

# Uncertainty Communication for Decision-making

CMSC839E: Advanced Topics in Human-Computer Interaction

# Fumeng Yang

foo-mung



foo



mung

<https://www.thespruceeats.com/yam-fufu-2138088>

[https://stock.adobe.com/search?k=%22mung+bean%22&asset\\_id=432625489](https://stock.adobe.com/search?k=%22mung+bean%22&asset_id=432625489)

# **Fumeng**

foo-mung

# **Hmm...**

# Me: HCI + Visualization

New faculty



Postdoc



PhD



Masters



personal



lab



I'm recruiting PhD/MS students

**We have a TA!!** ★



**Huy Nghiem**

Teaching Assistant

Pronouns: he/him

# Exercise

Raise your hands if you are in a PhD program

Raise your hands if you are in a Master program

Have first-author papers at a major conference/journal

Have done peer reviews for a conference or journal

Hear about or use the “golden rule”  $p < .05$



# **Uncertainty Communication for Decision-making**

CMSC839E: Advanced Topics in Human-Computer Interaction

**What do you think this  
course is about?**

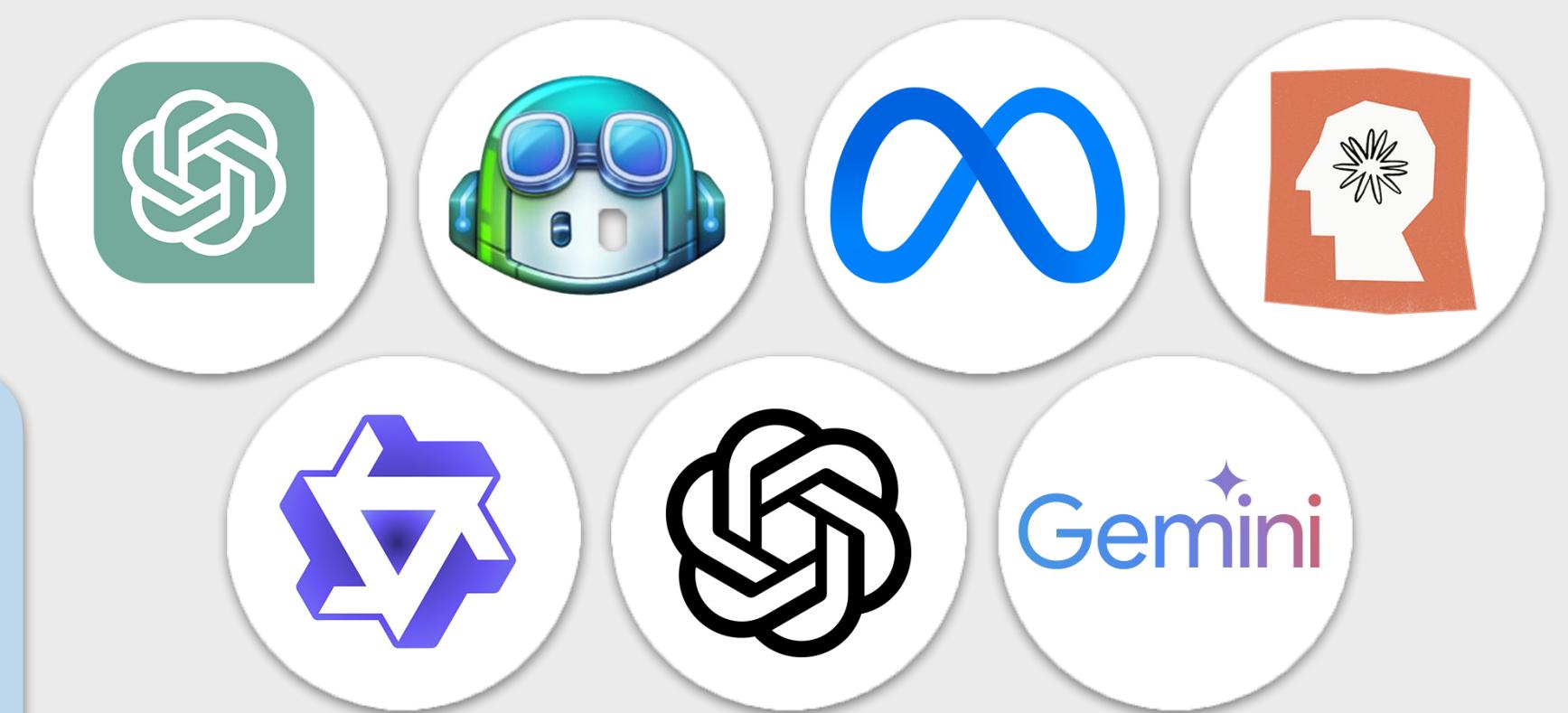
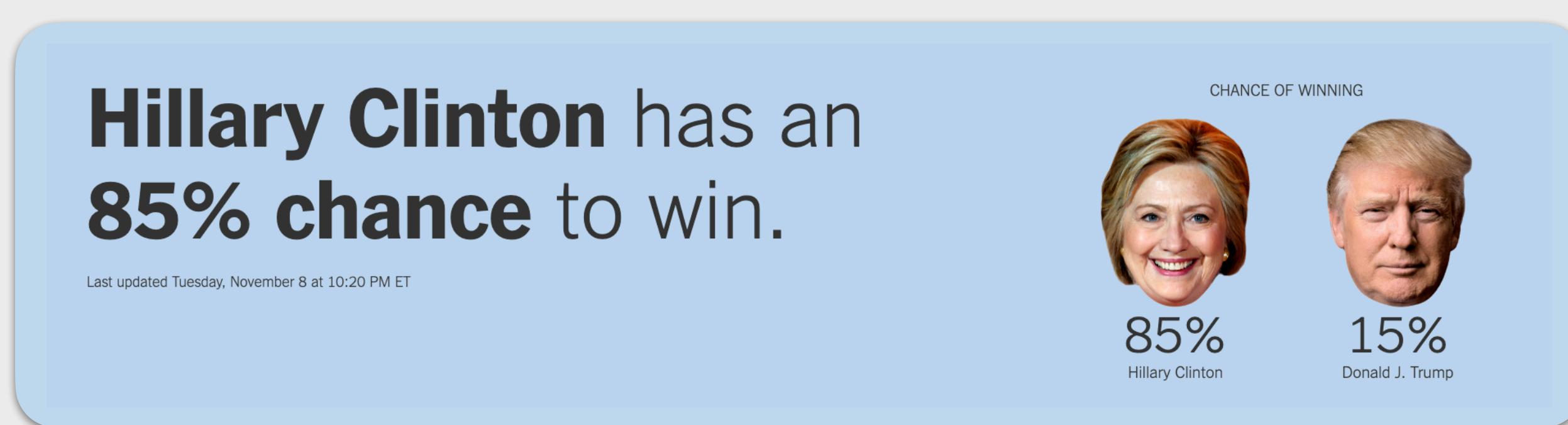
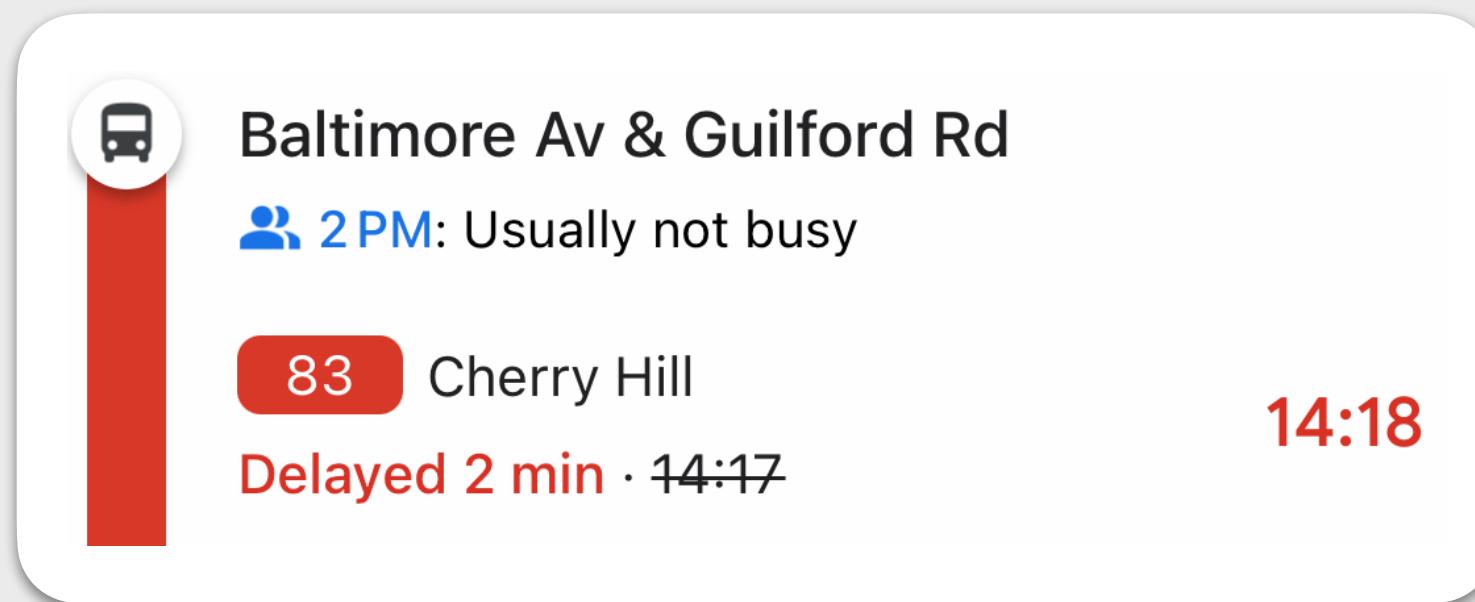


