



Data Science as a Superpower

Amelia McNamara @amelia@vis.social
University of St Thomas St Paul, MN
Department of Computer & Information Sciences

About me

I am a

- white
- straight
- cisgender
- upper-middle class
- highly educated
- American lady



I'm doing the best I can when I talk about issues of race, class, gender, and other sensitive topics. But you should *always feel free* to call me out (publicly or privately).



D,₁

A,₁

T,₁

A,₁

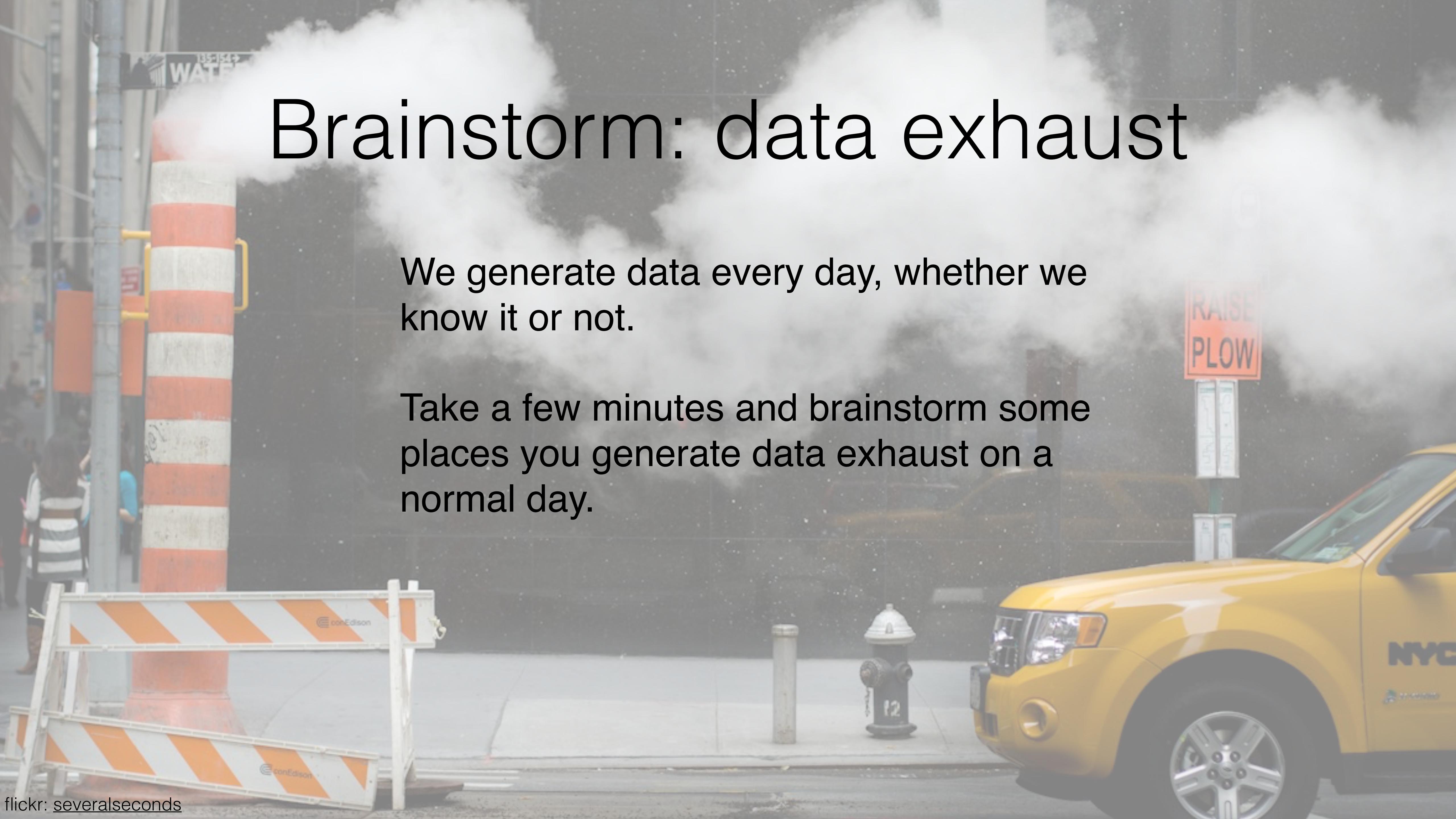
I think about data as any information that we can collect (write down or record on the computer) about the world.

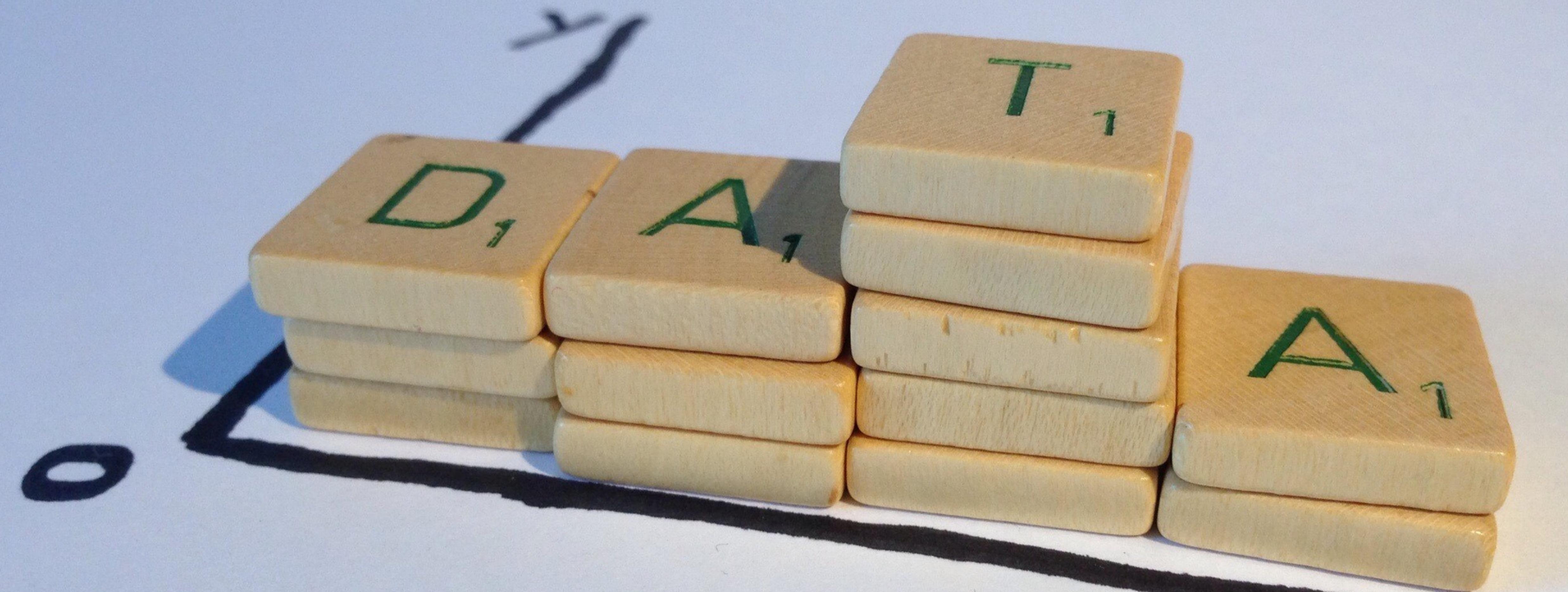
Numbers are data, but images, text, and user behavior can be, too!

Brainstorm: data exhaust

We generate data every day, whether we know it or not.

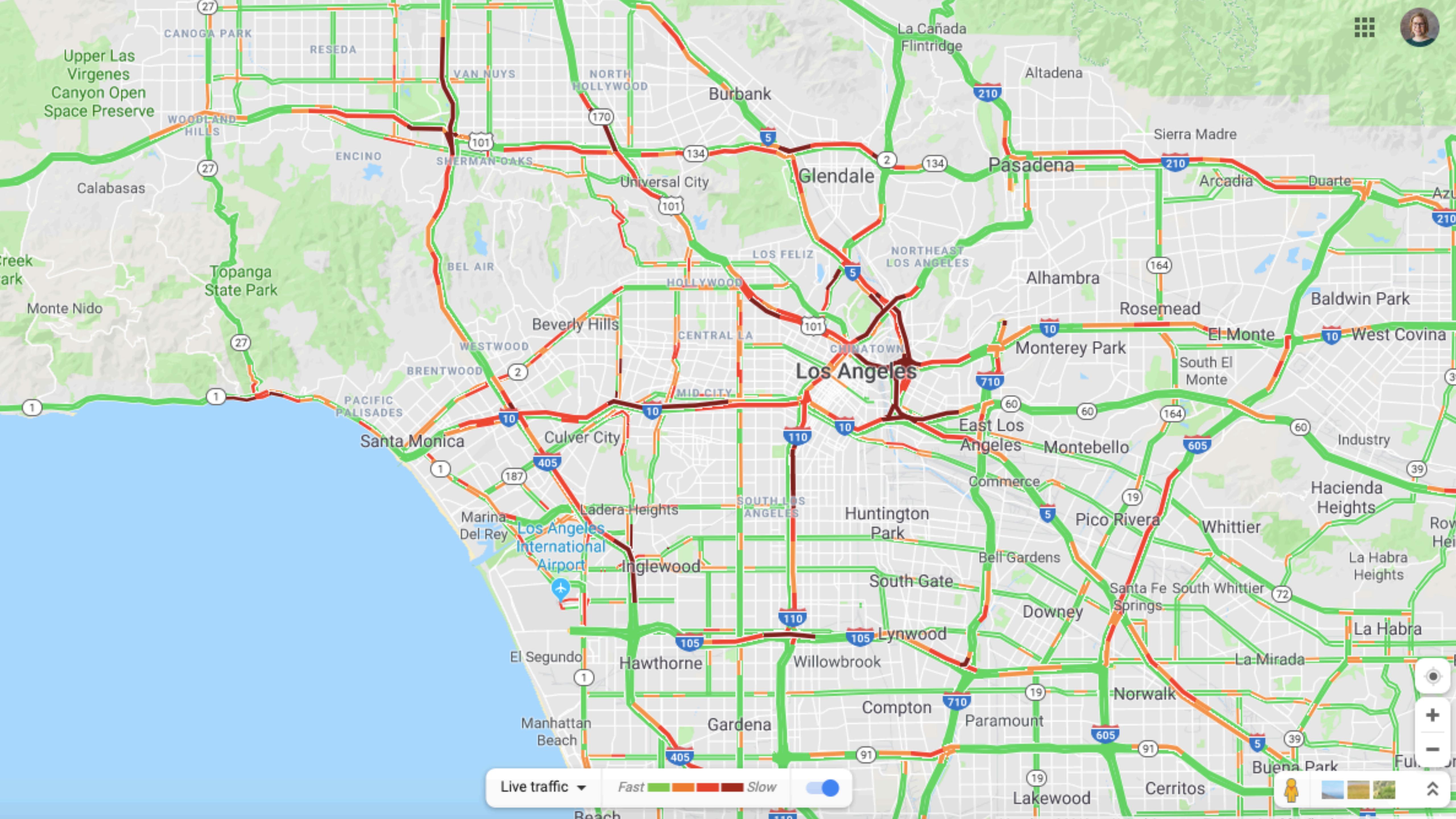
Take a few minutes and brainstorm some places you generate data exhaust on a normal day.





I think of data science as doing stuff in the world, using data.

