

CSE 518A

# Human-in-the-Loop Computation

Instructor: Chien-Ju (CJ) Ho

# Course Information

- Announcements and discussion
  - Website: <http://chienjuho.com/courses/cse518a>
  - Piazza: <http://piazza.com/wustl/fall2022/cse518a>
  - Please check the website and Piazza regularly.
- Time and location
  - Tue/Thu 4:00-5:20pm
  - Hillman 70

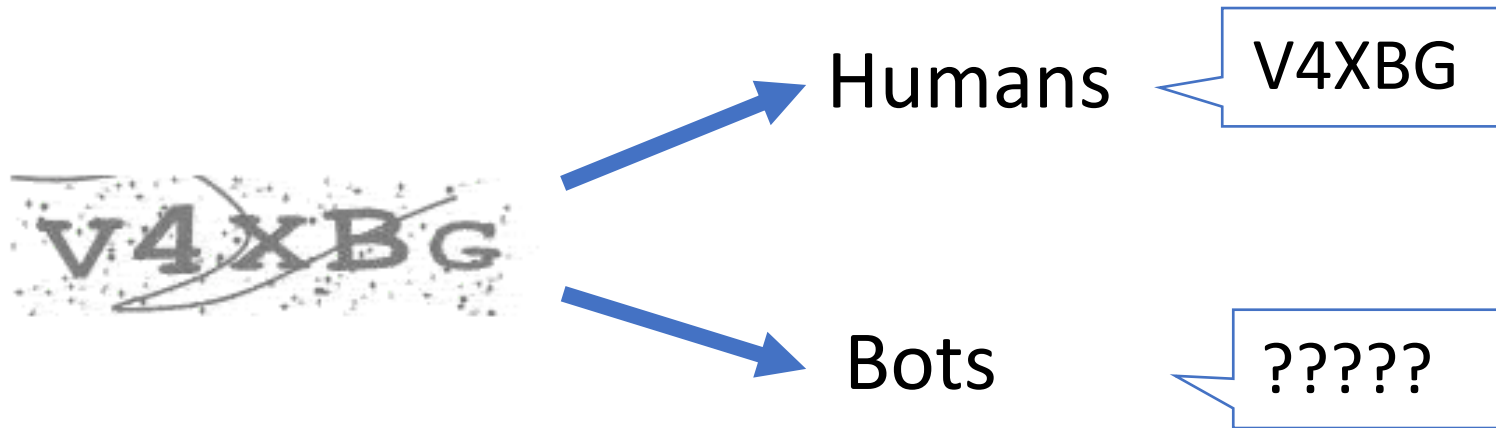
# Plan for today

- Welcome and introduction
- What's the class about?
- Logistics

Human-in-the-Loop Computation?

# CAPTCHA

Completely Automated Public Turing test to tell Computers and Humans Apart



Показывать информацию обо мне

☐ Всем

☐ Только зарегистрированным пользователям

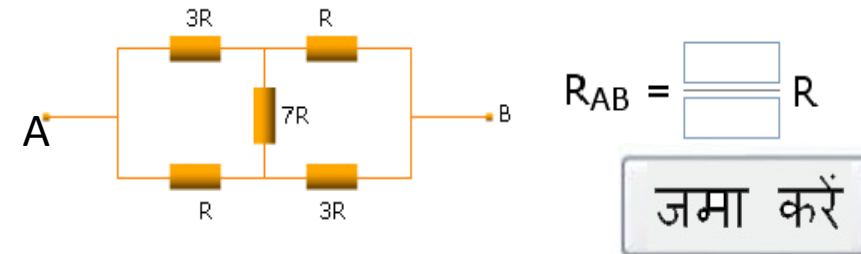
☐ Никому

Защита от автоматической регистрации

$$\lim_{x \rightarrow 0} \ln \left( 2 + \sqrt{\arctg x \cdot \sin \frac{1}{x}} \right)$$

Введите ответ

<http://forum.academ.org/>



# Humanity wastes about 500 years per day on CAPTCHAs. It's time to end this madness

05/13/2021



Thibault Meunier

Can we utilize this wasted human computation power?

