Strategic Decision-Making for Social Impact (CSE 5539)—Autumn 2021

Wednesdays, 10:20 am–12:25 pm

Instructor

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Description

This is a special topics course on artificial intelligence methodologies for decision-making in single- and multi-agent interactions. AI for social impact is a fast-emerging research area that aims to apply AI techniques to societally impactful problems. This course is focused on understanding foundations as well as the latest research in this area.

This course covers a variety of AI methods to address decision-making challenges in such settings, including planning and optimization, multi-agent systems, and machine learning.

Evaluation will be based on two papers presentations over the course of the semester and a final project. The course will refer to applications in socially impactful domains such as public health and conservation, but presentations and course projects need not have a social impact component if they are connected to the methodologies of the course.

PRE-REQs: CSE 3521 or grad standing.

Textbook: there is no required textbook for this course. All resources are available online, either freely or through the OSU library search.

Learning objectives

- Describe the fundamental AI methods covered in this course and what kinds of problems each one can be applied to
- Identify societal challenges where AI methods are potentially impactful
- Model real-world decision problems mathematically and apply or adjust the techniques discussed in the course to solve the modeled problems
- Describe and evaluate recent progress and key questions in recent research in decision-making AI and their applications to socially relevant challenges

Evaluation

1. Participation in class discussions (10%). All participants are expected to have read the assigned papers.
2. Paper presentation #1 (15%)—send selection (or several options) by Sept. 10

3. Project proposal (10%)—Oct. 8
4. Paper presentation #2 (15%)—send selection (or several options) by Oct. 29
5. Project presentation (Dec. 8) (20%)
6. Final report (Dec. 13) (30%)

Statement on academic misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Statement on disability services: The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Mental health statement: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Course Summary:

Date	Details	Readings
Wed Aug 25, 2021	Lecture 1: Introduction	Optional: Shi, Wang, and Fang. Artificial Intelligence for Social Impact: A Survey. (2020).

Date	Details	Readings
Wed Sep 1, 2021	Lecture 2: Intro to Optimization	Chapter 5 of Boyd and Vanderberghe. Convex Optimization.
Wed Sep 8, 2021	Lecture 3: Linear and Mixed-Integer Programming, Conservation Planning	Le Bras et al. Robust Network Design for Multispecies Conservation. AAAI 2013. Reference: Dilkina and Gomes. Solving Connected Subgraph Problems in Wildlife Conservation. CPAIOR 2010. Dilkina et al. Trade-offs and efficiencies in optimal budget-constrained multispecies corridor networks. Conservation Biology, 2016. Applied Mathematical Programming, Ch. 2 and 9
Fri Sep 10, 2021	Submit first paper presentation selection (or options)	
Wed Sep 15, 2021	Lecture 4: Sequential Decision-Making/Bike Repositioning	Dynamic Bike Reposition: A Spatio-Temporal Reinforcement Learning Approach Reference: Multi-Agent Reinforcement Learning for Order-dispatching via Order-Vehicle Distribution Matching Reinforcement Learning: An Introduction, Chapters 3, 6, 13 David Silver's RL course, especially Lecture 5 Is Q-Learning Minimax Optimal? A Tight Sample Complexity Analysis Is Q-learning Provably Efficient?
Wed Sep 22, 2021	Student presentations 1	
Wed Sep 29, 2021	Student presentations 2	
Wed Oct 6, 2021	Student presentations 3	
Fri Oct 8, 2021	Project proposal	

Date	Details	Readings
Wed Oct 13, 2021	Student presentations 4	
Wed Oct 27, 2021	Lecture 5: Deep reinforcement learning	Mnih et al. Playing Atari with Deep Reinforcement Learning. 2013. Reference: van Hasselt et al. Deep reinforcement learning with double Q-learning. AAAI 2016. Silver et al. Mastering the game of Go with deep neural networks and tree search. Nature, 2016. David Silver's RL course, especially lectures 6 and 7. Greydanus et al. Visualizing and Understanding Atari Agents.
Fri Oct 29, 2021	Submit second paper selection (or options)	
Wed Nov 3, 2021	Lecture 6: Game theory and robustness	Robust reinforcement learning for continuous control with model misspecification, 2020. Reference: Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Ch. 3-5 A Unified Game-Theoretic Approach to Multi-Agent Reinforcement Learning Planning in the Presence of a Cost Function Controlled by an Adversary
Wed Nov 10, 2021	Student presentations 5	
Wed Nov 17, 2021	Student presentations 6	
Wed Dec 8, 2021	Project presentations	