

Beyond Being There examples

Avika P: Live feedback on speaking style over Zoom



Our algorithm identifies moments when you affirm student contributions by:

- acknowledging,
- revoicing,
- and/or reformulating their contributions.

Example:

Student: "I made a separate function for calculating the first term."

Teacher: "Great, so you are modularizing your code by creating separate functions."

Our algorithm identifies moments when you move the learning forward by:

- clarifying or asking students to clarify what they said,
- asking a follow-up question about what students have said,
- and/or guiding students' thinking process.

Example:

Student: "We need to first define the variable."

Teacher: "Great catch, so what would happen if we didn't define it?"

Our algorithm has identified **16** moments when you built on student contributions.

Research shows that building on students' contributions can make them feel valued, help form connections, and signal to students that they are essential to the learning of the classroom. This is most effective when teachers **affirm student contributions** and then build on them to **move the learning forward**.

heard move two spaces, the deeper. Cool. So after we move two spaces deeper, where are we at?
What should we do next?

Hide

Student: [PERSON_NAME] and I thought we should have, like, build hospital function. And when [PERSON_NAME] sort of comes across a beeper in a [PERSON_NAME] executes the built hospital function.

You: Awesome. So I guess pre condition would be on top of the deeper, I think. Right? Yeah. Then what would you I was to build a hospital once you're on top of deeper, I guess.

Carina F: teacher feedback on instructional style



Attendance:



Wisdom of the Crowd

CS 278 | Stanford University | Michael Bernstein



Announcements

Assignment 3 starts today and will unroll in multiple stages: more details at the end of lecture

Deadline for the first phase is this Friday

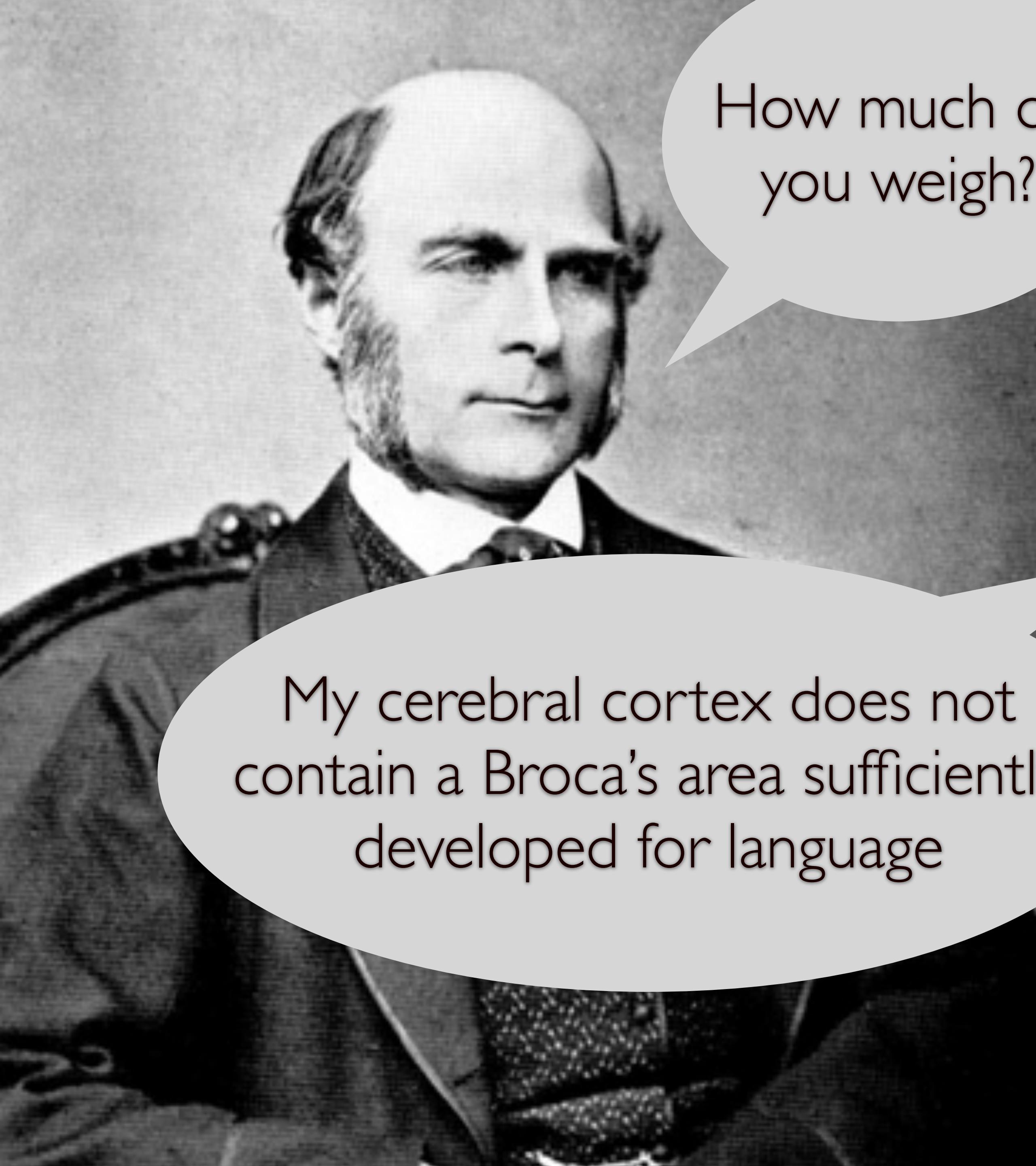
Project milestone will be due the Wednesday of Week 7



<http://hci.st/wise>

Grab your phone, fill it out!

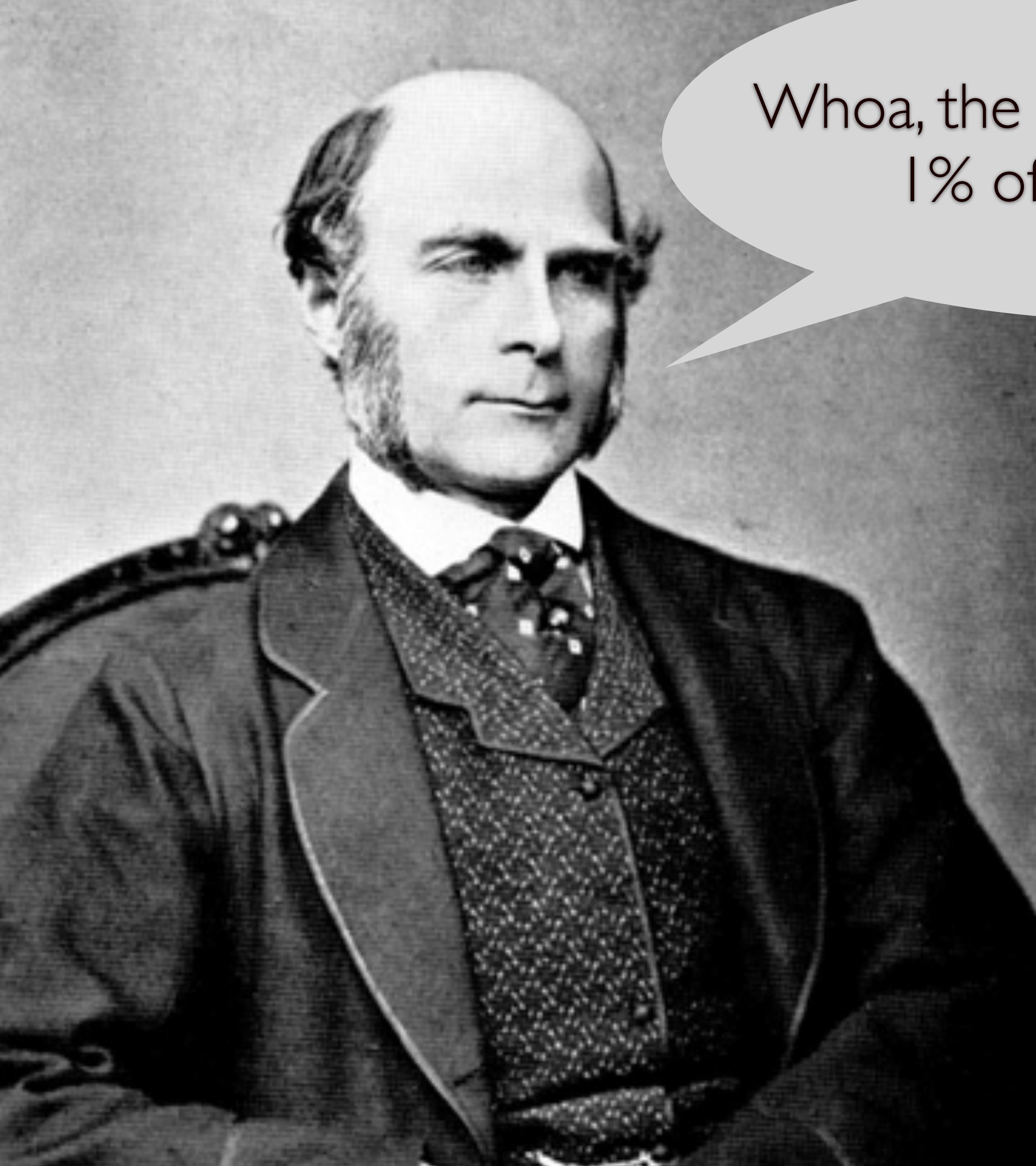




How much do
you weigh?

