Course Reminders

Due Sunday (11:59 PM)

- D3
- Q4
- A2
- Previous Project Review
- Weekly Project Survey (*optional; discuss*)

Notes:

- Discuss project proposal: https://github.com/COGS108/Projects/blob/wi24/FinalProject_Guidelines.md#project-proposal
- `04_07_dataviz_updated` has the updated notes

Final Project Check in

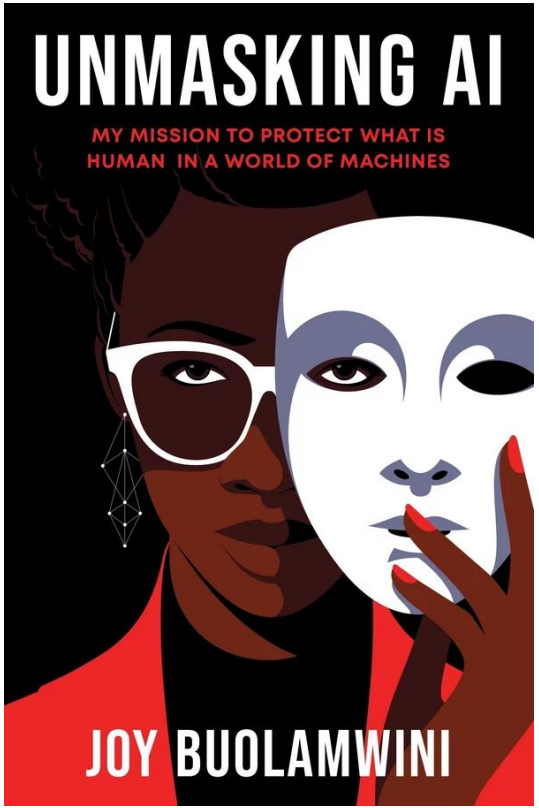
I know what topic I want to work on for the final project...

A	B	C	D	E
Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree

February Fridays: Who you should know

Joy Buolamwini

- Computer Scientist and Digital Activist | MIT Media Lab
- Founder | American Justice League
- Initially inspired to enter the field when a face detection algorithm did not detect her face in graduate school (at MIT)...but did when she put on a white mask
- Driven by "*who has the power to shape technology and whose preferences and priorities are baked in — as well as also, sometimes, whose prejudices are baked in.*" - NPR Fresh Air Episode [link]



Ethics & Analysis

Shannon E. Ellis, Ph.D
UC San Diego

Department of Cognitive Science
sellis@ucsd.edu

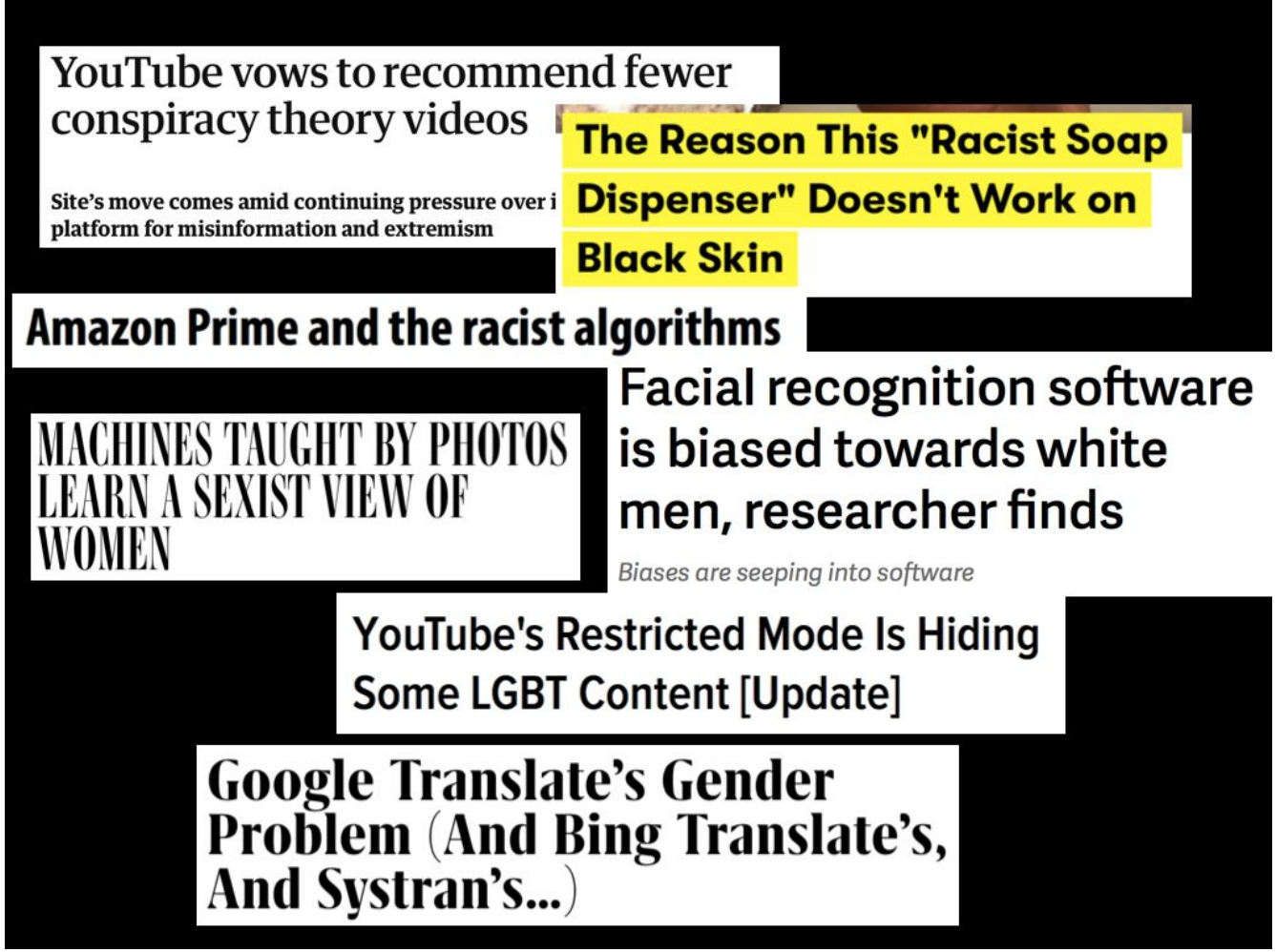
Data Science Ethics

When working on a data science project, data privacy is the primary ethical concern.

A	B	C	D	E
Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree

"Big data and analytics technology can reap huge benefits to both individuals and organizations – bringing personalized service, detection of fraud and abuse, efficient use of resources and prevention of failure or accident. So **why are there questions being raised about the ethics [of data science]**?"