# **The big picture**

# Vision

We are surrounded by many computational models.

→ LLM, election forecasts, traffic time estimate, recommenders, ...



# Vision

We are surrounded by many computational models.

All models are imperfect.



Based on her own words in speeches and emails,  
a devastating indictment of a disastrous election defeat.

## HOW I LOST BY HILLARY CLINTON



WITH A FOREWORD BY JULIAN ASSANGE  
INTRODUCED AND ANNOTATED BY JOE LAURIA

# Vision

We are surrounded by many computational models.

All models are imperfect.

How to cope with these imperfections for human users to make the right decision?



miss a bus/a meeting, medical decisions, voting, ...



individual decision, public policy, election results, ...

# Vision

We are surrounded by many computational models.



LLM, election forecasts, traffic time estimate, recommenders...

All models are imperfect.



uncertain, wrong, hallucination,...

How to cope with these imperfections for human users to make the right decision?



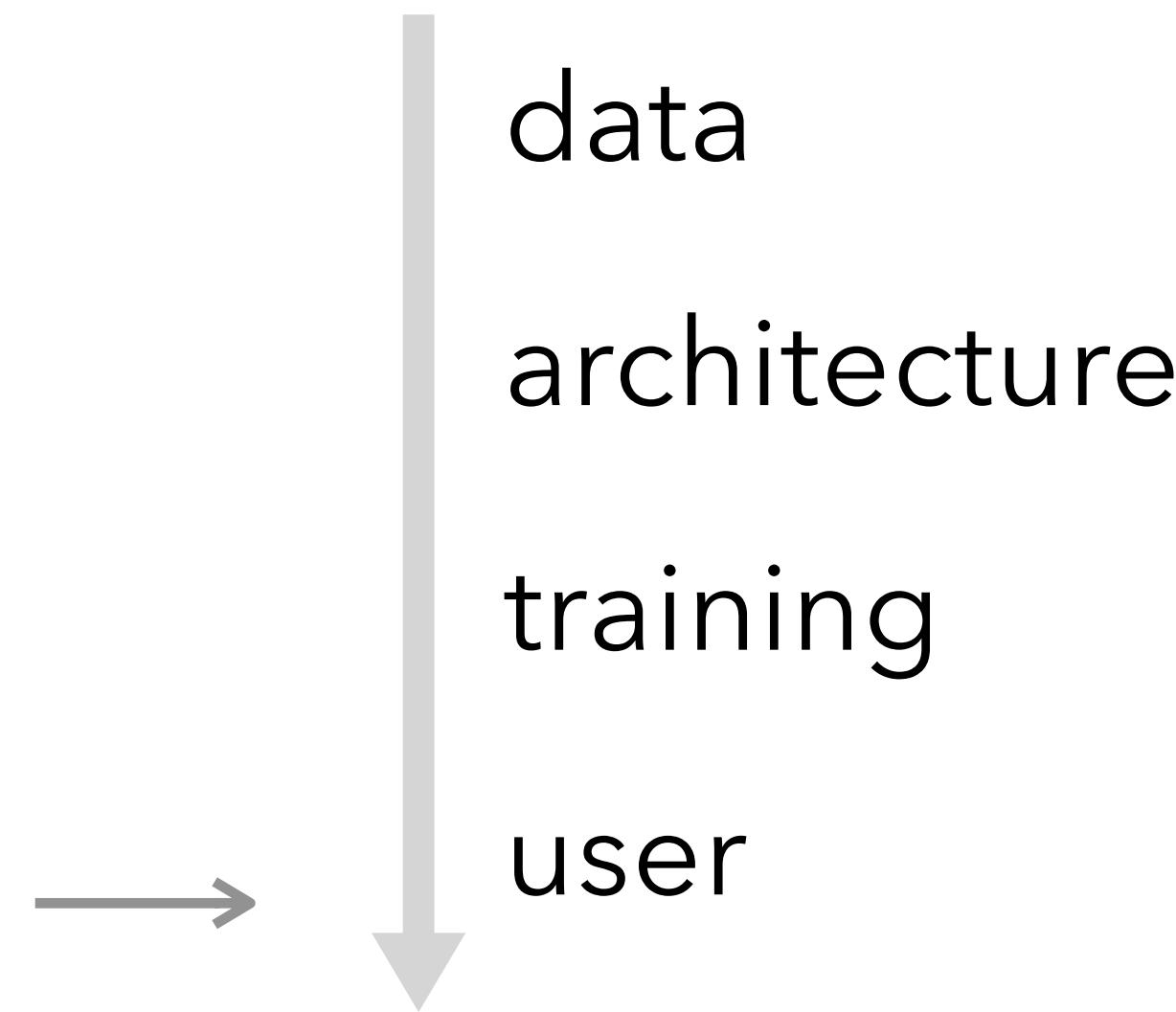
individual decision, public policy, election results...

# Vision

We are surrounded by many computational models.

All models are imperfect.

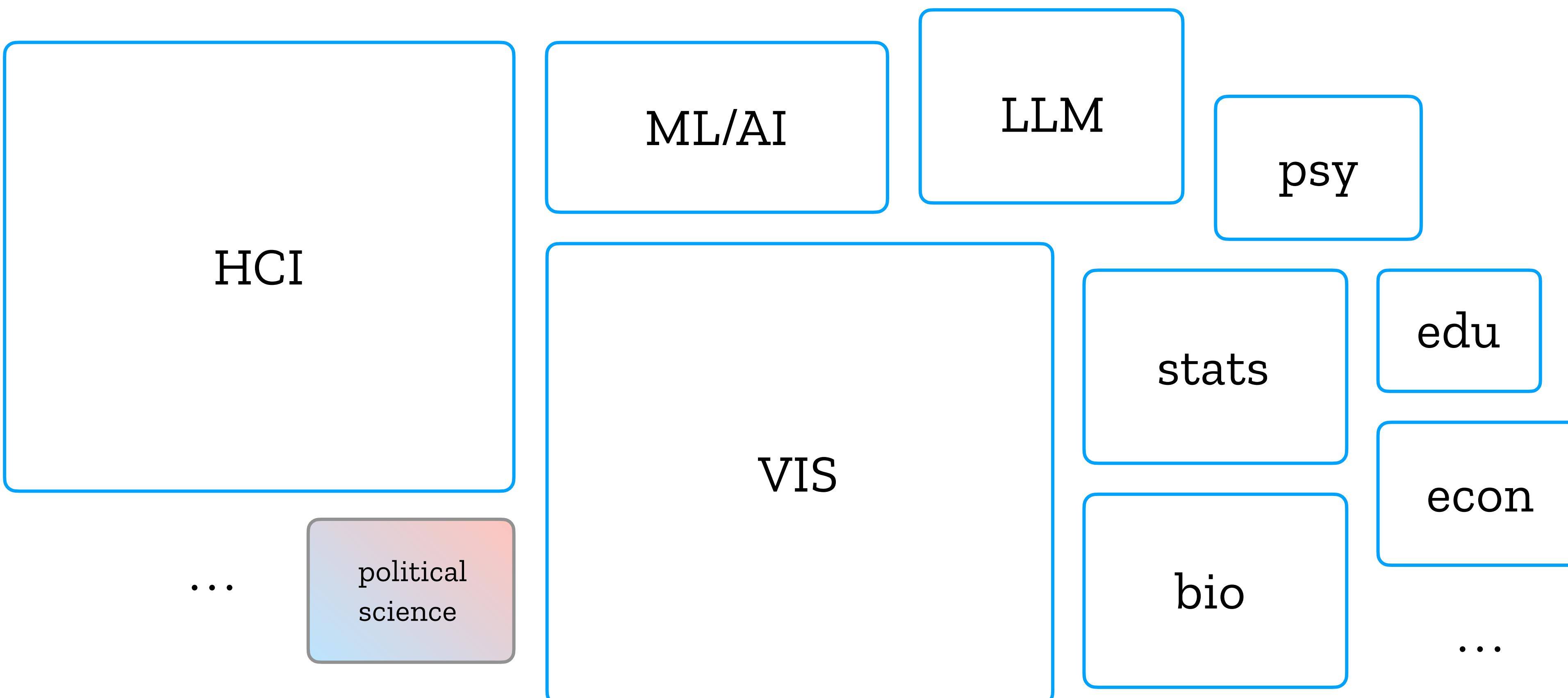
How to cope with these imperfections for human users to make the right decision?