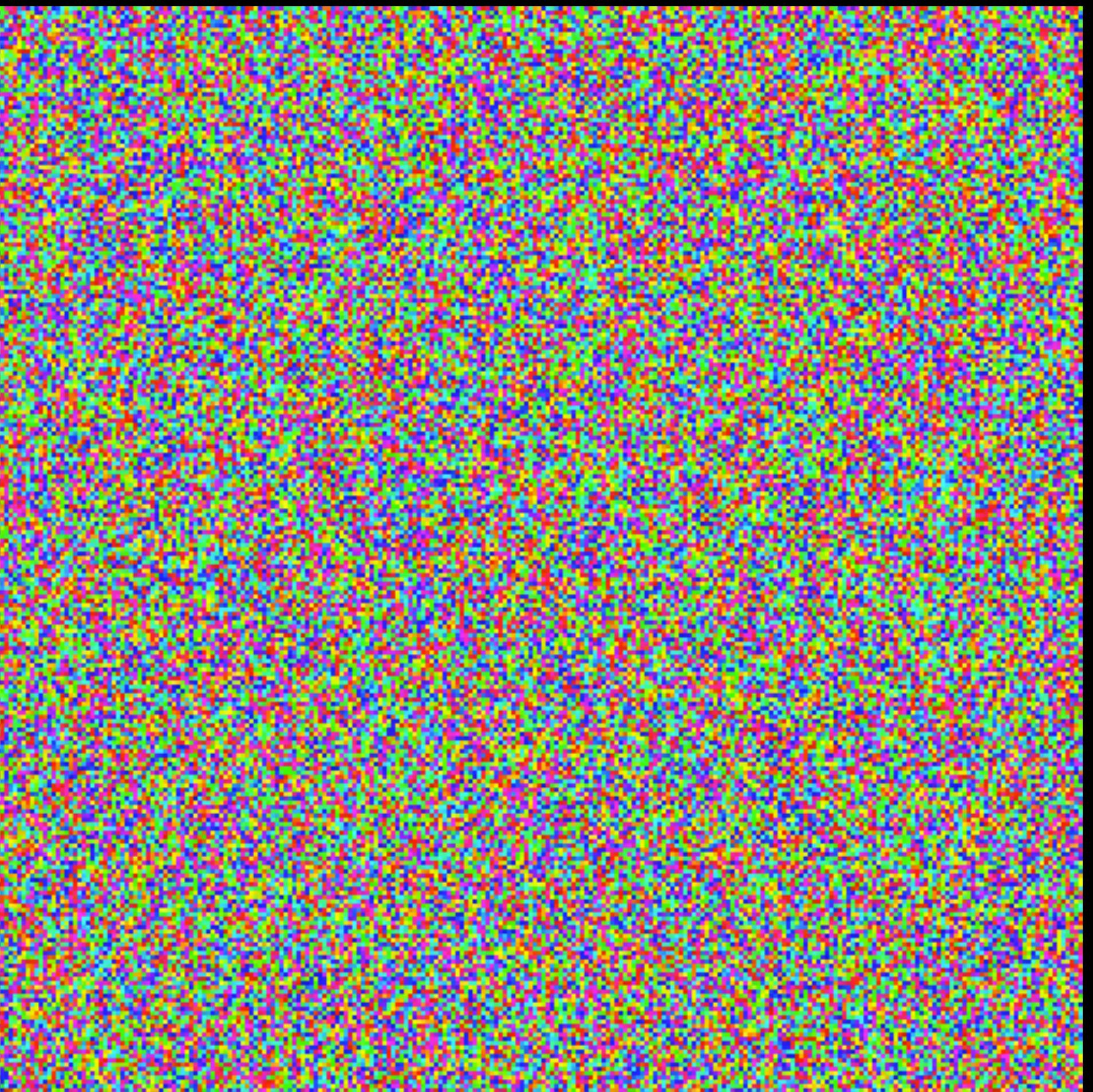
Data science requires the use of a computer.



An algorithm is a set of instructions to achieve a specific goal



Merge sort, breadth first



Bubble sort



nest

11:46

COOLING

73



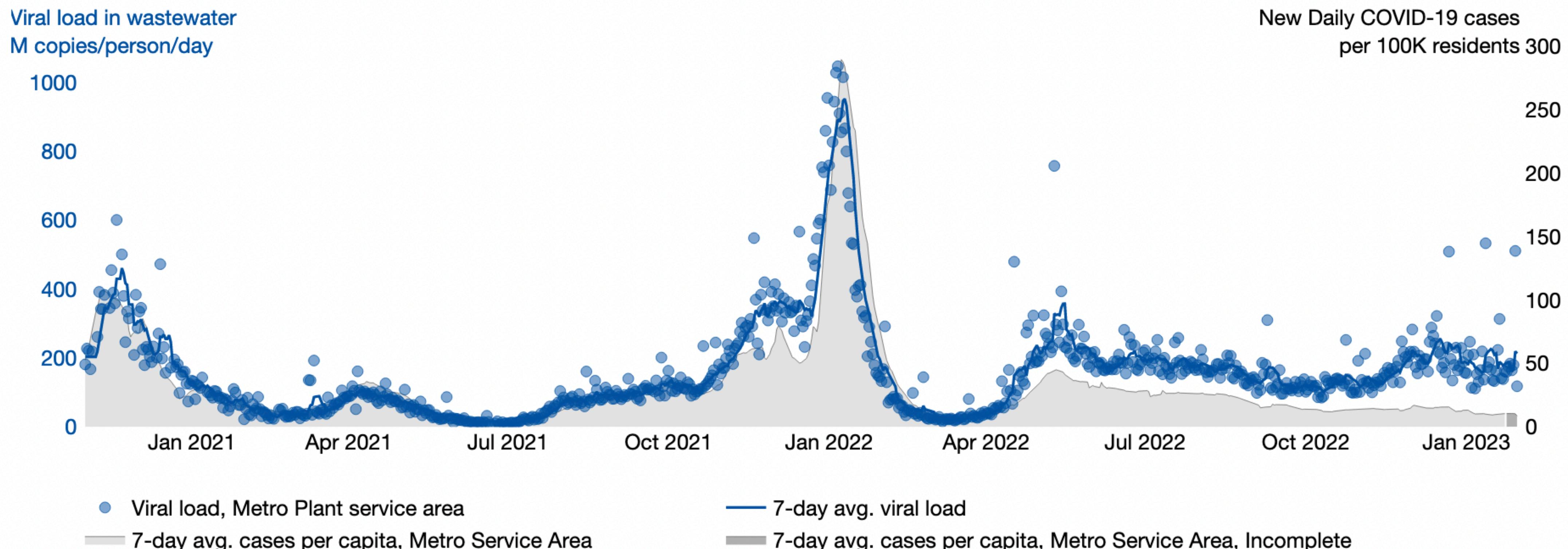
COVID-19 Surveillance at the Metro Plant

Total Viral Load Viral Load by Variant Variant Frequencies (%) This Week's Summary

This graph shows the amount of SARS-CoV-2 viral RNA entering the Metro Plant each day (blue line) and the number of new daily COVID-19 cases in the Metro Plant's service area, by sample collection date (gray line; data from the Minnesota Department of Health). The most recent case data (darker gray) are incomplete and subject to change.

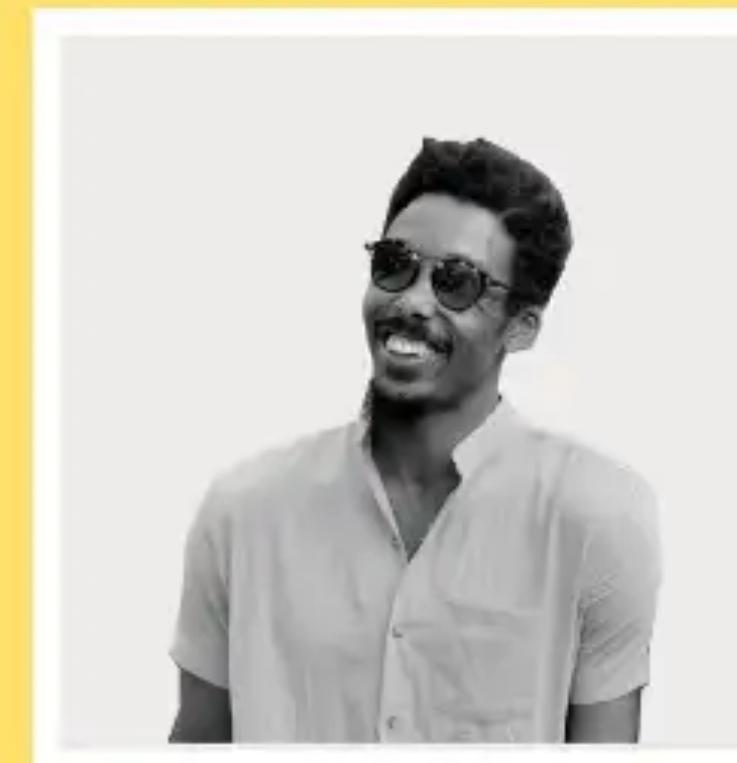
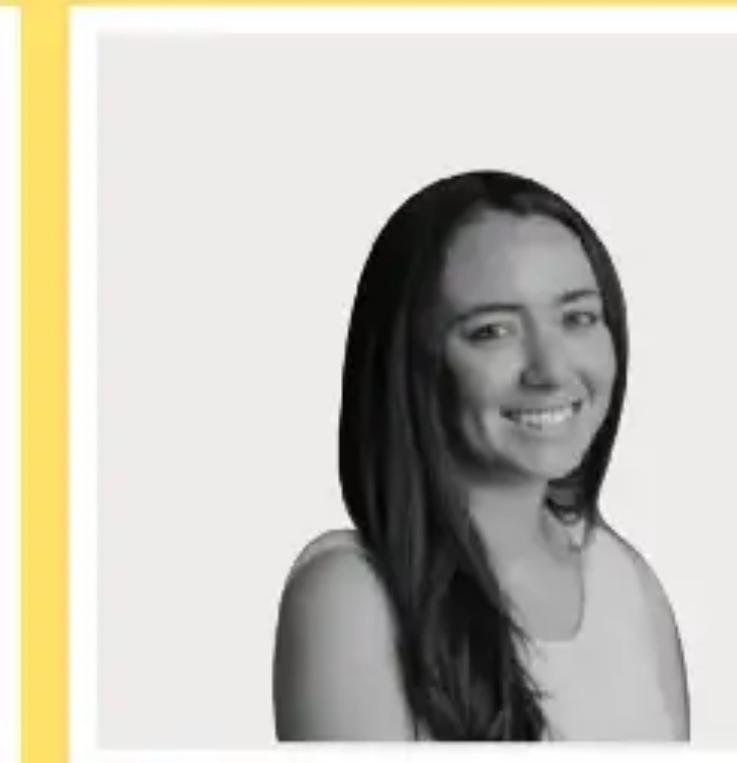
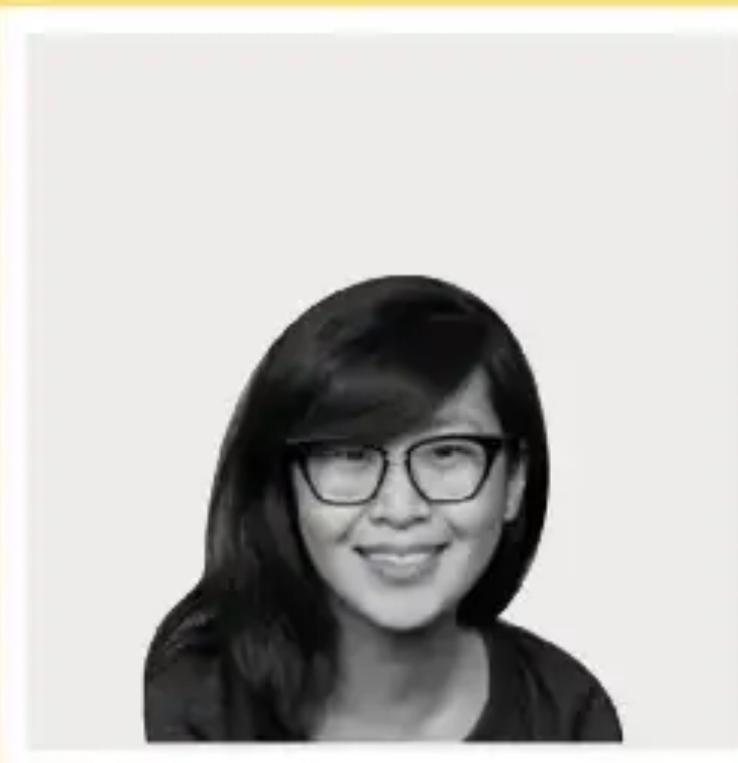
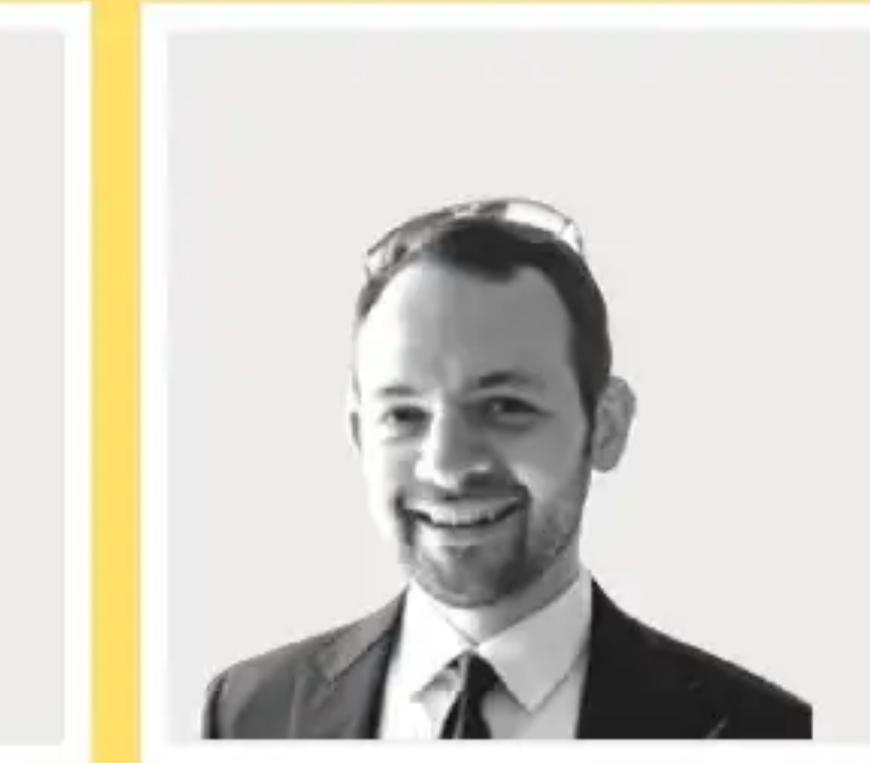
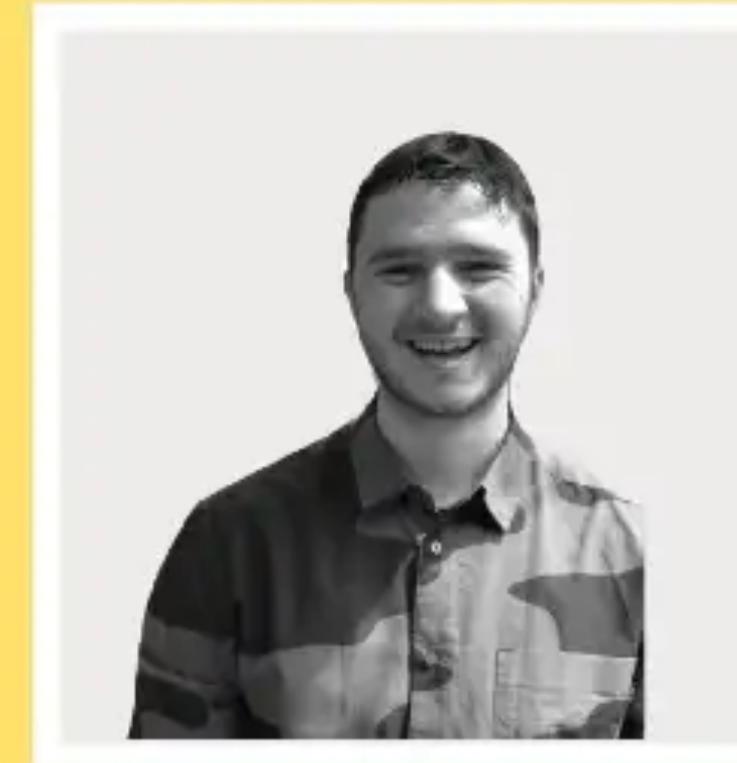
Last Sample Date: January 30, 2023.