Source: IBM


YouTube vows to recommend fewer conspiracy theory videos
Site's move comes amid continuing pressure over i
platform for misinformation and extremism
The Reason This "Racist Soap Dispenser" Doesn't Work on Black Skin
Amazon Prime and the racist algorithms
MACHINES TAUGHT BY PHOTOS LEARN A SEXIST VIEW OF WOMEN
Facial recognition software is biased towards white men, researcher finds
Biases are seeping into software
YouTube's Restricted Mode Is Hiding Some LGBT Content [Update]
Google Translate's Gender Problem (And Bing Translate's, And Systran's...)

A whole bunch of examples from the last decade...

- Ashley Madison Hack [link]
- OKCupid Data Published [link]
- Equifax Hack [link]
- Google & Pentagon Team Up on Drones [link]
- Cambridge Analytica Data Breach To Influence US Elections [link]
- Amazon and Police Team Up on Facial Recognition & Surveillance [link]
- Amazon scraps secret AI recruiting tool biased against women [link]
- Study of bias in AI [link]
- Pasco County Algorithmic Bias [link]
- Ethical issues (misogyny, racism) in large available dataset [link]
- Florida COVID-19 dashboard data scientist debacle [link]
- Banjo surveillance via fake apps [link]
- Google fires AI ethics founder [link] & Timnit Gebru's firing [link]
- Racist dataset -> racist AI [link]

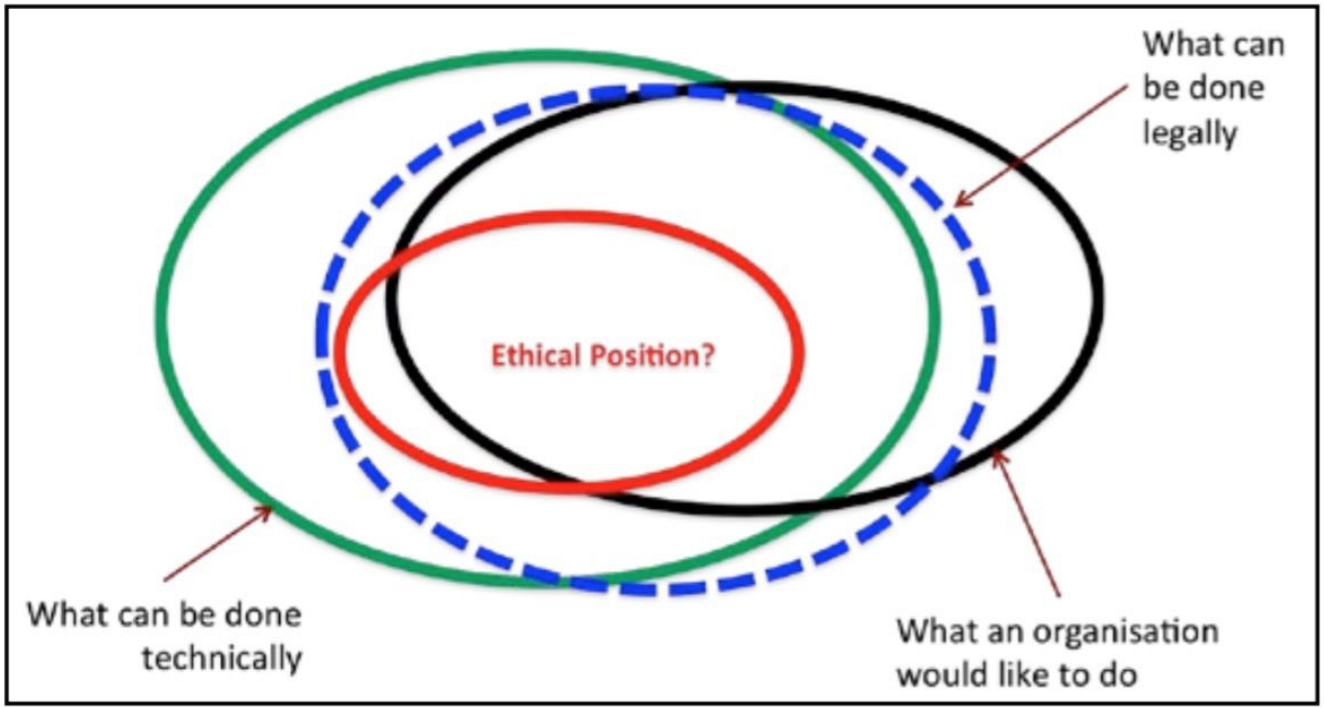
Always consider ethics.

ETHICS

“Moral principles that govern a person's behaviour or the conducting of an activity.”

Source: Oxford Dictionary

Big Data Ethics



Source: IBM

adapted from Brad Voytek

Ethical Data Science

Data science pursued in a manner so that is equitable, with respect for privacy and consent, so as to ensure that it does not cause undue harm.

On INTENT and OBJECTIVITY

- Intent is not required for harmful practices to occur
- Data, algorithms and analysis are not objective.
  - It is done by people, who have biases
  - It uses data, which have biases
- Data Science is powerful
- Bias & discrimination driven by data & algorithms can give new scale to pre-existing inequities

NINE THINGS TO CONSIDER TO NOT RUIN PEOPLE'S LIVES WITH DATA SCIENCE

1. THE QUESTION
2. THE IMPLICATIONS
3. THE DATA
4. INFORMED CONSENT
5. PRIVACY
6. EVALUATION
7. ANALYSIS
8. TRANSPARENCY & APPEAL
9. CONTINUOUS MONITORING

NINE THINGS TO CONSIDER TO NOT RUIN PEOPLE'S LIVES WITH DATA SCIENCE

adapted from Thomas Donoghue

1. THE QUESTION

- What is your question? Is it well-posed?
- Do you know something about the context and background of your question?
- What is the scope your investigation? What correlates might you inadvertently track? Is it possible to answer this question well?

