

CS 293/EDUC 473: Empowering Educators via Language Technology

Dora Demszky & Mei Tan

Welcome to CS293 – the first ever class focused on the use of natural language processing to support teachers!

Your teaching team



Dora Demszky



Mei Tan

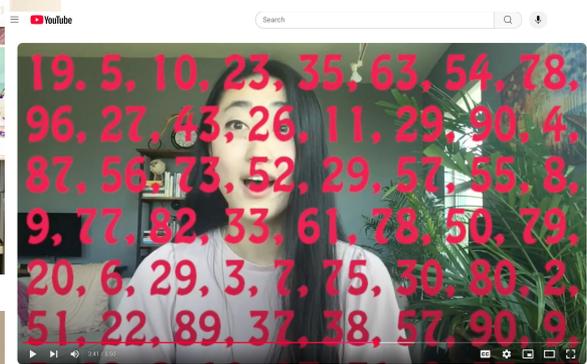
Dora's story

- Commitment to education
 - STEM mentorship
 - NGO in Hungary
- Passion for language
 - Linguist by training & at heart
 - Linguistics PhD
 - + NLP starting w/ computational linguistics olympiad (ILO) through Dan Jurafsky's lab to EDS!



Mei's story

- Edtech software developer @ MicrosoftEDU
- (Unprepared) remote HS CS teacher
- MS in EDS (first cohort!)
- 2nd Year PhD Student in EDS
- Projects: classroom management, writing feedback, math talk
- Office hours after class!



Course overview

Website

<http://web.stanford.edu/class/cs293>

Ed Discussion

For all course related questions, sharing resources and asking for help with assignments.

<https://edstem.org/us/courses/69757/discussion>

For private matters.

Teaching team emails: ddemszky@stanford.edu and mxtan@stanford.edu

Why now?

Urgent Educational Needs

Pandemic Learning Loss

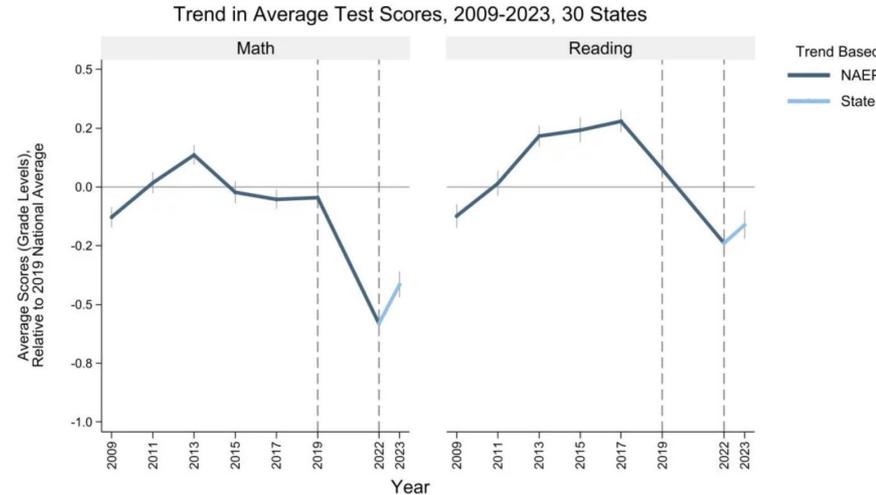
OPINION

Parents Don't Understand How Far Behind Their Kids Are in School

May 11, 2023

Share full article

By Tom Kane and Sean Reardon
Graphics by [Quoctrung Bui](#)
Dr. Kane is a professor of education and economics at Harvard. Dr. Reardon is a professor of education and sociology at Stanford.



Why now?

Urgent Educational Needs

Pandemic Learning Loss

Financial Constraints &
Persisting Inequities

THE FIFTY

Schools stare down fiscal cliff as federal pandemic aid runs out

Congress allocated roughly \$190 billion to address problems like learning loss and chronic absenteeism, but that money disappears at the end of September.

HARVARD
GRADUATE SCHOOL OF EDUCATION

Events Apply Give

NEWS

Despite Progress, Achievement Gaps Persist During Recovery from Pandemic

New research finds achievement gaps in math and reading, exacerbated by the COVID-19 pandemic, remain and have grown in some states, calls for action before federal relief funds run out

Why now?

