

Andrew Perrault

CONTACT INFORMATION

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RESEARCH INTERESTS

Decision-making in uncertain multi-agent systems with social good applications: game theory, sequential decision-making, machine learning, optimization, agent-based modeling.

CURRENT ACADEMIC APPOINTMENTS

Postdoctoral Fellow, Harvard University December 2018 to Present
Center for Research on Computation and Society
• Supervisor: Milind Tambe
• Moved June 2019 from the Center for Artificial Intelligence and Society at the University of Southern California.

EDUCATION

University of Toronto, Toronto, Ontario, Canada

Ph.D., Computer Science September 2013 to November 2018
• Thesis Title: *Developing and Coordinating Autonomous Agents for Efficient Electricity Markets*
• Adviser: Craig Boutilier

M.Sc., Computer Science May 2011 to August 2013
• Thesis Title: *Efficient Coordinated Power Distribution on Private Infrastructure*
• Adviser: Craig Boutilier

Cornell University, Ithaca, New York

B.A., Computer Science September 2007 to May 2011
• Research Supervisors: Carla Gomes and Ashutosh Saxena

RIGOROUSLY REFEREED CONFERENCE PUBLICATIONS

- [1] Lily Xu and Andrew Perrault and Fei Fang and Haipeng Chen and Milind Tambe. Robust Reinforcement Learning Under Minimax Regret for Green Security. *Proceedings of the 37th Conference on Uncertainty in Artificial Intelligence (UAI 2021)*, 2021.
- [2] Jackson Killian, Andrew Perrault, and Milind Tambe. Beyond “To Act or Not to Act”: Fast Lagrangian Approaches to General Multi-Action Restless Bandits. *Proceedings of the 20th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2021)*, 2021.
- [3] Aditya Mate, Andrew Perrault, and Milind Tambe. Risk-Aware Interventions in Public Health: Planning with Restless Multi-Armed Bandits. *Proceedings of the 20th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2021)*, 2021.
- [4] Lily Xu, Elizabeth Bondi, Fei Fang, Andrew Perrault, Kai Wang, and Milind Tambe. Dual-Mandate Patrols: Multi-Armed Bandits for Green Security. To appear: *Proceedings of the Thirty-Fifth AAAI Conference on Artificial Intelligence (AAAI 2021)*, 2021. **Best paper runner-up.**
- [5] Aditya Mate, Jackson A Killian, Haifeng Xu, Andrew Perrault, and Milind Tambe. Collapsing Bandits and Their Application to Public Health Interventions. In: *Advances in Neural Information Processing Systems 33 (NeurIPS 2020)*, 2020.

- [6] Kai Wang, Bryan Wilder, Andrew Perrault, and Milind Tambe. Automatically Learning Compact Quality-aware Surrogates for Optimization Problems. In: *Advances in Neural Information Processing Systems 33 (NeurIPS 2020)*, 2020. **Spotlight presentation.**
- [7] Ayan Mukhopadhyay, Kai Wang, Andrew Perrault, Mykel Kochenderfer, Milind Tambe, and Yevgeniy Vorobeychik. Robust Spatial-Temporal Incident Prediction. In: *Proceedings of the 36th Conference on Uncertainty in Artificial Intelligence (UAI 2020)*, 2020.
- [8] Han-Ching Ou, Arunesh Sinha, Sze-Chuan Suen, Andrew Perrault, Alpan Raval, and Milind Tambe. Who and When to Screen: Multi-Round Active Screening for Network Recurrent Infectious Diseases Under Uncertainty. In: *Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2020)*, 2020.
- [9] Kai Wang, Andrew Perrault, Aditya Mate, and Milind Tambe. Scalable Game-Focused Learning of Adversary Models: Data-to-Decisions in Network Security Games. In: *Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2020)*, 2020.
- [10] Andrew Perrault, Bryan Wilder, Eric Ewing, Aditya Mate, Bistra Dilkina, and Milind Tambe. End-to-End Game-Focused Learning of Adversary Behavior in Security Games. In: *Proceedings of the Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI 2020)*, 2020.
- [11] Sanket Shah, Arunesh Sinha, Pradeep Varakantham, Andrew Perrault, and Milind Tambe. Solving Online Threat Screening Games using Constrained Action Space Reinforcement Learning. In: *Proceedings of the Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI 2020)*, 2020.
- [12] Andrew Perrault and Craig Boutilier. Experiential Preference Elicitation for Autonomous Heating and Cooling Systems. In: *Proceedings of the 18th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2019)*, 2019.
- [13] Andrew Perrault and Craig Boutilier. Multiple-Profile Prediction-of-Use Games. In: *Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17)*, 2017. An earlier version was selected as a workshop best paper at AAMAS 2017.
- [14] Andrew Perrault, Joanna Drummond, and Fahiem Bacchus. Strategy-Proofness in the Stable Matching Problem with Couples. In: *Proceedings of the 15th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2016)*, 2016.
- [15] Andrew Perrault and Craig Boutilier. Approximately Stable Pricing for Coordinated Purchasing of Electricity. In: *Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (IJCAI-15)*, 2015.
- [16] Joanna Drummond, Andrew Perrault, and Fahiem Bacchus. SAT is an Effective and Complete Method for Solving Stable Matching Problems with Couples. In: *Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (IJCAI-15)*, 2015.
- [17] Andrew Perrault and Craig Boutilier. Efficient Coordinated Power Distribution on Private Infrastructure. In: *Proceedings of the 13th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS 2014)*, 2014.
- [18] Bryan Wilder, Marie Charpignon, Jackson A. Killian, Han-Ching Ou, Aditya Mate, Shahin Jabbari, Andrew Perrault, Angel Desai, Milind Tambe, and Maimuna S. Majumder. Modeling between-population variation in COVID-19 dynamics in Hubei, Lombardy, and New York City. *Proceedings of the National Academy of Sciences*. 117(41), 2020.