Media file

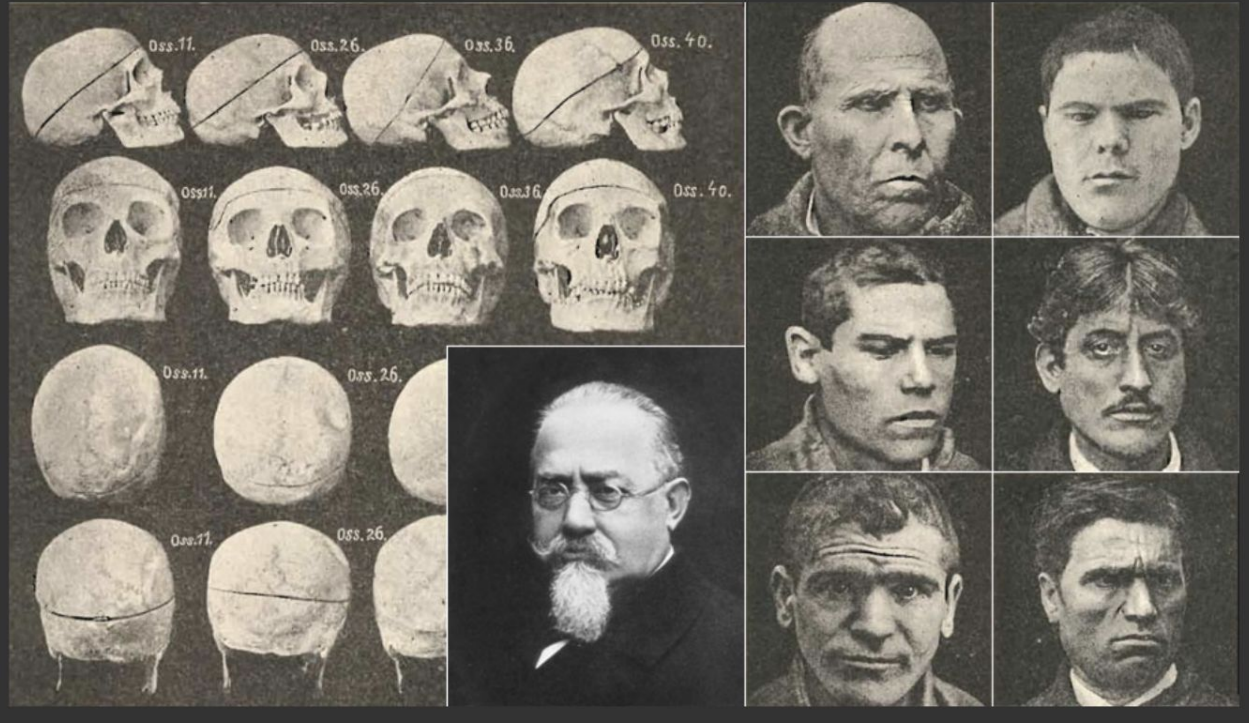
Racial Photograph

View media page | View source file

Citations of this media

"Origin of Criminology
From its inception photography had a profound effect on anthropological work as measuring device when studying races. While many would expect the photograph to bring truth and an end to the accentuated stereotyping by hand-drawn image, the medium would still be used to promote ideas of racial inferior traits. For example, Carl Victor and Friedrich Wilhelm Dammann's photographic book, Races of Men has influenced and propelled the viewpoints and stereotypes of different races. Containing black and white photos along with brief captions describing physical and mental traits, the context of these depictions serve to relay the idea of a Darwinian racial evolution from the Polynesians culminating with the Germanic race. Alphonse Bertillon founded modern anthropometric photography for the purpose of identifying repeated offenders by photographing and recording measures of physical features that remain constant throughout an individual's adult life. Cesare Lombroso, the founder of anthropological criminology, claimed to identify a links between common physical and mental traits and those highly likely to commit crimes. Dubbing the concept of being a "born criminal" Lombroso argued in favor of biological determinism, He found that skull and facial features were clues to genetic criminality and could be measured into quantitative research. The image depicts some of the 14 traits of a criminal Lombroso identified as large jaws, forward projection of jaw, low sloping forehead; high cheekbones, flattened or upturned nose; handle-shaped ears; hawk-like noses or fleshy lips; hard shifty eyes; scanty beard or baldness; insensitivity to pain; long arms, and so on. Lombroso viewed criminality as a hereditary disposition due to having traits similar to primitive human ancestors of monkeys and apes. His theories have also helped with influencing eugenics and anti-miscegenation laws, while his legacy can be found in modern day policing with racial profiling. "

—from "The Origins of Criminology"



Details

Scalar URL	https://scalar.usc.edu/works/measuring-prejudice/media/racial-photograph (version 1)
Source URL	https://scalar.usc.edu/works/measuring-prejudice/media/racial%20photography.jpg (image/JPEG)
dcterms:title	Racial Photograph
View as	RDF-XML, RDF-JSON, or HTML

Case Study: Labelling Faces

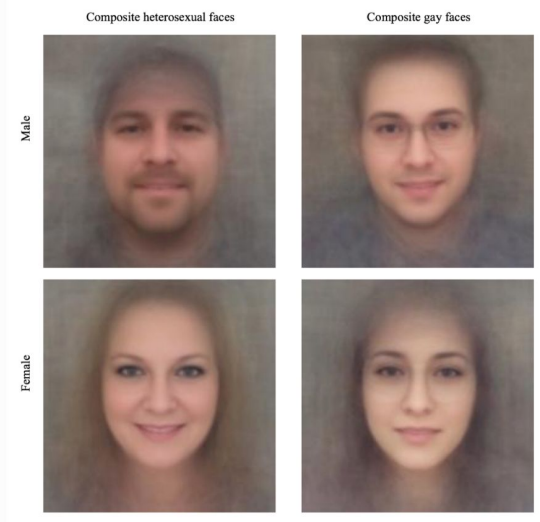
Detecting criminality from faces [link, paper]

(a) Three samples in criminal ID photo set S_c.

(b) Three samples in non-criminal ID photo set S_n

Figure 1. Sample ID photos in our data set.

Detecting Sexual Orientation From Faces with computer vision [link, paper]



This stuff just doesn't go away...

ARTICLE

https://doi.org/10.1038/s41467-020-18566-7 OPEN

Tracking historical changes in trustworthiness using machine learning analyses of facial cues in paintings

Lou Safra [1,2,3]✉, Coralie Chevallier[1], Julie Grèzes[1] & Nicolas Baumard [2]✉

Received: 19 May 2019; Accepted: 10 August 2020;
Published online: 22 September 2020

https://www.nature.com/articles/s41467-020-18566-7.epdf

Data Science Question

What should you do when working on a data science project on an unfamiliar topic?

A	B	C	D	E
Read what is already known	Think about what we do not yet know	Learn about typical approaches for studying this and similar topics	When possible, discuss with or learn from people familiar/expert on this topic	A-D

2. THE IMPLICATIONS

- Who are the stakeholders? How does this affect them?
- Could the information you will gain and/or the tool you are building be co-opted for nefarious purposes?
  a. If so, can you protect them from that?
- Have you considered potential unintended consequences?

Case Study: Abuse of social networks

Facebook has been co-opted by military personnel to spread misinformation, hate speech, and promote ethnic cleansing [news link, UN Report]

3. THE DATA

- Are the data available? Is this data directly related to your question, or only potentially related through proxies?
- Who do you have data from?
- Do you have enough data to make reliable inferences?
- What biases does your data have?
- If you do not have, and can not get, enough good, appropriate data, you may just have to stop.

Case Study: Biomedical Science

Biomedical research has often excluded female subjects

This was based on a (faulty) assumption that females would be more variable

These findings do not generalize as well

Sources: link, link, link

Complete guide to GDPR compliance

GDPR.eu is a resource for organizations and individuals researching the General Data Protection Regulation. Here you'll find a library of straightforward and up-to-date information to help organizations achieve GDPR compliance.

https://gdpr.eu/

Consumer Tech

Don’t sell my data! We finally have a law for that

You’re going to have to jump through some hoops, but you can ask companies to access, delete and stop selling your data using the new California Consumer Privacy Act - even if you don’t live in California.

