Reminders

Upcoming due dates
Mon Oct 13th Quiz 2
Wed Oct 15th Project group signup, Github username quiz; both on Canvas
Fri Oct 17th Discussion Lab 2

Discussion section covers Pandas this week

Asking good questions

Data Science in Practice

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Includes material supplied by Tom Donoghue, Benjamin S. Baumer, Daniel T. Kaplan, and Nicholas J. Horton

Today's Learning Objectives:

- How to think about the data science process
- Demonstrate ability to move from a general question to a data science question

Nature of a data scientist

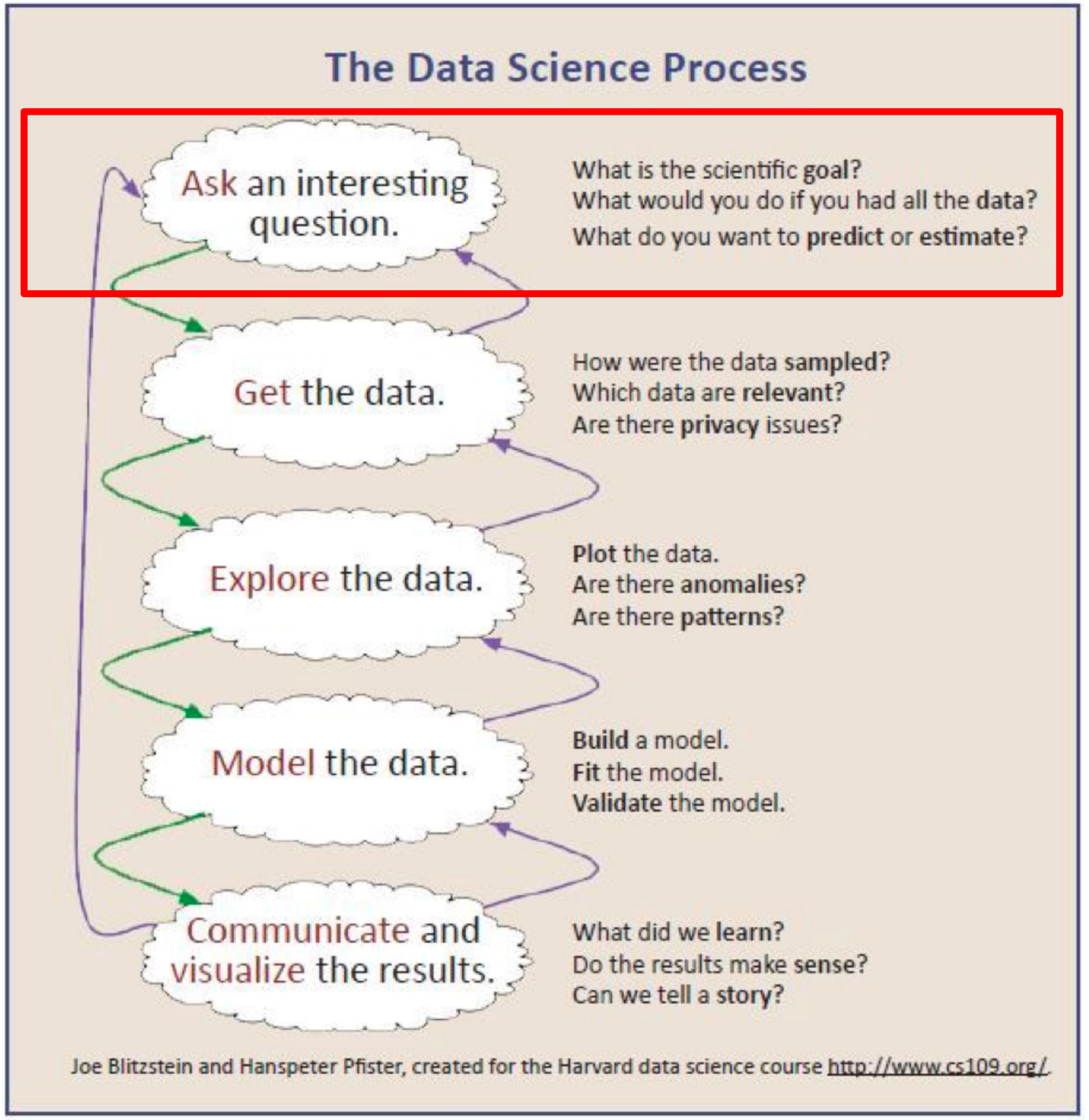
adapted from Chris Keown

- data-driven
- care about answers
- analyze data to discover something about how the world works
- know that each analysis is just a different viewpoint, trying to make sense of a complex whole that can’t easily be perceived
- care about whether the results make sense, because they care about it means
- are comfortable with the idea that data have errors
- are comfortable with the idea that there’s more than one way to analyze the same
- know nothing is ever completely true or false in science
- know that you can still learn something and make decisions in spite of these uncertainties
- cares about communicating these subtleties as well as the results themselves

Nature of a GREAT data scientist

- Conscientious, works using proven and understood methods, triple checks things
- Yet is open to new methods and creative at finding solutions (just checks them thoroughly!)