- BOOK CHAPTER [19] Andrew Perrault and Craig Boutilier. Multiple-Profile Prediction-of-Use Games. In: *Autonomous Agents and Multiagent Systems: AAMAS 2017 Workshops, Best Papers, São Paulo, Brazil, May 8-12, 2017, Revised Selected Papers*, 2017.
- MAGAZINE [20] Andrew Perrault, Fei Fang, Arunesh Sinha, and Milind Tambe. AI for Social Impact: Learning and Planning in the Data-to-Deployment Pipeline. *AI Magazine*, Winter 2020.
- ARTICLE
- LIGHTLY [21] Jackson Killian, Andrew Perrault, and Milind Tambe. Fast Intervention Scheduling via Lagrangian Solutions to Multi-Action Restless Bandits. In: *The AAAI-21 Workshop on AI For Behavior Change*, 2021.
- REFEREED
- PUBLICATIONS
- [22] Jackson Killian, Andrew Perrault, and Milind Tambe. Fast Lagrangian Approaches to General Multi-Action Restless Bandits with Applications in Public Health. In: *IJCAI 2020 Workshop on AI for Social Good*, 2021.
- [23] Andrew Perrault, Marie Charpignon, Jonathan Gruber, Milind Tambe, and Maimuna S. Majumder. Designing Efficient Contact Tracing Through Risk-Based Quarantining. In: *medRxiv*, 2020.
- [24] Andrew Perrault, Marie Charpignon, Jonathan Gruber, Milind Tambe, and Maimuna S. Majumder. Designing Efficient Contact Tracing Through Risk-Based Quarantining. In: *National Bureau of Economic Research Working Paper Series*, 2020.
- [25] Elizabeth Bondi, Andrew Perrault, Fei Fang, Benjamin Rice, Christopher Golden, and Milind Tambe. Mapping for Public Health: Initial Plan for Using Satellite Imagery for Micronutrient Deficiency Prediction. In: *KDD 2020 Workshop on Humanitarian Mapping*, 2020.
- [26] Jackson A. Killian, Marie Charpignon, Bryan Wilder, Andrew Perrault, Milind Tambe, and Maimuna S. Majumder. Evaluating COVID-19 Lockdown and Business-Sector-Specific Reopening Policies for Three US States. In: *KDD 2020 Workshop on Humanitarian Mapping*, 2020.
- [27] Bryan Wilder, Marie Charpignon, Jackson A. Killian, Han-Ching Ou, Aditya Mate, Shahin Jabbari, Andrew Perrault, Angel Desai, Milind Tambe, and Maimuna S. Majumder. Modeling Between-Population Variation in COVID-19 Dynamics in Hubei, Lombardy, and New York City. In: *KDD 2020 Workshop on Humanitarian Mapping*, 2020.
- [28] Alaisha Sharma, Jackson Killian, and Andrew Perrault. Optimization of the Low-Carbon Energy Transition Under Static and Adaptive Carbon Taxes via Markov Decision Processes. In: *Harvard CRCS Workshop on AI for Social Impact*, 2020.
- [29] Lily Xu, Elizabeth Bondi, Fei Fang, Andrew Perrault, Kai Wang, and Milind Tambe. Dual-Mandate Patrols: Multi-Armed Bandits for Green Security. In: *Harvard CRCS Workshop on AI for Social Impact*, 2020.
- [30] Lily Xu, Andrew Perrault, Andrew Plumtre, Margaret Driciru, Fred Wanyama, Aggrey Rwetsiba, and Milind Tambe. Game Theory on the Ground: The Effect of Increased Patrols on Deterring Poachers. In: *Harvard CRCS Workshop on AI for Social Impact*, 2020.
- [31] Anya Zhang and Andrew Perrault. Influence Maximization and Equilibrium Strategies in Election Network Games. In: *Harvard CRCS Workshop on AI for Social Impact*, 2020.
- [32] Bryan Wilder, Marie Charpignon, Jackson A. Killian, Han-Ching Ou, Aditya Mate, Shahin Jabbari, Andrew Perrault, Angel Desai, Milind Tambe, and Maimuna S. Majumder. Bayesian inference of between-population variation in COVID-19 dynamics. In: *ICML 2020 Workshop on Machine Learning for Global Health*, 2020.

