BROWN
Computer Science

CS1951A: Data Science

Lecture 1: Introduction

Lorenzo De Stefani

Spring 2022

Overview

- Introduction: What is Data Science, and why should you care?
- Course organization
- Course contents

Harvard Business Review

DATA

Data Scientist: The Sexiest Job of the 21st Century

More than anything, what data scientists do is make discoveries while swimming in data. It's their preferred method of navigating the world around them. At ease in the digital realm, they are able to bring structure to large quantities of formless data and make analysis possible. They identify rich data sources, join them with other, potentially incomplete data sources, and clean the resulting set. In a competitive landscape where challenges keep changing and data never stop flowing, data scientists help decision makers shift from ad hoc analysis to an ongoing conversation with data.

Data scientists realize that they face technical limitations, but they don't allow that to bog down their search for novel solutions. As they make discoveries, they communicate what they've learned and suggest its implications for new business directions. Often they are creative in displaying information visually and making the patterns they find clear and compelling. They advise executives and product managers on the implications of the data for products, processes, and decisions.

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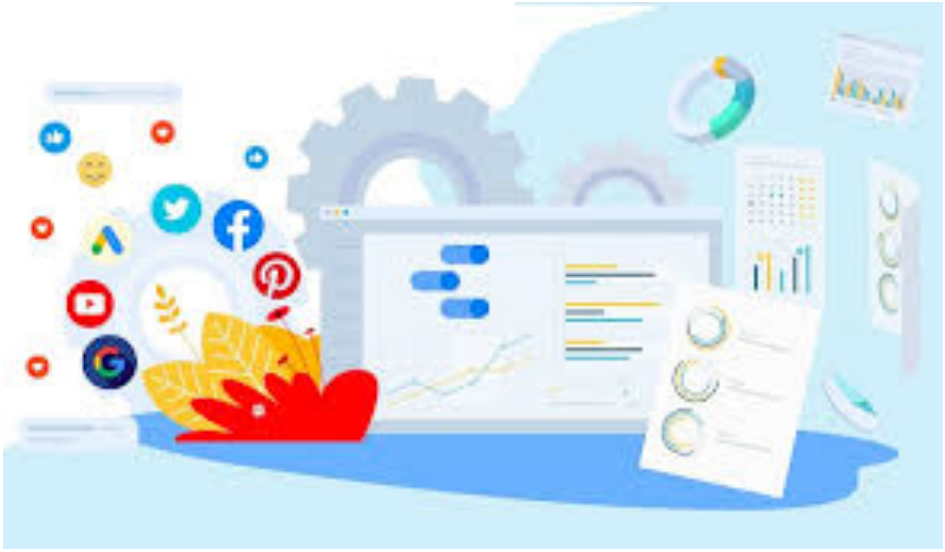
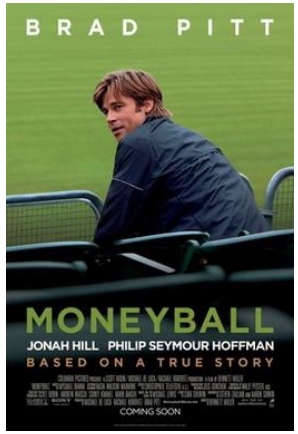
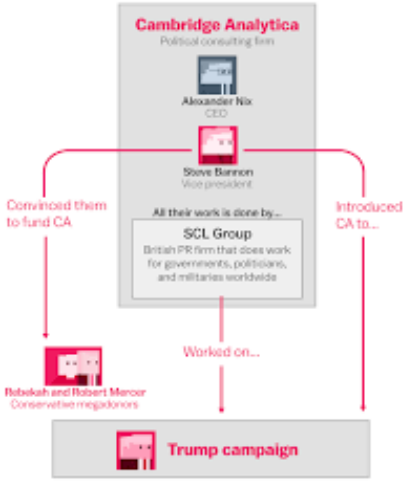
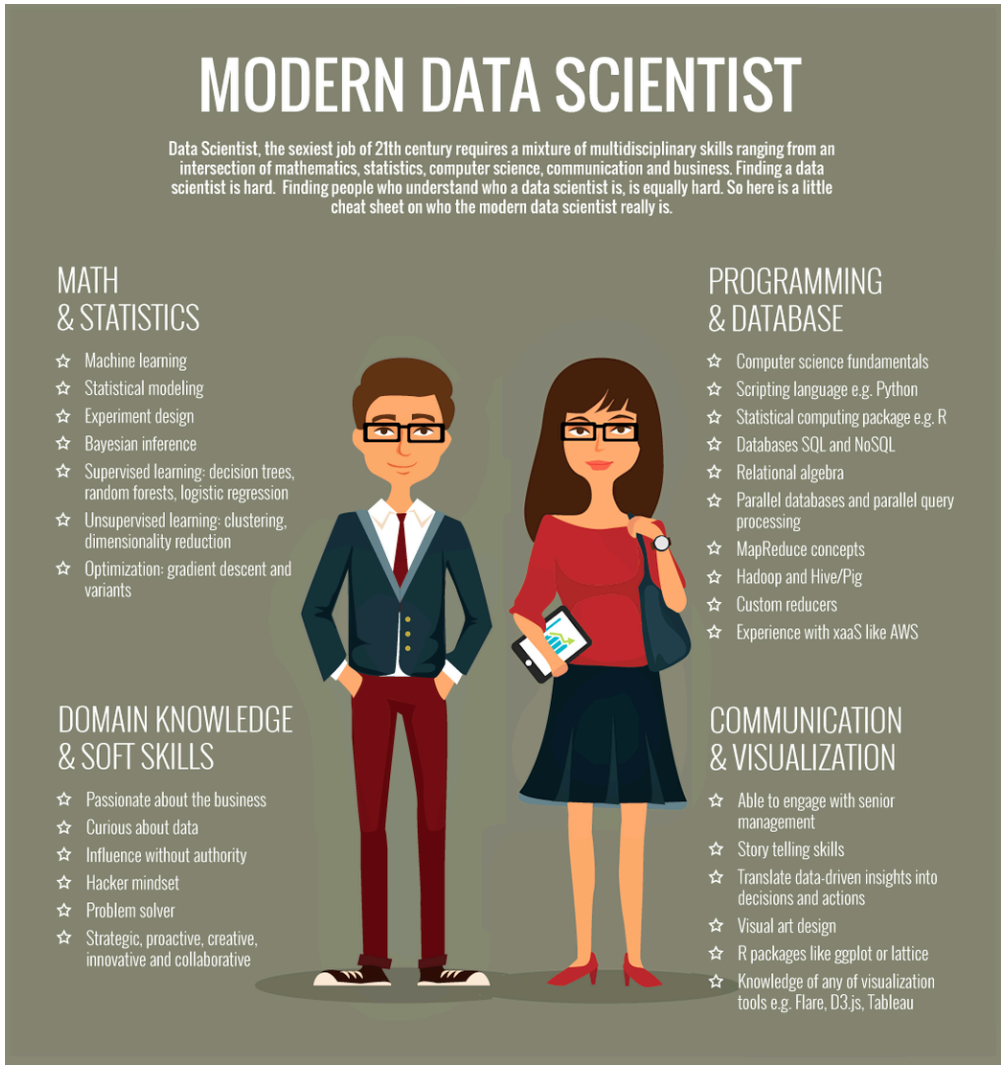
Data Science is everywhere







