAMO.* Equity and Access in Algorithms, Mechanisms, and Optimization | 2021, 2022 |
| *AIES.* Artificial Intelligence, Ethics, and Society | 2022 |
| *FAccT.* ACM Conference on Fairness, Accountability, and Transparency | 2022 |
| *COMPASS.* ACM SIGCAS Conference on Computing and Sustainable Societies | 2021 |

→ *Workshops*

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|---|---|
| RL Ready for Production Workshop @ AAAI | 2023 |
| AI for Social Good Workshop @ AAAI | 2023 |
| Cooperative AI Workshop @ NeurIPS | 2022 |
| Data-Driven Humanitarian Mapping @ KDD | 2020, 2021, 2022 |
| Black in AI Workshop @ NeurIPS | 2020, 2021, 2022 |
| Machine Learning for the Developing World (ML4D) @ NeurIPS | 2020, 2021 |
| Machine Learning for Public Health (ML4PH) @ NeurIPS | 2021 |
| Autonomous Agents for Social Good (AASG) Workshop @ AAMAS | 2021 |
| AI for Social Good Workshop @ IJCAI | 2020 |
| Resistance AI @ NeurIPS | 2020 |
| Fourth Workshop on Mechanism Design for Social Good (MD4SG) | 2020 |
| AI for Social Good Workshop @ Harvard CRCS | 2020 |

**Competition Selection Committee**

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| AI2, EarthRanger Conservation Tech Award | 2022 |

**Reviewer**

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|---|---|
| Deep Learning Indaba | 2022 |

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| Caltech Computer Vision for Ecology (CV4Ecology) Summer School           | 2022      |
| ICML, *subreviewer*                                                      | 2021      |
| NeurIPS, *subreviewer*                                                   | 2020      |
| IJCAI Special Track on CompSust and Human Well-being, *subreviewer*      | 2020      |
| COMPASS, *subreviewer*                                                   | 2019      |
| Bloomberg Data for Good Exchange (D4GX), *subreviewer*                    | 2019      |

INVITED PANELS

| | |
|---|---|
| *Hertz Foundation Workshop.* AI Science and Policy, *moderator* <br> Jacob Steinhardt, Julie Owono, Jessica Fjeld | July 2022 |
| *Harvard CRCS.* The Future of AI for Social Impact, *co-moderator* <br> Fei Fang, Lynn Kaack, Danaë Metaxa, Bryan Wilder | April 2022 |
| *South by Southwest (SXSW).* AI for Wildlife | March 2021 |
| *Harvard CRCS.* AI for Social Impact, *moderator* <br> Susan Murphy, Erez Yoeli, Desmond Patton | March 2020 |

INVITED TALKS    *Does not include contributed conference and workshop talks*

**Causal AI and Conservation**

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|---|---|
| *WWF.* Fuller Seminar Series on Conservation AI | January 2023 |

**Learning and Planning Under Uncertainty for Wildlife Conservation**

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|---|---|
| *Operations Research Society of South Africa.* | 2023 |
| *Georgia Tech.* ISyE DEI seminar | November 2022 |
| *Analytics for a Better World.* | September 2022 |
| *Harvard University.* Kempner Institute celebration | September 2022 |
| *Universität Tübingen.* Decision Making Group | August 2022 |
| *Harvard Kennedy School.* "Leading in AI" Executive Education | July 2022 |
| *Harvard SEAS.* Summertime Seminar Series | June 2022 |
| *UC Berkeley.* Ethics and Practices of Algorithmic Conservation | April 2022 |
| *MD4SG.* Environment Working Group | April 2022 |
| *UCL.* Climate Hack AI Competition, *keynote* | March 2022 |
| *Harvard University.* AI-Assisted Decision-Making Colloquium | February 2022 |
| *Pasteur's Quadrant.* Seminar Series | February 2022 |
| *Harvard Business School.* From Data to Decisions | October 2021 |
| *INFORMS.* Doing Good with Good OR Finalists | October 2021 |

**Ranked Prioritization of Groups in Combinatorial Bandit Allocation**

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|---|---|
| *Sony.* Computer Science Laboratories (CSL) Paris | October 2022 |
| *Stanford.* Computing & Society group | October 2022 |
| *INFORMS Annual Meeting.* "Fairness in Sequential Decision Making" | October 2022 |

**Envisioning Communities: A Participatory Approach to AI for Social Good**

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|---|---|
| *MIT.* AI Ethics group | September 2022 |
| *Harvard.* AI for Social Impact (CS 288) | September 2022 |
| *Women's Forum.* Women4AI Daring Circle workshop | June 2022 |

**Robust Reinforcement Learning Under Minimax Regret for Green Security**

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|---|---|
| *CompSust.* Computational Sustainability Doctoral Consortium | March 2022 |
| *Google Research India.* AI for Social Good | January 2022 |

**PAWS: AI to Predict and Plan Against Poaching**

*ICCB.* International Congress for Conservation Biology. Kigali, Rwanda   December 2021

*IUCN WCC.* World Conservation Congress. Marseille, France          September 2021

*WILDLABS.* Tech Tutors: Season Three                                September 2021