*All data are preliminary and subject to revision



BlueDot protects people around the world from infectious diseases with human and artificial intelligence.





**MEET THE ANALYTICS
TEAM!**

ACLU



OCEAN HEALTH INDEX

A healthy ocean sustainably delivers a range of benefits to people now and in the future. The Ocean Health Index is the comprehensive framework used to measure ocean health from global to local scales.

<http://www.oceanhealthindex.org/>

**GLOBAL
ASSESSMENT**

**INDEPENDENT
ASSESSMENTS**



R for better science in less time

Julia Stewart Lowndes, PhD
Marine Data Scientist & Mozilla Fellow
National Center for Ecological Analysis & Synthesis
University of California at Santa Barbara, USA

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 jules32.github.io/useR-2019-keynote

ANNALS OF CRIME NOVEMBER 27, 2017 ISSUE

THE SERIAL-KILLER DETECTOR

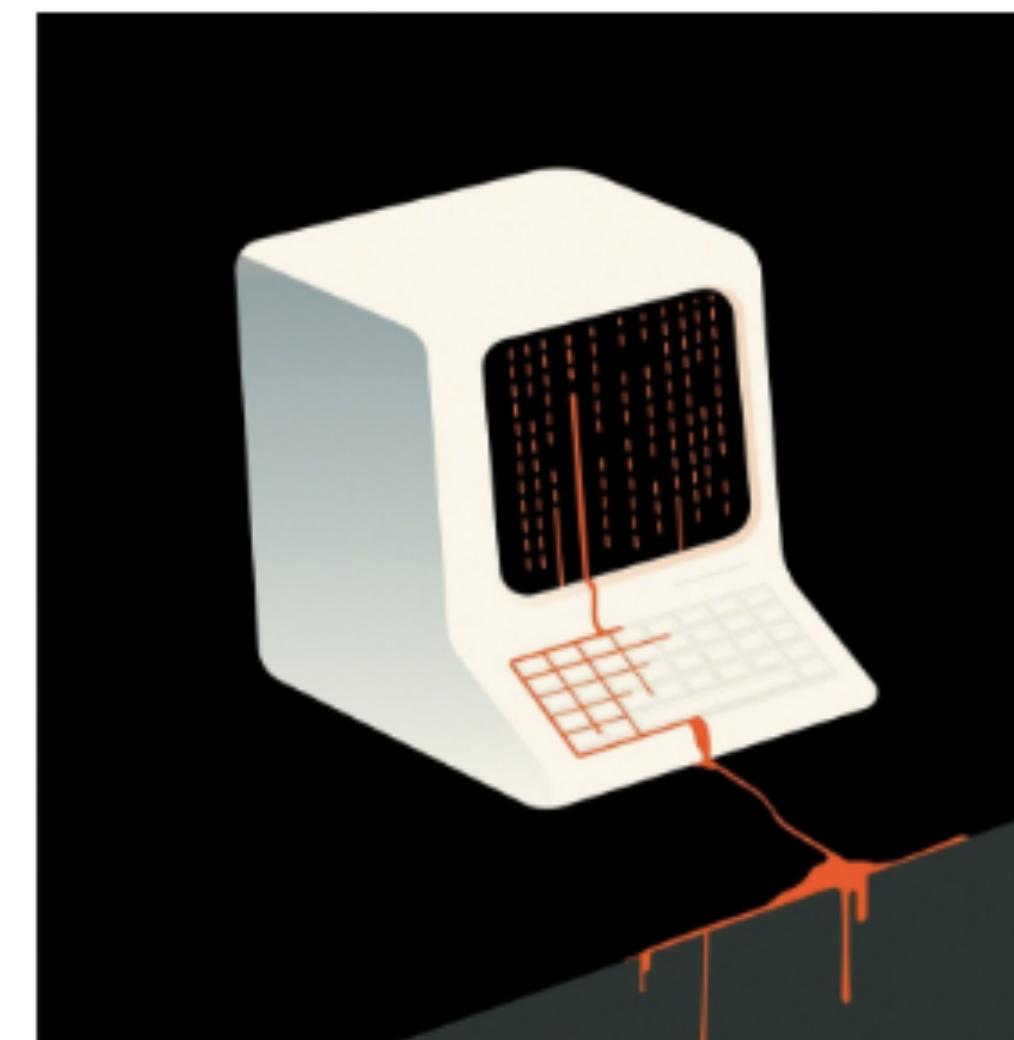
A former journalist, equipped with an algorithm and the largest collection of murder records in the country, finds patterns in crime.



By Alec Wilkinson



Thomas Hargrove is a homicide archivist. For the past seven years, he has been collecting municipal records of murders, and he now has the largest catalogue of killings in the country—751,785 murders carried out since 1976, which is roughly twenty-seven thousand more than appear in F.B.I. files. States are supposed to report murders to the Department of Justice, but some report inaccurately, or fail to report altogether, and Hargrove has sued some of these states to



Hargrove estimates that two thousand serial killers are at large in the U.S.

Illustration by Harry Campbell

PRODUCT MARCH 28, 2018

Detecting Crisis: An AI Solution

by Ankit Gupta, Senior Data Scientist

DATA SCIENCE

TECH

AI

MACHINE LEARNING

SUICIDE PREVENTION

Content warning: This post references words and phrases associated with suicide, in the context of how Crisis Text Line identifies texters at most imminent risk.

Editor's Note: In July 2017, The Cool Calm presented a post on how Crisis Text Line was using machine learning to triage texters by severity. This post follows up on the evolution of that product.



It's mid-evening on December 1, 2017. A post goes viral on Instagram, resulting in record texter volume at Crisis Text Line. Hundreds of volunteer Crisis Counselors pour into the system to respond. An opening message from one texter reads (paraphrased for confidentiality):

"I just took an overdose of Lithium and I'm letting it build up in my system for a few days."

The triaging algorithm flags this message as high-risk for a suicide attempt, and moves it straight to the top of the queue. A Crisis Counselor responds within 20 seconds. Within an hour, the texter has been located by emergency services, and is safe. This is the power of data at scale. Here's how we did it:



$$\log \frac{p}{1-p} = a + X\beta + Zb$$

...

$$\min_a \sum_i \sum_j a_{ij} q_{ij}$$

$$s.t. \quad a_{ij} \in \{0,1\}, \forall i,j$$

$$\sum_j a_{ij} = 1 \quad \forall i$$

$$\sum_i a_{ij} < k_j \quad \forall j$$

...

$$\frac{\partial x}{\partial t} = f(x_t, u_t, w_t)$$

...

$$\begin{aligned} p(i \rightarrow j) \\ = \text{logit}(\beta_0 + \beta_1 x_1 \dots) \end{aligned}$$



Algorithms Tour

How data science is woven into the fabric of Stitch Fix

AND, A SHORT DISTANCE AWAY...

MY FAULT--ALL MY FAULT! IF ONLY I HAD STOPPED HIM WHEN I **COULD** HAVE/ BUT I **DIDN'T**--AND NOW --UNCLE BEN -- IS DEAD...



AND A LEAN, SILENT FIGURE SLOWLY FADES INTO THE GATHERING DARKNESS, AWARE AT LAST THAT IN THIS WORLD, WITH GREAT POWER THERE MUST ALSO COME -- GREAT RESPONSIBILITY!



AND SO A LEGEND IS BORN! AND A NEW NAME IS ADDED TO THE ROSTER OF THOSE WHO MAKE THE WORLD OF FANTASY THE MOST EXCITING REALM OF ALL!



Data science often serves “the three Ss: science (universities), surveillance (governments), and selling (corporations).”

- Data Feminism, D'Ignzaio & Klein

Kroger's 84.51° Labs: Pushing the Boundaries of Data Science



Mike O'Brien

October 11, 2022



In 2015, major grocer Kroger acquired the U.S. assets of its data science partner dunnhumby. Out of that grew **84.51°**, a retail data and analytics unit that encompasses shopper insights, loyalty marketing and retail media advertising.

The unit is credited with helping **Kroger** become an omnichannel powerhouse in a sector that had been lagging others in retail, reaching \$10 billion in digital sales in 2020 and seeing 113% growth since. The output from the group benefits Kroger's CPG brand partners, as well.

ADAM ROGERS BUSINESS 04.02.18 07:00 AM

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HOW GRUBHUB ANALYZED 4,000 DISHES TO PREDICT YOUR NEXT ORDER



JONATHAN KITCHEN/GETTY IMAGES



POLICY ▾ TECH ▾ LABOR ▾

Stitch Fix stylists reportedly quit in droves as the company leans on algorithms to serve customers

The new CEO said recently its stylists “play a very active role” in training machine learning models

By Kim Lyons | [@SocialKimLy](#) | Aug 20, 2021, 11:24am EDT

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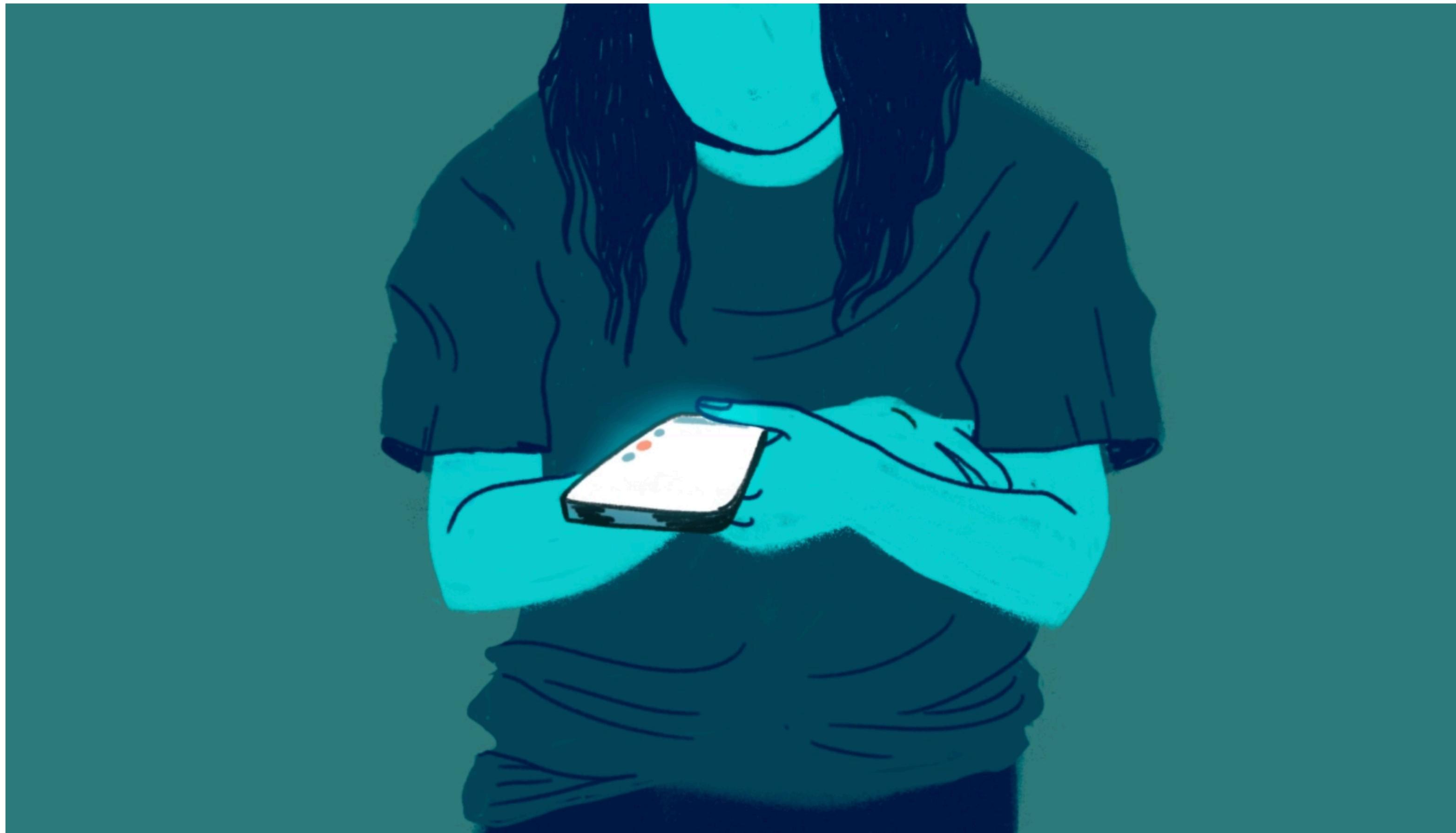
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[Mental Health](#) [Mental Health](#)

Crisis Text Line tried to monetize its users. Can big data ever be ethical?