What makes a "Data Scientist"?



Learning the language of data

Learning the language of data

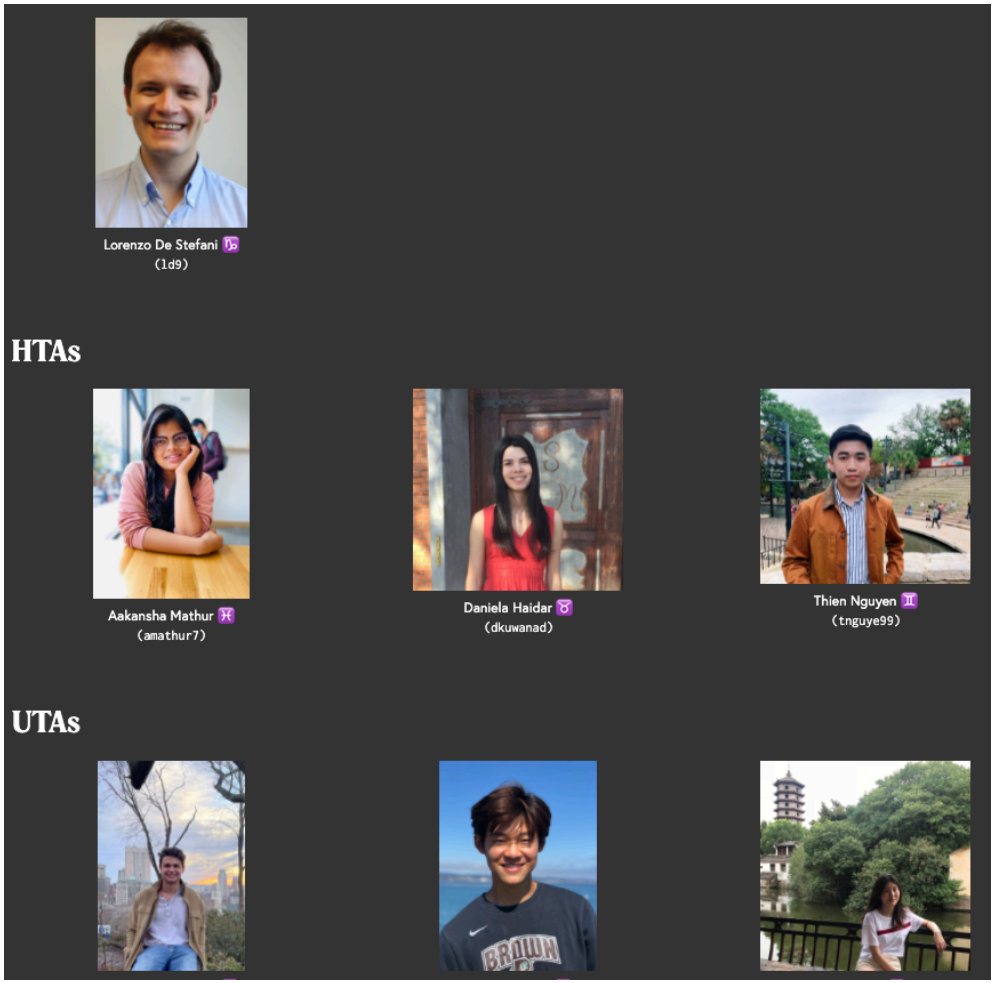
- We will see many useful tools!
- Data science is not just a composition of techniques
- It transcends its tools
- More like a “thinking approach”