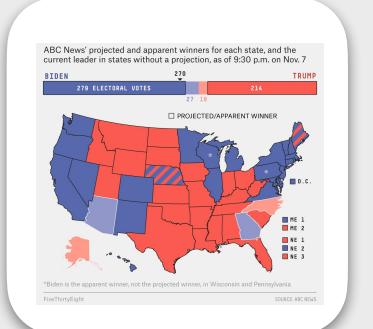
**touch on  
this course  
in light of  
uncertainty**

# Course scope

context



... this is a societal problem



# Course goals

| **Not** a hardcore ML/AI/LLM/Statistics course.

I hope you can improve your understandings of these. We welcome different opinions.

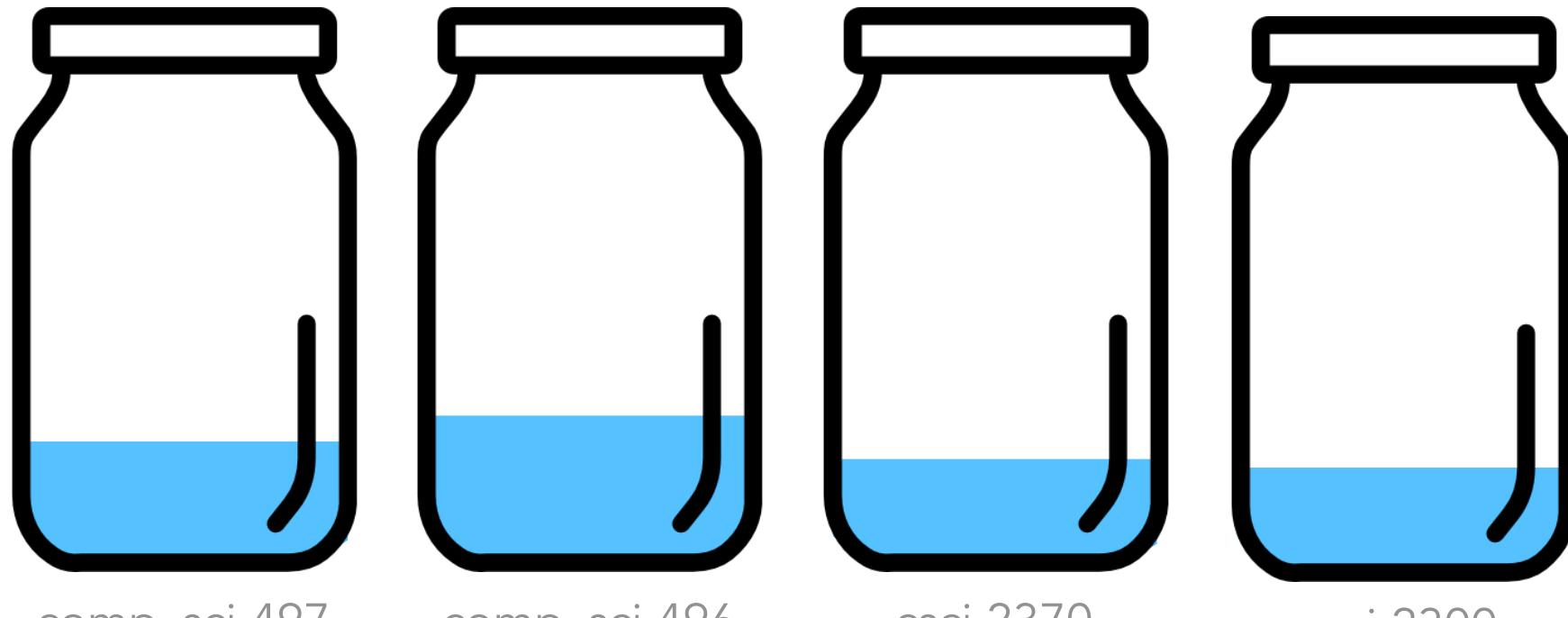
| **Low** programming but it depends on the project of your choice.

I assume you have some programming skills?

| Train junior grads on **how to do HCI/VIS research.**

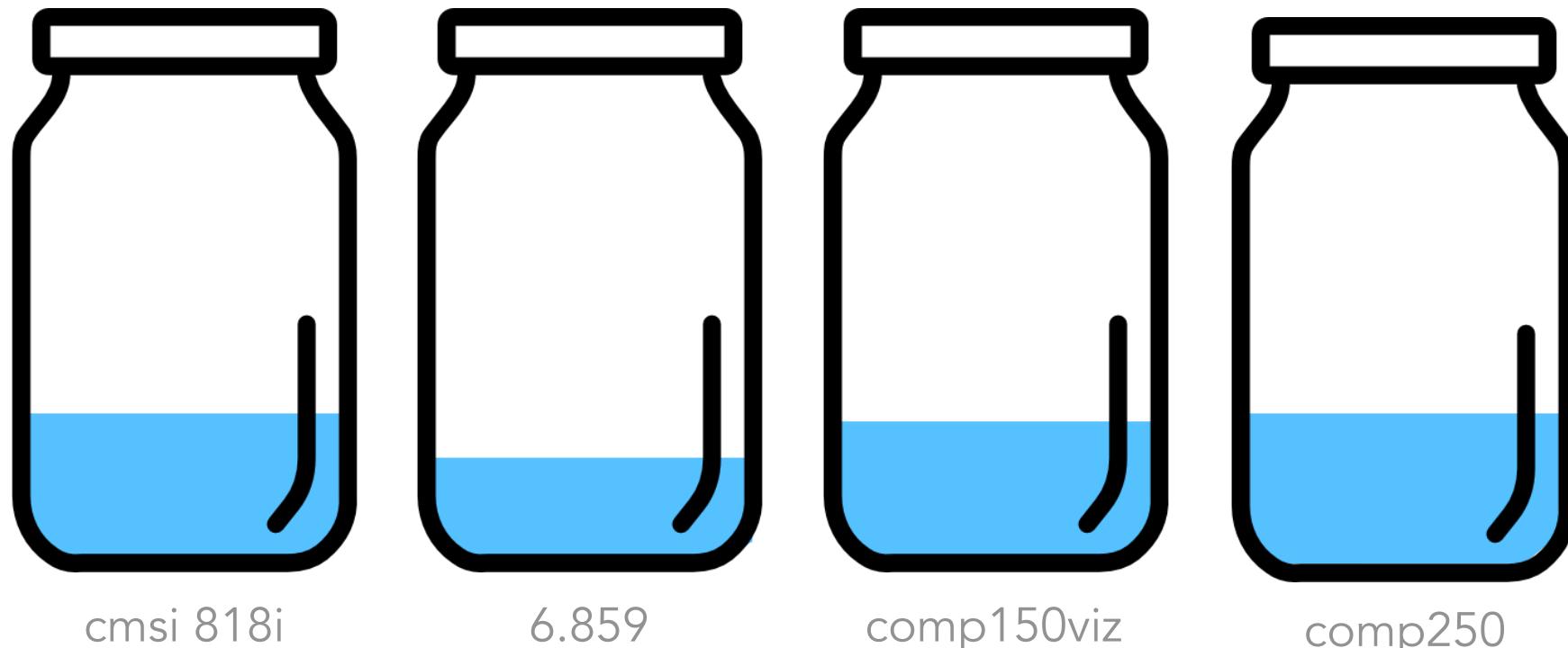
quantitative analysis, paper writing, reviewing, project management,  
tho your advisor may have a different opinion; MS for grad schools & useful methods