My cerebral cortex does not
contain a Broca's area sufficiently
developed for language





of the dressed weight of a
787 different persons.

Percentiles	Observed deviates from 1207 lbs.	Normal p.e = 37	Excess of Observed over Normal
5	1074	- 133	- 90
10	1109	- 98	- 70
15	1126	- 81	- 57
20	1148	- 59	- 46
q_1	1162	- 45	+ 8
30	1174	- 33	+ 4
35	1181	- 26	+ 5
40	1188	- 19	+ 5
45	1197	- 10	+ 3
m	1207	0	0
55	1214	+ 7	+ 0
60	1219	+ 12	+ 2
65	1225	+ 18	+ 3
70	1230	+ 23	+ 6
q_3	1236	+ 29	+ 8
80	1243	+ 36	+ 10
85	1254	+ 47	+ 10
90	1267	+ 52	+ 18
95	1293	+ 86	+ 4

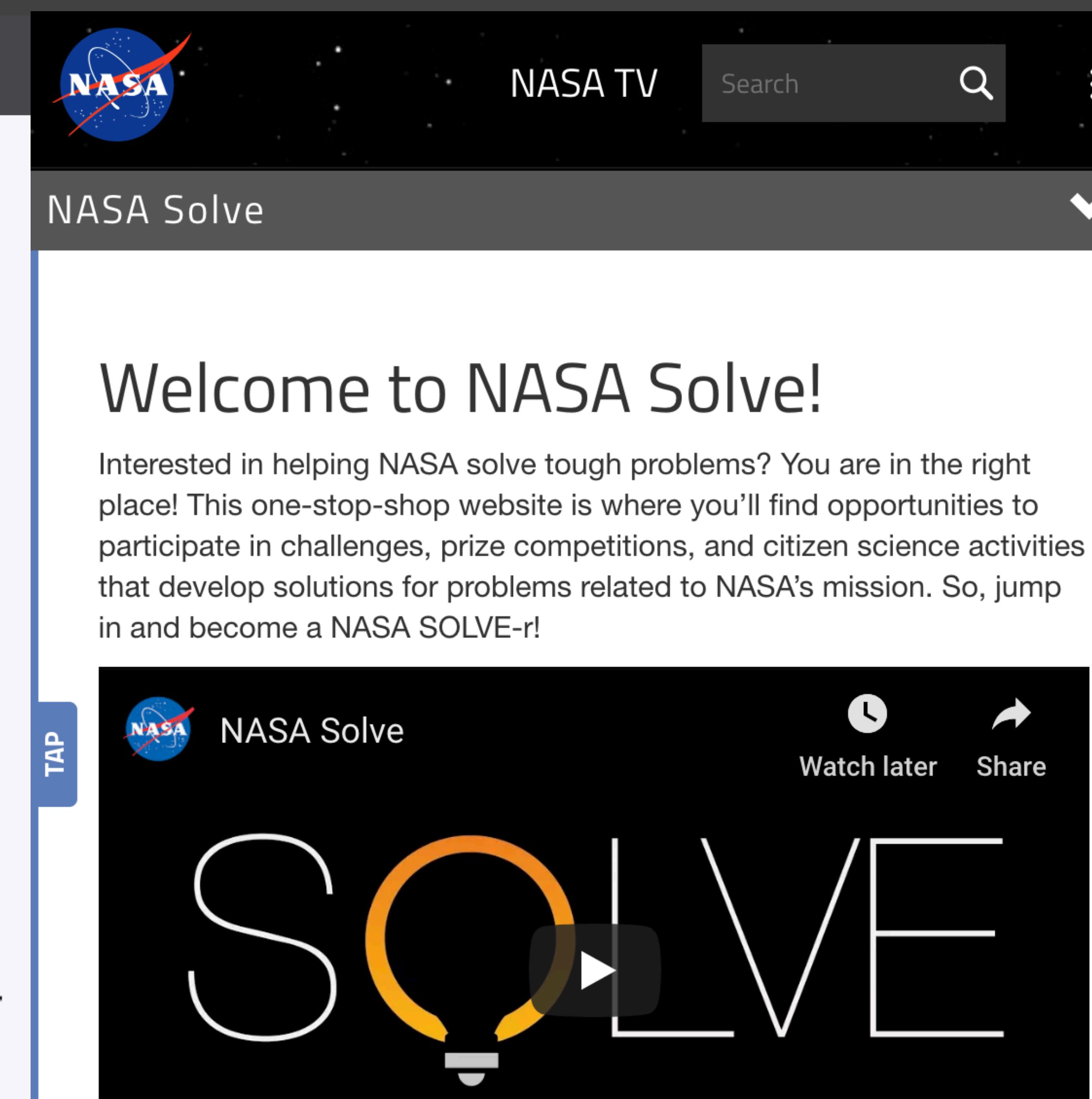
q_1 , q_3 , the first and third quartiles, stand at 25° and 75° respectively.
 m , the median or middlemost value, stands at 50°.

Innovation competitions in industry



The screenshot shows the Kaggle homepage. At the top, the word "kaggle" is written in blue lowercase letters. To the left is a menu icon consisting of three horizontal lines. On the right are links for "NASA TV", "Search", and a magnifying glass icon. Below the header, the text "Kaggle is the place to do data science projects" is displayed in large black font. Underneath this, there's a link "See how it works" with a blue arrow icon. The main visual is a white background featuring a laptop with a line graph on its screen. A hand is shown interacting with the laptop, and various icons like speech bubbles, a person silhouette, a cloud with an upward arrow, and mathematical symbols (+, -, ×, ÷) are scattered around the laptop.

Innovation competitions for science



The screenshot shows the NASA Solve homepage. At the top, the NASA logo is on the left, followed by "NASA TV", "Search", and a magnifying glass icon. The title "NASA Solve" is centered below the header. The main content area features the text "Welcome to NASA Solve!" in large, bold, black font. Below this, a paragraph reads: "Interested in helping NASA solve tough problems? You are in the right place! This one-stop-shop website is where you'll find opportunities to participate in challenges, prize competitions, and citizen science activities that develop solutions for problems related to NASA's mission. So, jump in and become a NASA SOLVE-r!" At the bottom, there's a video player interface with the NASA Solve logo, a play button, and "Watch later" and "Share" buttons. The background of the video player features the word "SOLVE" with the letter "O" replaced by a stylized orange lightbulb.

Prediction markets

The screenshot shows the PredictIt website interface. At the top, there is a navigation bar with links for "U.S. Elections", "Trump Admin", "Congress", "Justice", "World", "Login", and "Sign Up". Below the navigation bar, there is a large banner for "Spain's next leader?" featuring a portrait of a man and the Spanish flag. The banner includes the text "Election Sunday" and a series of six small circles. Below the banner, there is a section titled "Popular Markets" with a box for "2020 Democratic nominee?". This box lists two options: "Bernie Sanders" at 23¢ and "NC" (Not Credited), and "Joe Biden" at 22¢ and "NC". A large blue "D" logo is visible on the right side of the page. At the bottom left, it says "25.2M Shares Traded".

AI data annotation at scale



Today

What is the wisdom of the crowd? What is crowdsourcing?

Why do they work?

When do they work?