Overview

- What is data science
- Course organization
- Cool facts about data science

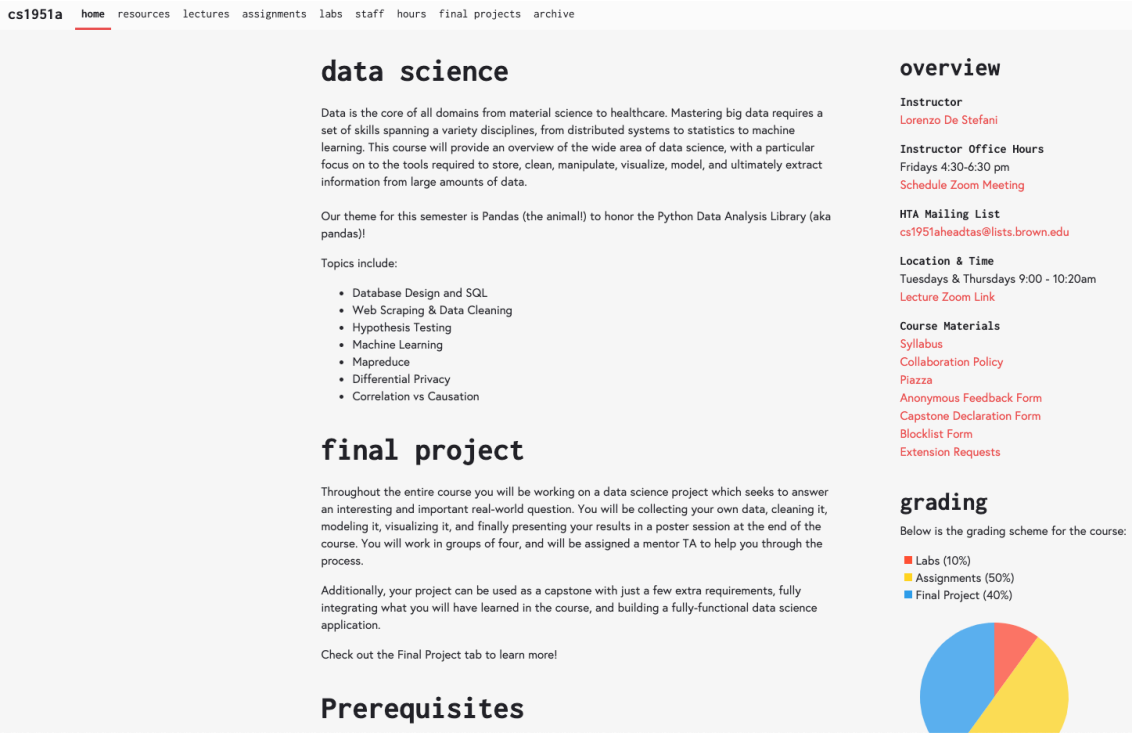
Couse Staff

- Instructor: Lorenzo De Stefani
- HTAs:
  - Aakansha Mathur
  - Daniela Haidar
  - Thien Nguyen
- UTAs:
  - Austin De Stefanis
  - Benjamin Shih
  - Ella Liang
  - Emily Ye
  - James (Yicheng) Shi
  - Kenya Kimata
  - Livia Gimenes
  - Dharam Madnani
  - Micah Buring
  - Nadav Druker
  - Nange Li
  - Robert Scheidegger
  - Shirley Loayza Sanchez
  - Sunny Li
  - Joanna Tasmin (also STA)
- STAs
  - Aanchal Sheth



Course website

- https://cs1951a-s21-brown.github.io/index.html
- https://piazza.com/class/kjqpfnm6w6b4f7



Grading

Three main components:

- 50%: Assignments
- 10%: Labs
- 40%: Project

Lectures and recordings

- All lectures streamed live on Panopto
  - Live attendance is strongly encouraged
  - Join class meeting a couple of minutes in advance
  - Ask questions using the chat
- Recoding of the class lectures will be available within 24 hrs of live classes on Panopto
  - We will have a pinned post on Ed
- Lecture slides will be uploaded before class
- Jupyter notebooks for code-along available before class

Late days policy

- Assignments are due at 11:59 pm on the listed due date
- 3 late days total you can use at most 2 for any assigment
- Additional late days request must be accompanied by a Deans Note and can only be approved by Lorenzo
- SEAS accommodation: reach out to Lorenzo ASAP
- Assignments submitted past the deadline after late days will not be graded
- No late days for Final Project deliverables
- Timely communication is key!

Collaboration policy

- Collaboration on assignments is allowed and encouraged ☺
- But! Your submission must be your own!
- Write your own solutions and your own code
  - Copy paste = BAD ☹
  - Do not search the web for solutions

Please review sign and submit the syllabus

Waitlist

- The class is currently full
- We have some little wiggle room with the cap
- Send requests via email and on CAB so we can keep track of them
- We will give priority fairly
  - Seniors > Juniors > Sophomores
  - Priority to students matching all prerequisites

Capstone

- Senior students can take CS1951A as a capstone
  - Please fill in the capstone form request on the website
- You will extend your project to include an interactive component or an extended analysis
  - If one person in a group plans to use the project for a capstone, the entire group will be held to the capstone standard
- All graduate students must complete the project at the capstone level

Overview

- Intro: what is data science?
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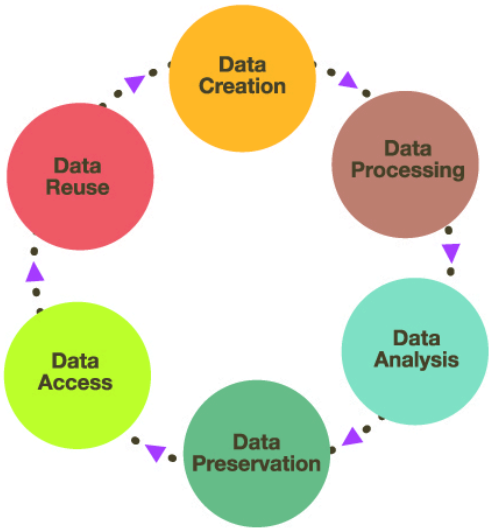
What we are going to talk about

- Database design and SQL
- Data Cleaning
- MapReduce
- Hypothesis testing
- Machine Learning
- Data Visualization
- Crowdsourcing
- Causality/vs correlation
- Ethics of Data Analysis