The crisis intervention service had concerns about its financial future, but made a huge mistake.

By [Rebecca Ruiz](#) on February 3, 2022



Crisis Text Line tried to make a business out of user data. It went terribly wrong. Credit: Vicky Leta / Mashable



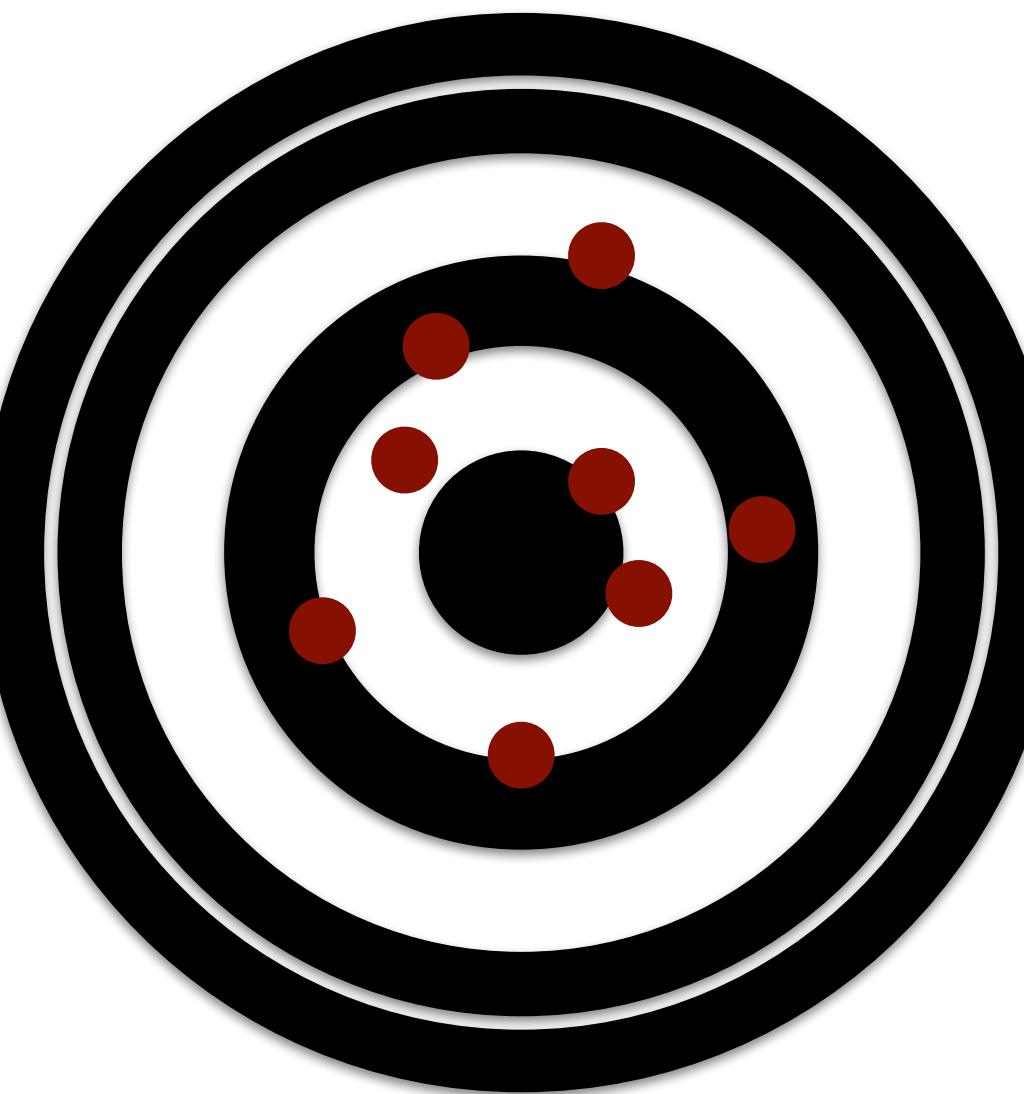
We want to ensure
algorithms are fair

Low bias

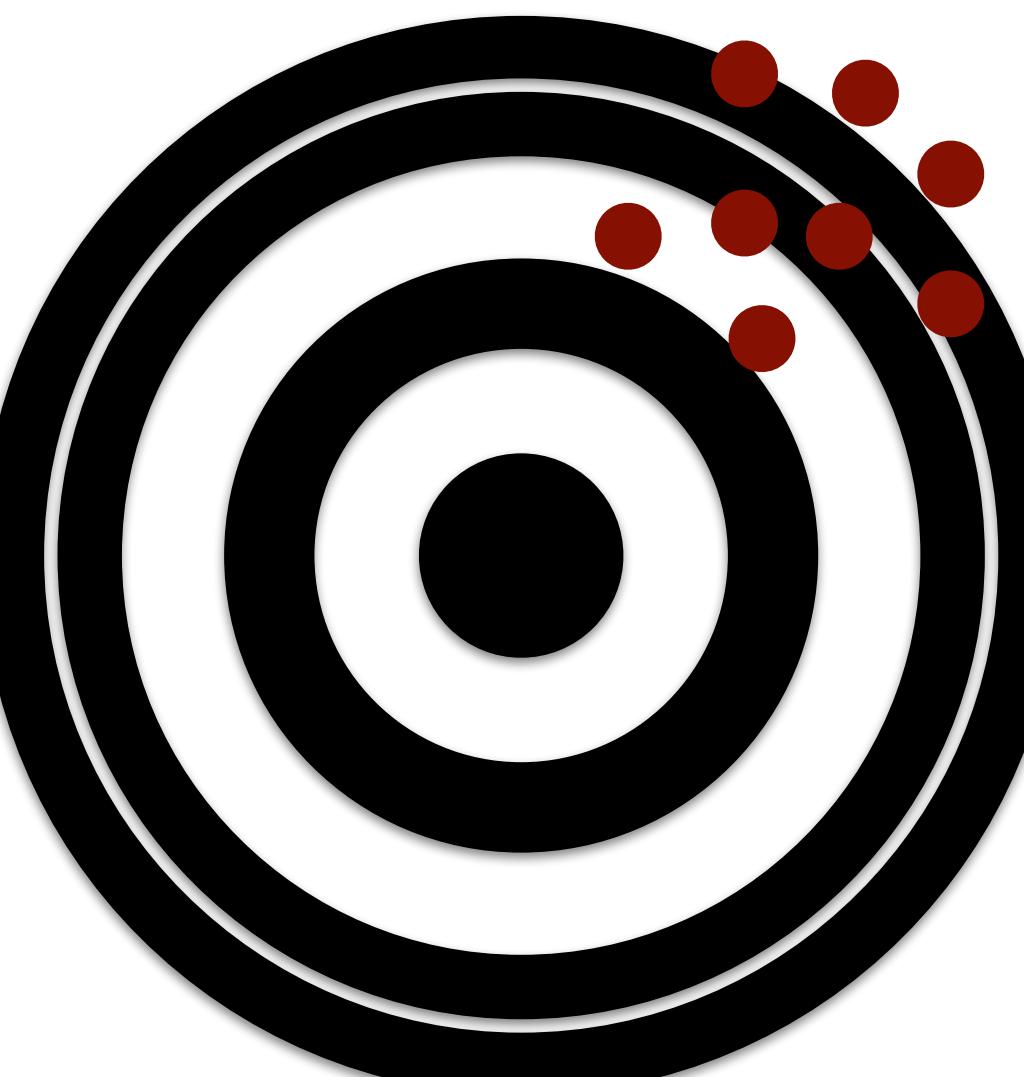
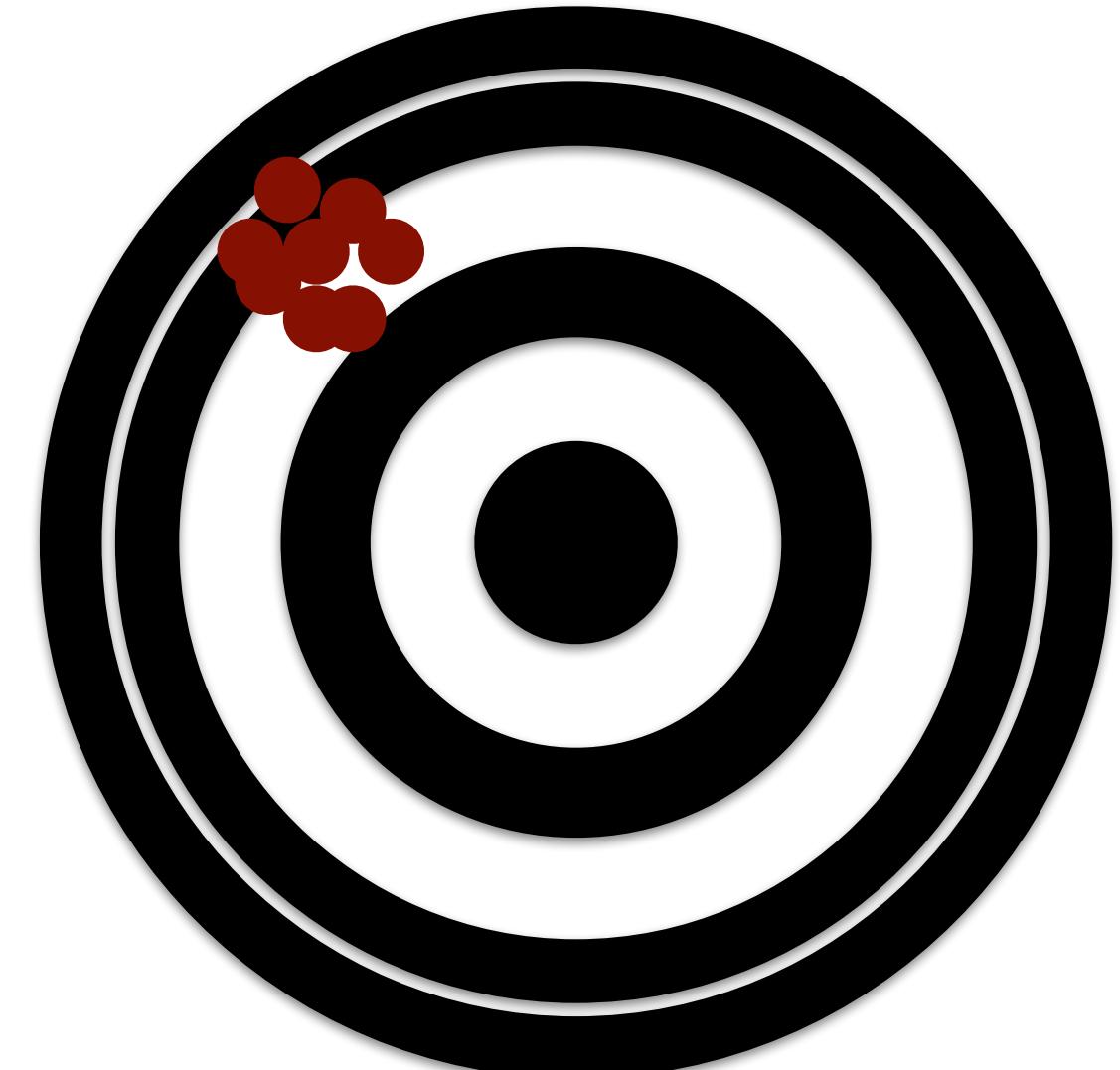
Low variance



