2022 - present

lily\_xu@g.harvard.edu lily-x.github.io

#### **EDUCATION** Harvard University. Cambridge, MA (expected) 2024 PhD Candidate in Computer Science Advised by Prof. Milind Tambe Dartmouth College. Hanover, NH 2018 A.B. with Honors in Computer Science, minor in Spanish Magna cum laude 2023 Honors and Stanford Rising Star in Management Science and Engineering (MS&E) Awards Google PhD Fellowship 2022 INFORMS Doing Good with Good OR Competition Winner 2021 Recognizes the "most exciting work performed by students in partnership with public and private organizations that yields tangible and beneficial outcomes for individuals, communities, and organizations". AAAI Best Paper Award Runner Up 2021 3 best papers and 3 runner-ups were selected out of 9,034 submissions and 1,692 accepted papers. Harvard University Certificate of Distinction in Teaching 2021 Certificate of Appreciation from the SMART Consortium 2018 2014 - 2018Five Citations for Academic Excellence at Dartmouth College Special distinction rarely awarded by faculty members "for meritorious characteristics not indicated adequately by academic grades", received across five computer science and Spanish courses. 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.

### Non-Profit Service

### SMART Conservation Partnership.

AI Lead

I work with SMART to effectively integrate AI, computation, and research into their conservation management activities. The SMART Partnership is the global leader in protected area solutions, consisting of 9 leading conservation NGOs: WWF, WCS, Peace Parks Foundation, Wildlife Protection Solutions, Frankfurt Zoological Society, ZSL, NC Zoo, Panthera, and Re:wild.

## Publications (Journals)

\* indicates equal contribution

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

# Towards more effective use of ranger-based monitoring for protected area management

 $in\ preparation$ 

with Timothy Kuiper, Anthony Dancer, Colin Beale, Arash Ghoddousi, Harriet Ibbett, Laure Joanny, Blessing Kavhu, Aidan Keane, Daniel Makaza, Jennifer F. Moore, E.J. Milner-Gulland

Ranger patrols deter poaching: first causal insights for improving

### protected area management

under review at Science

Rachel Guo<sup>†\*</sup>, **Lily Xu**\*, Andrew Perrault, Luke W. Miratrix, Andrew J. Plumptre, Joshua Mabonga, Herbert Kitimbo, Fredrick Wanyama, Milind Tambe, Andrew B. Davies

### Human histories shape the biodiversity data that decides our future

under review at Science; preliminary abstract accepted at EGU 2023 Melissa Chapman, Benjamin Goldstein, Christopher Schell, Justin Brashares, Neil Carter, Diego Ellis-Soto, Hilary Faxon, Jenny Goldstein, Joycelyn Longdon, Kari Norman, Dara O'Rourke, Caleb Scoville, **Lily Xu**, Carl Boettiger

## Bridging adaptive management and reinforcement learning for more robust decisions

Philosophical Transactions of the Royal Society B (2023) Melissa Chapman, Lily Xu, Marcus Lapeyrolerie, Carl Boettiger

# Publications (Book Chapters)

### Environment, Society, and Machine Learning

S) Oxford Handbook of the Sociology of Machine Learning (2023)

Caleb Scoville, Hilary Faxon, Melissa Chapman, Samantha Jo Fried, **Lily Xu**, Carl Boettiger, J. Michael Reed, Marcus Lapeyrolerie, Amy Van Scoyoc, Razvan Amironesei

# Publications (Conferences)

## Combinatorial optimization for sequential decisions: interventions on restless bandits

 $in\ preparation$ 

Lily Xu, Bryan Wilder, Milind Tambe

### Online Learning for Contextual and Non-Stationary Restless Multi-Armed Bandits

in preparation

Biyonka Liang, Lily Xu, Aparna Taneja, Milind Tambe, Lucas Janson

### 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

#### Optimistic Whittle Index Policy: Online Learning for Restless Bandits

AAAI 2023. Thirty-Seventh AAAI Conference on Artificial Intelligence Kai Wang\*, Lily Xu\*, Aparna Taneja, Milind Tambe

