

IST 597.7

Artificial Intelligence for Humanity

Spring 2019

Location & Time: E213 Westgate, Tue/Thu 10:35 AM – 11:50 AM

Basic Information

- **Lecture Time:** Tue/Thu 10:35 AM – 11:50 AM
 - **Lecture Place:** E213 Westgate
 - **Instructor:** Amulya Yadav
 - **Email:** amulya@psu.edu
 - **Office:** E368 Westgate
 - **Office Hours:** By Appointment
 - **TA:** TBD
 - **Email:** TBD
 - **Office Hours:** TBD
 - **Course Homepage:** TBD
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Course Description

The overarching goal of this course is to impress upon students the enormous potential of Artificial Intelligence (AI) to be used as an agent for good in today's increasingly connected societies. To achieve this goal, this course explores a set of advanced AI methods such as machine learning, convex and combinatorial optimization, game theory and mechanism design, sequential planning, etc., and illustrates how these methods have been used to tackle challenging problems that afflict humanity, particularly in the areas of healthcare, conservation and public safety and security.

The intended audience for this course are PhD students, Masters students, and advanced undergraduates interested in exploring research questions in AI which lead to a tangible societal impact. To get the most out of this course, the student should have a decent mathematical background, although that is not required and will not be used as a criteria for course evaluation. Although the course is listed with IST, graduate students in CS, EE, OR and the Social Work departments would also find this course of interest.

Learning Objectives

By the end of this course, the student is expected to have achieved the following objectives:

- Describe the AI methods covered in the course, including the basic concepts, the key algorithms, and the commonly-used implementation of the methods
 - Identify societal challenges that can potentially be tackled by AI methods, and determine which AI methods can be applied
 - Model the societal challenges as AI problems where AI techniques taught in the course can be applied and propose how to adjust and modify the AI techniques to fit the problems
 - Describe evaluation criteria and methodologies of applying AI methods for social good
 - Deliver written and oral presentation on research papers and on their research projects
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Learning Resources

No formal textbook. References for papers and additional resources will be provided in slides on the course website and on Canvas.

Requirements and Grading

The final course grade will be calculated using the following categories:

Assessment	Percentage of Final Grade
Class Participation	10%
Paper Summary & Presentation	40%
Final Project	50%

- **Class Participation:** The grading of the class participation will be mostly based on asking and answering meaningful questions in class and on Canvas. The class participation will account for 10% of the total grade.
- **Paper Summaries:** The course will require all students to complete weekly paper reading assignments individually. In each assignment, the students are required to provide a summary of the paper/article, a list of questions, and a few brainstorming ideas. Collaboration and discussion among students is allowed, even encouraged, though students must write up their solutions independently. All these paper summaries would account for 10% of the total grade.
- **Paper Presentation:** Each student will be asked to present one or two papers in front of the class throughout the semester (depending on the number of registered students). This presentation will account for 30% of the total grade.
- **Final project:** The students will be split into teams, with 1-3 students in each team. The students are expected to focus on one or more societal challenges which afflict humanity, summarize or propose models and AI-based solutions to tackle the challenges, and evaluate the solutions. The students are required to (i) submit a project report through Canvas; and (ii) deliver an oral presentation on their project at the end of the course. The instructor will provide suggested project topics. The students can also propose their own projects topics related to AI and Social Good but they will need consent from the instructor. This final project will account for 50% of the total grade.

