

Deploying Data Science & Writing

DS198-003: Data Discovery Scholars Seminar
UC Berkeley - Computation, Data Science, and Society

Spring 2022

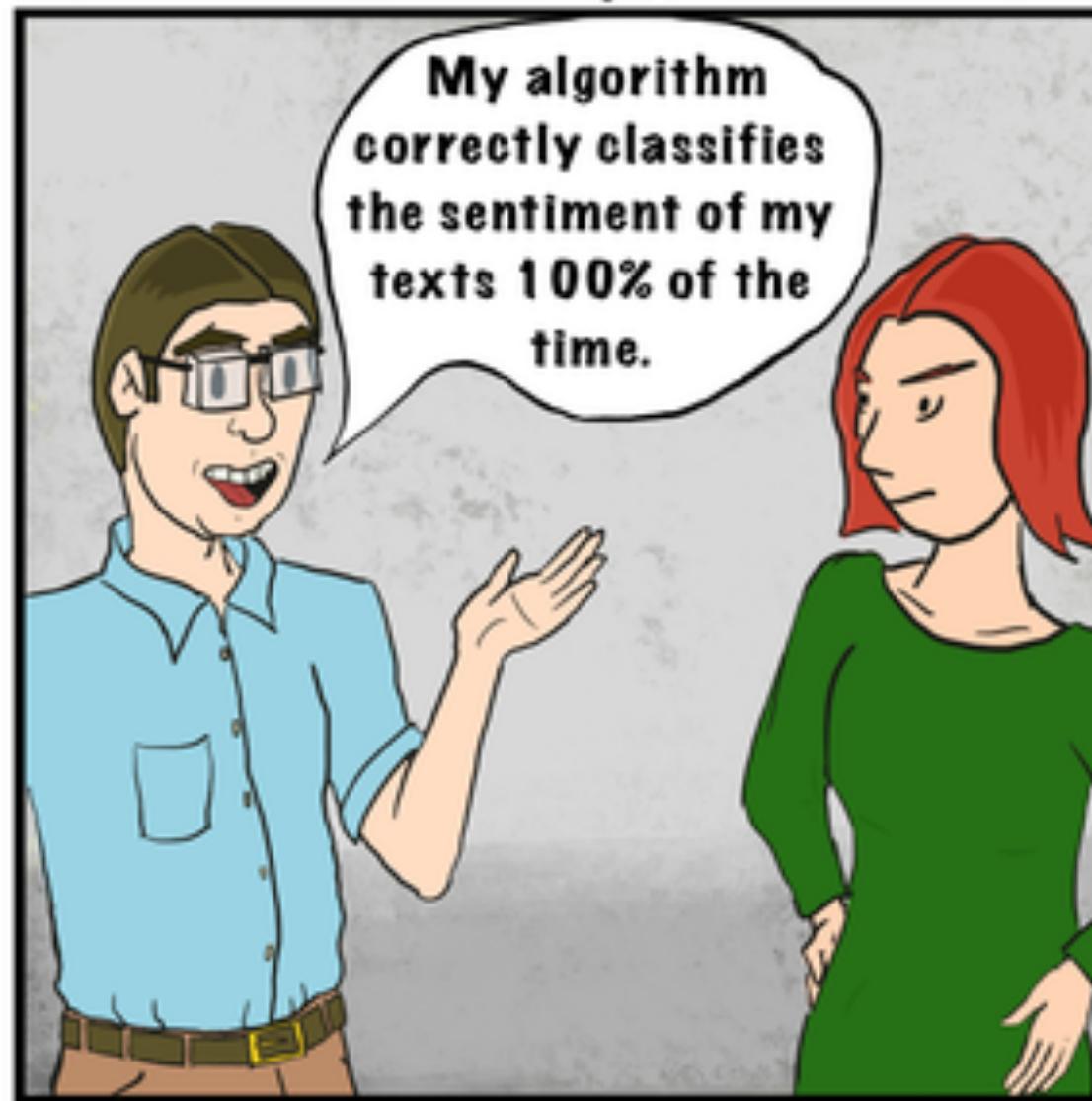
Next Weeks

April Schedule

Date	#	Description	Assignments
4/5	6	Deployment & Writing	Case Study
4/12	7	What's hot in DS & Presenting	
4/19		Check-In II	
4/26	🏁	Final Presentation	Capstone

Meme of the Week

MACHINE YEARNING



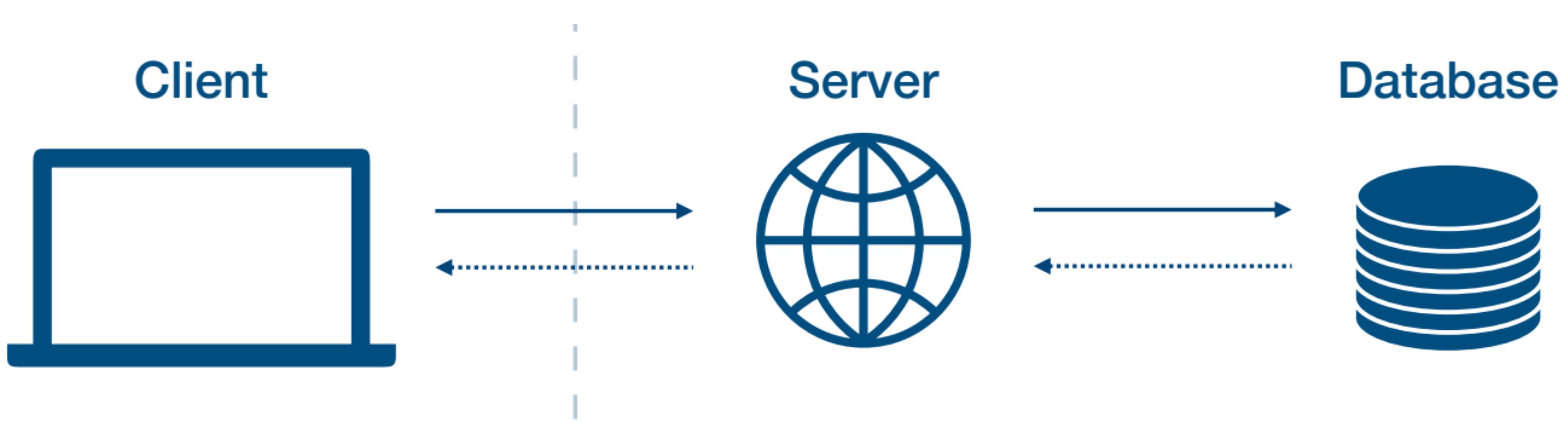
A man with brown hair and glasses, wearing a light blue button-down shirt and brown pants, stands in front of a large screen displaying a 3x3 confusion matrix. A woman with red hair, wearing a green dress, stands behind him, pointing at the screen.