By **Geoffrey A. Fowler**

FEBRUARY 19, 2020

https://www.washingtonpost.com/technology/2020/02/06/ccpa-faq

...with more and more concern surrounding ethics of AI

Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence

BRIEFING ROOM ▸ PRESIDENTIAL ACTIONS

https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

4. INFORMED CONSENT

INFORMED CONSENT: the voluntary agreement to participate in research, in which the subject has an understanding of the research and its risks

Informed consent can be withdrawn at any point in time

Case Study: Biomedical Research

Medical doctors have a history of playing God. Egregiously unethical medical research was famously conducted by Nazis, but also by Americans (Tuskegee Syphilis Study, Chester Southam injecting people with cancer, and many others) and other nations throughout history. This led to the creation of the Belmont Report and our current system of IRBs (institutional ethics review boards) for research that involves human subjects. [historical timeline]

The Belmont report establishes principles that must be fulfilled for research on humans:

- *Respect for persons*. This principle includes both respect for the autonomy of human subjects and the importance of protecting vulnerable individuals.
- *Beneficence*. More than just promotion of well-being, the duty of beneficence requires that research maximize the benefit-to-harm ratio for individual subjects and for the research program as a whole.
- *Justice*. Justice in research focuses on the duty to assign the burden and benefits of research fairly.

Informed Consent

Do you need Informed Consent for your Final Project

5. PRIVACY

- Can you guarantee privacy?
- What is the level of risk of your data, and how will you mitigate the risks? Are all subjects equally vulnerable?
- Anonymization: the process of removing personally identifiable information from datasets (PII)
- Use secure data storage, with appropriate access rights

Case Study: Running Data

Strava, a company who made an app that released running data, geotagged from around the world [link]

Fitness tracking app Strava gives away location of secret US army bases

Data about exercise routes shared online by soldiers can be used to pinpoint overseas facilities

Latest: Strava suggests military users 'opt out' of heatmap as row deepens

▲ A military base in Helmand Province, Afghanistan with route taken by joggers highlighted by Strava. Photograph: Strava Heatmap

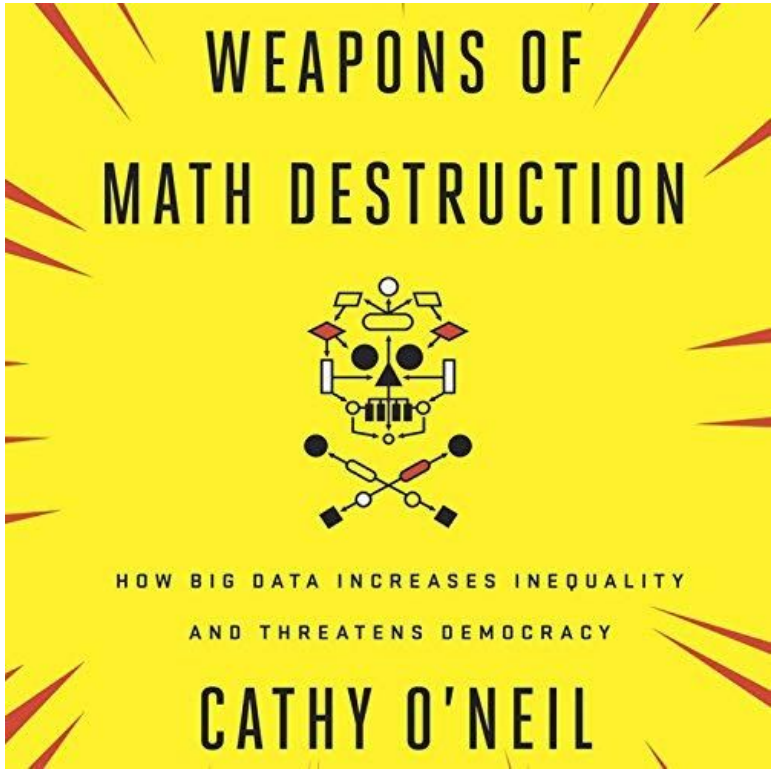
6. EVALUATION

- How will you evaluate the project?
  a. Do you have a verifiable metric of success?
- Goodhart's Law: when a measure becomes a target, it ceases to be a good measure.

Case Study: Teacher Rating

Washington, DC school district used an algorithm to rate teachers, based on test scores. Scores from this algorithm were used to fire ‘low performers’

They had no independent measure of whether this measure improved teaching



https://techliberation.com/2018/11/07/book-review-cathy-oneils-weapons-of-math-destruction/

7. ANALYSIS

- Do your analyses reflect spurious correlations?
  a. Can you tease apart causation?
- What kind of covariates might you be tracking?
  a. Are you inferring latent variables from proxies?