COURSE POLICIES

- **Late Submissions:** Students will be allowed 5 late days for homework, to be used in integer amounts and distributed as the student sees fit. No additional late days are allowed.
- **Academic Integrity:** Plagiarism is not allowed at all. Students are encouraged to discuss the paper readings with other student peers, but each student is expected to complete the paper summaries/presentations on his/her own. For the final project, the students can discuss and collaborate with others (including students, faculty members, and domain experts), but the students need to give proper credits to whoever involved, and report the contributions of each group member in the final report and presentations, which will be considered in the grading. Violations of these policies will be dealt with as per Penn State's policy on academic integrity: <https://handbook.psu.edu/content/academic-integrity>
- **Accommodating Disabilities:** Students with any kind of disability who require accommodations are most welcome to come talk to me about their accommodations and needs early in the semester if possible. I will work with you to ensure that accommodations are provided as needed. It is also a good idea to formally document your disability and needs with Student Disability Resources in the Office of the Vice Provost for Educational Equity. More information at <http://equity.psu.edu/student-disability-resources/>
- **Student Wellness:** If you experience any kind of challenges that are interfering with your learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation, etc., please consider reaching out to University Park CAPS at (814) 863-0395 or by visiting <http://studentaffairs.psu.edu/counseling/> . Alternatively, you could reach the 24/7 Penn State Crisis Phone Line by calling at (877) 229-6400, or a Crisis Text Line, which you can reach by texting LIONS to 741741.

COURSE SCHEDULE (SUBJECT TO CHANGE)

30 Classes in Total

27 Classes to Cover Actual Content

Paper Areas

1. Empirical Evaluations of AI
2. Machine Learning
3. Social Networks and Sequential Planning
4. Game Theory Applications for Social Good

01/08 Course Introduction

01/10 AI for Humanity: Empirical Evaluations
Paper Reading List

1. Kube, Amanda, Sanmay Das, and Patrick J. Fowler. "Allocating Interventions Based on Predicted Outcomes: A Case Study on Homelessness Services." (2019).
2. Ackermann, Klaus, et al. "Deploying Machine Learning Models for Public Policy: A Framework." *Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*. ACM, 2018.

01/15 AI for Humanity: Empirical Evaluations
Paper Reading List

1. Yadav, Amulya, et al. "Influence maximization in the field: The arduous journey from emerging to deployed application." *Proceedings of the 16th Conference on Autonomous Agents and MultiAgent Systems*. International Foundation for Autonomous Agents and Multiagent Systems, 2017.

01/17 AI for Humanity: Empirical Evaluations
Paper Reading List

1. Finale Doshi-Velez, Been Kim. "Towards A Rigorous Science of Interpretable Machine Learning"

01/22 AI for Humanity: Machine Learning
Paper Reading List

1. ***Using Machine Learning to Assess the Risk of and Prevent Water Main Breaks.*** Avishek Kumar, Syed Ali Asad Rizvi, Benjamin Brooks, Ali Vanderveld, Kevin Hayes Wilson, Chad Kenney, Adria Finch, Andrew Maxwell, Sam Edelstein, Joe Zuckerbraun and Rayid Ghani. To Appear in 24th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD-2018)

01/24 AI for Humanity: Machine Learning
Paper Reading List

1. Cloudy with a Chance of Poaching: Adversary Behavior Modeling and Forecasting with Real-World Poaching Data Debarun Kar, Benjamin Ford, Shahrzad Gholami, Fei Fang, Andrew Plumptre, Milind Tambe, Margaret Driciru, Fred Wanyama, Aggrey Rwetsiba

01/29. AAI (No Class)

01/31. Daniel Susser Invited Lecture (CLASS CANCELED DUE TO UNIVERSITY CLOSURE)

