Crowdsourcing and Human Computation

Instructor: Chris Callison-Burch

Website: crowdsourcing-class.org

What will we cover in this class (and should you take it)?

Syllabus

- Taxonomy of crowdsourcing and human computation
- The Mechanical Turk crowdsourcing platform
- Programming concepts for human computation
- The economics of crowdsourcing
- Crowdsourcing and machine learning
- Applications to human computer interaction
- Crowdsourcing and social science
- Collective intelligence

Who should take this class

- Anyone who wants to be on the cutting edge of this new field
- Entrepreneurial students who want to start their own companies
- Students from the business school who want to experiment with markets
- Students from the social sciences who want to conduct large-scale studies with people

What will you get out of this class?

- Understanding of an emerging field of CS
- Basic python and machine learning skills
- Ideas that you could transform into a startup company or academic research
- A new way of thinking about collective decision making companies and countries
- $10,000?

Inter-related concepts

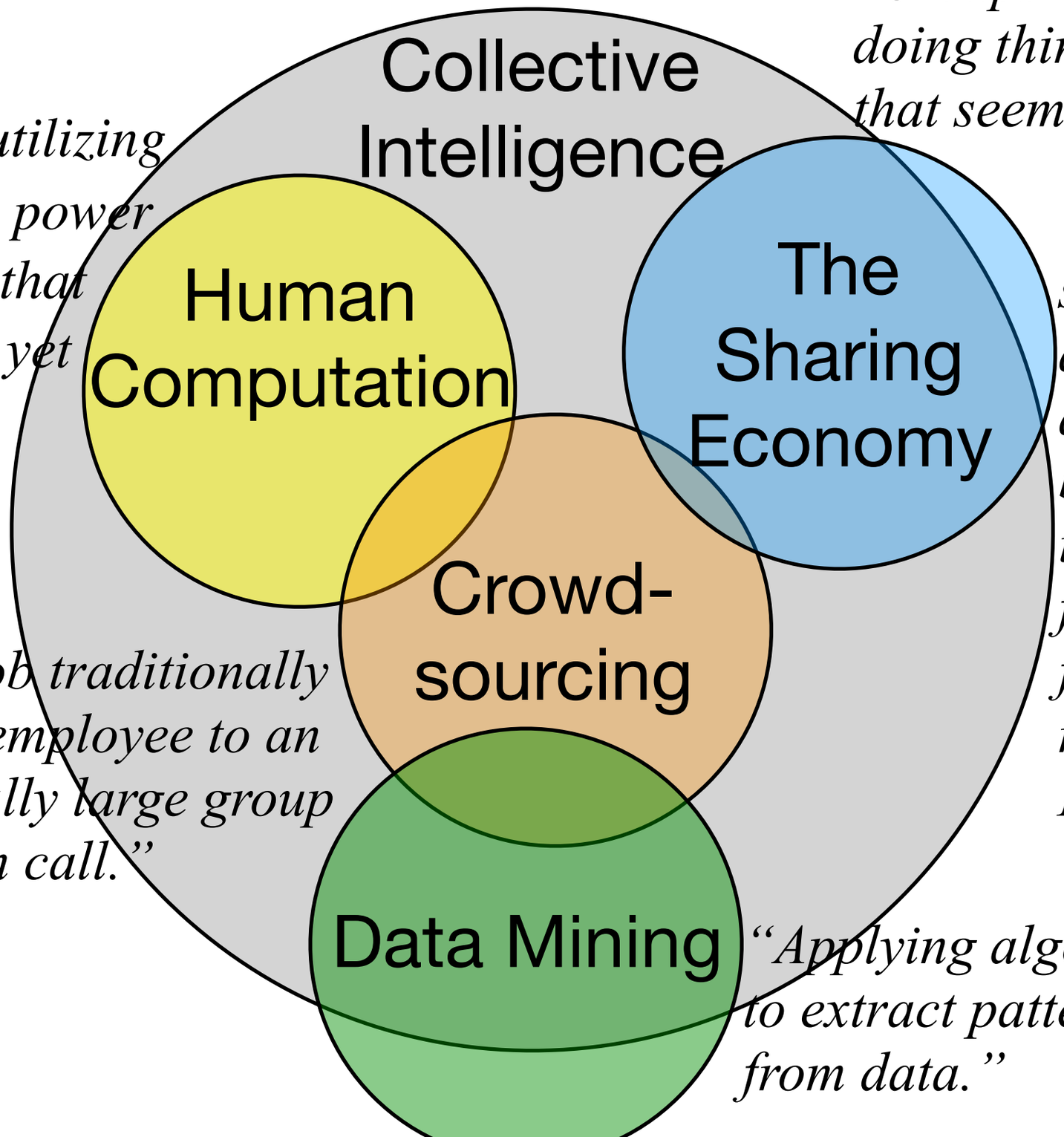
"Groups of individuals doing things collectively that seem intelligent"

"A paradigm for utilizing human processing power to solve problems that computers cannot yet solve."

"An economic system in which assets or services are shared between private individuals, either for free or for a fee, typically by means of the Internet:."

"Outsourcing a job traditionally performed by an employee to an undefined, generally large group of people via open call."

"Applying algorithms to extract patterns from data."



Crowdsourcing Companies

"Outsourcing a job traditionally performed by an employee to an undefined, generally large group of people via open call."

UBER

airbnb

Crowdsourcing Companies

"Outsourcing a job traditionally performed by an employee to an undefined, generally large group of people via open call."

lyft

UBER

airbnb

yelp

KICKSTARTER

CrowdMed beta

POSTMATES

Quora

Silk Road
anonymous marketplace

duolingo

Quirky

Rotten Tomatoes

amazonmechanical turk beta
Artificial Artificial Intelligence

Your Account | HITs | Qualifications

Already have an account?
Sign in as a Worker | Requester

Introduction | **Dashboard** | **Status** | **Account Settings**

Mechanical Turk is a marketplace for work.

We give businesses and developers access to an on-demand, scalable workforce.
Workers select from thousands of tasks and work whenever it's convenient.

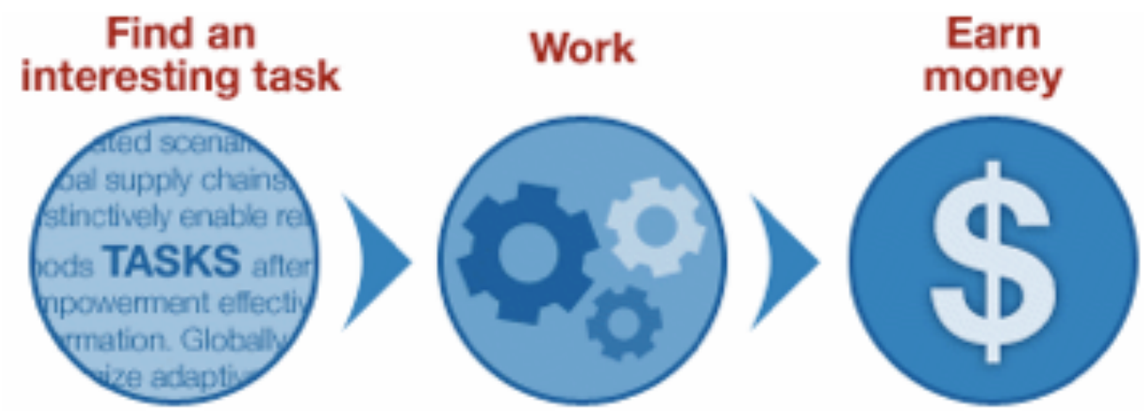
37,649 HITs available. View them now.

Make Money
by working on HITs

HITs - *Human Intelligence Tasks* - are individual tasks that you work on. Find HITs now.

As a Mechanical Turk Worker you:

- Can work from home
- Choose your own work hours
- Get paid for doing good work



Find HITs Now

or learn more about being a **Worker**

Get Results
from Mechanical Turk Workers

Ask workers to complete HITs - *Human Intelligence Tasks* - and get results using Mechanical Turk. Register Now

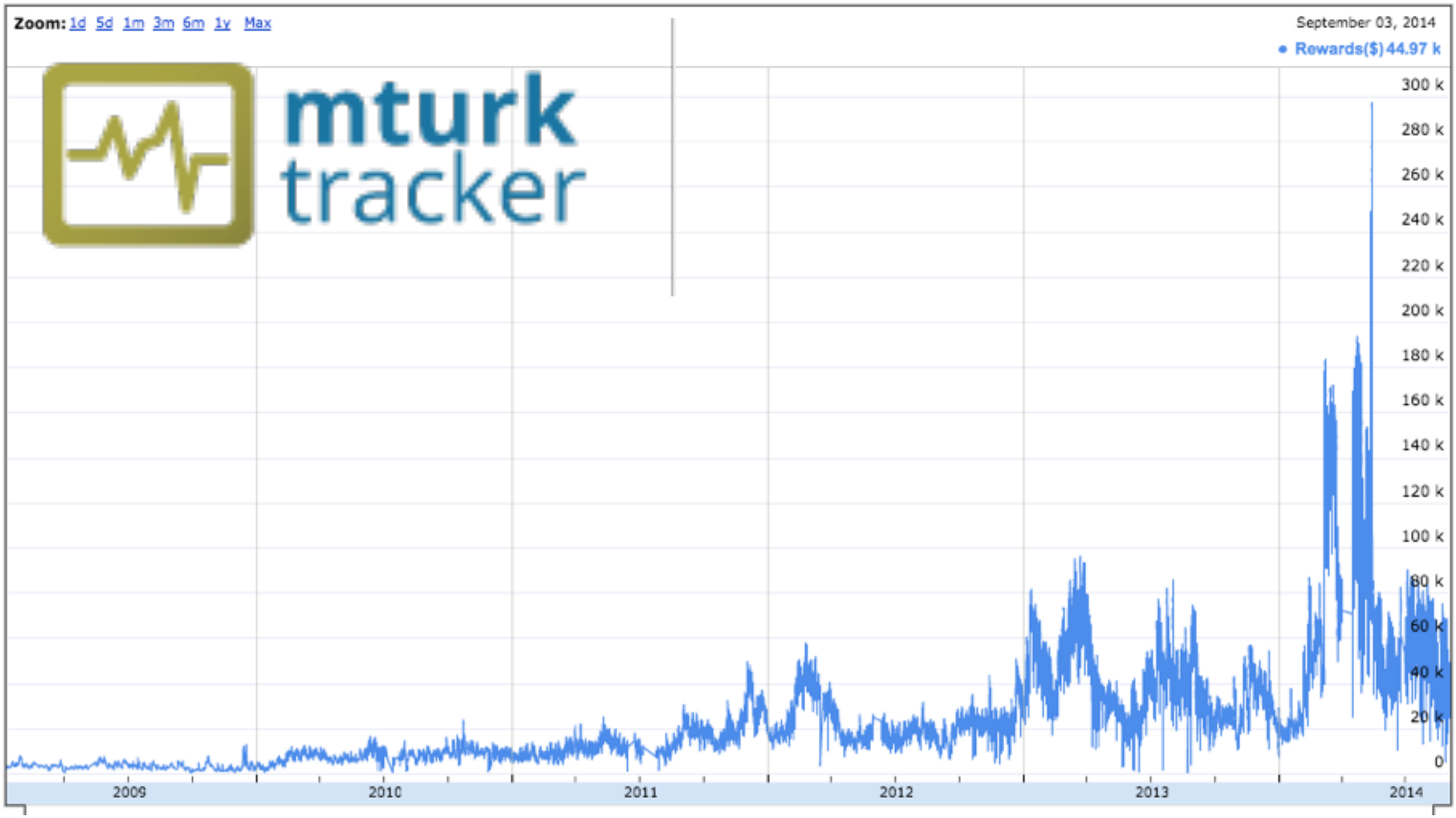
As a Mechanical Turk Requester you:

- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results

Get Started

or learn more about being a **Requester**

Rewards over past 5 years



300k

200k

150k

100k

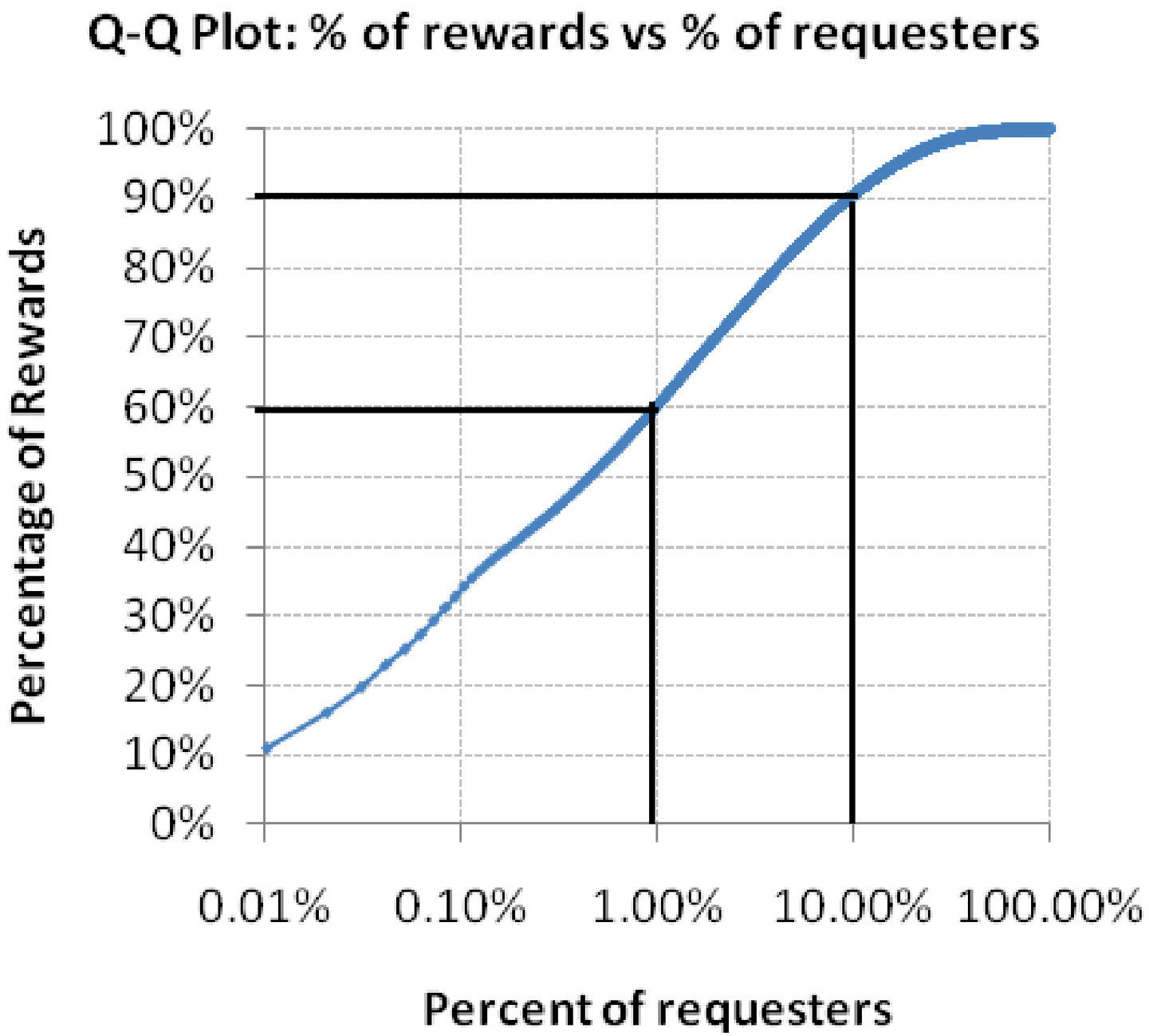
20k

2009 2010 2011 2012 2013 2014

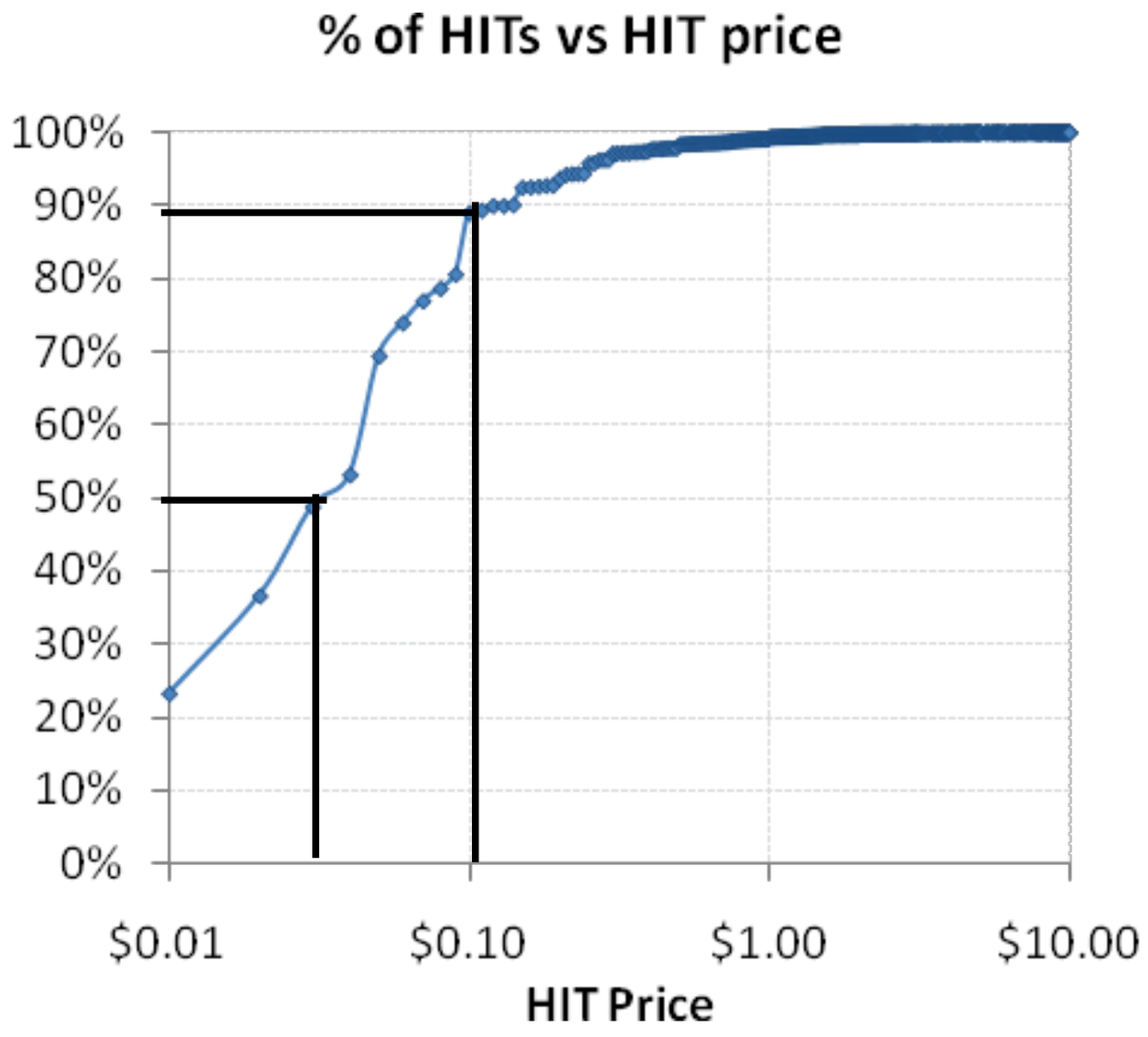
Top Requesters

Requester ID	Requester Name	#HIT groups	Total HITs	Rewards	Type of tasks
A3MI6MIUNWCR7F	CastingWords	48,934	73,621	$59,099	Transcription
A2IR7ETVOIULZU	Dolores Labs	1,676	320,543	$26,919	Mediator for other requesters
A2XL3J4NH6JI12	ContentGalore	1,150	23,728	$19,375	Content generation
A1197OGL0WOQ3G	Smartsheet.com Clients	1,407	181,620	$17,086	Mediator for other requesters
AGW2H4I480ZX1	Paul Pullen	6,842	161,535	$11,186	Content rewriting
A1CTI3ZAWTR5AZ	Classify This	228	484,369	$9,685	Object classification
A1AQ7EJ5P7ME65	Dave	2,249	7,059	$6,448	Transcription
AD7C0BZNKYGYV	QuestionSwami	798	10,980	$2,867	Content generation and evaluation
AD14NALRDOSN9	retaildata	113	158,206	$2,118	Object classification
A2RFHBFTZHX7UN	ContentSpooling.net	555	622	$987	Content generation and evaluation
A1DEBE1WPE6JFO	Joel Harvey	707	707	$899	Transcription
A29XDCTJMAE5RU	Raphael Mudge	748	2,358	$548	Website feedback

A few requesters offer most of the rewards



HITs by price



amazonmechanical turk beta
Artificial Artificial Intelligence

Your Account | HITs | Qualifications

158,849 HITs available now

Chris C

All HITs | HITs Available To You | HITs Assigned To You

Find HI that pay at least $ 0.00

- HIT Creation Date (oldest first)
- HIT Creation Date (newest first)
- HITs Available (fewest first)
- HITs Available (most first)
- Reward Amount (least first)
- ✓ Reward Amount (most first)
- Expiration Date (soonest first)
- Expiration Date (latest first)
- Title (A–Z)
- Title (Z–A)
- Time Allotted (least first)
- Time Allotted (most first)

HITs f
1-10 of

Sort by: GO!

Show all details | Hide all details

Transcr nderstand, would be useful to know how to clean up aud

Requ

HIT Expiration Date: Sep 4, 2013 (1 day 21 hours) Reward:

Time Allotted: 24 hours HITs Availa

Transcription of approximately 15 minutes of audio

Requester: Amelia Jones

HIT Expiration Date: Sep 5, 2013 (2 days 23 hours) Reward:

Time Allotted: 8 hours HITs Availa

By Invitation Only: Answer a few questions in a brief survey

Requester: Qualtrics Survey

HIT Expiration Date: Sep 5, 2013 (2 days 21 hours) Reward:

Time Allotted: 30 minutes HITs Availa

Take a geo-tagged photo of a landmark in North Dakota

Requester: Crowdsourcing at Thomson Reuters

HIT Expiration Date: Sep 5, 2013 (2 days 16 hours) Reward:

Time Allotted: 3 days HITs Avai

amazonmechanical turk beta | REQUESTER

Home | Create | Manage | Developer | Help

Results | Workers | Qualification Types | Manage HITs

Manage Batches

Click on the name of the batch to see more details

▼ **Batches in progress (1)**

Compression HIT - grammar/meaning 10 — Results | Cancel th

Created:	July 04, 2013	**Assignments Completed:**	2,468 / 2,468
Time Elapsed:	1 day	**Estimated Completion Time:**	COMPLETE
Average Time per Assignment:	3 minutes 40 seconds	**Effective Hourly Rate:**	$4.091

Batch Progress:

100% submitted — 100% published

▼ **Batches ready for review (143)**

« Previous **1** 2 3 4 5 6 7 8 9 ...

Word Alignment - Trusted Workers - Dev 0.7 — Results | Delete

Created:	July 02, 2013	**Assignments Completed:**	1,995 / 2,000
Time Elapsed:	15 days	**Estimated Completion Time:**	September 03, 2013 4:41 PM (TODAY)
Average Time per Assignment:	1 minute 58 seconds	**Effective Hourly Rate:**	$4.576

I tried one of his tasks to see, I gave it up at 4 minutes in and about 2/3 of the way through. For the whole hit, I'd have taken about 6 minutes. 10 hits an hour - **$1.70 an hour.** Restricted to U.S. residents.

This is far too low to be considered a fair wage for a U.S. resident. My performance may be very far off from what others can do. Perhaps I took 4 times or more as long as an average worker would.

My complaint is that any U.S. requester knows what wage rate is required for a U.S. resident to survive. We may not agree on an exact number. But as they say, I know a fair wage when I see it, and this is not it.

Mturk is actually much smaller than what it can appear to be. **Something close to requester monopoly has the power to keep wages low.** Requester co-operation, explicit or implicit, reinforces this.

Chris Callison-Burch is not unaware, I think, of the mechanics of the wage structure of Mturk.

WORKERS
OF THE WORLD
UNITE!

Word Alignment

Requester: Chris Callison-Burch

HIT Expiration Date: Nov 12, 2013 (9 weeks

ime Allotted: 60 minutes

communicativity: 4.05 / 5
generosity : 4.01 / 5
fairness : 4.25 / 5
promptness : 4.01 / 5

What do these scores mean?

Scores based on 95 reviews
Terms of Service violation flags: 1
Report your experience with this requester »

ntact Us | Careers at Amazon | Developers |

For those of you who know Arabic, this is a very solid requester with a very fair pay. Highly recommended for those who want to make some real money Payment usually take one week depending on the HITs you are doing

don't waste your time trying to submit machine translated crap, or random answers to multiple choice questions, you will get blocked instantly
---

Jul 27 2013 | hala...@h... | flag | comment

Chris is one of the better requesters on MTurk, if you meet his qualifications and actually do the work as he requires. Glad to see that someone out there can finally work on those Arabic translation HITs that we've all seen for months now.

Jul 27 2013 baudelai...@m...

Good requester. Everything approved in a couple of days. I had no problems. This is a safe requester to work for.

qualitative v quantitative

TurkOpticon's qualitative attributes	**CrowdWorker's quantitative equivalents**
promptness: How promptly has this requester approved your work and paid?	**Expected time to payment:** On average, how much time elapses between submitting work to this Requester and receiving payment?
generosity: How well has this requester paid for the amount of time their HITs take?	**Average hourly rate:** What is the average hourly rate that other Turker make when they do this requester's HITs?
fairness: How fair has this requester been in approving or rejecting your work?	**Approval/rejection rates:** What percent of assignments does this Requester approve? What percent of first-time Workers get any work rejected?
communicativity: How responsive has this requester been to communications or concerns you have raised?	**Reasons for rejection:** Archive of all of the reasons for Workers being rejected or blocked by this Requester.

Ethics

- Fair pay for workers
- Guidelines for human subjects research
- Legal implications of sharing economy
- Ethics of companies like Uber

Classification System for Human Computation

- Motivation
- Quality Control
- Aggregation
- Human Skill
- Process Order
- Task-request Cardinality

Motivation

How can we motivate people to participate?
Even with a low barrier to entry (anyone with an computer can contribute) we still need to make a case **why** they should contribute.

