

CS 744: SUMMARY

Shivaram Venkataraman

Spring 2025

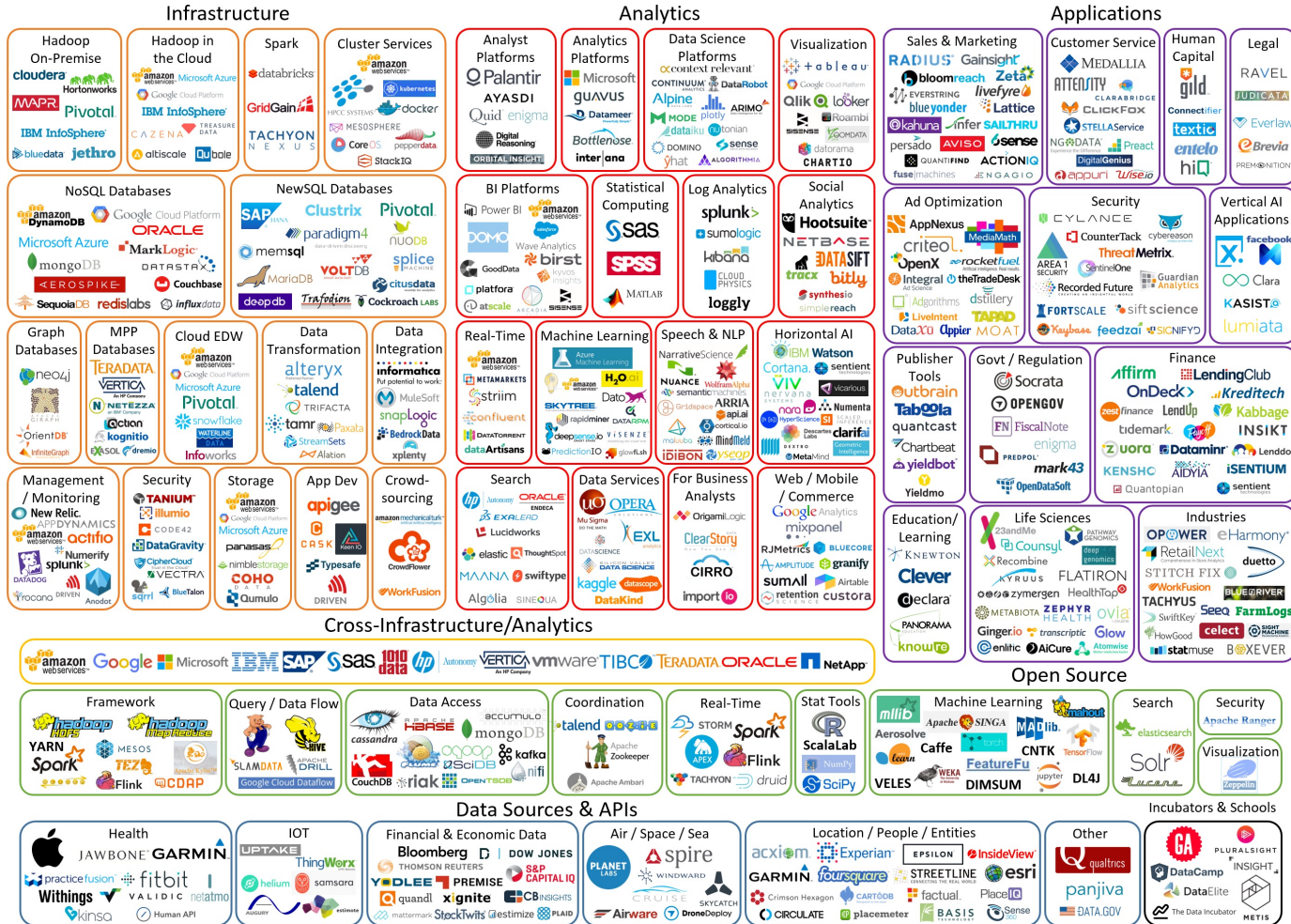
Quick Poll on Papers! <https://tinyurl.com/cs744-sp25-poll>