Handling and understanding data

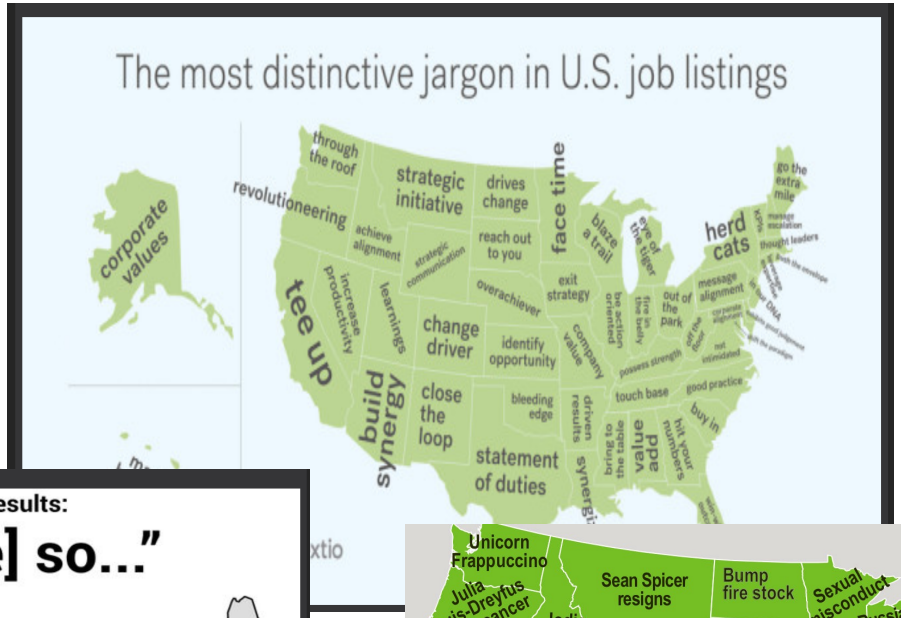
BIG DATA

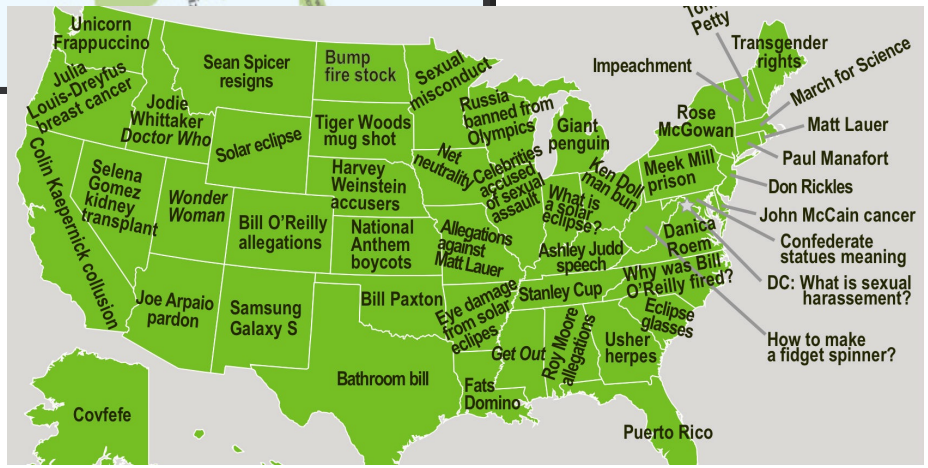
- Easy to acquire
- Hard to manage
- Consistency/cleanliness issues
- We need automatic ways to extract information
- Time sensitive
- Efficiency challenges
- Can provide lots of reliable insight!

SMALL DATA

- Hard to acquire
  - "Precious data" (e.g. clinical trials, interviews, etc.)
- Easy to manage and review
- Long life cycle
- How can we make the most of it?
- Can we extract insights which are guaranteed to generalize to the larger world?

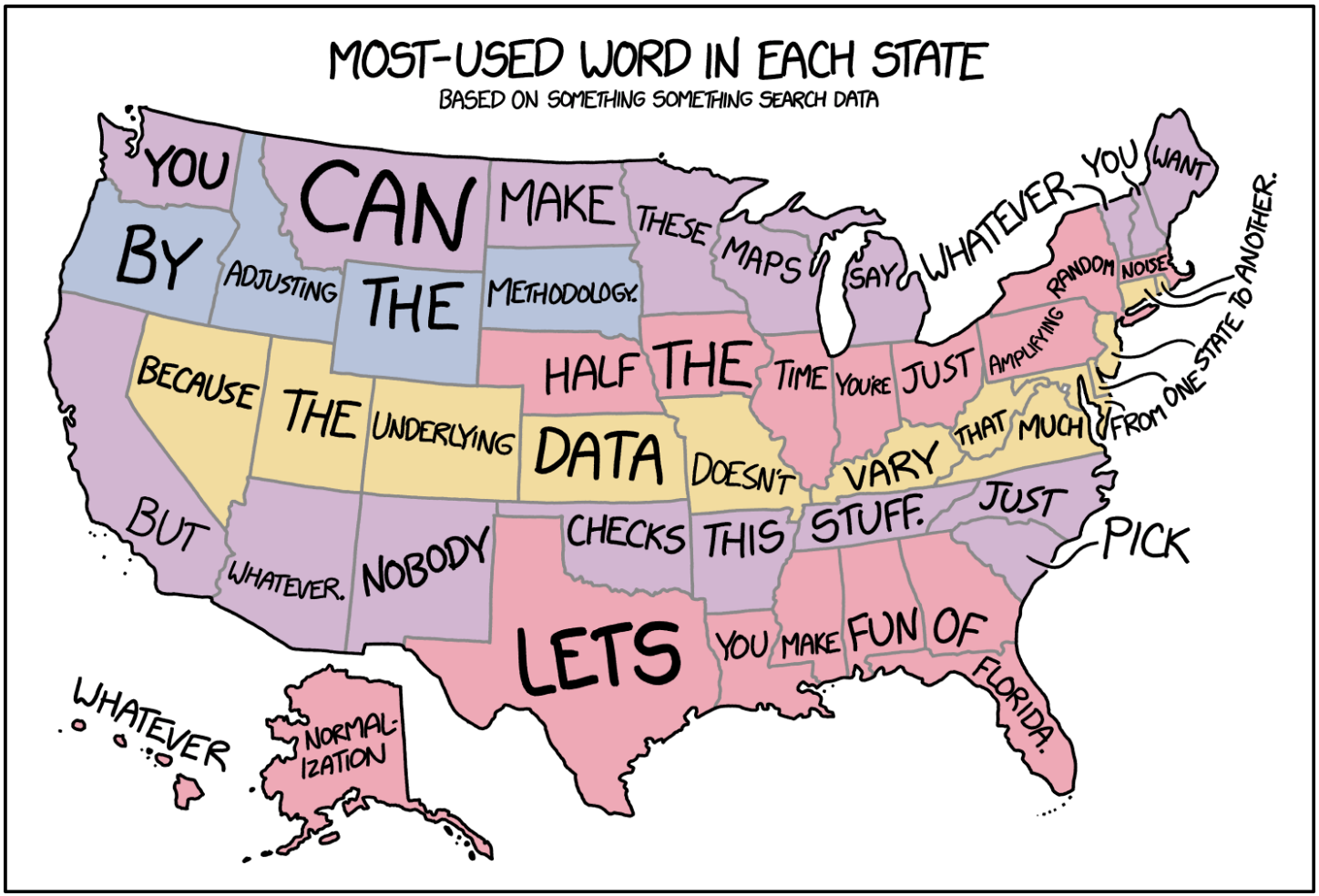
Data “Science”?





https://www.dailydot.com/unclick/state-googled-2017
http://nerdgeeks.co/us-state-words-map