# What are humans doing for solving CAPTHCAs?

- Solving tasks that AIs cannot do well yet
- Optical Character Recognition (OCR)
  - Hard for AI (used to be but not anymore)
  - Relatively Easy for humans

**This aged portion of society were distinguished from**

Can we utilize CAPTCHAs to help solve OCR tasks?



The Norwich line steamboat train, from New-London for Boston, this morning ran off the track seven miles north of New-London.

morning

morning overlooks

Type the two words:



Word 1: an OCR task to solve  
Word 2: tell apart humans and bots

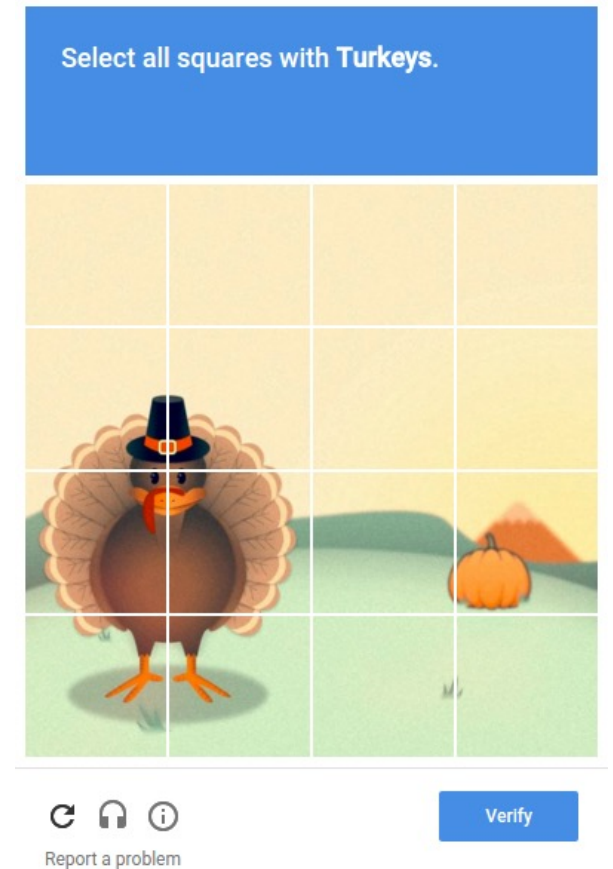
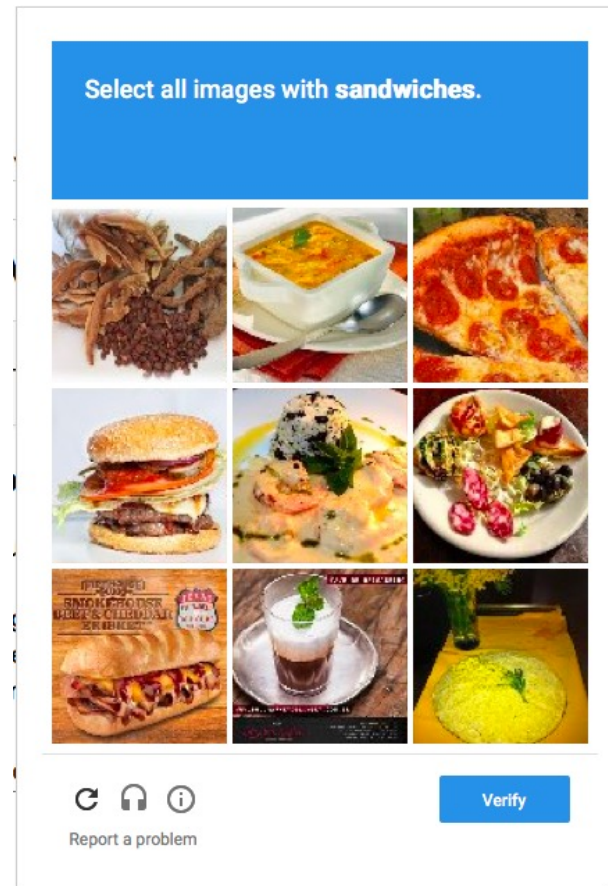
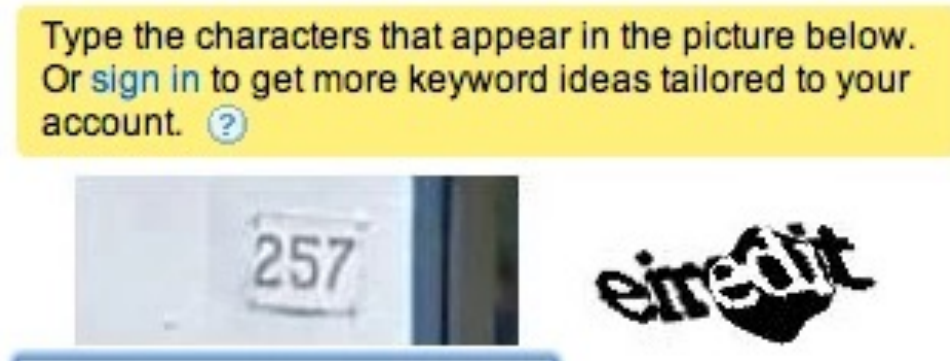
“reCAPTCHA has completely digitized the archives of The New York Times and books from Google Books, as of 2011”

