Data science questions

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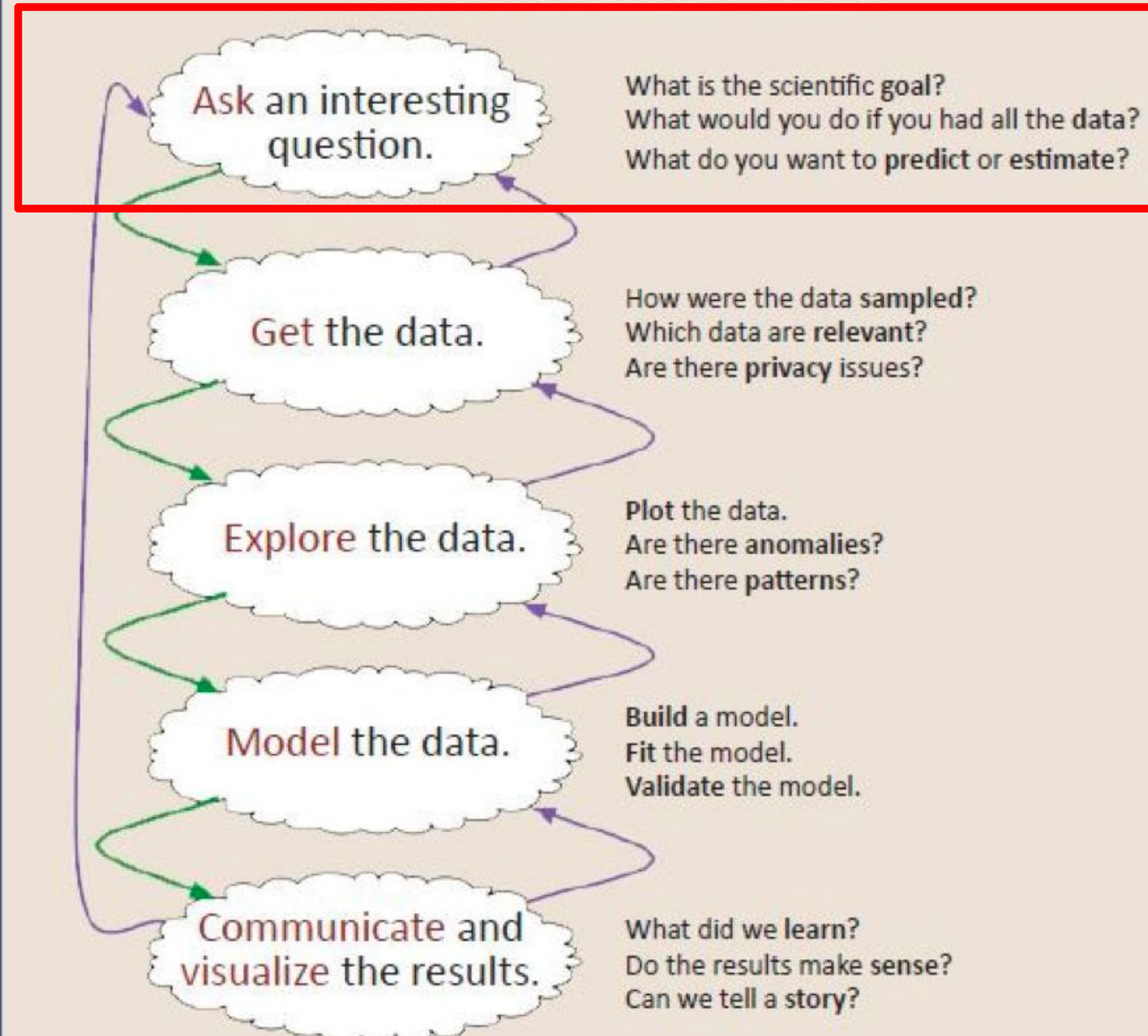# Today's Learning Objectives:

Explain the data science process
Demonstrate ability to move from a general question to a data science question

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/.

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 specific
- Be answerable with data
- Specify what's being measured

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?
- What should I do?
- How can I increase my profits?

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?

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 2020?

