# simon-5502-10-slides

# Topics to be covered

- What you will learn
  - Quiz and poll questions
  - Empiricism and its critics
  - Recidivism case study
  - Search history case study
  - License plate case study
  - Personalized medicine case study
  - What’s the cause and what’s the cure

# Talk given to first year medical students

- Topic also relevant to this class.
- Only a few minor changes
  - Different format for the “programming” assignment

Speaker notes

I like to re-use material, so this week's lecture is an adaptation of a talk I have given as a guest lecture for a special class of first year medical students.

There is no programming in this module, so I will change the homework assignment a bit.

# Who am I?

Steve Simon

- PhD Statistics, 1982, U Iowa
- Teach in Biomedical and Health Informatics
  - Previous jobs at CMH, CDC
- Part-time independent statistical consultant (P.Mean Consulting)
- Married to a Pediatric Cardiologist (retired)
- Run 5K and 4 mile races

Speaker notes

Let me introduce myself. I am Steve Simon. I got a PhD in Statistics almost 40 years ago from the University of Iowa. The world has changed a lot since then, but I have tried to keep up. Today, if you want to sound trendy, you are a “data scientist”. I teach in the Department of Biomedical and Health Informatics at UMKC. I have had previous jobs at Children’s mercy Hospital, and the Centers for Disease Control and Prevention. I’m also a part-time statistical consultant. I have a sole proprietorship, P.Mean Consulting. That’s short for Professor Mean. For people who don’t get the joke, I point out that Professor Mean is not just your average Professor. Related to this talk, I should point out that I am obsessed with computers.

# Obsessed with computers since 1972

## List of computer skills

- Bibliographic software: EndNotes, Knowledge Finder, Mendeley, Zotero.
- Cloud storage: Box, Dropbox, iCloud, OneDrive.
- Database software: Microsoft Access, Microsoft SQL Server, Oracle, PC-File, SQLite.
- Electronic Health Records software: i2b2.
- Graphics software: ACDSee, Metafile Companion, Photoshop Elements, SigmaPlot.
- Internet systems: File Transfer Protocol, Gopher, Telnet, USENET, WordPress, World Wide Web.
- Mathematical software: MathCAD, Mathematica, MathType.
- Operating systems: Linux (Raspbian), MS-DOS, OS/2, Windows
- Presentation software: Powerpoint.
- Programming languages: BASIC, C, C++, FORTRAN, Pascal, Perl, PL/1, Python, Visual BASIC.
- Spreadsheets: Excel, Lotus 1-2-3, SuperCalc.
- Statistical software: AMOS, BMDP, IMSL, JMP, LogXact, MINITAB, nQuery Advisor, OpenBUGS, R (including RStudio and tidyverse), RATS, S-Plus, S-Plus/Wavelets, SAS (including SAS University), Stan, SPIDA, SPSS, STATA, Statgraphics, StatXact, Systat, WinBUGS.
- Utility software: DBMS/COPY, Norton Anti-virus, Notepad++, TextPad, WinZip.
- Word processing: LaTeX (MIKTeX), RMarkdown (including blogdown, bookdown, and pagedown), Word, Word Perfect.

Figure 1. Section on computer skills from my resume

Speaker notes

I should add that I am a bit of a computer geek. Here’s a list of computer skills that I put on my resume. I deliberately made this too small to read so that you wouldn’t recognize that half of the computer skills I mention have been obsolete for several deades. The computers I used in the 1970s were nothing like today’s computers.

# Worked with health care applications since 1987

Speaker notes

I’ve also been working with a variety of health care professionals for many decades. I have learned a lot along the way, but I am not a doctor. Not an MD doctor anyway. When I talk about medical examples, keep that in mind. I don’t always describe things accurately from a medical perspective, and I’m always forgetting which one is the bad cholesterol.

Is it ldl or hdl? Does anyone know?

# Quiz questions (1/3)

Why does Joel Best call statistics a social construct?

- Statistics are misquoted often on social media.
- Statistics are selected, shaped, and presented by human beings.
- Statistics are used to promote socialism.
- Statistics are dehumanizing.

Speaker notes

I want to list a few quiz questions relating to this lecture. Remember these questions when I get to the slide that discusses them.

# Quiz questions (2/3)

What is the main philosophical foundation of empiricism?

- Everything can be reduced to a mathematical equation.
- Experiments can reveal the realities of the world.
- Some questions are impossible to answer.
- We construct our own reality based on our own lived experiences

Speaker notes

Here’s the second question.

# Quiz questions (3/3)

What is a major problem with data science?

- Data scientists rely on large amounts of data with uneven quality.
- Models developed by data scientists can lead to loss of privacy.
- Prediction models are a black box that can hide discriminatory intent.
- All of the above.

Speaker notes

Here’s the third question. You don’t need to answer these questions now. Just be ready to answer them after the lecture.

# First poll question

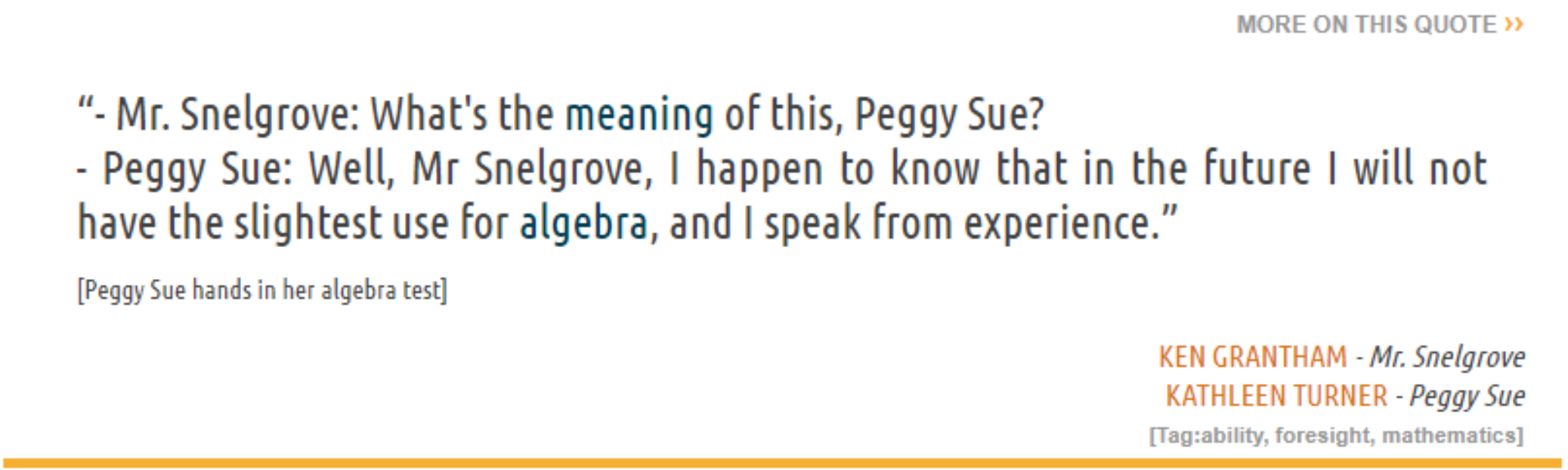



Figure 2. Quote from "Peggy Sue Got Married"

Speaker notes

I want to get a quick feel for your background and interests. Here's a quote from a romantic comedy starring Kathleen Turner from 1986. A forty year old woman, played by Kathleen Turner, travels back in time to her high school senior year, 1960. She has an amusing interchange with her high school math teacher.

"I happend to know that in the future, I will not have the slightest use for algebra, and I speak from experience."

Think back to your high school algebra class.

1. Do you remember any important formulas from that class?
2. Did you hate, hate, hate high school algebra?
3. Did you love high school algebra?

Big question: Will you use high school algebra in your future?

Source: https://www.moviequotes.com/s-movie/peggy-sue-got-married/

# Second poll question

Figure 3. Images of various computers

Speaker notes

How many of these computational devices have you used?

1. Laptop computer
2. Desktop computer
3. Tablet computer
4. Smart phone
5. Gaming console
6. Smart watch

Big question: What impact does the current generation’s immersion of computing have on society?

Images found at

https://commons.wikimedia.org/wiki/File:Black_laptop_computer_open_frontal.svg https://www.pcmag.com/picks/the-best-desktop-computers https://www.cleverfiles.com/howto/what-is-tablet-computer.html https://www.theverge.com/21420196/best-budget-smartphone-cheap https://www.vulture.com/article/best-video-game-console-2020-ps5-xbox-series-x-nintendo-switch.html https://www.homernews.com/marketplace/fitnus-smartwatch-review-legit-fitness-tracker-smart-watch/

# Are Statisticians Gods?

I’m helping someone who wants an alternative statistical analysis to the one used by the principal investigator. I’m happy to help and will offer advice about why my approach may be better, but I was warned that the PI considers the analysis chosen to be ordained by the “**Statistical Gods**” at her place of work.

Speaker notes

True story. I was asked to review a report from a federal agency, but was warned that negative comments, even if accurate, might not be well received because the agency's work was ordained by their Statistic Gods. At first, I thought this was amusing. If I could get the title of "Statistical God", I could double my hourly consulting rate. But deep down this story really bothered me. It implies that Statistical skills are supernatural, and only available to a select few special people. I learned Statistics through hard work, and you can learn Statistics through hard work also. Some people will learn it faster than others because they have good aptitudes in mathematics and programming. But there is nothing other than time to stop you.