		Actual		
		Happy	Sad	Desperate
Predicted	Happy	0	0	0
	Sad	0	0	0
	Desperate	0	0	1207

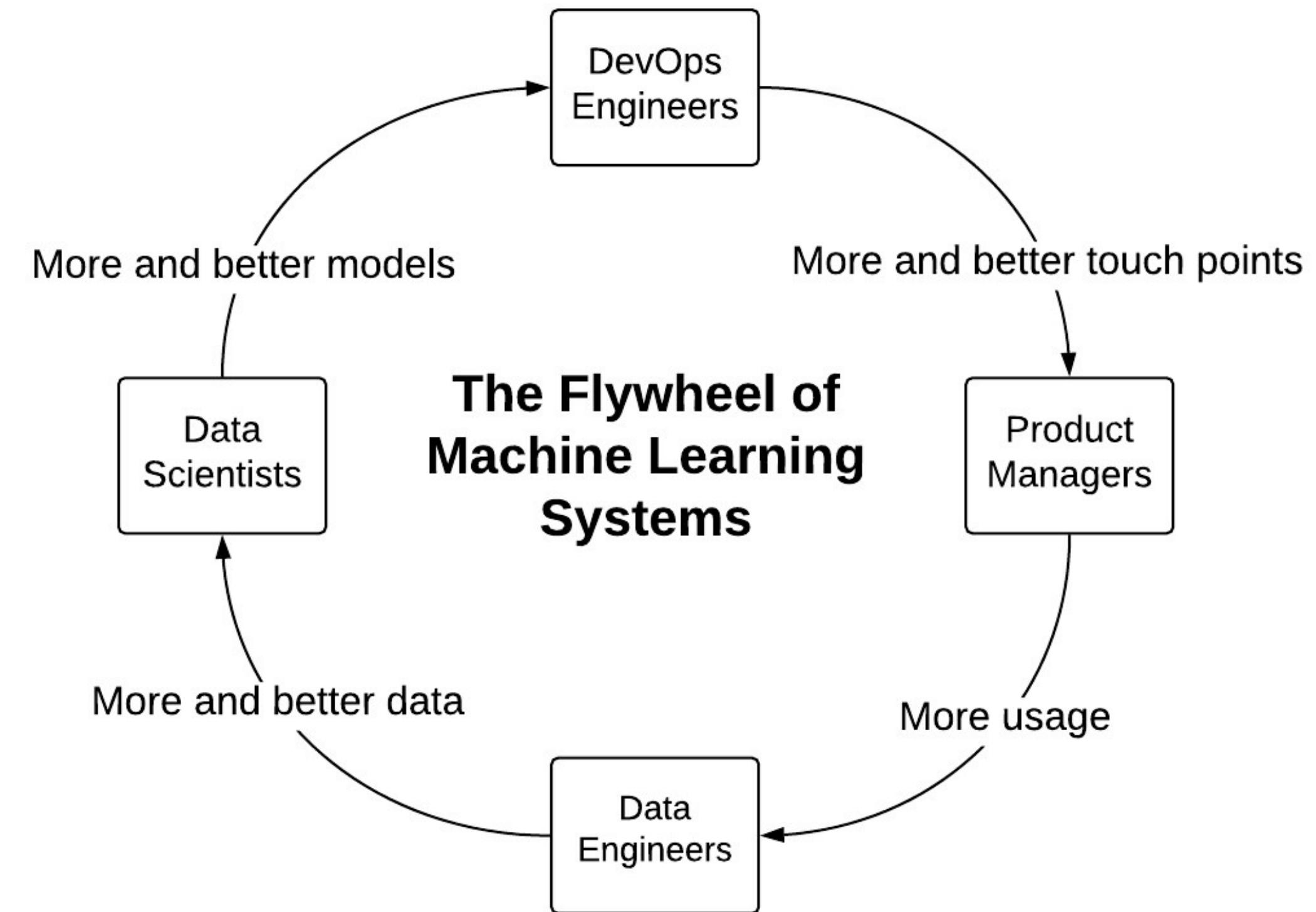
Deployment

Credits to S. Karayev, J. Tobin and P. Abbeel's CS194-80: Full Stack Deep Learning Course