- Pay
- Altruism
- Reputation
- Enjoyment
- Implicit work

Quality Control

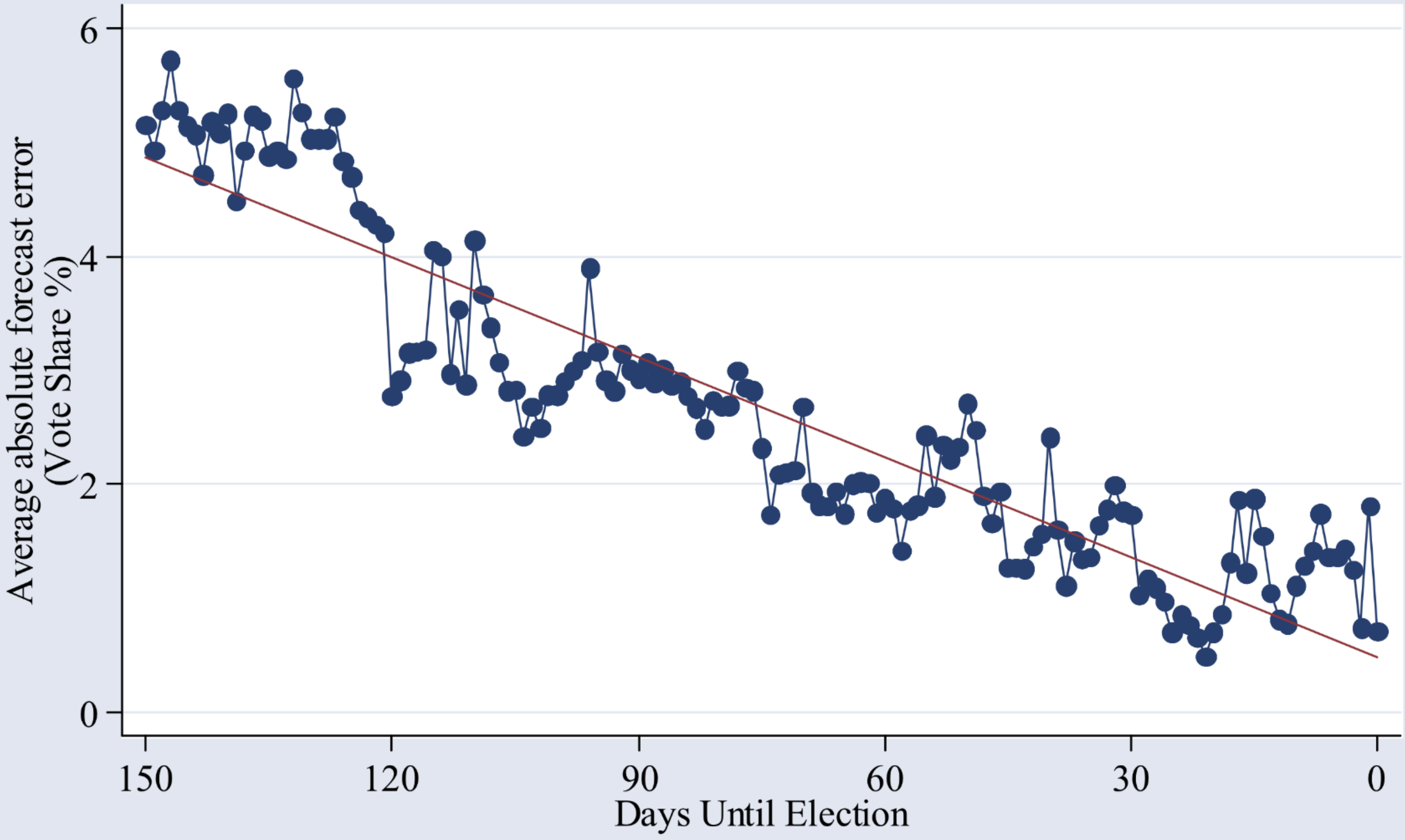
- Reputation systems
- Redundancy and agreement
- Gold standards
- 2nd pass reviewing
- Statistical models
- Defensive task design
- Economic incentives

Aggregation

- Wisdom of Crowds
  - Voting
  - Prediction markets
  - Collection
  - Search
  - Iterative improvement
  - Machine learning

Iowa Electronic Markets: Predictive Accuracy Through Time

Average absolute error in predicting two-party vote shares, 1988-2000



Source: Author's calculations based on data available at: www.biz.uiowa.edu/iem/

Human skill

- Visual recognition
- Language understanding
- Translation
- Reasoning
- Creativity

Avoiding dieting to prevent from flu	abstention from dieting in order to avoid Flu	Abstain from decrease eating in order to escape from flue	In order to be safer from flu quit dieting
This research of American scientists came in front after experimenting on mice.	This research from the American Scientists have come up after the experiments on rats.	This research of American scientists was shown after many experiments on mouses.	According to the American Scientist this research has come out after much experimentations on rats.
Experiments proved that mice on a lower calorie diet had comparatively less ability to fight the flu virus.	in has been proven from experiments that rats put on diet with less calories had less ability to resist the Flu virus.	It was proved by experiments the low calories eaters mouses had low defending power for flue in ratio.	Experimentaions have proved that those rats on less calories diet have developed a tendency of not overcoming the flu virus.
research has proven this old myth wrong that its better to fast during fever.	Research disproved the old axiom that " It is better to fast during fever"	The research proved this old talk that decrease eating is useful in fever.	This Research has proved the very old saying wrong that it is good to starve while in fever.

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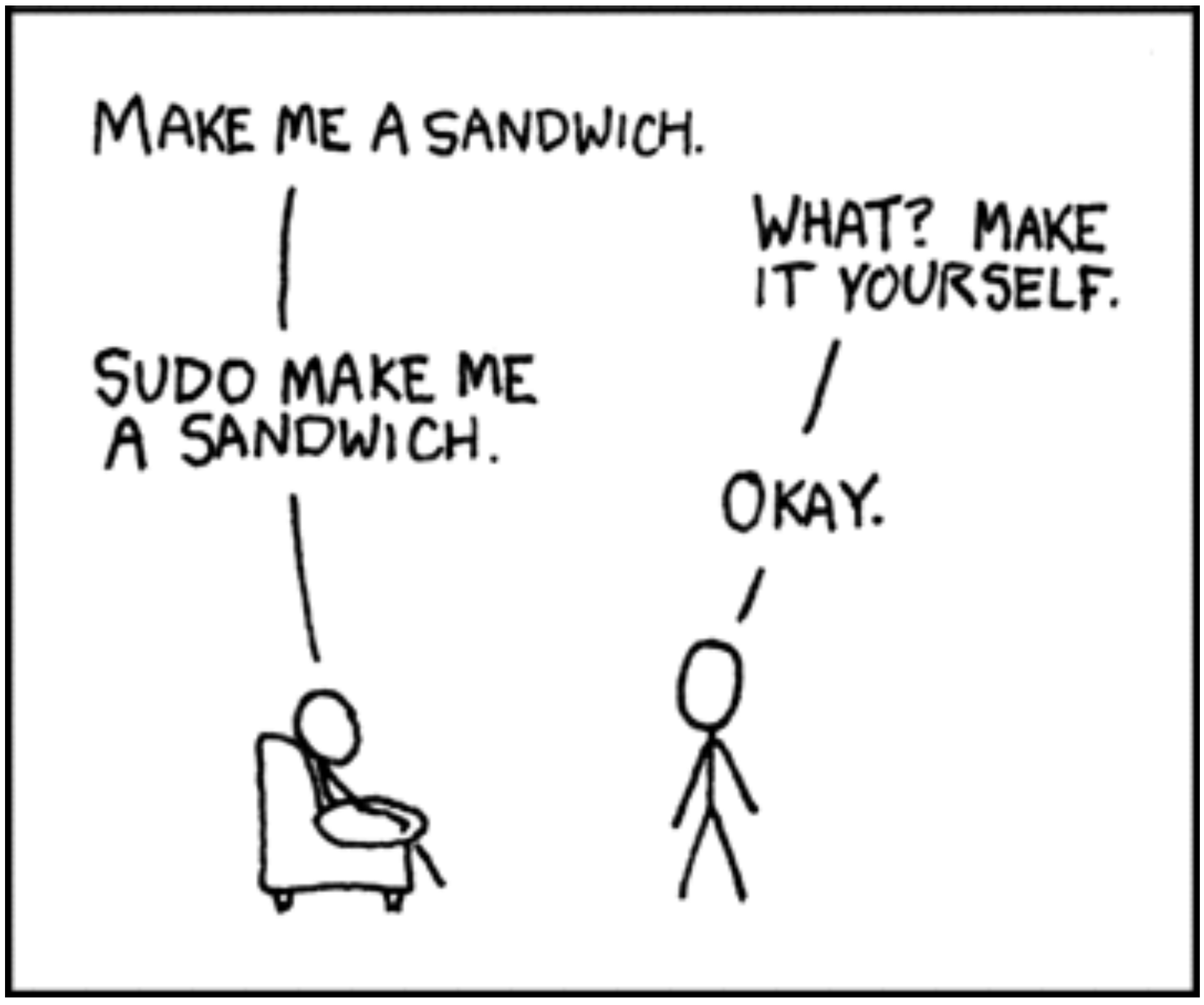
New Programming Languages Concepts



TurKit: A programming language for the crowd

```
ideas = []
for (var i = 0; i < 5; i++) {
 idea = mturk.prompt(
  "What's fun to see in New York City? Ideas so
  far: " + ideas.join(", "))
 ideas.push(idea)
}
ideas.sort(function (a, b) {
 v = mturk.vote("Which is better?", [a, b])
 return v == a ? -1 : 1
})
```

New Programming Languages Concepts

- Latency
- Cost
- Parallelization
- Non-determinism
- Iterative improvement

New keyword **once**

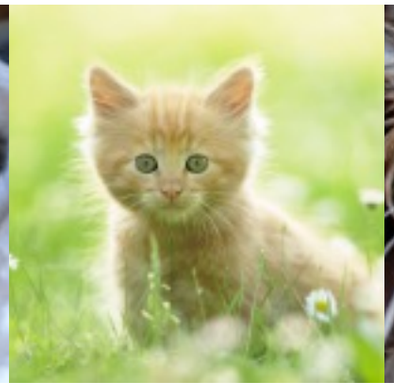
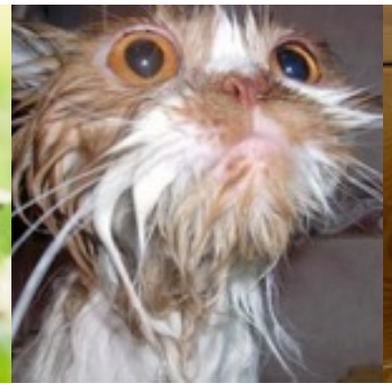
- Costly operations can be marked in a TurKit program with keyword **once**
- **once** denotes that an operation should only be executed once across all runs of a program

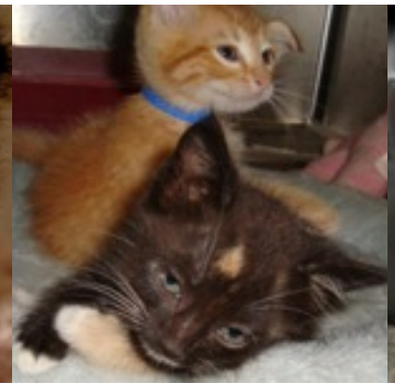
Quicksort on MTurk

```
compare(a, b)
    hitId ← once createHIT(...a...b...)
    result ← once getHITResult(hitId)
    return (result says a < b)
```

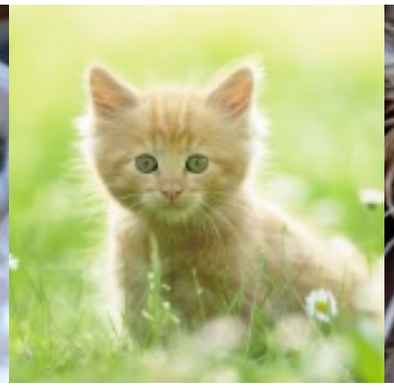
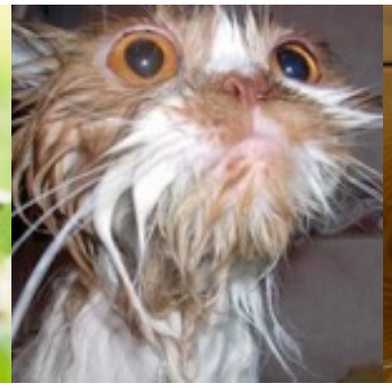
- Subsequent runs of the program will check the database before performing these operations

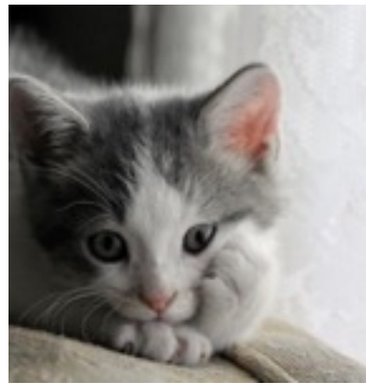
Quicksort for kittens

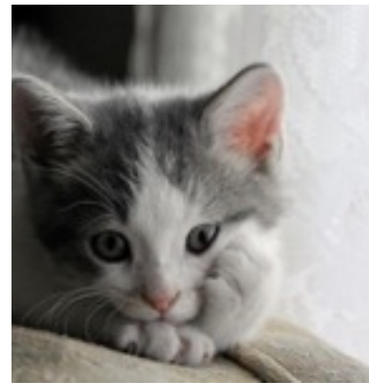






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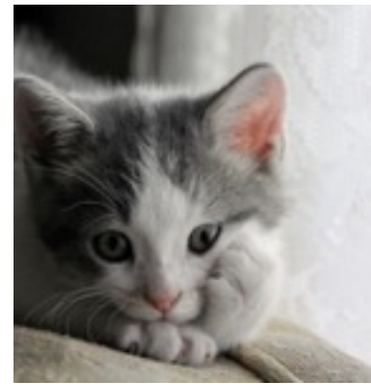