- Methodical
- Yet after working down in the details, takes a step back and questions the big picture


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/

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. —attributed to Einstein

Data Science questions should be…

- answerable with data it is possible to collect
- unambiguous in meaning
- specifically describing exactly what data/metrics/analysis are required to answer the question
- big enough to be interesting, small enough to be accomplishable

What makes a question a good question?

Specifying what you're going to measure is important

Examples of poor questions that leave wiggle room for useless answers:

- What can my data tell me about my business?
- How can I increase my profits?

Examples of more realistic poor questions from projects:

- What characteristics make a character in my favorite battle game more likely to win?
- Do days when public events take place have worse traffic?
- Is there a relationship between weather and people's mood?

Examples of good questions where the answer is impossible to avoid:

- How many Model 3s will Tesla sell in San Diego during the third quarter?
- How many students will apply for admission to UCSD in 2030?
- How many students should UCSD admit in 2030 for a target class size of 50,000?

Working toward a strong data science question

Nailing down the right question: politics

Too-vague question: What impacts politics in America?

Improving: 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?

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

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

Nailing down the right question: cause of death

Too-vague question: What gets attention in the news?

Improving: Do terrorist attacks get reported too much?

… Is there a relationship between the number of people who die relative to the amount of media attention a story gets?

… What causes of death are over reported in the news relative to CDC death data? Underreported?

… Is there a relationship over time between cause of death terms in the *NYT*, The Guardian, and Google trends data relative to data from the CDC?

*do you think asking the question above would give different results on data up to 2019 vs a dataset that includes through 2021?

https://github.com/COGS108/FinalProjects-Wi18/blob/master/010-FinalProject.ipynb

Refining a question

https://forms.gle/haxpaaVJcjAQ9Yy86

Here is a much too vague question:

What racial disparities exist in policing?

Let’s refine it. Which of the following would be the best possible data science question?

Nailing down the right question: student success (a skit)

Too-vague question: Who does well at university?

Improving:

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Your turn to nail down the right question: $an Diego Co$t$ (think for 3 min, groups of 2-4 for 5 min, share for 5 min)

Too-vague question: Why is it so expensive to live in San Diego?

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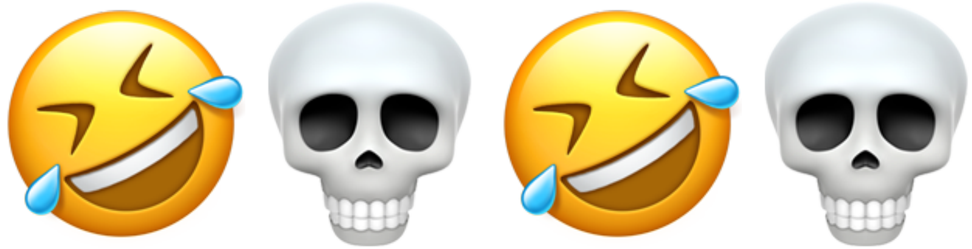
Are these good enough questions? What could be improved?