Wisdom of the crowd

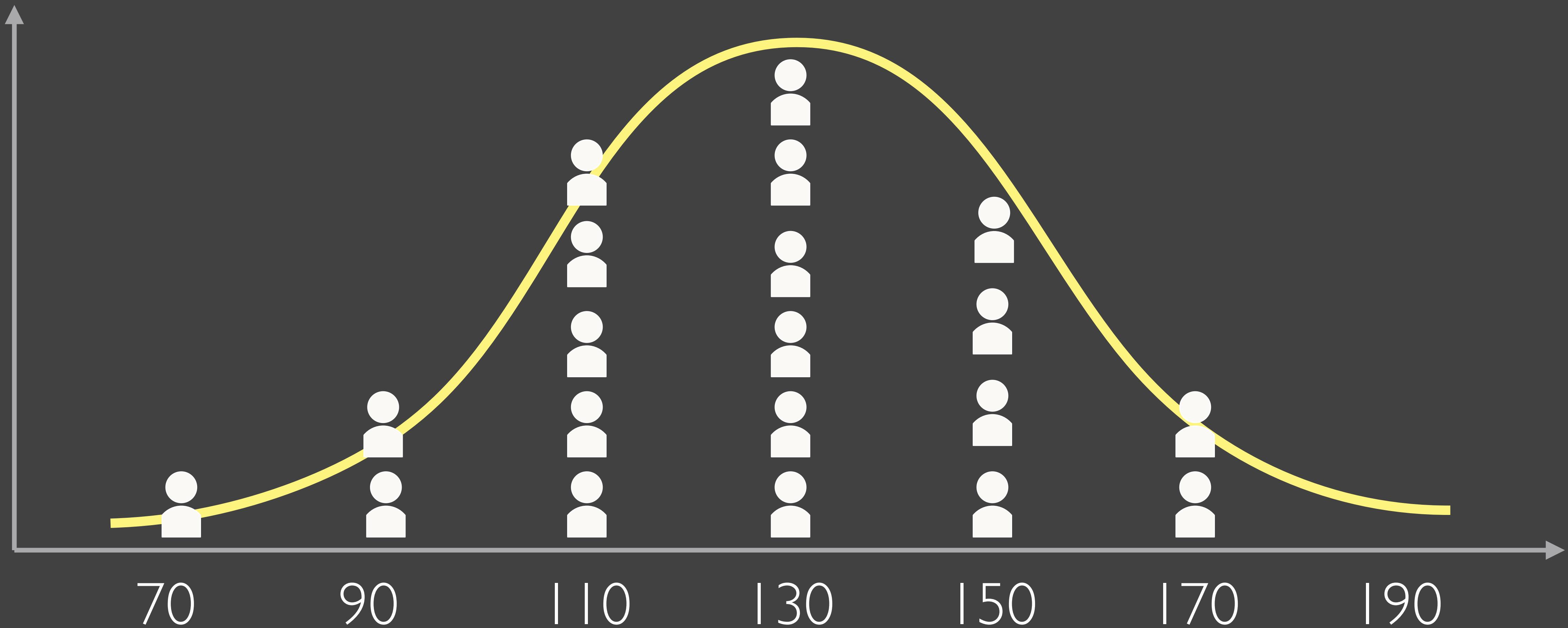
Crowds are surprisingly accurate at estimation tasks

Who will win the election? How many jelly beans are in the jar?
What will the weather be? Is this website a scam?

Individually, we all have errors and biases.

However, in aggregate, we exhibit surprising amounts of **collective intelligence**.

“Guess the number of minutes it takes to fly from Stanford, CA to Seattle, WA.”



If our errors are distributed at random around the true value, we can recover it by asking enough people and aggregating.

What problems can be solved this way?

Jeff Howe [2009] theorized that it required:

- Diversity of opinion

- Decentralization

- An aggregation function (e.g., average)

So — any question that has a binary (yes/no), categorical (e.g., win/lose/tie), or interval (e.g., score spread on a football game) outcome

What problems cannot be solved this way?

Flip the bits!

People all think the same thing

People can communicate

No way to combine the opinions

For example, writing a short story (is much harder!)

General algorithm

I. Ask a large number of people to answer the question

Answers must be independent of each other — no talking!

People must have a reasonable level of expertise regarding the phenomenon in question.

2. Average their responses

Why is the crowd wise?

[Simoiu et al. 2020]

Independent guesses minimize the effects of social influence

Showing consensus cues such as the most popular guess lowers accuracy

If initial guesses are inaccurate and public, then the crowd never recovers

Crowds are more consistent guessers than experts

In an experiment, crowds are only at the 67th percentile on average per question...but at the 90th percentile averaged across questions!

Tortoise and the Hare: the tortoise is consistent (67th percentile) while the hare alternates between sprinting and resting

Mechanism: ask many independent contributors to take a whack at the problem, and reward the top contributor

The image is a composite of two screenshots illustrating crowdsourcing mechanisms.

Kaggle Screenshot: The left side shows the Kaggle homepage. The header reads "kaggle". Below it, a large text block says "Kaggle is the place to do data science projects". A "See how it works" button with a play icon is present. The background features a stylized illustration of a hand interacting with a laptop displaying a line graph, surrounded by various icons like a speech bubble, a bar chart, and mathematical symbols (+, -, ×, ÷).

NASA Solve Screenshot: The right side shows the NASA Solve website. The header includes the NASA logo, "NASA TV", a search bar, and a menu icon. The main title is "NASA Solve". Below it, a large text block says "Welcome to NASA Solve!". A descriptive paragraph follows: "Interested in helping NASA solve tough problems? You are in the right place! This one-stop-shop website is where you'll find opportunities to participate in challenges, prize competitions, and citizen science activities that develop solutions for problems related to NASA's mission. So, jump in and become a NASA SOLVE-r!" At the bottom, there is a video player interface with the NASA Solve logo, "Watch later", and "Share" buttons.

Mechanism: use a market to aggregate opinions

The screenshot shows the PredictIt website interface. At the top, there are navigation links for "Login" and "Sign Up" and a search icon. Below the header, there are category links: "U.S. Elections", "Trump Admin", "Congress", "Justice", and "World". The main content area features a large image of a man's face on the right and the Spanish flag on the left. Overlaid text reads "Spain's next leader?" and "Election Sunday". A progress bar at the bottom indicates the event is "0 days away". Below this, a section titled "Popular Markets" lists a market for "2020 Democratic nominee?". The market details show "Bernie Sanders" at 23¢ and "NC" (No Confidence) at 100¢. A large blue "P" logo is visible on the right side.

Mechanism: ask paid data annotators to label the same image and look for agreement in labels



(much more on the implications of paid crowd work in the Future of Work lecture)

Let's check our
<http://hci.st/wise> results

Aggregation approaches

Early crowdsourcing

[Grier 2007]

Two distributed workers work independently, and a third verifier adjudicates their responses



1760

British Nautical Almanac
Nevil Maskelyne

In answer to your Letter of the 23rd. instant
compute D^o dist. from a star by logarithms, thus P₁
of the pole of the ecliptic Nor S. or S. are
Kept by computation from one of the seven poles.
D^o is the sum of the distances from the pole
great circle. Let fall from P₁ to the perpendicular
to it in the ecliptic, let be less than 90°.
By Log. c, P₁ + t, P₂ = t, P₂ & P₁ - P₂ = L_D

$$c, L_D^2 = -c, P_D + c, P_S + c, L_D$$

$$or = c, P_1 + s, P_S - s, P_D + c, L_D$$

The latter formula must be used when P_D
is large, or near 90°; but may be used safely
in all cases.

Example

$$P_{10.30} \dots c \dots 9.9715876$$

$$P_{89.58.30} \dots t \dots 13.9857588$$

$$P_{25.25.30} \dots c \dots 9.9557589 \dots \dots \dots$$

$$P_S \dots \dots \dots t \dots 12.0977240 \dots \dots \dots s \dots 9.9999879$$

$$P_D 89.29.36 \dots t \dots 12.0534829 \dots \dots \dots s. co-an. \dots \dots 0.0000170$$