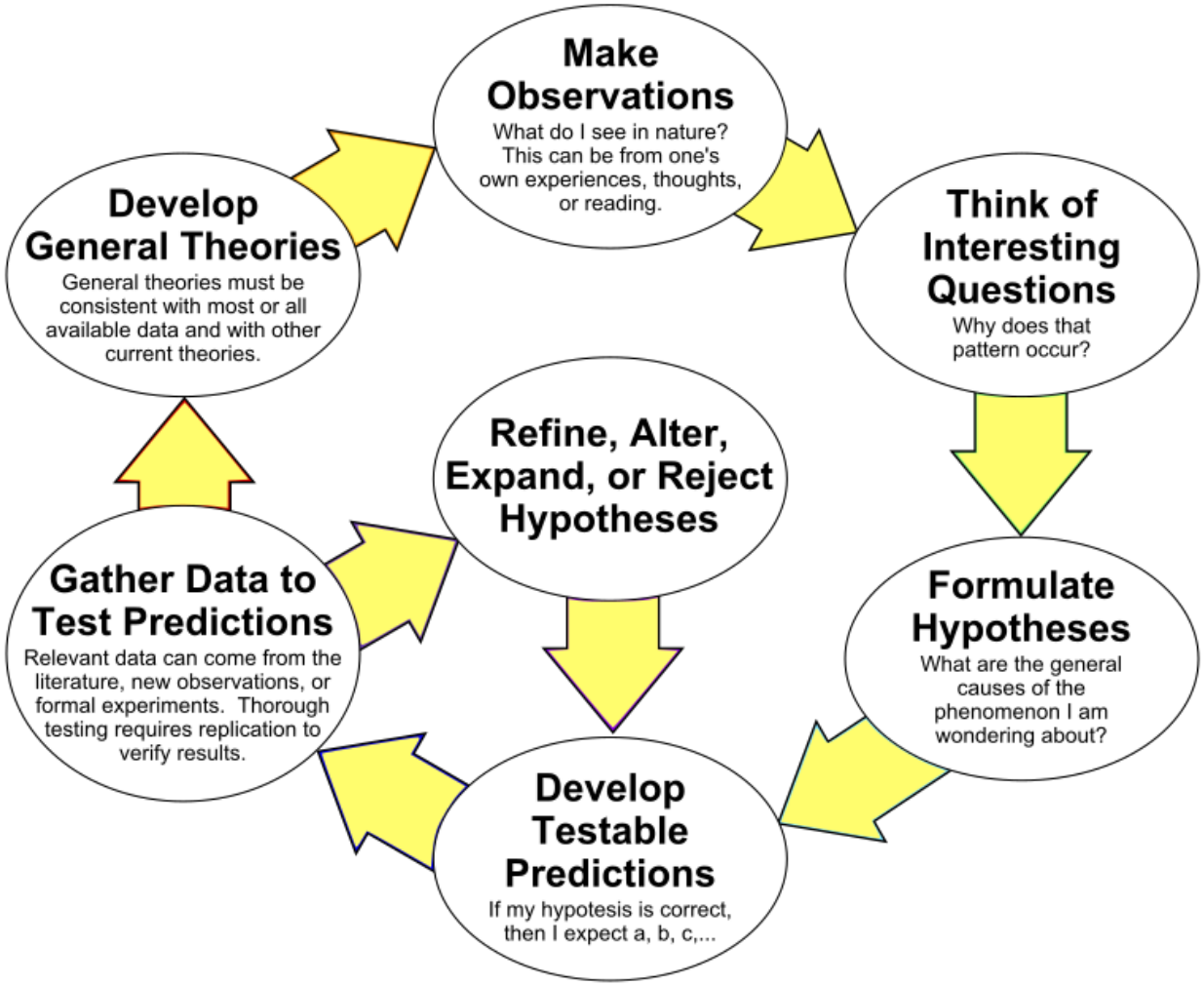
Data "Science"?