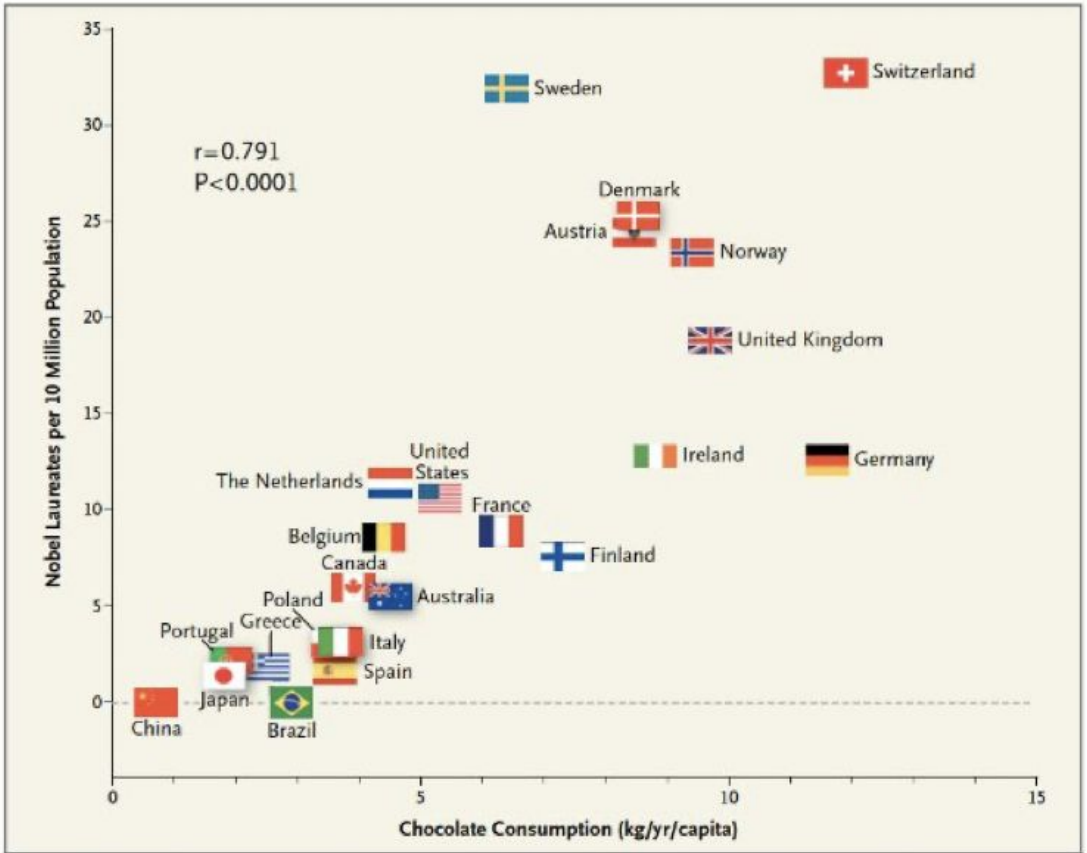


Figure 1. **Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.**

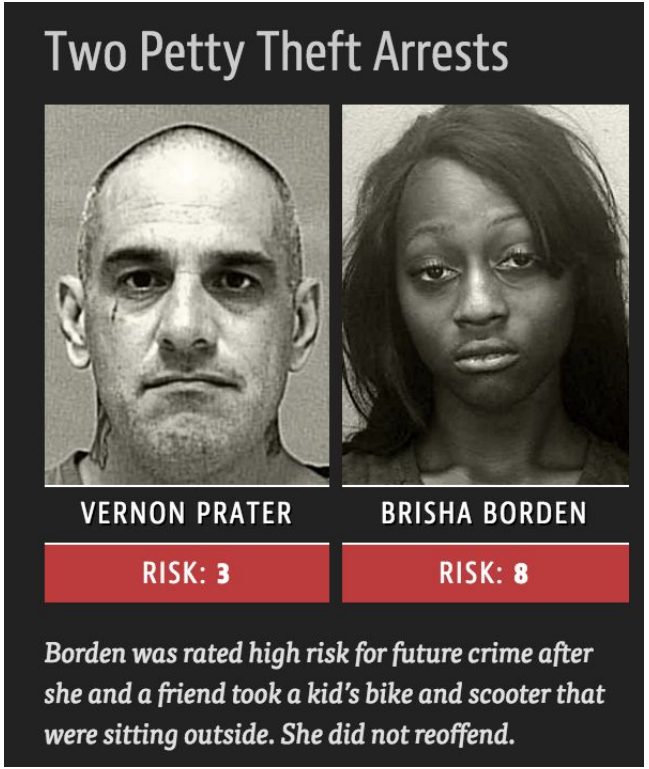
https://www.nejm.org/doi/full/10.1056/NEJMon1211064

8. TRANSPARENCY & APPEAL

- Is your model a black box?
  a. Is it interpretable as to how it came to any particular decision?
- Is there a way to appeal a model decision?
  a. What kind of evidence would you need to refute a decision?

Case Study: Predictive Policing

- Predictive policing uses algorithms to predict crime, and recidivism
- Input data can be highly correlated [link] with race & SES, reflecting spurious correlations and leading to discriminatory decisions.
- These algorithms and decisions are often opaque and un-appealable.



Transparency

Which of the following would make a recidivism algorithm more transparent?

A
The ability to submit an appeal for the metric assigned

B
The ability to see other individuals' scores

C
The ability to see the data used to calculate your score

D
The ability to see the data used and how it was used in calculating your score

E
I'm lost.

9. CONTINUOUS MONITORING

- Healthy models maintain a back and forth with the thing(s) in the world they are trying to understand.
- Are you tracking for changes related to your data, assumptions, and evaluation metrics?
- Are you proactively looking for potential unintended side effects of your model itself or harmful outputs?
- Do you have a mechanism to fix and update your algorithm?

Case Study: Fake news and video recs

- Social media apps are continuously making predictions about what you are going to do, which it uses to try to influence behavior and then update its models based on the results
- Models optimize for engagement and sharing - can promote the spreading of misinformation

ON SYSTEMS & INCENTIVE STRUCTURES

- Novel systems are not, *de facto*, equalizers. They will tend toward propagating existing inequalities.
- Companies working on these systems may have conflicts of interest with respect to the incentive structures imposed by the system and/or the business

ON PERPETUATING INEQUALITY

- Data & Algorithms can & will entrench social disparities
- Errors and bias typically target the disenfranchised
- The combination of damage, scale, and opacity can be incredibly destructive
- They can introduce feedback in such a way as to enact self-fulfilling prophecies

PUTTING IT ALL TOGETHER (GOOD)

- well-posed question that you know something about
- have considered implications of work
- adequate data, covering population of interest, with known and manageable biases
- allowed to use the data
- have de-identified data, stored securely
- defined metrics for success, objectively measured
- if suggesting causality, have actually established causality
- model is understandable, has procedure for appeal
- will monitor system for changes, have way & plan to update

HOW TO BE BAD WITH DATA SCIENCE

- ill-posed question you know nothing about
- don’t consider implications
- haphazardly collected biased data
- didn’t check or are not allowed to use data for this purpose
- un-anonymized, identifiable data, stored insecurely
- no clear metric for success (meh, it ‘seems to work’)
- present spurious correlations as meaningful
- model is a black box, no method for appeal in place
- no monitoring, no way to identify biases or update model

Data Science Ethics

When working on a data science project, data privacy is the primary ethical concern.

A	B	C	D	E
Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree

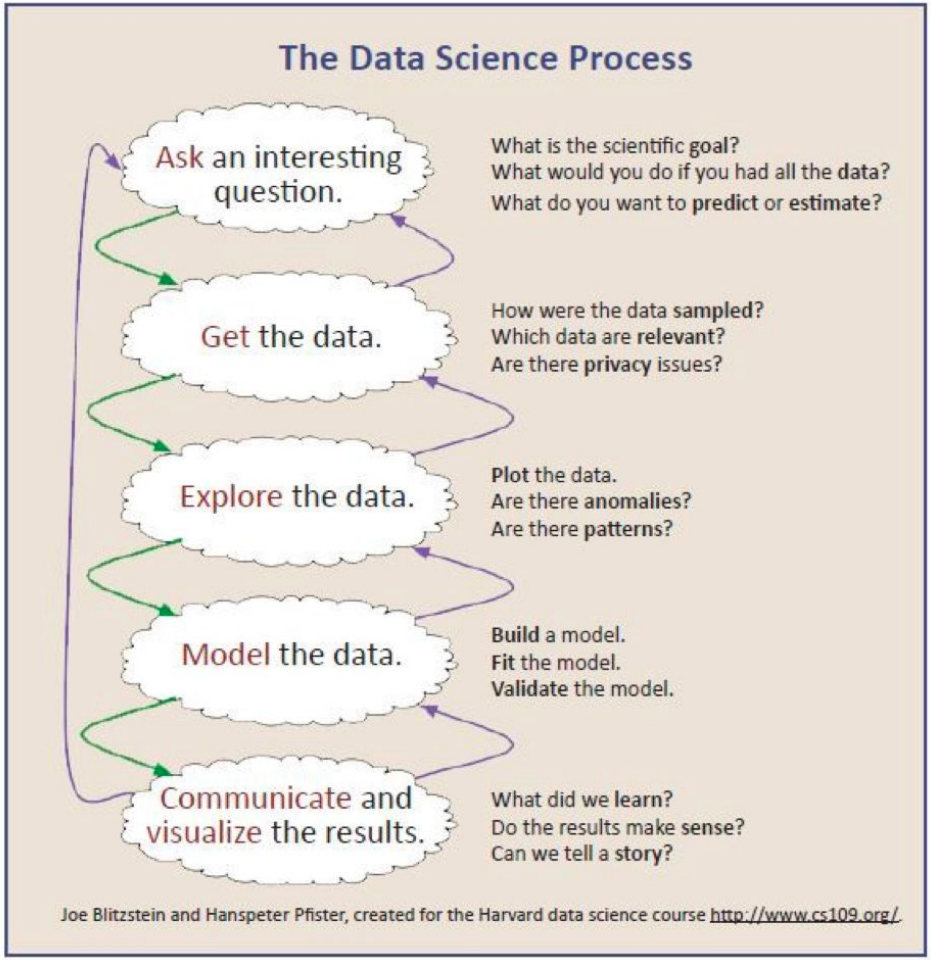
...so how do you incorporate this into *your* data science work (including the COGS 108 project)