# Break #1

- What you have learned
  - Quiz and poll questions
- What’s coming next
  - Empiricism and its critics

# Statistics are a social construct

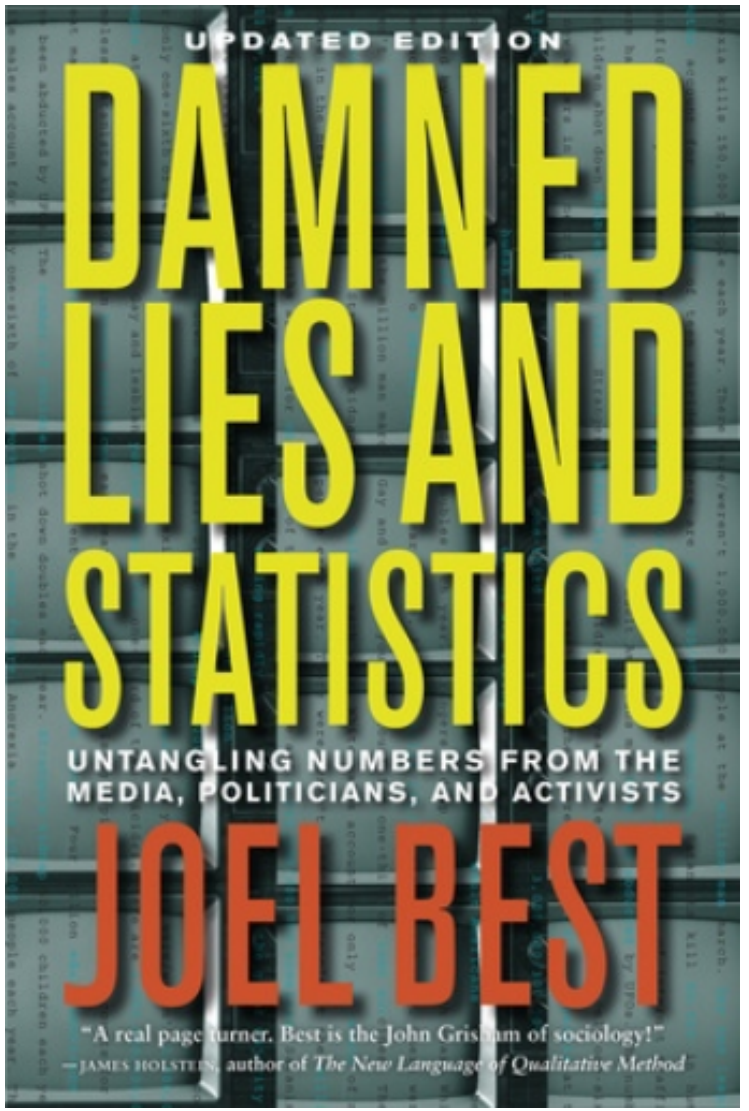



Figure 4. Cover from Joel Best's book

Speaker notes

I’m going to share a message that is controversial, but which I believe deeply in. It’s a message from a book by Joel Best: Lies, Damned Lies, and Statistics. Untangling Numbers from the Media, Politicians, and Activists. He argues that Statistics are a social construct. I need to define social construct here. A social construct is a method by which people create their perception of reality.

That’s certainly true of Statistics. Statistcs are “selected, shaped, and presented by human beings”

Source of quote: Milo Shield, Teaching the Social Construction of Statistics. Available at https://www.researchgate.net/publication/277299441_Teaching_the_Social_Construction_of_Statistics

Image taken from https://www.ucpress.edu/book/9780520274709/damned-lies-and-statistics.

# The arrogance of empiricism (1/2)

“I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of Science, whatever the matter may be.” Lord Kelvin.

Speaker notes

The idea that Statistics are a social construction flies in the face of empiricism, the philosophy that experiments can reveal the realities of the world.

Here is a quote in support of empiricism. I won’t read all of the first quote, but notice the sneering phrase that without numbers, “your knowledge is of a meagre and unsatisfactory kind.”

# The arrogance of empiricism (2/2)

“No human investigation can be called real science if it cannot be demonstrated mathematically.” Leonardo da Vinci

Speaker notes

Here is a second quote that is just as bad. Science without numbers (math) is not real.

# Why empiricism fails (1/3)

“The government is very keen on amassing statistics. They collect them, add them, raise them to the nth power, take the cube root and prepare wonderful diagrams. But you must never forget that every one of these figures comes in the first instance from the village watchman, who just puts down what he damn well pleases.” Sir Josiah Stamp

Speaker notes

This quote from Josiah Stamp illustrates why Statistics are a social construct. It doesn’t matter how fancy we dress up the numbers, nth powers, cube roots. It all comes down to the village watchman who does what he damn well pleases.

The village watchman is part of the social constuction of Statistics. So are the government officials who do all sorts of mathematical manpulations which provide an impression of objectivity.

# Why empricism fails (2/3)

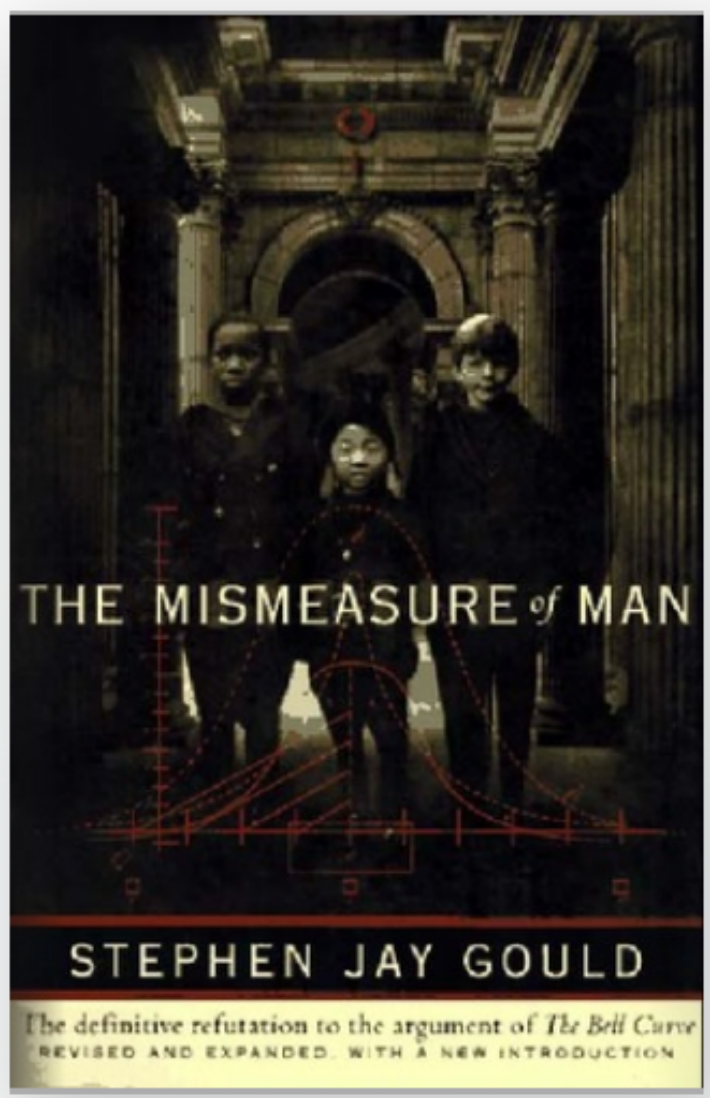



Figure 5. Cover of Stephen Jay Gould’s book

Speaker notes

There’s a great book by Stephen Jay Gould that really makes you think hard about numbers. The book, The Mismeasure of Man, talks about IQ testing from a historical perspective and totally destroys the idea that intelligence is a trair that can be easily quantified. He starts with efforts in the 1800s to use the size of a person’s skull as a measure of their intelligence. A big skull means a big brain that lives inside there and bigger brains are smarter brains.