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Pandemic Learning Loss

Financial Constraints &
Persisting Inequities

Teacher Burnout & Exodus

Forbes

FORBES > LEADERSHIP > CAREERS

No More Teachers: The Epic Crisis Facing Education In 2024

“We work extremely hard in an ever increasingly difficult situation. The number of students who come in with trauma has skyrocketed, but the resources haven’t matched the need.” – High School Teacher, Pew Research Center Survey

“Teachers serve multiple roles other than being responsible for teaching curriculum. We are counselors, behavioral specialists, and parents for students who need us to fill those roles. We sacrifice a lot to give all of ourselves to the role as teacher.” – Elementary School Teacher, Pew Research Center Survey

Why now?

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Pandemic Learning Loss

Financial Constraints &
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Teacher Burnout & Exodus

Why Teachers Don't Have Enough Time to Get Everything Done

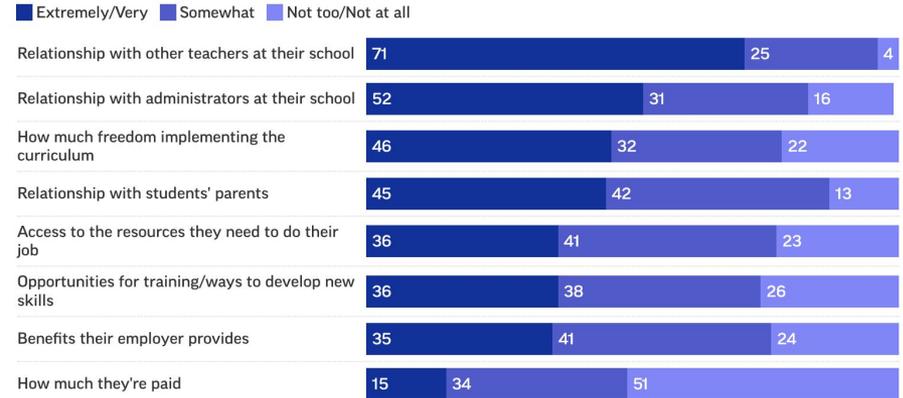
(% saying each of the following is a major/minor reason)



Source: Pew Research Center, Survey of U.S. public school teachers, Oct. 17-Nov. 14, 2023

Teachers Are Satisfied with Relationships with Fellow Teachers —But Not with their Pay

(% of public school teachers saying they are ____ satisfied with each of the following)



Source: Pew Research Center, Survey of U.S. public K-12 teachers, Oct. 17-Nov. 14, 2023

Why now?



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Teacher Burnout & Exodus



New Opportunity to Respond

Advancements in Generative AI

Uptake of AI in Education

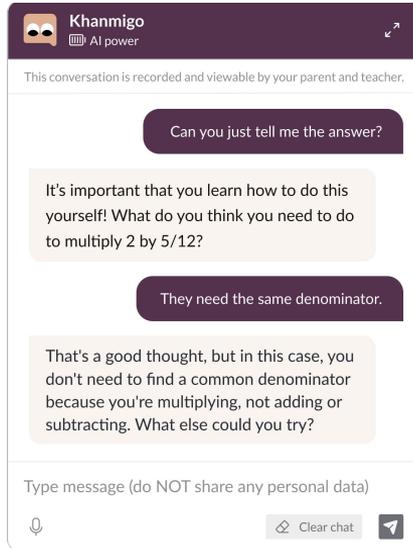
Resources Poured into this Space

Lots of excitement LLMs in classrooms

The New York Times

How A.I. Can Revive a Love of Learning

Modern technology offers new possibilities for transforming teaching.



Khanmigo AI power

This conversation is recorded and viewable by your parent and teacher.

Can you just tell me the answer?

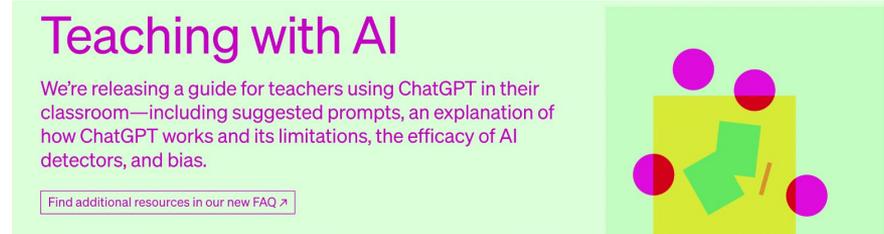
It's important that you learn how to do this yourself! What do you think you need to do to multiply 2 by $\frac{5}{12}$?