*AI for Climate.* Mexico Lightning Talks Series powered by Huawei          July 2021

*SMART Partnership.* International Women's Day Webinar                 March 2021

*WWF.* Webinar on SMART                                               April 2020


### Dual-Mandate Patrols: Multi-Armed Bandits for Green Security

*Beijing Academy of Artificial Intelligence.*                         March 2021

*University College London.* AI Society                            February 2021

*Harvard University.* EconCS Seminar                                  March 2020


### Poaching Prediction and Patrol Planning Under Uncertainty

*AI LA.* Earth Summit                                                 April 2021

*Harvard CRCS.* Rising Stars Workshop                                 March 2020

*Harvard University.* PhD on Tap                                   February 2020


OUTREACH

### Speaking

*Harvard.* Tech for Social Good, *panelist*                           April 2021

*Harvard SEAS.* PhD Admitted Students Open House, *panelist*          March 2021

*Harvard SEAS.* Research Labs Open House                          November 2020

*GirlsComputingLeague.* AInnovation Business Summit               September 2020

*IEEE Computer Society.* Women in Computing, Kerala Chapter      September 2020

*Data Science Africa.* Tutorial on MD4SG and the Environment          July 2020

*Ledyard Canoe Club.* Inclusivity in the Outdoors                     July 2020

*Dartmouth.* Women in Computer Science, *panelist*                     May 2020

*Harvard SEAS.* Diversity, Inclusivity, and Belonging, *panelist*       May 2020

*Center for Initiatives in Jewish Education.* High school student visit   March 2020

*World Science Festival.* Science and Storytime                       June 2019

*L.A. Unified School District (LAUSD).* African American Family Day    May 2019

*Zoo Magnet High School.* College and Career Day                 November 2018


### Mentoring

*Harvard University.* InTouch Peer Mentor                             2020 –

*Harvard University.* Women in STEM Mentor                      2019 – 2020

*Dartmouth College.* Women in Computer Science                   2017 – 2018


### Volunteering

*Harvard SEAS.* A Guide to Your PhD                               October 2020

*Harvard University.* Project Teach                                   April 2020

*Cambridge Public Schools.* STEAM It Up!                          October 2019

*Hustle N' Code.* Hackathon, *technical lead*                     December 2018

   Hustle N' Code is a Los Angeles hackathon for youth in public housing.
   My team won first place, and the four students each received a laptop.


PRESS

### Case Studies

*Harvard Business School.* SMART: AI and ML for Wildlife Conservation   October 2022


### Podcasts

*INFORMS Resoundingly Human Podcast.*                                 May 2022

*Rethinking Economics NL.* Disruptive Technologies podcast series.      May 2021

**Video**

*AIhub.* New Voices in AI: environmental conservation with Lily Xu.    October 2022
*Voice of America (VOA) News.* Wildlife Rangers Use AI to Predict Poachers' Next
Moves.        January 2022

**Text**

*Business Insider.* Conservationists are using artificial intelligence to map out the
best ways for saving threatened wildlife and resources      October 2022
*Oxford Science.* AI in conservation: a modern-day solution to the biodiversity
crisis?        March 2022
*The Hill.* These new technologies could transform wildlife conservation.    February
2022
*Harvard SEAS.* Computer Conservation.        November 2021
*AIhub.* Interview with Lily Xu.        October 2021
*Engadget.* PAWS anti-poaching AI predicts where illegal hunters will show up next.
March 2021
*Mongabay.* Where to patrol next: 'Netflix' of ranger AI serves up poaching
predictions.        November 2020
*Harvard SEAS.* Preventing poaching.        June 2020
*BBC Sounds.* How tech is tackling wildlife trafficking.        June 2020
*BBC World Service.* Using technology to take on poachers.      August 2019
*USC Viterbi Magazine.* AI is for Animals.        April 2019

NON-ACADEMIC
LEADERSHIP

**Ledyard Canoe Club at Dartmouth**. *Secretary, Canoeing Leader*      2014 – 2018
- Co-governed club functions for over 100 undergraduates. Managed club assets that include $1M in endowments, a student-run rental business with annual revenues of $50K, and boats and equipment valued at $150K.
- Co-organized an Explorers Symposium featuring ten notable speakers, including Olympic racers and members of National Geographic–sponsored expeditions.
- Led a group of twenty-eight students on a nine-day, 220-mile canoe expedition.
- Voted by my peers to receive the Jay Evans '49 Award for service and commitment to the club.

**Fusion Dance Ensemble**. *Director*        2014 – 2018
- Led a group of fourteen dancers. Choreographed, taught, and performed contemporary and hip-hop dances, with over 20 performances each year.

**Dartmouth Sophomore Trips**. *Co-director*        2015 – 2016
- Planned the Sophomore Trips program for 130 undergraduates across 14 three-day outdoor trips throughout New Hampshire and Vermont.

**Dartmouth First-Year Trips**. *Grant Crew Volunteer*      Summer 2015
- Served on a nine-person crew for a 21-day, round-the-clock commitment to assist with five-day outdoor orientation trips for 1,000 incoming students.

PERSONAL      Residential member, Los Angeles Eco Village        2018 – 2019