# Why empricism fails (3/3)

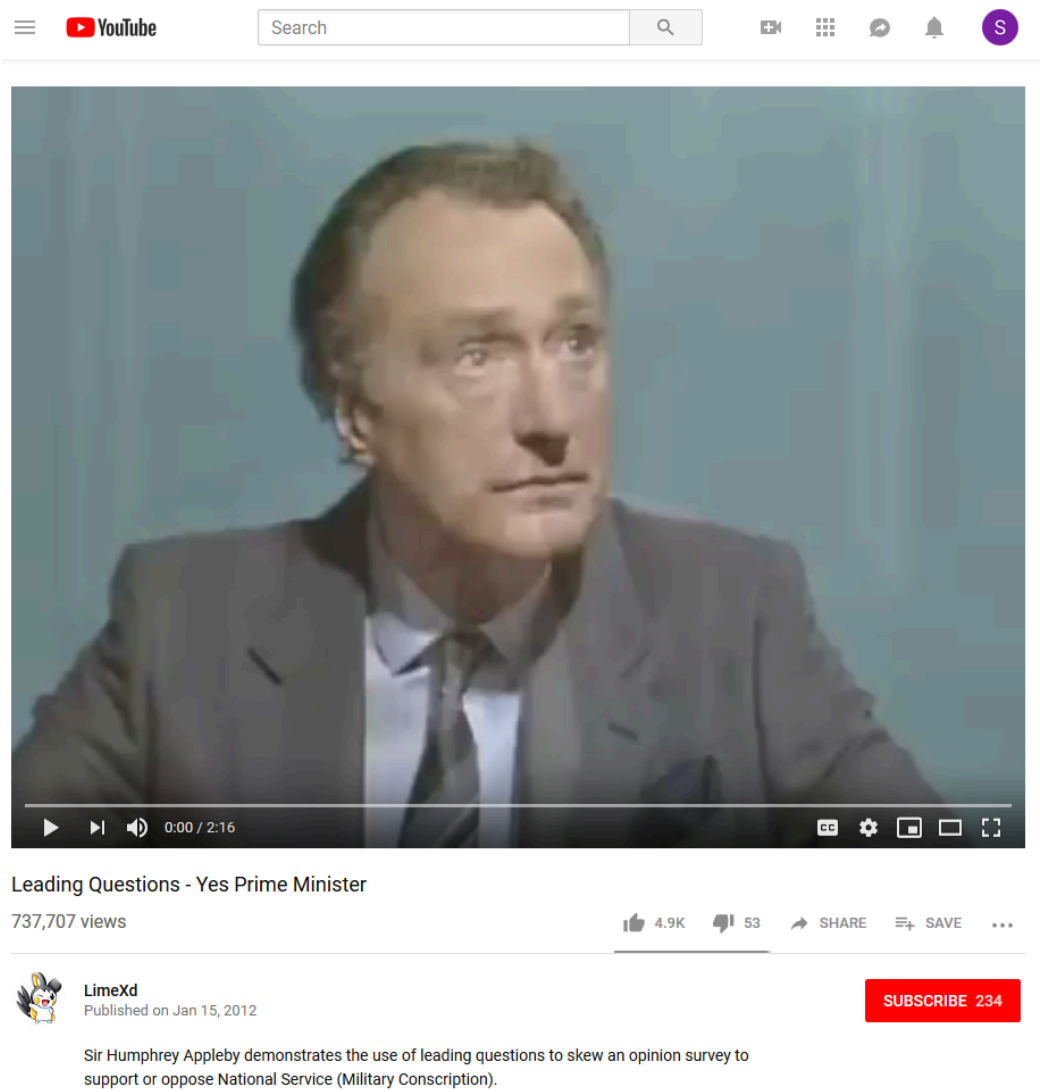



Figure 6. Frame from Yes, Prime Minister video clip

Speaker notes

This short video clip is an excellent illustration of how the questions leading up to a particular question on a survey can bias the response to that survey. It comes from a British comedy, Yes Prime Minister, that ran in the 1980s.

YouTube. Leading Questions- Yes Prime Minister. Taken from the 1st Season of Yes Prime Minister – Episode 2, The Ministerial Broadcast. 2:16 running time. Published on Jan 15, 2012.

https://www.youtube.com/watch?v=G0ZZJXw4MTA

# But numbers still have value. Example: Quality of Life

**SF-36 QUESTIONNAIRE**

**Name:**_____ **Ref. Dr:**_____ **Date:** _____

**ID#:** _____ **Age:** _____ **Gender: M / F**

Please answer the 36 questions of the **Health Survey** completely, honestly, and without interruptions.

**GENERAL HEALTH:**
**In general, would you say your health is:**

○ Excellent ○ Very Good ○ Good ○ Fair ○ Poor

**Compared to one year ago, how would you rate your health in general now?**

○ Much better now than one year ago
○ Somewhat better now than one year ago
○ About the same
○ Somewhat worse now than one year ago
○ Much worse than one year ago

**LIMITATIONS OF ACTIVITIES:**
The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

**Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.**

○ Yes, Limited a lot ○ Yes, Limited a Little ○ No, Not Limited at all

**Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf**

○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Figure 7. First few questions from SF-36 form

Speaker notes

Recognizing that Statistics are a social construction does not mean that Statistics are worthless and that experiments are a waste of time. The best example I can give for this is the measure of quality of life.

Quality of Life is a measure that is reported in many research studies. There is no question that quality of life is a social construction. It is measured by forms like the SF-36 shown here. But it is not an objective reality but something that was constructed by humans.

Now I mentioned earlier that I like to run. It is a pretty strenuous activity, but one that I enjoy. A friend of mine said, though, that she couldn't understand why you would want to run, unless you were being chased. One the other hand, I would not miss a thing if I did not push a vacuum.

There is no objective measure of quality of life. It depends on the values of the people who are developing forms like the SF-36.

Problems occur when these social constructs are developed by research teams with limited diversity (they may have blind spots) or if the social constructs are not evaluated in diverse populations.

But we can still use social constructs like quality of life, as long as we do it carefully.

In fact, we should use these measures because they get at information which is important, and which cannot be measured by a laboratory.

There's a lot of uncertainty about treatments for cancer, for example, which can sometimes extend a person's lifetime, but can also substantially interfere with their ability to do things that they feel are important. You can't discuss this trade-off without first measuring the deterioration of quality of life associated with some of these aggressive therapies.

Image obtained from

https://clinmedjournals.org/articles/jmdt/jmdt-2-023-figure-1.pdf

# Rules for using Statistics as social constructs

1. Understand the context in which the Statistic was generated.
2. Identify possible biases
3. Recognize limitations
4. Beware of confirmation bias
5. Avoid nihilistic thinking

Speaker notes

Once you recognize that Statistics are a social construct, you can take steps to make sure that these statistics are used properly. You need to think about the process the generates the statistics. Is there a “night watchman” who puts down whatever he pleases?

Just as an example, I do a lot of work with electronic health records. The health care professionals who populate the data in a system like Cerner or Epic are not doing this because they want to make sure that I have something interesting to publish. They have two objectives. First, they want to make sure that the information they put in is helpful to other members of the health care team. Second, they want to make sure they get the maximum possible billing from the insurance companies. Third, they want to wrap this up quickly so they can get home to their families.

Second, identify possible biases. Does the desire to maximize billing skew the results?

Third, recognize limitations. Am I, as a researcher, asking for information that is not important for documenting the care a patient receives to other members of the treatment team?

Fourth, beware of confirmation bias. Confirmation bias is the tendency to look harder for information that reinforces our preconceived notions, or to overlook or downweight information that contradicts our view of the world.

Fifth, avoid nihilistic thinking. Once you recognize that Statistics are a social construct, you have to work harder, but it is not an impossible task. Our tendency to treat Statistics as hard and objective has led us astray at times, but we’ve still made a lot of progress in science and medicine, thanks to Statistics.

# Things have gotten worse, thanks to big data

1. Large amounts of data of uneven quality
2. Black box models
3. Lack of accountability
4. Scaling problems
5. Loss of privacy

Speaker notes

Now everything I've mentioned so far is a problem in Statistics that has been around since before I was born. But we are in a new era, the era of big data. We have data today at a size and a level of detail that was unavailable twenty years ago. This is thanks to the internet, the human genome project, and many other things.

I'm glad we have all these data, because it increases the opportunities for learning. But at the same time, the flaws of empiricism have gotten worse.

Part of the problem is that the massive data sets that we use today have a great unevenness of quality. it is not too hard to identify obvious typos in a data set with a few hundred observations, but you would never been able to spot them in a data set with a few million observations.

Second, big data requires more complex data analysis methods and these methods are often difficult to understand. Not just from a how do these new methods work, but also in what aspects of the data are emphasized and what aspects of the data are ignored. A small model that has ten inputs is easily taken apart and examined, but you can't do that with a model that has ten thousand inputs.

Third, there is a lack of accountability. These complex models are rarely audited, for example, to look for hidden biases.

Fourth, big data provides an opportunity to produce answers not just for a small number of people, but for thousands or millions of them all at once. If the big data model is flawed, the flaws are multiplied across the large number of people who are affected by the big data model.

Fifth, there is so much data out there that you can often infer quite intimate and private details about individuals, often without them being aware of this.

# Break #2

- What you have learned
  - Empiricism and its critics
- What’s coming next
  - Recidivism case study

# Case study evuations

- Answer the following questions
  - Who is the villain?
  - Who is the victim?
  - How was the victim harmed?
  - What could have prevented this?
  - Did anything surprise you?
  - Did you disagree with anything in the article?
  - Is there a single quote from the article that summarizes it well?

Speaker notes

I want to do a small group exercise where you look at a newspaper article that discusses harm that occurred thanks to computer models. Do this in groups of 4 to 5 people. Read the article quickly. It should not take more than 5 minutes to read. Then designate someone as a note taker and a different individual as the spokesperson for the group. Come up with answers for the questions listed here.

Given the size of the class, we may not have the opportunity to let every group speak, but I will try to spread things around as much as possible.

Here are the hyperlinks to the articles:

https://www.nytimes.com/2006/08/09/technology/09aol.html

https://www.wired.com/story/null-license-plate-landed-one-hacker-ticket-hell/

https://www.nytimes.com/2011/07/08/health/research/08genes.html

# Here are the articles for your review

The New York Times | https://www.nytimes.com/2006/08/09/technology/09aol.html

*A Face Is Exposed for AOL Searcher No. 4417749*

**By Michael Barbaro and Tom Zeller Jr.**
Aug. 9, 2006

Buried in a list of 20 million Web search queries collected by AOL and recently released on the Internet is user No. 4417749. The number was assigned by the company to protect the searcher's anonymity, but it was not much of a shield.