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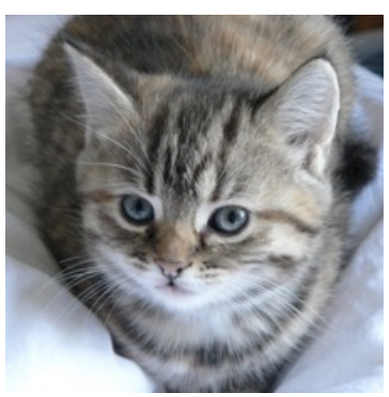



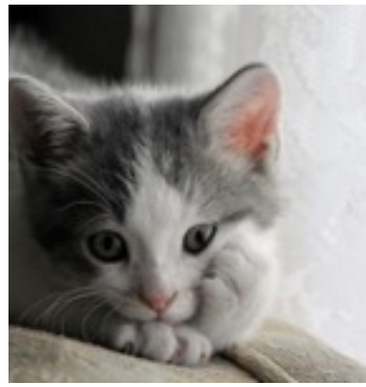


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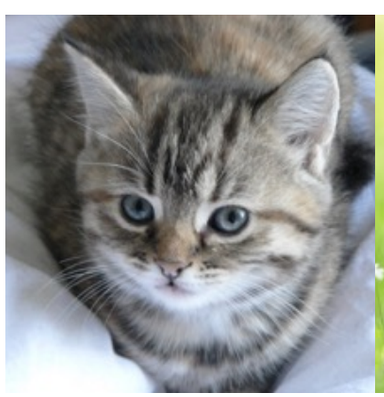
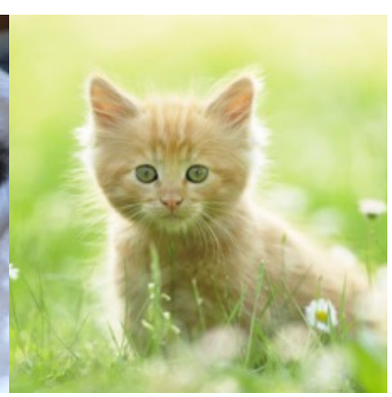

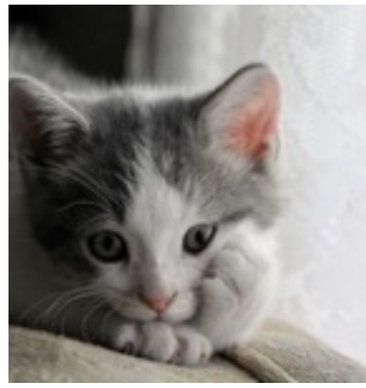

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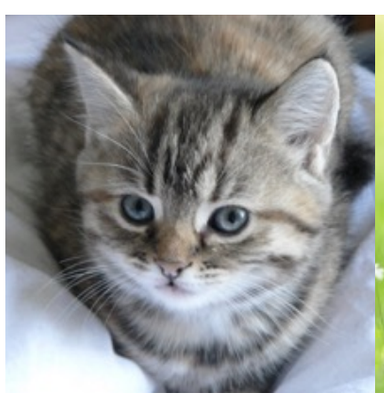

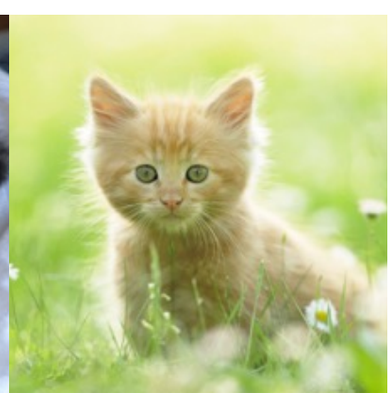

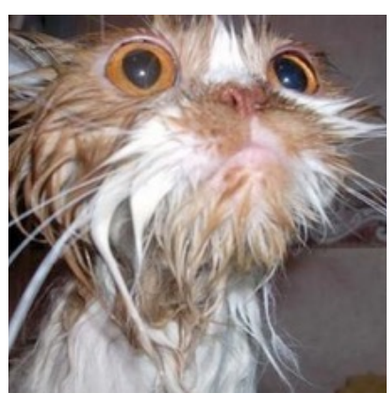

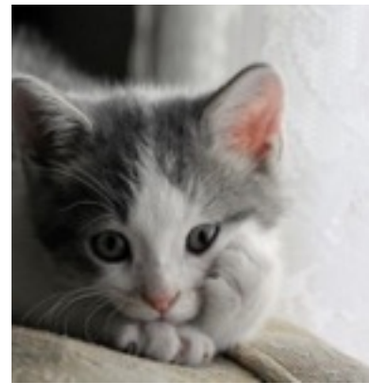

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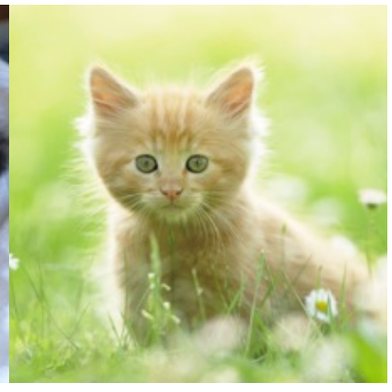

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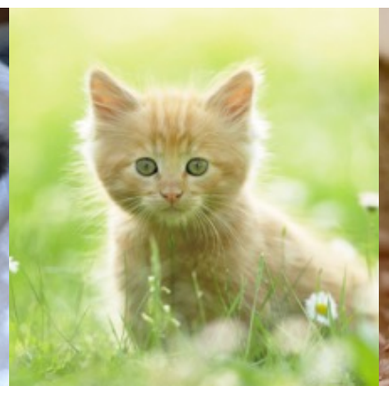

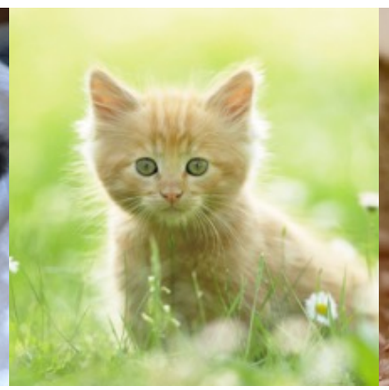

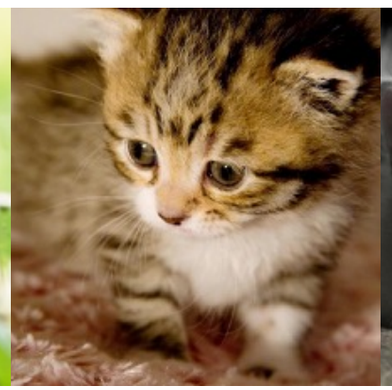

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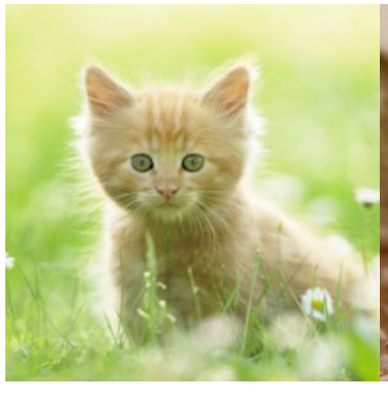
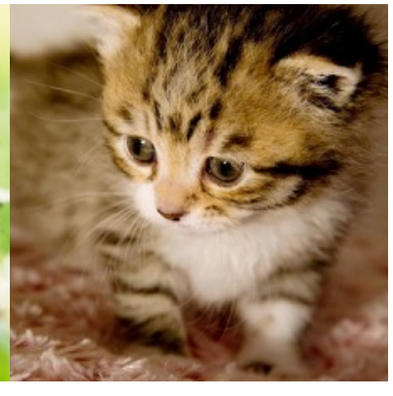












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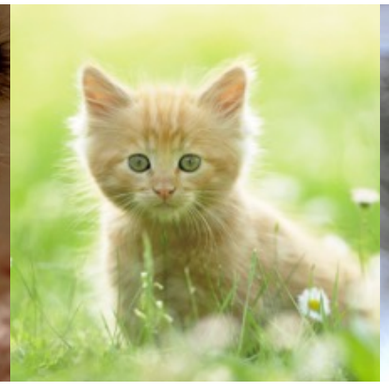




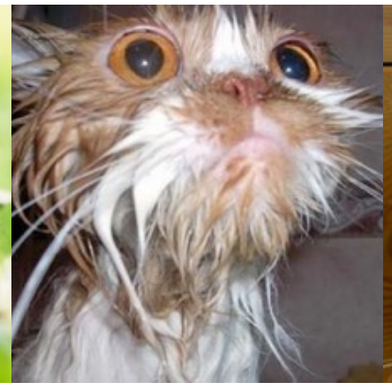

When should you mark a function with **once**?

- **High cost -** This is its main usage. Whenever a fn is high-cost in terms of money or time, **once** saves the day

When should you mark a function with **once**?

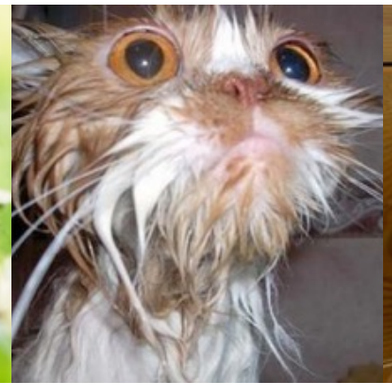
- **Non-determinism -** storing results in DB assumes that the program executes in a deterministic way

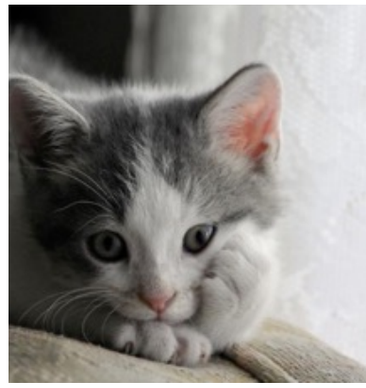








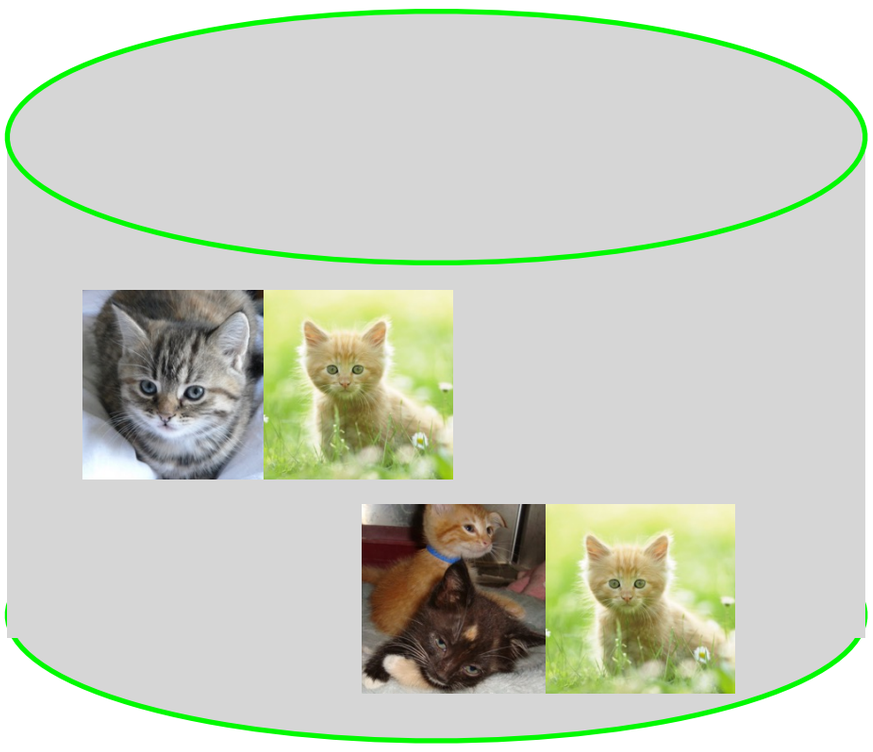








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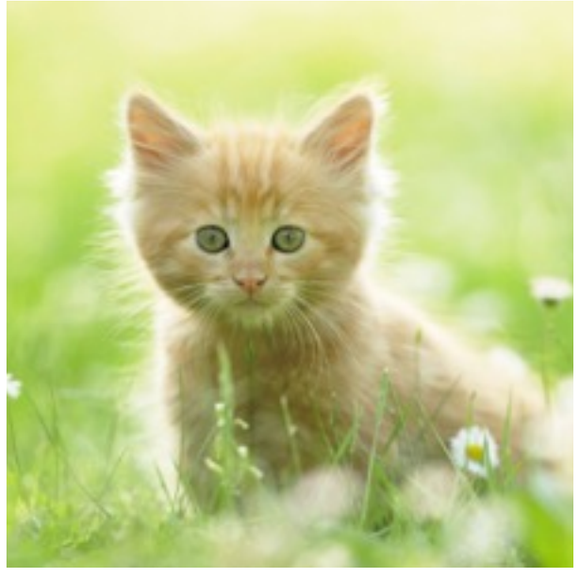

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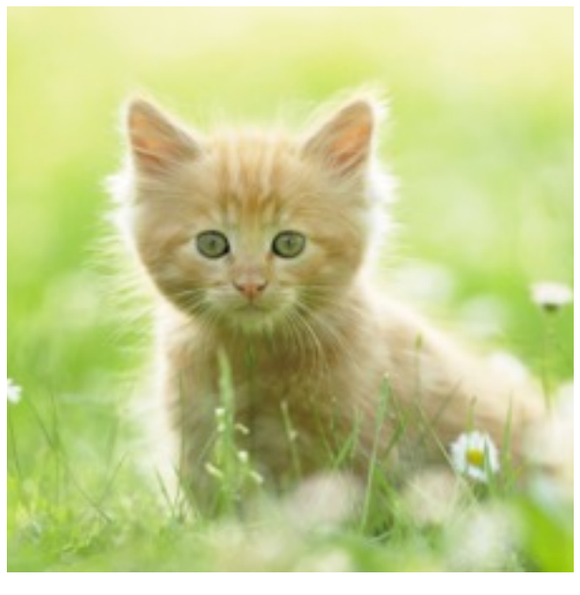
X