# Flexible Budgets in Restless Bandits: A Proximal Primal-Dual Algorithm for Efficient Budget Allocation

AAAI 2023. Thirty-Seventh AAAI Conference on Artificial Intelligence Paula Rodriguez Diaz, Jackson A. Killian, **Lily Xu**, Aparna Taneja, Arun Sai Suggala, Milind Tambe

# Robust Planning over Restless Groups: Engagement Interventions for a Large-Scale Maternal Telehealth Program

AAAI 2023. Thirty-Seventh AAAI Conference on Artificial Intelligence 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

### 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

# WORKSHOP PAPERS Enhancing Poaching Predictions for Under-Resourced Wildlife / Preprints Conservation Parks Using Remote Sensing Imagery

NeurIPS~MD4D. Workshop on Machine Learning for Development 2020 Rachel Guo<sup>†</sup>, **Lily Xu**, Andrew Plumptre, Drew Cronin, Francis Okeke, and Milind Tambe

Best Lightning Paper

Work Experience	<b>Google Research</b> . India, AI for Social Good lab Student Researcher	Spring 2022
	Google. Seattle, WA Software Engineering Intern	Summer 2017
	<b>Dyn, Inc.</b> Hanover, NH Data Analytics Research Intern	Spring 2016
TEACHING EXPERIENCE	→ Guest Lecturer Cornell University. INFO 6960. Data Science for Global Developm MIT. 15 076. Analytics for a Better World Harvard University. CS 96. Machine Learning for Social Impact Wellesley University. CS 115. Computing for the Socio-Techno We Ohio State University. CSE 3521. Survey of Artificial Intelligence Inviversity of Southern California. ISE 599. Analytics for Social Im University of Pennsylvania. OIDD 941. Recent Advances in Data- Decision-Making Harvard University. CS 96. Machine Learning for Social Impact Cornell Tech. ORIE 5355/INFO 5370. People, Data, Systems Wellesley University. CS 115. Computing for the Socio-Techno We Australian National University. CECS8001. Building Cyber-Physic 2021 University of Pittsburgh. CS 1699. AI for Good: Ethics and Implic 2021 University of Michigan. SI 431. Algorithms and Society Harvard University. CS 182. Artificial Intelligence Dartmouth College. CS 11. Foundations of Applied Computer Scie  Harvard University  → Head Teaching Fellow	Spring 2023 Spring 2023 Spring 2023 Spring 2022 I Fall 2022 Spring 2022 Spring 2022 Spring 2022 Fall 2021 Scal Systems Fall Spring 2021 Fall 2021 Fall 2021 Fall 2021 Spring 2021 Fall 2020 Spring 2021 Fall 2020 Fall 2020 Spring 2018
	CS 182: Artificial Intelligence  Dartmouth College	Fall 2020
	<ul> <li>→ Teaching Assistant, Department of Computer Science</li> <li>CS 31: Algorithms</li> <li>CS 11: Foundations of Applied Computer Science, head TA</li> <li>CS 10: Object-Oriented Programming</li> <li>CS 10: Object-Oriented Programming</li> <li>CS 1: Intro to Programming and Computation</li> </ul>	Winter 2017 Spring 2018 Spring 2016 Spring 2015 Spring 2018 Fall 2017 Spring 2017 Winter 2016 Fall 2015
	Tuck FWP: Fundamentals of Web Programming Tuck DSA: Data Structures and Analytics	Spring 2017 Spring 2017
STUDENTS ADVISED	Vincent Börsch-Supan '25	Sept 2022 – e 2022 – Dec 2022 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 - May 2023 NCWIT Collegiate Award Winner CRA Outstanding Undergraduate Researcher Award — Honorable Mention Harvard Hoopes Prize for Outstanding Thesis NSF Graduate Research Fellowship Thesis: On the Effect of Ranger Patrols on Deterring Poaching: A Bayesian Approach for Causal Inference Using Field Tests as an Instrument Next step: Stanford ICME PhD student **Initiative Organization** Co-organizer, Mechanism Design for Social Good (MD4SG) March 2021 -Co-lead, MD4SG Community Engagement Oct 2020 - Apr 2021 Co-founder and co-organizer, MD4SG Working Group on Environment Jan 2020 -Apr 2021 Workshop Organization Co-organizer, AI-Assisted Decision Making for Conservation Workshop October 2022 Organizer, SMART/PAWS Workshop. Rio Bravo, Belize August 2022 Lead organizer, Harvard CRCS Rising Stars Workshop March 2020 Co-organizer, Computational Sustainability Doctoral Consortium October 2019 **Tutorials** Lead organizer, AI for Social Impact tutorial August 2023 with Emily Aiken, Priya Donti, Nikhil Garg, and Paul Gölz Conference Event Organization Social co-chair, ACM EAAMO'23 October 2023 Social chair, ACM EAAMO'22 October 2022 Social co-chair, ACM EAAMO'21 October 2021 Social co-chair, Fourth Workshop on MD4SG August 2020 Seminar Organization 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 Co-organizer, Harvard CRCS Rising Stars Speaker Series April 2021 Co-organizer, CompSust Open Graduate Seminar (COGS) Spring 2020 Program Committee (Reviewing) Conferences AIES. Artificial Intelligence, Ethics, and Society 2022, 2023 AAAI. AAAI Conference on Artificial Intelligence 2023 AAAI AISI track. AAAI Conference on Artificial Intelligence 2020, 2021, 2022 COMPASS. ACM SIGCAS Conference on Computing and Sustainable Societies EAAMO. Equity and Access in Algorithms, Mechanisms, and Optimization 2021, 2022, 2023 FAccT. ACM Conference on Fairness, Accountability, and Transparency 2022, 2023 IAAI. AAAI Innovative Applications of Artificial Intelligence 2023