Nailing down the right question: policing

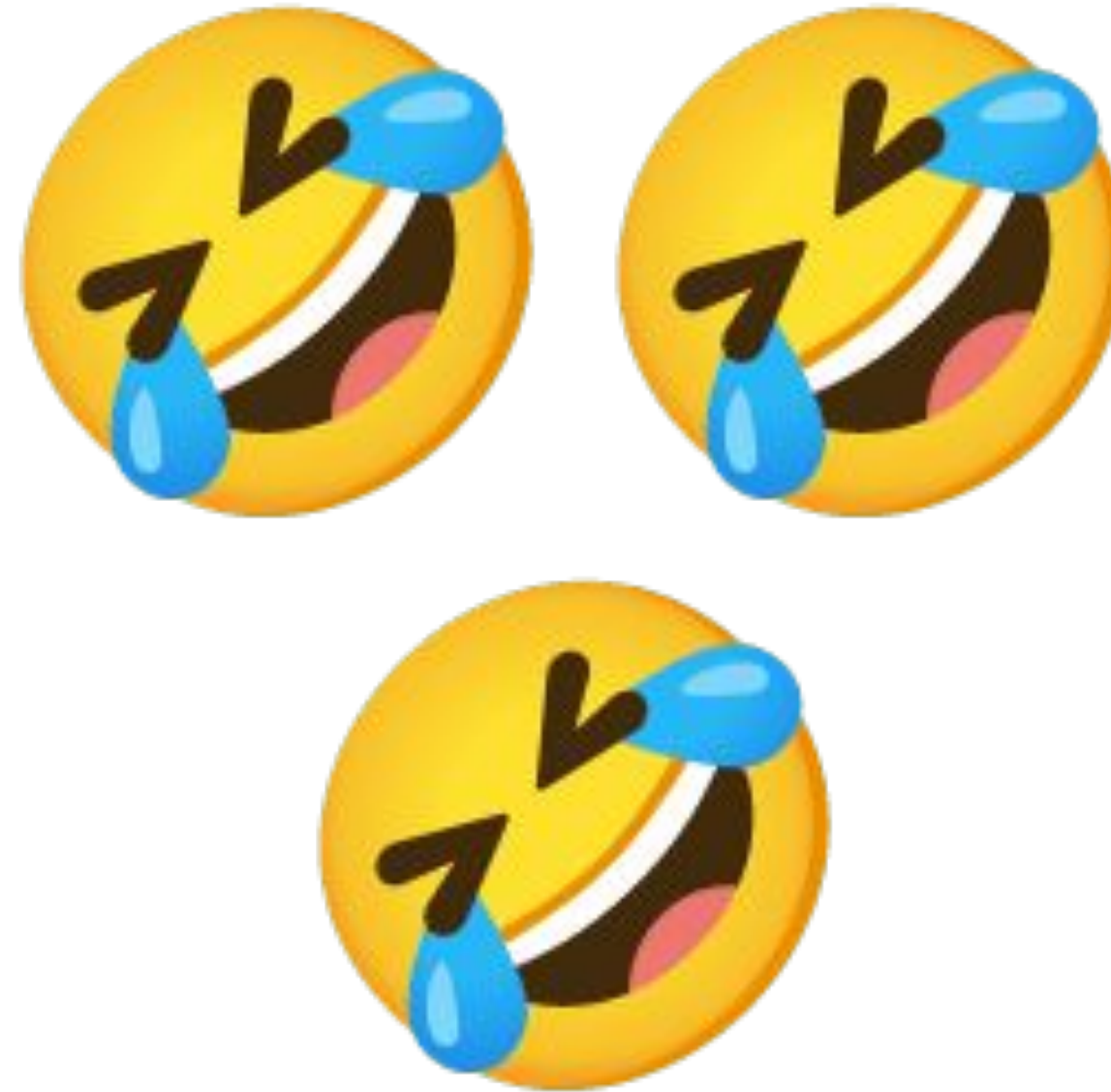Too-vague question: Why isn't police response time always the same?

Improving: How can we improve police response time?

... Do crime levels and time of day affect response time?