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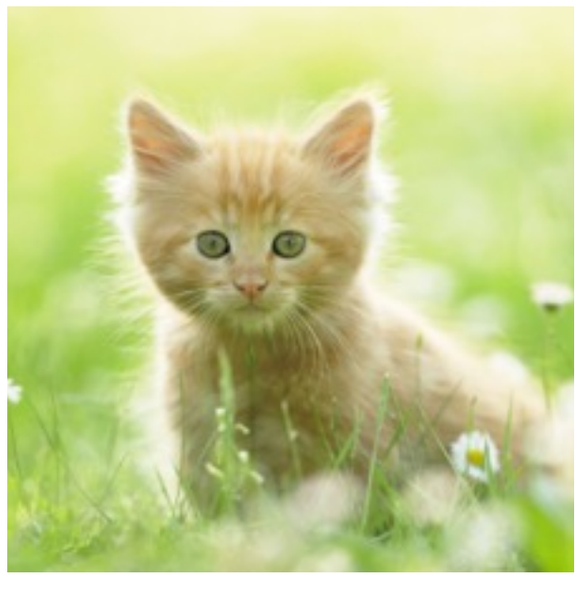

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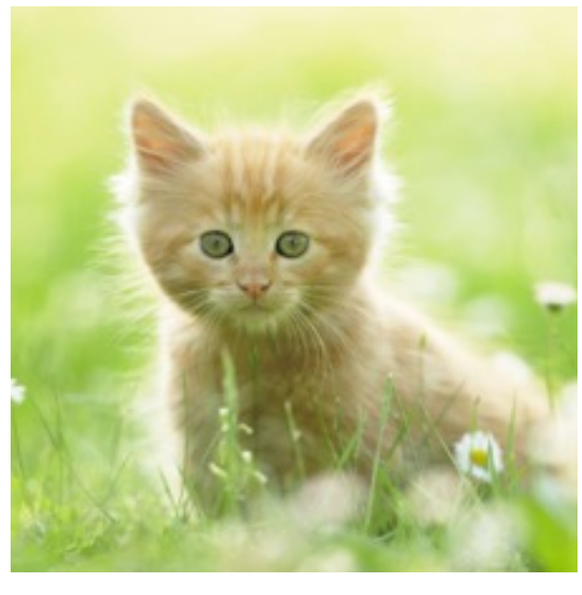

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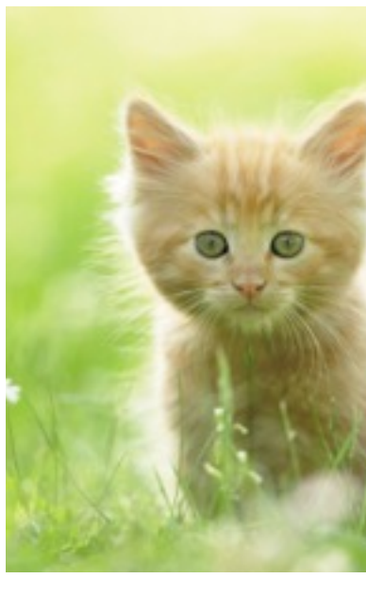

Wizard of Oz in HCl

Automatic clustering generally helps separate different kinds of records that need to be edited differently, but it isn't perfect. Sometimes it creates more clusters than needed, because the differences in structure aren't important to the user's particular editing task. For example, if the user only needs to edit near the end of each line, then differences at the start of the line are largely irrelevant, and it isn't necessary to split base on those differences. Conversely, sometimes the clustering isn't fine enough, leaving heterogeneous clusters that must be edited one line at a time. One solution to this problem would be to let the user rearrange the clustering manually, perhaps using drag-and-drop to merge and split clusters. Clustering and selection generalization would also be improved by recognizing common test structure like URLs, filenames, email addresses, dates, times, etc.

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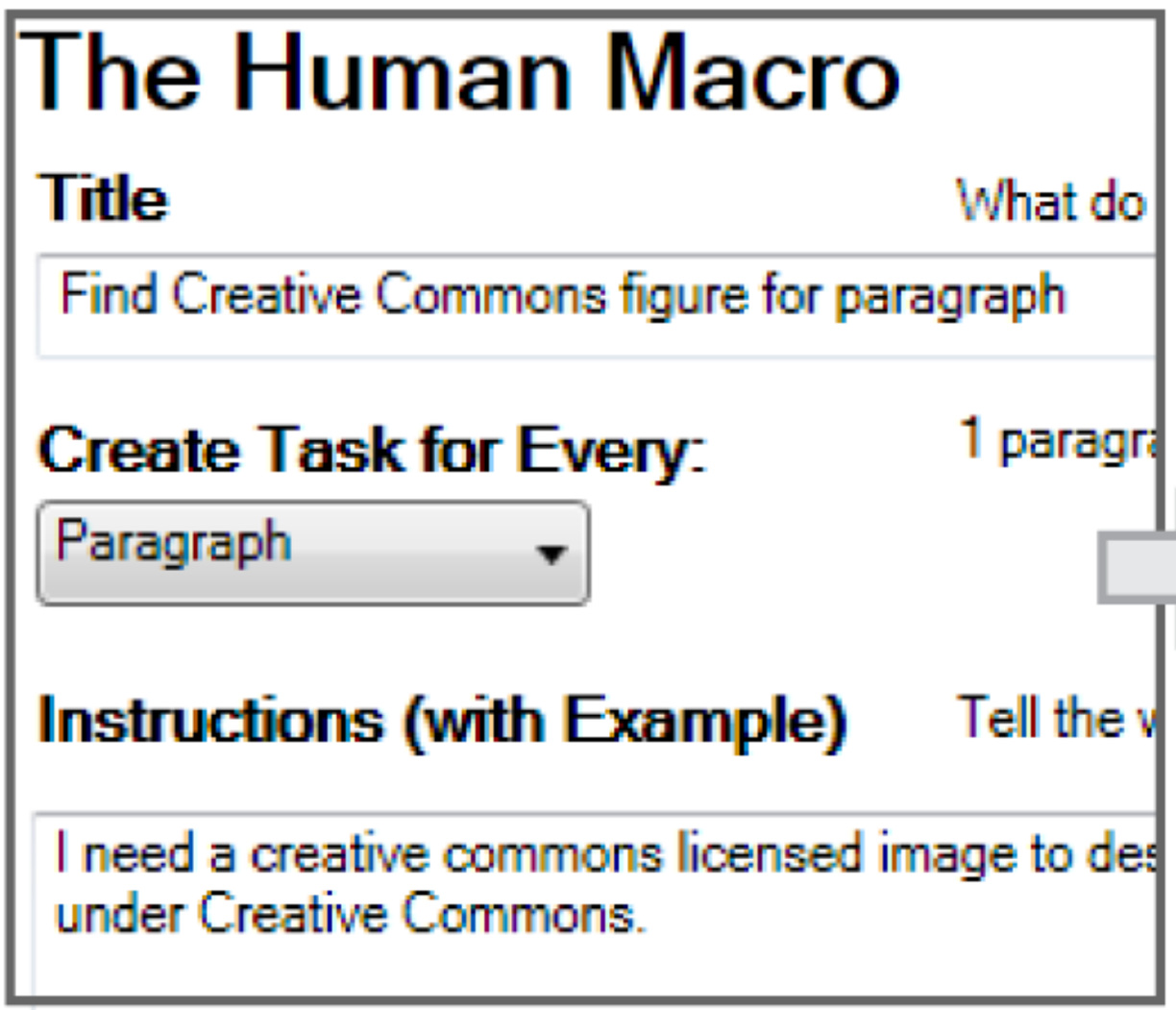
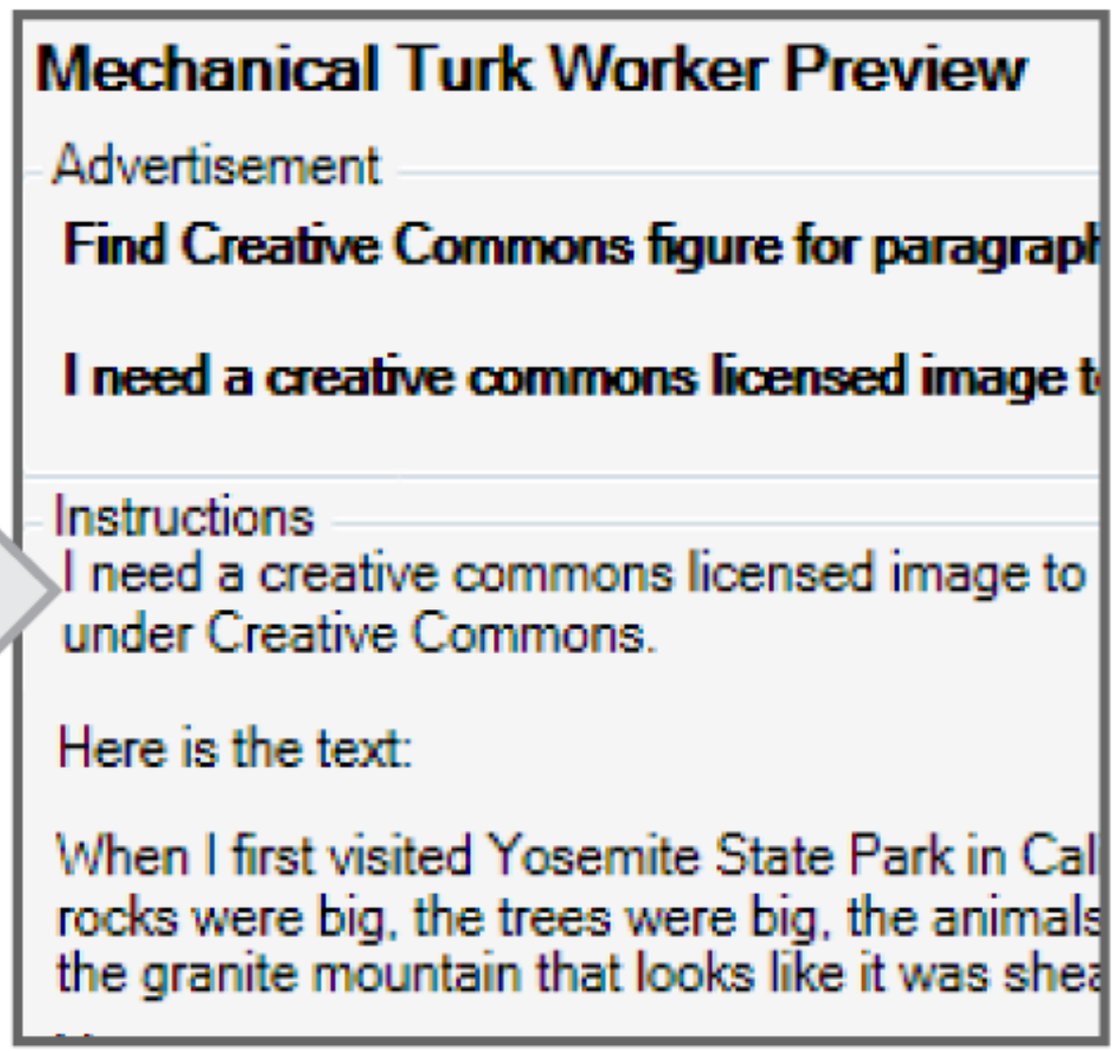
The Human Macro





Human Macro Examples

Request	“Pick out keywords from the paragrah like Yosemite, rock, half dome, park. Go to a site which has CC licensed images [...]”
Input	When I first visited Yosemite State Park in California, I was a boy. I was amazed by how big everything was [...]
Output	

VizWiz: Answers to Visual Questions for Blind Users

What denomination is this bill?

(24s) 20
(29s) 20

Do you see picnic tables across the parking lot?

(13s) no
(46s) no

What temperature is my oven set to?

(69s) it looks like 425 degrees but the image is difficult to see.
(84s) 400
(122s) 450

Can you please tell me what this can is?

(183s) chickpeas.
(514s) beans
(552s) Goya Beans

What kind of drink does this can hold?