Professional

SERVICE

	NeurIPS. Neural Information Processing Systems $UAI$ . Uncertainty in Artificial Intelligence	2023 2023
		2023 2023 2021, 2023 2023 2022 2020, 2021, 2022 2020, 2021, 2022 2020, 2021 2020 2020 2020 2020 2020 2020
	Competition Selection Committee AI2, EarthRanger Conservation Tech Award	2022, 2023
	Reviewer Deep Learning Indaba Caltech Computer Vision for Ecology (CV4Ecology) Summer School ICML, subreviewer NeurIPS, subreviewer IJCAI Special Track on CompSust and Human Well-being, subreviewer COMPASS, subreviewer Bloomberg Data for Good Exchange (D4GX), subreviewer	2022 2022 2021 2020 2020 2019 2019
Invited Panels	Hertz Foundation Workshop. AI Science and Policy, moderator panelists: Jacob Steinhardt, Julie Owono, Jessica Fjeld Harvard CRCS. The Future of AI for Social Impact, co-moderator panelists: Fei Fang, Lynn Kaack, Danaë Metaxa, Bryan Wilder South by Southwest (SXSW). AI for Wildlife, panelist Harvard CRCS. AI for Social Impact, moderator panelists: Susan Murphy, Erez Yoeli, Desmond Patton	July 2022 April 2022 March 2021 March 2020
Invited Talks	Does not include contributed conference and workshop talks	
	Minimax Regret Optimization: Robust Planning for Conser Maternal Health  UC Berkeley. Multi-Agent Learning Seminar (Berkeley MARL)  Brown University. Algorithmic Game Theory group	March 2023 March 2023
	Causal AI and Conservation  INFORMS Annual Meeting. ML for Social Good session  ICCB. SMART Symposium  Microsoft Research New England. Machine Learning Ideas seminar  United Nations ITU. AI for Good Summit  WWF. Fuller Seminar Series on Conservation AI  Learning and Planning Under Uncertainty for Wildlife Cons	October 2023  July 2023  June 2023  June 2023  April 2023  servation
	and I among a near a near of the first tribulation and the second and the	