Deployment



Objective: Data Flywheel

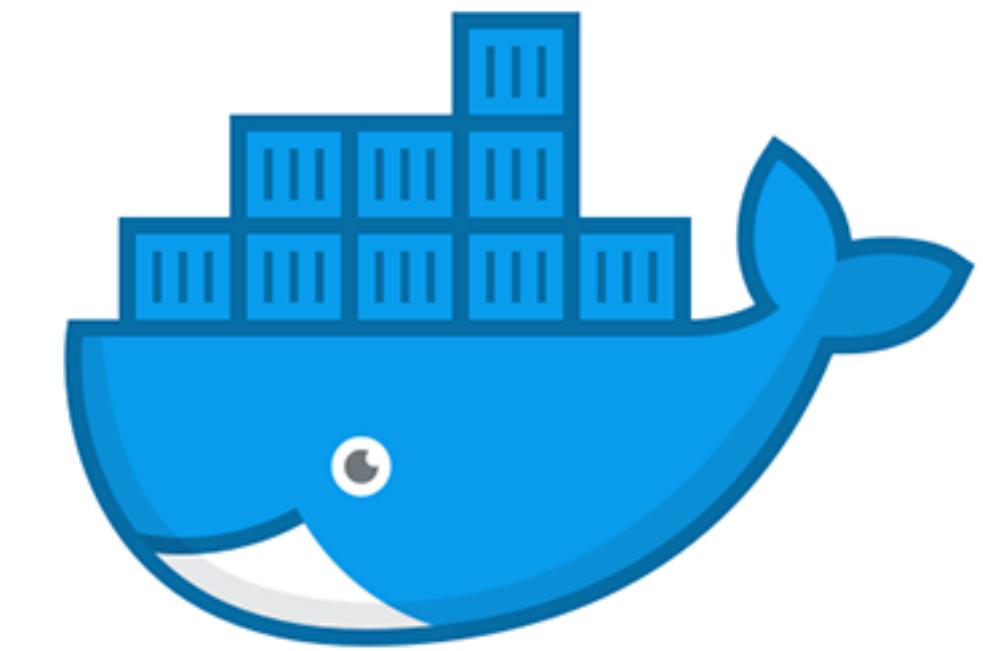


Deployment Design

- **Batch Prediction**
 - Run the model on the outputs every few hours/days in batches
 - Pros: Cheap, Easy Setup
 - Cons: Slow, Not up-to-date
- **Model-in-service**
 - Wrap your ML code in the server code
 - Pros: Same Code
 - Cons: Might eat up resources from your original server, web server might different code, not optimized for ML
- **Model-as-service**
 - Run your code on its own server as a standalone service
 - Pros: Scales up nicely, good computation
 - Cons: Latency, more complexity

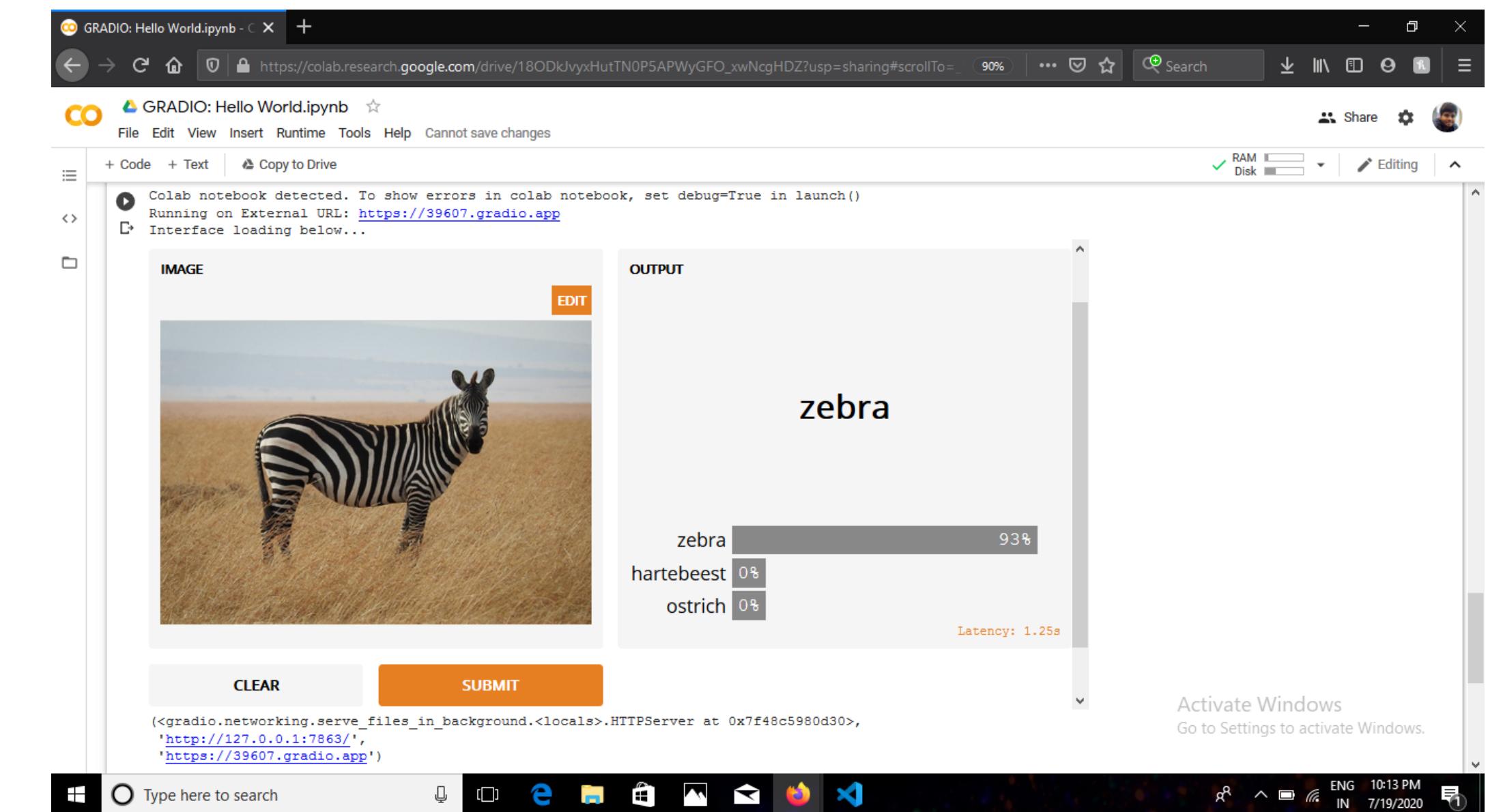
Dependencies: To Docker or not ... ?

