

# Lily Xu

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

EDUCATION	<b>Harvard University.</b> Cambridge, MA PhD Candidate in Computer Science <i>Advisor: Milind Tambe</i> <i>Thesis committee: Dimitris Bertsimas, Yiling Chen, Andrew Davies</i> <b>Dartmouth College.</b> Hanover, NH A.B. with Honors in Computer Science, minor in Spanish <i>Magna cum laude</i>	expected 2024      2018
HONORS	Siebel Scholar <i>Awarded for academic excellence and demonstrated leadership.</i> GATech Rising Star in EECS Stanford Rising Star in Management Science and Engineering (MS&E) Google PhD Fellowship <i>One of 13 awardees in machine learning globally.</i> INFORMS Doing Good with Good OR Competition Winner <i>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”.</i> AAAI Best Paper Award Runner Up <i>3 best papers and 3 runner-ups were selected out of 9,034 submissions and 1,692 accepted papers.</i> Harvard University Derek Bok Certificate of Distinction in Teaching Certificate of Appreciation from the SMART Partnership <i>Recognition for contribution to developing PAWS system.</i> Five Citations for Academic Excellence at Dartmouth College <i>Special distinction rarely awarded by faculty members “for meritorious characteristics not indicated adequately by academic grades”, received across five computer science and Spanish courses.</i> Adobe Women-In-Technology Scholarship – Honorable Mention	2024      2023 2023 2022  2021   2021  2021 2019  2014 – 2018  2017
NON-PROFIT SERVICE	<b>SMART Conservation Partnership.</b> AI Lead <i>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 8 leading conservation NGOs: WWF, Wildlife Conservation Society, Wildlife Protection Solutions, Frankfurt Zoological Society, ZSL, NC Zoo, Panthera, and Re:wild.</i>	2022 – present
WORK EXPERIENCE	<b>Google Research.</b> India, AI for Social Good lab Student Researcher  <b>Google.</b> Seattle, WA Software Engineering Intern  <b>Dyn, Inc.</b> Hanover, NH Data Analytics Research Intern	Spring 2022   Summer 2017  Spring 2016

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PREPRINTS

\* indicates equal contribution

† indicates undergraduate I advised

( $\alpha$ - $\beta$ ) indicates alphabetical ordering

**Reinforcement learning with combinatorial actions for coupled restless bandits**

*Under review*

Lily Xu, Bryan Wilder, Elias B. Khalil, Milind Tambe

**Ranger patrols deter poaching: first causal insights for improving protected area management**

*Working paper*

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

**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

**Reflections from the Workshop on AI-Assisted Decision Making for Conservation**

*White paper*

Lily Xu<sup>\*</sup>, Esther Rolf<sup>\*</sup>, Sara Beery, Joseph R. Bennett, Tanya Berger-Wolf, Tanya Birch, Elizabeth Bondi-Kelly, Justin Brashares, Melissa Chapman, Anthony Corso, Andrew Davies, Nikhil Garg, Angela Gaylard, Robert Heilmayr, Hannah Kerner, Konstantin Klemmer, Vipin Kumar, Lester Mackey, Claire Monteleoni, Paul Moorcroft, Jonathan Palmer, Andrew Perrault, David Thau, Milind Tambe

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PUBLICATIONS  
(JOURNALS)

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

*Philosophical Transactions of the Royal Society B*, 2023. Vol. 378, Issue 1881.  
Melissa Chapman, Lily Xu, Marcus Lapeyrolerie, Carl Boettiger

PUBLICATIONS  
(CONFERENCES)

**Stay Ahead of Poachers: Illegal Wildlife Poaching Prediction and Patrol Planning Under Uncertainty with Field Test Evaluations**

*ICDE 2020*. 36th IEEE International Conference on Data Engineering

Lily Xu<sup>\*</sup>, Shahrzad Gholami<sup>\*</sup>, 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

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

*AAAI 2021*. 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*

**Envisioning Communities: A Participatory Approach Towards AI for**

## Social Good

*AIES 2021.* 4th AAI/ACM Conference on AI, Ethics, and Society  
Elizabeth Bondi\*, **Lily Xu\***, Diana Acosta-Navas, Jackson A. Killian