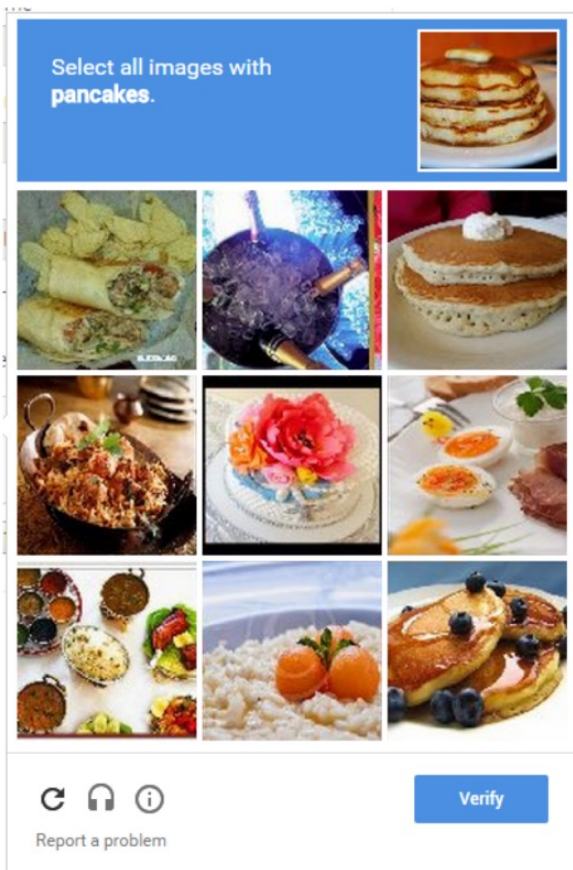




# More than OCR

- Google acquired reCAPTCHA in 2009.