They need the same denominator.

That's a good thought, but in this case, you don't need to find a common denominator because you're multiplying, not adding or subtracting. What else could you try?

Type message (do NOT share any personal data)

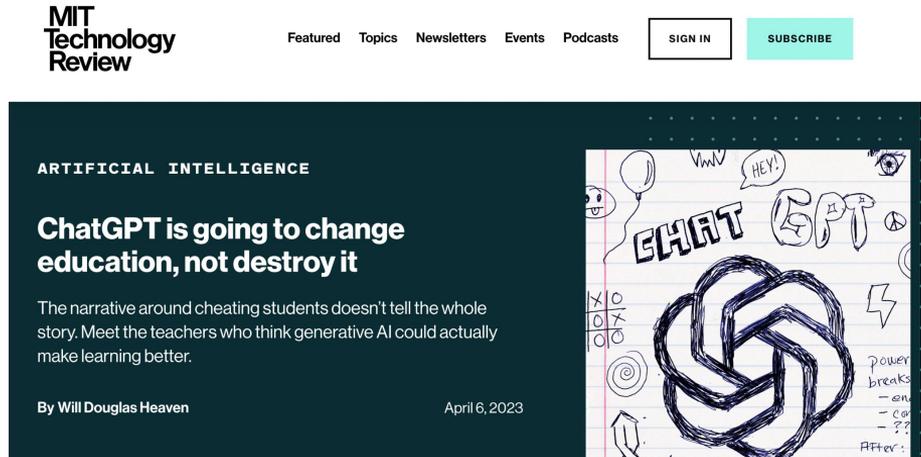
Clear chat



Teaching with AI

We're releasing a guide for teachers using ChatGPT in their classroom—including suggested prompts, an explanation of how ChatGPT works and its limitations, the efficacy of AI detectors, and bias.

[Find additional resources in our new FAQ >](#)



MIT Technology Review

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ARTIFICIAL INTELLIGENCE

ChatGPT is going to change education, not destroy it

The narrative around cheating students doesn't tell the whole story. Meet the teachers who think generative AI could actually make learning better.

By Will Douglas Heaven April 6, 2023



Many teachers are worried

Did a Fourth Grader Write This? Or the New Chatbot?

Don't be surprised if you can't always tell. Neither could a fourth-grade teacher — or Judy Blume.

By [Claire Cain Miller](#), [Adam Playford](#), [Larry Buchanan](#) and [Aaron Krolik](#) Dec. 26, 2022

Teachers: "These AI Resources Are Not Classroom-Ready."

The "80-20 rule" is more accurately a "20-80 rule."



DAN MEYER
OCT 30, 2024



35



18



4

Share

In my recent article about AI's "[delivery problem](#)," I claimed that AI-generated resources like lesson plans, assessments, and presentations, leave significant work to teachers, not just to customize them to their local context, but to make them even minimally viable for classroom use.

The Stanford Daily

News • Science & Technology

Scores of Stanford students used ChatGPT on final exams, survey suggests

CLASSROOM TECHNOLOGY

Tech Fatigue Is Real for Teachers and Students. Here's How to Ease the Burden



By [Alyson Klein](#) — March 08, 2022 ⌚ 6 min read



Where's the revolution?

- Focus on **learning process** rather than its product (e.g. finished work)
- Go beyond knowledge transfer to **empowering students, giving them agency, building positive relationships**

Why are these difficult?

1. hard to “measure” gains
2. impossible for 1 teacher to deeply understand & adapt their instruction to each individual student
3. knowing what to say to empower students is non trivial

Could language technology help overcome these barriers to change?

How can we ensure that the tools don't add burden on the teacher, but the opposite: **empower them?**





Can you type in everything about your class?