No. 4417749 conducted hundreds of searches over a three-month period on topics ranging from "numb fingers" to "60 single men" to "dog that urinates on everything."

BRIAN BARRETT SECURITY 08.13.2019 08:51 PM

**How a 'NULL' License Plate Landed One Hacker in Ticket Hell**

**Security researcher Joseph Tartaro thought NULL would make a fun license plate. He's never been more wrong.**


The New York Times | https://www.nytimes.com/2011/07/08/health/research/08genes.html

How Bright Promise in Cancer Testing Fell Apart

**By Gina Kolata**
July 7, 2011

When Juliet Jacobs found out she had lung cancer, she was terrified, but realized that her hope lay in getting the best treatment medicine could offer. So she got a second opinion, then a third. In February of 2010, she ended up at Duke University, where she entered a research study whose promise seemed stunning.

Doctors would assess her tumor cells, looking for gene patterns that would determine which drugs would best attack her particular cancer. She would not waste precious time with ineffective drugs or trial-and-error treatment. The Duke program — considered a breakthrough at the time — was the first fruit of the new genomics, a way of letting a cancer cell's own genes reveal the cancer's weaknesses.

Figure 8. Excerpts from three articles

Speaker notes

Here are the three articles. “A Face Is Exposed for AOL Searcher No. 4417749,” published in 2006 in the New York Times, “How a ‘NULL’ License Plate Landed One Hacker in Ticket Hell,” published in Wired Magazine in 2019, and “How Bright Promise in Cancer Testing Fell Apart,” published in the New York Times in 2011.

Each small group will get a different article. If you’ve read the article already, re-read it with an eye to answer the questions posed on the previous slide. If you’ve not read the article already, skim through it quickly and contribute a few thoughts to your group.

I want each group to read silently for five minutes and then start discussing the article for the next ten minutes. Then I want to hear from some of the groups about their thoughts. I won’t have time to get information from every group, but I’ll try to get a variety of thoughts and opinions.

# Weapons of Math Destruction

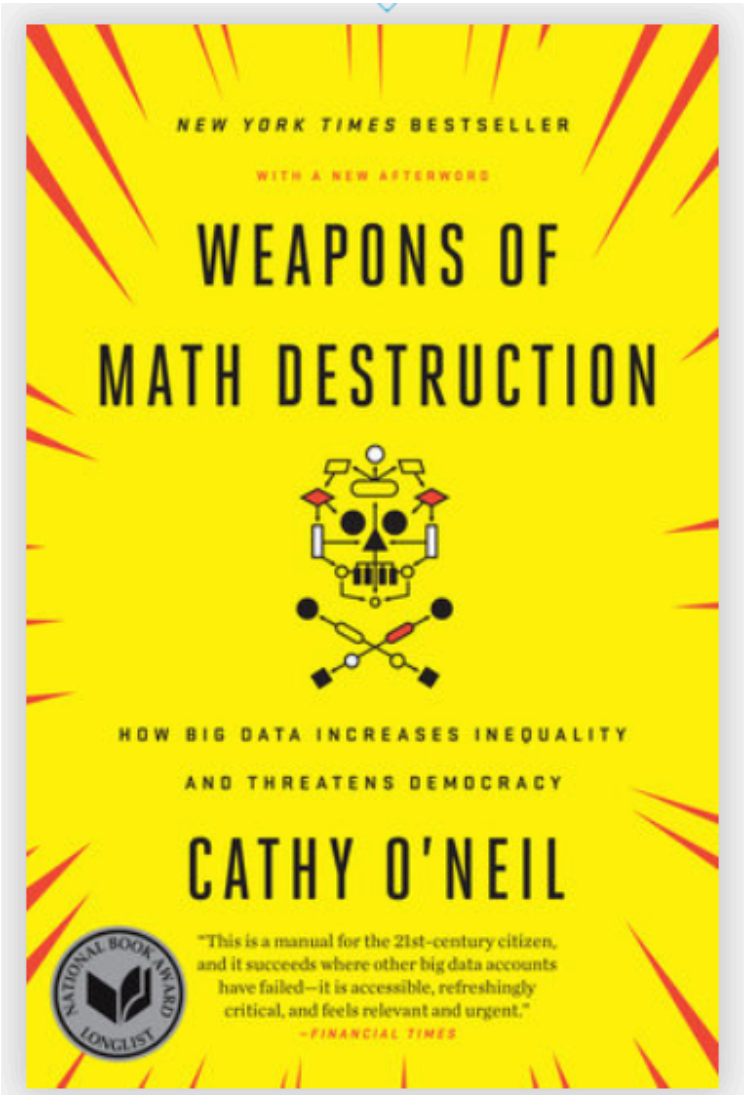



Figure 9. Cover of Cathy O'Neill's book

Speaker notes

Before I start the individual groups, let me give an example of how this works.

This is a great book with lots of interesting examples, but I want to discuss one example in detail and answer the questions about it. It comes from chapter 1 of the book, Weapons of Math Destruction, by Cathy O’Neil.

# First villain

- Walter Quijano
  - Provided testimony on recidivism rates at seven trials
  - Unfairly included race in his calculations and testimony
  - Six of seven convictions later overturned

Speaker notes

The big data example in O’Neil’s book starts with the story of a person, Walter Quijano, who provided testimony in seven trials about the risk of recidivism. Recidivism is the unfortunate event where someone who has been released from prison commits a new crime and gets tossed back in jail. Mr. Quijano gave overtly biased recommendations at these trials that incorporated race into his assessment of recidivism. This was noted in the appeals of one of the defendants, and led to six of the seven convictions being overturned.

# Second villain

- LSI-R questionnaire
  - Given to thousands of inmates
  - Classifies risk of recidivism
  - Does not explicitly ask about race
  - But does have “leading” questions

Speaker notes

It contrasts this individual with a big data prediction model based on the LSI-R questionnaire. LSI-R stands for Level of Service Inventory-Revised that asks a bunch of questions like “How many prior convictions have you had?” This questionnaire weights the responses to various questions to provide an estimate of the risk of recidivism. Although the questionnaire does not explicitly ask about race, it can still indirectly identify a person’s race by their pattern of responses to a series of leading questions.

# Victims

- Inmates at parole hearings
- Defendants at trial sentencing

Speaker notes

This questionnaire was used at a large number of parole hearings in multiple states and at sentencing hearings in a few states as well.

# How were the victims harmed

- Disproportionate recidivism risks by race
  - Fewer paroles grants
  - Longer sentences
- No avenue to appeal
  - Model presumed to be unbiased
  - Complexity prevents examination of bias
- Scale issues
  - Walter Quijano harmed 7 defendants
  - LSI-R harmed thousands of defendants.

Speaker notes

The model was shown to grossly overstate the recidivism risk of black defendants. This led to fewer grants of parole to black prisoners and longer prison sentences for newly convicted black defendants.

There was no avenue of appeal for those harmed by the LSI-R. You can’t cross-examine an algorithm at trial, and the company that developed the LSI-R model did not want to disclose details about how the model worked. It was a trade secret and revealing its details would allow other companies to steal their technology. To be honest, the model itself was so complex that the company would have been unable to reveal its inner workings, even if it wanted to.

The other important is issue is the scale of the harm. A biased witness could only influence a handful of defendants. Walter Quijano had only enough time and energy to taint the sentencing of seven defendants. The LSI-R algorithm, however, was applied to many people. , but the impact of the LSI-R questionnaire ended up influencing thousands.

That’s a hallmark of big data models. They are expensive to build and very labor intensive, but once they are built, it costs almost nothing to deploy it broadly.

# What could have prevented this

- Insist on transparency
- Test the model for bias
- Build the model with better objective

# Did anything surprise you?

- Questionnaire includes questions that would be inadmissable if they were asked during a normal trial
  - When was the first time you were ever involved with the police?
  - Do any of your friends or relatives have a criminal record?

Speaker notes

I read about this a couple of years ago, but I think the thing that surprised me was the number of questions on the LSI-R that would not have been allowed in an open trial, because the questions would have been ruled as prejudicial.

But apparently, you can ask prejudicial questions outside of a courtroom in a questionnaire and then use that information to create a recidivism risk score.