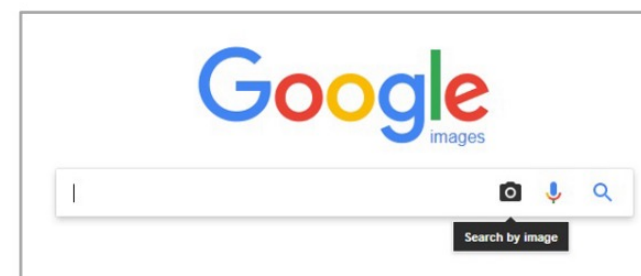
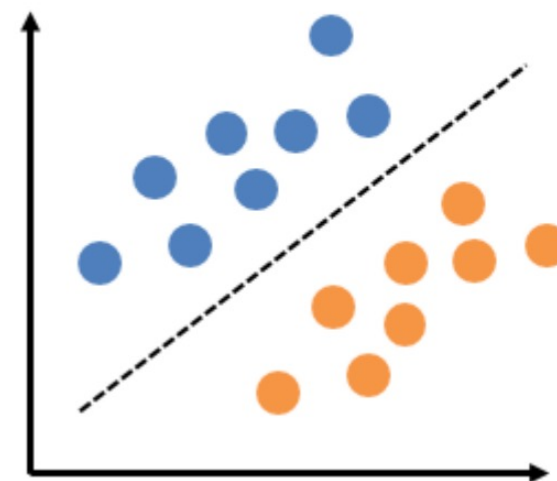




*Training Data*



*Hard Tasks*



Technology

## **Massachusetts woman's lawsuit accuses Google of using free labor to transcribe books, newspapers**

The lawsuit was tossed by the judge. But ethical considerations (e.g., fairness, privacy) are important issues to consider in human-in-the-loop computation.

Are there other examples of  
human-in-the-loop computation?



WIKIPEDIA  
The Free Encyclopedia

Article

[Talk](#)

Read

[Edit](#)

[View history](#)

Search Wikipedia



# Crowdsourcing

From Wikipedia, the free encyclopedia

**Crowdsourcing** is a [sourcing model](#) in which individuals or organizations obtain [goods and services](#). These services include ideas and finances, from a large, relatively open and often rapidly-evolving group of [internet](#) users; it divides work between participants to achieve a cumulative result. The word crowdsourcing itself is a [portmanteau](#) of [crowd](#) and [outsourcing](#), and was coined in 2005.<sup>[1][2][3][4]</sup> As a mode of sourcing, crowdsourcing existed prior to the digital age (i.e. "[offline](#)").<sup>[5]</sup>

There are major differences between crowdsourcing and outsourcing. Crowdsourcing comes from a less-specific, more public group, whereas outsourcing is commissioned from a specific, named group, and includes a mix of bottom-up and top-down processes.<sup>[6][7][8]</sup> Advantages of using crowdsourcing may include improved costs, speed, quality, flexibility, scalability, or diversity.<sup>[9][10]</sup>

Some forms of crowdsourcing, such as in "idea competitions" or "innovation contests" provide ways for organizations to learn beyond the "base of minds" provided by their employees (e.g. [LEGO Ideas](#)).<sup>[11]</sup> Tedious "microtasks" performed in parallel by large, paid crowds (e.g. [Amazon Mechanical Turk](#)) are another form of crowdsourcing. It has also been used by [not-for-profit](#) organizations and to create [common goods](#) (e.g. [Wikipedia](#)).<sup>[12]</sup> The effect of user communication and the platform presentation should be taken into account when evaluating the performance of ideas in crowdsourcing contexts.<sup>[13]</sup>





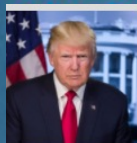
HEALTHY LIVING 09/19/2011 03:37 pm ET | Updated Nov 19, 2011

## Gamers Decode AIDS Protein That Stumped Researchers For 15 Years In Just 3 Weeks

von Ahn and Dabbish. "Labeling Images with a Computer Game". 2004.