- [33] Aditya Mate, Jackson A Killian, Haifeng Xu, Andrew Perrault, and Milind Tambe. Building Decision Aids for Community Health Workers: Optimizing Interventions via Restless Bandits. In: *11th International Workshop on Optimization and Learning in Multiagent Systems (OptLearnMAS 2020)*, 2020.
- [34] Sanket Shah, Arunesh Sinha, Pradeep Varakantham, Andrew Perrault, and Milind Tambe. Solving Online Threat Screening Games using Constrained Action Space Reinforcement Learning. In: *11th International Workshop on Optimization and Learning in Multiagent Systems (OptLearnMAS 2020)*, 2020.
- [35] Kai Wang, Andrew Perrault, Aditya Mate, and Milind Tambe. Scalable Game-Focused Learning of Adversary Models: Data-to-Decisions in Network Security Games. In: *11th International Workshop on Optimization and Learning in Multiagent Systems (OptLearnMAS 2020)*, 2020.
- [36] Andrew Perrault, Bryan Wilder, Eric Ewing, Aditya Mate, Bistra Dilkina, and Milind Tambe. Decision-Focused Learning of Adversary Behavior in Security Games. In: *Games, Agents and Incentives Workshop*, 2019.
- [37] Han Ching Ou, Arunesh Sinha, Sze-Chuan Suen, Andrew Perrault, and Milind Tambe. Who and When to Screen: Multi-Round Active Screening for Recurrent Infectious Diseases Under Uncertainty. In *Joint Workshop on Autonomous Agents for Social Good*, 2019.
- [38] Andrew Perrault and Craig Boutilier. Experiential Preference Elicitation for Autonomous Heating and Cooling Systems. In *Joint Workshop on Autonomous Agents for Social Good*, 2019.
- [39] Andrew Perrault and Craig Boutilier. Multiple-Profile Prediction-of-Use Games. In *8th International Workshop on Cooperative Games and Multiagent Systems*, 2017. **Best workshop paper.**
- [40] Andrew Perrault and Craig Boutilier. Multiple-Profile Prediction-of-Use Games. In *19th International Workshop on Agent-Mediated Electronic Commerce and Trading Agents Design and Analysis*, 2017.
- [41] Andrew Perrault, Joanna Drummond and Fahiem Bacchus. Strategy-Proofness in the Stable Matching Problem with Couples. In *The 7th International Workshop on Cooperative Games and Multiagent Systems*, 2016.
- [42] Ronan LeBras, Andrew Perrault, and Carla Gomes. Polynomial Time Construction for Spatially Balanced Latin Squares. In: *eCommons@Cornell, Computing and Information Science Technical Reports*, 2012.

PRESENTATIONS

- Machine Learning and Game Theory (tutorial). IJCAI 2020. Joint with Fei Fang and Bo Li.
- Learning And Differentiating Through A Surrogate Optimization Model. INFORMS Annual Meeting, 2020.
- Designing Efficient Contact Tracing Through Risk-Based Quarantining. Computational Health Informatics Program Seminar, Massachusetts Institute of Technology, 2020.
- Game-Focused Learning. CRCS Rising Stars Workshop, 2020.
- Game-Focused Learning in Cooperative and Non-Cooperative Games. EconCS Seminar, Harvard, 2019.
- Game-Focused Learning in Cooperative and Non-Cooperative Games. Center for Research on Computation and Society Seminar, Harvard, 2019.