(91s) Energy
(99s) no can in the picture
(247s) energy drink

Know when work is imminent

61 seconds	Start app, take picture
71 seconds	Record the question
78 seconds	Press send
221 seconds	Wait for response

Start recruiting workers

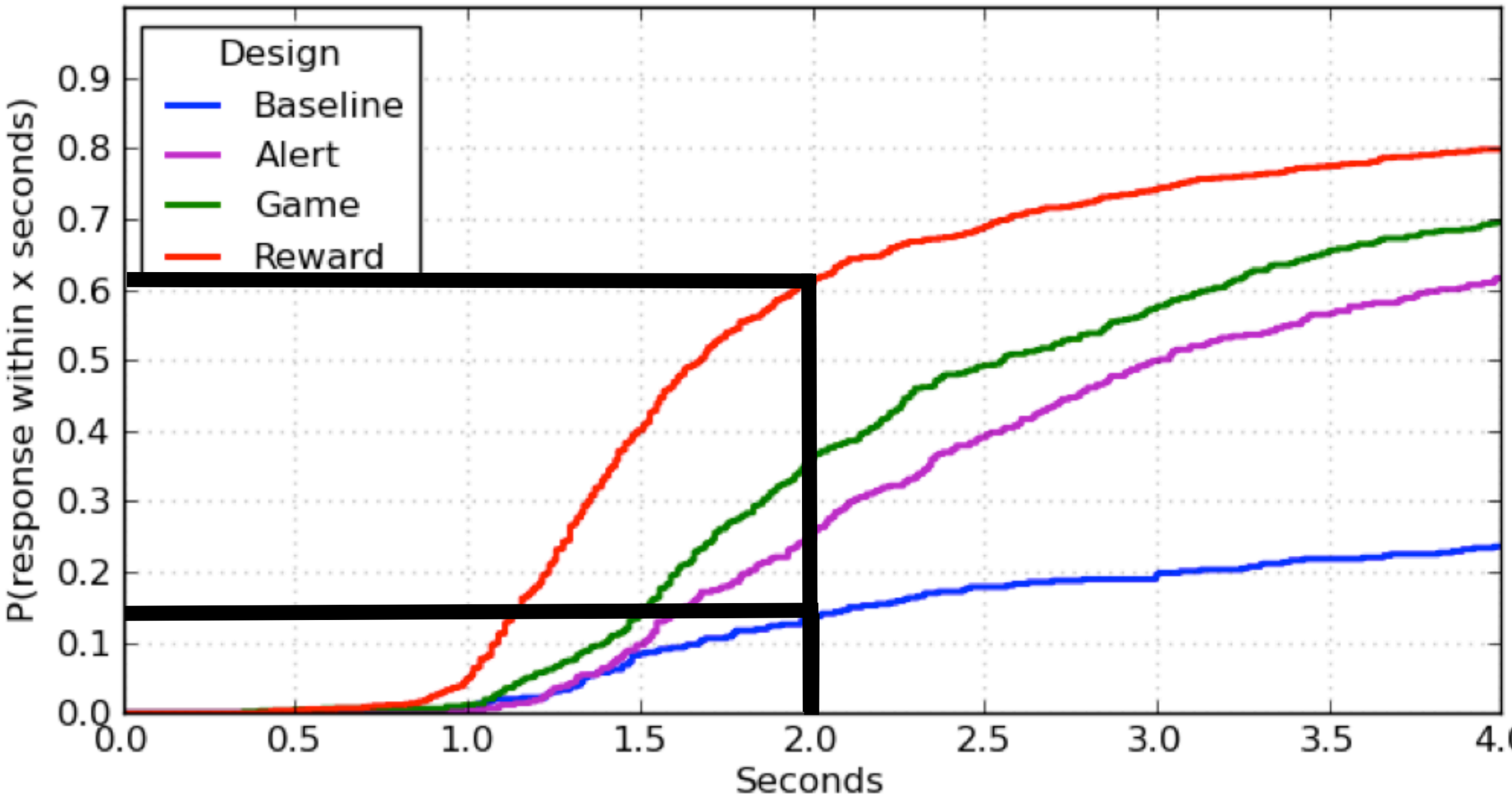
Maintain a work pool

- TurKit also experimented with maintaining a group of workers, even when there was no work
  - Created dummy assignments from past assignments, to ensure work
  - When a new request arrived a dummy was replaced with the real request
  - Can be costly to constaintly maintain a pool

Retainer model

- Alternate to maintaining worker pool with dummy tasks
- Hire crowd workers in advance, and pay them a small amount to wait for work to come online
- All them to pursue other work while waiting
- Alert them when our task is ready with a popup box, and pay them for that work too

Improving 10 minute retainer response time

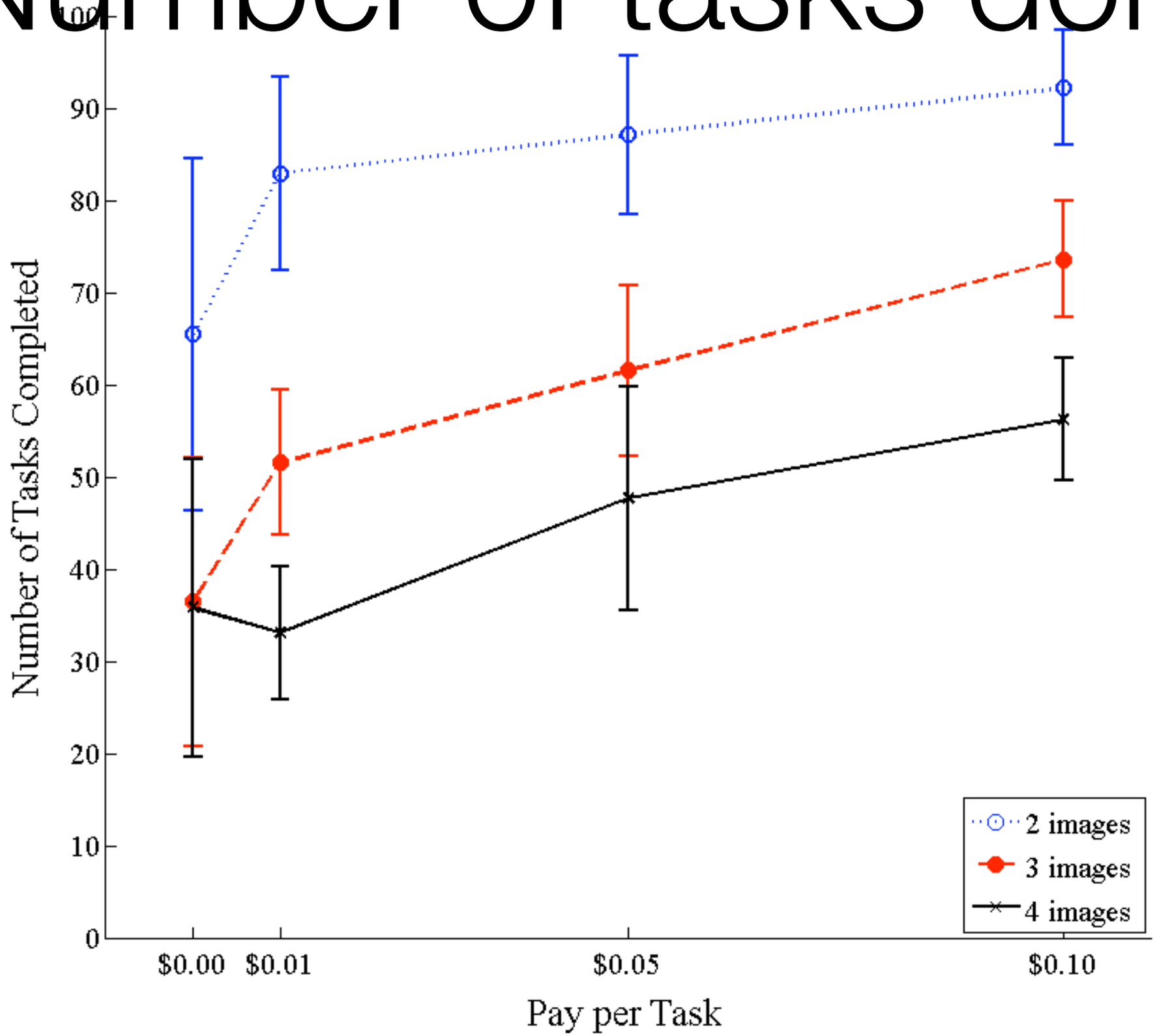


Studying Economic Markets

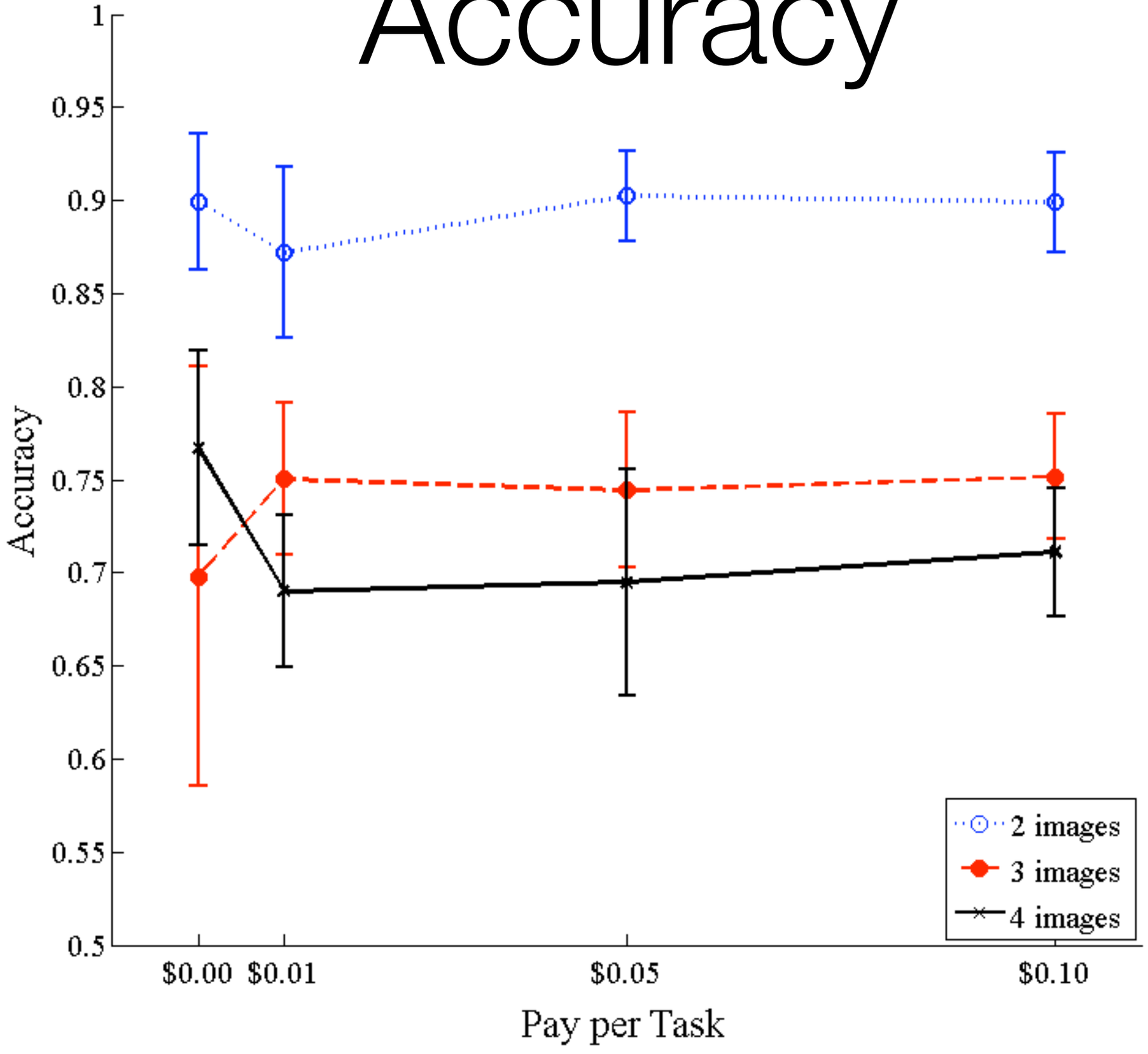
Financial Incentives and the "Performance of Crowds"

- Experiment with economic incentives on Amazon Mechanical Turk
- Does compensation change the quantity of work performed (output)?
- Does it change the quality of the work (accuracy)?

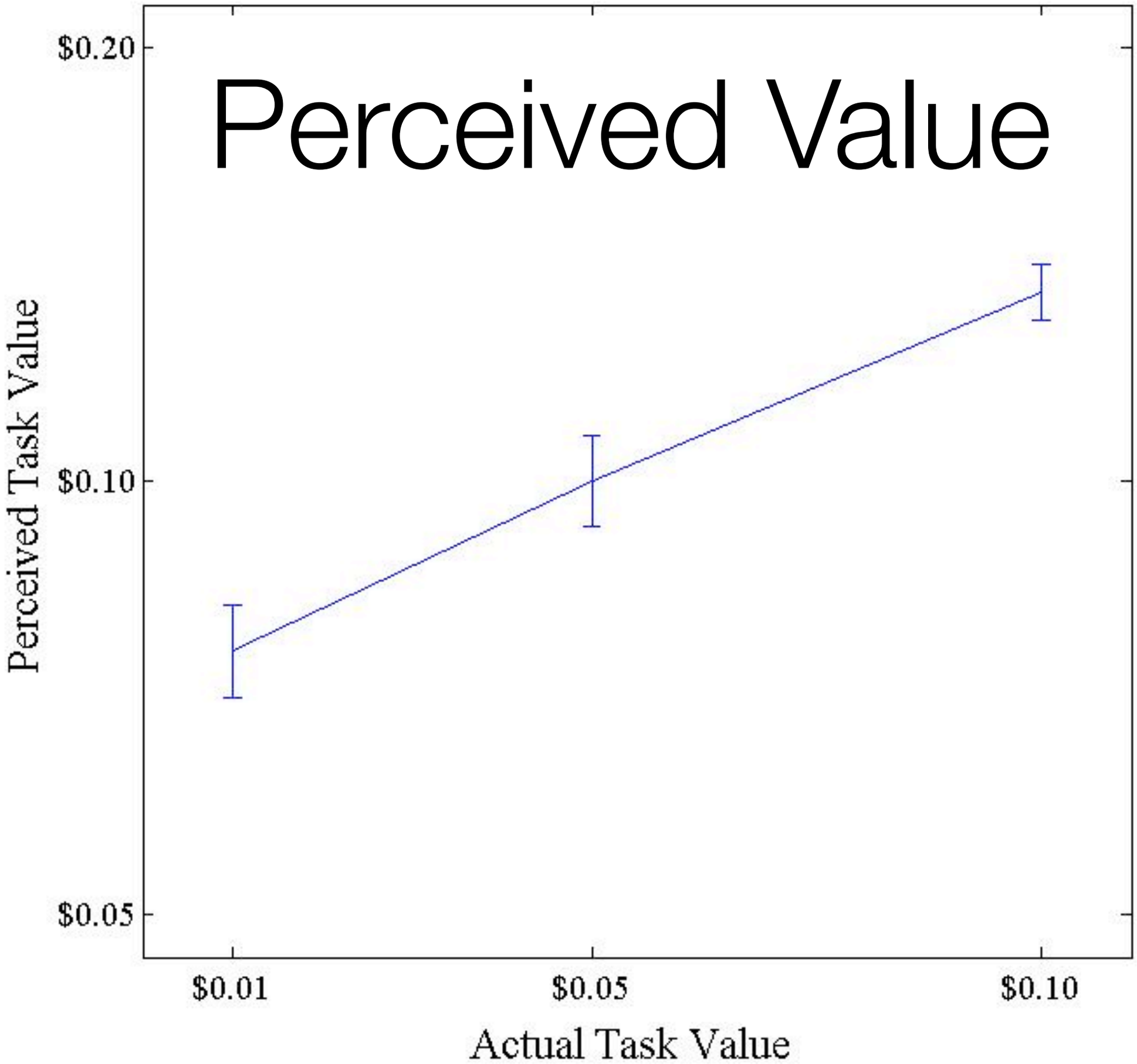
Number of tasks done



Accuracy


1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
Accuracy
$0.00
$0.01
$0.05
$0.10
Pay per Task
2 images
3 images
4 images

Perceived Value



MTurk for social science research

- Many social science experiments require recruitment of a large number of subjects
- MTurk contains the major elements required to conduct research:
  - A participant compensation system
  - A large pool of potential participants
  - A streamlined process for study design, participant recruitment, and data collection

How Do MTurk Samples Compare With Other Samples?