# How often will Trump tweet this week?

**PREDICT IT NOW!**



**39 or fewer**

39.POTUSTWEETS.020717

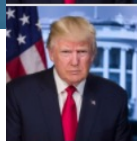
1¢ ↓ 1¢

2¢

1¢

99¢

98¢



**40 - 44**

40.POTUSTWEETS.020717

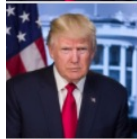
2¢ ↓ 5¢

3¢

2¢

98¢

97¢



**45 - 49**

45.POTUSTWEETS.020717

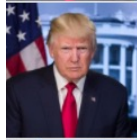
12¢ ↓ 11¢

14¢

12¢

88¢

86¢



**50 - 54**

50.POTUSTWEETS.020717

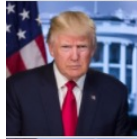
19¢ ↓ 7¢

21¢

19¢

81¢

79¢



**55 - 59**

55.POTUSTWEETS.020717

24¢ ↑ 1¢

25¢

23¢

77¢

75¢



**60 - 64**

60.POTUSTWEETS.020717

26¢ ↑ 12¢

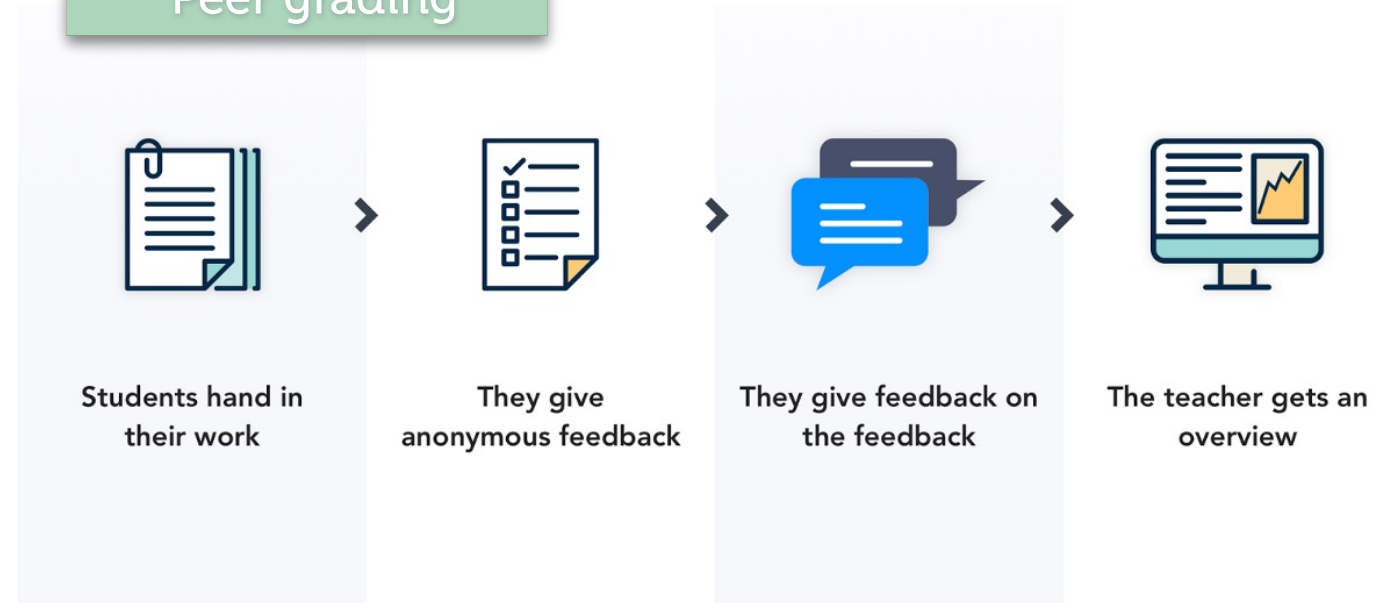
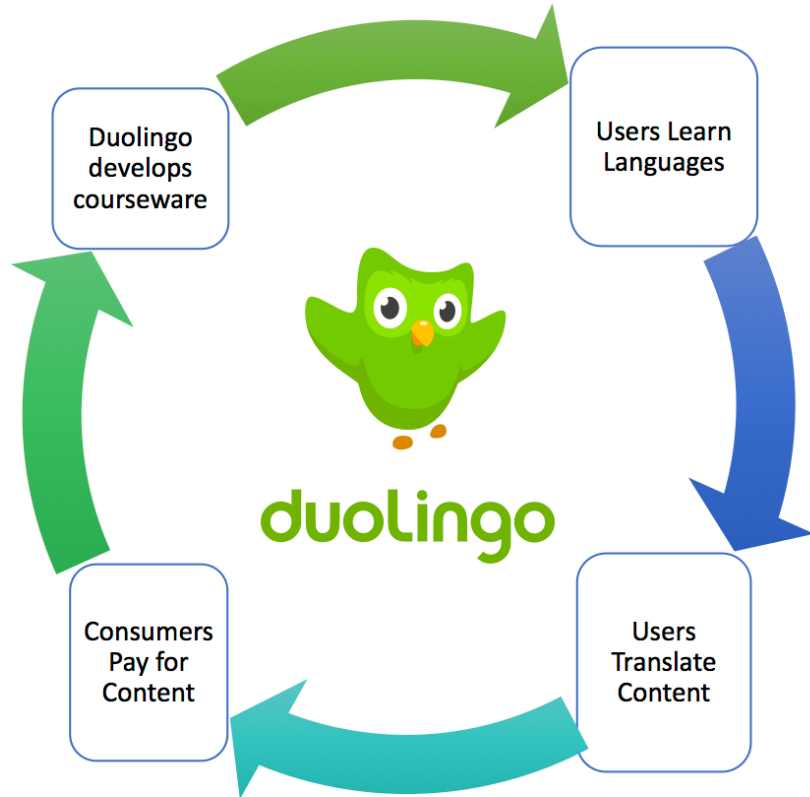
25¢