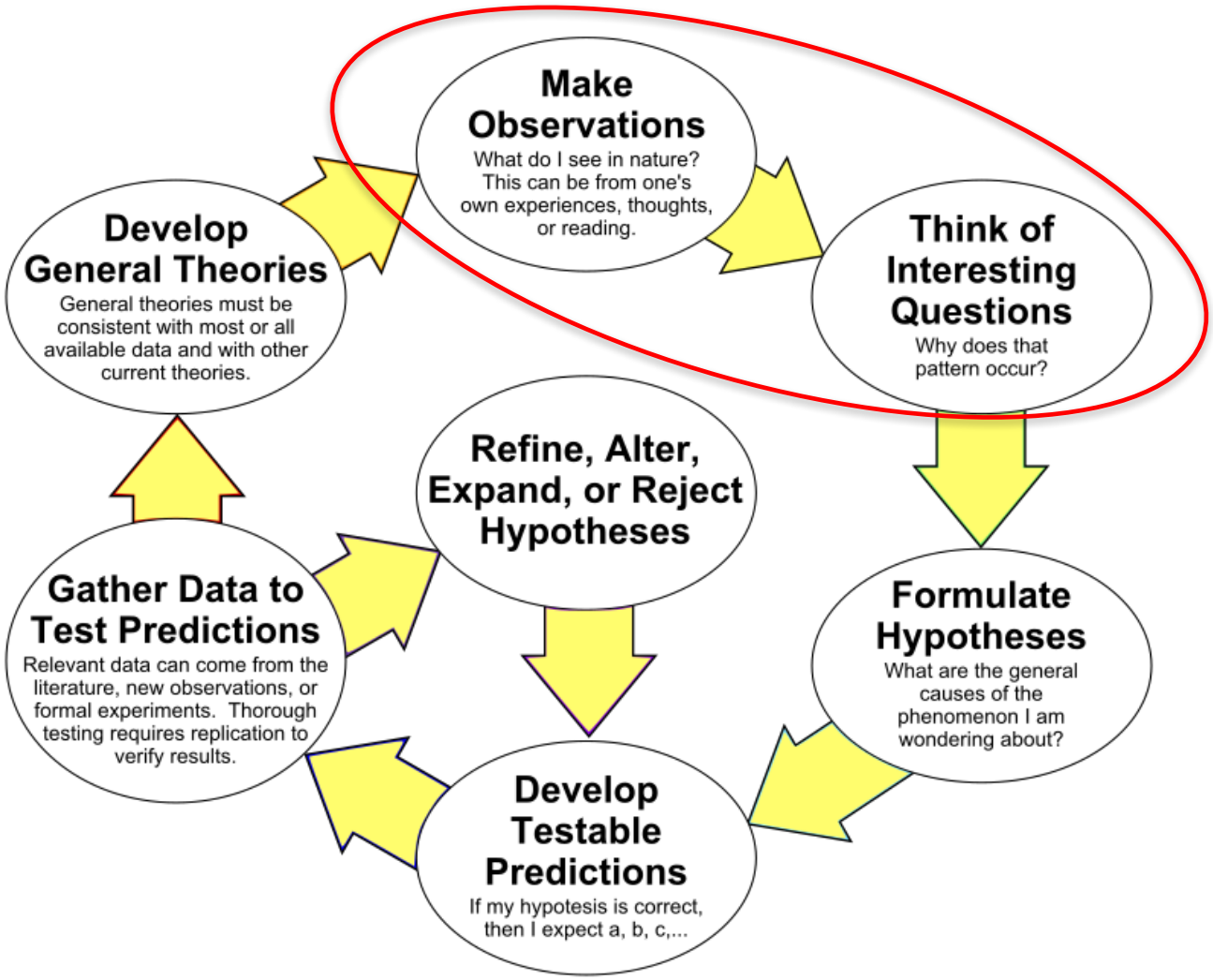
Science and Art

- Intuition and empirical techniques play a huge role in Data Science
  - What is the best approach to analyze the given data?
  - What are interesting insights to evaluate?
  - How do I define the “interest” of a discovery
  - How can I effectively present the results of my analysis?