Formulating Data Science Questions

When you and your group sit down to figure out what you're going to do for your final project in this class, you'll have to formulate a strong question - one that is specific, can be answered with data, and makes clear what exactly is being measured.

Nature of a data scientist

- data-driven.
- care about answers. They analyze data to discover something about how the world works.
- care about whether the results make sense, because they care about what the answers mean.
- are comfortable with the idea that data have errors.
- know nothing is ever completely true or false in science, while everything is either true or false in computer science or mathematics.

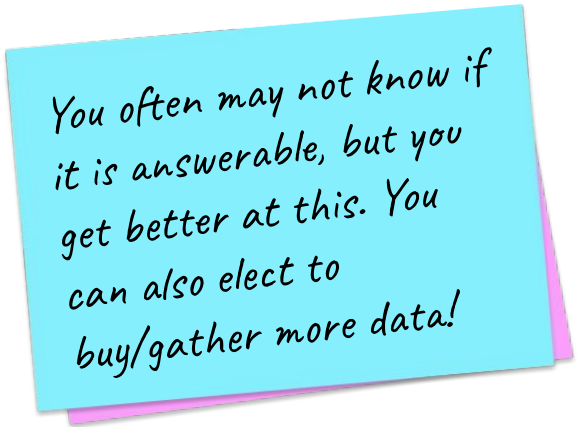

The Data Science Process
Ask an interesting question.
What is the scientific goal?
What would you do if you had all the data?
What do you want to predict or estimate?
Get the data.
How were the data sampled?
Which data are relevant?
Are there privacy issues?
Explore the data.
Plot the data.
Are there anomalies?
Are there patterns?
Model the data.
Build a model.
Fit the model.
Validate the model.
Communicate and visualize the results.
What did we learn?
Do the results make sense?
Can we tell a story?
Joe Blitzstein and Hanspeter Pfister, created for the Harvard data science course http://www.cs109.org/

Asking Good Questions is Key!

If I had an hour to solve a problem and my life depended on it, I would use the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes.
—Einstein

Data Science questions should...

- Be answerable with (available/attainable) data
- Specify what's being measured
- Have relevance to someone or something
- Be specific



Nailing down the right question: **politics**

Too-vague: What impacts American politics?

... Does pop culture have an impact on American politics?

... Do American TV shows have an *impact* on American politics?

... Does South Park *affect* American politics?

... Is there a *relationship between* words in South Park episodes and American politics?

... Is there a relationship between the sentiment of political words in South Park and American politics?

Better: What is the relationship between the sentiment of political words in South Park and America's presidential approval rating?

Nailing down the right question: education

Too-vague: How has COVID-19 impacted students?

Improving: How has COVID-19 impacted university students' education?

... Do students' grades and how they rate their classes differ pre- and during remote learning, due to COVID-19?

... At UCSD, is there a difference between students' grades and how they rate their classes before COVID-19 and during remote learning, due to COVID-19?

Better: At UCSD, comparing remote learning during COVID-19 to the two years pre-COVID, what was the effect on students' grades and how students rate their courses?

Data Science Question

You're interested in learning more about age in US politics.

Which of the following is the BEST data science question?

A How old are Congress members?

B How many people are in Congress currently?

C What is best about US politics? What is worst?

D What should I learn about US politics age and where should I learn that information?

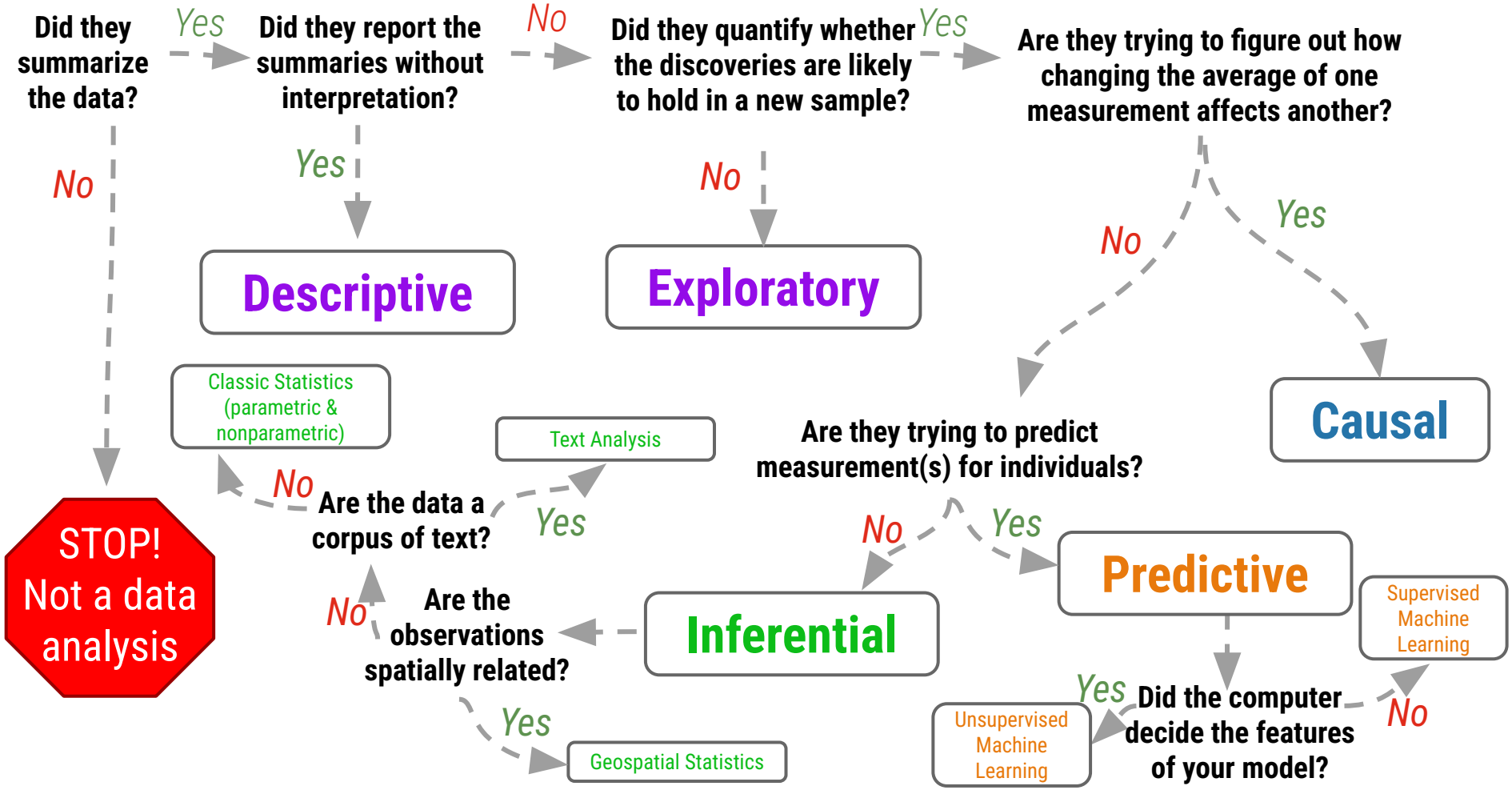
E How has the average age of members in Congress changed over time (1950-2022) and how does that compare to the average age of all adults in America?