High variance



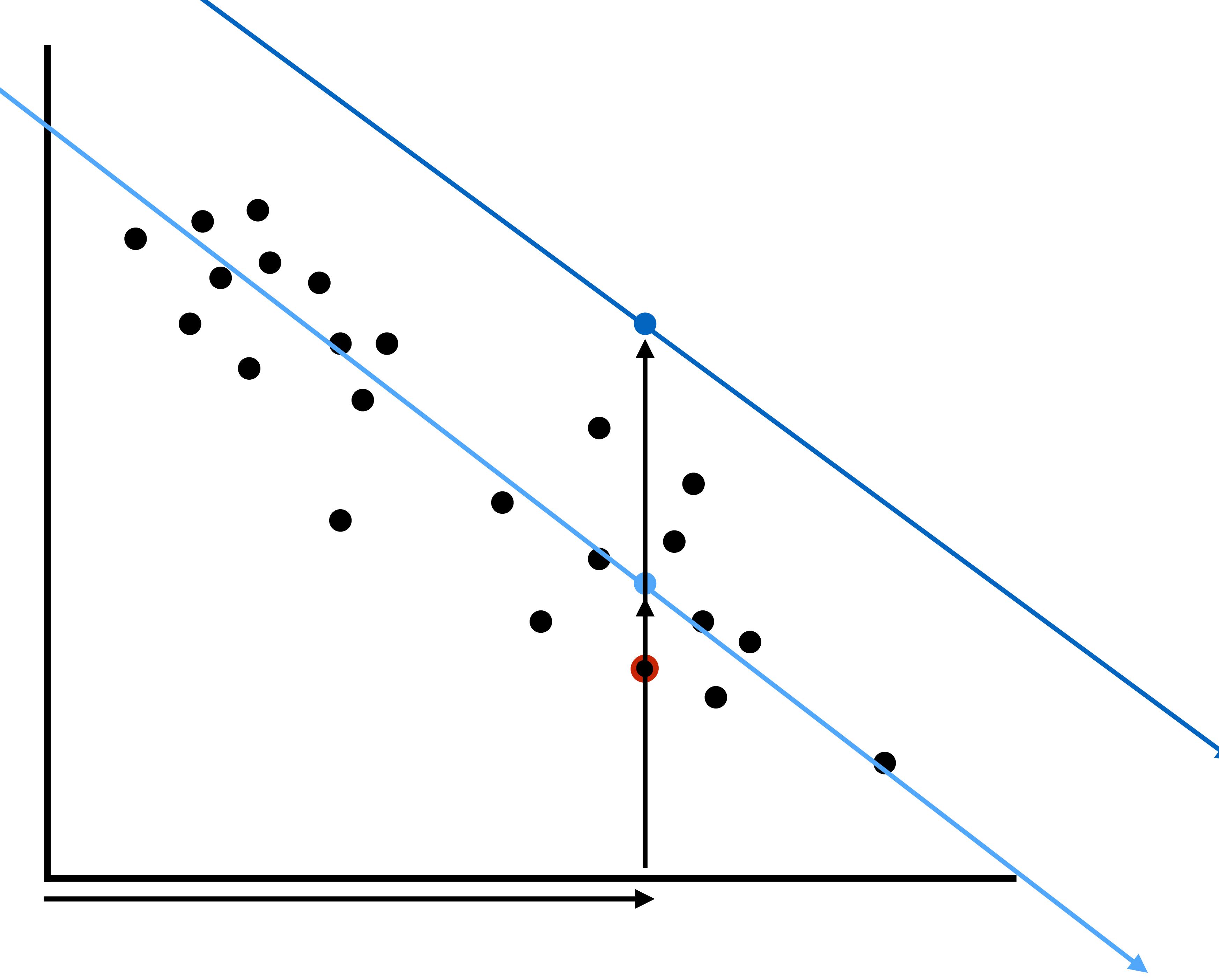
High bias



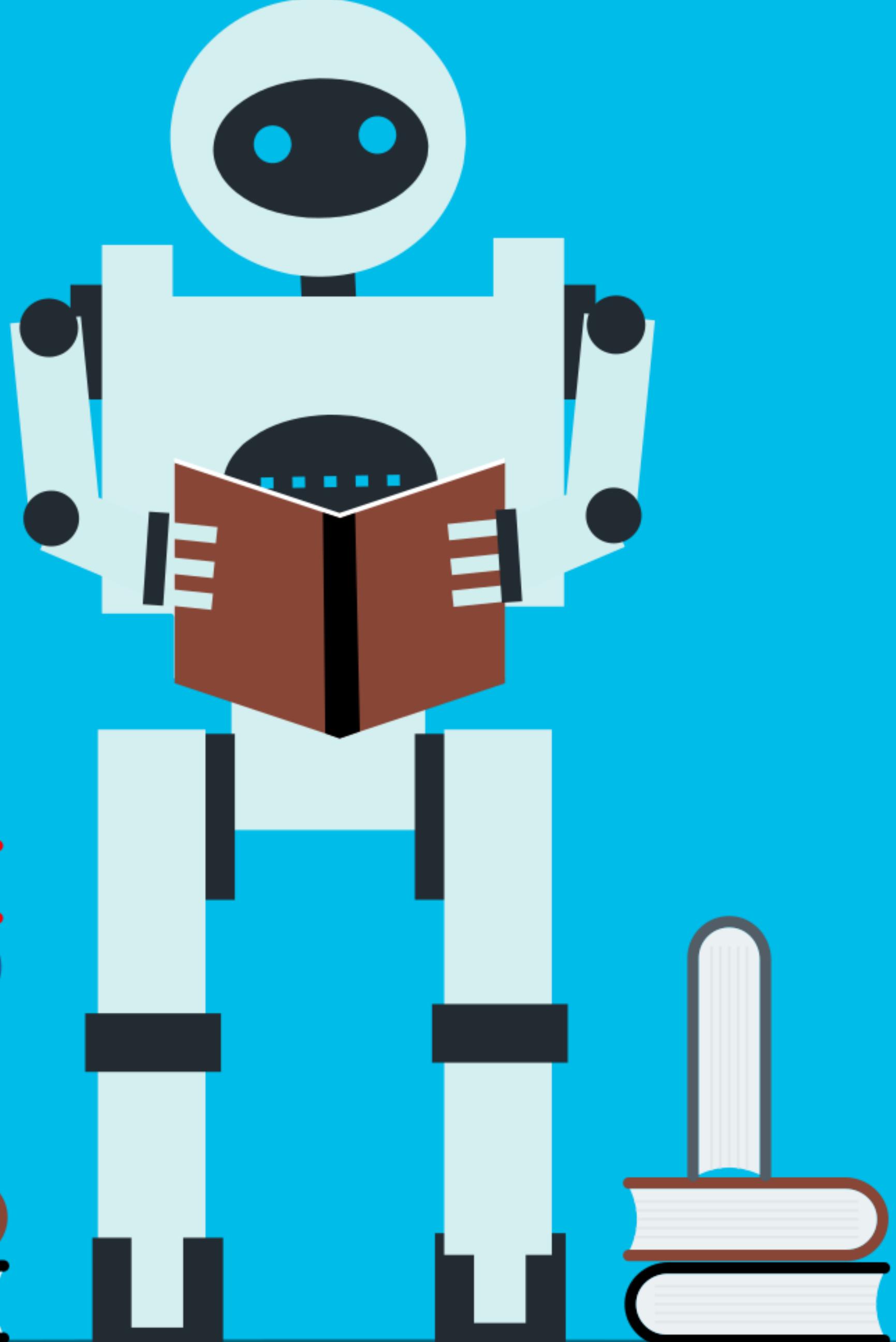
bias noun

Definition of *bias*

1.
 - a.
 - b.
 - c.
 - d. (1): deviation of the expected value of a statistical estimate from the quantity it estimates



Bias can be
worse for one
group than
another



bias noun

Definition of *bias*

1.
 - a. an inclination of temperament or outlook
especially: a personal and sometimes unreasoned judgment: prejudice
 - b. an instance of such prejudice

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MACHINE BIAS

Facebook Lets Advertisers Exclude Users by Race



Facebook's system allows advertisers to exclude black, Hispanic, and other "ethnic affinities" from seeing ads.

by Julia Angwin and Terry Parris Jr., Oct. 28, 2016, 1 p.m. EDT

Oct. 28, 2016



MACHINE BIAS

Facebook (Still) Letting Housing Advertisers Exclude Users by Race



After ProPublica revealed last year that Facebook advertisers could target housing ads to whites only, the company announced it had built a system to spot and reject discriminatory ads. We retested and found major omissions.

by Julia Angwin, Ariana Tobin and Madeleine Varner, Nov. 21, 2017, 1:23 p.m. EST

Nov. 21, 2017



Facebook CEO Mark Zuckerberg speaks in San Jose, California, in October 2016. (David Paul Morris/Bloomberg via Getty Images)



Technology

Facebook Finally Agrees to Eliminate Tool That Enabled Discriminatory Advertising

Six years after ProPublica revealed that Facebook allowed advertisers to exclude Black users and others, the company agreed to a settlement with the Justice Department to overhaul its ad algorithm system.

June 22, 2022

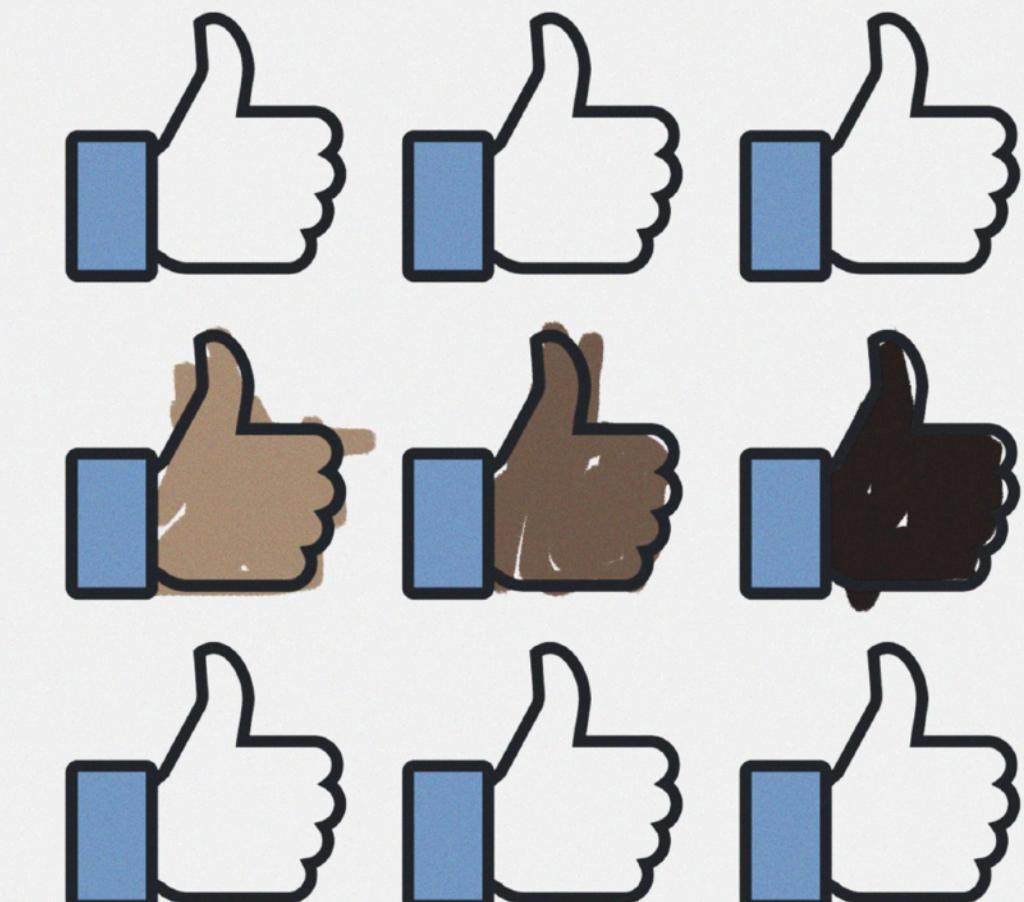


Illustration by ProPublica

by Ariana Tobin and Ava Kofman

June 22, 2022, 4:30 p.m. EDT

**MACHINE BIAS**

Dozens of Companies Are Using Facebook to Exclude Older Workers From Job Ads



Among the companies we found doing it: Amazon, Verizon, UPS and Facebook itself. “It’s blatantly unlawful,” said one employment law expert.

by Julia Angwin, ProPublica, Noam Scheiber, The New York Times, and Ariana Tobin, ProPublica, Dec. 20, 2017, 5:45 p.m. EST



Mark Edelstein, a social media marketing strategist who is also legally blind, says he never had serious trouble finding a job until he turned 50. (Whitney Curtis for The New York Times)

Amazon reportedly scraps internal AI recruiting tool that was biased against women

21 ▾

The secret program penalized applications that contained the word “women’s”