23¢

77¢


75¢

# Education





# General-Purpose Platform: Crowdsourcing Markets



Artificial Artificial Intelligence

HIT Groups (1-20 of 1318)

Show Details

Hide Details

Items Per Page: 20

Requester	Title	HITs	Reward	Created	Actions	
<div><div></div><div>Megan</div></div>	Categorization	45,696	\$0.01	1h ago	<a href="#">Preview</a>	<a href="#">Qualify</a>
<div><div></div><div>Perch Mturk</div></div>	Kitchen Appliance Classification	14,958				<a href="#">Qualify</a>
<div><div></div><div>Alexandra Dodson</div></div>	Find email address and first/last name of Office Manag...	9,327				<a href="#">Work</a>
	Find email address and first/last name of Office Manag...	8,677	\$0.11	1d ago	<a href="#">Preview</a>	<a href="#">Accept &amp; Work</a>
	Why is this review positive?	7,965	\$0.01	6d ago	<a href="#">Preview</a>	<a href="#">Accept &amp; Work</a>
	Why is this review negative?	7,058	\$0.01	6d ago	<a href="#">Preview</a>	<a href="#">Accept &amp; Work</a>
	Market Research Survey	6,680	\$0.01	1h ago	<a href="#">Preview</a>	<a href="#">Accept &amp; Work</a>
<div><div></div><div>Alexandra Dodson</div></div>	Find email address and first/last name of owners or ge...	4,511	\$0.11	1d ago	<a href="#">Preview</a>	<a href="#">Accept &amp; Work</a>
<div><div></div><div>Scottt</div></div>	Classify Receipt	4,322	\$0.02	2m ago	<a href="#">Preview</a>	<a href="#">Qualify</a>

## Post Tasks:

- Audio transcription
- Image tagging
- Relevance evaluation
- Handwriting recognition
- Product information collection

Specify payments

In fact, a lot more...