- 02/05 AI for Humanity: Game Theory
1. Lecture on Decision Theory, Calculation of Expected Utilities, Utilitarian Perspective, Rational Players
- 02/07 AI for Humanity: Game Theory
1. Lecture on Game Theory, Zero Sum Games, General Sum Games, Nash Equilibrium, Stackelberg Equilibrium
- 02/12 CLASS CANCELED DUE TO SNOW
- 02/14 Student Presentations: Machine Learning
1. [Erika Salomon, et al. "Reducing Incarceration through Prioritized Interventions." SIGKDD 2017.](#)
 2. [Garren Gaut et al. "Improving Government Response to Citizen Requests Online", COMPASS 2018](#)
 3. [Eric Potash et al. "Predictive Modeling for Public Health: Preventing Childhood Lead Poisoning." KDD 2015.](#)
- 02/19 Intro to Deep Learning and Neural Networks
- 02/21 Intro to Convolutional Neural Networks and Recurrent Neural Networks
- 02/26 Guest Lecture by Prof. Saeed Abdullah
- 02/28 STUDENT PRESENTATIONS: Deep Learning
Paper Reading List
1. Deep Gaussian Process for Crop Yield Prediction Based on Remote Sensing Data
Jiaxuan You, Xiaocheng Li, Melvin Low, David Lobell, Stefano Ermon
 2. Combining satellite imagery and machine learning to predict poverty Neal Jean, Marshall Burke, Michael Xie, Matthew Davis, David B. Lobell, Stefano Ermon
 3. Fred Sun Lu et al. "Accurate Influenza Monitoring and Forecasting Using Novel Internet Data Streams: A Case Study in the Boston Metropolis" JMIR 2018
- 03/05 Spring Break. No Class
- 03/07 Spring Break. No Class
- 03/12 Invited Lecture by Prof. Fei Fang, CMU
- 03/14 Lecture on MDPs and POMDPs, Value Iteration Algorithms
- 03/19 Invited Lecture by Prof. Matthew Ferrari, Center for Infectious Disease and Dynamics, Penn State
- 03/21 STUDENT PRESENTATIONS: Game Theory
Paper Reading List
1. Nikolas- <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.676.2784>
 2. Alex – <http://teamcore.usc.edu/kiekintveld/papers/2009/trkot-IRIS.pdf>
 3. Seth - <http://amulyayadav.com/Papers/PAAMS16.pdf>

- 03/26 Lecture on Influence Maximization Applied to Real World Problems
- 03/28 STUDENT PRESENTATIONS – Game Theory
 1. Chris – <http://www.ntu.edu.sg/home/boan/papers/AAMAS2012-protect.pdf>
 2. Kyle - <http://teamcore.usc.edu/papers/2014/iaai2014traffic.camera.pdf>
 3. Lu - http://teamcore.usc.edu/papers/2014/IAAI_2014.pdf
- 04/02 AI for Humanity: Social Networks & Sequential Planning
 Paper Reading List
 1. Monte-Carlo Planning in Large POMDPs David Silver, Joel Veness
 2. Bandit based Monte-Carlo Planning Levente Kocsis and Csaba Szepesvari
- 04/04 STUDENT PRESENTATIONS – Game Theory
 1. Roopali - <https://www.cs.purdue.edu/homes/yexiang/publications/aaai15-pastoral.pdf>
 2. Nikolas - <https://link.springer.com/article/10.1007/s10994-013-5378-z>
 3. Alex - <http://teamcore.usc.edu/papers/2016/AAAI.DARMS.CAMERA.pdf>
- 04/09 AI for Humanity: Social Networks & Sequential Planning
 Paper Reading List
 1. PAC Optimal MDP Planning with Application to Invasive Species Management
 Majid Alkaee Taleghan, Thomas G. Dietterich, Mark Crowley, Kim Hall, H. Jo Albers
 2. PAC Optimal Planning for Invasive Species Management: Improved Exploration for Reinforcement Learning from Simulator-Defined MDPs Thomas G. Dietterich, Majid Alkaee Taleghan, Mark Crowley
- 04/11 STUDENT PRESENTATIONS – Game Theory
 1. Seth - <http://amulyayadav.com/Papers/AAMAS16.pdf>
 2. Chris - <http://amulyayadav.com/Papers/AAMAS17B.pdf>
 3. Kyle - <http://amulyayadav.com/Papers/AAMAS18b.pdf>
- 04/16 BUFFER CLASS
- 04/18 STUDENT PRESENTATIONS – Social Networks
 1. Lu - <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.702.5040>
 2. Roopali https://www.cs.purdue.edu/homes/yexiang/publications/aaai13_robust_network_design.pdf
 3. Nikolas - http://teamcore.usc.edu/people/bryanwilder/publications/aaai_election_defense.pdf
- 04/23 PROJECT PRESENTATION 1
- 04/25 PROJECT PRESENTATION 1 (Last Day of Class)