## Robust Reinforcement Learning Under Minimax Regret for Green Security

*UAI 2021.* 37th Conference on Uncertainty in Artificial Intelligence  
**Lily Xu**, Andrew Perrault, Fei Fang, Haipeng Chen, Milind Tambe  
**Oral Presentation**  
*Top 6.17% of submissions*

## Coordinating Followers to Reach Better Equilibria: End-to-End Gradient Descent for Stackelberg Games

*AAAI 2022.* 36th AAAI Conference on Artificial Intelligence  
Kai Wang, **Lily Xu**, Andrew Perrault, Michael K. Reiter, Milind Tambe

## Ranked Prioritization of Groups in Combinatorial Bandit Allocation

*IJCAI 2022.* 31st International Joint Conference on Artificial Intelligence  
**Lily Xu**, Arpita Biswas, Fei Fang, Milind Tambe

## Restless and Uncertain: Robust Policies for Restless Bandits via Deep Multi-Agent Reinforcement Learning

*UAI 2022.* 38th Conference on Uncertainty in Artificial Intelligence  
Jackson A. Killian, **Lily Xu**, Arpita Biswas, Milind Tambe

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

*AAAI 2023.* 37th AAAI Conference on Artificial Intelligence  
Kai Wang\*, **Lily Xu\***, Aparna Taneja, Milind Tambe

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

*AAAI 2023.* 37th 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

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

*AAAI 2023.* 37th AAAI Conference on Artificial Intelligence  
Paula Rodriguez Diaz, Jackson A. Killian, **Lily Xu**, Aparna Taneja, Arun Sai Suggala, Milind Tambe

## PUBLICATIONS (BOOK CHAPTERS)

### Environment, Society, and Machine Learning

*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

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## FUNDING: PROPOSALS AND AWARDS

Lily Xu. Siebel Scholar, awarded 2023. \$35,000

Co-I (submitted as PhD student, with 0% funding). Hannah Kerner, Sara Beery, **Lily Xu**, Jacob Muise, Shay Chan Hodges, Nicholas Winfrey. *Combating Invasive Axis*

*Deer in Maui, Hawaii with Earth Observations and Machine Learning.* Submitted to NASA in response to 2022 Research Opportunities in Space and Earth Sciences (ROSES) A.40 Earth Science Applications: Ecological Conservation (ECON)

Lily Xu. Google PhD fellowship, awarded 2022. \$88,029

## INVITED TALKS

*Does not include contributed conference and workshop talks*  
Major talks underlined

### **High-stakes decisions from low-quality data: AI decision-making for planetary health**

<i>Georgia Tech.</i> EECS Rising Stars	November 2023
<i>UC Berkeley.</i> Data Science Toolbox Series	October 2023
<i>INFORMS Annual Meeting.</i> ML for Social Good session	October 2023
<i>Cornell ORIE.</i> Young Researchers Workshop	October 2023
<i>J.P. Morgan.</i> AI Research team	October 2023

### **Causal AI and Conservation**

<i>ICCB.</i> SMART Symposium, Kigali, Rwanda	July 2023
<i>Microsoft Research New England.</i> Machine Learning Ideas seminar	June 2023
<i>United Nations ITU.</i> AI for Good Summit	June 2023
<i>WWF.</i> <u>Fuller Seminar Series on Conservation AI</u>	April 2023

### **Minimax Regret Optimization: Robust Planning for Conservation and Maternal Health**

<i>Berkeley MARL.</i> Multi-Agent Learning Seminar	March 2023
<i>Brown University.</i> Algorithmic Game Theory group	March 2023