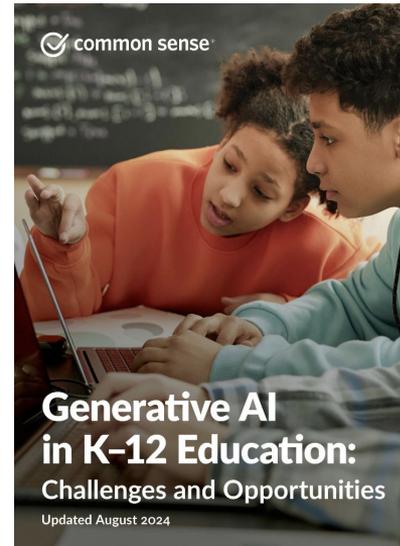
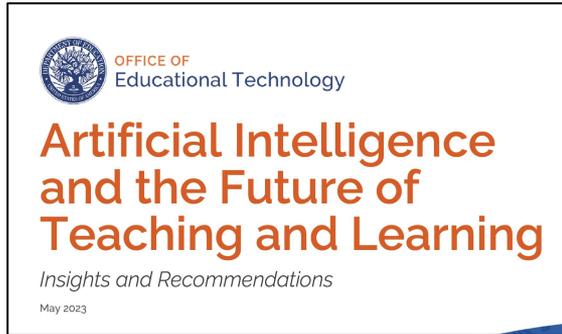
Let's make that last mile!

Source: Dan Meyer

Vision: creating NLP technology to...

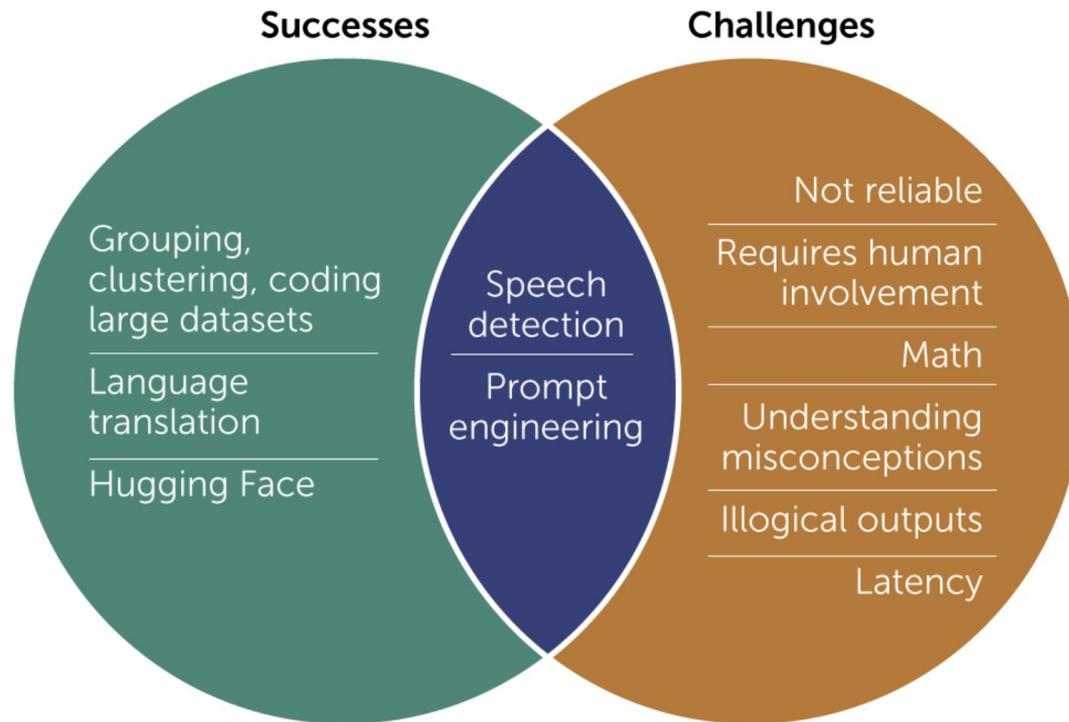
1. Speed or deepen student learning
2. Automate routine (and complex) classroom tasks
3. Improve instructional quality
4. Inform educational theory

Check out some of the recent AI Education reports!



linked from week 1 of the syllabus!

Figure 2. Overview of the successful and challenging tasks for AI during this project.



[Report from Digital Promise](#) (28 AI pilot projects)

This class



Identify
Problem

Weeks 1-2



Data
Exploration

Week 2-4



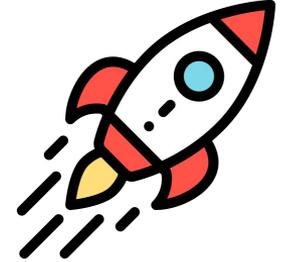
Algorithm
Development
& Validation

Week 3-6



Tool
Development

Week 6-7



Deployment

Week 8-9

Overarching Themes:



Bias &
Fairness



Working
closely with
teachers

Exciting guest lectures!