- **Docker** is a container orchestration application that allows for application scalability and transferability
 - No needs to worry about OS and downloading the right software anymore
 - Relies on images
 - Cons: Difficult to work with
- **Alternatives:** How to create dependencies in python?
 - Use **condo**
 - **requirements.txt** file
 - Creating dependencies: `pip freeze > requirements.txt`
 - Download dependencies: `pip install -r requirements.txt`



Model-as-service for Python

- Application Development
 - **Flask/Django:** Python
 - **REACT app:** Java Script-based
 - After development, you can host on:
 - Heroku, Render, AWS CodeDeploy
- In-Line Development
 - Gradio
 - Streamlit
 - In-Cloud Development a little bit more difficult (Combine with application dev methods)

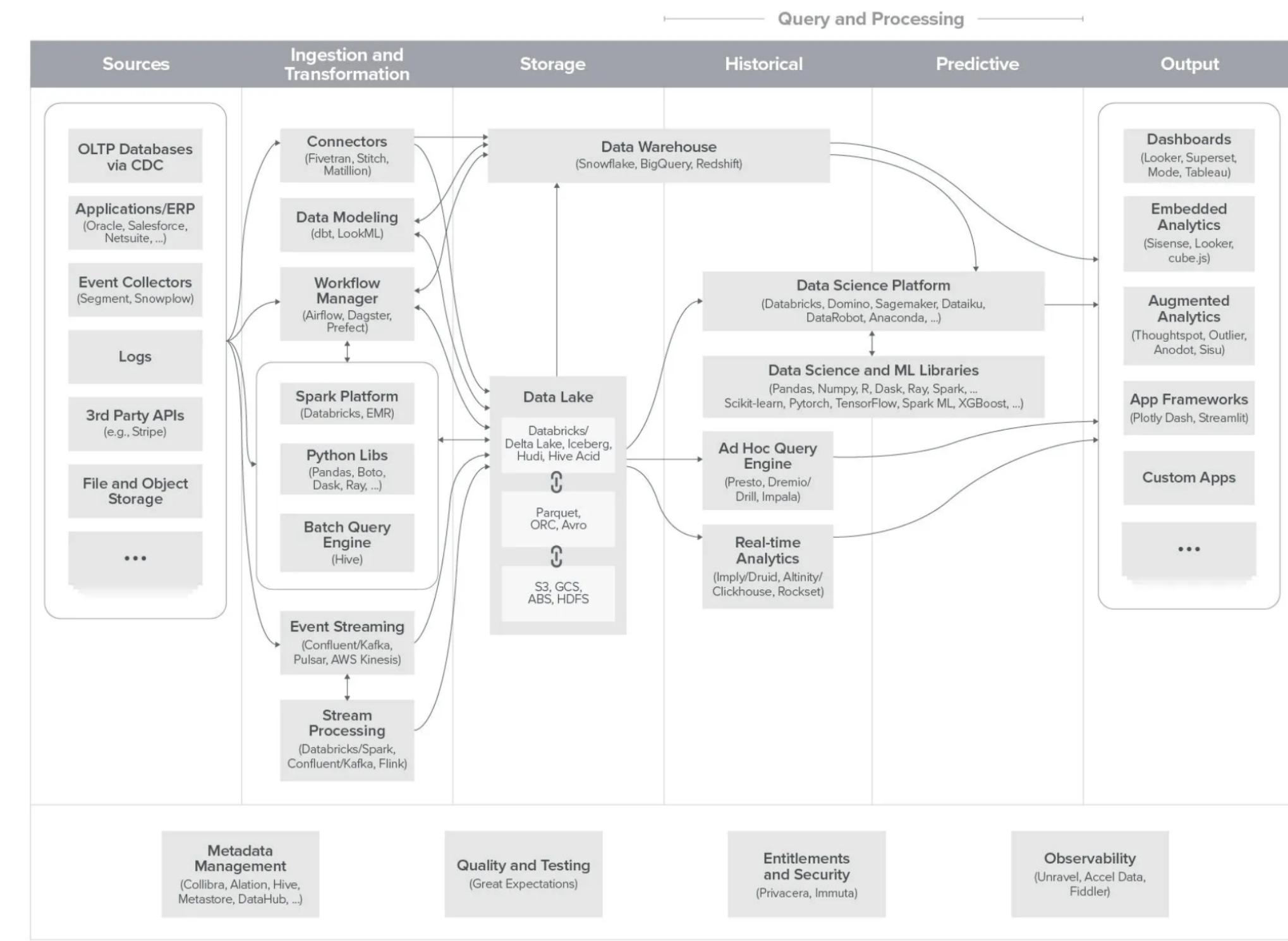


In-App Development

- We can also readily deploy ML models directly on a device such as iPhone or Android
- Pros:
 - Mobile devices actually have really fast GPUs (Think about Snapchat)
 - Directly on-device
- Cons:
 - Large models need to be downloaded on the device
 - Device specific language needs to be written
 - What version will be stored? How do we update models?
- CoreML, GoogleML Kit

Data

- Where do you store data?
 - Database
 - SQL,
 - Data Lake: Snowflake, Databricks
 - Buckets: AWS Buckets, Google Datawarehouse
 - Store large images, videos, music (Non-text, non-tabular data)
- How do I label data?
 - Aquarium, Label Studio



Yes, it's **complex**

Group Discussion

Group Discussion

- **What example did you write about in your reflection?**
- **What went wrong or worked well in your case study?**
- **Who is to blame?**
- **What technological advancements do you think will be useful in solving or further advancing unintended behavior? If none exists, what would a prospective system have to fulfill?**

ARTIFICIAL INTELLIGENCE

Our weird behavior during the pandemic is messing with AI models

Machine-learning models trained on normal behavior are showing cracks — forcing humans to step in to set them straight.