- MTurk population is more diverse than college students (or non-students who reside in college towns)
- Good gender splits
- Good minority representation
- Large number of non-US participants

Is MTurk viable for mental health data?

- Shapiro et al (2013) tested Turkers for characteristics of depression and anxiety
- Asked about clinically relevant life events (e.g., trauma and drug and alcohol consumption)
- Attempted to assessed misrepresentation of basic demographic information and reporting of clinical symptoms

Is MTurk viable for mental health data? Surprisingly, Yes.

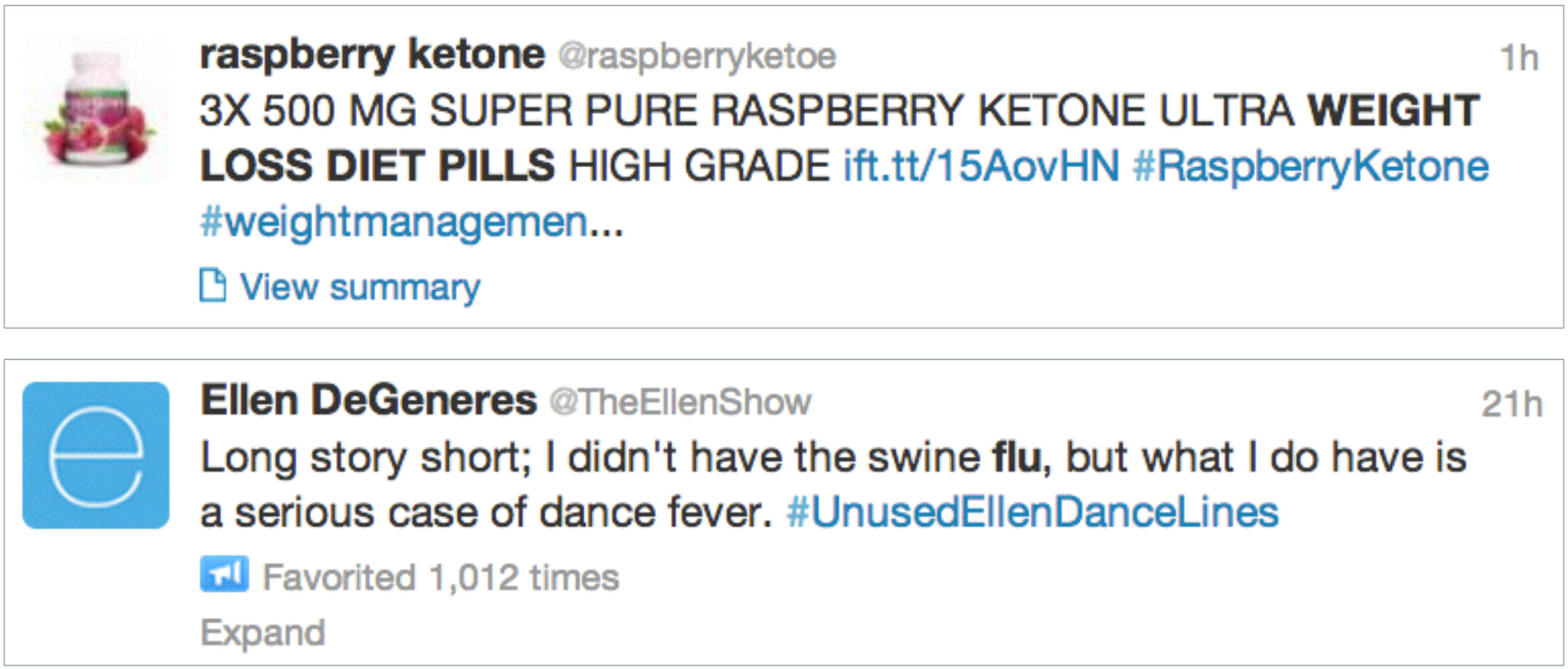
- MTurk might actually be a useful resource for accessing and studying clinical populations
- Workers reported greater comfort disclosing clinical information in an online format than an a hypothetical in-person interview
- MTurk can be used to complete sophisticated research designs, including longitudinal studies, survey research, interviews

Active versus Passive Crowdsourcing

- In the first half of the semester we mainly looked at *active* crowdsourcing, where we explicitly solicit help from the crowd
- Many applications of crowdsourcing rely on *passive* information collection from multitudes of individual

Finding health tweets

- Step 1: keyword filtering



- Step 2: supervised machine learning

amazon mechanical turk
beta
Artificial Artificial Intelligence

Finding health tweets

- About **1%** of tweets contained the 20,000 health keywords

- About **15%** of those were tagged as relevant by the health machine learning classifier

about **0.1%** of all tweets are health-related

- **1.6 million** health tweets from 2009-2010
- Over **150 million** collected since Aug 2011

Flu surveillance

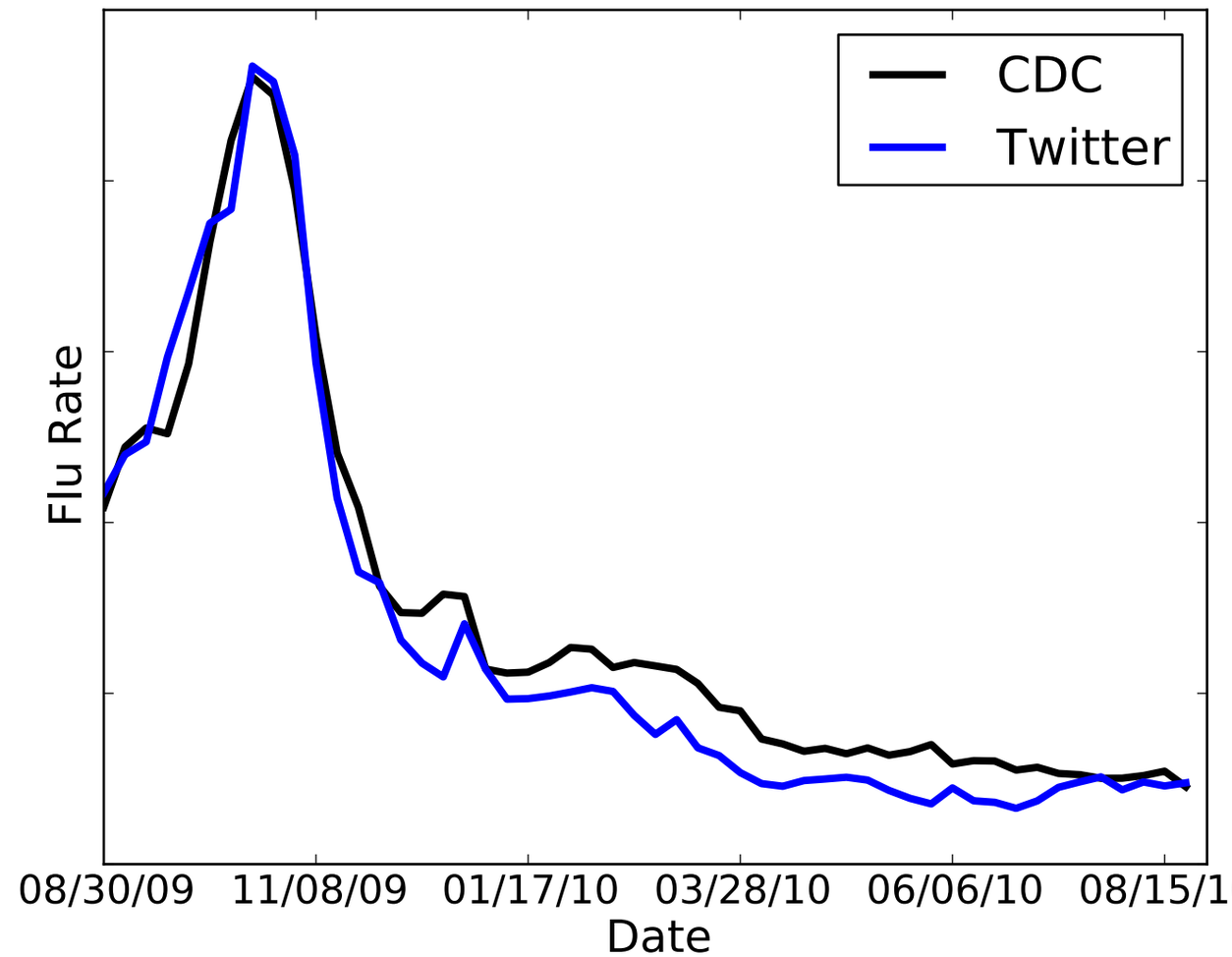
- Estimated weekly rate of flu on Twitter:

$$\frac{\text{\# tweets about flu infection that week}}{\text{\# of all tweets that week}}$$

- Normalize by number of all tweets to adjust for change in Twitter volume over time