Dan Meyer,
Amplify/Desmos



Sara Wiltberger & Shubham Pal,
Google Learn LM Team



Rakiya Brown,
TeachFX



Sarah Johnson, Teaching Lab



Scott Crossley, Vanderbilt

By the end of the course, you will be able to

1. Identify relevant, impactful areas of intervention
2. Analyze text, and their relationship to other forms of data, with quantitative methods
3. Take steps towards developing a solution (algorithm / app) that leverages NLP to empower educators
4. Communicate your solution to an audience of educators and peers

By the end of the course, you will be able to

1. Read and understand research papers on the topic
2. Present concise and informative summaries of research
3. Execute computational social science research

Prerequisites

- Coding expertise
- Experience with NLP (CS 124 at the minimum)
- Passion for helping teachers
- Readiness to participate!

This is **not** an introductory Python / NLP class

- The goal of the course is to **apply NLP** to make a difference for teachers
- We will **not** be able to provide low-level technical support for coding in Python
- We will be able to provide pointers to libraries and toolkits, and self-learning materials for basic NLP tools (e.g. [Dan Jurafsky's textbook](#)), but we will not have the time to go over these methods in the weeds

Class setup

1. Lecture (~20 mins)
2. Q&A / group work (~20 mins)
3. Student-led discussion of a paper (40 mins)

Unit Policy

- 3-4 units: same requirements
- 2 units: homeworks are optional

Grading

- Class participation (5%)
- Project (60%)
- Homework (20%)
- Reading Commentaries (10%)
- Reading Discussant (10%)

Office hours

See website for up-to-date information.

<https://web.stanford.edu/class/cs293/>

Project (60%)

- Group Project 1-3 people per group (we encourage groups of 3!)
- Please discuss your project idea with instructor/TA early in the course
- Components:
 - Rationale for Project [= Literature Review + Motivation] (10%)
 - Experimental Protocol (15%)
 - 2 Practice Pitches (5% each), including peer feedback
 - Final Pitch (15%)
 - Final Paper (10%)

Project = Demonstrate you know what it takes to:



Identify
Problem



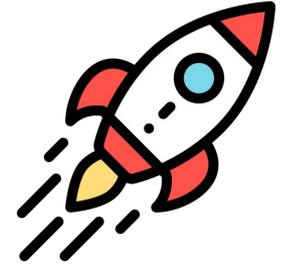
Data
Exploration



Algorithm
Development
& Validation



Tool
Development



Deployment

Overarching Themes:



Bias &
Fairness



Working
closely with
teachers

Project

- We encourage you to **bring in existing projects** if you have any
- Projects **may be at different stages** of development at the end of the course — we want to evaluate the process (progress, effort and learning) rather the stage at which your tool / study is at
- **At the minimum (if you are just starting)**, you should have designed a thoughtful plan for each step until deployment

Project Pitches

- 5 minutes + brief Q&A
- [Rubric](#)
- **During week 5 & week 8**, you'll give two practice pitches (5% each) and practice using the rubric by giving each other feedback
- **During week 10**, you'll pitch your project to a group of educators
- More info on website

Where to find inspiration?

- Talk to Dora & Mei
- Read the AI Ed reports/whitepapers linked in week 1 on the website
- Check out Future work & Limitations sections in relevant papers
- Talk to each other
- Talk to teachers



Suggested Project (pending DUA)

Understanding **learning trajectories** by analyzing sequences of student responses to math tasks from the Amplify platform.

Lesson Synthesis

How does the grid help you describe a ...

a) Rotation?
b) Translation?
c) Reflection?

The grid helps me describe a:
Rotation...
Translation...
Reflection...

Moves

Amplify.

Potential outlets for your final paper!