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

<i>Harvard Kennedy School.</i> “Leading in AI” Executive Education	July 2023
<i>Penn State.</i> CSRAI Young Achievers Symposium	March 2023
<i>UC Berkeley.</i> Global Policy Lab	February 2023
<i>Centro de Analítica para Políticas Públicas (CAPP).</i> (in Spanish)	December 2022
<i>Georgia Tech.</i> ISyE department seminar	November 2022
<i>Analytics for a Better World.</i> ABW Webinar Series	September 2022
<i>Harvard Kennedy School.</i> “Leading in AI” Executive Education	July 2022
<i>UC Berkeley.</i> Ethics and Practices of Algorithmic Conservation	April 2022
<i>UCL.</i> Climate Hack AI Competition, <i>keynote</i>	March 2022
<i>Harvard University.</i> HCI Colloquium: AI-Assisted Decision-Making	February 2022
<i>Pasteur’s Quadrant.</i> Seminar Series	February 2022
<i>INFORMS.</i> <u>Doing Good with Good OR Finalists</u>	October 2021

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

<i>Sony.</i> Computer Science Laboratories (CSL) Paris	October 2022
<i>Stanford.</i> Computing & Society group	October 2022
<i>INFORMS Annual Meeting.</i> Fairness in Sequential Decision Making	October 2022

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

<i>MIT.</i> AI Ethics group	September 2022
<i>Women’s Forum.</i> Women4AI Daring Circle workshop	June 2022

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

## Security

*Google Research India.* AI for Social Good research group January 2022

## PAWS: AI to Predict and Plan Against Poaching

*ICCB.* International Congress for Conservation Biology December 2021

*IUCN WCC.* World Conservation Congress September 2021

*WILDLABS.* Tech Tutors: Season Three September 2021

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

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

*WWF.* Webinar on SMART April 2020

*AI LA.* Earth Summit April 2021

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

*Beijing Academy of Artificial Intelligence.* March 2021

*University College London.* AI Society February 2021

## INVITED PANELS

*Hertz Foundation Workshop.* AI Science and Policy, *moderator* July 2022

panelists: Jacob Steinhardt, Julie Owono, Jessica Fjeld

*South by Southwest (SXSW).* AI for Wildlife, *panelist* March 2021

*Harvard CRCS.* AI for Social Impact, *moderator* March 2020

panelists: Susan Murphy, Erez Yoeli, Desmond Patton

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## PROFESSIONAL SERVICE

### Mechanism Design for Social Good (MD4SG)

Nonprofit incorporation and Executive Director recruitment, lead April 2023 –

MD4SG initiative-wide co-organizer March 2021 –

*with Charles Cui, Francisco J. Marmolejo Cossío, George Obaido,*

*Matthew Olckers, and Ana-Andrea Stoica;*

*previously with Rediet Abebe, Irene Lo, and Wanyi Li*

Community Engagement team, founder and co-lead Oct 2020 – Apr 2021

Working Group on Environment, co-founder and co-organizer Jan 2020 – Apr 2021

### Workshop Organization

Co-organizer, AI-Assisted Decision Making for Conservation Workshop October 2022

*with Esther Rolf and Milind Tambe*

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

*with Priya Donti, Genevieve Flaspohler, Aaron Ferber, and Sebastian Ament*

### Tutorials

Lead organizer, AI for Social Impact tutorial @ EAAMO October 2023

*with Emily Aiken, Priya Donti, Nikhil Garg, and Paul Gözl*

### Panels

Co-organizer and co-moderator. The Future of AI for Social Impact April 2022

*panelists: Fei Fang, Lynn Kaack, Danaë Metaxa, Bryan Wilder*

### Conference Event Organization

Social co-chair, ACM EAAMO'23 October 2023

Social co-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 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

<i>AIES</i> . Artificial Intelligence, Ethics, and Society	2022, 2023
<i>AAAI</i> . AAAI Conference on Artificial Intelligence	2023
<i>AAAI AISI track</i> . AAAI Conference on Artificial Intelligence	2020, 2021, 2022
<i>COMPASS</i> . ACM SIGCAS Conference on Computing and Sustainable Societies	2021
<i>EAAMO</i> . Equity and Access in Algorithms, Mechanisms, and Optimization	2021, 2022, 2023
<i>FAccT</i> . ACM Conference on Fairness, Accountability, and Transparency	2022, 2023
<i>IAAI</i> . AAAI Innovative Applications of Artificial Intelligence	2023
<i>NeurIPS</i> . Neural Information Processing Systems	2023
<i>UAI</i> . Uncertainty in Artificial Intelligence	2023