The scientific method



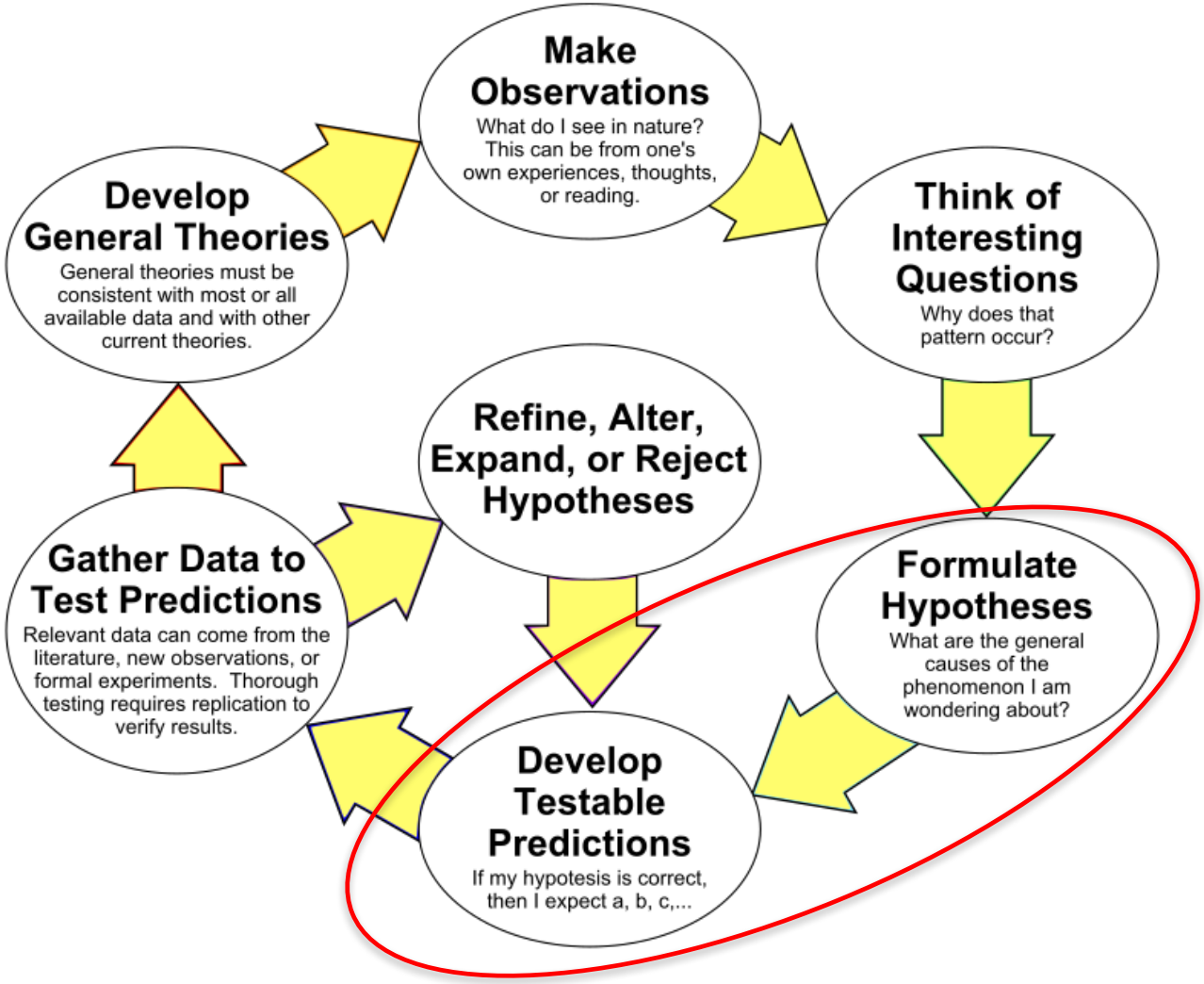
The scientific method



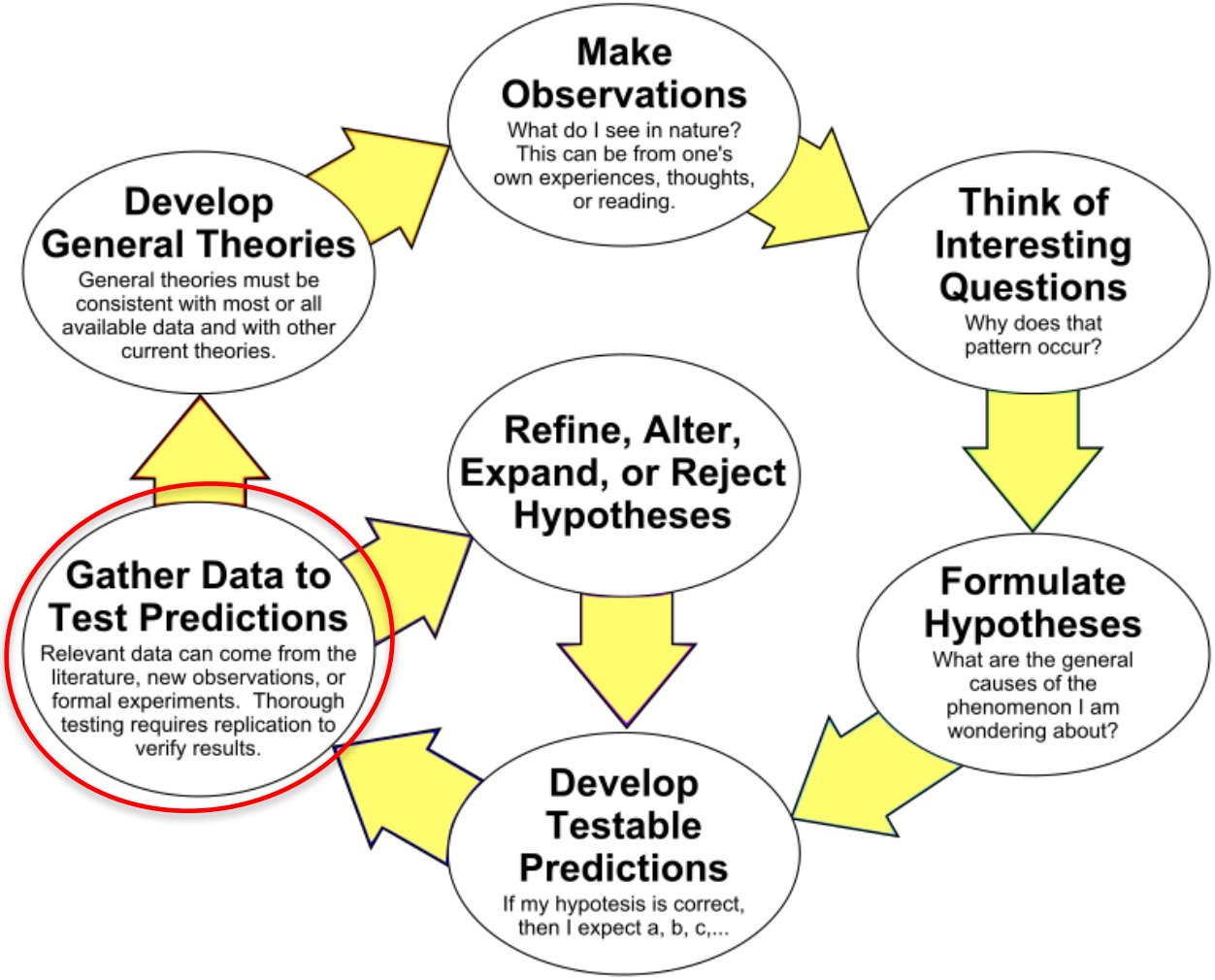
The Scientific method of data science

- Theoretical models and analysis help us understand the validity of our insight
  - Exploratory analysis (even when it involves the biggest of data) is meant to *form* a hypothesis, not test one
  - Good experimental design and rigorous statistics are essential if we want to make claims about how the world works
  - "All models are wrong, but some are useful."