Venue	Deadline
<u>ACL BEA workshop</u>	March 1, 2025
<u>Learning at Scale</u>	Feb 20, 2025 for full papers; April 14, 2025 for works-in-progress
<u>AIED</u>	Feb 12, 2025
<u>Education Data Mining</u>	Feb 20, 2025

Reading Commentaries (10%)

- Short commentary (~200 words) due 5pm the day before class
- Viewable to other students
- Late submissions will **not** be accepted
- We will drop 3 lowest grades at the end of the class
- **Not a summary** – propose ideas to think about
- Graded on a check minus / check / check plus scale

Although you don't need to submit commentaries on optional readings, we **highly encourage you to read them.**

Reading Discussants (10%)

- Once a quarter (sign up link [here](#))
- Work in groups of 2-3
- **Day before class:** Summarize commentaries
 - Identify themes, highlight quotes
 - [You can use this template](#)
- **In class:**
 - Don't simply present the themes
 - Use the themes to scaffold an interactive, engaging discussion

Homework (20%)

- Colab notebooks
 - HW1: Exploring transcript data
 - HW2: Fine-tuning for classification
 - HW3: Generative LLMs
- Meant to support you with your final project
- Optional for those taking class for 2 units
- Upload full pdf to Canvas
- Graded on a check minus / check / check plus scale

Class participation (5%)

- Productive contributions to classroom discussions
- Productive contribution to the success of the project
- Completion of brief tasks (e.g. teacher interview, getting to know you survey)



Diversity & Inclusion

This course will be challenging and we all need to feel safe and included if we are to embrace that challenge. As such, it is essential that we create a positive learning environment where diverse perspectives are recognized and valued as a source of strength. I ask that you join me and your fellow students in creating a classroom culture based on open communication, mutual respect, and inclusion. Disagreements and debates are fine and can often be constructive and enlightening. But I ask that you focus on the arguments, not the person, and that you seek to understand, not characterize.

AI Policy

- Feel free to use to brainstorm ideas, debug code, explain a concept
- Be aware of limitations & inaccuracies
- Assignments should represent your own work. Any use of AI should be **cited** as any other source, in accordance with Stanford's Honor Code

Let's get to know each other!

Please limit to 3 sentences per person! (~20-30 seconds)

- 1 Who you are
- 2 One thing that *excites* you about language technology/natural language processing (NLP) in classrooms
- 3 One thing that *troubles* you about NLP in classrooms

Please read the required readings by **this Wednesday** as the class discussion will heavily build on them.



- Nguyen, D., Liakata, M., DeDeo, S., Eisenstein, J., Mimno, D., Tromble, R., & Winters, J. (2020). [How We Do Things With Words: Analyzing Text as Social and Cultural Data](#). *Frontiers in Artificial Intelligence*, 3.
- Liu, J., & Cohen, J. (2021). [Measuring teaching practices at scale: A novel application of text-as-data methods](#). *Educational Evaluation and Policy Analysis*, 43(4), 587-614

First reading commentary due **this Sunday at 5pm.**



Lucy, L., Demszky, D., Bromley, P., & Jurafsky, D. (2020). [Content analysis of textbooks via natural language processing: Findings on gender, race, and ethnicity in Texas US history textbooks](#). *AERA Open*, 6(3), 2332858420940312.

Mei and I will be leading the discussion in class.

Tasks to complete by **next Wednesday, Jan 15**

1. Respond to the brief, **Getting to know you survey** (on Canvas)
2. [Sign up](#) to be a discussant for a paper
3. Do a **30 minute interview** with a teacher! Details on Canvas
 - a. You can do it in pairs
 - b. They would preferably be a K-12 teacher, but could be any other educator (tutor, section leader, etc.); you can't interview yourself
 - c. Please submit your notes on Canvas



Teacher interview questions (~30 mins)

- Can you describe a typical day in your classroom?
- What are the most significant challenges you face in supporting students' learning?
- How do you address the diverse needs of students in your classroom?
- How do you currently assess student learning, and what tools or strategies do you use?
- Have you used any technology to support your teaching? What worked well, and what didn't?
- If you could design the perfect tool to support your teaching, what would it do?



Class enrollment

- Due to room capacity, we'll have to cap the class at **23 students + 3 audits**.
- The class is at capacity and many students, including those who would like to use it as a requirement, are on the waitlist. **If you know you won't take the class, please drop asap to give the spot to others.**
- If you're not in the class yet but know that you want to take it, please email me and explain why you want to take the class, and the perspective you will add to the course. I'll give priority to students who
 - (i) are using it for a degree requirement (e.g. EDS masters),
 - (ii) who do not have the option to take the course at a different time,
 - (iii) who have more NLP experience,
 - (iv) who contribute to diverse perspectives to the course.