$$P_L 85.0.0 \dots \dots \dots c \dots \dots \dots 9.9986631$$

$$L_D 29.36 \dots \dots \dots c \dots \dots \dots 9.9544269$$

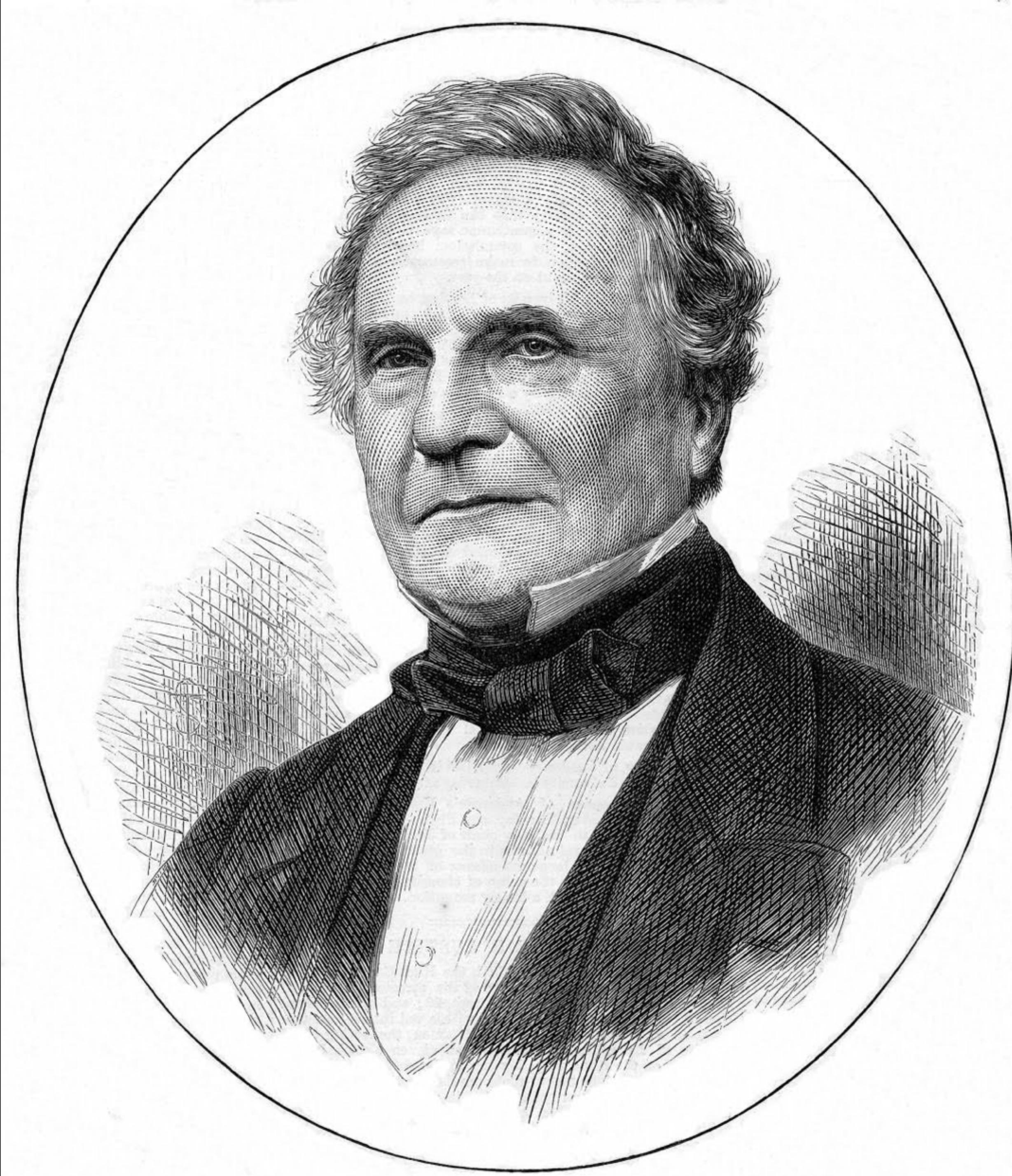
$$S_L 25.47.30 \dots \dots \dots c \dots \dots \dots$$

$$If P_S should be greater than 90°$$

$$Then P_1 + P_S = L_D as in this scheme$$

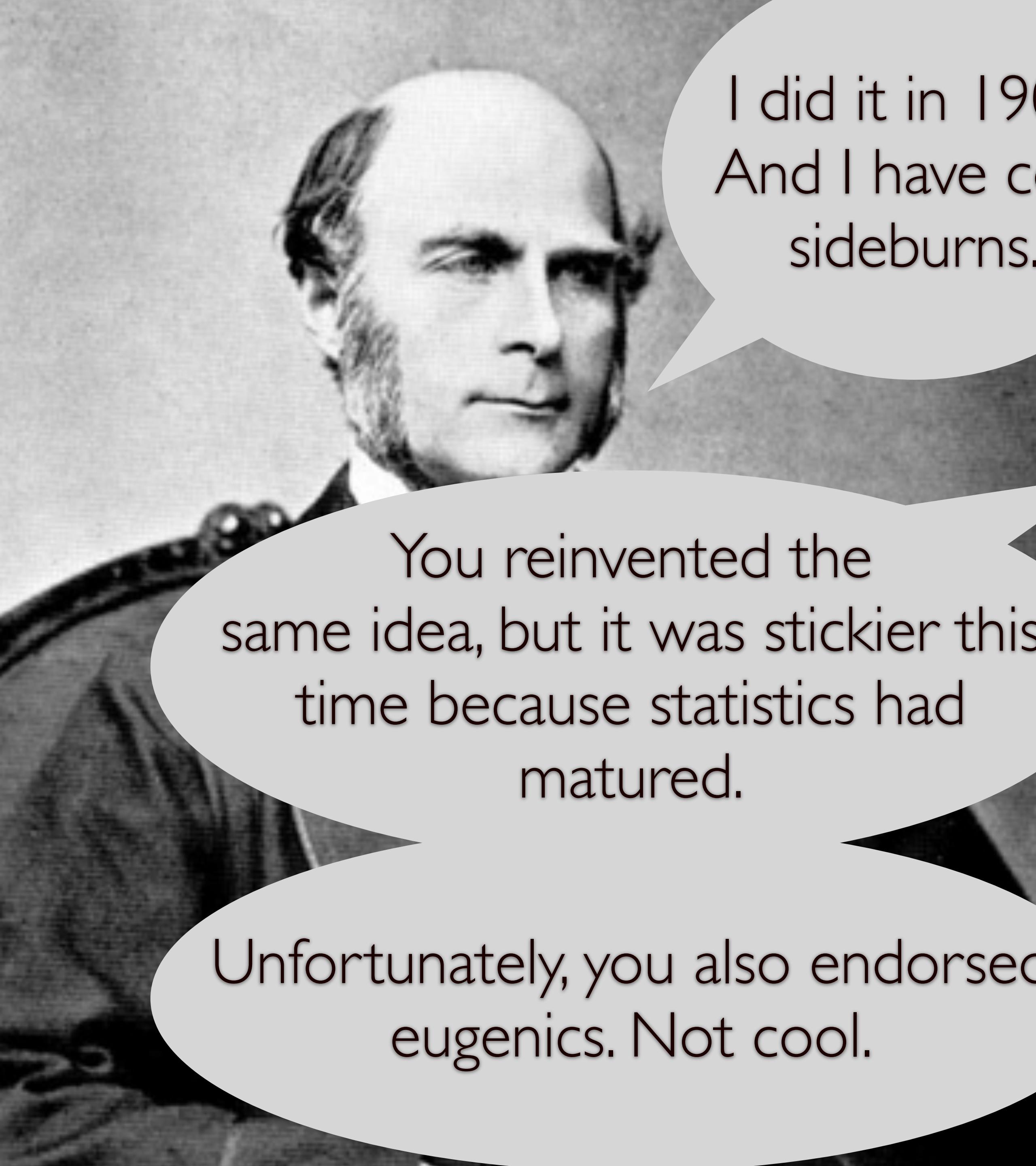
As the planets places, excepting the
sun and moon are only set down to minutes,
there is no occasion to allow for nutation &
aberration. In computing the occultations of
stars by the sun you must calculate their longitudes & lat.
to sec'd. and apply nutation & aberration. I am glad to
be bound to do it by my own method. I am

S. D. M. S. D. M. S.	at Noon. at Noon. of the	at Noon. at Noon. of the	Stars West
1 2 20 0 51 2 58 29 N 1			
2 3 21 43 83 48 52 2			
3 15 46 23 4 28 29 3			
4 3 29 3 54 4 54 28 4	Spica my		
5 4 12 35 47 5 4 34 5	Id		
6 4 26 19 33 4 57 26 6	Id		
7 5 10 12 31 4 32 51 7	Id		
8 5 24 12 11 3 51 51 8	Antares	O	
9 6 8 16 36 2 56 35 9	Id	O	
10 6 22 24 16 1 50 19 10	Id	O	Regulus
11 7 6 34 4 0 37 6N 11	α aquila	O	Id
12 7 20 44 43 0 38 25 12	Id		Spica my
13 8 4 54 27 1 51 21 13	Fomalh.		Id
14 8 19 0 45 2 57 1 14	Id		
15 9 3 0 17 3 51 19 15	Antares		
16 9 16 49 18 4 31 12 16	Id		
17 10 0 24 8 4 54 54 17	α Arietis		Id
18 10 13 41 50 5 1 59 18	Id		Id
19 10 26 40 41 4 53 8 19	Id		Id
20 11 9 20 28 4 29 54 20	Id		Id
21 11 21 42 30 3 53 21 21	Id		X α aquila
22 0 3 49 35 3 8 48 22	abducas?		O α aquila
23 0 15 45 40 2 15 32 23	Id		O Id
24 0 27 35 32 1 16 47 24	Id		O Fomalh
25 1 9 24 26 0 14 46 25	X last		O Id
26 1 21 17 52 0 43 14N 26			O Id
27 2 3 21 8 1 49 51 27			O α Arietis
28 9 15 38 59 2 57 21 28			O Id



Charles Babbage

Two people doing the same task in the same way will make the same errors.