ADMINISTRIVIA

- Poster presentation May 1st - Thursday
- Final report due May 8th
- Course feedback form <https://heliocampusac.wisc.edu/>

Big Data Landscape 2016 (Version 3.0)



Applications

Machine Learning

SQL

Streaming

Graph

Computational Engines

Scalable Storage Systems

Resource Management



Datacenter Architecture



 PyTorch

 Spark™

 hadoop



Open Compute Project

OUTLINE

Fairness in ML

Survey results, Discussion

Big data systems: Looking forward

Fairness in ML

JASON TASHEA OPINION 04.17.17 07:00 AM

COURTS ARE USING AI TO SENTENCE CRIMINALS. THAT MUST STOP NOW

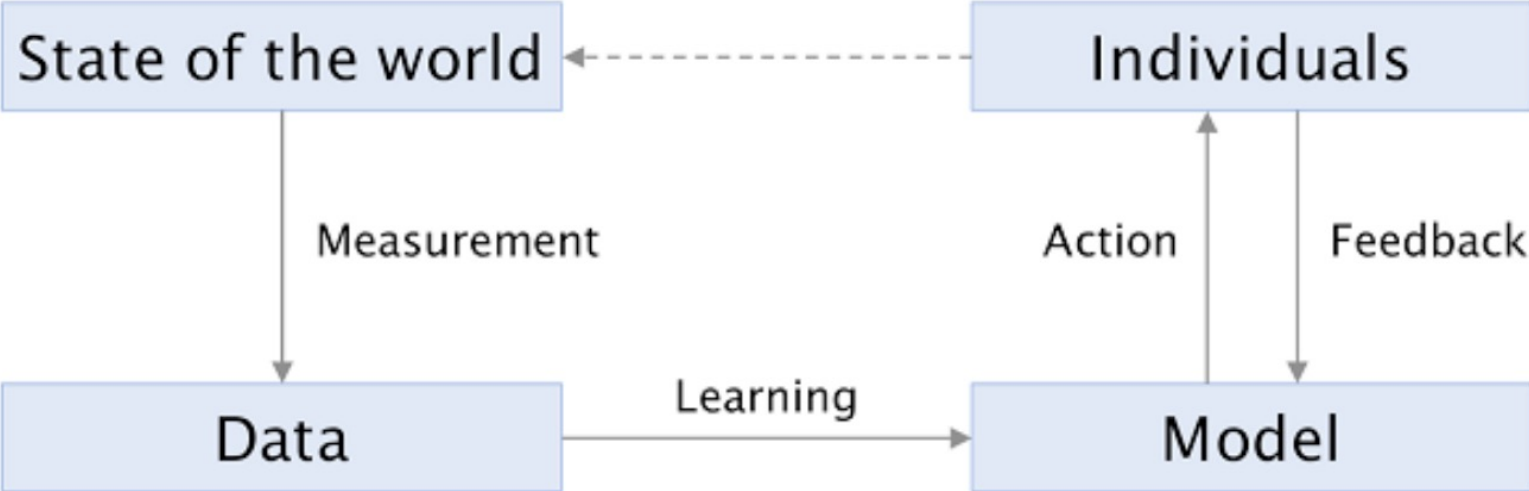


The UK used a formula to predict students' scores for canceled exams. Guess who did well

The formula predicted rich kids would do better than poor kids who'd earned the same grades in class.

