

COS 597H (Fall 2024): AI, Society, and Education

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Meeting times:

Wednesdays, 1.30-2.50 pm

Location: Friend Center 111

Course Description:

We examine the use of AI, algorithms, and machine learning to improve educational outcomes, expand access, and inform educators. Recent developments such as predictive personalization and generative AI present new risks, opportunities, and challenges. Course readings will address model design, intervention design and evaluation science, and discuss normative consequences. There will be a focus on statistical methods and causal inference. We will also explore how educational research, particularly in educational measurement and psychometrics, can be brought to bear on the validity and evaluation challenges posed by modern machine learning. Students will present readings and complete a final project.

Prerequisites:

The course is open to all graduate students, juniors and seniors, although extensive preparation in statistics (ORF 245 or equivalent) and machine learning / artificial intelligence is expected and required (COS 324 or equivalent).

Instructor:

Prof. Lydia Liu (*she/her*)

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Office Hours: 3-4 pm, by appointment.

Location: CS 414

Schedule of Course Meetings

1. Sign up for presentation slots: [📅 COS597H presenter and discussant schedules](#)
2. Upload presentation and discussion slides here: [📁 Student Presentations](#)

Week 1 (Sept 4, 2024): Introduction to Machine Learning in Education

- Liu, L. T. et al (2023) [Reimagining the machine learning life cycle to improve educational outcomes of students](#). Proceedings of the National Academy of Sciences 120 (9), e2204781120

Week 2 (Sept 11, 2024): Model design - Problem Formulation and Validity

- [A validity perspective on evaluating the justified use of data-driven decision-making algorithms](#) (Coston, Amanda and Kawakami, Anna and Zhu, Haiyi and Holstein, Ken and Heidari, Hoda)
- Extra readings:
 - “Validity”, pp 9-17, [Standards for Educational and Psychological Testing \(1999 Edition\)](#)

Week 3 (Sept 18, 2024): Evaluation Science - Observational studies, Treatment effect estimation

- [Estimating treatment effects with causal forests: An application](#) (Athey & Wager)
- Extra readings:
 - Causal inference background: Chapter 1 and 2, [Hernán MA, Robins JM \(2020\). Causal Inference: What If \[preprint\]](#)

Week 4 (Sept 25, 2024): Evaluation Science - Experimental studies, Predictive Targeting

- [Machine Learning Who to Nudge: Causal vs Predictive Targeting in a Field Experiment on Student Financial Aid Renewal](#) (Athey, Keleher, Spiess)
- Extra readings:

Another interesting experiment in the education context is Project Star

 - [HOW DOES YOUR KINDERGARTEN CLASSROOM AFFECT YOUR EARNINGS? EVIDENCE FROM PROJECT STAR](#) (Chetty et al)
 - [What Have Researchers Learned from Project STAR? Diane Whitmore Schanzenbach](#)

Week 5 (Oct 2, 2024): Evaluation Science - Dataset and Task design

- **Guest Speaker (zoom), Kristen Dicerbo (Khan Academy)**
On [“LLM Based Math Tutoring: Challenges and Dataset”](#)
- Extra Readings:
 - [Generative AI Can Harm Learning](#) (Bastani et al)

Week 6 (Oct 9, 2024): Evaluation Science - Algorithmic Decision Making, Trust

- **Guest Speaker, Rebecca Johnson (Georgetown University)**
On “Predictive Algorithms and Perceptions of Fairness: Parent Attitudes Toward Algorithmic Resource Allocation in K-12 Education

FALL BREAK (No class & office hours on Oct 16)

Week 7 (Oct 23, 2024): Evaluation Science - Measurement, Item response theory

- [Item Response Theory – A Statistical Framework for Educational and Psychological Measurement](#) (Yunxiao Chen, Xiaou Li, Jingchen Liu and Zhiliang Ying)

Week 8 (Oct 30, 2024): Evaluation Science - Fairness, Generalization across contexts