# How I made this course



Taking the part I like about from those courses I took, attended, or taught.

I hope this will be a **like-able** and **useful** course.



I think my teachers'd be happy to see that I pass down their wisdom to the next generation.

And I wish (some of) you can do so as well one day.

# **Questions?**

# **Course organization**

# Course website & Canvas

<https://fumeng-yang.github.io/CMSC839E/>

Course materials will be publicly released on this website.

Confidential information will be class-only (e.g., on UMD Google Drive).

Synced on Canvas.

It is git-tracked. **I may adjust the syllabus.**

[demo the web] [demo the repo]

# What do students do?

Week	Date	Topics	Reading list (due before the class)	Assignments
0	08/26/24	Logistics + Warm-up exercise	A reminder: start reading the papers	QPR out
	08/28/24	Lecture: Background knowledge on statistics, uncertainty, and visualization	<p>Presentations start next week, but make sure to read this week's papers and submit your questions!</p> <p>[1] Statistical rethinking (Chapter 1 The golem of prague) <a href="#">↗</a></p> <p>Only if you haven't taken a vis course before:</p> <p>[2] Visualization analysis &amp; design (Chapter 5 Marks and channels) <a href="#">↗</a></p> <p>Optional:</p> <p>[3] Rethinking the ranks of visual channels <a href="#">↗</a></p>	
1	09/02/24	Labor day (no class)		
	09/04/24	Quantitative results I - Null Hypothesis Significance Testing (NHST)	<p>[4] Rethinking statistical analysis methods for CHI <a href="#">↗</a></p> <p>[5] Confusion over measures of evidence (p's) versus errors (a's) in classical statistical testing</p> <p>Statistical tests, p values, confidence intervals, and power: A guide to misinterpretations <a href="#">↗</a></p>	Q.1 finalized
2	09/09/24	intervals & Bayesian methods	<p>[6] Statistical communication in HCI <a href="#">↗</a></p> <p>[7] Can visualization alleviate dichotomous thinking? Effects of visual representations on the cliff effect <a href="#">↗</a></p> <p>[9] Researcher-centered design of statistics: Why Bayesian statistics better fit the culture and incentives of HCI <a href="#">↗</a> and [reviews]</p>	
	09/11/24	Uncertainty visualization	<p>[10] Fundamentals of data visualization (Chapter 16 Visualizing uncertainty) <a href="#">↗</a></p> <p>[11] Why authors don't visualize uncertainty <a href="#">↗</a></p> <p>Optional:</p> <p>[12] ggdist: Visualizations of distributions and uncertainty in the grammar of graphic <a href="#">↗</a></p> <p>[13] The UncertaintyVis browser <a href="#">↗</a></p>	

# Topics

- | Statistical communication
- | Uncertainty visualization
- | Explainable AI (XAI)
- | Decision theory
- | Probabilistic forecasts
- | Species tree
- | LLM uncertainty
- | AI literacy

# Grading

8% Weekly reading responses	→	questions for papers
16% Class presentations	→	paper and project presentations
41% Three assignments/projects	→	written/programming
15% Midterm exam: take-home	→	MS/PHD qualifying
20% Final exam: take-home		
10% Extra credit	→	exceptional performance

# Grading

8% Weekly reading responses ◀

16% Class presentations

41% Three assignments/projects

15% Midterm exam: take-home

20% Final exam: take-home

10% Extra credit

# **Weekly reading responses - 8%**

**1-2 questions for each required paper by noon on the day of the class.**

**≥2 questions per week should be non-trivial.**

We **won't** strictly count non-trivial questions.

Show us that your efforts in reading and critical thinking.

Lateness: ...try to submit on time because they'll be used in class.

# Grading

8% Weekly reading responses

16% Class presentations ◀

41% Three assignments/projects

15% Midterm exam: take-home

20% Final exam: take-home

10% Extra credit

## **Class presentations - 8% + 8%**

- ~2 paper presentations (depends on the class size)
- 1 group presentation of your course project(s)
- Get you **extra credit** if you do extra paper presentations. 20-30 minutes.
- Plz sign up **≥2-3 days** before your presentation.

# **Class presentations - 8% + 8%**

**~2 paper presentations (depends on the class size)**

**1 group presentation of your course project(s)**

No preparation is **not good**, not good.

At least introduce the problem, present some methods and results, and stimulate a discussion.

Any format: slides, no slides, grab two papers for one class, etc.

Exceptional presentations get extra credit.

# **Class presentations - 8% + 8%**

**~2 paper presentations (depends on the class size)**

**1 group presentation of your course project(s)**

→ You can coordinate and decide how to present and lead the discussion.