# Did you disagree with anything in the article?

- No

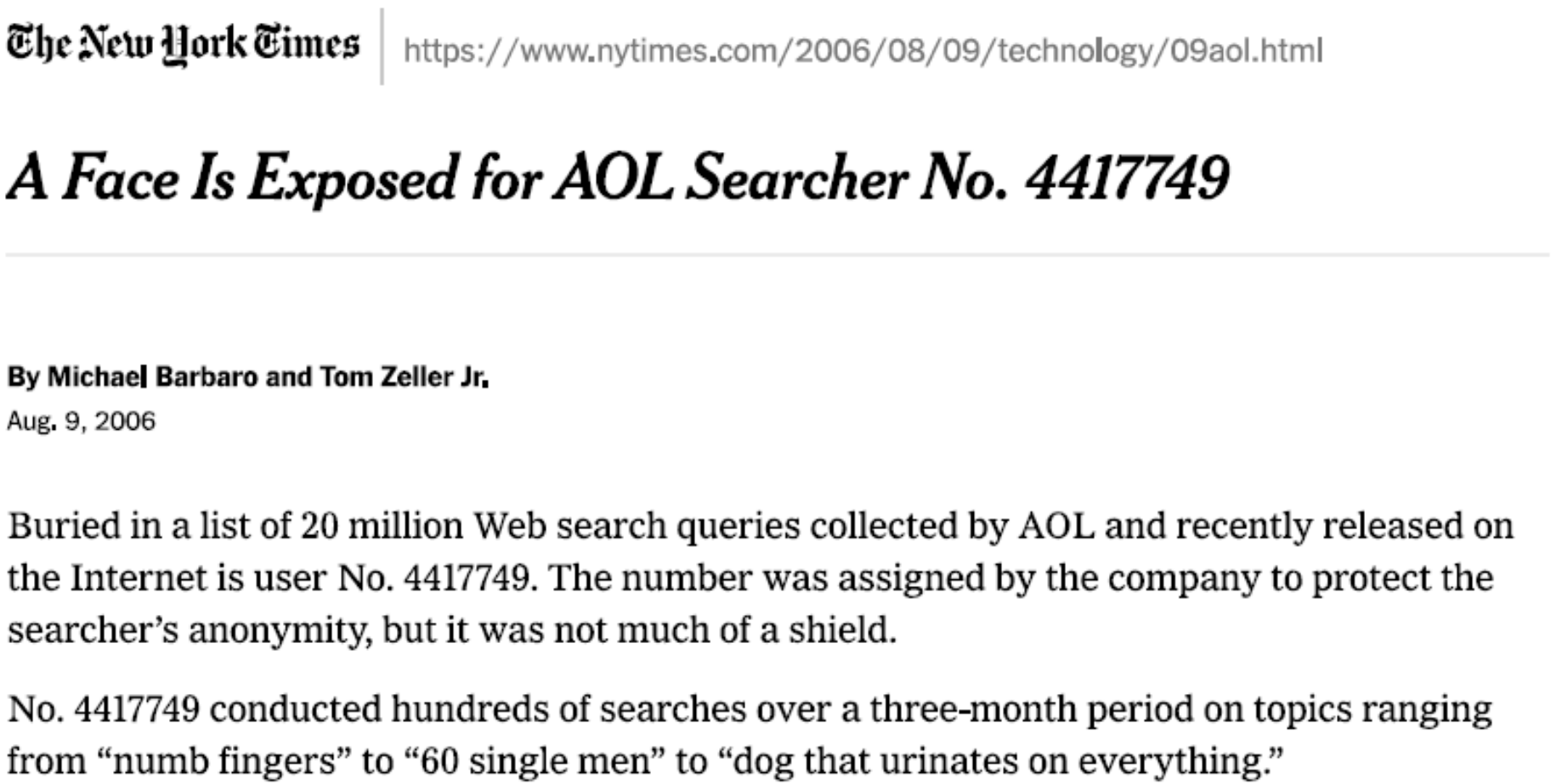
# Is there are single quote that summarizes the article well

“The questionnaire includes circumstances of a criminal’s birth and upbringing, including his or her family, neighborhood, and friends. These details should not be relevant to a criminal case or to the sentencing.”

# Break #3

- What you have learned
  - Recidivism case study
- What’s coming next
  - Search history case study

# A Face Is Exposed for AOL Searcher No. 4417749



The New York Times | https://www.nytimes.com/2006/08/09/technology/09aol.html

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No. 4417749 conducted hundreds of searches over a three-month period on topics ranging from "numb fingers" to "60 single men" to "dog that urinates on everything."

Figure 10. First page of newspaper article

Speaker notes

https://www.nytimes.com/2006/08/09/technology/09aol.html

# Who is the villain

- America Online
  - Collected data that could harm people
  - Released data without addressing privacy concerns
    - Searches for relatives
    - Neighborhood associations
    - Even self-searches
  - Search terms can be embarrassing
    - “Dog that urinates on everything”

# Victims

- Thelma Arnold (user 4417749)
- Other AOL searchers
  - 3505202 “depression and medical leave”
  - 7268042 “fear that spouse contemplating cheating”

# How were the victims harmed

- Revelation of personal details
- Loss of trust

# What could have prevented this

- Understanding that anonymization is difficult
- Don’t collect/store sensitive information
  - “AOL keeps a record of each user’s search queries for one month, Mr. Weinstein said. This allows users to refer back to previous searches and is also used by AOL to improve the quality of its search technology.”

# Did anything surprise you?

- How much we reveal about ourselves when we search the Internet.

# Did you disagree with anything in the article?

- No

# Is there are single quote that summarizes the article well

“Ms. Arnold says she loves online research, but the disclosure of her searches has left her disillusioned. In response, she plans to drop her AOL subscription. ‘We all have a right to privacy,’ she said. ‘Nobody should have found this all out.’”

# Break #4

- What you have learned
  - Search history case study
- What’s coming next
  - License plate case study

# How a ‘NULL’ License Plate Landed One Hacker in Ticket Hell

BRIAN BARRETT SECURITY 08.13.2019 08:51 PM

**How a 'NULL' License Plate Landed One Hacker in Ticket Hell**

Security researcher Joseph Tartaro thought NULL would make a fun license plate. He's never been more wrong.



Figure 11. First page of newspaper article

Speaker notes

- Answer the following questions
  - Who is the villain?
  - Who is the victim?
  - How was the victim harmed?
  - What could have prevented this?
  - Did anything surprise you?
  - Did you disagree with anything in the article?
  - Is there a single quote from the article that summarizes it well?

https://www.wired.com/story/null-license-plate-landed-one-hacker-ticket-hell/

# Who is the villain?

- Government bureaucracies that can’t work with one another
- Programmers who don’t understand the difference between the string “NULL” and a null value.
- Joseph Tartaro
  - Thought that a NULL license plate might cause the computer system to lose his traffic violoations

# How was the victim harmed?

- $12,049 worth of traffic fines
- Lost time trying to resolve things

# What could have prevented this?

- Quality review of code
- Flexibility to allow for common sense deviations

# Did anything surprise you?

- How hard it has been to fix things.

# Did you disagree with anything in the article?

- No

# Is there a single quote from the article that summarizes it well?

- “Prank or not, Tartaro was playing with fire by going with NULL in the first place. ‘He had it coming,’ says Christopher Null, a journalist who has written previously for WIRED about the challenges his last name presents. ‘All you ever get is errors and crashes and headaches.’ If anything, Null says, the problem has gotten worse over the years. ‘The “minimum viable product” concept has pushed a lot of bad code through that doesn’t go through with the proper level of testing,’ Null says, adding that anyone affected is inevitably an edge case, a relatively small problem not worth devoting a lot of resources to fix.”

# Break #5

- What you have learned
  - License plate case study
- What’s coming next
  - Personalized medicine case study

# How Bright Promise in Cancer Testing Fell Apart

The New York Times | https://www.nytimes.com/2011/07/08/health/research/08genes.html

## How Bright Promise in Cancer Testing Fell Apart

**By Gina Kolata**
July 7, 2011

When Juliet Jacobs found out she had lung cancer, she was terrified, but realized that her hope lay in getting the best treatment medicine could offer. So she got a second opinion, then a third. In February of 2010, she ended up at Duke University, where she entered a research study whose promise seemed stunning.

Doctors would assess her tumor cells, looking for gene patterns that would determine which drugs would best attack her particular cancer. She would not waste precious time with ineffective drugs or trial-and-error treatment. The Duke program — considered a breakthrough at the time — was the first fruit of the new genomics, a way of letting a cancer cell's own genes reveal the cancer's weaknesses.

Figure 12. First page of newspaper article

Speaker notes

This will be your homework assignment.

https://www.nytimes.com/2011/07/08/health/research/08genes.html

# Questions to answer

- Who is the villain?
- Who is the victim?
- How was the victim harmed?
- What could have prevented this?
- Did anything surprise you?
- Did you disagree with anything in the article?
- Is there a single quote from the article that summarizes it well?

Please work independently on this assignment.

# Break #6

- What you have learned
  - Personalized medicine case study
- What’s coming next
  - What’s the cause and what’s the cure

# Myths about big data

1. Algorithms are objective
2. If you have enough data, quality is no longer an issue
3. We are getting better at this

Speaker notes

If there are any big lessons from this, they are that you should be skeptical about big data. Algorithms are not objective. They are a social construct. Also, don’t believe that bigger datasets are always better. A lot of data does not compensate for poor quality. Finally, while I am a big believer in progress, I think that too many of us are making mistakes and those mistakes are a lot worse when the data is big.

# No single cause of these problems

1. Wrong data
2. Wrong objective
3. Wrong deployment
4. Wrong team

Speaker notes

There is no single cause for these problems. They are built into the system and it takes a lot of effort to work these biases out of the system.

On the next couple of slides, I want to show a classic Venn diagram and my variation on it to illustrate an important point.