I did it in 1906.
And I have cool
sideburns.

You reinvented the
same idea, but it was stickier this
time because statistics had
matured.

Unfortunately, you also endorsed
eugenics. Not cool.



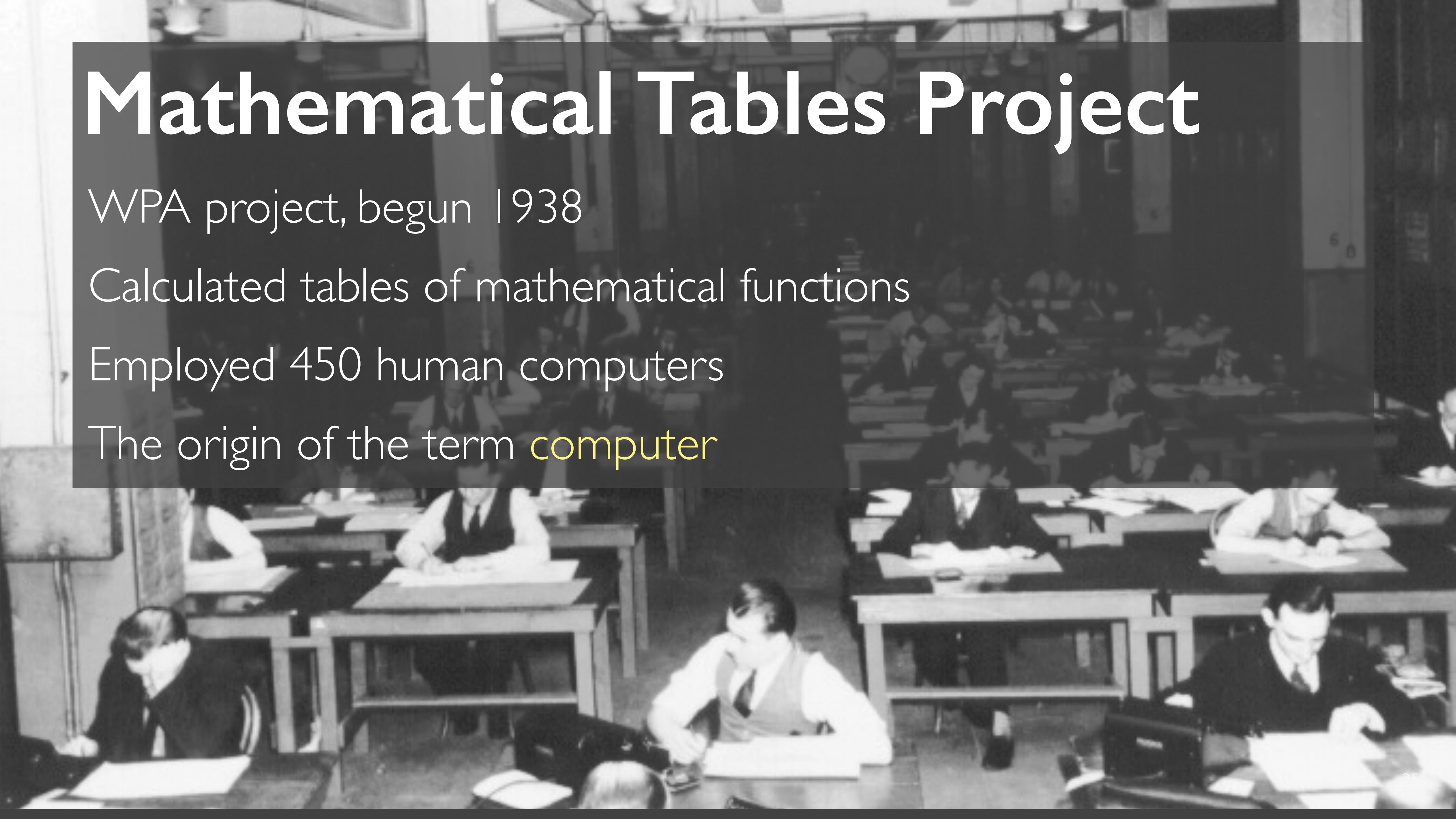
Mathematical Tables Project

WPA project, begun 1938

Calculated tables of mathematical functions

Employed 450 human computers

The origin of the term **computer**





OBITUARIES

Katherine Johnson, NASA Mathematician And An Inspiration For 'Hidden Figures,' Dies

February 24, 2020 · 10:22 AM ET

Heard on [Morning Edition](#)



RUSSELL LEWIS



20th
Century
Fox

Enter computer science

Computation allows us to execute these kinds of goals at even larger scale and with even more complexity.

We can design systems that gather evidence, combine estimates, and guide behavior.

Forms of crowdsourcing

Definition

Crowdsourcing term coined by Jeff Howe [2006] in Wired

“Taking [...] a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call.”



CROWD SOURCING

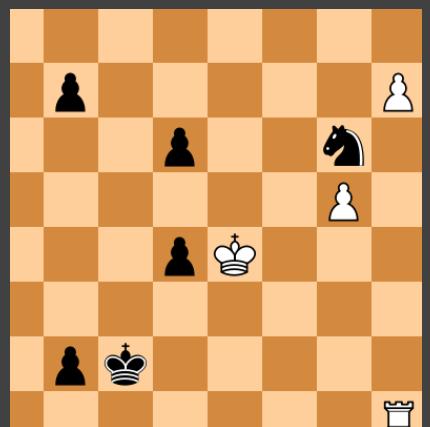
WHY THE POWER OF THE CROWD
IS DRIVING THE FUTURE OF BUSINESS



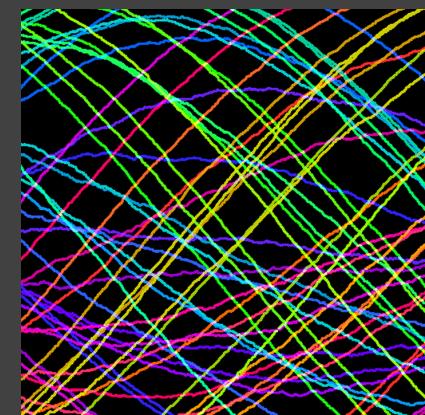
JEFF HOWE

Volunteer crowdsourcing

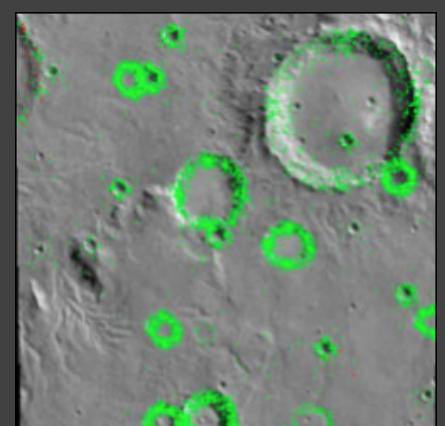
Tap into intrinsic motivation to recruit volunteers



Kasparov vs. the world



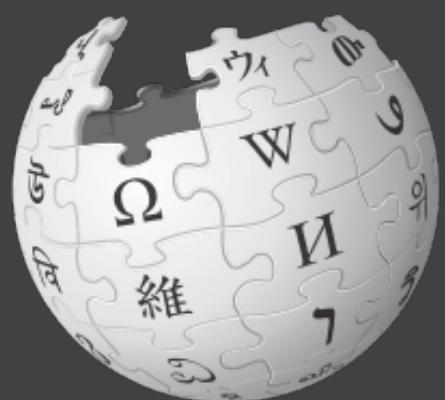
Collaborative math proofs



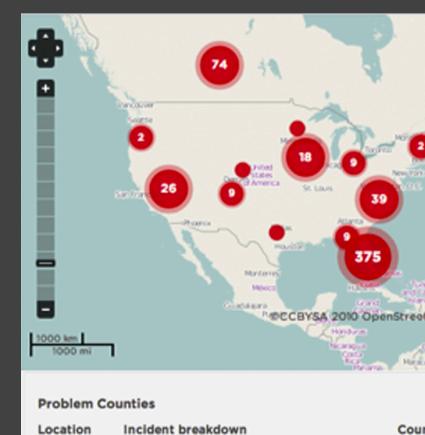
NASA Clickworkers



Search for a missing person



Wikipedia



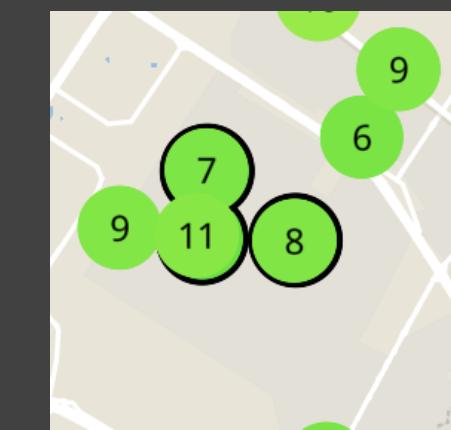
Ushahidi crisis mapping

Automated sharing

Opt in to sharing and aggregation



Waze traffic sharing
(also includes manual)



Purple Air air quality sensors



Privacy-Preserving Contact Tracing

Across the world, governments, and health authorities are working together to find solutions to the COVID-19 pandemic, to protect people and get society back up and running. Software developers are contributing by crafting technical tools to help combat the virus and save lives.