By Kelsey Piper | Aug 22, 2020, 7:30am EDT

ML TRAINING LOOP



MEASUREMENT

Why is this hard? E.g., measuring college campus demographics over time

Defining a target variable

“credit-worthiness”

ImageNet class names from WordNet

▼ person

ballplayer, baseball player

groom, bridegroom

scuba diver

LEARNING

Learning: Data → Models
Calibrates to training data

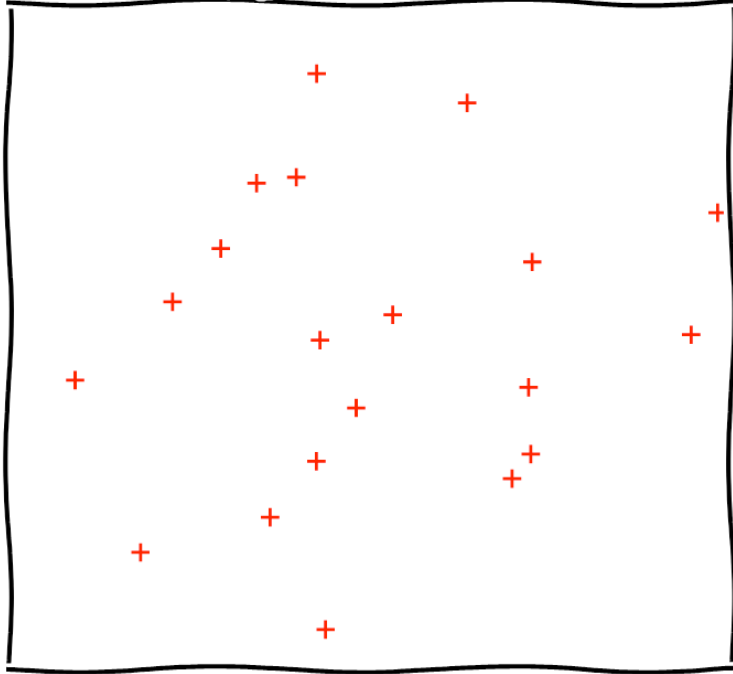
Sample size disparity

¹⁸ Translating from English to Turkish, then back to English injects gender stereotypes.**

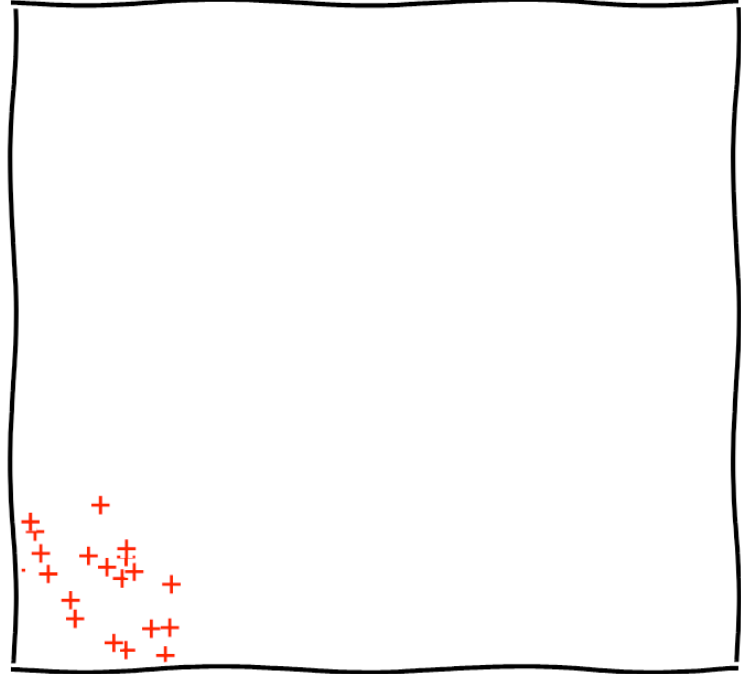
The image shows two screenshots of the Google Translate interface. The top screenshot shows the translation of the English text "She is a doctor. He is a nurse." into Turkish, resulting in "O bir doktor. O bir hemşire." (He is a doctor. He is a nurse). The bottom screenshot shows the translation of the Turkish text "O bir doktor. O bir hemşire" back into English, resulting in "He is a doctor. She is a nurse". This demonstrates how gender bias is introduced when translating back to the source language.