What and how should you choose your topic/question for your final project?

"Data science is the process of formulating a quantitative question that can be answered with data, collecting and cleaning the data, ***analyzing the data****, and communicating the answer to the question to a relevant audience."*

To do this, you have to *look at, describe, and explore* the data

https://simplystatistics.org/2015/03/17/data-science-done-well-looks-easy-and-that-is-a-big-problem-for-data-scientists/


Did they summarize the data?
Yes
Did they report the summaries without interpretation?
No
Did they quantify whether the discoveries are likely to hold in a new sample?
Yes
Are they trying to figure out how changing the average of one measurement affects another?
No
Yes
Causal
No
Yes
Descriptive
No
Exploratory
Classic Statistics (parametric & nonparametric)
Text Analysis
Are they trying to predict measurement(s) for individuals?
No
Yes
Predictive
Supervised Machine Learning
No
Are the data a corpus of text?
Yes
No
Are the observations spatially related?
Inferential
Yes
Did the computer decide the features of your model?
Yes
No
Unsupervised Machine Learning
Yes
Geospatial Statistics
STOP! Not a data analysis

Summary: Analytical Approaches

1. Exploratory Data Analysis is the first step
2. Inference establishes relationships
    a. Classic Statistics
    b. Geospatial Analysis
    c. Text Analysis
3. Machine Learning is for prediction
    a. Supervised
    b. Unsupervised
4. Experiments best way to establish causality

Your final project can ask an inferential, predictive, (or sometimes causal) question. You and your group decide!

General question: What impacts politics in America?

Data Science question: Is there a relationship between the sentiment of political words in South Park and America's presidential approval rating?

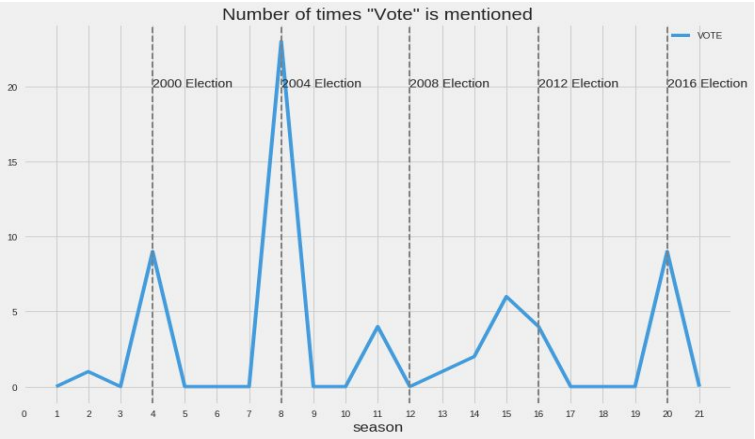
Descriptive

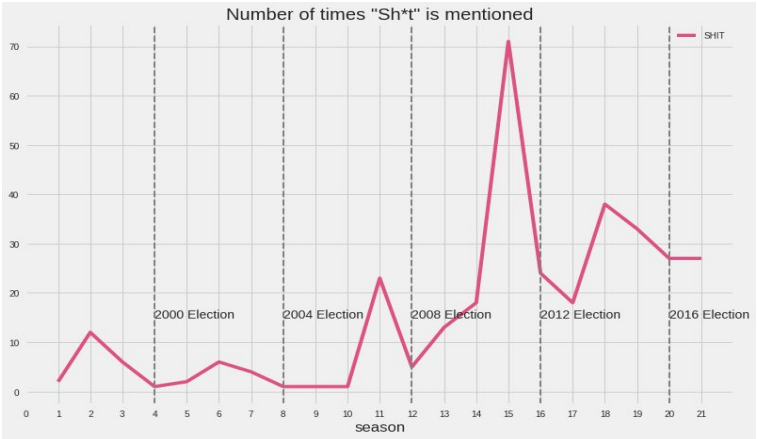
Exploratory

Inferential

Text Analysis

Classic Statistics (parametric & nonparametric)





https://github.com/COGS108/FinalProjects-Wi18/blob/master/071-FinalProject.ipynb

General question: How has COVID-19 impacted students?

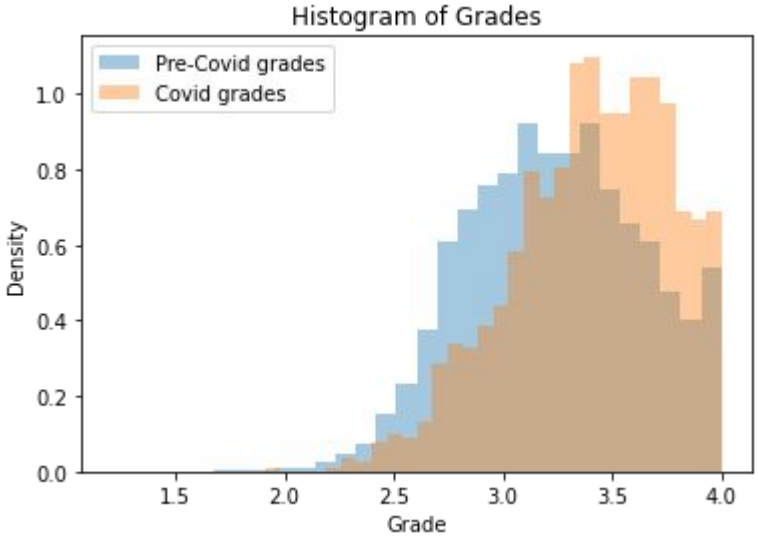
Data Science question: At UCSD, comparing remote learning during COVID-19 to the two years pre-COVID, what was the effect on students' grades and how students rate their courses?