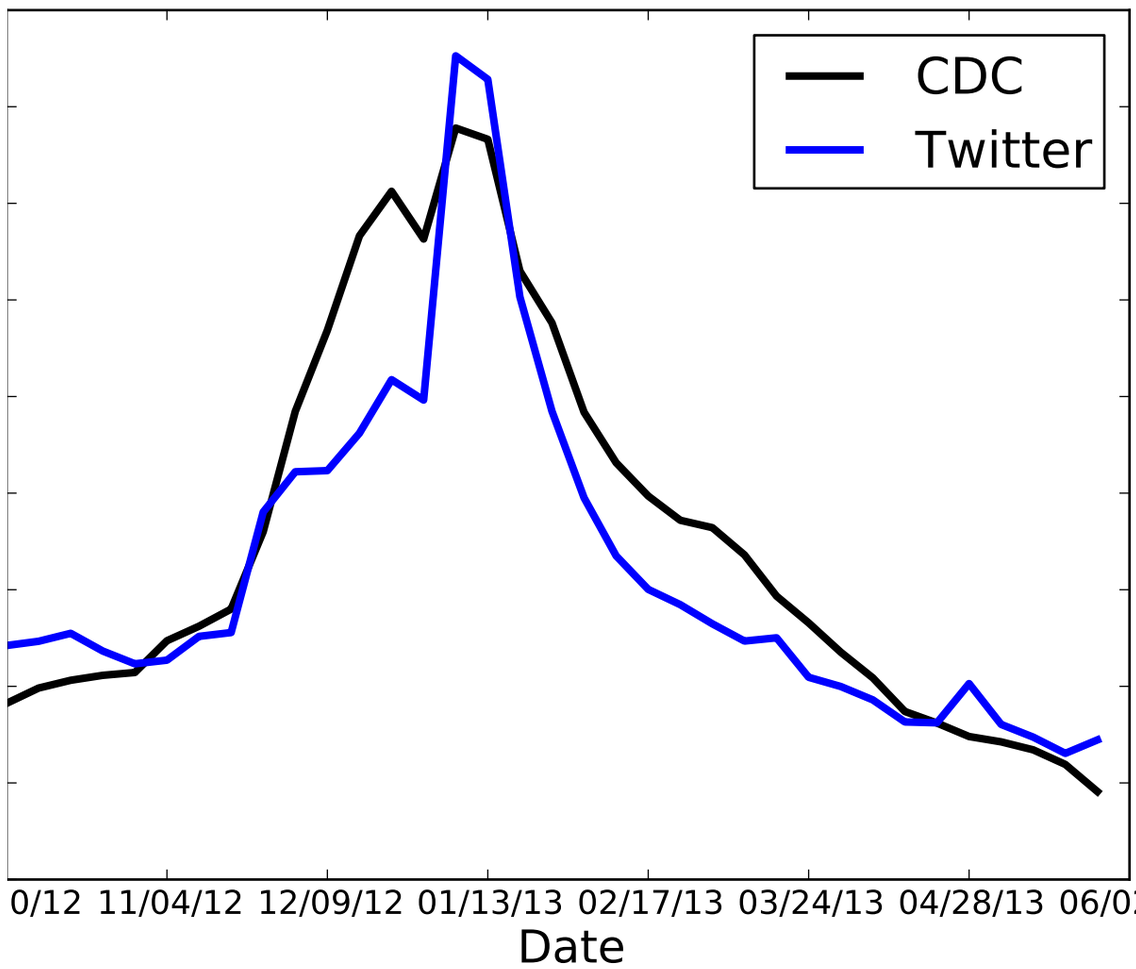
Flu surveillance

2009-10



- Correlation with CDC: 0**.99**

2012-13

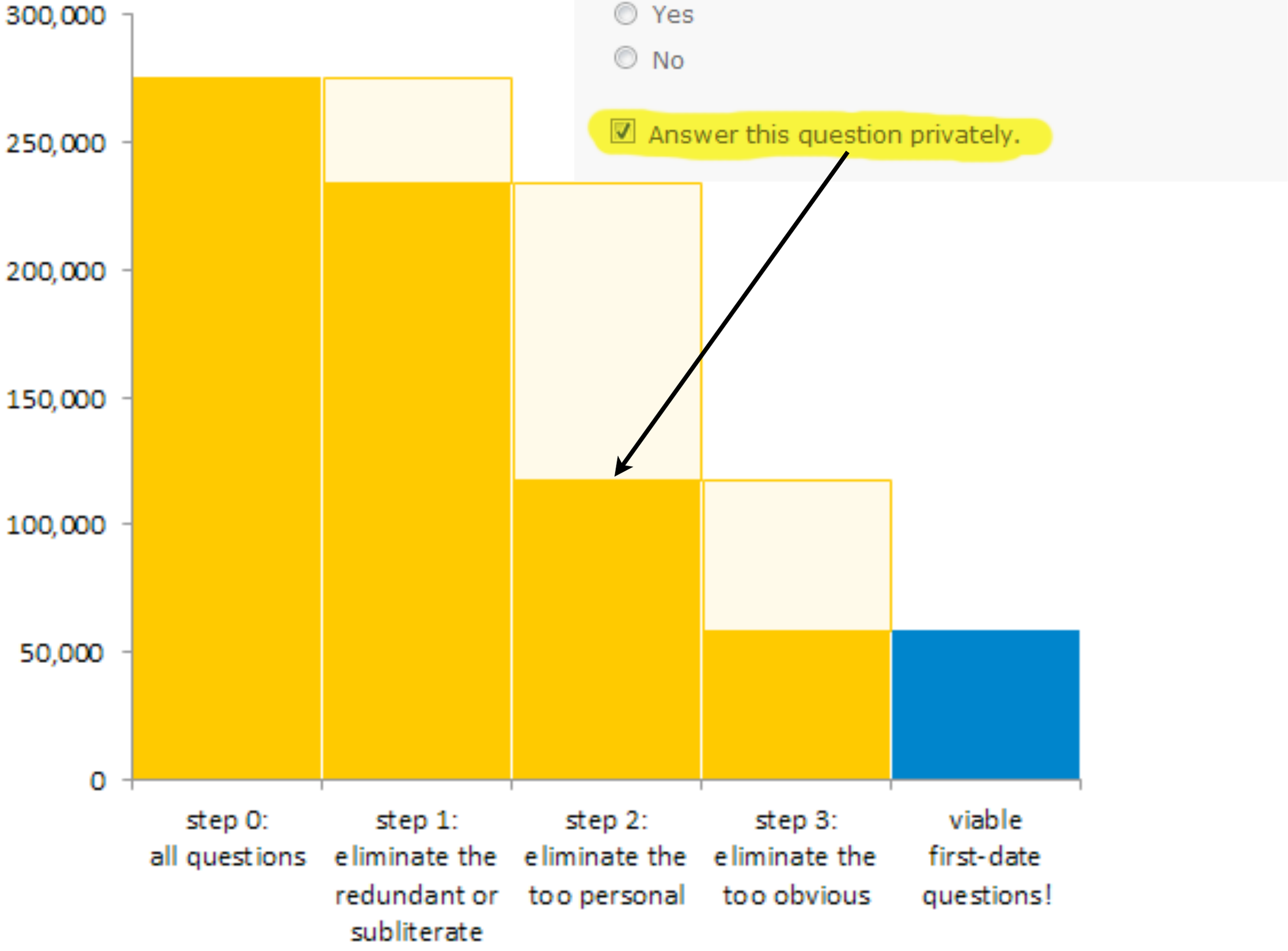


- Correlation with CDC: 0**.93**

The Best Questions on a First Date

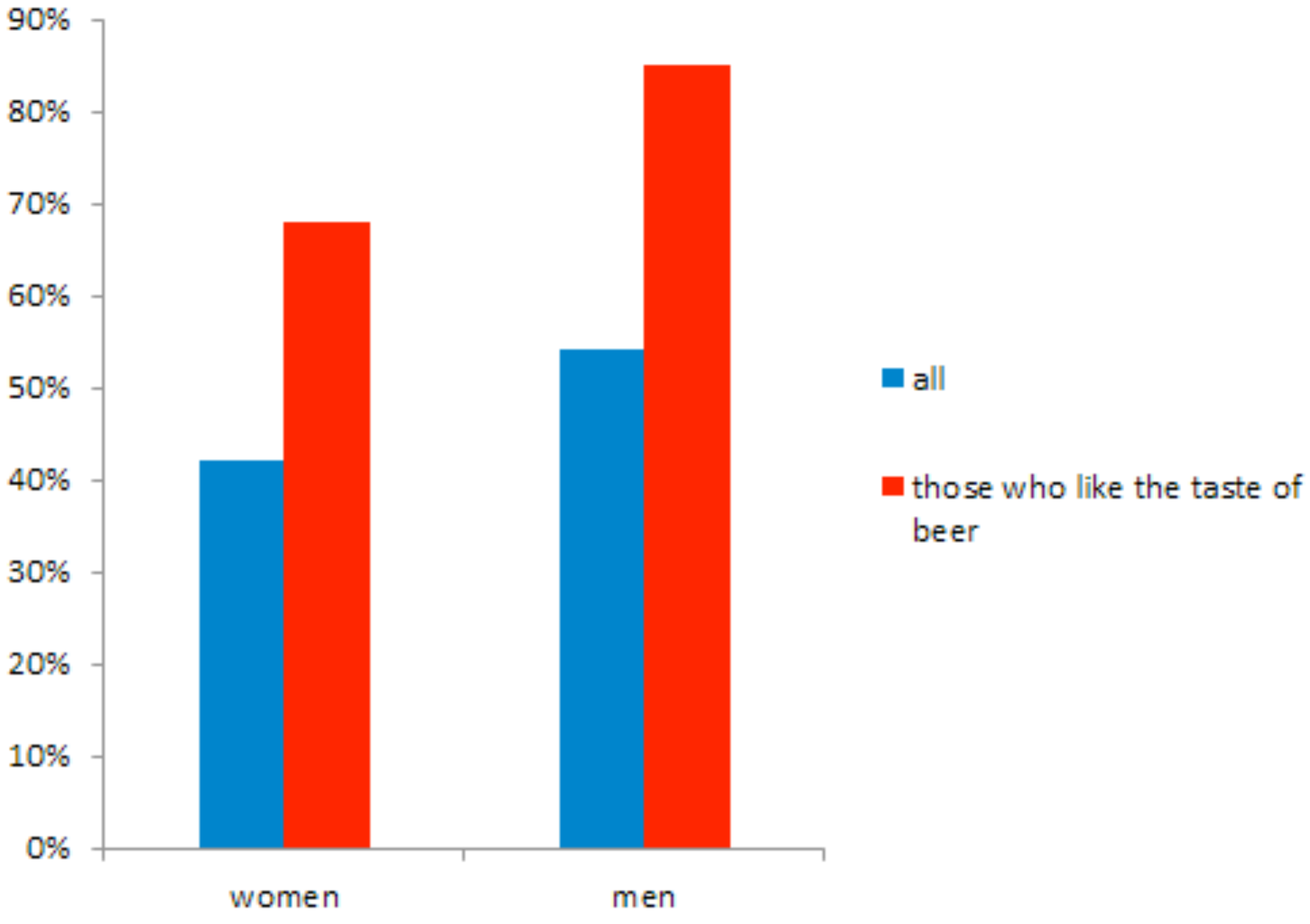
- You would like to learn about your date, some important things that you would like to know are awkward to ask directly
- Find questions that correlate with what you want to know, but which people are more free about answering publicly

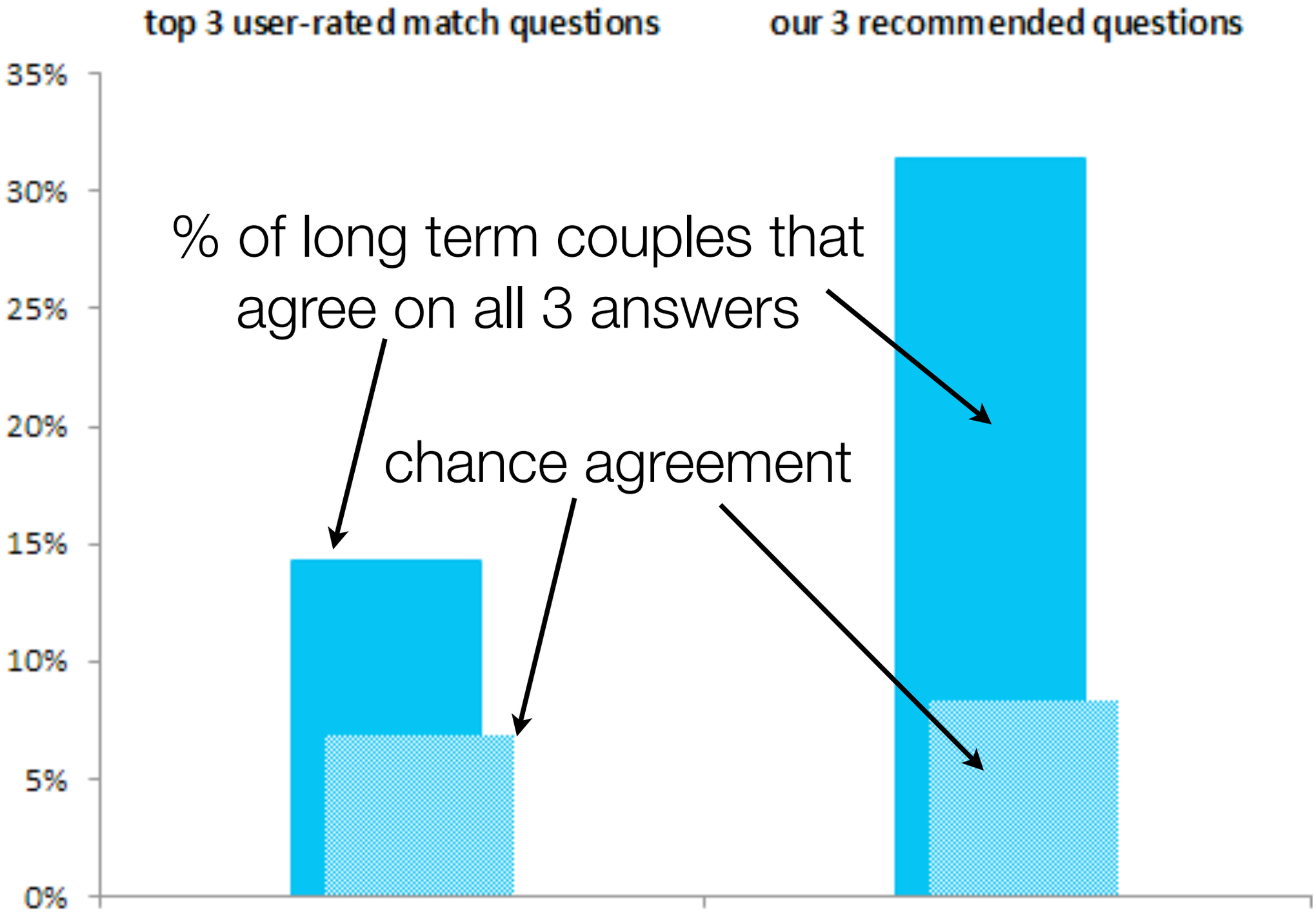
okcupid


Are you looking for a partner to have children with?
Yes
No
Answer this question privately.
300,000
250,000
200,000
150,000
100,000
50,000
0
step 0: all questions
step 1: eliminate the redundant or subliterate
step 2: eliminate the too personal
step 3: eliminate the too obvious
viable first-date questions!

Would you consider sleeping with someone on the first date?

- % answering yes -




top 3 user-rated match questions
our 3 recommended questions
35%
30%
25%
20%
15%
10%
5%
0%
% of long term couples that agree on all 3 answers
chance agreement
Q: Is God important in your life?
Q: Is sex the most important part of a relationship?
Q: Does smoking disgust you?
Q: Wouldn't it be fun to chuck it all and go live on a sailboat?
Q: Do you like horror movies?
Q: Have you ever traveled around another country alone?

What can you do with Crowdsourcing?

- Crowdsourcing is a transformative idea for business and research
- You all are exhibiting hugely creative thinking about it with your final projects
- I am looking forward to seeing what you come up with for the final, and beyond!

Final project details

- Thursday, May 5th from 9-11am in two locations: LRSM and Skirkanich Auditorium
- 5 minute video for each team, plus 2 minute Q&A
- You must provide links to your at least 1 hour before the presentations begin, and validate that they work.
- Questionnaires due on the 5th. Submit them before 9am.

$10,000 prize

- $10k of my research money to developing your idea
- Launch a startup!
- Write a research paper!
- Do something awesome! I'm excited to see what you produce!

Thanks!