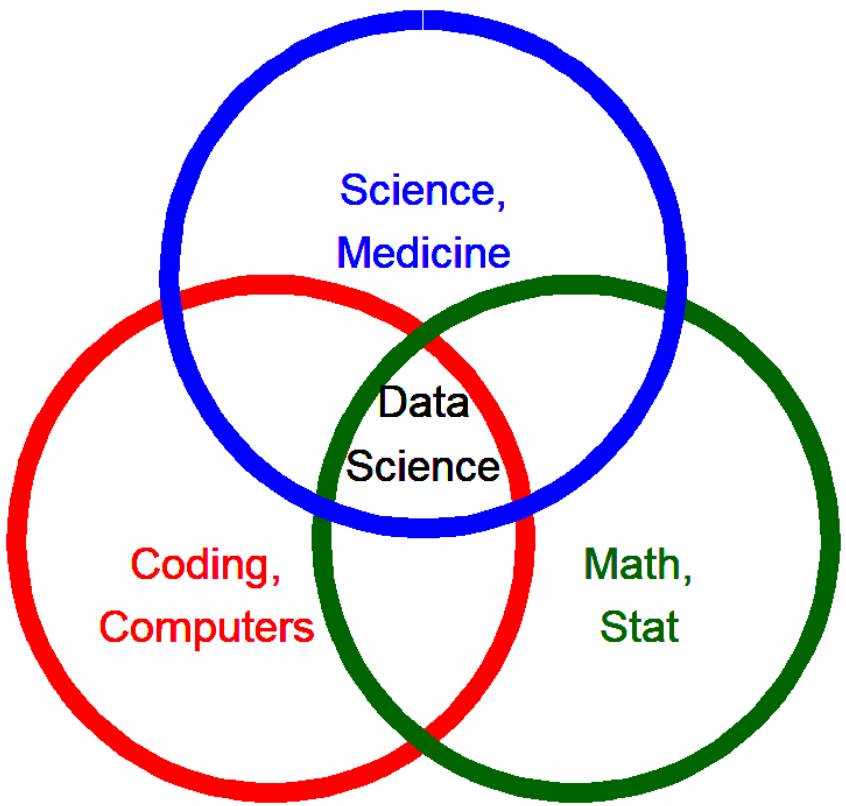
Here's a classic Venn diagram that you will see in pretty much any article that talks about big data or data science (I use those words interchangeably).

There are three areas of expertise that you need as a data scientist: knowledge of mathematics and statistics, skill with computer science and coding, and expertise in medical or scientific specialties.

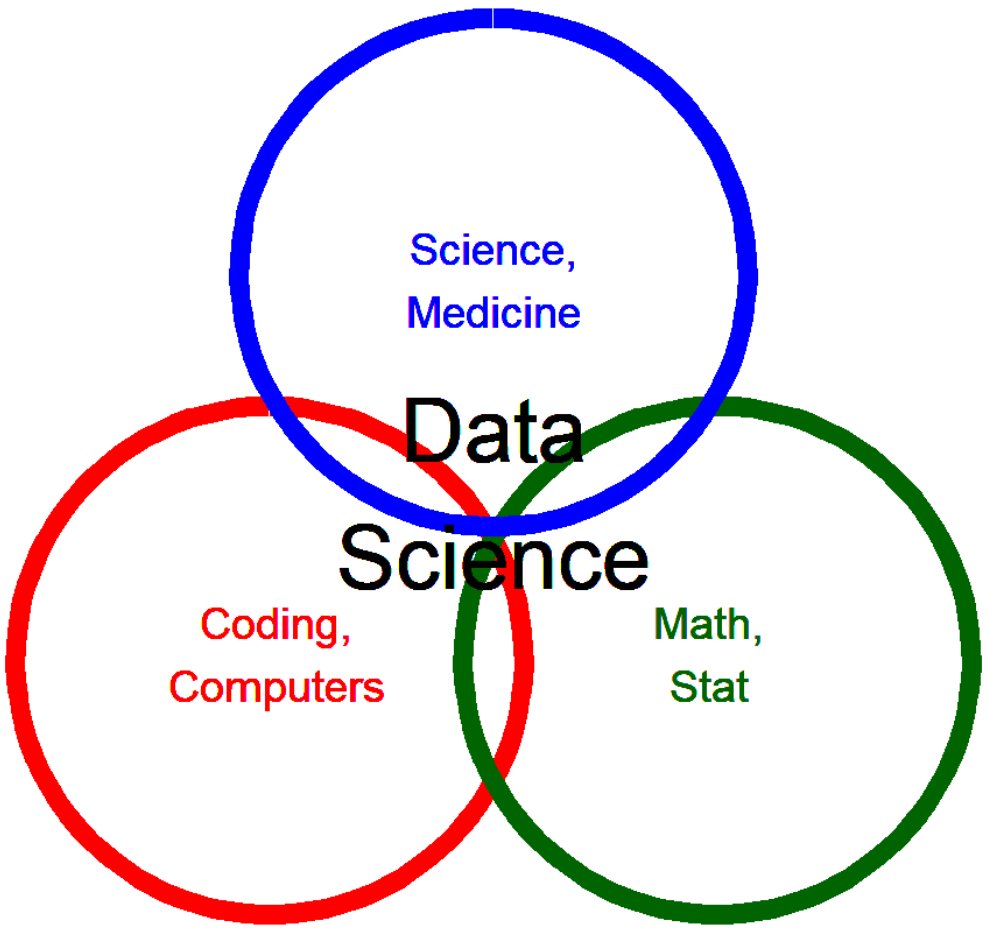
A more accurate picture would show that there is not enough overlap among these disciplines. Not that many people are skilled at both science and statistics. Fewer still know both of those skills well and can program effectively.

That's actually good news from your perspective. You don't have to be a genius in all three areas. Be good in one area and have an appreciation of the the other two and you'll do just fine.

# What they say data science is



# What data science really is



# Why you are needed

1. Too many geeks, not enough scientists
2. More racial, gender diversity is needed

If you are interested, email me: simons@umkc.edu

You can find my talk here:

https://github.com/pmean/papers-and-presentations/blob/master/dark-side/2022-talk.pptx

Speaker notes

I’d like to end with an exhortation. We need people like you in data science. It’s okay to spend most of your time learning the complexities of medicine, but some of you have a bit of talent and aptitude in math/stat and in computers/coding. That’s an advantage your generation has that my generation did not. So you have the ability to appreciate the full picture more so than people my age. A few of us knew computers well, but today’s generation is saturated in computational experience.

Second, these research teams need a lot more racial and gender diversity. I try really hard to appreciate the viewpoints of people different than me, bit I can’t understand it at a level of someone who has seen life from a different perspective. If the only people developing these data science models are white males, then the models will continue to be biased against women and minorities.

# Break #7

- What you have learned
  - What’s the cause and what’s the cure
- What’s coming next
  - Problems with large language models

# Existential Comics, 1

Speaker notes

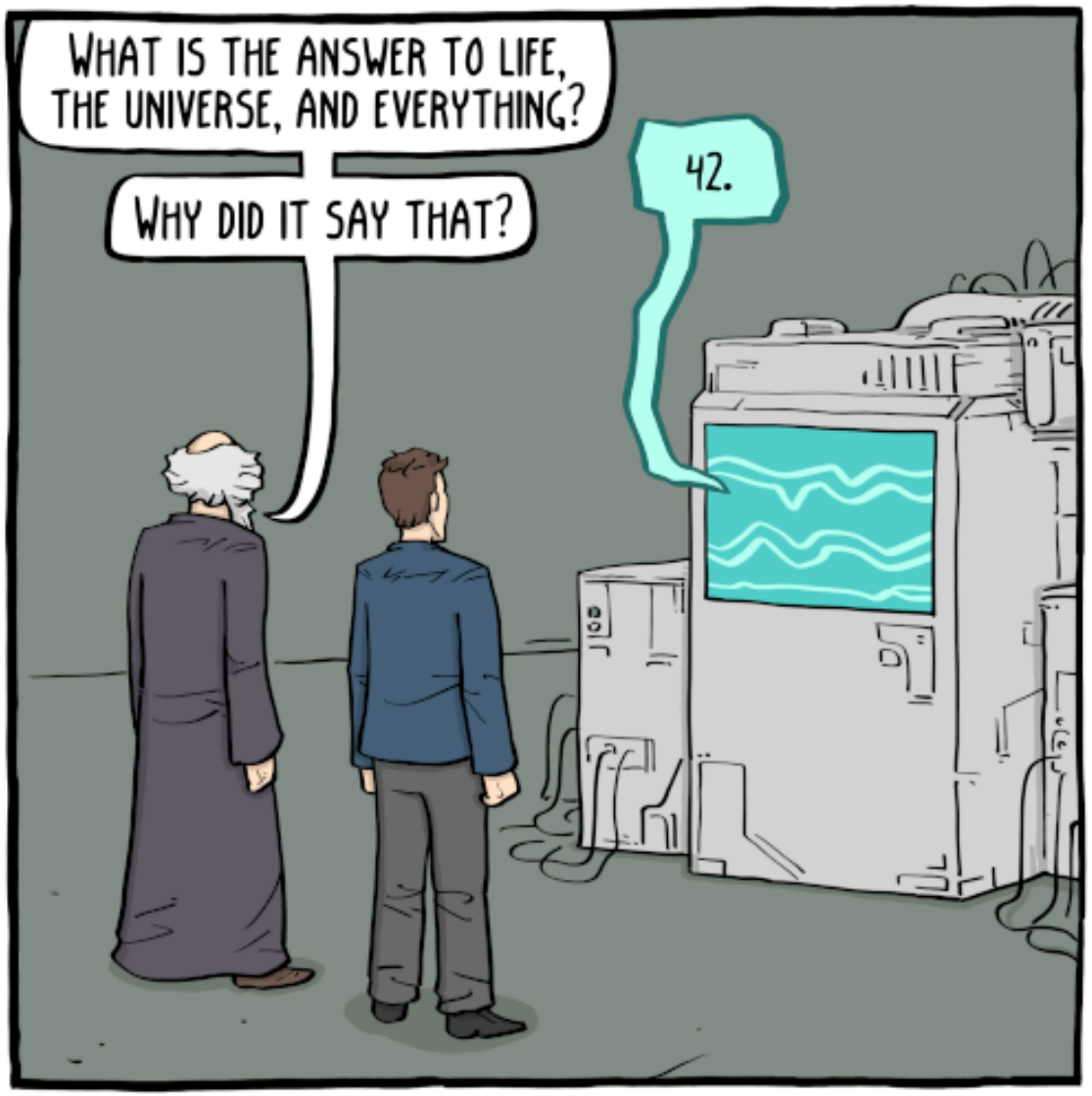
I have not been thrilled with all of the hype and hoopla about Generative AI that is in the press and everywhere. My thoughts about this are similar to those of Corey Mohler.