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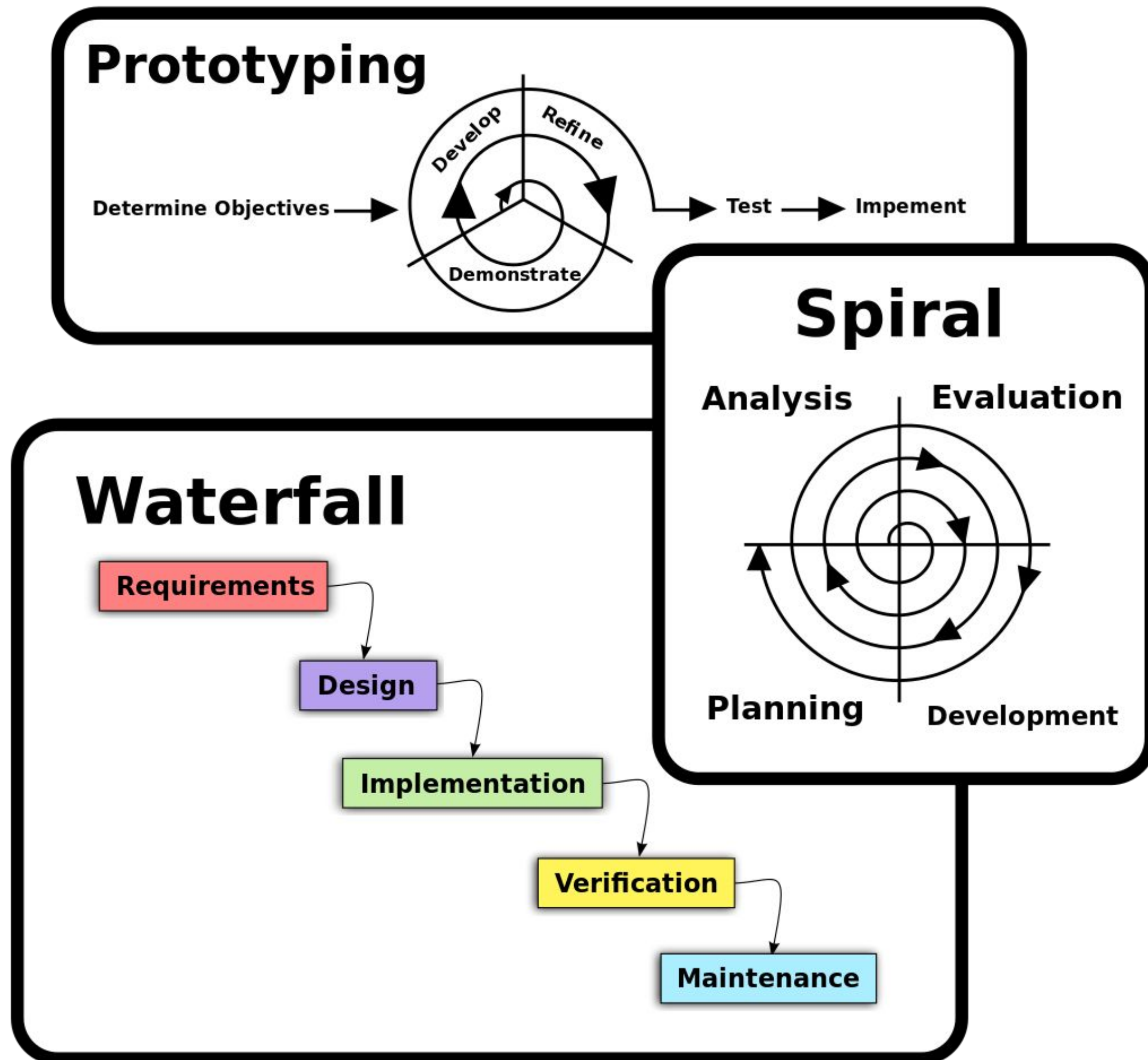
... Where should police cars be stationed, accounting for crime levels and time of day, to make police response times equitable throughout San Diego?

The boss/customer gives me the question!