By Will Douglas Heaven

May 11, 2020

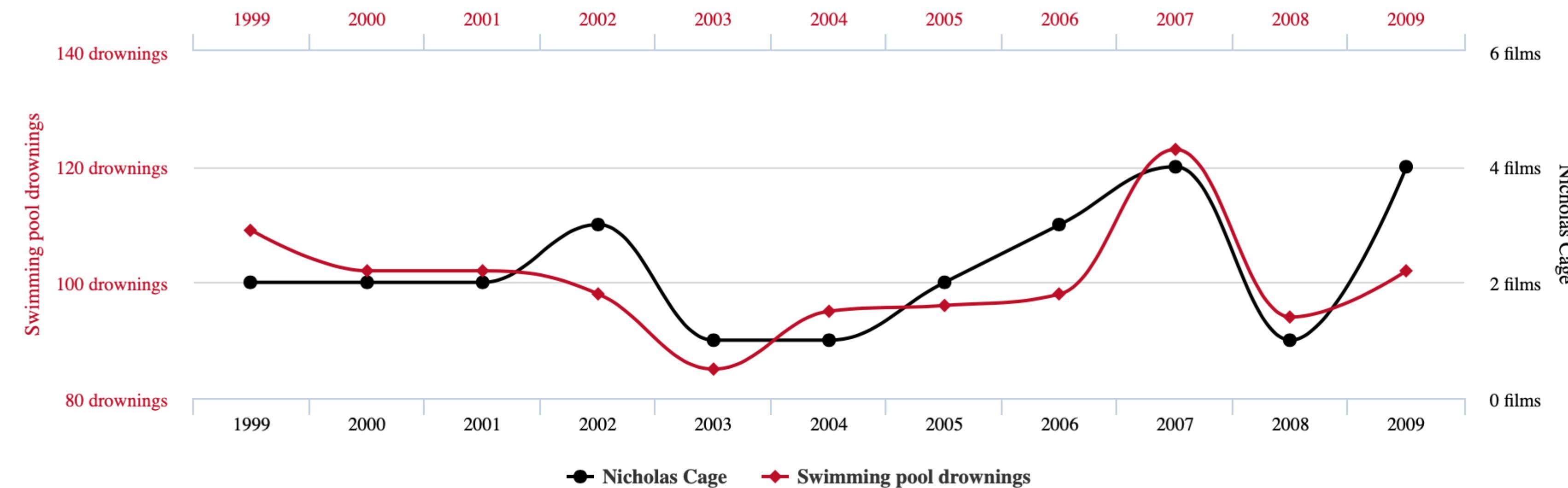


Number of people who drowned by falling into a pool

correlates with

Films Nicolas Cage appeared in

Correlation: 66.6% ($r=0.666004$)



Data sources: Centers for Disease Control & Prevention and Internet Movie Database

tylervigen.com

Wound Detection



**Is this a wound?
If there is no bandaid?**

Training Data

Monitoring Applications

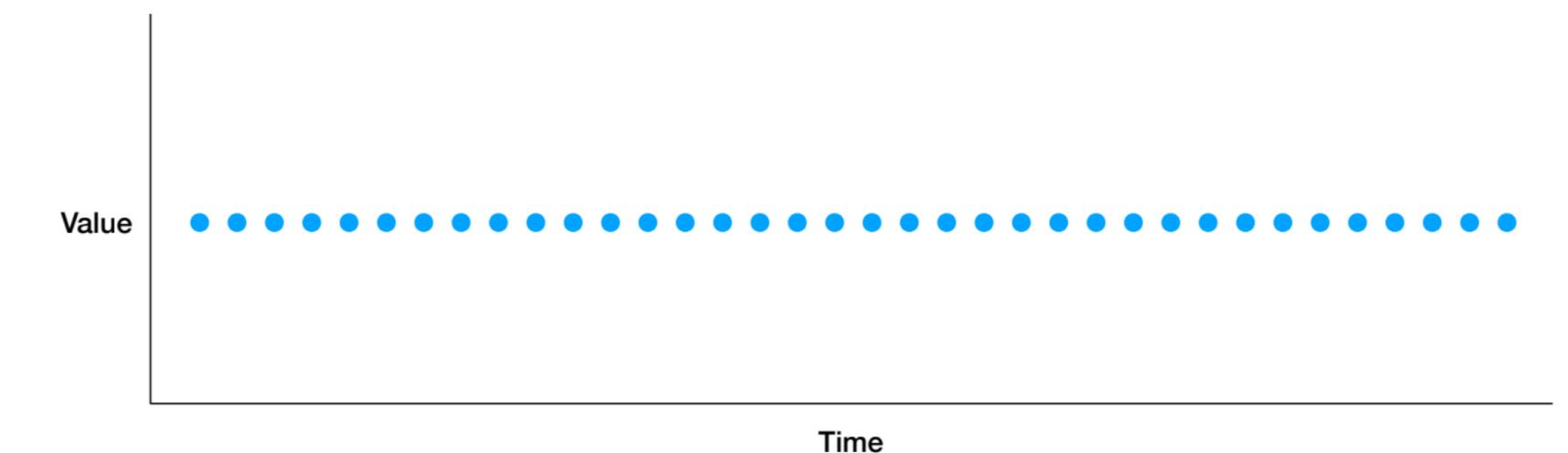
Data Distribution

- We can think of our **models** in terms of *sampling* from some kind of underlying distribution.
 - Think about distributions in terms of:
 - Distribution of kids height
 - Distribution of adults height
 - Would we use a model trained on adult heights on kids data?
 - NO

Walter Huang, a 38-year-old Apple software engineer, was driving his Tesla Model X in Mountain View, California, in Autopilot mode at about 70 mph (113 kph) when it crashed into a safety barrier. The NTSB said Huang had reported issues on prior trips with Autopilot steering the wheel toward an area between a highway ramp and the lane. It is a moving violation to cross into that section of the road, known as the "gore area."

Distribution Drift

- **Your model can also be right today, but that change tomorrow?**
 - Imagine that people would become taller or shorter in general
 - What if your Netflix recommendations change people's preferences to watch movies.
- **Distribution Drift:** Your population's underlying data distribution changes
 - Why is this dangerous?
 - Types:
 - **Instantaneous:** COVID
 - **Gradual:** People move away from using Facebook
 - **Seasonal:** Holiday Season
 - **Temporary:** Attack