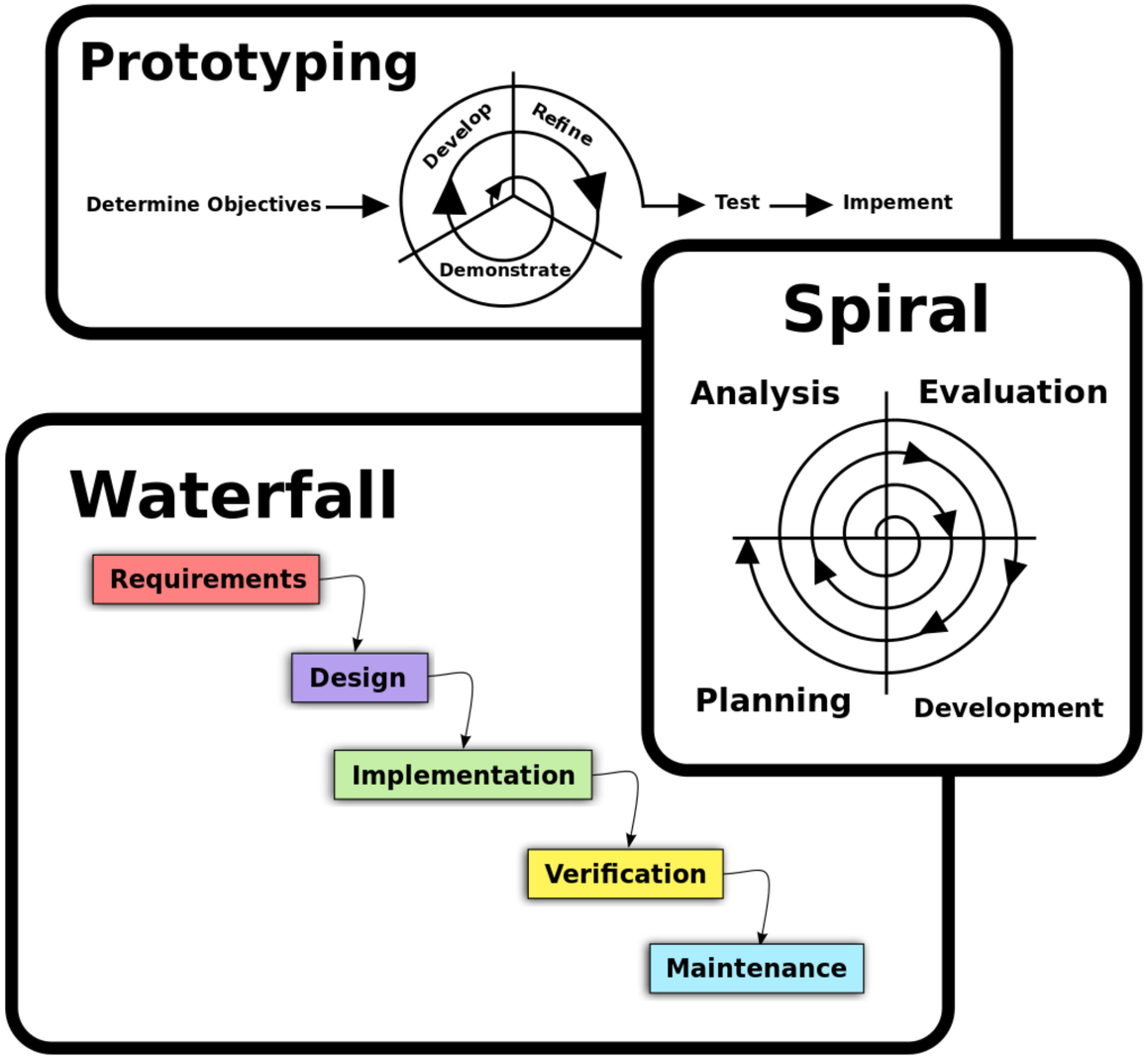
- Does one US political party have a tendency to disproportionately use more negative sentiment on Twitter than the other and if so, what motivates this?
- Is the city’s population, game day weather conditions, and this season’s win rate sufficient to predict attendance at a professional sports match?
- What effects do demographic factors such as age structure, median household income and racial diversity have in influencing pet (cat and dog) adoption rates per state during 2019?

I don’t need to define a question… the boss/customer gives me the question!



Software engineering methods

Metaphor and tool for data science projects



What happens next?

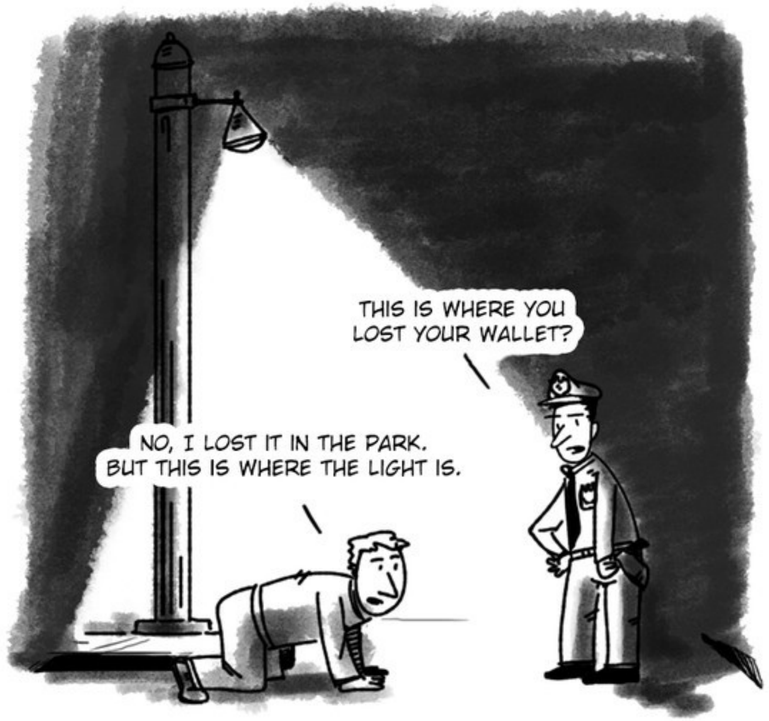
After the question is defined, should it become a project?

- What are the constraints?
- What are the resources available?
- IS THE NECESSARY DATA GETTABLE??
- What are the sure costs and benefits?
- What are the potential risks and rewards? (Includes ethical!)
- Can we define a metric to determine the success of the project?

Unanswerable questions worth asking

A well-spec’d question can still be unanswerable

- Often only bits and pieces of the data puzzle are available, options are:
  - Guide the project to (GOOD!) questions that can be answered with the data available
  - Create a new project to gather the data to answer the question (opportunity!)
- Raising an unanswerable can change how people think and react



“The streetlight effect”