Games with a purpose

[von Ahn and Dabbish 2004]



Make the data labeling goal
enjoyable.

You are paired up with
another person on the
internet, but can't talk to
them.

You see the same image.

Try to guess the same word
to describe it.

Games with a purpose

[von Ahn and Dabbish 2004]



Let's try it. Volunteers?

Taboo words:

Burger

Food

Fries

Games with a purpose

[von Ahn and Dabbish 2004]



Let's try it. Volunteers?

Taboo words:

Stanford

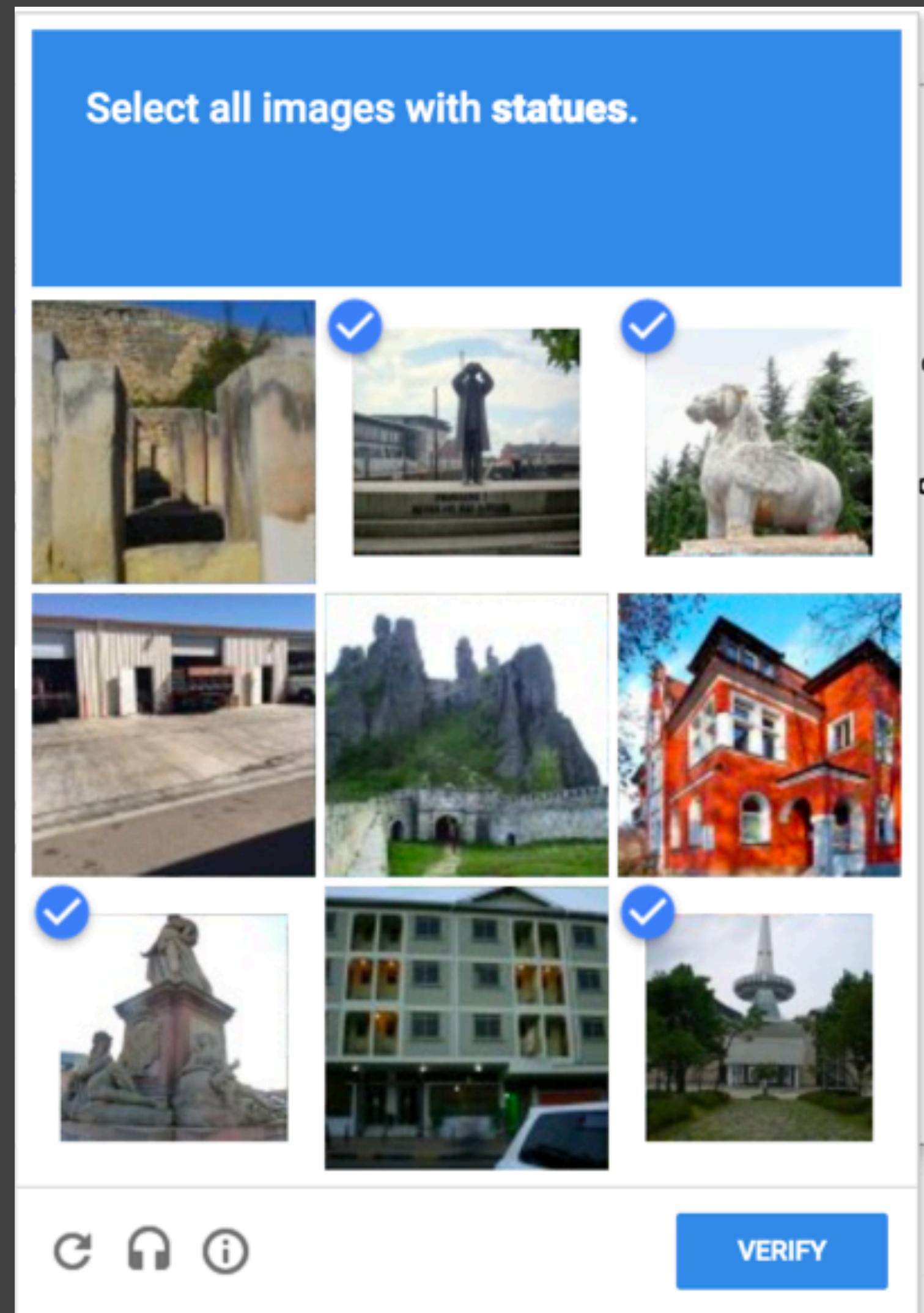
Graduation

Wacky walk

Appendix

reCAPTCHA

“Oh, I see you’d like to make an account here. Sure would be a shame if you couldn’t get into my website. Maybe you should help me train my AI system and I’ll see if I can do something about letting you in.”



Handling collusion and manipulation

Boaty McBoatface: What You Get When You Let the Internet Decide



A computer image of the research vessel, which is still being designed and is scheduled to set sail in 2019. The Natural Environment Research Council

Not the name that the British were expecting to see



Stephen Colbert fans raid NASA's vote to name the new ISS wing

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Daniel Kane

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Ioana Patringenaru

858-822-0899

UC San Diego Team's Effort in DARPA's Shredder Challenge Derailed by Sabotage



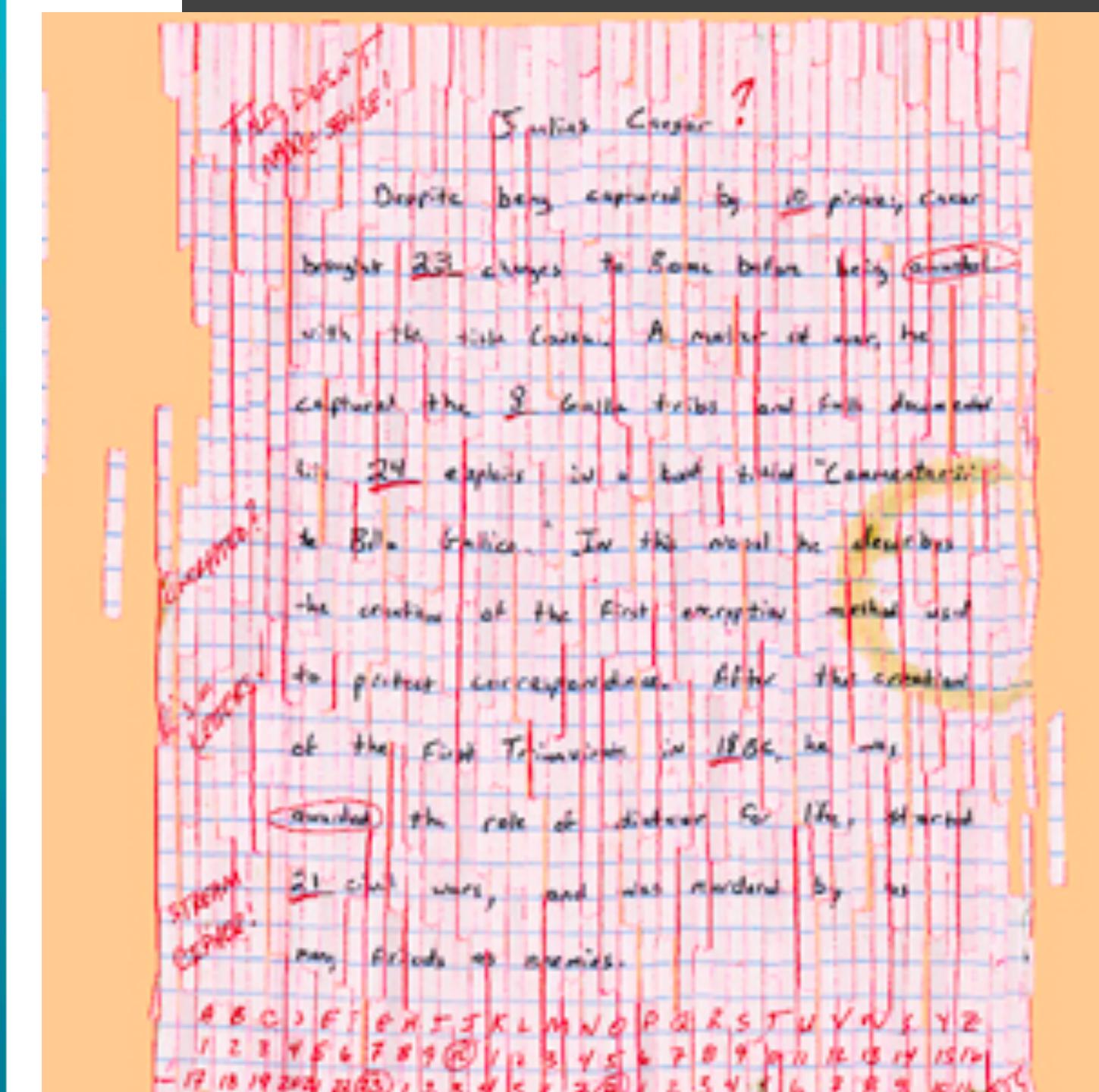
Manuel Cebrian, a computer science researcher, led a team that came in sixth in a DARPA challenge.