You may reuse any online materials, and any online guidance.

If your paper includes reviews, please also summarize the reviews.

# Class presentations - 8% + 8%

~2 paper presentations (depends on the class size)

1 group presentation of your course project(s)

	11/20/24	Project presentations	<a href="#">Sign up here</a>	R.2 peer-review out
12	11/25/24	Thanksgiving (no class)		
	11/27/24	Thanksgiving (no class)		
13	12/02/24	Project presentations	<a href="#">Sign up here</a>	
	12/04/24	Project presentations	<a href="#">Sign up here</a>	
14	12/09/24	Project presentations (if needed) Reflection and Q&A		R.2 peer-review due

Lemme know if you all wanna be after the holiday...

# Reading list

Date	Topics	Reading list (due before the class)	Assignments
08/26/24	Logistics + Warm-up exercise	A reminder: start reading the papers	QPR out
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09/09/24	Quantitative results II - Confidence intervals & Bayesian methods	<p>[7] Fair statistical communication in HCI <a href="#">🔗</a></p> <p>[8] Can visualization alleviate dichotomous thinking? Effects of visual representations on the cliff effect <a href="#">🔗</a></p> <p>[9] Researcher-centered design of statistics: Why Bayesian statistics better fit the culture and incentives of HCI <a href="#">🔗</a> and [reviews]</p>	
09/11/24	Uncertainty visualization	<p>[10] Fundamentals of data visualization (Chapter 16 Visualizing uncertainty) <a href="#">🔗</a></p> <p>[11] Why authors don't visualize uncertainty <a href="#">🔗</a></p> <p>Optional:</p> <p>[12] ggdist: Visualizations of distributions and uncertainty in the grammar of graphic <a href="#">🔗</a></p> <p>[13] The UncertaintyVis browser <a href="#">🔗</a></p>	
09/16/24	XAI I: Explainable AI	<p>[14] Questioning the AI: Informing design practices for Explainable AI user experiences <a href="#">🔗</a></p> <p>[15] Visual analytics in deep learning: An interrogative survey for the next frontiers <a href="#">🔗</a></p> <p>[16] CNN explainer: Learning convolutional neural networks with interactive visualization <a href="#">🔗</a></p>	
09/18/24	XAI II: Explainability	<p>[17] Explanation, prediction, and causality: Three sides of the same coin? <a href="#">🔗</a></p> <p>[18] The mythos of model interpretability: In machine learning, the concept of interpretability is both important and slippery <a href="#">🔗</a></p>	Q.1 due Q.2 finalized, [dataset]

# **Uncertainty & Flexibility**

The more future papers are subject to change

You are welcome to suggest a paper

Most of them have free access

One or two might need you to be on campus/VPN

Lemme if you want me to do a lecture (LaTeX, slides, etc.)

# Signup

**Spreadsheet (link on Canvas; will be UMD email only)**

If you are auditing, signing up presentations will be helpful

~~I hope I can a UMD email & Canvas when the class begins...~~

	Date	Slot 1	Slot 2	Slot 3	Slot 4
week 0	Aug 26, 2024	NA			
	Aug 28, 2024	Signup example: [1] Statistical... by Fumeng Yang			
week 1	Sep 2, 2024	Labor day (no class)			
	Sep 4, 2024				
week 2	Sep 9, 2024				
	Sep 11, 2024				
week 3	Sep 16, 2024				
	Sep 18, 2024				
week 4	Sep 23, 2024				
	Sep 25, 2024				

# **Questions?**

# **Grading**

**8% Weekly reading responses**

**16% Class presentations**

**41% Three assignments/projects** ◀

**15% Midterm exam: take-home**

**20% Final exam: take-home** ◀

**10% Extra credit**

# **I release you all assignments this week**

## **But, they are drafts**

The submission methods and deadlines might be different.

Expect a full version on the finalized date.

Important changes (e.g., deadlines) will be announced in class.

# **Assignment Q: Quantitative analysis - 10%**

**The pipeline of experimental design and analysis**

**Q.1** write a preregistration

**Q.2** the dataset will be released after 2 weeks

then you conduct your preregistered analysis & write a 1-2 page report

Any software: Python, R, SAS, SPSS, Excel, Tableau, Matlab, Javascript, etc.

Hand calculating ... yes

# **Assignment P: Paper & project - 20%**

**The major major thing of this course**

**P.1** write a proposal using the template at week 6 - 5%

**P.2** abstract & author information at week 9 - 1%

**P.3** paper submission at week 11 - 14%

# **Assignment P: Paper & project - 20%**

## **The major major thing of this course**

start to think about it now

**P.1** - have your team at week 6 - 5%

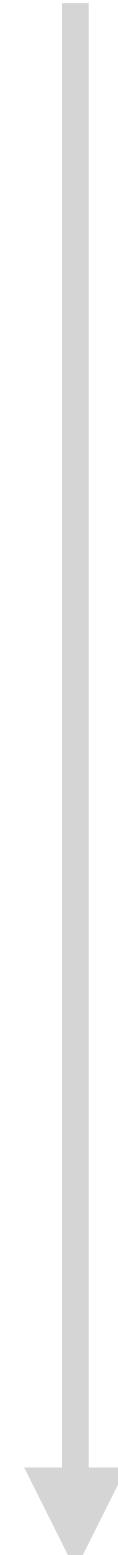
... do the work

**P.2** - have some results at week 9 - 1%

... do the work

**P.3** - final paper at week 11 - 14%

presentation



# **Assignment P: Paper & project - 20%**

**The major major thing of this course**

P.1 - have your team at week 6

P.2 - have some results at week 9    ←    not submitting on time = 0 of P.3

P.3 - final paper at week 1                      ←    no late submission accepted



# **Assignment R: Peer Review - 11%**

**Look at each other papers and write 1-2 reviews**

**R.1 - bidding & conflict**

Indicate your preference

**R.2 - write reviews for other papers**

## **Final exam: Address peer reviews - 20%**

**Revise your paper based on the two peer reviews**

# Assignment R + final exam

## To simulate the paper submission process

Can't fully simulate the anonymous part. Try not to reveal reviewers.