ML ERROR

RANDOM ERRORS



SYSTEMATIC ERRORS



From <https://fairmlclass.github.io/>

ACTION – FEEDBACK LOOP

ML reveals correlations, but often used as if causation!

Prediction affects outcome

Traffic congestion

ML Feedback loop

Search engine sort by pages linked more often

More user clicks → more often linked to

Feedback loop: Rank more highly

WHAT CAN WE DO

Toy Example of Hiring

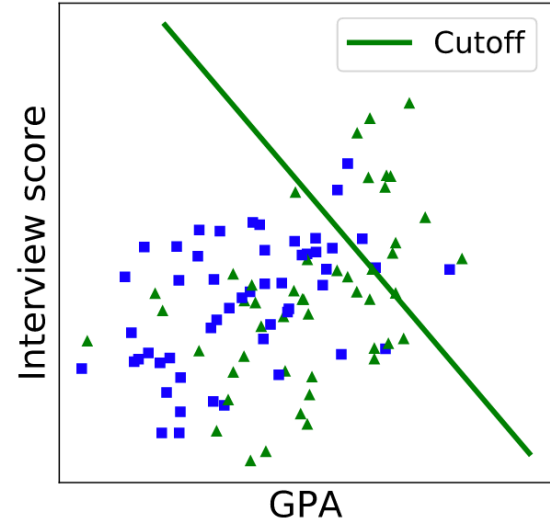
Use ML to make predictions

Based on GPA, interview score

Predict "job performance" based on that

Intervention

Use similarity between individuals in objective



CHALLENGES AND OPPORTUNITIES

Limitations on what we can measure: unbiased measurements infeasible

Data-driven decision-making potential to be more transparent

Need for explainable ML models

New research shows effective interventions (read rest of the book?)

SURVEY RESULTS

LEARNING OBJECTIVES

At the end of the course you will be able to

- Explain the design and architecture of big data systems
- Compare, contrast and evaluate research papers
- Develop and deploy applications on existing frameworks
- Design, articulate and report new research ideas

Paper Review

Discussion

Assignment

Project

DISCUSSION
+
COURSE FEEDBACK

<https://forms.gle/ya93u4rRe9NCNwsr8>



What were some of your goals when you started the course? (Think about the first survey.) Reflect on what part of your goals have been achieved and how.

What are some other trends you have noticed across the papers in the class? (e.g., specialization vs unification) Or what are some commonalities across papers/topics?

LOOKING FORWARD

NEXT-GENERATION BIG DATA SYSTEMS ?

Workloads

Data Processing Systems

Hardware

TRENDS IN WORKLOADS

New functionalities

- LLM agents

- Robotics

New data sources

- Bio-medical data

- Video streams

- IoT / edge devices

WHAT CAN SYSTEMS RESEARCH DO ?

More than performance?

Latency, throughput, efficiency

Ease of use

Some other goals to consider ?

Security, Privacy

Robustness

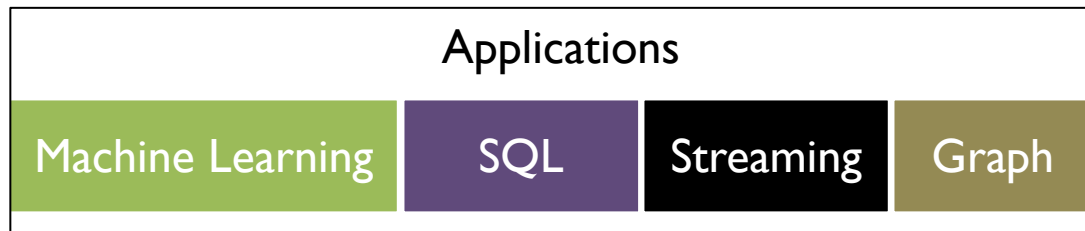
Data bias / ethics

COURSE SUMMARY

Large scale data analysis has changed the world



COURSE SUMMARY



Computational Engines

Scalable Storage Systems

Resource Management

Your System Here ?



kubernetes