The scientific method

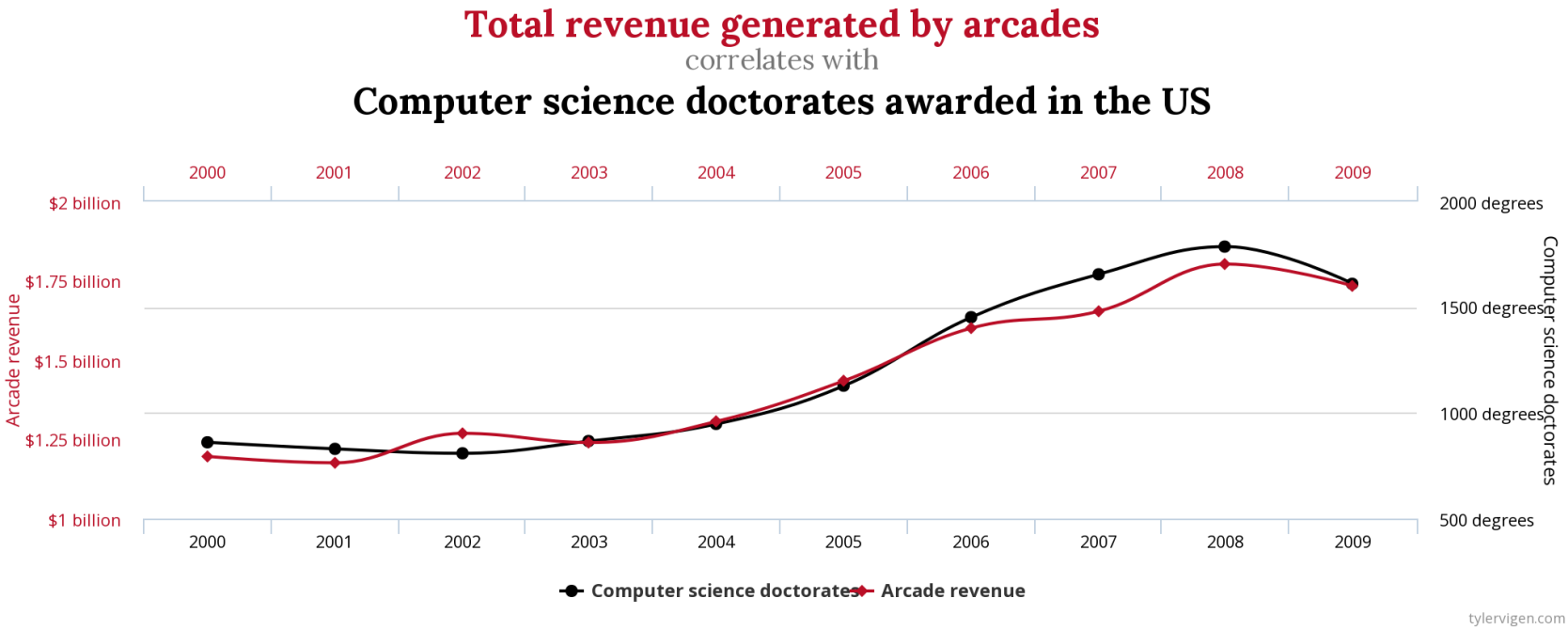


The scientific method



The Scientific method of data science

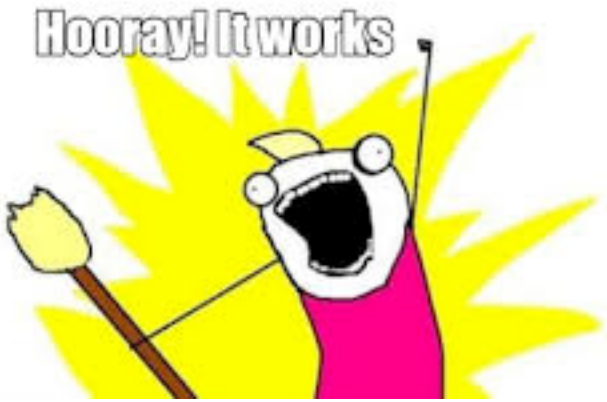
Intuition can be useful but also very dangerous!



... just because something looks right or relevant it does not mean that it is!

The problem with heuristic and intuition

- We have plenty of great more or less complicated heuristics that work great!



That's great!
How does it work?

The problem with heuristic and intuition

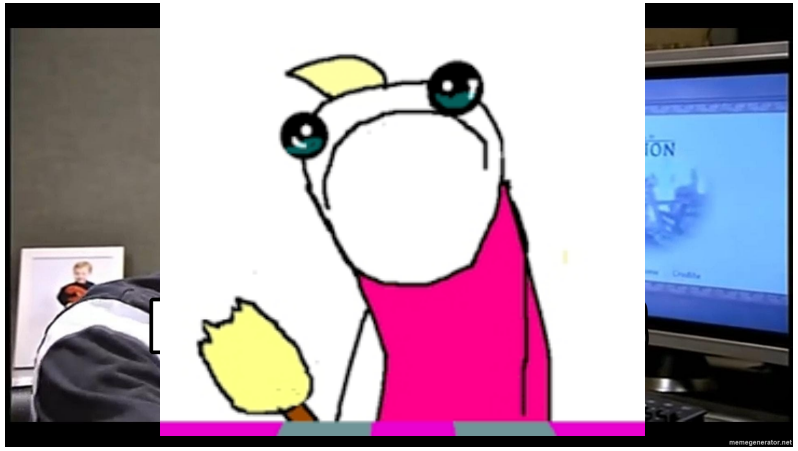
- We have plenty of great more or less complicated heuristics that work great!

I mean….it works! YAY!

OK I get it!
But how are you sure that it is working correctly?

The problem with heuristic and intuition

- We have plenty of great more or less complicated heuristics that work great!



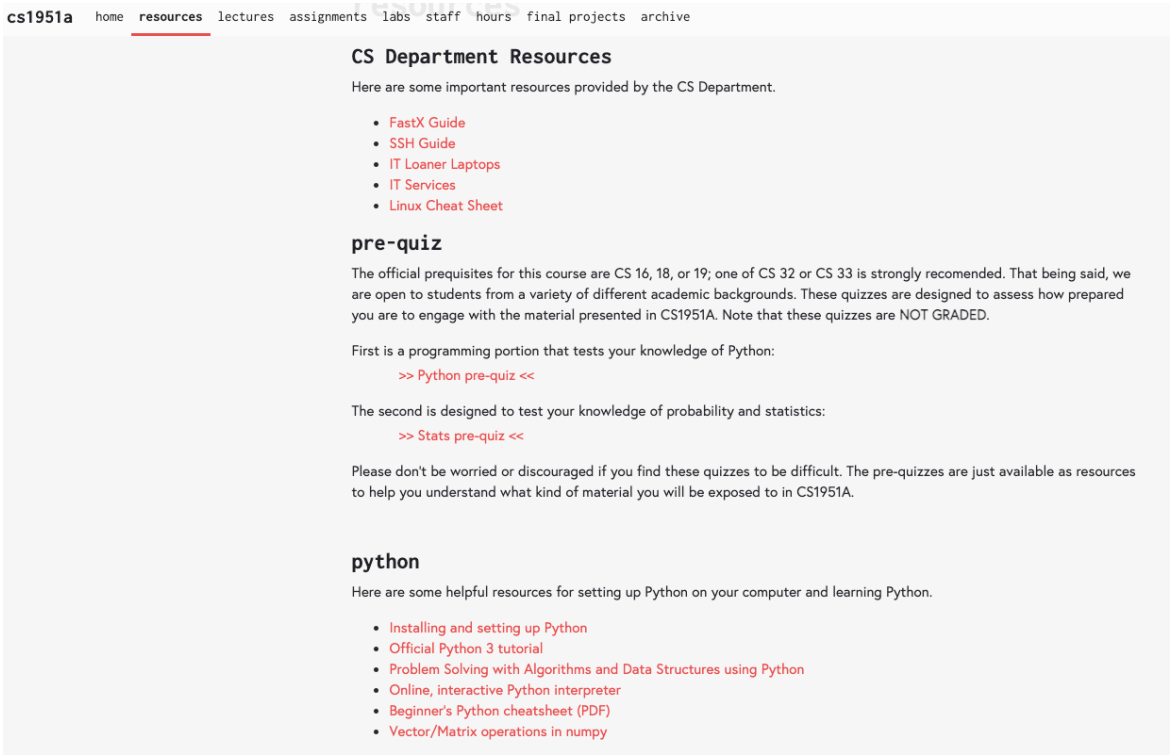
You really have no idea, have you?

The benefit of rigorous analysis

- Helps us understand why our methods are working!
  - Guarantees on the significance and correctness of our insights
  - Generalizability of our discoveries
  - Distinguish "true" phenomena from noise in the data
  - Understanding of the properties of the population being considered
  - Crucial for reproducibility

What do I need to know?

- Programming experience is very useful
  - Python 3.7
  - Use the resources on the website
- Background in statistics



To do now

- Make sure you are registered on Ed
- Submit signed syllabus
- Consult resources on the website
- Apply for a lab slot
- Start thinking on the group project
  - Find collaborators
  - Share ideas