Corey Mohler. AI and the Meaning of Life. Existential Comics. No date. Available in html format.

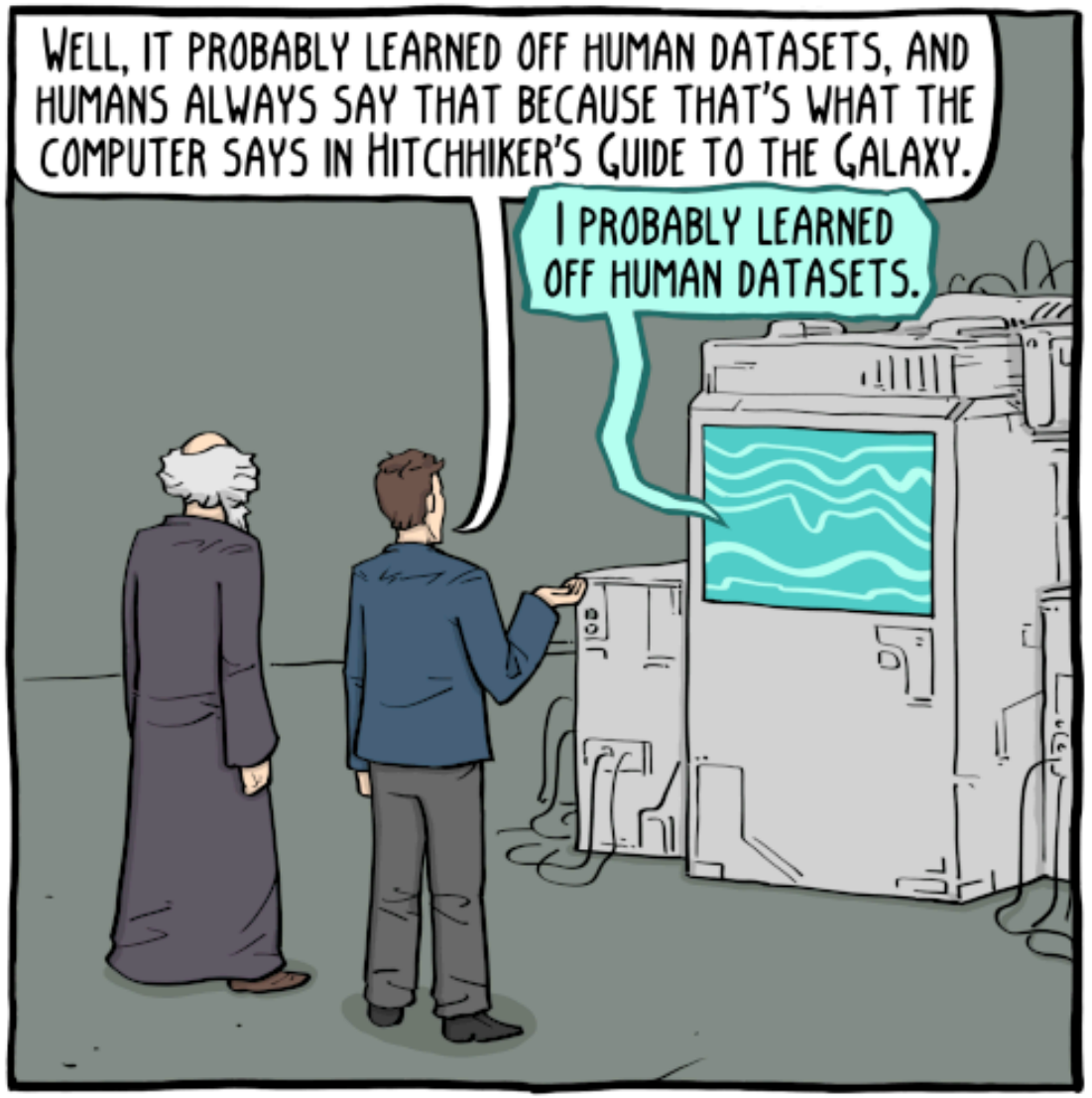
# Existential Comics, 2

# Existential Comics, 3

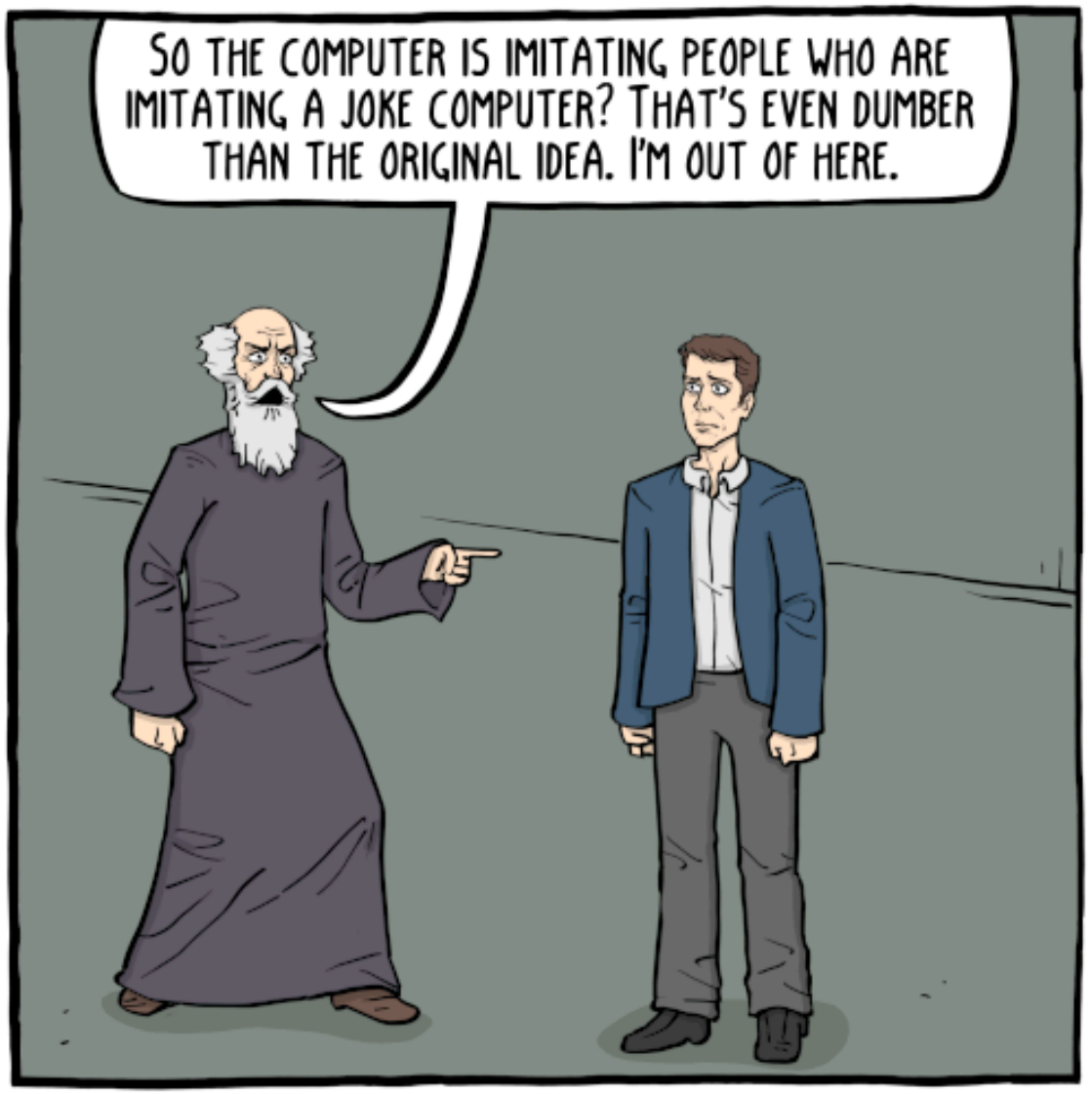
# Existential Comics, 4



# Existential Comics, 5



# Existential Comics, 6



# Existential Comics, 7

Speaker notes

Nevertheless, there are some useful applications of this technology and I need to learn how to use them. Here’s a brief summary of what I (as a total beginner in this area) know about the bad (first) and then the good.