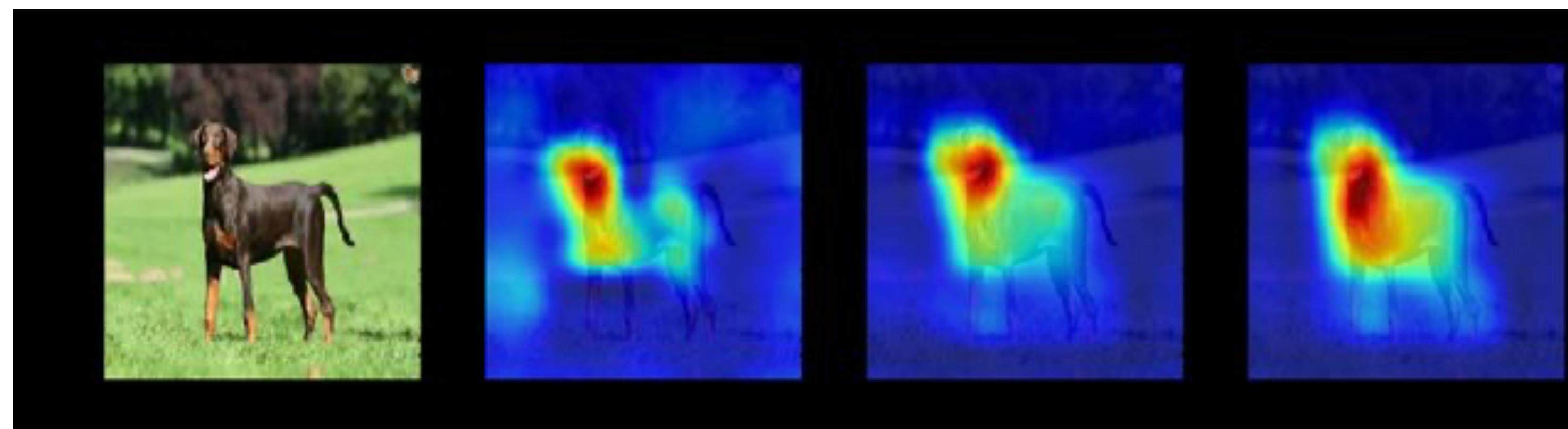
How do we mitigate?

- **Tracking and monitoring**
 - Embed ways in your software so you can track metrics
 - Business, Accuracy, Performance, System (How does my model perform?)
 - Measure **divergence** (How much did my input data change?)
- Human-in-the-loop
 - **Tesla Autopilot**
 - **Medical Diagnosis**
 - **Siri asking you confirmation**
- Explainability & Interpretability

Interpretability & Explainability

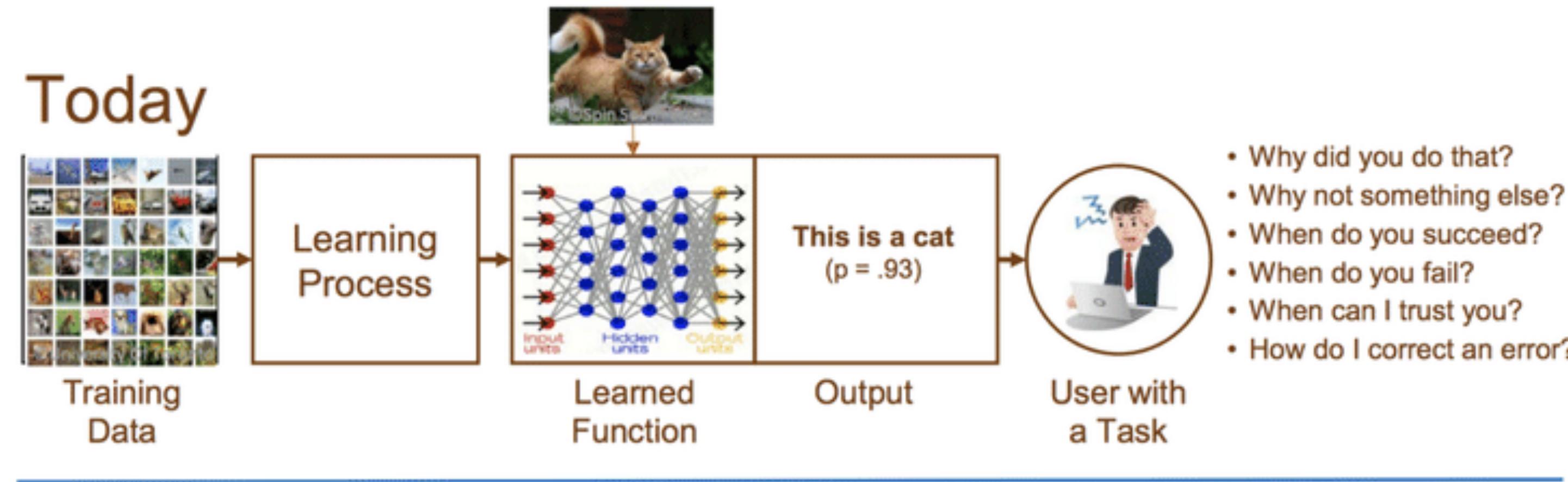
Explainable Artificial Intelligence

- **Problem:** Machine Learning and Statistical Models are so interpretable. How can we make them more explainable or controllable?
- New Field
- Saliency & Occlusion
 - What is my model looking at?