By James Vincent | Oct 10, 2018, 7:09am EDT

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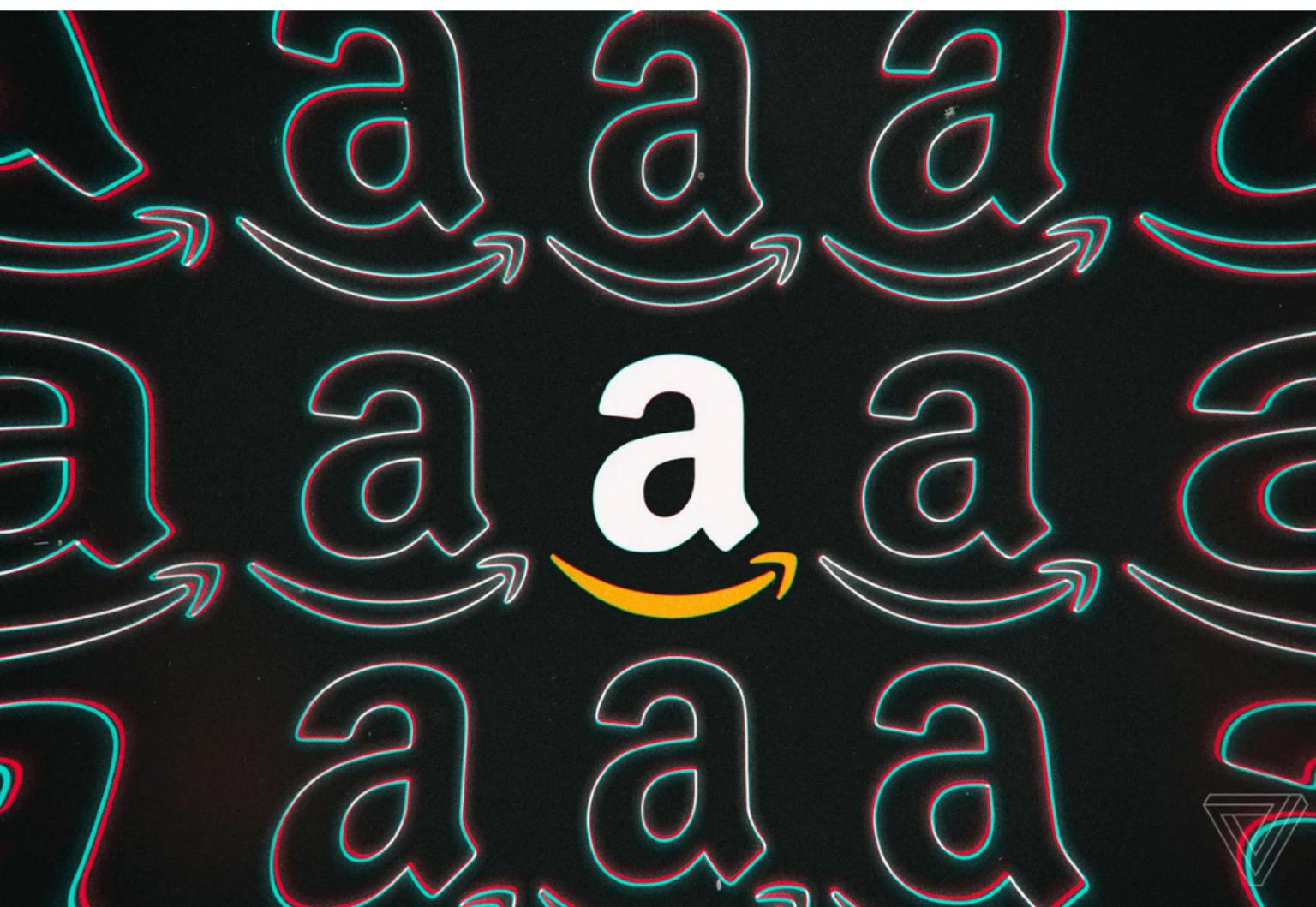


Illustration by Alex Castro / The Verge



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Because AI systems learn to make decisions by looking at historical data they often perpetuate existing biases. In this case, that bias was the male-dominated working environment of the tech world. According to *Reuters*, Amazon's program penalized applicants who attended all-women's colleges, as well as any resumes that contained the word "women's" (as might appear in the phrase "women's chess club").

IMAGE: GETTY IMAGES / COMPOSITION: JASON KOEBLER**MOTHERBOARD**
TECH BY VICE

Students Are Rebell ing Against Eye-Tracking Exam Surveillance Tools

Invasive test-taking software has become mandatory in many places, and some companies are retaliating against those who speak out.

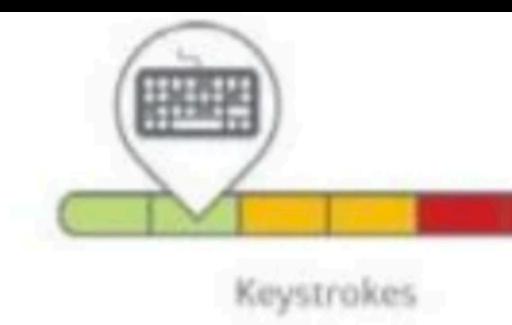


By Todd Feathers

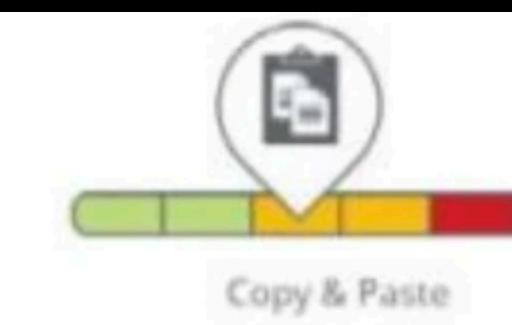
By Janus Rose
NEW YORK, US



Navigating Away



Keystrokes



Copy & Paste

Suspicion Levels

Proctorio is intended to be used to uphold academic integrity by discouraging cheating. However, some incidents will still occur. When these do happen, Proctorio makes the identification of these cases as simple as possible. One way is through the suspicion level. The suspicion level is a percentage that represents low, medium, or high suspicion for an individual's exam attempt.

The suspicion level is a quick calculation based on the aggregation of frames (captured activity) during the exam that were deemed suspicious and the detection of abnormal (deviation from the class norm) behaviour. If the suspicion level shows a large percentage, then this is an exam attempt that should be considered for further review.

The suspicion level will increase or decrease depending on how heavily each **Behaviour Setting** is weighted and which abnormalities are enabled.

A SLIDE FROM PROCTORIO'S TRAINING MATERIALS, DETAILING HOW THE SYSTEM MEASURES "SUSPICION LEVELS" WHILE STUDENTS TAKE EXAMS.

Students' and educators' objections to exam proctoring software go beyond the privacy concerns around being watched and listened to in their bedrooms while they take a test. As more evidence emerges about how the programs work, and fail to work, critics say the tools are bound to hurt low-income students, students with disabilities, students with children or other



Bernard Parker, left, was rated high risk; Dylan Fugett was rated low risk. (Josh Ritchie for ProPublica)

Machine Bias

There's software used across the country to predict future criminals. And it's biased against blacks.

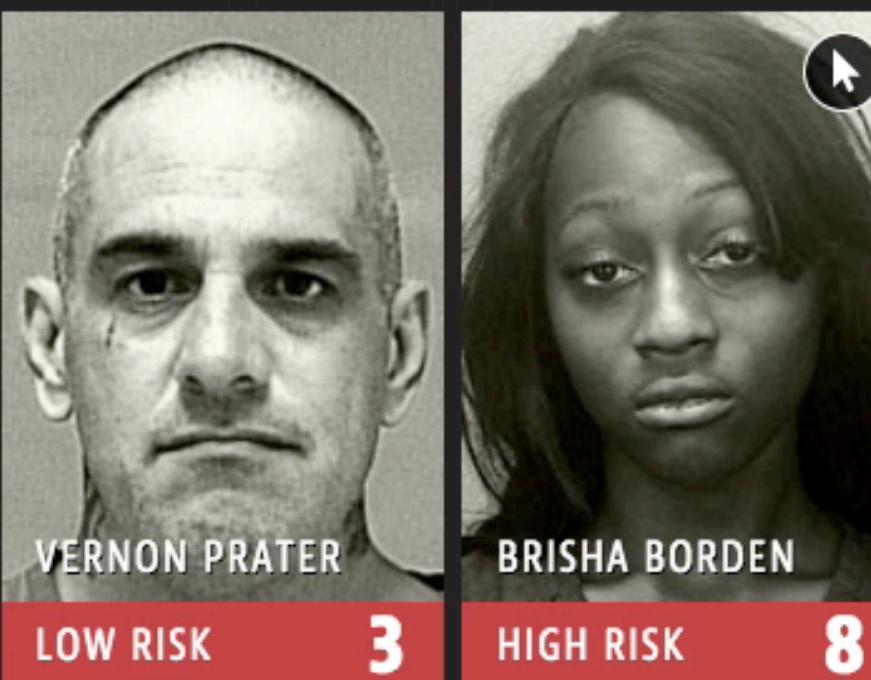
by Julia Angwin, Jeff Larson, Surya Mattu and Lauren Kirchner, ProPublica

May 23, 2016

Arizona, Colorado, Delaware, Kentucky, Louisiana, Oklahoma, Virginia, Washington and Wisconsin, the results of such assessments are given to judges during criminal sentencing.

Rating a defendant's risk of future crime is often done in conjunction with an evaluation of a defendant's rehabilitation needs. The Justice Department's National Institute of Corrections now encourages the use of such combined assessments at every stage of the criminal justice process. And a landmark sentencing [reform bill](#) currently pending in Congress would mandate the use of such assessments in federal prisons.

Two Petty Theft Arrests



Borden was rated high risk for future crime after she and a friend took a kid's bike and scooter that were sitting outside. She did not reoffend.

hidden effect of algorithms in American life.

We obtained the risk scores assigned to more than 7,000 people arrested in Broward County, Florida, in 2013 and 2014 and checked to see how many were charged with new crimes over the next two years, the [same benchmark used](#) by the creators of the algorithm.

The score proved remarkably unreliable in forecasting violent crime: Only 20 percent of the people predicted to commit violent crimes actually went on to do so.

When a full range of crimes were taken into account — including misdemeanors such as driving with an expired license — the algorithm was somewhat more accurate than a coin flip. Of those deemed likely to re-offend, 61 percent were arrested for any subsequent crimes within two years.

We also turned up significant racial disparities, just as Holder feared. In forecasting who would re-offend, the algorithm made mistakes with black and white defendants at roughly the same rate but in very different ways.

In 2014, then U.S. Attorney General Eric Holder warned that the risk scores might be injecting bias into the courts. He called for the U.S. Sentencing Commission to study their use. "Although these measures were crafted with the best of intentions, I am concerned that they inadvertently undermine our efforts to ensure individualized and equal justice," he said, adding, "they may exacerbate unwarranted and unjust disparities that are already far too common in our criminal justice system and in our society."

The sentencing commission did not, however, launch a study of risk scores. So ProPublica did, as part of a larger examination of the powerful, largely



- keep your eyes open to ways that data and algorithms are being used to perpetuate inequity
- talk to your representatives about legislation for algorithmic transparency and fairness
- look for the helpers

Dr. Latanya Sweeney



Comparing

DATA PRIVACY LAB

SSN Social Security Number

Matching a Person to a SSN

Using publicly available information about this person's background, the Data Privacy Server identifies the issuing state, date issued, and expiration date of an SSN.

Sample uses:

- Job Applications
- Apartment Rentals
- Insurance Claims
- Student Applications

Enter the SSN and select the state of issue of the SSN. Enter the date issued and expiration date of the SSN.

SSN and state of issue of the SSN
Enter the date issued and expiration date of the SSN.

Results for SSN 078-38-

Geography	New York
Date of issuance	Received 10/05/1995
Year of birth	1970 (born 1968 to 1990)
Digit profile	005,000,350,00,350

If the person presenting the SSN fails to list or acknowledge New York as a prior residence, then it is extremely unlikely that the provided SSN was issued to that person.

Results for SSN

Geography

Date of issuance

Dr. Jake Porway



Tawana Petty



Data for Black Lives is a movement of activists, organizers, and mathematicians committed to the mission of using data science to create concrete and measurable change in the lives of Black people. Since the advent of computing, big data and algorithms have penetrated virtually every aspect of our social and economic lives. These new data systems have tremendous potential to empower communities of color. Tools like statistical modeling, data visualization, and crowd-sourcing, in the right hands, are powerful instruments for fighting bias, building progressive movements, and promoting civic engagement.

But history tells a different story, one in which data is too often wielded as an instrument of oppression, reinforcing inequality and perpetuating injustice. Redlining was a data-driven enterprise that resulted in the systematic exclusion of Black communities from key financial services. More recent trends like predictive policing, risk-based sentencing, and predatory lending are troubling variations on the same theme. Today, discrimination is a high-tech enterprise.

The Team



Founder &
Executive
Director



Co-Founder



Director of
Research

Jamelle Watson-
Daniels



National
Organizing
Director

Tawana Petty



Director of
Policy
Innovation

Akina (Aki) Younge



Research
Associate

Paul Watkins



Research
Associate

Linda Denson

Dr. Joy Buolamwini





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RACIAL JUSTICE REQUIRES ALGORITHMIC JUSTICE. SUPPORT THE MOVEMENT.