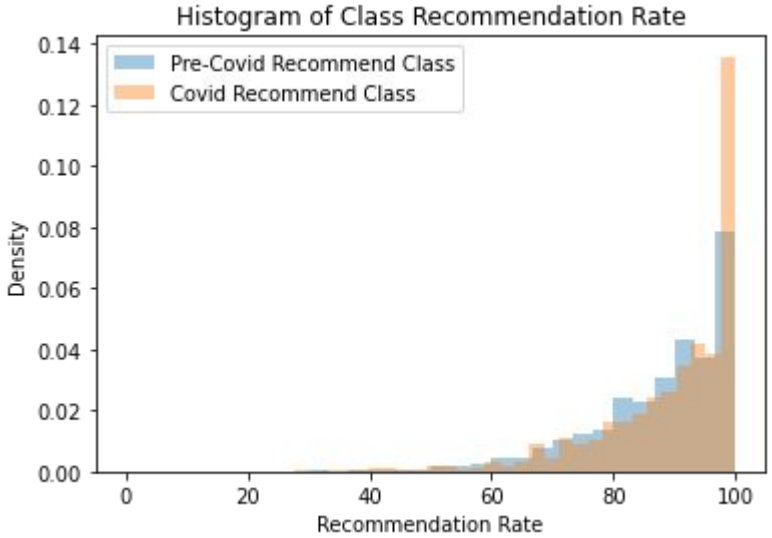
Descriptive

Exploratory

Inferential

Classic Statistics (parametric & nonparametric)

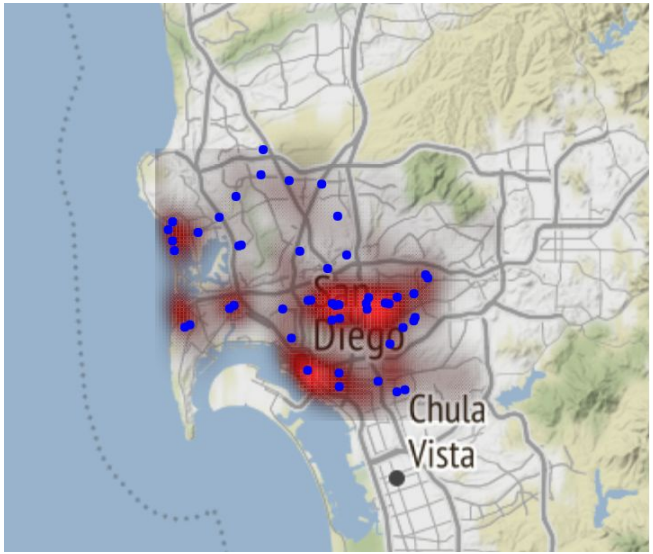


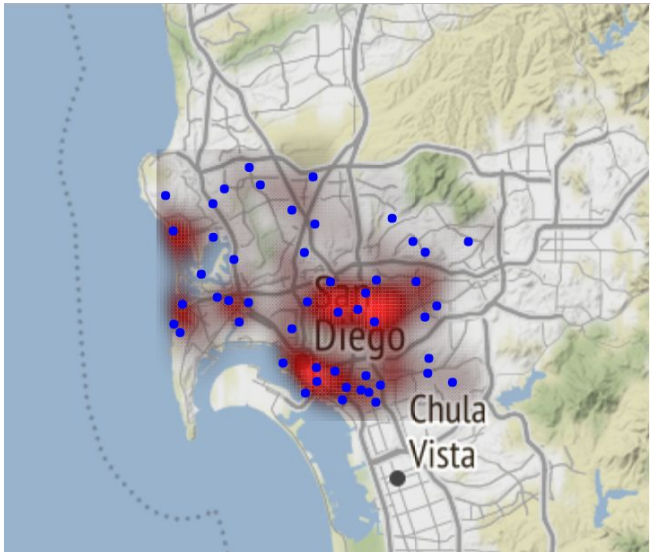


https://github.com/COGS108/FinalProjects-Wi21/blob/main/FinalProject_group084.ipynb

General question: Why isn't police response time always the same?

Data Science question: Where should police cars be stationed, accounting for crime levels and time of day, to make police response times equitable throughout San Diego?





Descriptive

Exploratory

Predictive

Inferential

Geospatial Analysis

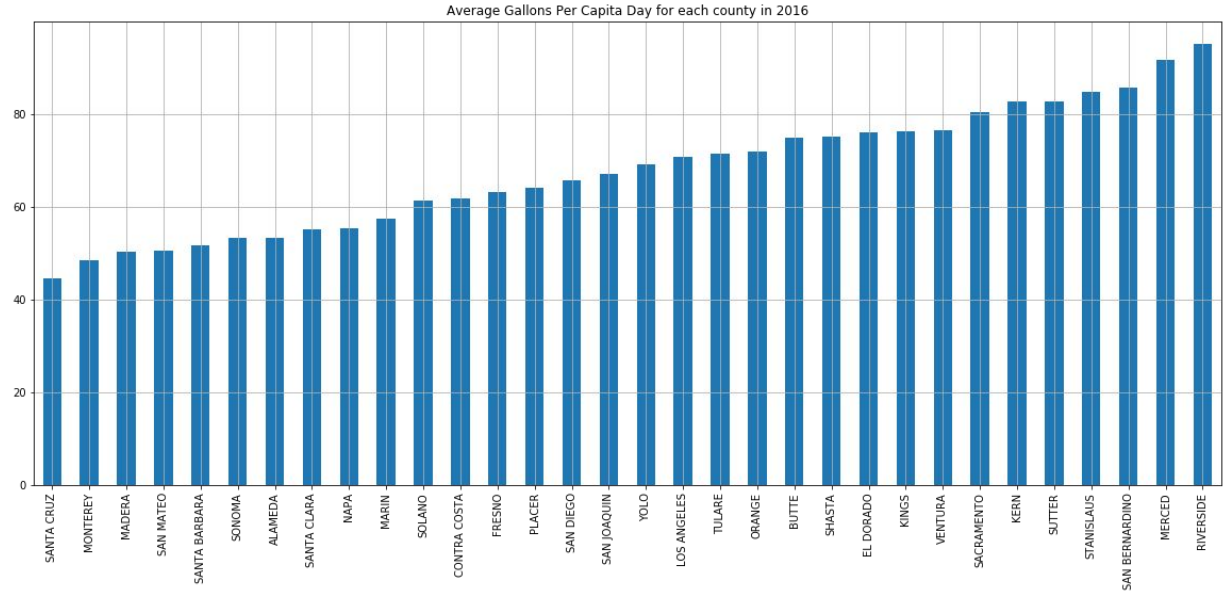
https://github.com/COGS108/FinalProjects-Sp17/blob/master/029-FinalProject.ipynb

In case of the total drought in California, how many desalination plant projects we need to supply residential use water for population who live in urban areas in California?

Descriptive

Exploratory

Predictive



https://github.com/COGS108/FinalProjects-Sp17/blob/master/018-FinalProject.ipynb