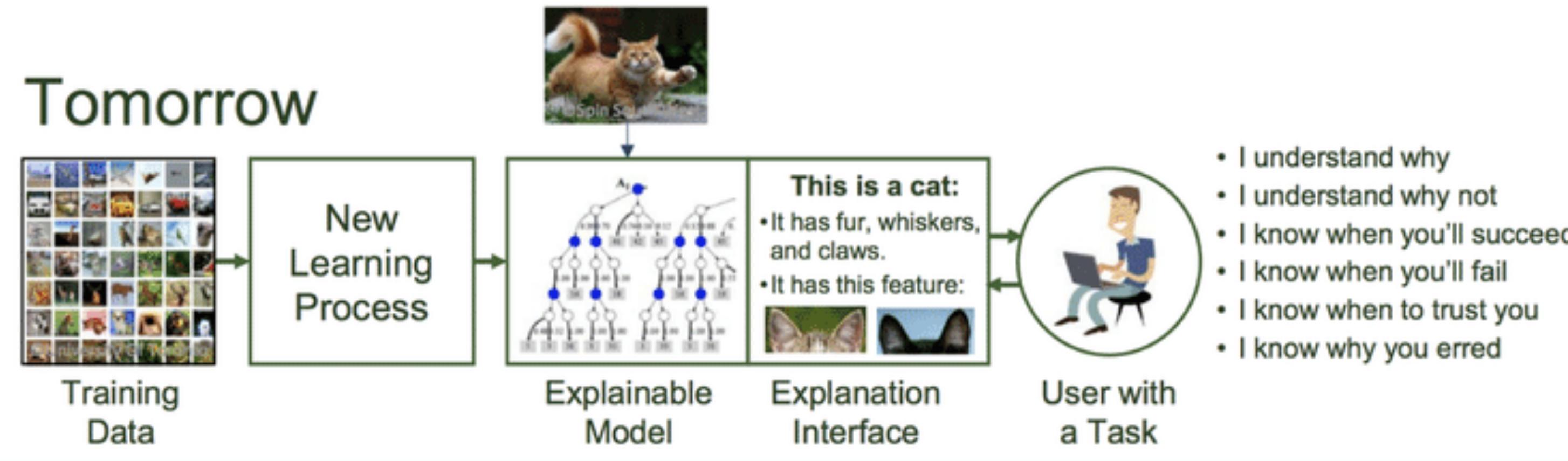


Explainable Artificial Intelligence

Today



Tomorrow



Explainable Artificial Intelligence

- If you trap misconceptions a model has, you can address these issues using:
 - Shaping
 - Weight Initialization
 - Adversarial Training

NEWS | ARTIFICIAL INTELLIGENCE

Engineering Bias Out of AI

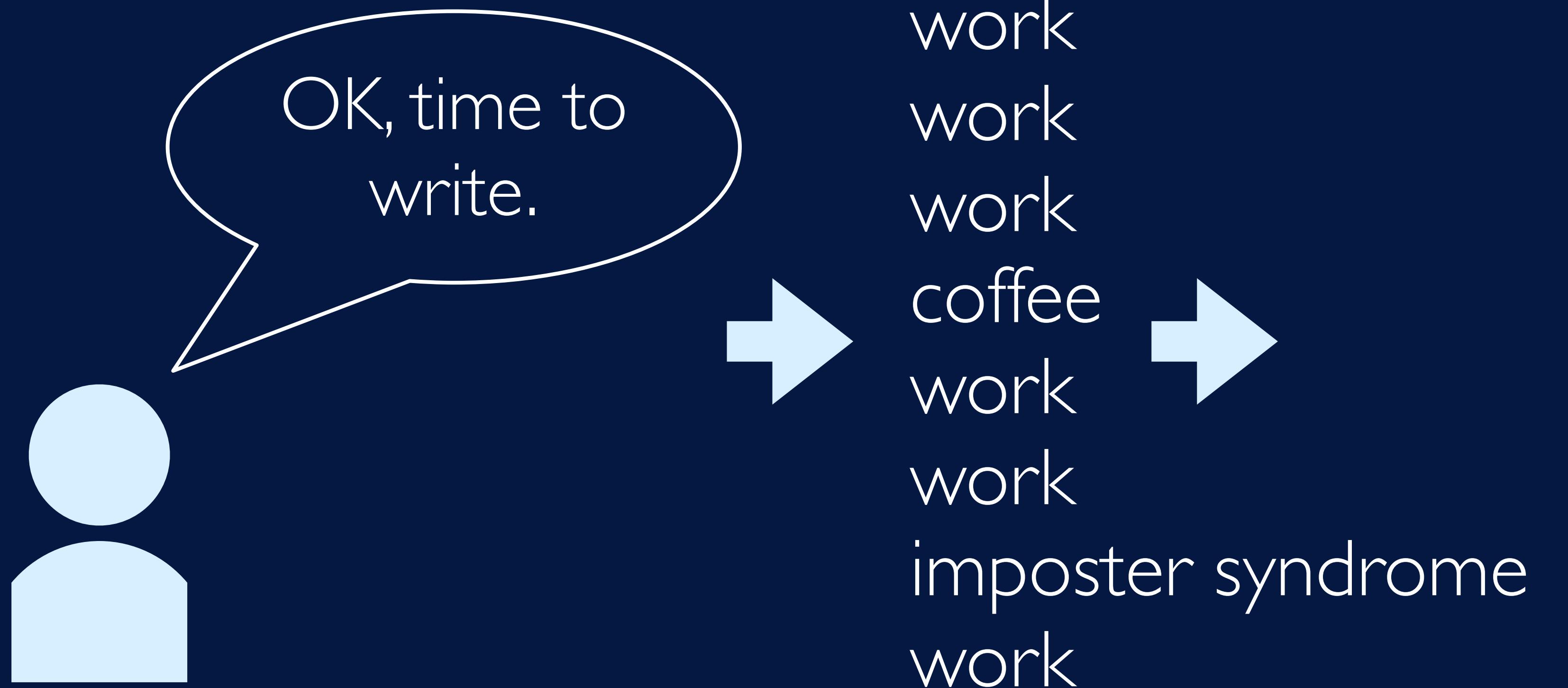
Machines that learn the worst human impulses can still relearn