The Data-to-Deployment Pipeline. Project meeting for MURI Grant “Multi-Scale Network Games of Collusion and Competition”, 2019.

Sequential Decision Making. Guest lecture for CSCI 599: AI for Social Impact, University of Southern California.

Experiential Preference Elicitation for Autonomous HVAC Systems. Computational Sustainability Open Graduate Seminar, 2018.

Developing and Coordinating Autonomous Agents for Efficient Electricity Markets. Center for Artificial Intelligence and Society Seminar, University of Southern California, 2018.

Knowledge Representation and Reasoning. Undergraduate AI Day, University of Toronto, 2016.

Efficient Coordinated Power Distribution on Private Infrastructure. 2013 Research in Action Showcase, University of Toronto (research won post-event IdeaCrawl pitching competition).

GRANTS

Awarded

- [1] Lead Writer, “End-to-End Integrated Learning and Strategic Defense in Security Games”, Multidisciplinary University Research Initiatives, Department of Defense, \$500,000, 2020.
- [2] Contributor, “Post hoc Explanations in the Wild: Exposing Vulnerabilities and Ensuring Robustness”, NSF Program on Fairness in Artificial Intelligence in Collaboration with Amazon, \$450,000, 2020.

Not Awarded

- [1] Contributor, “Combating poaching and measuring rhino abundance and behavior through detection of dung middens and rhinos in remotely sensed imagery from unmanned aerial vehicles and camera traps”, Microsoft AI for Earth, \$100,000, 2019.
- [2] Lead Writer, “AI for Conservation at USC CAIS”, Microsoft AI for Earth, \$200,000, 2018.

MENTORING

Graduate Students

- **Elizabeth Bondi**, 2018–present
- **Jackson Killian**, 2018–present
- **Aditya Mate**, 2018–present
- **Kai Wang**, 2018–present
- **Lily Xu**, 2018–present

Undergraduate Theses

- **Gayatri Balasubramanian**, 2020–2021
Senior thesis topic: Fairness in Sequential Decision-Making
(*in progress*)
- **Anya Zhang**, 2019–2020
Senior thesis topic: Learning Equilibrium Strategies in Election Networks.

Undergraduate Research

- **Alaisha Sharma**, 2020
Topic: Optimization of the Low-Carbon Energy Transition Under Static and Adaptive Carbon Taxes via Markov Decision Processes.

TEACHING
EXPERIENCE

University of Toronto, Toronto, Ontario, Canada

Teaching Assistant

September 2011 to May 2018

- CSC 384: Introduction to Artificial Intelligence
 - Fall 2013 (50%), Winter 2014, Winter 2015, Winter 2016, Winter 2017, Winter 2018.
 - Upper-level introduction to artificial intelligence.
 - Instructors: Sheila McIlraith, Fahiem Bacchus.
 - Wrote assignments, gave tutorials and lectures, edited exams, marked assignments, exams and projects.
 - Winner, Best TA Team, 2016.
- CSC 304: Algorithmic Game Theory and Mechanism Design
 - Fall 2017.
 - Upper-level algorithmic game theory.
 - Instructor: Nisarg Shah.
 - Gave tutorials, prepared and marked assignments and exams.
- CSC 200: Economic and Social Networks
 - Winter 2016 (50%).
 - Introductory social networks and game theory.
 - Instructor: Allan Borodin.
 - Gave tutorials, prepared and marked assignments and exams.
- CSC 263: Data Structures and Analysis
 - Winter 2013.
 - Second-year algorithms and data structures.
 - Instructor: Sam Toueg.
 - Marked assignments and exams.
- CSC 165: Mathematical Expression and Reasoning for Computer Science
 - Fall 2011, Winter 2012, Fall 2012, Fall 2013 (50%).
 - Introduction to the mathematical computer science.
 - Instructors: Tom Fairgrieve, François Pitt.
 - Gave tutorials, edited and marked assignments and exams.

PROFESSIONAL
SERVICE

Workshop Organizing Committee

- *IJCAI Workshop on Artificial Intelligence for Social Good*: 2020 (lead).
- *Harvard CRCS Workshop on Artificial Intelligence for Social Impact*: 2020.