Google



Quora



duolingo



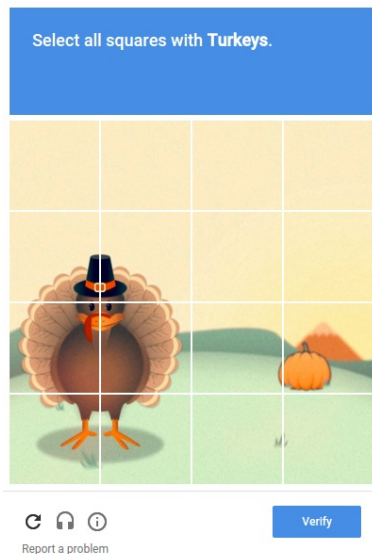
PredictWise

kaggle



# What is this course about?

- Study the design and analysis of human-in-the-loop computation.



## Human as data sources:

### Label aggregation

Probabilistic reasoning to aggregate noisy human data

## Practical challenges:

### Complex tasks and teams

Studies on workflow and team designs from HCI perspective

## Humans are “Humans”:

### Incentive design

Game theoretical modeling of humans and incentive design

## Selected recent topics:

Ethical issues of AI/ML, learning with strategic behavior, Human-AI collaborations.

- Will cover research papers from a wide spectrum of research fields, including machine learning, economics, optimization, and human-computer interactions.

# Let's take a look at the course schedule

- <http://chienjuho.com/courses/cse518a>

Logistics

# Grading

- **Course Project: 40%**
- Homework assignment: 20%
  - 4 homework assignments
- Paper reviews and class participation: 20%
- Paper presentation and leading of discussion: 20%

# Course Project

- The main component of the course.
- Could be an **original research project** or an **extensive literature survey**.
  - You are encouraged to start with a research project. You will have the chance to convert the project to literature review if things don't go well.
- Tentatively, you should work in groups of 2 (or 3 if the class size is large).
  - Will announce the detailed guidelines next week after the class size is finalized.

# Tentative Timeline of Project

- Sep 24: Project proposal (and deciding team members)
  - Brief description of the proposed project (1~2 paragraph)
  - Citing at least one paper that's relevant to your proposal
- Oct 14: Milestone 1
  - A brief literature review and the description of your plan (one page)
  - Last chance to change the topic of the project
- Nov 4: Milestone 2
  - Summary of your current progress (up to 2 pages)
  - Last chance to convert the research project to (a more extensive) literature review
- Dec 6/8: In-class project presentations
- Dec 9: Project report due



# Grading

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- **Homework assignment: 20%**
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# Homework Assignments

- Assignment 1
  - Be a crowdsourcing worker and write a report.
- Assignment 2
  - Programming assignment
  - Implement label aggregation algorithms covered in class on a given dataset
- Assignment 3
  - Math assignment
  - Using game theory to analyze some given human-in-the-loop mechanisms.
- Assignment 4
  - TBD
- No TA in this course
  - You are expected to be able to work independently

# Grading

- Course Project: 40%
- Homework assignment: 20%
  - 4 homework assignments
- **Paper reviews and class participation: 20%**
- Paper presentation and leading of discussion: 20%

# Paper Reviews and Class Participation

- Before each lecture, finish the required reading and submit a review (including a summary and answers to additional questions).
  - Due by the **midnight before each lecture** on **Gradescope**.
  - Exception: the review for next lecture is due at 2pm the day of the lecture.

Crowdsourcing:  
Background and Applications

## Required

[The Rise of Crowdsourcing](#). Howe. Wired. 2006.

## Optional

[Labeling Images with a Computer Game](#). von Ahn and Dabbish. CHI 2004.  
[reCaptcha: Human-based Character Recognition via Web Security Measures](#).  
von Ahn et al. Science. 2008.  
[Predicting Protein Structures with a Multiplayer Online Game](#). Cooper et al.  
Nature. 2010.