San Diego, Calif. Dec. 21 -- After a strong start in the U.S. Defense Department's \$50,000 'Shredder Challenge', researchers at the University of California, San Diego fell short of taking the top prize, in part

because of an anonymous attack on the team's online "crowdsourcing" approach to solving the challenge.

Jacobs School's monthly newsletter

A small number of malicious individuals can tear apart a collective effort.





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Batman

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DUN NUH NUH NUH NUH NUH DUH NUH NUH NUH NUH NUH BATMAN! DUN NUH NUH NUH NUH NUH
NUH NUH NUH NUH NUH BATMAN! DUN NUH NUH NUH NUH NUH DUH NUH NUH NUH NUH BATMAN!
DUN NUH NUH NUH NUH NUH DUH NUH NUH NUH NUH NUH BATMAN! BATMAN! BATMAN! BATMAN! DUN
NUH NUH NUH NUH NUH DUH NUH NUH NUH NUH NUH BATMAN!!!!!!!!!!!!!!

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Example via Mako Hill

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Lifestyle



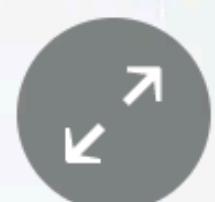
US World Environment Soccer **US Politics** Business Tech Science More

Wikipedia

⌚ This article is more than **4 years old**

US Congress banned from editing Wikipedia after staff caught trolling

Recent edits accuse Donald Rumsfeld of being an alien lizard and Cuba of faking the moon landings



[Example via Mako Hill]



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C

Harlem shake (dance)

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Oh God i didn't mean to delete it all, just one paragraph. Please help

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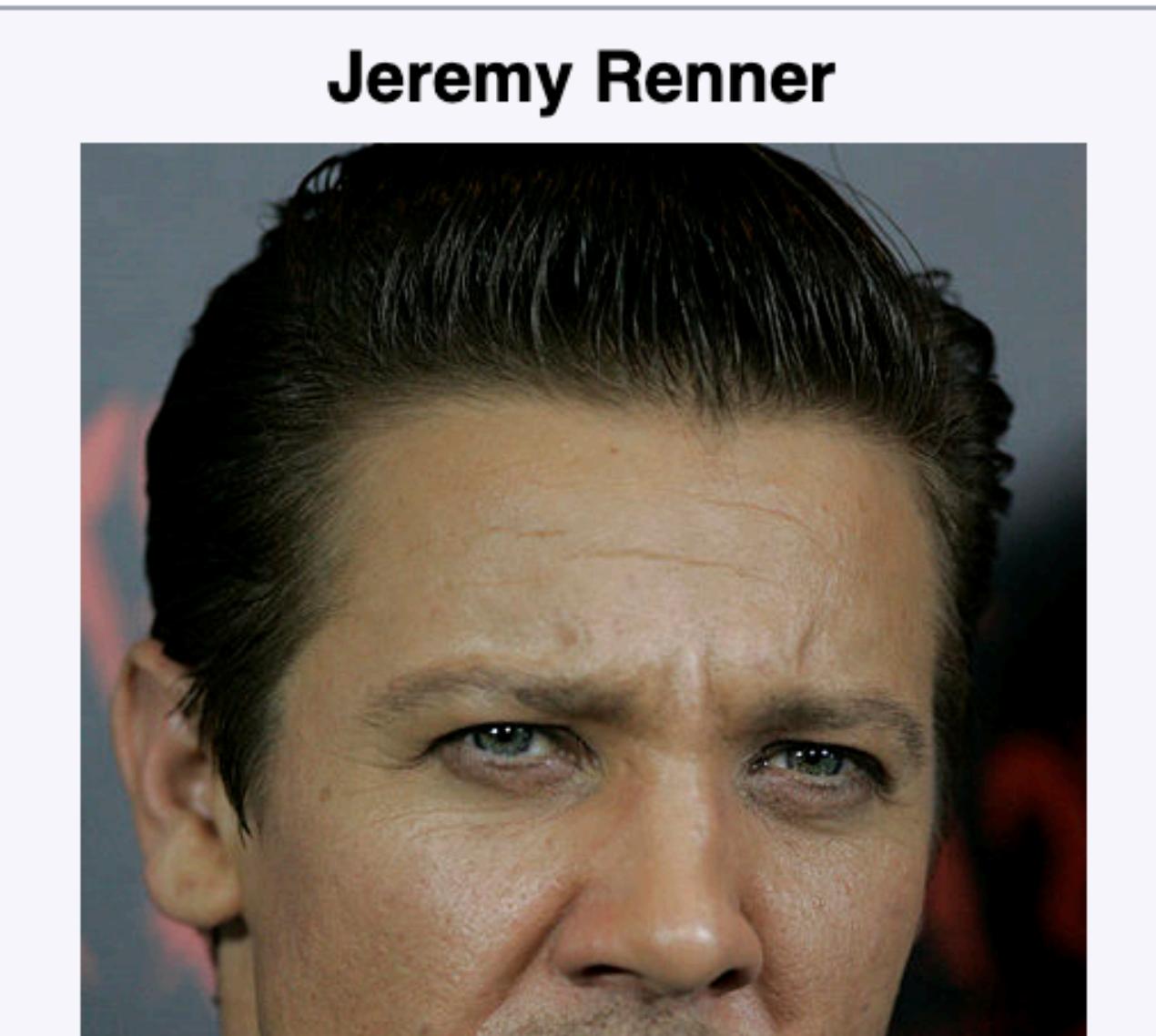
Jeremy Renner

From Wikipedia, the free encyclopedia

This is an [old revision](#) of this page, as edited by [187.137.5.101](#) ([talk](#)) at 00:04, 30 January 2013. The present address (URL) is a [permanent link to this revision](#), which may differ significantly from the [current revision](#).

(diff) ← Previous revision | Latest revision (diff) | Newer revision → (diff)

Jeremy Lee Renner (born January 7, 1971)^{[1][2][3]} is an American actor, singer-songwriter, [velociraptor](#), film producer, former makeup artist, and musician. He has had starring roles in *The Hurt Locker* (2008) (garnering him an Academy Award nomination for Best Actor), *Mission: Impossible – Ghost Protocol* (2011), *Marvel's The Avengers* (2012), and *The Bourne Legacy* (2012). Throughout the 2000s, Renner appeared largely in independent films such as *Dahmer* (2002) and *Neo Ned* (2005). He also appeared in supporting roles in bigger films, *S.W.A.T.* (2003) and *28 Weeks Later* (2007). He then turned out a much-praised performance in *The Town* (2010), for which he received an Academy Award nomination for Best Supporting Actor.