Conference Referee

- *International Joint Conference on Artificial Intelligence*: 2021 (demo track), 2020 (computational sustainability and demo tracks), 2019 (demo track), 2018 (subreviewer), 2016 (subreviewer).
- *AAAI Conference on Artificial Intelligence*: 2021 (social impact and main tracks), 2020 (social impact and demo tracks), 2015 (subreviewer).
- *Annual Conference on Innovative Applications of Artificial Intelligence*: 2020.
- *Neural Information Processing Systems*: 2020, 2021.
- *International Conference on Machine Learning*: 2021.
- *Conference on Artificial Intelligence, Ethics and Society*: 2020.
- *International Conference on Autonomous Agents and MultiAgent Systems*: 2019.

Journal Referee

- *Decision Analysis*
- *PeerJ Computer Science*
- *Nature Sustainability*
- *Journal of Artificial Intelligence Research*

Workshop Referee

- *IJCAI Workshop on Artificial Intelligence for Social Good*: 2019, 2020, 2021.
- *AAMAS Workshop on Games, Agents and Incentives*: 2020, 2019.
- *AAMAS Workshop on Optimization and Learning in Multiagent Systems*: 2020.
- *AAMAS Workshop on Strategic Reasoning for Societal Challenges*: 2019.
- *AAMAS-IJCAI Workshop on Agents & Incentives in AI*, 2018.
- *AAMAS Workshop on Agent-Mediated Electronic Commerce and Trading Agents Design and Analysis*, 2017.

Proposal Referee

- Advanced Research Projects Agency—Energy, 2019.

Organizer, Center for Research on Computation and Society Seminar Series on AI for Social Impact, Harvard University, Fall 2020

- Organized virtual seminar series with nine distinguished speakers.

Mentor, TryAI Diversity and Inclusion Event at AAAI 2020

- Introduced high school students, especially those who are traditionally underrepresented in computer science, to artificial intelligence.

Graduate Student Representative at Faculty Meetings, Department of Computer Science, University of Toronto, 2013–2015

- Elected representative for graduate student body at faculty meetings. Conveyed information and collected feedback from graduate students about departmental policies and hiring.

Student Volunteer

- *International Joint Conference on Artificial Intelligence*: 2017.
- *International Conference on Autonomous Agents and MultiAgent Systems*: 2014, 2016.
- *AAAI Conference on Artificial Intelligence*: 2012.

SERVICE

Founder, Board Member, and Secretary, The School Fund, 2008–Present

- Non-profit organization that funds educational expenses for middle and high school students in the developing world.
- 1351 students funded.
- Developed Python-based website, made program policy decisions, planned and promoted events, worked on legal and tax compliance, hiring and managing employees and contractors.
- 1st Place, Clinton Global Initiative University Commitment Challenge, 2011.

AWARDS

Best paper runner-up, AAAI 2021.

Nominated, Victor Lesser Distinguished Dissertation Award, International Conference on Autonomous Agents and Multi-Agent Systems, 2018.

Best workshop paper, 8th International Workshop on Cooperative Games and Multiagent Systems, 2017.

Ontario Graduate Scholarship, 2014–2017, \$45,000.

Queen Elizabeth II Graduate Scholarship in Science and Technology, 2012–2013, \$15,000.

PRESS

Viviane Callier. *Shorter quarantines could actually help prevent COVID-19 outbreaks*. National Geographic, December 17, 2020.

Aria Bendix. *Four days of work, followed by 10 days of lockdown could help prevent another wave of infections. Here's how the idea compares to other reopening strategies*. Business Insider France, May 25, 2020.

William Bredderman and Olivia Messer. *New Model Shows How Deadly Lifting Georgia's Lockdown May Be*. The Daily Beast, May 13, 2020.

Leah Burrows. *What is the right strategy to limit the spread of COVID-19?* Medical Xpress, May 4, 2020.

Models for the spread of COVID-19. Interview on ABC-7 WJLA. April 30, 2020.

Amanda Mull. *Georgia's Experiment in Human Sacrifice*. The Atlantic, April 29, 2020.

REFERENCES

Milind Tambe

Gordon McKay Professor of Computer Science and Director of Center for Research in Computation and Society at Harvard University

Director "AI for Social Good" at Google Research India

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Craig Boutilier

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Sheila McIlraith

Professor and Canada CIFAR AI Chair

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Fei Fang

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Carnegie Mellon University

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