# Required Reading and Review

- You should be ready to answer the following questions:
  - Summary the paper in 3~4 sentences.
    - What's the research question the paper is solving?
    - What's the proposed approach?
    - What are the results?
  - Illustrate what you like/dislike about the paper.
  - Answer additional questions related to the paper.
- Try also to think about your project during reading
  - It might be hard in the beginning. Try to think about what assumptions they make, and whether you can relax some of those? Can you apply the method/approach of the paper in different domains/applications, etc?

# Class Participation

- Participation is important for this course
- I plan to enforce the participation requirement
  - A non-linear grading scheme
    - Most students will either get full credits or 0 credits for participation.
    - Examples:
      - Attend every lecture but rarely participate in discussion: 0 credits for participation
      - Attend less than 60~70% of the lectures: 0 credits for participation

# Grading

- Course Project: 40%
- Homework assignment: 20%
  - 4 homework assignments
- Paper reviews and class participation: 20%
- **Paper presentation and leading of discussion: 20%**

# Paper Presentations and Leading of Discussion

- You will need to sign up to present the paper(s) and lead the discussion, in groups of 2~3 students (again, more to come next week).
  - Take a look at the current schedules
- Presenters:
  - Read the required paper and additional optional papers for the assigned class
  - Discuss with me (one week before class) about the presentation and the reading questions
  - We will talk more about the presentation format next week
- Non-presenters:
  - Submit reviews on time and engage in the discussion in class.



# Grading

- Course Project: 40%
- Homework assignment: 20%
  - 4 homework assignments
- Paper reviews and class participation: 20%
- Paper presentation and leading of discussion: 20%

# More on The Grades

- Homework assignments / reviews will be lightly graded
- Condition on you complete all other requirements satisfactorily, your final grades are determined by your final project
  - A+: Your project is close to be published in top venues
  - A: I'm happy to use your project as model projects in the future
  - A-: Overall good, but there are minor flaws (in reports/presentation/approaches/...)
  - B+ or lower: There are more significant flaws in the project (e.g., poorly motivated problems, etc)
- Your final grades will be decreased from the above for missing reviews / homework issues / non-participation using the grading scheme (following the standard mapping)

# Collaboration and Late-Day Policy

- Collaboration policy
  - You are encouraged to collaborate, but all assignments **must** be written down on your own.
- Late day policy
  - Assignments
    - 4 late days in total. No 2 late days per assignment.
  - Reviews
    - No late submissions. But you can skip 2 of them without penalty.
  - Project-related reports
    - No late submissions.

# Next lecture:

- Read the required reading of next lecture and submit the review!

Crowdsourcing:  
Background and Applications

**Required**

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**Optional**

[Labeling Images with a Computer Game](#). von Ahn and Dabbish. CHI 2004.  
[reCaptcha: Human-based Character Recognition via Web Security Measures](#).  
von Ahn et al. Science. 2008.  
[Predicting Protein Structures with a Multiplayer Online Game](#). Cooper et al.  
Nature. 2010.

- Please submit the review on time so I can get a better sense of how many students will stay in the course.
- You **cannot** apply the late-day rule and skip this review.

# Another thing to do

- Register as a worker in one of the crowdsourcing platforms
  - Amazon Mechanical Turk: <https://www.mturk.com/worker>
    - Recommended, but they don't approve all registration requests
  - Appen: <https://appen.com/jobs/>
  - microWorkers: <https://www.microworkers.com/faq.php>
  - Clickworker: <https://www.clickworker.com/clickworker>
- You need to be a worker and complete tasks for Assignment 1
- Do it early, and let me know if there are any issues in the process
  - The registration process could take several business days
  - It's likely Amazon will deny registration

# Is the course for you?

- Need to be comfortable with **several math concepts** and **basic programming**
  - Probability
  - linear algebra
  - calculus
  - **basic concepts about computer science and ability to program**
- If you are not sure, please take a peek at the papers from **Sep 9 – 30**
  - You should at least be able to understand the formulation and main results
  - You will need to implement some algorithms in these papers

Questions?