- **Guest Speaker, Renzhe Yu (Teachers college, Columbia University)**
On “AI and educational equity”
 - Assigned reading: Xu, Z., Olson, J., Pochinki, N., Zheng, Z., & Yu, R. (2024). Contexts Matter but How? Course-Level Correlates of Performance and Fairness Shift in Predictive Model Transfer. Proceedings of the 14th Learning Analytics and Knowledge Conference (LAK '24), 713–724.
<https://doi.org/10.1145/3636555.3636936>
 - Extra reading: Lee, J., Hicke, Y., Yu, R., Brooks, C., & Kizilcec, R. F. (2024). The life cycle of large language models in education: A framework for understanding sources of bias. British Journal of Educational Technology, 00, 1–21.
<https://doi.org/10.1111/bjet.13505>

Week 9 (Nov 6, 2024): Model Design - Adaptive testing, test item selection

- **Guest speaker (zoom), James Sharpnack (Duolingo English Test)**
On “A Thompson Sampling Approach to IRT-based Computerized Adaptive Tests”
 - Assigned reading: BanditCAT and AutoIRT: Machine Learning Approaches to Computerized Adaptive Testing and Item Calibration [link in Ed Resources]

Week 10 (Nov 13, 2024): Intervention Design - Human-in-the-loop

- **Guest Speaker (zoom), Rose E. Wang (Stanford University)**
On [Tutor CoPilot](#), a randomized controlled trial on real-time decision aids for improving virtual math tutoring
 - Assigned reading: Tutor CoPilot: A Human-AI Approach for Scaling Real-Time Expertise [link in Ed Resources]

Week 11 (Nov 20, 2024): Normative Considerations of AIED / TBD

- [Holstein, Kenneth, and Shayan Doroudi. "Equity and artificial intelligence in education: will" aided" amplify or alleviate inequities in education?." arXiv preprint arXiv:2104.12920\(2021\).](#)
- Extras:
 - Jurenka, I. et al (2024) [Towards Responsible Development of Generative AI for Education: An Evaluation-Driven Approach.](#)
 - Burstein et al (2024). [Duolingo English Test Responsible AI Standards](#)

Week 12 (Dec 4, 2024): **Final Project Oral presentations**

Sample readings

- [Standards for Educational and Psychological Testing \(1999 Edition\)](#)
- Jurenka, I. et al (2024) [Towards Responsible Development of Generative AI for Education: An Evaluation-Driven Approach.](#)
- Burstein et al (2024). [Duolingo English Test Responsible AI Standards](#)
- Liu, L. T. et al (2023) [Reimagining the machine learning life cycle to improve educational outcomes of students](#). Proceedings of the National Academy of Sciences 120 (9), e2204781120

Grading and assessment requirements

Percentage of final grade / %	Coursework
20	Final oral presentation
40	Final project report
40	Participation <i>In-class participation in discussions, 10%;</i> <i>In-class presentations (including as discussant), 20%; Reading microassignments, 10%.</i>

Due dates

Final project report is due on Dean's Date, Dec 13, 2024.

Gradescope and Ed

We will be using Gradescope for submitting assignments and Ed for questions and discussions. Both can be accessed via Canvas. All course materials (readings, slides) are uploaded to Ed resources. Communication with instructors should take place primarily through Ed; **please reserve email for emergencies only.**

Class presentations and discussions

There will be **1 student presenters** and **1 discussant** in every 80 minute class (with some exceptions on the schedule). Presentations will be 20 minute talks with the goal of practicing the skill of summarizing and presenting the highlights of a paper, with an appropriate level of technical depth. More [resources](#) on how to give a talk.

After the presentation, the discussant has approximately 10 minutes to introduce a critical or complementary perspective, e.g. from extra readings that week. A typical presentation by a discussant would include – as a general guideline – a title page and no more than five slides. One of these slides should pose thoughtful questions to simulate conversation with the rest of the class. Further guidance on the [discussant role](#).