	Harvard Kennedy School. "Leading in AI" Executive Education Penn State. CSRAI Young Achievers Symposium UC Berkeley. Global Policy Lab Centro de Analítica para Políticas Públicas (CAPP). (in Spanish) Georgia Tech. ISyE seminar Analytics for a Better World.  Harvard University. Kempner Institute launch celebration Universität Tübingen. Decision Making Group Harvard Kennedy School. "Leading in AI" Executive Education Harvard SEAS. Summertime Seminar Series UC Berkeley. Ethics and Practices of Algorithmic Conservation MD4SG. Environment Working Group UCL. Climate Hack AI Competition, keynote Harvard University. AI-Assisted Decision-Making Colloquium Pasteur's Quadrant. Seminar Series Harvard Business School. From Data to Decisions INFORMS. Doing Good with Good OR Finalists	July 2023 March 2023 February 2023 December 2022 November 2022 September 2022 September 2022 August 2022 July 2022 June 2022 April 2022 April 2022 March 2022 February 2022 February 2022 February 2022 October 2021 October 2021
	Ranked Prioritization of Groups in Combinatorial Bandit A Sony. Computer Science Laboratories (CSL) Paris Stanford. Computing & Society group INFORMS Annual Meeting. Fairness in Sequential Decision Makin 2022	October 2022 October 2022
	Envisioning Communities: A Participatory Approach to AI Good  MIT. AI Ethics group	September 2022
	Harvard. AI for Social Impact class Women's Forum. Women4AI Daring Circle workshop	September 2022 June 2022
	Robust Reinforcement Learning Under Minimax Regret for Security	r Green
	CompSust. Computational Sustainability Doctoral Consortium Google Research India. AI for Social Good research group	March 2022 January 2022
	PAWS: AI to Predict and Plan Against Poaching ICCB. International Congress for Conservation Biology IUCN WCC. World Conservation Congress WILDLABS. Tech Tutors: Season Three AI for Climate. Mexico Talk Series powered by Huawei SMART Partnership. International Women's Day Webinar WWF. Webinar on SMART AI LA. Earth Summit	December 2021 September 2021 September 2021 July 2021 March 2021 April 2020 April 2021
	Dual-Mandate Patrols: Multi-Armed Bandits for Green See Beijing Academy of Artificial Intelligence. University College London. AI Society Harvard University. EconCS Seminar	curity  March 2021  February 2021  March 2020
OUTREACH	Speaking  Harvard. Tech for Social Good and Harvard Computer Society  Harvard. Tech for Social Good, panelist  Harvard SEAS. PhD Admitted Students Open House, panelist  Harvard SEAS. Research Labs Open House	March 2023 April 2021 March 2021 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	t March 2020
World Science Festival. Science and Storytime	June 2019
L.A. Unified School District (LAUSD). African American Family Da	ay 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**

Ecochat. AI for Conservation - Using Machine Learning to Stop Poaching	2023
Cold Call (Harvard Business School podcast). Can AI and Machine Learn	ing Help
Park Rangers Prevent Poaching?	2023
INFORMS Resoundingly Human Podcast.	May 2022
Rethinking Economics NL. Disruptive Technologies podcast series.	May 2021

### Video

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

#### Articles

Business Insider. Conservationists are using artificial intelligence to ma	p out the
best ways for saving threatened wildlife and resources	October 2022
Oxford Science. AI in conservation: a modern-day solution to the biodi	versity
crisis?	March 2022
The Hill. These new technologies could transform wildlife conservation.	February

2022

November 2021

Alhub. 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.

BBC Sounds. How tech is tackling wildlife trafficking.

BBC World Service. Using technology to take on poachers.

USC Viterbi Magazine. AI is for Animals.

June 2020

August 2019

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