I look for **reasonable** reviews, and you aim for **helpful** reviews.

I will read all to ensure they're reasonable.

When grading final exams, I also look for **reasonable** responses,  
showing that you learn something from this course.

# **QPR + final exam + presentation = a project cycle**

Brainstorm & discussion

Do the work

Analyze the data

Submit an abstract

Submit the paper

Get reviewed

Revise your paper

Accepted & present at conference

Due to course planning,  
we have to joggle things around...



# **QPR + final exam + presentation = a project cycle**

**CHI**

Brainstorm & discussion

**VIS**

Do the work

**CSCW**

Analyze the data

**Ubicomp**

Submit an abstract

**VR**

**ISMAR (?)**

**Journal...**

Submit the paper

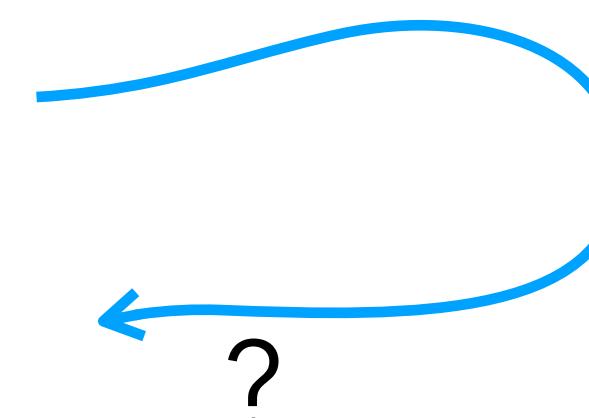
Get reviewed

Revise your paper

**IUI/UIST/  
SIGGRAPH/  
ISMAR (?)**

Rebuttal

proposed changes

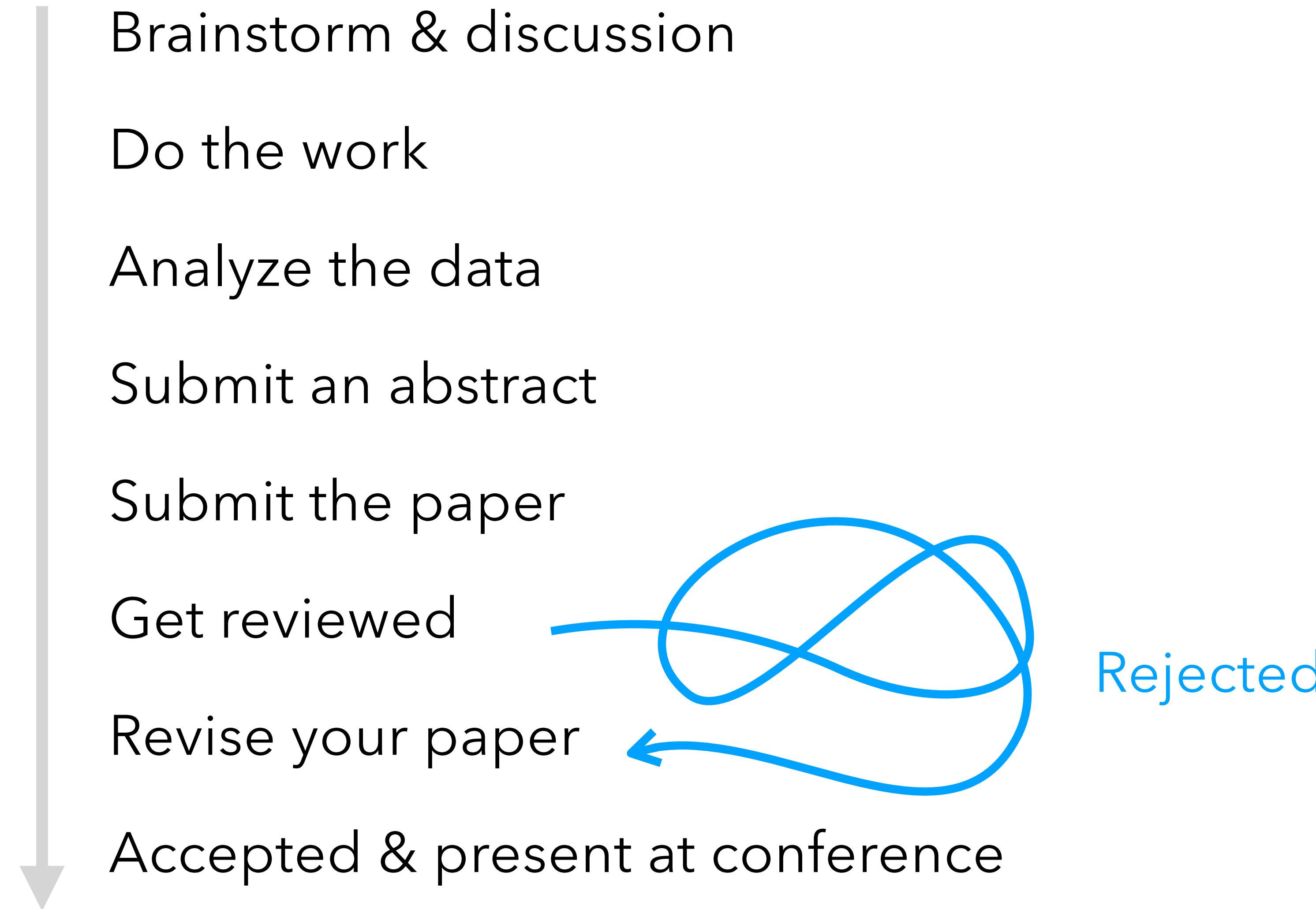


Accepted & present at conference

# **QPR + final exam + presentation = a project cycle**

- 
- Brainstorm & discussion
  - Do the work
  - Analyze the data
  - Submit an abstract
  - Submit the paper
  - Get reviewed
  - ~~Revise your paper~~
  - Accepted & present at conference

# **QPR + final exam + presentation = a project cycle**



# **Questions?**

# Grading

8% Weekly reading responses

16% Class presentations

41% Three assignments/projects

15% Midterm exam: take-home ◀

20% Final exam: take-home

10% Extra credit

# Midterm exam

4-6 total questions based on lectures, readings, and discussions (open-book)

2-3 conventional

2-3 open-ended

1-3 paragraphs for each

No LLM/GPT/etc. I won't grade based on grammar or readability either.