#### → Workshops

AI for Wildlife Conservation @ SIGSPATIAL	2023
Autonomous Agents for Social Good (AASG) @ AAMAS	2021, 2023
AI for Social Good @ AAAI	2023
Data-Driven Humanitarian Mapping @ KDD	2020, 2021, 2022
Regulating Machine Learning @ NeurIPS	2023
Computational Sustainability @ NeurIPS	2023
Cooperative AI Workshop @ NeurIPS	2022
Black in AI Workshop @ NeurIPS	2020, 2021, 2022
Machine Learning for the Developing World (ML4D) @ NeurIPS	2020, 2021
Machine Learning for Public Health @ NeurIPS	2021
Resistance AI @ NeurIPS	2020
AI for Social Good @ IJCAI	2020
Mechanism Design for Social Good (MD4SG)	2020
AI for Social Good @ Harvard CRCS	2020

### Competition Selection Committee

AI2, EarthRanger Conservation Tech Award	2022, 2023
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### Reviewer

Deep Learning Indaba	2022
Caltech Computer Vision for Ecology (CV4Ecology) Summer School	2022
ICML, <i>subreviewer</i>	2021
NeurIPS, <i>subreviewer</i>	2020
IJCAI Special Track on CompSust and Human Well-being, <i>subreviewer</i>	2020
COMPASS, <i>subreviewer</i>	2019
Bloomberg Data for Good Exchange (D4GX), <i>subreviewer</i>	2019

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### STUDENTS ADVISED → At Harvard College

Vincent Börsch-Supan '25	Sept 2022 –
Alejandra Perea Rojas '24	June 2022 – Dec 2022
Christopher Ong '23	Spring 2022
April Chen '22	Summer 2021
<i>Adobe Research Women-In-Technology Scholarship Winner</i>	

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*

## TEACHING EXPERIENCE

→ *Guest Lecturer*  
*Cornell Tech.* CS 6382. Data Science for Social Change Fall 2023  
*Cornell Tech.* ORIE 5355/INFO 5370. Applied Data Science: Decision-making  
 beyond prediction Fall 2023  
*Harvard.* CS 182. Artificial Intelligence Fall 2023  
*Cornell.* INFO 6960. Data Science for Global Development Spring 2023  
*MIT.* 15 076. Analytics for a Better World Spring 2023  
*Harvard.* CS 96. Machine Learning for Social Impact Spring 2023  
*Wellesley.* CS 115. Computing for the Socio-Techno Web Fall 2022  
*Ohio State.* CSE 3521. Survey of Artificial Intelligence I Fall 2022  
*Harvard.* CS 288. AI for Social Impact class 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.* CS 96. Machine Learning for Social Impact Spring 2022  
*Cornell Tech.* ORIE 5355/INFO 5370. People, Data, Systems Fall 2021  
*Harvard Business School.* HBSMBA 2231. From Data to Decisions Fall 2021  
*Wellesley.* 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.* CS 182. Artificial Intelligence Fall 2020  
*Dartmouth.* CS 11. Foundations of Applied Computer Science Spring 2018

## Harvard University

→ *Head Teaching Fellow*  
 CS 182: Artificial Intelligence Fall 2020  
[Harvard Derek Bok Certificate of Distinction in Teaching](#)

## Dartmouth College

→ *Teaching Assistant, Department of Computer Science*  
 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*

Tuck FWP: Fundamentals of Web Programming Spring 2017

Tuck DSA: Data Structures and Analytics Spring 2017

## OUTREACH

### Speaking

*Harvard*. Tech for Social Good and Harvard Computer Society March 2023

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

*Harvard SEAS*. Research Labs Open House November 2020

*GirlsComputingLeague*. AIInnovation 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.

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## 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 Learning Help Park Rangers Prevent Poaching? 2023

*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

### Articles

*Business Insider*. Conservationists are using artificial intelligence to map out the



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