🤣🤣
🤣

Software engineering methods

Metaphor and tool for data science projects
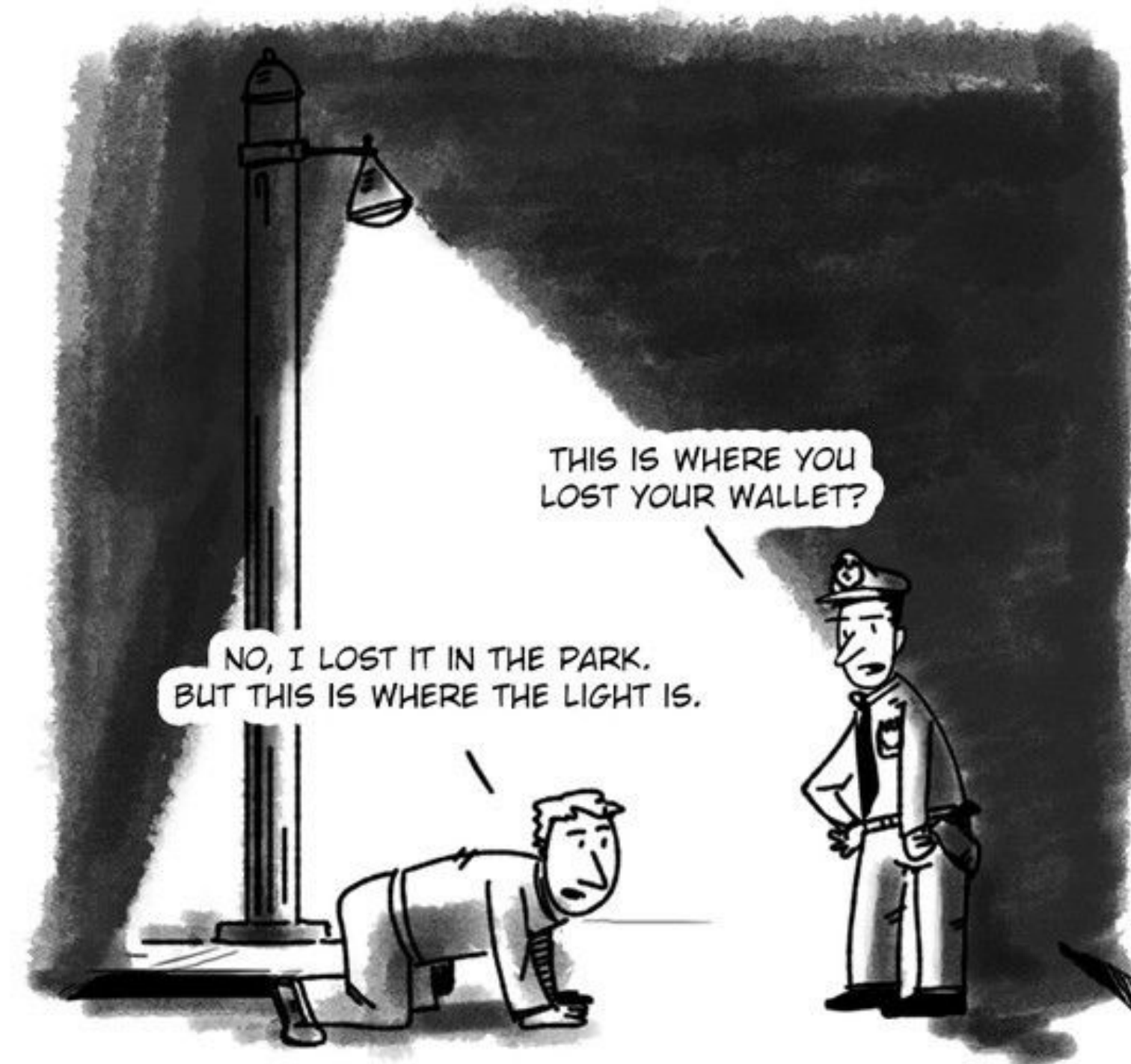
What happens next?

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

- What are the constraints?

- What are the resources available?

- 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"

Nailing down the right question: environment

Too-vague question: What did the pandemic change about our environmental problems?

Improving:

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Nailing down the right question: housing costs

Too-vague question: Why are housing costs so high in San Diego

Improving:

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