Dr. Stephanie Russo Carroll





GIDA
Global Indigenous
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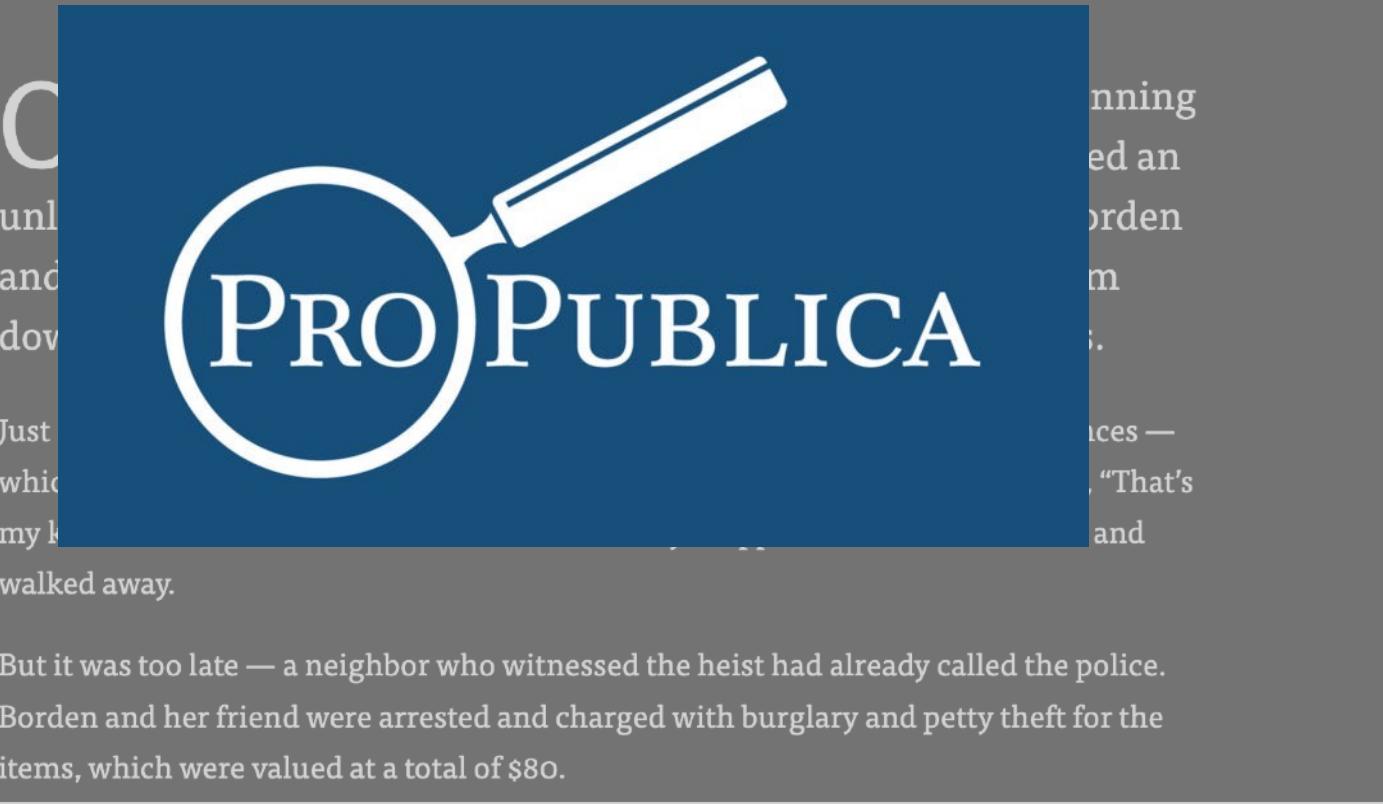
Journalists can be
data science
superheroes

Machine Bias

There's software used across the country to predict future criminals. And it's biased against blacks.

by Julia Angwin, Jeff Larson, Surya Mattu and Lauren Kirchner, ProPublica

May 23, 2016



But it was too late — a neighbor who witnessed the heist had already called the police. Borden and her friend were arrested and charged with burglary and petty theft for the items, which were valued at a total of \$80.

How a Wealthy Cleveland Suburb Profits From Ticketing Black Drivers

Black Clevelanders say Bratenahl police have targeted them for years.



BUSINESS

Regulators probe racial bias with UnitedHealth algorithm

Regulators say racial bias in algorithm leads to poorer care for black patients; UnitedHealth defends product.

By Christopher Snowbeck Star Tribune | OCTOBER 28, 2019 — 6:59PM



New York regulators said the research showed an Optum data analytics program "significantly underestimates health needs for black patients."

THE VERGE



THE VERGE

Illustration by Alex Castro / The Verge



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Students Are Rebelling Against Eye-Tracking Exam Surveillance Tools

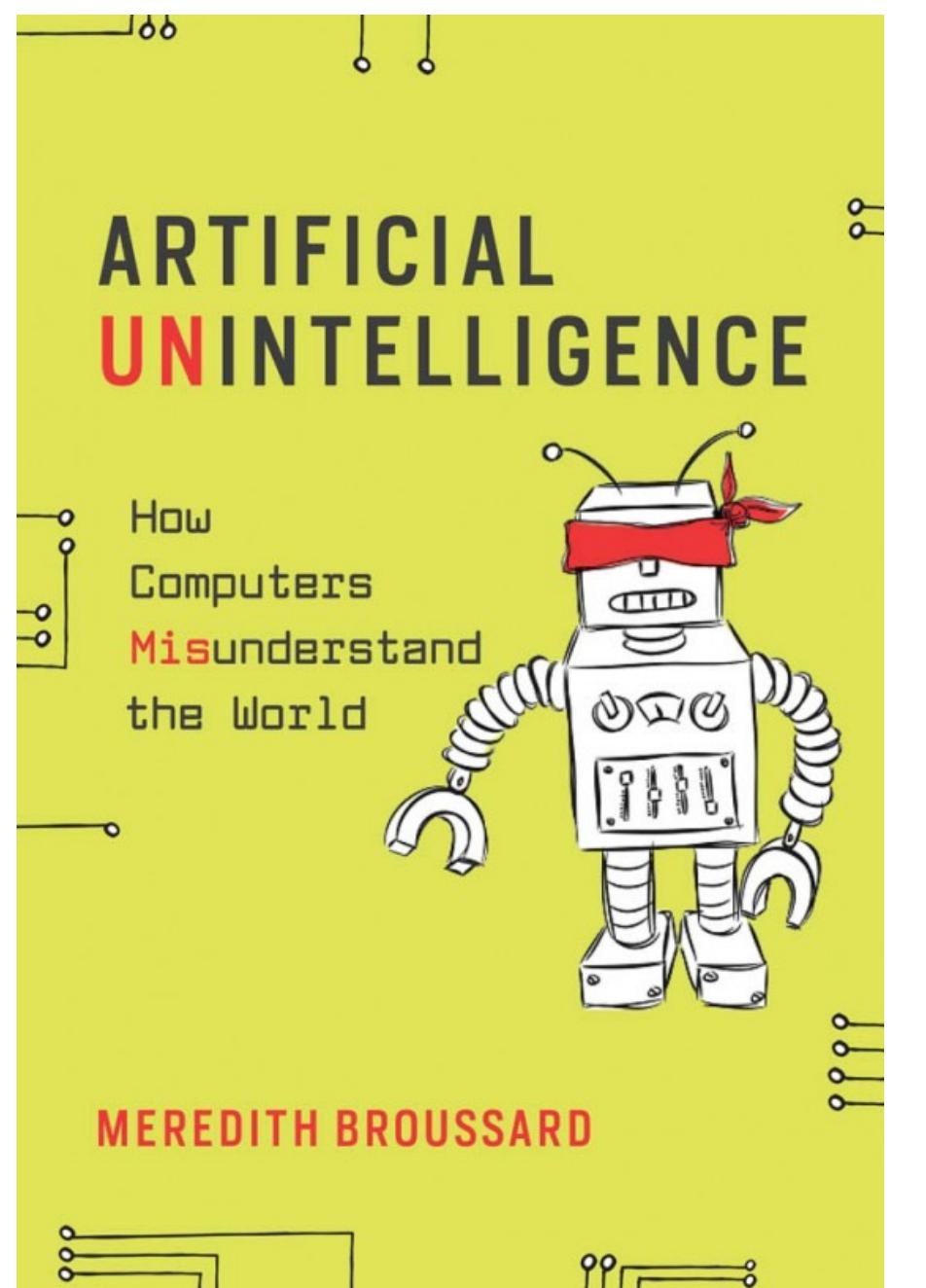
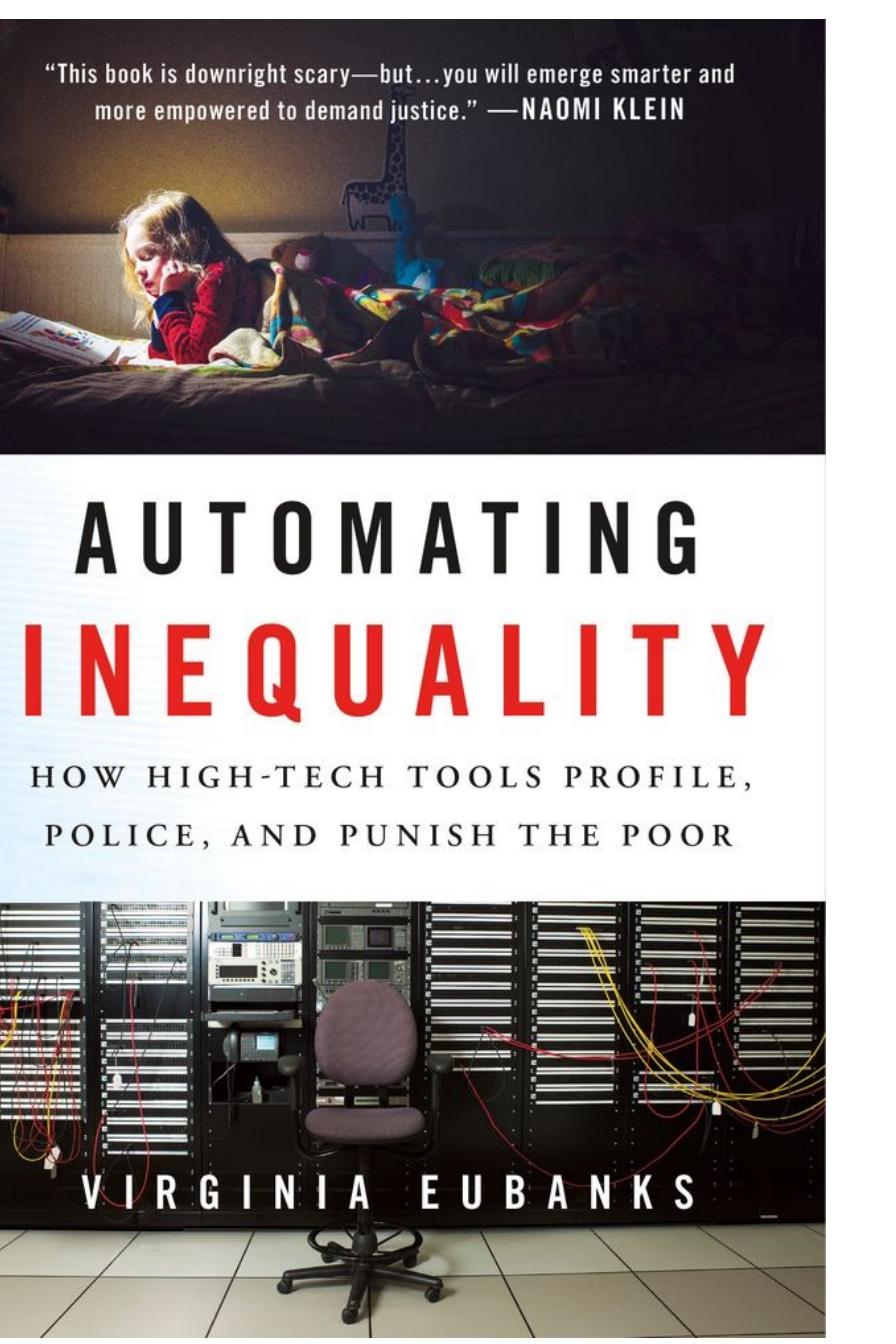
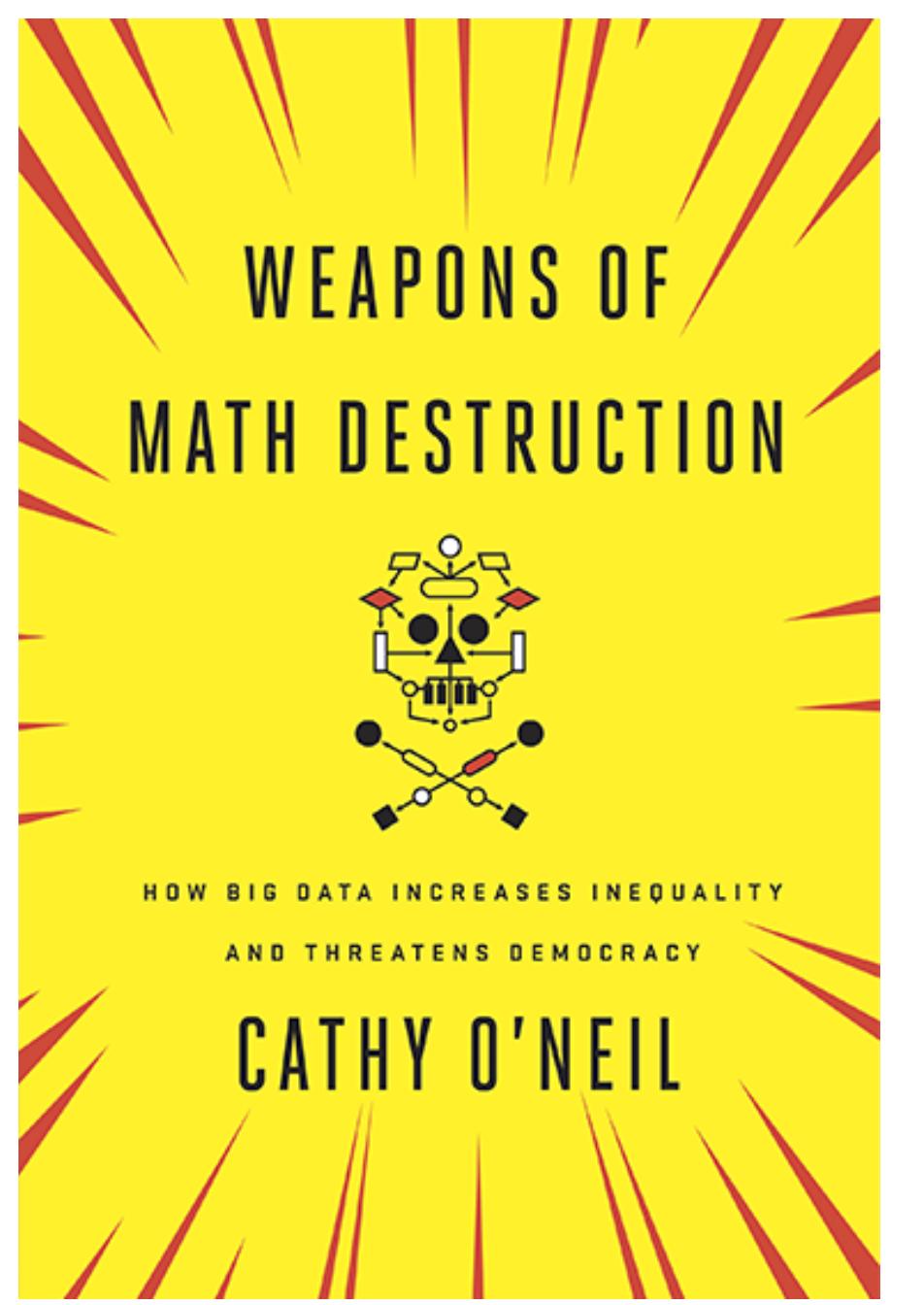
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By Todd Feathers