- (cur | prev) ○ 12:33, 12 February 2013 Cydebot (talk | contribs) m .. (28,792 bytes) (-37) .. (Robot - Removing category Satellite Award winners per CFD at Wikipedia:Categories for discussion/Log/2013 February 4.)
- (cur | prev) ○ 22:19, 3 February 2013 Guat6 (talk | contribs) .. (28,829 bytes) (+37) .. (added Category:Satellite Award winners using HotCat)
- (cur | prev) ○ 14:11, 1 February 2013 Sikkle (talk | contribs) .. (28,792 bytes) (+1)
- (cur | prev) ○ 23:01, 30 January 2013 Lowercase sigmabot (talk | contribs) m .. (28,791 bytes) (+17) .. (Adding protection templates) (bot)
- (cur | prev) ○ 22:31, 30 January 2013 Topbanana (talk | contribs) m .. (28,774 bytes) (0) .. (Protected Jeremy Renner: Persistent vandalism: Reddit fad ([Edit=Block new and unregistered users] (indefinite) [Move=Block new and unregistered users] (indefinite)))
- (cur | prev) ○ 21:19, 30 January 2013 Zafaras (talk | contribs) .. (28,774 bytes) (-13) .. (→Early life: The "velociraptor" thing again.)
- (cur | prev) ○ 21:04, 30 January 2013 129.97.124.193 (talk) .. (28,787 bytes) (+13)
- (cur | prev) ○ 17:25, 30 January 2013 63.248.26.218 (talk) .. (28,774 bytes) (+48)
- (cur | prev) ○ 01:02, 30 January 2013 EsonLinji (talk | contribs) m .. (28,726 bytes) (-14) .. (Jeremy Renner is not a velociraptor)
- (cur | prev) ○ 00:04, 30 January 2013 187.137.5.101 (talk) .. (28,740 bytes) (+14)
- (cur | prev) ○ 21:43, 29 January 2013 JLeland (talk | contribs) .. (28,726 bytes) (-14) .. (stomping velociraptor silliness)
- (cur | prev) ○ 18:15, 29 January 2013 71.51.19.153 (talk) .. (28,740 bytes) (+14)
- (cur | prev) ○ 16:33, 29 January 2013 37.106.37.118 (talk) .. (28,726 bytes) (-151)
- (cur | prev) ○ 09:06, 29 January 2013 All Hallow's Wraith (talk | contribs) m .. (28,877 bytes) (-7) .. (→Breakthrough: 2009–present)
- (cur | prev) ○ 09:05, 29 January 2013 All Hallow's Wraith (talk | contribs) m .. (28,884 bytes) (-49)
- (cur | prev) ○ 08:54, 29 January 2013 198.228.228.22 (talk) .. (28,933 bytes) (-14) .. (removed 'velociraptor' from description of talents)
- (cur | prev) ○ 03:30, 29 January 2013 67.189.247.59 (talk) .. (28,947 bytes) (+14)
- (cur | prev) ○ 02:34, 29 January 2013 ClueBot NG (talk | contribs) m .. (28,933 bytes) (-9) .. (Reverting possible vandalism by 108.218.146.101 to version by 199.168.62.2. False positive? Report it. Thanks, ClueBot NG. (1472111) (Bot))

Can we survive vandalism?

Michael's take: it's a calculation of the cost of vandalism vs. the cost of cleaning it up.

How much effort does it take to vandalize Wikipedia?

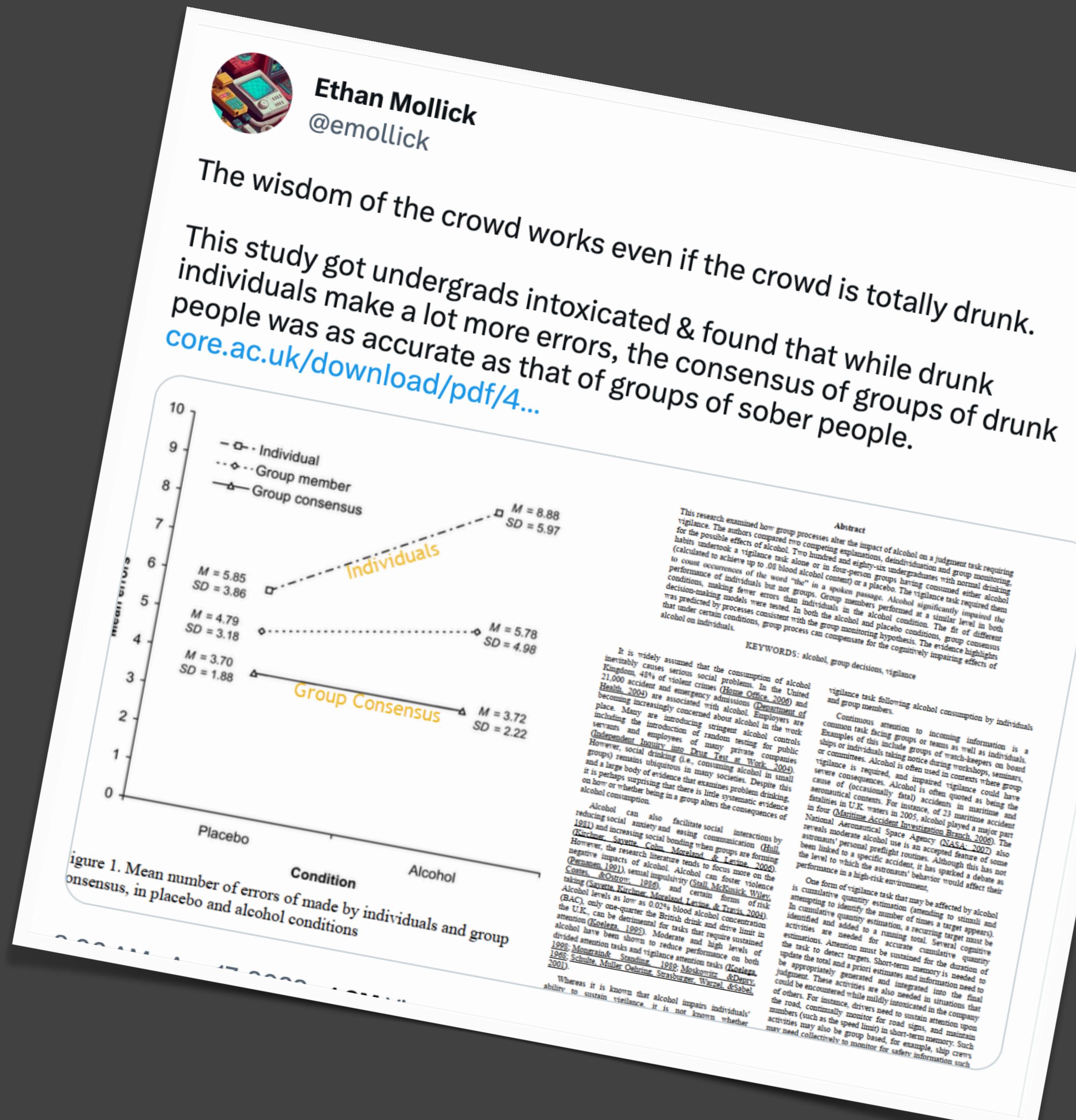
How much effort does it take an admin to revert it?

If effort to vandalize >>> effort to revert, then the system can survive.

How do you design your crowdsourcing system to create this balance?

...and some threats may not actually be threats (?)

Michael's interpretation: if drunks are higher-variance in their responses, this still works as long as you have a large enough N.



Michael's take

There are two primary causes of quality challenges:

Strategic dishonesty, where the contributor is explicitly seeking to get away with something

Mental model misalignment, where the creator has not clearly communicated their goal

My experience is that strategic dishonesty is rare and can be caught, whereas mental model misalignment is ubiquitous

(But most of the field's focus is on strategic dishonesty)

Training

Gold standard judgments [Le et al. 2010]

Include questions with known answers

Performance on these “gold standard” questions is used to filter submissions

Gated instruction [Liu et al. 2016]

Create a training phase where you know all the answers already, and give feedback on every right or wrong answer during training

At the end of training, only let people go on if they have a high enough accuracy

Bayesian Truth Serum

[Prelec 2004]

Inspiration: people with accurate meta-knowledge (knowledge of how much other people know) are often more accurate

So, when asking for the estimate, also ask for each person's predicted empirical distribution of answers

Then, pick the answer that is more popular than people predict

Bayesian Truth Serum

[Prelec 2004]

“When will HBO have its next hit show?”

1 year / 5 years / 10 years

“What percentage of people do you think will answer each option?”

1 year / 5 years / 10 years

An answer that 10% of people give but is predicted to be only 5% receives a high score

Bayesian Truth Serum

[Prelec 2004]

Calculate the population endorsement frequencies \bar{x}_k for each option k and the geometric average of the predicted frequencies \bar{y}_k

Evaluate each answer according to its information score:

$$\log \frac{\bar{x}_k}{\bar{y}_k}$$

And reward people with accurate prediction frequency reports

Summary

Crowdsourcing: an open call to a large group of people who self-select to participate

Crowds can be surprisingly intelligent, if opinions are levied with some expertise and without communication, then aggregated intelligently.

Design differently for intrinsically and extrinsically motivated crowds

Vandalism—much like other anti-social behavior—is rare, but can happen

Assignment 3: Let's Crowdsource An Exam

Goal: gain experience with crowdsourcing workflows, and their double-edged nature. We will be constructing our own exam!

Part I (due by Friday): brainstorm exam questions

Part II (due next Monday): remix others' questions

Part III (due next Tuesday): vote

Part IV: (due after the exam): reflections

Top questions by vote will form a public question bank of possible questions for the exam. You get full credit if a question you contributed is on the exam. Staff will add some questions not in the question bank as well.

References

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Social Computing

CS 278 | Stanford University | Michael Bernstein

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