BY PRACHI PATEL | 20 APR 2021 | 6 MIN READ |

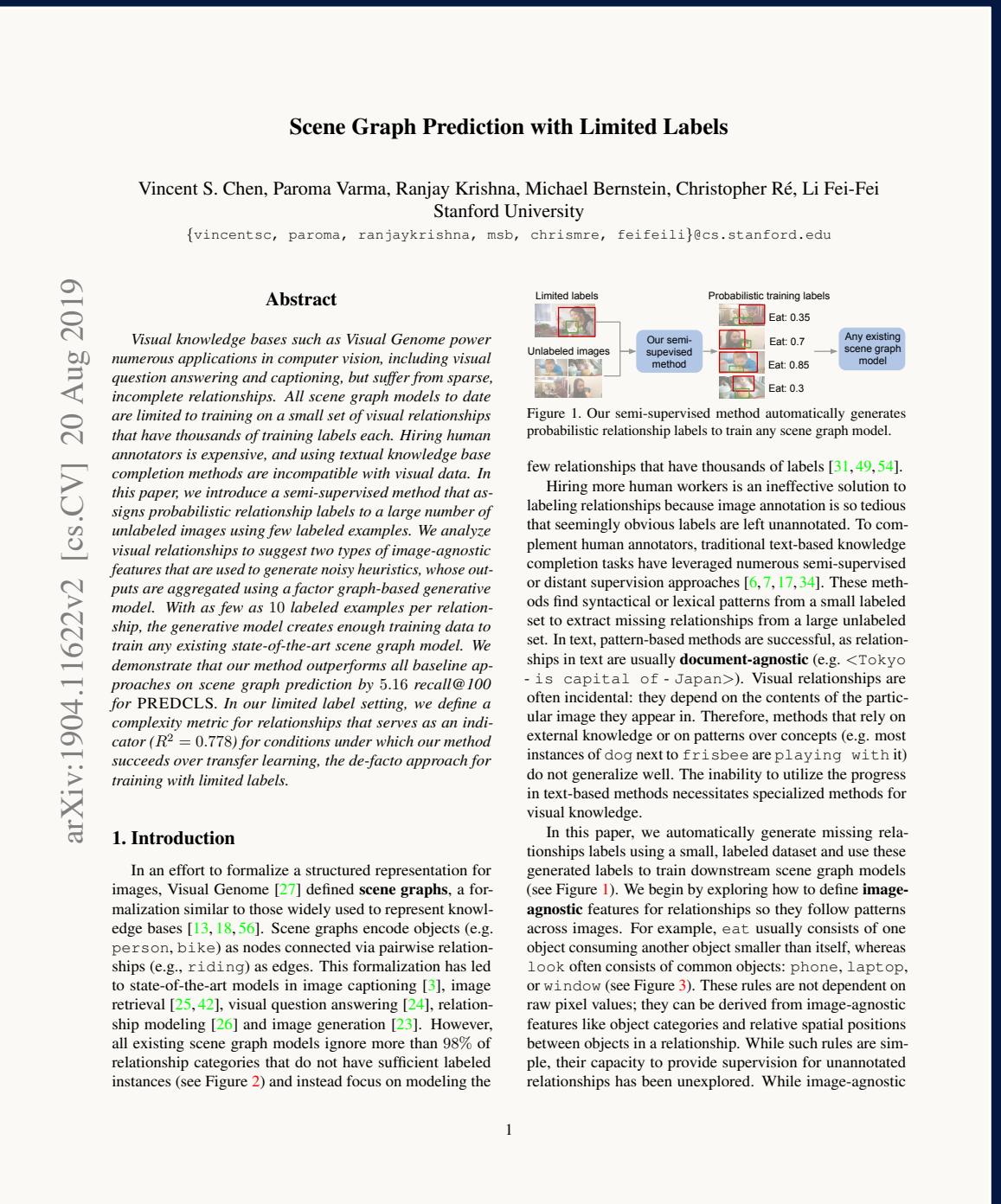
Writing Research

Credits to Lisa Yan for Stanford's CS197

The common malpractice



Why is this malpractice?



There are many genres

Even within areas, there exist many different genres of paper. Each genre is typically built around the claim you are making, and implies a structure to the sections and to the writing. For example:

We solve a problem: articulate the problem, explain what causes that problem and what others have done to deal with it, detail your approach, and prove that you make progress on the problem

We measure an outcome: explain that nobody has bothered understanding how a phenomenon behaves, explain how to create a study that sheds light, and report the outcomes of it

We introduce a technique: articulate a problem as above, but focus the narrative on the technique you've created, since it will generalize

Genres imply structure

Common “We Solve A Problem” structure:

Introduction: overview and thesis

Related Work: situate your contribution relative to prior research

Approach: describe your approach and important implementation details

Evaluation: test whether your approach succeeds at its stated goals

Method

Results

Discussion: reflect on limitations, implications, and future work

Conclusion: summarize and restate your contribution

“Which genre is our project?”

You can often derive the appropriate genre in the same way that you derived the evaluation — what is the thesis and claim that you are supporting?

But this may be challenging until you've read a large number of papers. So instead...

Model papers

A model paper is a paper that you can use as a model or template for constructing your paper.

You should be able to structure your paper in the same way as your model paper

Follow its general flow of argument in the introduction

Use similar section and subsection heading organization

Create figures, tables, and graphs that fulfill the same function as theirs

Apply the same general proportions, e.g., number of pages per section

Selecting your model paper

Model paper != nearest neighbor paper

The model paper should be a paper that makes the same type of argument as yours. It should be in the same genre as you seek.

Often the nearest neighbor paper will make a similar form of argument, but not necessarily

Often the nearest neighbor paper will be a well-written paper, but not necessarily

Find your model paper and share it with your mentor for a thumbs up before writing.

From model to paper

Start by outlining the model paper:

How does it structure its argument into sections?

What is the main expository goal of each section? What is its sub-thesis?

What role does each figure play?

From model to paper

Next, build a mapping from their outline to yours.

Translate each section and sub-section heading into what the equivalent heading is for you

Translate each sub-thesis into what the equivalent sub-thesis is for you

Translate each figure into what the equivalent figure is for you

What if it doesn't quite fit?

Model papers should be templates, not straightjackets. You will probably need to adapt your mapping slightly from what your model paper does.

e.g., you require a slightly different evaluation structure or visualization than them

e.g., you're drawing on a different literature than them, and need to explain something that they didn't

Writing about research is not
only limited to papers

Audience

Think about:

- Who is your audience?
- How do you engage your audience?
- How do we establish common language?
- What are the main important contributions of your work?
- How do you want to be conveyed?

The Power of Visualizations

- Anecdotally, a lot of researchers/professors barely read through someone's paper at all.
 - Main important components are:
 - Figures
 - Graphs/Visualizaitons
 - Summary
 - Conclusion

Point of Attack

- (1) Establish what you want to convey
- (2) Research your audience
- (3) Find the best kind of paper model
 - (A) Blog post
 - (B) Tweet
 - (C) Research paper/Thesis
- (4) Appeal

Do not be boring 😴

Next Week

**What hot topics in DS do you
want to talk about next week?**

Big Thanks to
S. Karayev, J. Tobin & L. Yan