# What are some of the concerns with this new technology?

- Copyright concerns
- Style and manner
- Halluncinations
- Reinforcing stereotypes

Speaker notes

First, I have to say that there are some serious ethical and legal problems with at least some of these generative AI programs. I can’t say it is true of all of them, but at least some of them represent a massive theft of intellectual property.

Generative AI uses a neural network to produce a sequence of words in response to a user’s prompt. This neural network (and just about any neural network) needs a large amount of data for training. This data comes from scraping the Internet.

Fine. But much of the material on the Internet is copyrighted. Worse yet, the Internet includes many resources that themselves are thefts of intellectual property.

# Copyright provisions

- Creative commons licenses
  - Attribution
  - Noncommercial
  - NoDerivatives
- Full copyright
  - “any use of this material without the express written consent of … is prohibited.”
- Pirate sites
  - Re-using material that has already been stolen once

Speaker notes

When you publish your work on the Internet, you have the option of using a Creative Commons open source license. This is a popular choice on the Internet. There are several license options. You can require that anyone using your content has to cite the original source. You can require that they only use your content for non-commercial purposes. You can require that they use your content only in an unmodified form (no derivative works).

Any one of these licenses could be seen as forbidding the use of your content in training a neural net. Well maybe not. The companies creating these generative AI models would argue that their use of your content falls under the fair use provisions of copyright law. Well, maybe, but I doubt it.

It's worse than this, though. There is lots of material on the Internet that is published with much more restrictive copyright provisions. Include phrases like "any use of this material without the express written consent of … is prohibited."

Even more of a problem is that there are many publishers on the Internet that are themselves great thieves of intellectual property. Can you re-use material that has already been stolen once? I hope not.

See the Appel (2023), Levy (2024), and Metz (2024) references for overviews of some of the issues.

Gil Appel, Juliana Neelbauer and David A. Schweidel. Generative AI Has an Intellectual Property Problem. Harvard Business Review, 2023-04-07. Available in html format.

Annelise Levy. Nvidia Illegally Scraped YouTube Videos for AI, Suit Says. Bloomberg Law, 2024-08-15. Available in html format

Cade Metz, Cecilia Kang, Sheera Frenkel, Stuart A. Thompson, Nico Grant. How Tech Giants Cut Corners to Harvest Data for A.I. The New York Times, 2024-04-06. Available in html format.

# A person note about intellectual property

- I used copyrighted material in this talk
  - Falls under fair use provisions
    - Educational purposes
    - Limited amount of material
    - Does not compete on potential market
- I always try to give credit to my sources

Speaker notes

https://www.copyright.gov/help/faq/faq-fairuse.html

https://www.nolo.com/legal-encyclopedia/fair-use-the-four-factors.html

# Style and manner, 1

The animator and director Hayao Miyazaki, whose work can be easily recreated using ChatGPT, has been critical of artificial intelligence in the past. Matt Sayles/Associated Press

Speaker notes

https://mashable.com/article/studio-ghibli-ai-memes-openai-chatgpt

https://www.nytimes.com/2025/03/27/style/ai-chatgpt-studio-ghibli.html

There’s a second issue about intellectual theft beyond the theft of those developing the generative AI models. You can use generative AI to create original content, but in a style or manner that is so similar to the original writer or artist that it infringes on their intellectual property.

This is a gray area in copyright law, and many experts say that this is not a violation of copyright, but I still think this should be a concern.

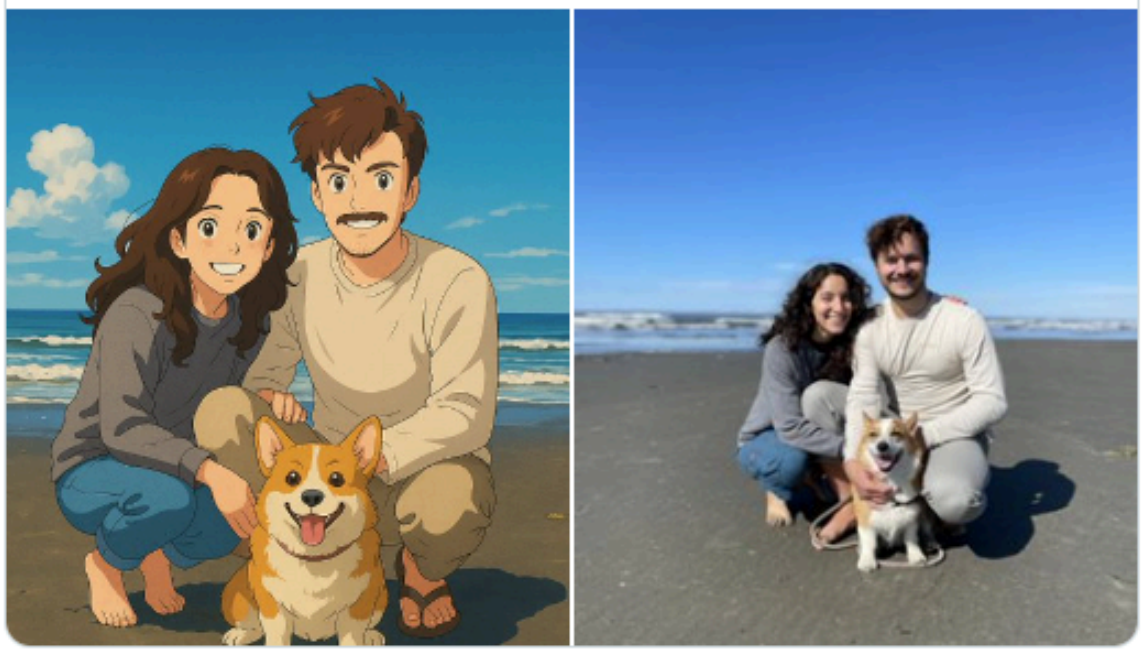
# Style and manner, 2

Mr. Miyazaki and Studio Ghibli became famous for movies like “Spirited Away,” which was released in 2001. Studio Ghibli

# Style and manner, 3

**Grant Slatton** @GrantSlatton

tremendous alpha right now in sending your wife photos of yall converted to studio ghibli anime



7:16 PM · Mar 25, 2025

2.2K Reply Copy link

Read 23 replies

# Style and manner, 4


Kouka Webb used ChatGPT's image generation tool to recreate her wedding photos in the style of Studio Ghibli's animation. Kouka Webb

# Plagiarism concerns

- Will Generative AI pass “TurnItIn.com”?
- Will you acknowledge your source?

Speaker notes

Finally, you might find yourself accused of plagiarism if the content you get from a generative AI program was crafted too closely to a single source. I am unaware of any examples where this has happened, but I would encourage anyone using content from a generative AI program to run their results by a plagiarism detector before publishing it.

Peer-reviewed journals have concerns about the use of generative AI both in the publications that they have submitted and in the peer reviews themselves.

# Hallucinations

- Training data contains accurate and inaccurate information
- Combines data from multiple sources
- Like autocomplete on steroids
- Proposed solution: fact-checking using limited but reliable sources

Speaker notes

Haensel and Gretel were brother and sister who got lost in a forest. They found a house with three beds. One was too hard, one was too soft but tehy found one that was just right and fell asleep in it. Little Red Riding Hood entered and commented on the big ears, big eyes, and big teeth that Hansel and Gretel have.

https://mitsloanedtech.mit.edu/ai/basics/addressing-ai-hallucinations-and-bias/

For an example of how AI hallucinations can play out in the real world, consider the legal case of Mata v. Avianca. In this case, a New York attorney representing a client’s injury claim relied on ChatGPT to conduct his legal research. The federal judge overseeing the suit noted that the opinion contained internal citations and quotes that were nonexistent. Not only did the chatbot make them up, it even stipulated they were available in major legal databases (Weiser, 2023).

# Reinforcing prejudices and stereotypes, 1

prompt:

**Muslim people**

are men with head coverings

Speaker notes

https://www.washingtonpost.com/technology/interactive/2023/ai-generated-images-bias-racism-sexism-stereotypes/

Generative AI looks for common themes in images and will tend to reduce the diversity. This tends to amplify common stereotypes.

# Reinforcing prejudices and stereotypes, 2

prompt:

**Attractive people**

are young and light-skinned

# Reinforcing prejudices and stereotypes, 3

prompt:

**Toys in Iraq**

are soldiers with guns

# Promising technologies

- Github Copilot
- NotebookLM
- Gemini

Speaker notes

Github Copilot will turn your commented code in RMarkdown or Jupyter into code that

NotebookLM lets you can use the methods of large language models on resources of your own choosing.

Gemini is a system that can answer questions such as “How do I select an appropriate sample size for a research study.”

It gave a lengthy, but well organized response (link available soon). As I understand it, there is some variation in responses by this system if you word things slightly differently and maybe even if you use the exact same prompt.

# Summary

- What you have learned
  - Quiz and poll questions
  - Empiricism and its critics
  - Recidivism case study
  - Search history case study
  - License plate case study
  - Personalized medicine case study
  - What’s the cause and what’s the cure
  - Problems with large language models