Microassignment

Read the assigned research paper carefully and annotate it by highlighting key sections and adding brief comments in the margins or in a separate document. Focus on the main contributions, methodology, data, results, and related work, noting any critiques or questions that arise. After annotating, write a concise summary (1-2 paragraphs) of your annotations, including the paper's main points and your critical insights. This can be in bullet form or long form.

Additionally, develop two (or more) discussion questions based on your annotations that could prompt further analysis or research. Submit both your annotated paper and your summary with discussion questions before class via Gradescope

Deadlines and extensions

2 late passes over the semester to turn in any micro-assignment up to 24 hours late without a penalty. No late pass for the final project proposal or report; please plan ahead.

The first two times you are late for submitting an micro-assignment, the late pass will automatically be applied.

Work that is more than 24 hours late will not receive credit.

Disability Services and Academic Accommodations

Princeton welcomes students with disabilities and values their diverse experiences and perspectives. If you anticipate or experience a barrier to learning in the classroom or in completing assignments or exams, please know there is support for you. Students who wish to request classroom accommodations can do so through the [Office of Disability Services](#) (ODS). If you have been approved for accommodations through the ODS, please contact me via email as soon as possible so we can develop an implementation plan together.

Academic Integrity and the Honor Code

Intellectual honesty is vital to an academic community and for my fair evaluation of your work. For these reasons, all students in this course are expected to abide by the Honor Code on examinations and to complete their written work in accordance with University regulations. All work submitted in this course must be your own, completed in accordance with the [University's academic regulations](#). You are welcome to use AI tools such as code generators and text generators for written work in so far as it aids your scholarly development. Ultimately, you are responsible for the originality, accuracy and quality of the work that you submit.

Commitment to Diversity, Equity and Inclusion

It is essential we build our class community into a place where everyone feels comfortable participating. Disrespect or discrimination on any basis will not be tolerated. We will strive to create a learning environment that supports a diversity of thoughts, perspectives, and experiences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

Preferred names and pronouns

Instructors are provided with class rosters with potentially out-of-date preferred names; information about students' pronouns is also not readily available to us. We encourage any corrections and look forward to learning your pronouns.

Land Acknowledgement

This course will be facilitated from Princeton, New Jersey – or the unceded, ancestral land of the Lenni-Lenape. As we gather, we honor the ongoing history and living culture of the Nanticoke Lenni-Lenape people, other Indigenous caretakers of these lands and waters, the elders who lived here before, the Indigenous people living today both in and beyond this space and the generations yet to come. For information about the histories of Indigenous stewardship of the land on which you reside, consult [Native Land Digital](#).

Mental Health Resources

Princeton University offers a variety of resources to support your mental health and wellbeing. If you or someone you know needs support or is looking to access specific services, consider reaching out to these university and student-led resources:

- Your [residential college advising team](#) is always a good first resource for advice and counsel. The assistant deans for student life ([DSLs](#)), whose offices are located in each residential college, serve as case managers in crisis situations. They are also available to talk with you about well-being concerns and can refer you to appropriate campus resources.
- If you are feeling distressed or need support, please contact [Counseling & Psychological Services \(CPS\)](#) at 609-258-3141 for immediate support or to schedule an appointment with a counselor. CPS is a confidential resource.
- The [Sexual Harassment/Assault Advising, Resources and Education](#) (SHARE) office is a survivor-centered, trauma-informed, confidential resource on campus. SHARE provides crisis response, support, counseling, advocacy, education, and referral services to students experiencing unhealthy relationships and abuse, including harassment, sexual assault, dating/domestic violence, and stalking.
- The [Princeton Peer Nightline](#) is a student-run anonymous peer listening service. It is not affiliated with CPS or the University administration. They offer anonymous chat/call peer support.

It is your responsibility to balance your personal commitments so that you can also meet your curricular obligations in this class. However, if a personal situation arises during the semester that threatens to affect your performance in the course, you are strongly encouraged to speak with the professor and your residential college dean or assistant dean for student life about your circumstances immediately.