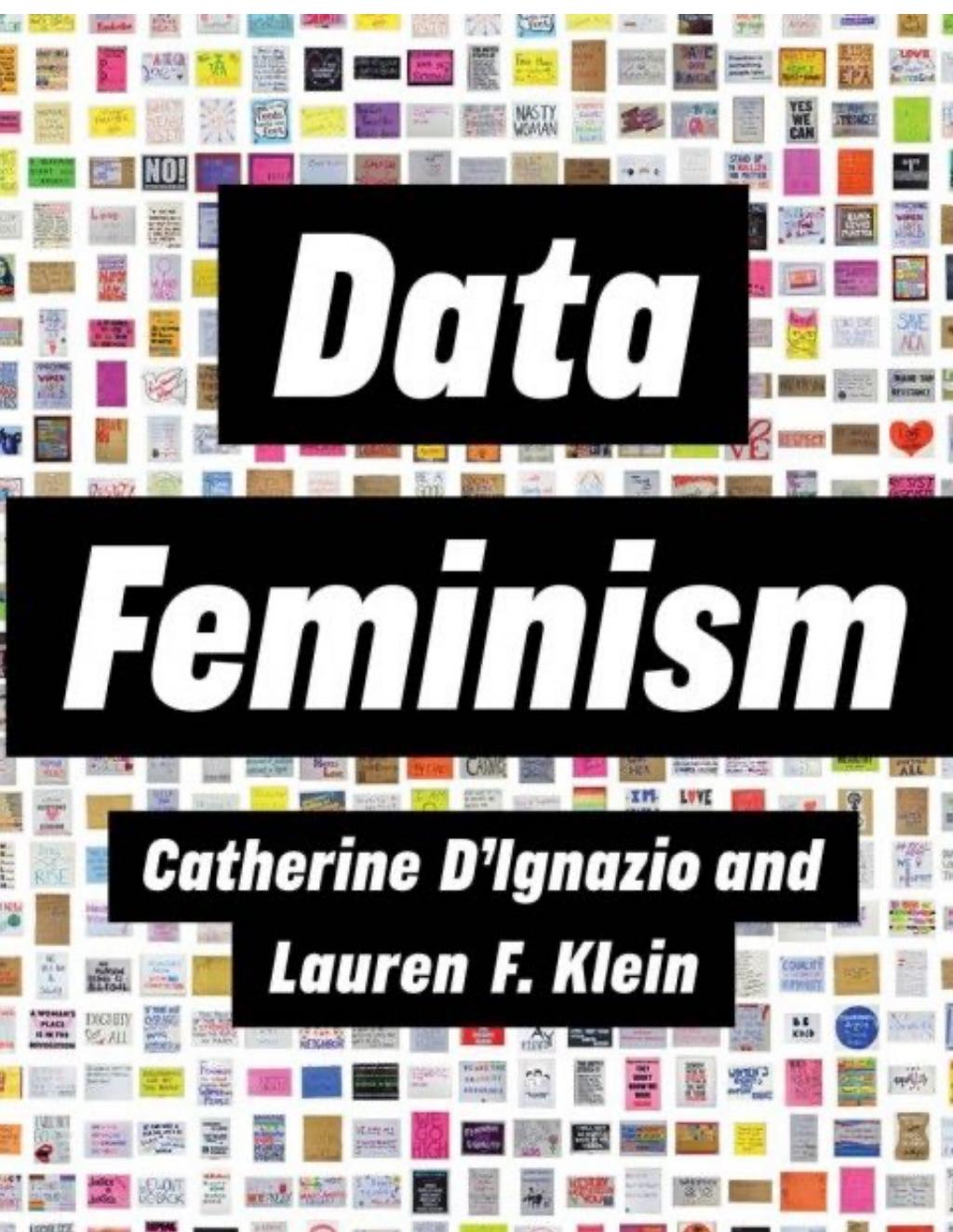
By Janus Rose
NEW YORK, US

A photograph of two Iron Man action figures. On the left, Tony Stark in his red and gold suit is shown from the waist up, looking off to the side with his right hand near his head. On the right, Iron Spider is shown from the waist up, also looking off to the side with one hand raised. They appear to be positioned on a dark, textured surface. The background is a warm, out-of-focus yellow and orange.

Students and
Teachers can be
data science
superheroes



Read



THE LINUX FOUNDATION PROJECTS

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Data Feminism

Catherine D'Ignazio and Lauren F. Klein

Data Values and Principles

VALUES

PRINCIPLES

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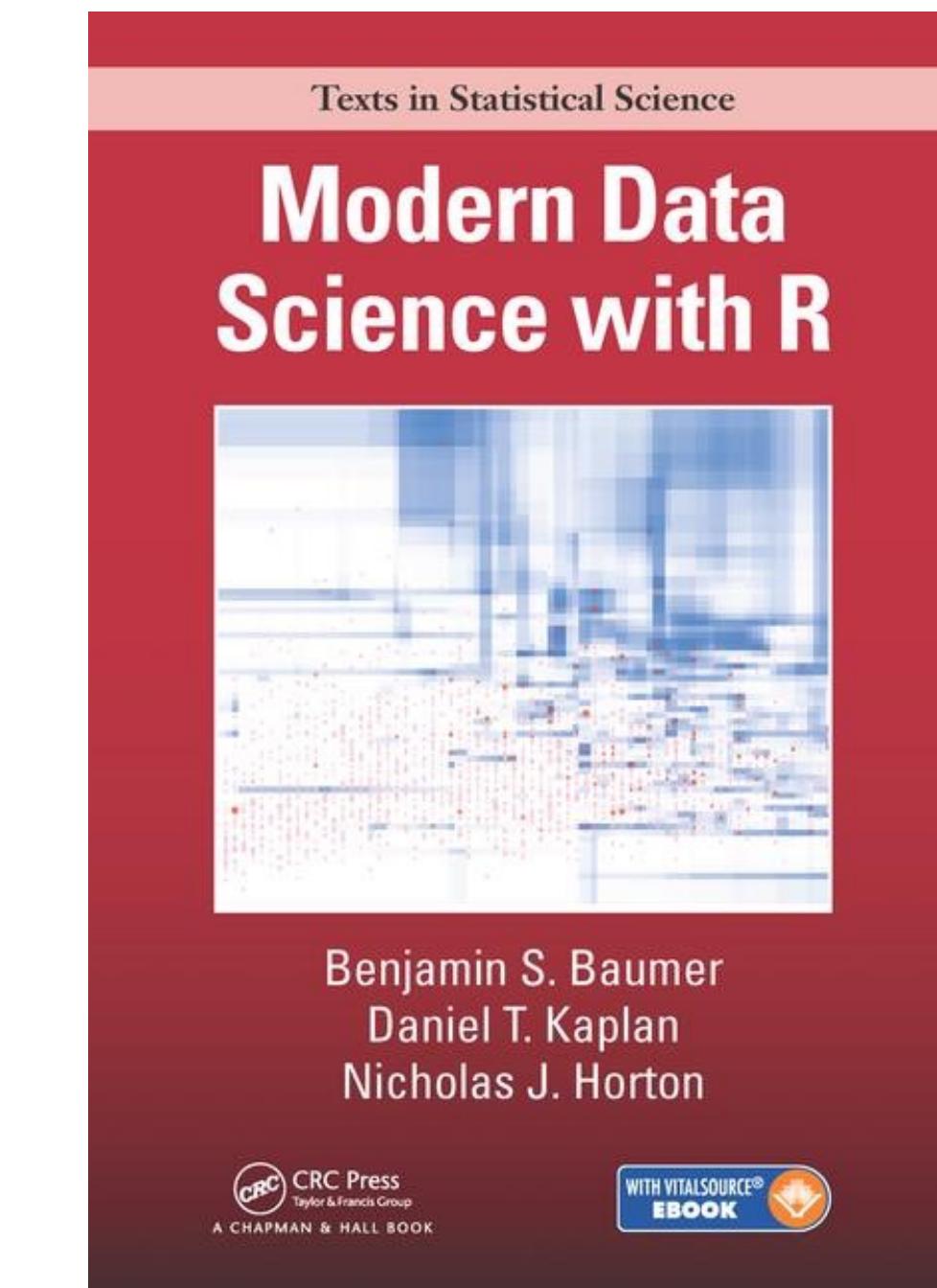
We believe these values and principles, taken together, describe the most effective, ethical, and modern approach to data teamwork.

Inclusion
Maximize diversity, connectivity, and accessibility among data projects, collaborators, and outputs.

Experimentation
Emphasize continuously iterative testing and data analysis.

Accountability
Behave ethically and transparently, fix mistakes quickly, and hold ourselves and others accountable.

Impact
Prioritize projects with well-defined goals, and design them to achieve measurable, substantive outcomes.



Watch

Bias Remediation



Listen

A Spotify episode page for 'Reply All' episode #127. The title is 'The Crime Machine, Part I'. It was released on October 12, 2018. The episode art features a red-toned mountain landscape. A 'LISTEN NOW' button with a play icon and a 'LISTEN ON Spotify' button are present. The Spotify logo and 'A SPOTIFY ORIGINAL' text are visible.

Freakonomics Radio episode page for Episode 42, titled 'America's Math Curriculum Doesn't Add Up'. The episode was produced by Morgan Levey and originally broadcast on Freakonomics Radio. The host is Steven D. Levitt. The episode art is orange with the title 'PEOPLE I ADMIRE (MOSTLY)' and a silhouette of two people. A 'FOLLOW THIS SHOW' button is present. The episode summary describes Steve's passion for modernizing high-school math education. A playback bar shows the episode is 43:43 long, starting at 00:00. The date of the post is Aug 27, 2021.

Not So Standard Deviations episode page featuring guests Roger Peng and Hilary Parker. The title of the show is 'NOT SO STANDARD DEVIATIONS'. The hosts are shown in a stylized illustration. The background is dark with a pink-to-black gradient and blue circular patterns.



- keep your eyes open to ways that data and algorithms are being used to perpetuate inequity
- talk to your representatives about legislation for algorithmic transparency and fairness
- look for the helpers



Thank you