## **Extra credit - 10%**

exceptional presentation, paper, or participation could earn  
up to 10% extra credit

# AI usage

In line with the spirit of this course...

- AI should **not** be used to **directly complete** coursework.
- Clearly **mark** any content that is directly generated by AI.
- Be **mindful** about your trust in AI-generated content.
- You may use AI to **assist** with coursework.
- We encourage you to use AI **creatively** and share your experiences.
- Violations may result in a zero for the affected portion.

# Miscs

**4 Slack days:** message on Canvas/Piazza in advance

**Office hours:** Mon after class to ~4:30pm

**Office:** IRB 2216 (for now)

**Location of office hours:** classroom to my office

**My email:** use the platform (Piazza)

# **Questions?**

# **Other things**

# How to read a paper

how to read a paper

X |

All Images Videos Shopping Forums News Books More Tools

acm sigcomm  
<http://ccr.sigcomm.org/files/p83-keshavA> :

**How to Read a Paper - Computer Communication Review**  
by S Keshav · Cited by 252 — This article outlines a practical and efficient three-pass method for reading research papers. I also describe how to use this method to do a literature ...  
2 pages

Harvard University  
<https://www.eecs.harvard.edu/postscripts/Read...> :

**How to read a research paper.**  
Underline key points the authors make. Mark the data that is most important or that appears questionable. Such efforts help the first time you read a paper and ...  
2 pages

**Scholarly articles for how to read a paper**

**How to read a paper** - Keshav - Cited by 252

**How to read a scientific research paper** - Durbin - Cited by 38

**How to read a review paper** - Callcut - Cited by 26

The BMJ  
<https://www.bmj.com/resources-readers/publications> :

**How To Read A Paper**  
On this page you will find links to articles in the BMJ that explain how to read and interpret different kinds of research papers:

**How to Read a Paper: The Basics of Evidence-Based Medicine**

Book by Trisha Greenhalgh :

Book preview  
31/185 pages available

Did you like this book?

How to Read a Paper describes the different types of clinical research reporting, and explains how to critically appraise the publications. The book provides the tools to find and evaluate the literature, and implement the findings in an evidence-based, patient-centered way. ...

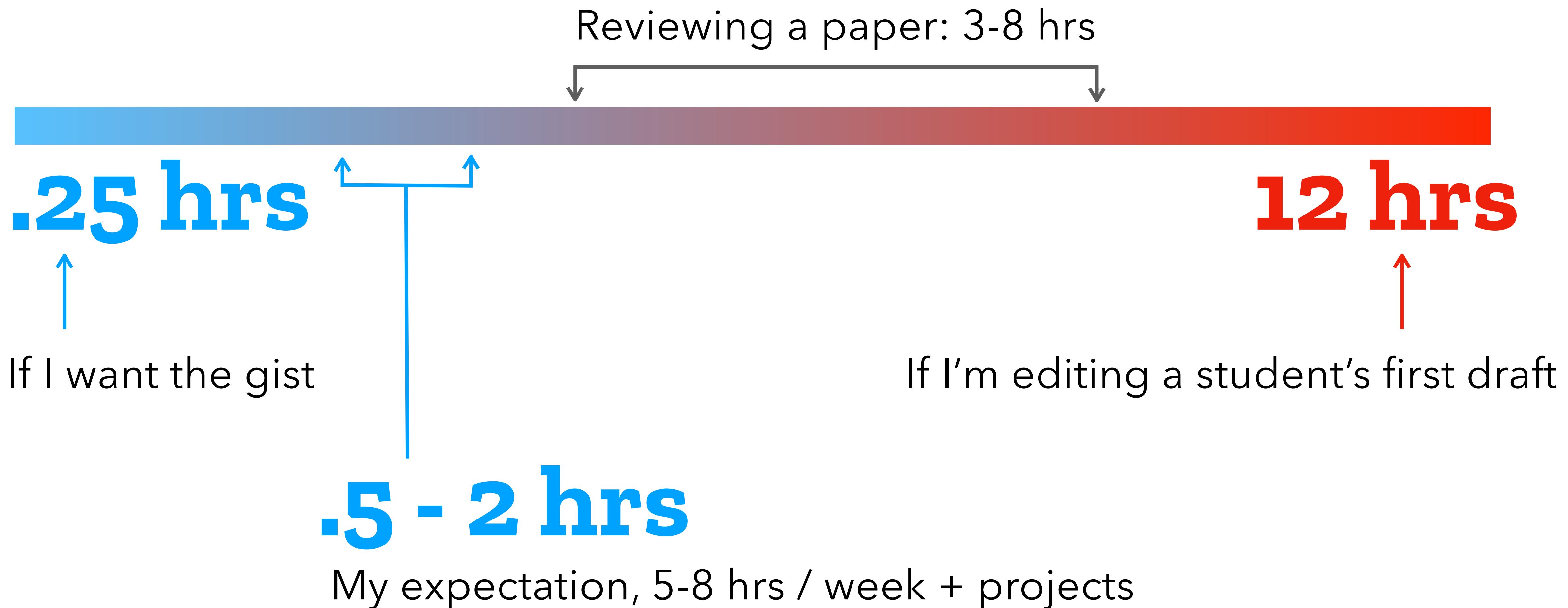
[Google Books](#)

**Originally published:** 1997

**Author:** Trisha Greenhalgh

# How to read a paper

How long it takes me to read a paper...



# How I read a paper

Definitely abstract, introduction

Methods

Results (it depends)

Related work (maybe)

Discussion (sometimes they are fun to read)

Conclusion (I almost never read it, but some people put this in the first line)

# **Questions?**

# Next 1-2 weeks

Wed: my lecture

Submit questions by the noon (1 non-trivial) if we fix Canvas

Start to read papers and sign up for presentations

*To be continued...*